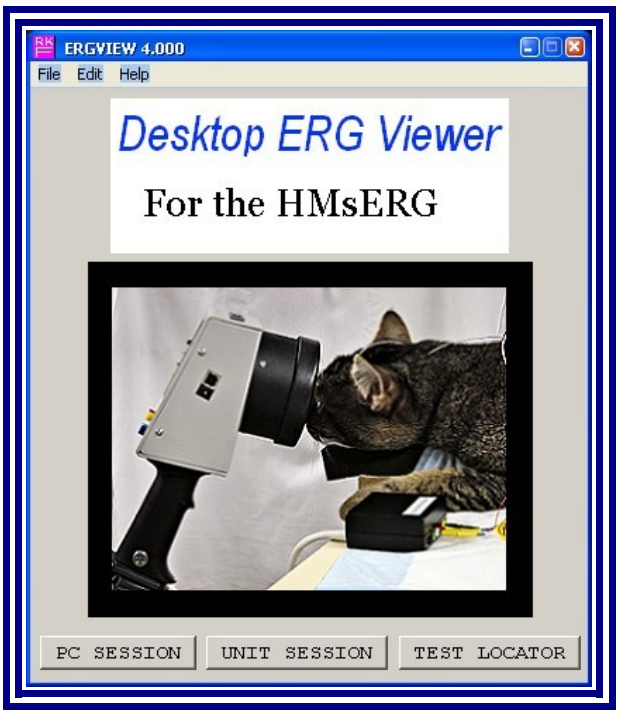
User's Manual for the ERG Desktop Viewer (ERGVIEW)

Version 4.3



Indications For Use:

The HMsERG/ERG system is an electro-diagnostic device used to generate photic evoked signals, to quantify and display the electrical signals generated by the retinal response and the visual nervous system. The device displays digitized electroretinogram (ERG) and visual evoked potential (VEP) signals. These functions are controlled and interpreted by trained medical professionals. This device is intended for prescription use.

The ERGVIEW program is...

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The Ocuscience Desktop ERG Viewer Application (***ERGVIEW***) is designed to display and analyze ERG test data files that were recorded by the **H**andheld **M**ulti-**s**pecies **E**lectro**R**etino**G**raph (**HMsERG**) Unit.

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Main (or Start-up) Window

The ERGVIEW Main window is the window displayed when the ERGVIEW program in initialized. It acts as a gateway to the Session window, and the Test Locator window. It is also possible to examine ERG's with Comparison graphs using only the Main window and drag and drop operations.

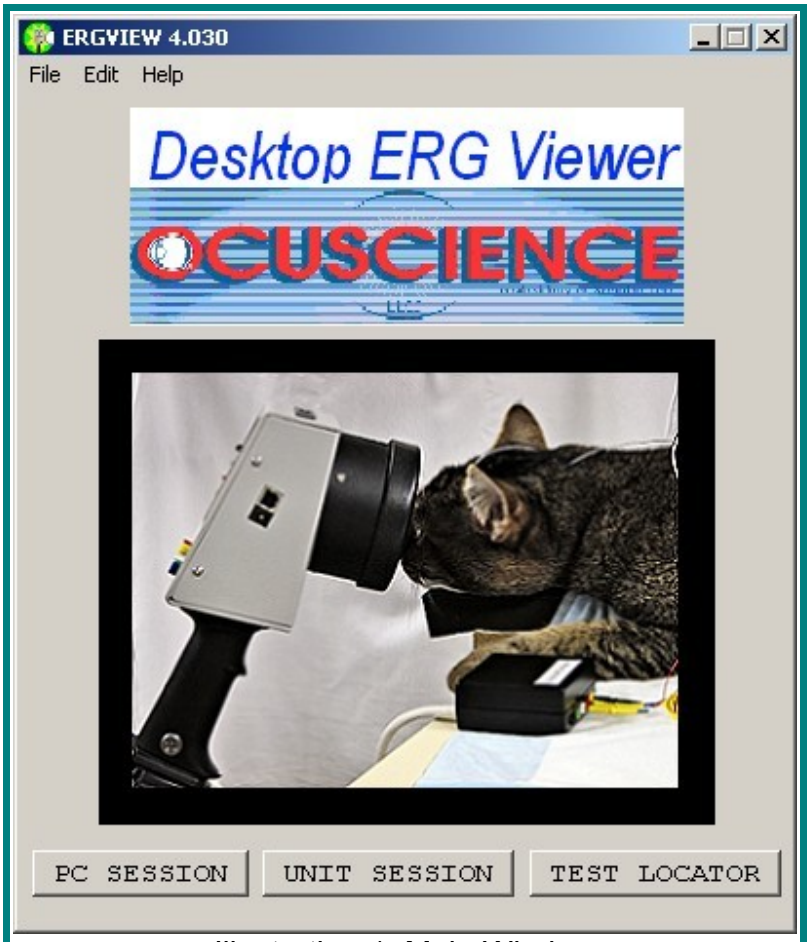

Illustration 1: Main Window

Starting the ERGVIEW program

Illustration 2: Desktop Icon

Start the ***ERGVIEW*** program by double clicking on the desktop icon (similar to the one to the left), or by selecting *Start > Programs > Ocuscience> ERGVIEW4030 > ERGVIEW.EXE*, or by double clicking on an ERG test file ('.tst' file). Any of these methods will bring up the main, or start-up, window as shown above. Double clicking on a test file will also open a session window.

From the Main window test files and patient information may be accessed by using the buttons along the bottom of the window or by using the drop down menus.

Ending the ERGVIEW program

The program can be terminated correctly in three ways, by clicking on the close button at the upper right corner of the Main window, by choosing the *File > Exit* menu, and by right clicking on the ERGVIEW taskbar icon and selecting 'Close'.

If any windows besides the Main window are open you will be asked if you want to end the program; otherwise, the Main window will close immediately.

Main window control reference:

Buttons:

Illustration 3: Main Window Buttons

PC SESSION button

Clicking this button will open a file selection dialog. The user may need to change this directory to a location where **HMsERG** data files of interest are stored (e.g. the desktop, or a directory where test files have been previously stored on the **PC**) and then, choose either an ERG test file or a special session file. If the test file selected is part of a session or of multiple runs of a single test, not only the selected file but all the associated files will be displayed in a session analyzer window - i.e. all files in the folder with the same patient number and session number will be placed in the session analyzer window. Multi selection of files is allowed. This means that the user may select files using the shift key for a range of files or the control key for individual files. If multi select is used (and more than one file is selected) <u>only</u> those files selected will be put into the session window.

This button is equivalent to the *File > Open Session from PC* menu selection.

UNIT SESSION button

Before using this selection, the **HMsERG** must be connected to the **PC** as per the Appendix.. When this button is pressed the USB connection with the unit will be checked and then a file

selection window will appear. This selection window will show the directory structure of the compact flash card within the **HMsERG** unit. Left click on a directory to open it and then left click on a test file to load it and the session files associated with it into a session window.

This button is equivalent to the *File > Open Session from Unit* menu selection.

TEST LOCATOR button

This selection will open a Test Locator window. The test locator window is used to aid in searching for ERGs test files stored on the PC.

This button is equivalent to the *File > Open Test Locator* menu selection.

Menus:

-File

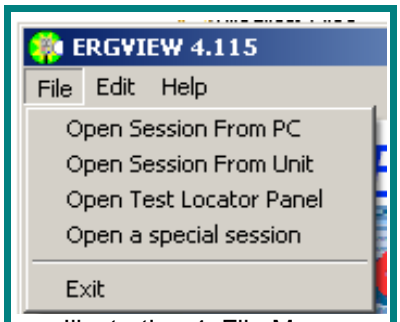

Illustration 4: File Menu

--Open Session From PC

This selection performs the same function as does the "PC SESSION" button.

--Open Session From Unit

This operation of this selection is the same as that of the the "UNIT SESSION" button.

--Open Test Locator Panel

This selection is the same as using the "TEST LOCATOR" button.

--Open a special session

Opens a file select dialog for choosing a special session file.

-Edit

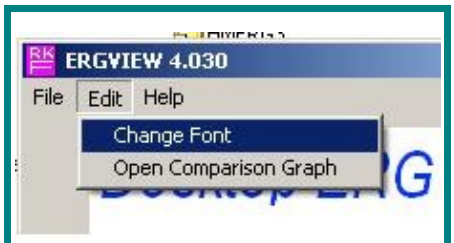

Illustration 5: Edit Menu

--Change Font

Allows the program font selection to be changed. All Session, Test Locator, and Graph windows opened after the font change will be affected.

--Open Comparison graph

Opens a blank Comparison graph. Test, xy, and csv files may be dragged and dropped onto a Comparison graph.

-Help

Illustration 6: Help Menu

--Open User Manual

Opens the (pdf formatted) user manual.

Drag and Drop operations:

Certain files can be dragged from a windows file list to the Main window of the ERGVIEW program. In general, what happens will be similar to what would happen if the file was selected by means of a menu or button.

Multiple files may be selected at the same time. In the case of test or special session files, one combined Session window will be created. For graph files ('xy', 'csv') they will all be placed on the same comparison graph.

HMsERG test files (extension 'tst')

Dragging and dropping a test file onto the Opening window will open a session the same as if that file was selected after the PC SESSION button was pressed.

Special session files (extension 's_f')

Dragging a special session file to the Main window will open the tests referenced by that file.

x-y formatted files (extension 'xy')

If a global comparison graph (Edit > Open Comparison Graph) exists, the xy data will be added to the current Comparison graph, if no graph is currently open, one will be created.

csv formatted files (extension 'csv')

If a global comparison graph (Edit > Open Comparison Graph) exists, the csv data will be added to the current Comparison graph, if no graph is currently open, one will be created.

Session Analyzer Window

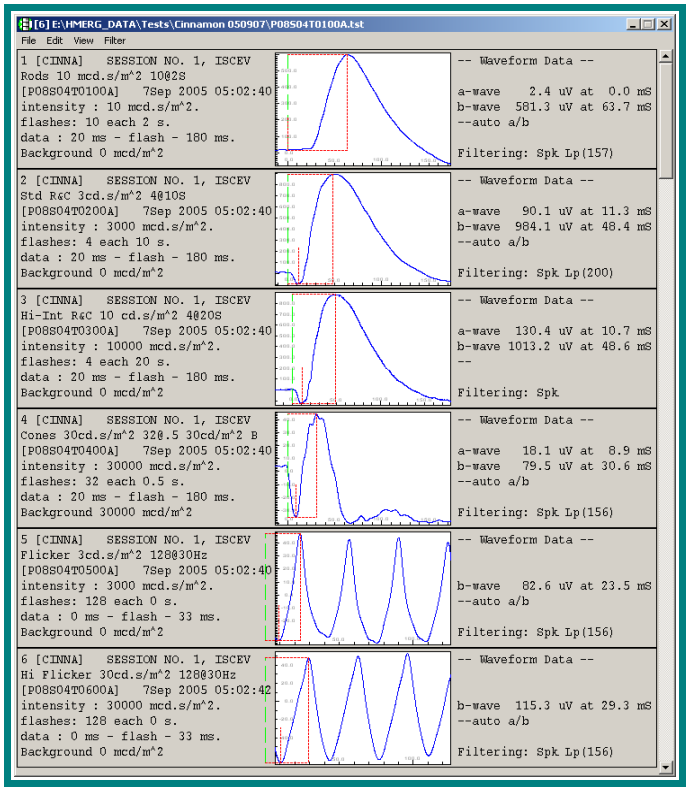

Illustration 7: Session Analyzer window

During normal use either individual ERG tests or an automatic series of tests collectively called a session are run on the **HMsERG**. Sessions are designed to comply with recommended protocols, such as the ISCEV protocol, the Dog Diag protocol, and the Short protocol. A Session Window is created by either of the **View Session** buttons on the opening screen, by way of another Session Window, or from a Test Locator Window. The Session Window displays thumbnail representations of all the ERG's in a session. From the Session Window, test results may be investigated by right clicking on a thumbnail and selecting an analysis tool from the pop-up menu.

The number of thumbnails displayed on a session window at one time is determined by the size of the screen it is displayed on and the currently selected font. The slider control may be used to scroll any hidden thumbnails into view.

The group of tests in a Session Window may be modified by selecting *File > Add to this*

Session from the menu bar or by "cutting" and "pasting" as described below under Thumbnail editing below. Multiple session windows may be opened by selecting *File > Load Another Session*.

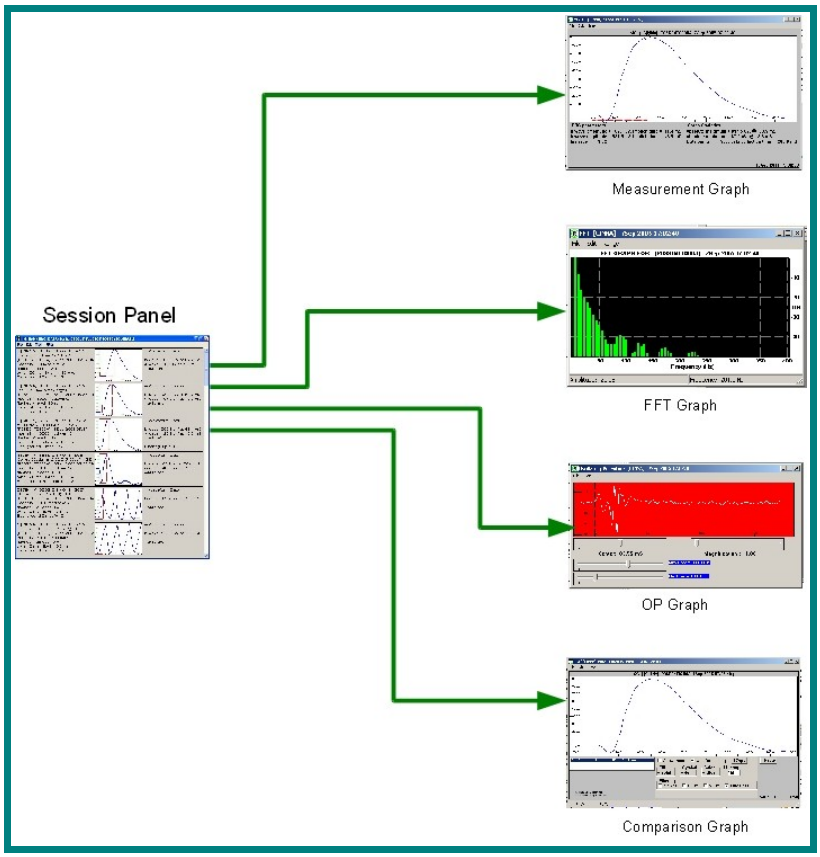

Illustration 8: Graphs that can be opened from thumbnails on a Session window.

- Changing the thumbnails on a Session window.

Thumbnails may be added to or removed from a Session window by using the *{right click} > Edit Test* menu. Cut, copy and paste operations may be performed within a single session or between thumbnails located on separate session windows. ERGs may also be copied from a Test Locator Window and placed on a Session window.[1]

1[1] ERG files from the PC and those read over the USB from the HMsERG must not be mixed using the editing commands.

Session window Menus.

File > Add to this Session

Opens up a disk file dialog and allows selection of ERG test files that will be appended to the current session window.

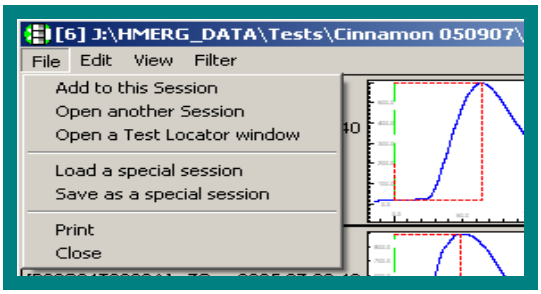

Illustration 9: Session File Menu

File > Open Another Session

Opens up a disk file dialog and allows selection of files that will be displayed in their own session window.

File > Open a Test Locator Window

Opens up a test locator window pre-loaded with the test id of the first thumbnail in the session.

File > Load a special session

This option allows the user to load a previously saved special session. The default file path for special sessions is independent of the default file path for regular sessions so that special sessions may be saved together in their own directory for later access.

File >Save as a special session

This option allows the user to save a reference to the tests of the current session window under a name of his choosing.

File > Print

Opens up a print dialog and prints all session thumbnails at six per page plus the session summary information.

File > Close

Same as clicking the 'X' close button at the upper right of the session window.

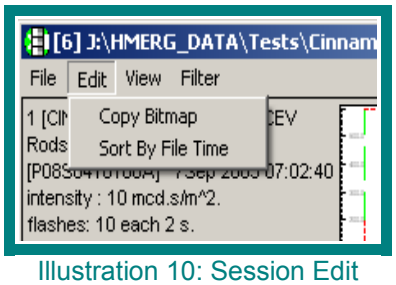

Illustration 10: Session Edit Menu

Edit > Copy BMP

Copies the user area of the session window to the windows clipboard in bitmap format. It can then be pasted into a paint or word processing program.

Edit > Sort By File Time

When a standard session is opened it is sorted by the file names used for each individual test. This is usually fine and

is automatically in chronological order. However, if a special session is opened or if thumbnails have been moved around using the thumbnail 'Edit Session' menu the thumbnails may not be ordered by time. This selection will restore the time ordering of the thumbnails as determined by the time the files were recorded. File times are accurate only to the nearest second.

View > Summary

Opens up a summary window.

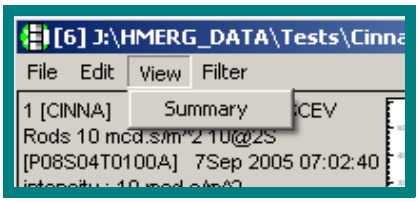

Illustration 11: Session View Menu

Filter > 60Hz Filtering
Filter > 50Hz Filtering
Filter > Spike Filtering
Filter> Low Pass Filtering

Enables software filtering of all thumbnails in a session at once. Filtering selected for a specific thumbnail interacts with this selection in that whichever selection is made last (session or thumbnail) will be the controlling selection. .

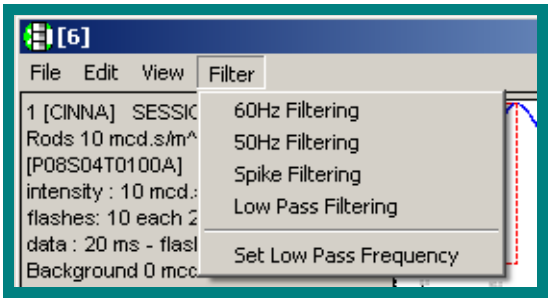

Illustration 12: Session Filter Menu

Filter> Set Low Pass Frequency

Opens up a window - as shown below - to allow the low pass cutoff frequency to be set. The value set here will be applied to all thumbnails in the session.

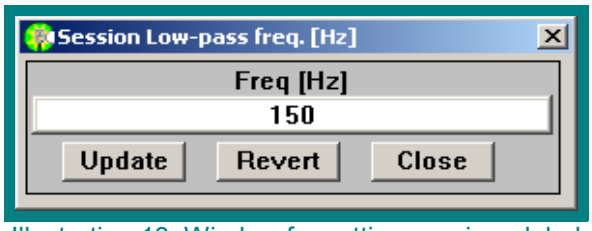

Illustration 13: Window for setting session-global low pass cutoff frequency.

Thumbnail Panels

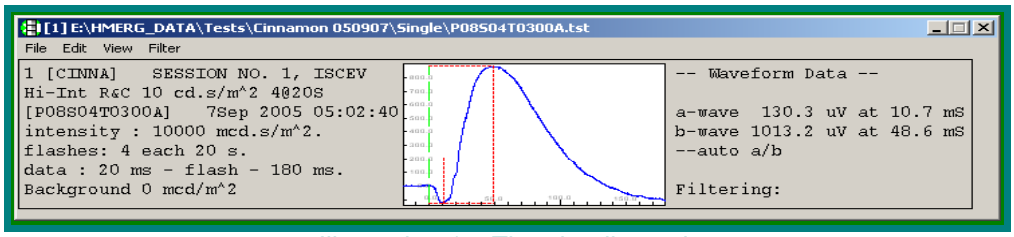

Illustration 14: Thumbnail panel.

Each ERG test is displayed on the Session Window in the form of a "thumbnail" panel with three main sections. The left section shows the relevant session/test information to identify this specific ERG. The center section is a graphical representation of the ERG. The area to the right of the graph displays current values for a and b waves along with filtering information. The line '–auto a/b' is displayed if the a and b-wave values are being calculated automatically by the program. If a and b-wave calculation is automatic the values will be recalculated whenever any filtering conditions are changed.

Each Thumbnail, by means of a popup menu, also provides a gateway to further analysis of that specific ERG test data.

To access the gateway right click on the desired ERG recording thumbnail. A popup menu, as shown below, will allow the user to:

1) copy the test data to a Measurement Graph, perform an FFT analysis, analyze the data to show the oscillatory potentials, open a Comparison Graph, or copy the ERG trace to the trace clipboard,

2) Apply a software filter to this particular ERG.

3) copy and paste thumbnails between (or within) session windows.

4) retrieve information about where the test data came from, and provide the capability to add notes and identification information about this particular ERG.

Selecting the *Test source info* item opens a window displaying the serial number of the unit that recorded the test, the compact flash card id it was originally recorded on, the version of the software on the unit, the path on the **PC** to where the test file is located. The State window also allows the user to enter notes about this specific ERG and assign it a User Id that can be searched for using the Test Locator window.

Thumbnail Menus

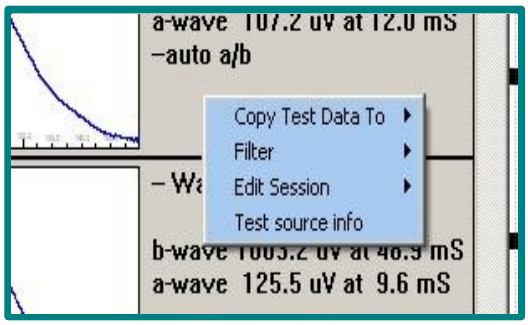

Illustration 15: Thumbnail Pop-Up Menu

{right click} > Copy Test Data To > Trace Clipboard

Puts the ERG data onto the trace clipboard allowing it to be pasted onto a Comparison graph.

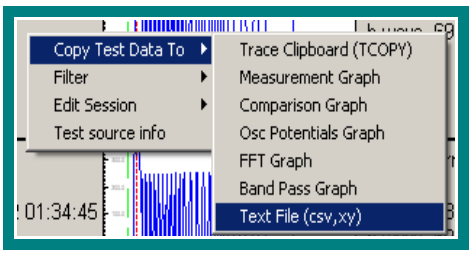

Illustration 16: Copy Test Data To Menu

{right click} > Copy Test Data To > Measurement Graph

Opens up a Measurement graph showing the selected ERG.

{right click} > Copy Test Data To > Osc Potentials Graph

Opens up an oscillatory potential graph showing the results of filtering of the selected ERG. The default range is a band pass filter from 100 to 300 Hertz.

{right click} > Copy Test Data To > Comparison Graph

Opens up a comparison graph showing the selected ERG.

{right click} > Copy Test Data To > FFT Graph

Opens up an FFT graph showing the Fourier coefficient magnitudes for the selected ERG.

{right click} > Copy Test Data To > Text file (csv,xy)

Allows for saving the ERG information into a text file of x-y values in either 'csv' or 'xy' format that can be read into a spreadsheet program.

{right click} > Filter > Show Sample Selection Window

This menu selection displays a samples window for the thumbnail. It is only available if the thumbnail has samples associated with it. See the WORKING WITH DATA SAMPLES section.

{right click} > Filter > 60 Hz
{right click} > Filter > 50 Hz
{right click} > Filter > Spikes
[right click]> Filter > Low Pass
[right click]> Filter > Set Low Pass Frequency

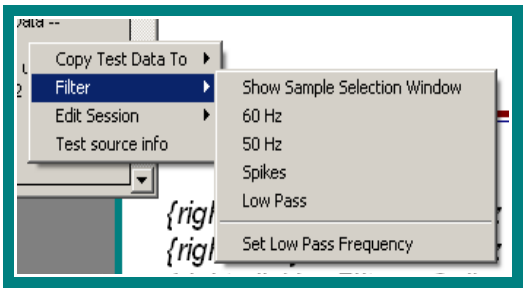

Illustration 17: Filter Menu

These five selections call up and set appropriate software filters for eliminating power line or hardware noise on the ERG waveform. The low pass filter defaults to a 150Hz cutoff point but the cutoff frequency can be changed by selecting 'Set Low Pass Frequency'; this will bring up a window for setting the low pass frequency cutoff.

In the low pass cutoff window, enter the desired cutoff frequency in hertz and select the 'Update' button to see the effect on the thumbnail graph (low pass filtering is automatically turned on if necessary). The 'Revert' button will reset the filter frequency value to what it was when the window was opened. The 'Close' button hides the window

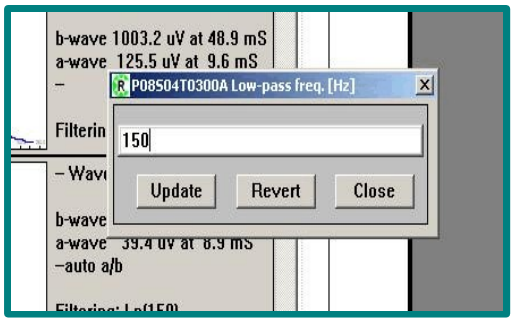

Illustration 18: Low Frequence Cutoff Edit Window

The new value for the low frequency cutoff will be stored with the thumbnail state information when the thumbnail closes.

{right click} > Edit Session > Cut

Removes the ERG from the session and sets it up to be "pasted" into another location.

{right click} > Edit Session > Copy

Sets up the ERG so a copy of it can be "pasted" into another location.

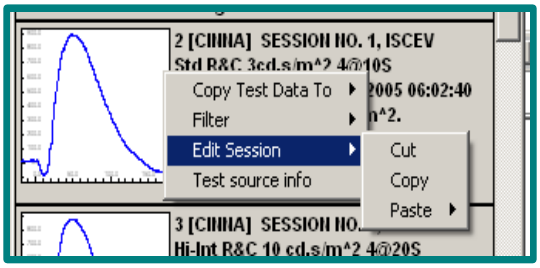

Illustration 19: Edit Session Menu

{right click} > Edit Session > Paste > Before This Test

Inserts the last ERG to be “cut” or “copied” before the selected thumbnail.

{right click} > Edit Session > Paste > After This Test

Inserts the last ERG to be “cut” or “copied” after the selected thumbnail.

{right click} > Test Source Info

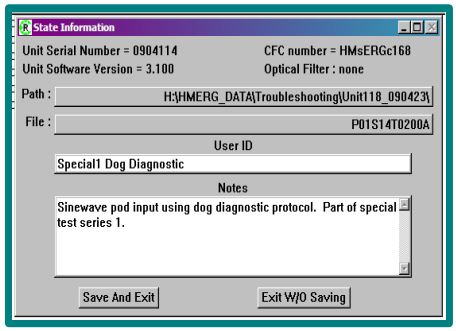

Illustration 20: Test Source Info or 'State' Window

Opens up a window displaying the serial number of the **HMsERG** unit the test was run on, the compact flash card id, the path on the **PC** where the test was stored, a User Id, and Notes. The User Id and Notes can be entered by the user and will be saved in the state file for the thumbnail.

The User ID entered here can be used on a test locator window for finding specific tests.

Summary window

The summary window is called up from a session window via session menu bar *View > Summary*. It displays data on all tests that are currently on the session window (visible or otherwise). The summary window provides a quick view of most of the ERG testing parameters and can be used to plot test parameter trends.

summary

File Edit Plot

session position	delta time	file name	eti (sec)	flash intensity (mcd.s/m^2)	a-wave amplitude (uV)	a-wave implicit time (mS)	b-wave amplitude (uV)	b-wave implicit time (mS)	b/a ratio
1	00|00:00:00.0	P08S04T0100A	0.0	10	4.7	1.0	586.1	62.4	125.66
2	00|00:00:00.0	P08S04T0200A	0.0	3000	102.1	11.4	981.5	48.5	9.62
3	00|00:00:00.0	P08S04T0300A	0.0	10000	125.5	9.6	1003.2	48.9	7.99
4	00|00:00:00.0	P08S04T0400A	0.0	30000	39.4	8.9	79.3	30.6	2.01
5	00|00:00:00.0	P08S04T0500A	0.0	3000	FLICKER	---	89.7	23.2	---
6	00|00:00:02.0	P08S04T0600A	0.0	30000	FLICKER	---	123.1	29.0	---

Illustration 21: Summary Window

There are two main areas of a summary window; the heading area and the data area. The heading area contains the column titles, the data area contains the values. The distinction becomes important for selecting and plotting values from the summary window.

When there are more rows in the session window than can be displayed on the summary window, the menu bar (to the right of "Plot") will display options to scroll up and scroll down. A-wave and b-wave values on the summary window are initially determined automatically by ***ERGVIEW***. When a measurement graph is opened these a and b wave points are displayed and may be modified by the user. As the a and b wave values on the measurement graph are changed the corresponding summary window values are also changed..

- Summary window columns

<u>number</u>

The position a specific data row occupies in the session window.

<u>delta time</u>

The time from the ERG occupying position 1 as determined by the file time associated with the test data. Delta time format is <days>|<hours>:<minutes>:<seconds>.

<u>test</u>

The **HMsERG** assigned test number for the row.

<u>eti</u>

The elapsed time from the start of a session till test data is stored.

<u>flash intensity</u>

The flash amplitude used for the test.

a-wave amplitude, a-wave implicit time, b-wave amplitude, b-wave implicit time

Parameters measured from the specific test data. The values can be examined visually on a Measurement Graph.

b/a ratio

The b-wave amplitude divided by the a-wave amplitude.

- Selecting data from a summary window for graphing.

The numeric values displayed on a summary sheet may be used as x and y values for display on a comparison graph. The following steps are recommended:

1) Before calling up the summary window, edit it's parent session window so that only the thumbnails for the ERGs desired are present.
2) Open a summary window.

3) Sort the column to be used for the 'x' coordinates by left clicking in the header area for that column. This may be any column except the test name column.

4) Select the column just sorted for 'x' values by right clicking in the header area for that column and selecting "X value" from the pop-up menu. The column data values will be colored red.

5) Select the desired 'y' column by right clicking in the header area for that column and selecting "Y value" from the pop-up menu. The column data values will be colored green.

6) Plot the selected values with *Plot > Selected Points* from the menu bar.

The data values can be saved for use in a spreadsheet program from the comparison graph. Alternatively, values from the summary window can be selected individually as x or y values by left clicking with the cursor on an x value and right clicking on the corresponding y value (x values become red and y values become green). The data points thus selected can be plotted (in the order selected) as described in step 6 above by selecting *Plot > Selected Points*.

Multiple sets of data may be plotted by creating the first plot, selecting *Plot > Reset*, then creating the next plot.

If desired, all summary sheet data may be saved in text format by selecting (summary window menu bar) *Edit > Save as Text*. The text data can then be loaded into a spreadsheet program (Excel, Quattro Pro, etc.) for analysis.

Summary window Menus

File > Print

This is the same as the menu bar selection on the session window. If columns of the summary window have been sorted, the printout will reflect the sorted order.

Edit > Save as Text

Opens a dialog for file selection and then outputs the contents of the summary page as tab-separated columns and newline separated rows. This format is accepted by most spreadsheet programs.

Plot > Selected Points

After x and y values have been selected from the summary window, then *Plot>Selected Points* will graph the values on a comparison graph.

Plot > Reset

Clears the selected point buffer so that another set of points may be chosen.

{left click in heading area}

Sorts (rearranges the rows) to put that column in ascending order (smallest to largest). The summary window data rows are moved around till the sort criteria is met.

{right click in heading area} X value

Selects the entire column in order (top to bottom) as x values for plotting.

{right click in heading area} Yvalue

Selects the entire column as y values for plotting.

When *File > Print* is selected on either a session window or a summary window a session printout is produced. This printout will contain all the tests of the session, presented in the same

way as the thumbnails on a session window and with the same ordering, followed by the contents of the summary window. Each page will have a heading showing the test id of the first test on the session and the name of the session - similar to the first line of the thumbnail text. At the bottom of the page will be the page number, the ERGVIEW version, and the date of the printout.

Special Sessions

Special sessions are composed of the contents of any session window that has been given a special session name. Usually it is a session in which the thumbnails (= ERG's) have been reordered, deleted, or inserted. They allow the user to create a session of his own choosing containing the ERG's relevant to a certain context. For example, ERG's for a certain patient recorded at different times, or ERG's of different patients for comparison.

The default directory for special sessions is separate from that of regular sessions. This allows the user to save his special session name files in a single directory, if desired, separate from the directory where the ERG's of that special session are stored.

Along with the test locator window, special sessions allow the user to find the ERG's she wants.

Logical relationship between session and thumbnail file menus.

If a specific filter (60 Hz, 50 Hz, Spike, Low Pass) is selected in every thumbnail in a session then that filter will be marked in the session filter menu.

If every thumbnail has it's low pass cutoff set to the same frequency, it is that frequency that will show up when the session *Filter > Set Low Pass Frequency* is opened; otherwise the session low pass frequency will be 150 Hz.

When the session low pass frequency is set, it will be set and low pass filtering will be turned on for every thumbnail of that session.

Each thumbnail can have filter values set that will be independent of the values of all other thumbnails until those same filter values are set using the session filter menu.

Comparison Graph

The Comparison graph is used for displaying one or more waveforms. ERG's can be visually compared, measured, and then saved in either xy or csv format for later viewing. The data points may be examined at varying magnifications and markers may be placed for making measurements. If there are data sample files associated with a test waveform the Show Samples button will be visible and can be used to open a Samples window.

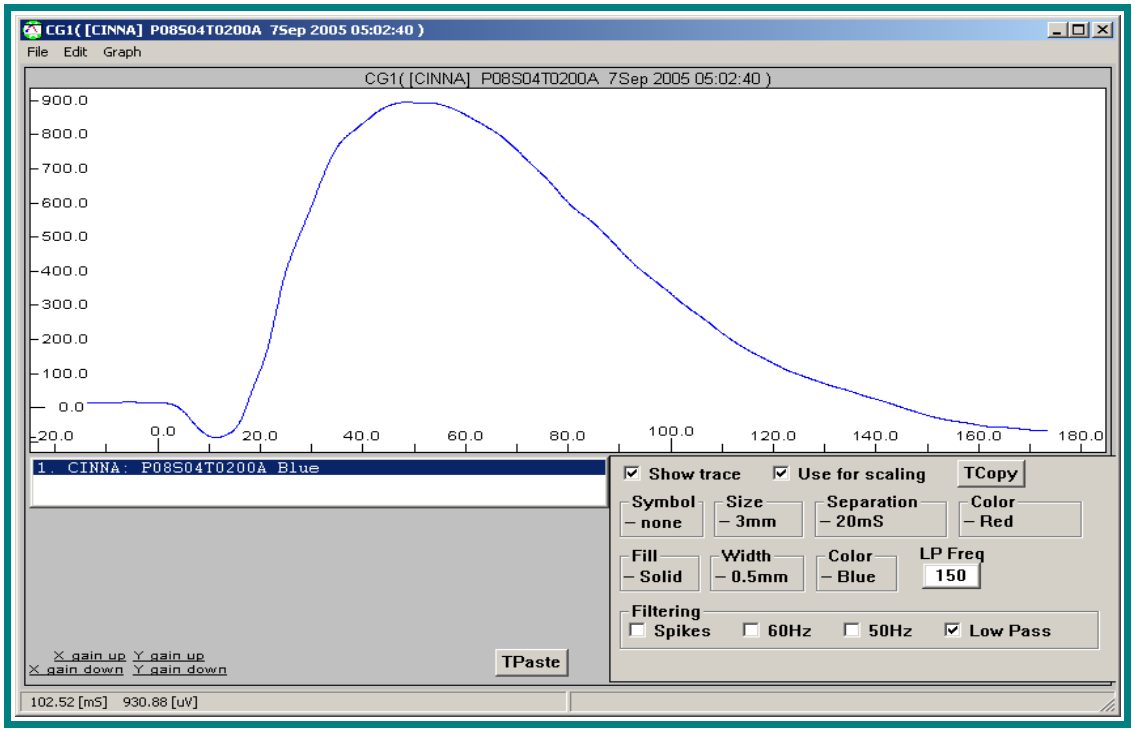

Illustration 22: Comparison graph showing an ERG waveform

- Major parts of the Comparison graph.

The white box on the left below the graph area is a list of the traces currently present on the graph. Three traces can be seen at a time in the list, if the graph has more than three, a scroll bar will show at the right of the tracelist.

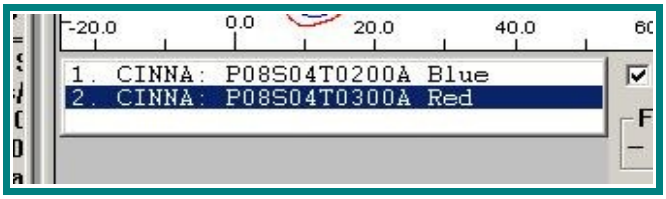

Illustration 23: Trace List

In the center is the 'attributes panel'. This panel shows the characteristics of the trace that is currently highlighted in the trace list.

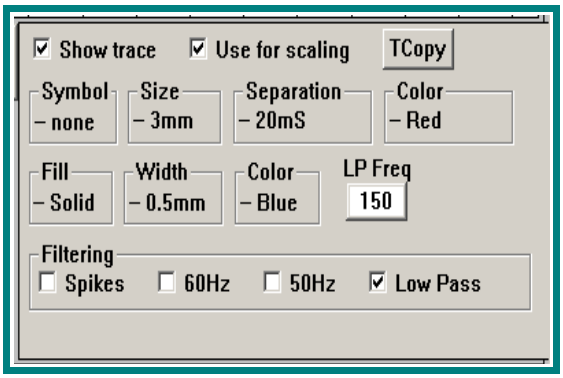

Illustration 24: Attributes Panel

In the lower left corner you can see the underlined phrases for changing the x and y gains. Each gain change is by a factor of 2 and is accomplished by left clicking on the appropriate phrase. Selecting *Graph > Reset Graph Scaling* will put the graph back to its original scaling.

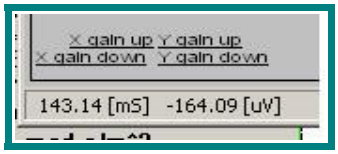

Illustration 25: Gain and Cursor Position

The status bar at the very bottom monitors the position of the cursor when it is in the graph area.

The TCopy and TPaste (Trace Copy/Trace Paste) buttons are for convenience. Copy is specific to the selected trace, paste brings into the graph the latest contents of the trace clipboard.

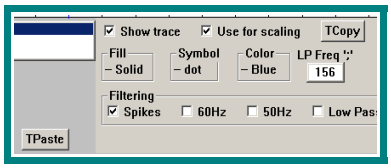

Illustration 26: Trace Copy and Trace Paste Buttons

- Markers

Comparison graphs allow for manual measurements using markers like the Measurement graph does. The popup menu following a right click includes entries to set marker 1 or marker 2. If selected, the appropriate marker will be set to the position of the windows cursor when the mouse was right clicked. The procedure is, set the windows cursor on a spot (time and voltage are reflected in the status display), right click and select a marker. Marker positions and their differences are listed below the trace list.

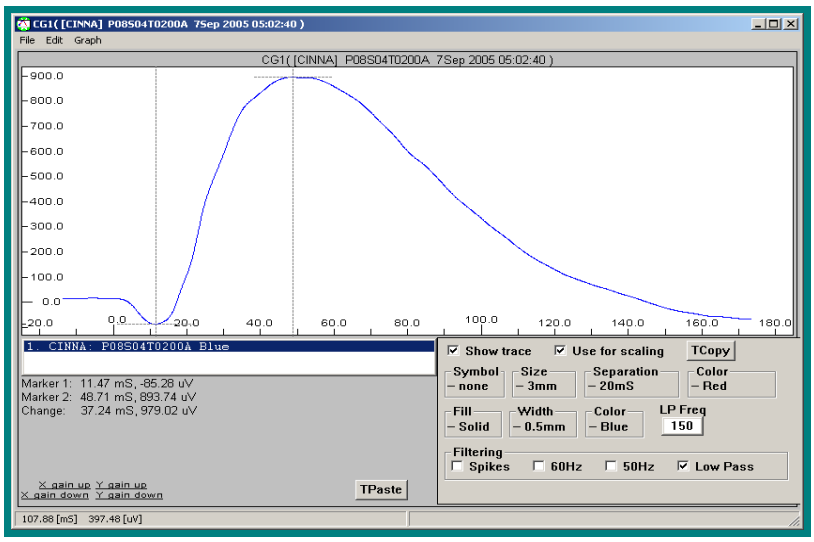

Illustration 27: Comparison Graph with markers placed.

Markers can be set by right clicking in the graph area and selecting either Marker one or Marker two.

Markers are indicated on the graph by gray vertical and horizontal lines. When markers have been placed their position(s) will be displayed below the trace list - Marker 1 on the first line, Marker 2 on the second line and, if both markers are set, the change in time and voltage on a third line.

Either marker may be reset to a new position any number of times. Markers may be hidden by unchecking a selection under the Graph menu.

- Attributes panel

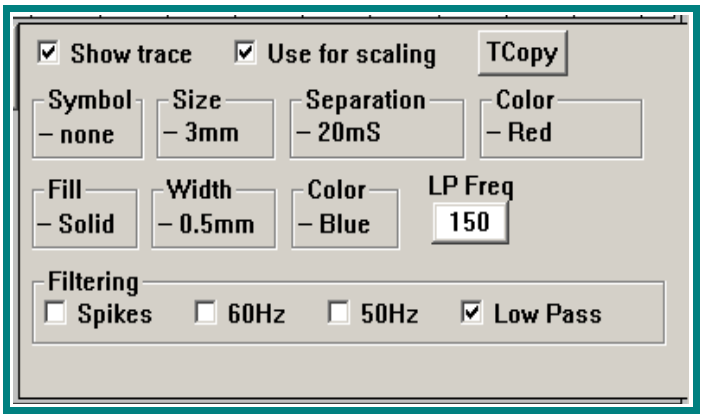

Illustration 28: Attributes Panel

The attributes panel displays and allows modification of the attributes of the trace being highlighted in the trace list.

-Buttons:

TCopy
Copies the selected trace to the trace clipboard.

Show Samples
This button is only visible is there are data samples associated with the current trace. It opens the sample window for this trace/test. See the WORKING WITH DATA SAMPLES section.

-Check Boxes:

Show trace
Shows or hides the trace. This selection is useful to hide a trace if the graph is too cluttered or if one trace is being obscured.

Use for scaling
Normally the graph scales itself so that all traces are visible. This means that a large amplitude trace could shrink a small amplitude trace to the point where it is hard to make out. When this happens, deselecting the Use for scaling attribute of the large amplitude trace will allow the graph to scale up the small amplitude trace.

Spikes, 60Hz, 50Hz, Low Pass

These four selections turn on or off the corresponding filtering.

-Edit Control:

LP Freq ';'
This is the value used for the low pass frequency cutoff. Entering a semicolon after a value is displayed in the window lets the program know that a new value has been requested. If the Low Pass check box is selected, the corresponding trace should update when the semicolon is entered.

-Selection Boxes:

Right clicking on any of the selection boxes will bring up a pop-up menu.

Symbol selection

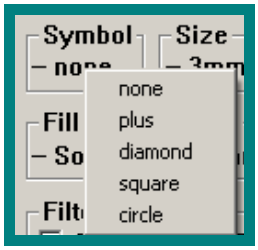

Illustration 29: Symbol pop-up menu.

Symbol (none, plus, diamond, square, circle)
Chooses the symbol placed at each 'separation distance' from time 0.0.

Size (3mm, 4mm, 5mm, 6mm, 7mm, 8mm)
This is the distance from the center of a symbol to it's sides and it's top and bottom on the screen.

Separation (5mS, 10mS, 20mS, 30mS)
Symbols are placed at time 0.0 and at each separation distance from there.

Color (Red, Yellow, Green, Blue, Violet, Black, Gray)
Selects the color of the symbol.

Trace line selection

Fill (None, Solid, Dash-2, Dash-5, Dash-10)
Selects what the program uses to fill in between the actual data points. Default is 'Solid'.

Width (0.5mm, 1.0mm, 1.5mm, 2.0mm, 2.5mm)
This selection determines the width of the line used to draw the trace and the symbols.

Color (Red, Yellow, Green, Blue, Violet, Black, Gray, White)
Selects the trace color.

Actions available on the comparison graph.

Left clicking on a point in the graph area will move that point to the center of the graph. Right clicking on a point in the graph opens up a menu that allows modification of the graph and it's traces on an individual basis.

The TCOPY and TPASTE buttons provide an alternate way to perform the trace copy and trace paste operations respectively.

- Menu Selections

File > Load Trace from Text File
Brings up a file dialog so a disk file in either CSV or XY format can be input.

File > Save traces in Text Format
Opens a 'save as' dialog for each trace on the graph. Individual traces can be saved in either CSV (default) or XY format.

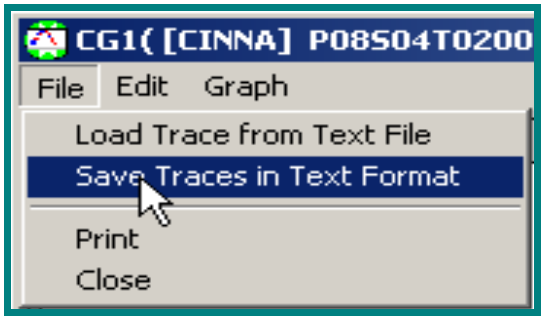

Illustration 30: File Menu.

File > Print
Brings up a print dialog and produces a hard copy of the graph.

File > Close
Same as the close button on the window.

Edit > Copy BMP
Puts a bitmap image of the user area onto the windows clipboard.

Edit > Paste Trace (TPASTE)
Loads and displays the current contents of the trace clipboard.

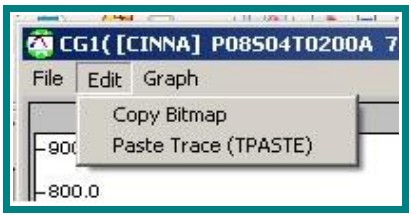

Illustration 31: Edit Menu

Graph > Reset Graph Scaling

Sets both the x and y gains to one and adjusts the graph so that all traces are visible.

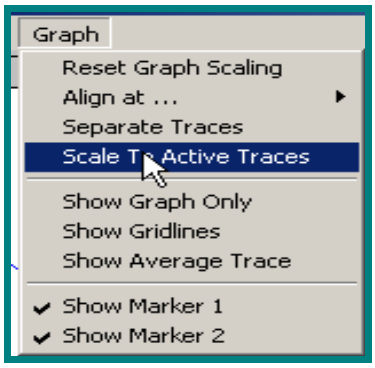

Illustration 32: Graph Menu

Graph > Align at > Flashpoint

Adjusts the vertical offset of all traces so that they pass through 0.0uV at time 0.

Graph > Align at > Marker 1 time

Adjusts the vertical offset of all traces so that they pass through 0.0uV at the time of marker 1.

Graph > Separate Traces

This menu selection opens up a Trace Separation panel on which the user can enter values to be added to all the data points of any traces after the first one. Scaling of traces two and on will be shifted by the amounts specified. The traces are automatically aligned at flashpoint before any separation is applied unless alignment at marker1 is first selected.

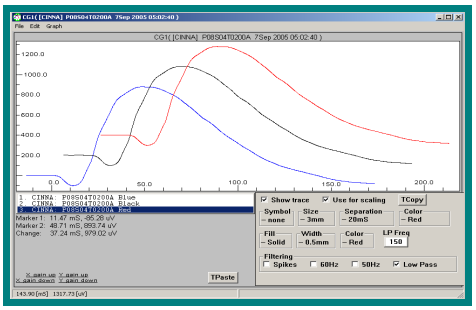
Illustration 33: Comparison graph with Traces Separated

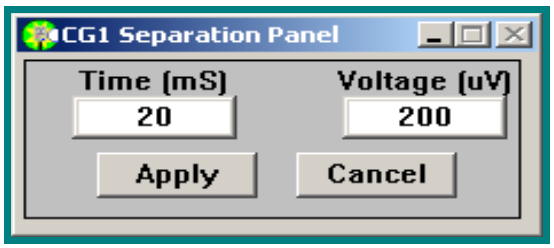

Illustration 34: Trace Separation panel

Graph > Scale To Active Traces

Scaling of the comparison graph is done in general to make all parts of all traces visible. When traces are separated it is possible that parts of some traces will be shifted off the screen. Also, when filtering is in effect it was decided to maintain scaling using the non-filtered trace so that the trace being filtered doesn't appear to shift due to end data points being lost in the filtering process. In either case, selecting this menu option will force the graph scaling to be such that all traces will be visible.

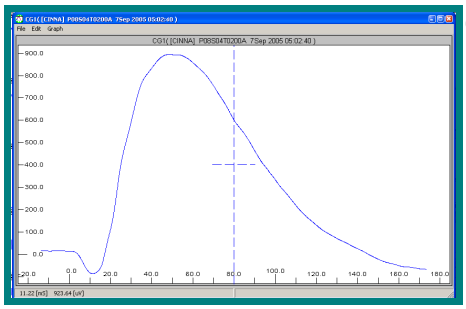

Illustration 35: Graph only display.

Graph > Show Graph Only

This selection expands the graph to include the whole client area of the window.

Graph > Show Gridlines

Draws light gray horizontal and vertical lines at each x and y marker position.

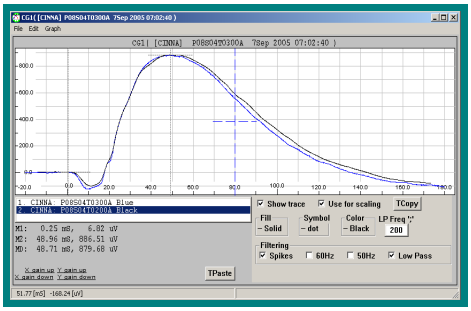

Illustration 36: Gridlines

Graph > Show Average Trace

Adds an extra trace to the Comparison Graph that shows the average of all the current traces that do not have *Use for scaling* unchecked.

Graph > Show Marker 1
Graph > Show Marker 2

These selections default to being checked. Unchecking them will hide the respective marker.

Pop-Up Menu

{right click} > Paste Trace

Adds the trace currently on the trace clipboard to the comparison graph.

{right click} > Set Marker 1
{right click} > Set Marker 2

Places a marker at the position of the windows cursor when the right click occurred. Marker positions are also displayed in the bottom panel and, when both markers have been placed, the difference (delta time and delta volts) between the markers is shown. The marker positions may be used to measure distances between graph points.

{right click} > Add Annotation

Opens up an 'edit annotation' panel to allow for placing user text onto the graph (see *Annotations* section below).

'Plot' (attributes) Pop-up Menu[2]

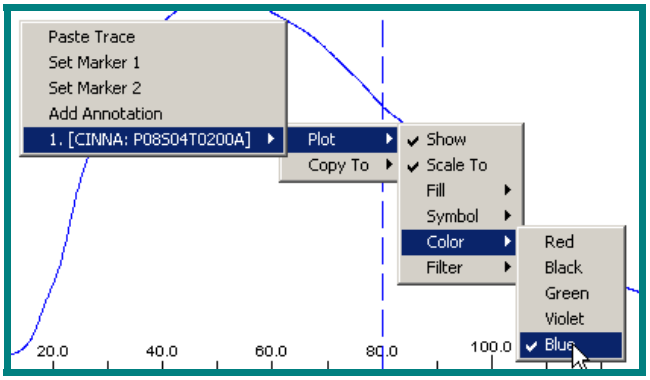

Illustration 37: Plot Pop-up Menu

{right click} > {trace entry} > Plot > Show

Toggles between displaying and hiding the selected trace.

{right click} > {trace entry} > Plot > Scale To

Determines whether this trace is used for scaling the overall graph when Graph > Reset is selected. The default is for the graph to be scaled so that all points of all plots are within the graph boundary. This selection toggles.

{right click} > {trace entry} > Plot > Fill > {line fill type}

Determines how the data points of a trace are filled in. The None selection displays the points with no fill. The Solid selection fills in between points with a straight line. The Dash selections alternate between fill and no fill for the indicated number of data points (2, 5, or 10).

{right click} > {trace entry} > Plot > Symbol > {symbol type}

Causes data points to be displayed as either a single pixel dot or as a plus sign.

{right click} > {trace entry} > Plot > Color > {color type}

Lets the user change the plot color. Colors listed are red, black, green, violet, and blue.

{right click} > {trace entry} > Plot > Filter > 60 Hz
{right click} > {trace entry} > Plot > Filter > 50 Hz
{right click} > {trace entry} > Plot > Filter > Spikes
{right click} > {trace entry} > Plot > Filter > Low Pass
{right click} > {trace entry} > Plot > Filter > Set Low Pass Frequency

This menu mimics the filter menu for a thumbnail window. Initially it will be set to

2 The functions of the Plot and Copy to pop up menus are retained for compatibility. Use of the Attributes panel for changing these items is encouraged.

correspond to the settings of the source thumbnail but each setting can be changed here. Modifications to the filter settings on the comparison graph effect ONLY the trace displayed on the graph.

'Copy to' Pop-up Menu

{right click} > {trace entry} > Copy to > Trace Clipboard

Copies the selected trace to the trace clipboard so it can be pasted into another comparison graph.

{right click} > {trace entry} > Copy to > Measurement Graph

Opens up a Measurement Graph *using the selected plot.*

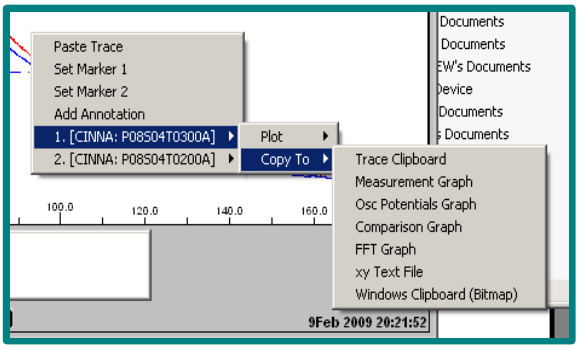

Illustration 38: Copy Pop-up Menu

{right click} > {trace entry} > Copy to > Osc Potentials Graph

Opens up an Oscillatory Potentials Graph using the selected plot.

{right click} > {trace entry} > Copy to > Comparison Graph

Opens a Comparison Graph displaying the selected plot.

{right click} > {trace entry} > Copy to > FFT Graph

Opens up an FFT Graph using the selected plot.

{right click} > {trace entry} > Copy to > Text File

Stores the data for the selected plot to a text file in "XY" format..

- Drag and Drop operations

Instead of opening up a file dialog to add traces to the Comparison graph it is possible to drag and drop certain files from a windows file listing to the Comparison graph. The file types available are test files (extension tst), xy files (extension xy), and csv files (extension csv).

Drag and drop can be used as an alternative to using the File > Load XY data and File > Load CSV data.

- Moving data from Thumbnails to Comparison graphs

As an alternative to doing a trace copy from a thumbnail panel and a trace paste on a comparison graph, the mouse can be used to simulate a drag and drop operation. Click on the graph portion of a thumbnail panel; this will create a small graph window at the cursor position. Move the cursor over to the graph area of a comparison graph and click again. A copy and paste operation will be performed automatically as illustrated by the sequence below.

User has clicked on the thumbnail panel graph area. The small window created will automatically follow the cursor.

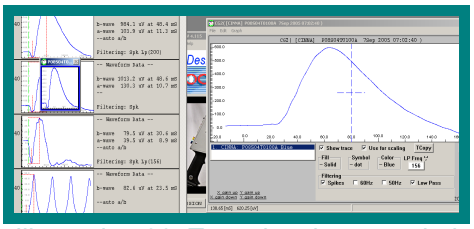

Illustration 39: Trace has been copied as indicated by the small graph window.

Cursor is moved from the thumbnail over to the comparison graph.

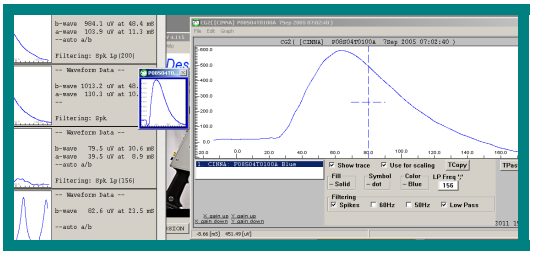

Illustration 40: Trace is being moved to the comparison graph.

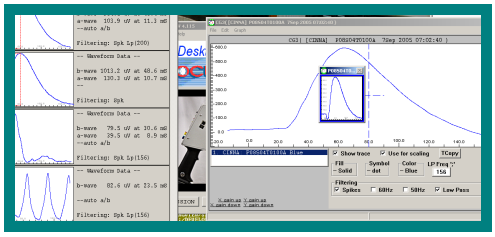

Illustration 41: Trace is ready to be pasted with a click of the mouse.

After clicking on the comparison graph, the selected trace has been pasted.

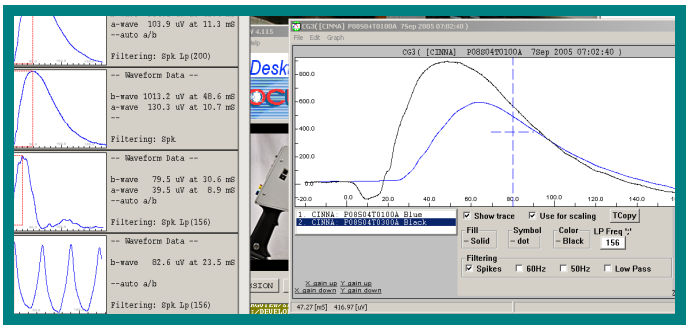

Illustration 42: After clicking on the comparison graph.

- *Annotations*

Text annotations may be placed on a comparison graph by right clicking on the graph and selecting "Add Annotation" from the pop-up menu. This will bring up a panel (see below) that will allow the user to enter a single line of text to be displayed on the graph.

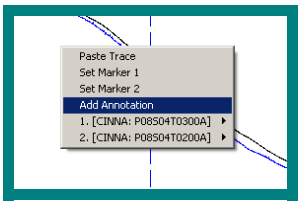

Illustration 43: Add Annotation pop-up menu

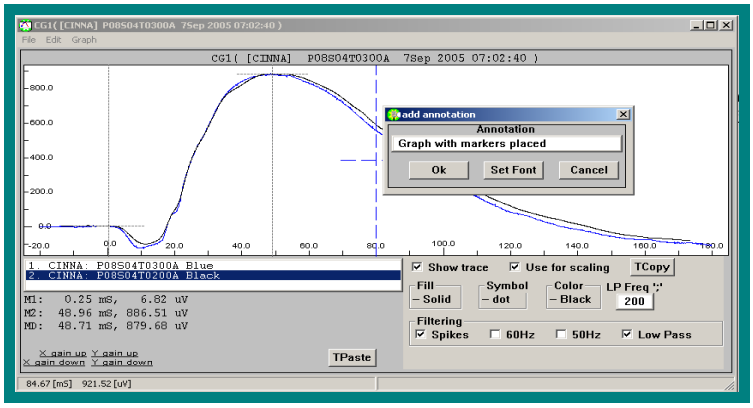

Illustration 44: Graph with edit annotation panel displayed.

Once an annotation is placed on the graph it may be modified by right clicking on it or moved by pressing the left mouse button while the cursor is on the annotation and releasing the button when the cursor is in the new location for the text (dragging the text). While the edit annotation panel is being displayed, text font and size may be adjusted by selecting the "Set Font" button. The "Cancel" button is provided in case the text, after modification, is not wanted. Only the text characters will revert on cancel, not any new font or font size that was selected.

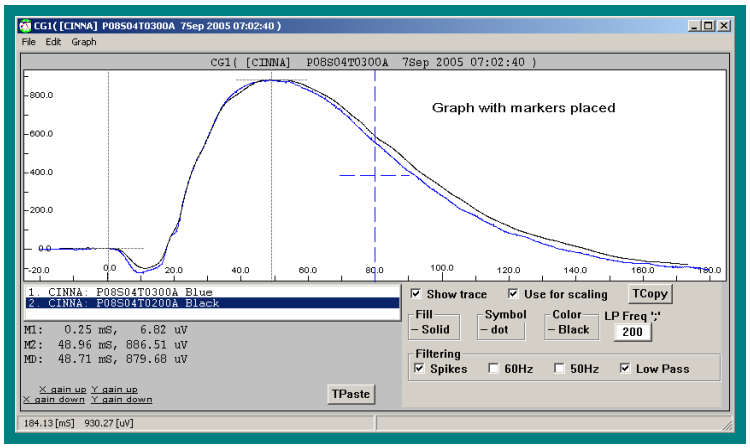

Illustration 45: Annotation is placed on the graph

A single annotation is limited to one line of 60 characters but any number of annotations may be added to a comparison graph.

Keep in mind that the position of the upper left corner of the rectangle defined by the annotation text is the reference point used when the graph is resized or shifted.

Measurement Graph

When the *Measurement Graph* selection is made from a thumbnail pop-up menu (*{rignt click} > Copy Test Data To > Measurement Graph*), the ERG data for that thumbnail will be displayed as shown in the following figure. The purpose of the Measurement graph is to present the user with values for a-wave and b-wave parameters and allow her to modify them if necessary.

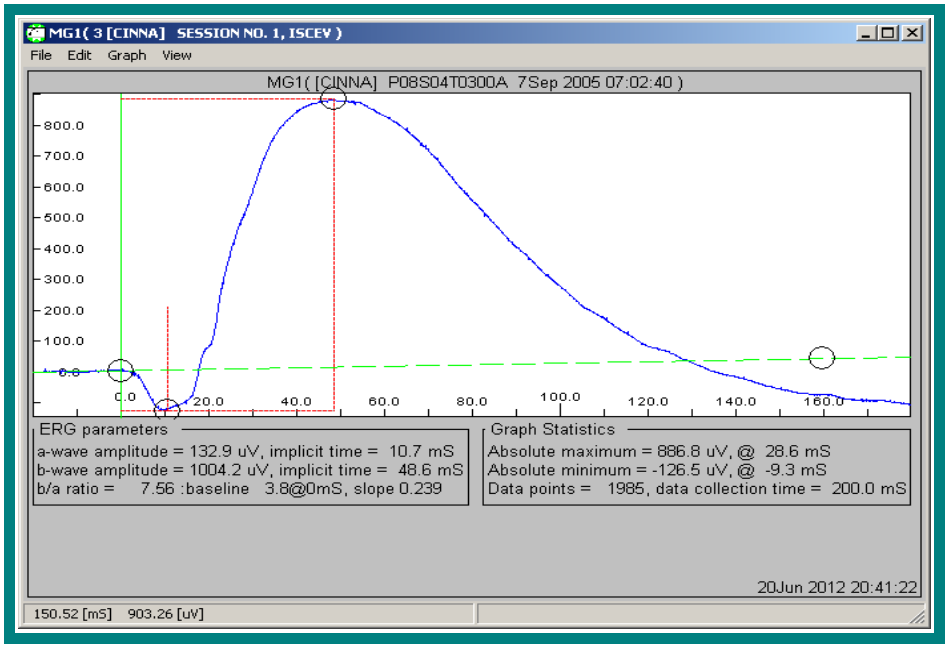

Illustration 46: Measurement graph

The Measurement graph display of a standard ERG shows the peak amplitudes in microvolts of the first negative wave (**a-wave**) and the following positive wave (**b-wave**). It also shows the implicit times in milliseconds. Implicit times are measured from the time of the flash to the time of the respective (a or b-wave) peak. The 'b/a ratio' is the absolute value of the b-wave peak voltage divided by the a-wave peak voltage.

The position of the red dashed lines on the graph where the implicit time and amplitude are measured may be adjusted by the user. To change the **a-wave** values, either 1) left click with the mouse inside the black circle for the a-wave and use the arrow keys to adjust the marker point; or 2) hold down the

control and **shift** keys and move the marker line using the arrow keys. To change the **b-wave** values, either 1) left click with the mouse inside the black circle for the b-wave and use the arrow keys to adjust the marker point; or 2) hold the **control** key only down and again use the arrow keys. When an implicit time value is changed this way (using the left or right arrow keys) the amplitude value will also change to follow the plot. Amplitude values will change directly with the up/down arrow keys without the time position changing.

A and b-wave values are measured relative to a baseline that is determined by examining the data points to the left of the flash time. Baseline values may be manually adjusted using the flash point and right hand adjustment circles. The flash point adjustment moves the baseline up and down and the right hand adjustment changes the baseline slope.

Changes to the a and b-wave values on a Measurement graph will be reflected both in the Measurement graph parameters box and on the summary sheet for the parent session window.

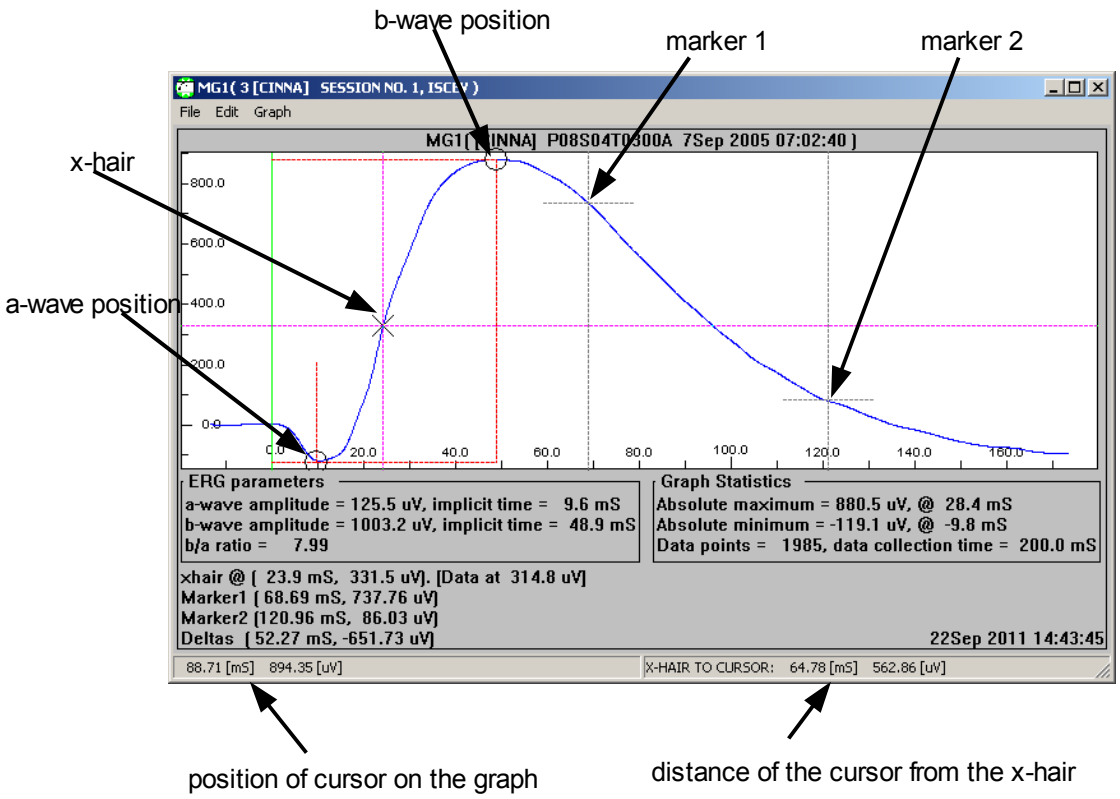

Illustration 47: Measurement graph showing markers and x-hair

If the cursor is on the graph outside of either the a or b wave or baseline adjustment circles and the mouse is left clicked, a crosshair (X-Hair) will be displayed. The X-Hair is for making additional time and amplitude measurements. After the X-hair is created, it can be moved to a any location on the graph by using the arrow keys on the keyboard or by again left-clicking with the windows cursor at a new graph location. The arrow keys will move the X-Hair by one pixel in the selected direction; the actual value change is dependent on the size of the graph on the screen. The X-hair position is displayed below the ERG parameters box.

Two more position markers are available to the user by positioning the cursor at the desired marker position, right clicking, and selecting *Set Marker 1* or *Set Marker 2*. The positions of each marker and - if both are used - the voltage and time between them will be displayed below the ERG parameters box.

To view and analyze other test waveforms with measurement graphs, go to the thumbnail window, right click, and again select *Copy Test Data To > Measurement Graph*. All graph windows opened from a specific session will stay open until either they are individually closed or the session itself is closed.

It should be noted that the default data plotted is the *averaged waveform* that results from the number of flashes made for that particular test (See the HMsERG User's Manual, section 1,L). By left clicking on *View* in the measurement graph menu bar, a drop-down menu gives the user options to show(or hide) the plot of the last ERG sample taken, and to show (or hide) the average ERG. The *Graph menu* provides options to scale the graph to either the averaged (by default) waveform or to the last ERG sample taken. Graph scaling is done by default from the averaged waveform so the last waveform may exceed the graph boundaries unless *Graph>Scale to Last Sample* is selected.

When **flicker** tests are stored, the ***HMsERG*** program adds a flag to the test data to indicate a flicker waveform and the ***ERGVIEW*** program provides a different set of ERG parameters.

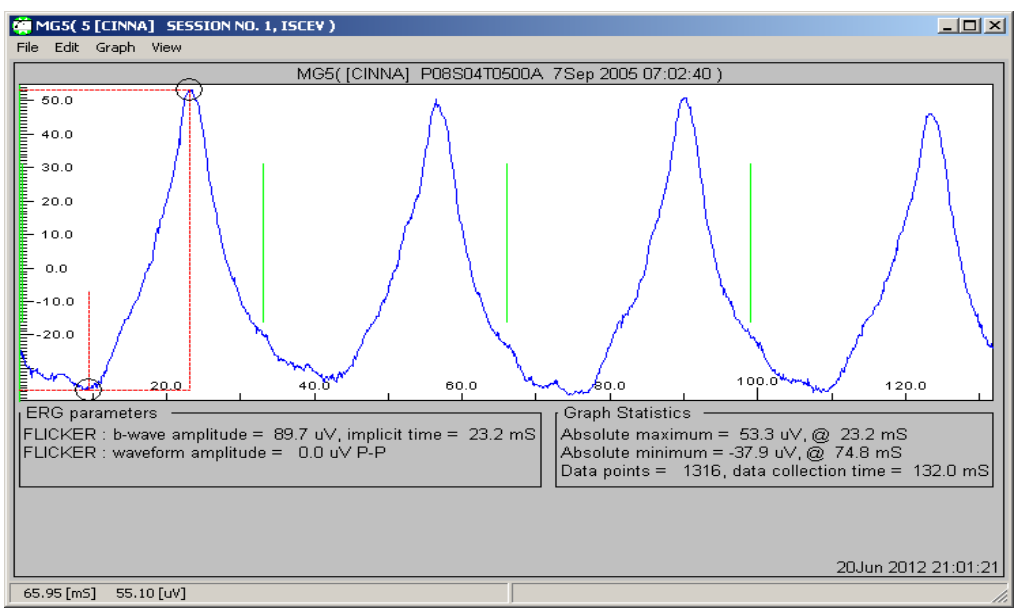

Illustration 48: Measurement graph showing a Flicker waveform

The displayed waveform is the result of averaging the entire series of test flashes - for this instance -

in groups of four. The data from the last set of four flashes can be viewed by using the *View > Last Sample* choice from the menu bar.

Note: For cursor, x-hair and marker actions, the windows cursor must be on the graph part of the Measurement graph display.

Special Keys

Ctrl + right or left arrow

Changes the b-wave implicit time. The b-wave amplitude will change so as to follow the graph.

Ctrl + up or down arrow

Changes the b-wave amplitude without affecting the implicit time.

Ctrl + Shift + right or left arrow

Changes the a-wave implicit time. The a-wave amplitude will change to remain on the graph.

Ctrl + Shift + up or down arrow

Changes the a-wave amplitude without affecting the implicit time.

Arrow Keys

When the measurement window has focus and an X-Hair has been placed the arrow keys (without any other keys being used) will move the current cursor position by one pixel in the indicated direction.

If an adjustment circle has been selected, turning the circle from black to green, the arrow keys will affect the corresponding parameter. A and b-wave adjustments respond to all four direction arrows, the baseline adjustments respond only to the up and down arrows.

Left Click

Places an X-Hair on the graph indicating the current cursor position. The X-Hair position is displayed in the bottom panel.

Menu Selections

File > Save Data as Text

Outputs the (average waveform) ERG data points in an x-y format so that they may be input to a spreadsheet program.

File > Print

Brings up a print dialog and produces a hard copy of the graph.

File > Close

Same as clicking the 'close' box ('X' at upper right of window).

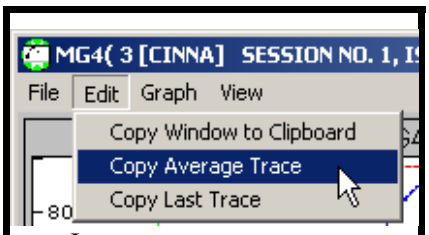

Illustration 49: Edit menu

Edit > Copy Window to Clipboard

Puts a bitmap image of the Measurement graph onto the windows clipboard.

Edit > Copy Average Trace

Puts the data from the average ERG waveform onto the trace clipboard.

Edit > Copy Last Trace

Puts the data from the last ERG sample onto the trace clipboard.

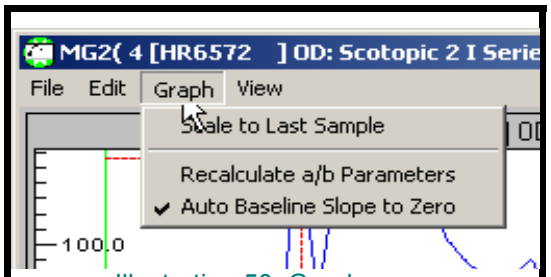

Illustration 50: Graph menu

Graph > Scale to Last Sample

It may happen that when View>Last Sample is selected, the last sample waveform is not completely contained on the display. If this is the case, *Graph>Scale to Last Sample* will adjust the graph display so that it can be seen.

Graph > Recalculate a/b Parameters

This selection will reset all values to the values calculated by the computer. This includes a and b-wave values along with the baseline intercept (value at the flashpoint). If *Graph>Auto Baseline Slope to Zero* is not selected the baseline slope will also be calculated.

Graph > Auto Baseline Slope to Zero

Default is on. This will set the slope value of the baseline to zero without affecting the position of the baseline at the flash point. This entry is to allow simulation of parameter values calculated by previous versions of ERGVIEW.

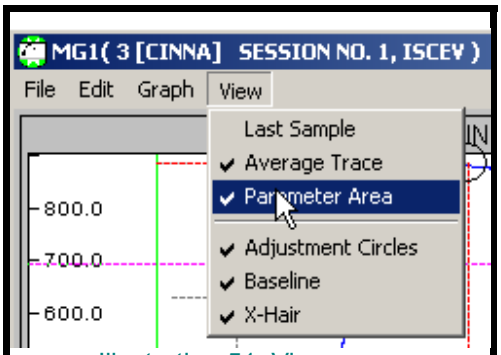

Illustration 51: View menu

View> Last Sample

Displays on the graph the last ERG sample taken.

View > Average Trace

Normally selected, this entry can be used to hide the average trace so that the last sample can be examined. Even if not shown, the average trace (and not the last sample) is used for parameter calculation

View > Parameter Area

This selection is the inverse of the previous version's *Graph>Show Graph Only* menu entry. The parameter area is the area below the plot(s) containing the ERG parameters, Graph statistics, marker and x-hair value displays.

View > Adjustment Circles

Hides (or by default, shows) the four adjustment circles.

View > Baseline

Shows (default) or hides the baseline indicator.

View > X-Hair

Turns the x-hair visibility on and off. The position of the x-hair is not changed and left clicking on the graph at another x-hair location will automatically turn the x-hair visibility on.

{right click} > Set Marker 1
{right click} > Set Marker 2

Places a marker at the current cursor ('X') position. Marker positions are also displayed in the bottom panel and, when both markers have been placed, the difference (delta time and delta volts) between the markers is shown. The marker positions may be used to measure distances between graph points.

{right click} > Copy Average Trace

This is the same as the *Edit > Copy Average Trace* selection in the menu bar. The data for the average ERG waveform is placed on the trace clipboard.

Notes:

When manually changing the a or b-wave implicit time and amplitude, make any changes in the time first, then if necessary, the amplitude. Whenever a time change is made the corresponding amplitude will revert to it's graph determined value.

It is possible to open multiple Measurement graph windows for the same thumbnail. Each one will display the average ERG waveform that corresponds to the thumbnail ERG data and filtering in effect at the time that particular graph was opened.

Automatic a/b wave and baseline calculation is done using the latest thumbnail filtering selections. So, while all opened Measurement graphs will display the ERG as it was at the time the graph was opened, their parameter values will reflect those of the latest thumbnail state. All parameters of all Measurement graphs (and values on the Summary panel) for a common thumbnail should be the same.

FFT Graph

To view the Fast Fourier Transform of one of the ERGs, right click on a thumbnail and choose **FFT.**

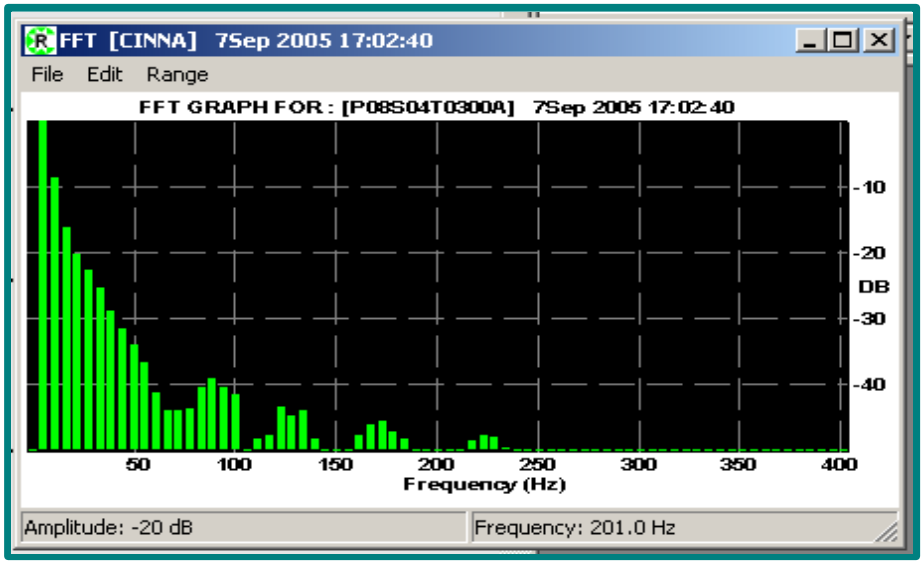

Illustration 52: Fast Fourier Transform Graph

The FFT shows the frequency components that make up the ERG waveform. The vertical axis measures the amplitude of the frequency in decibels below the maximum amplitude component. The 0Hz component is suppressed. The horizontal axis measures the frequency in hertz. The status bar displays the frequency and amplitude for where the windows cursor is currently located.

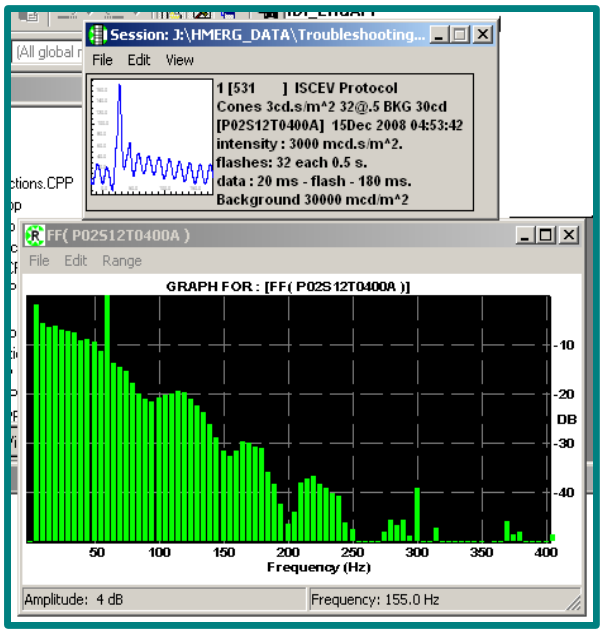

Illustration 54: FFT Graph of an ERG which displays 60Hz ripple

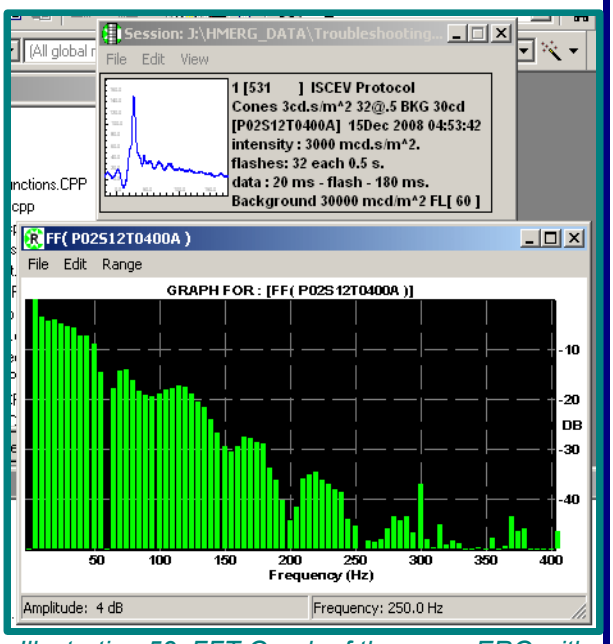

Illustration 53: FFT Graph of the same ERG with 60Hz ripple filtered out

FFT Menu Selections

File > Print

Brings up a print dialog and produces a hard copy of the graph.

Edit > Copy BMP

Puts a bitmap image of the graph on the windows clipboard.

Range >Toggle Freq Range

The default FFT display goes to 400 Hz, if there are frequency components greater than -50 DB past 400 Hz, toggling the range will display them.

Range > Linear Amplitude

Makes the vertical scale linear instead of logarithmic. The actual amplitude values in linear mode have no meaning except in their relation to other FFT components (so ignore the numbers).

{Right Click} > Inverse FFT

Displays an inverse FFT window.

Inverse FFT graph

An additional feature is offered where the user may display the "Inverse FFT" graph by right clicking on an FFT graph, then choosing (pop-up menu) *Inverse FFT*. This initially shows the inverse FFT of all of the FFT values obtained (which should give the original ERG waveform back). Slider controls on the inverse FFT graph allow frequency components to be removed and the resulting waveform displayed.

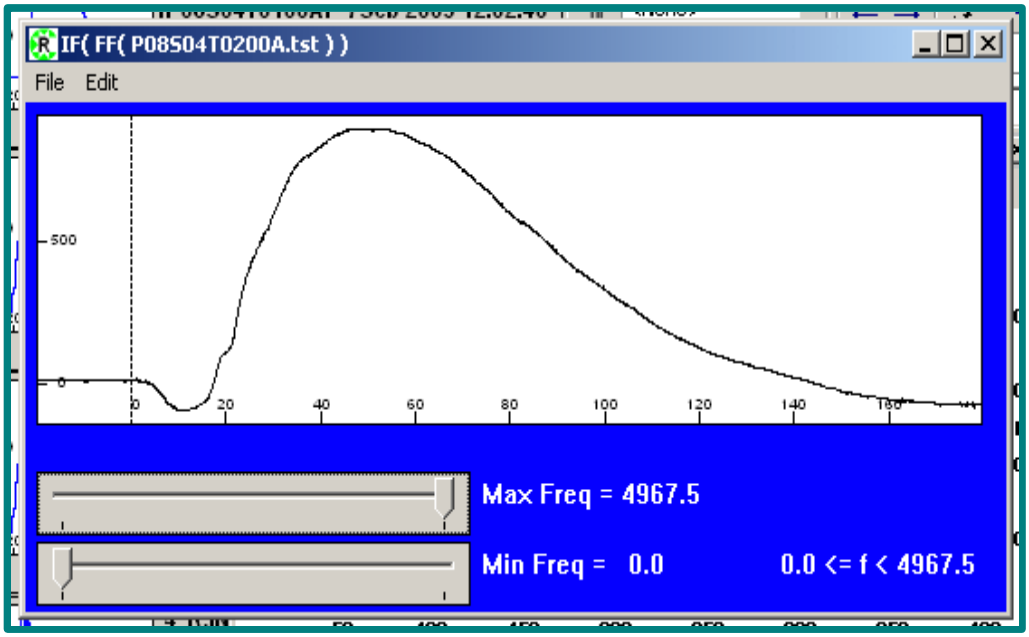

Illustration 55: Inverse FFT graph

The inverse FFT is provided as another way to filter the ERG waveform, similar to the oscillatory potential graph. It displays the real part of the inverse FFT including only the indicated frequency (Min Freq..Max Freq) components.

The inverse FFT graph initially shows the inverse of all significant FFT coefficients obtained, so what is seen when the inverse FFT is opened is the original ERG waveform. The slider controls may be adjusted to eliminate desired frequency components.

The parent FFT graph will indicate what components are being used by displaying removed

components in red.

Inverse FFT Menu Selections

File > Print

Brings up a print dialog and produces a hard copy of the graph.

Edit > Copy BMP

Puts a bitmap image of the graph on the windows clipboard.

Edit > Copy Trace

Copies the plot data to the trace clipboard.

Oscillatory Potentials Graph

*T*o view the Oscillatory Potentials of an ERG right click on the thumbnail of the ERG and choose Copy To > Osc Potentials Graph . The following oscillatory potential graph shows the ERG data filtered with a frequency window running from 100 to 300 Hz (which is the default frequency range). Oscillatory Potentials Graph

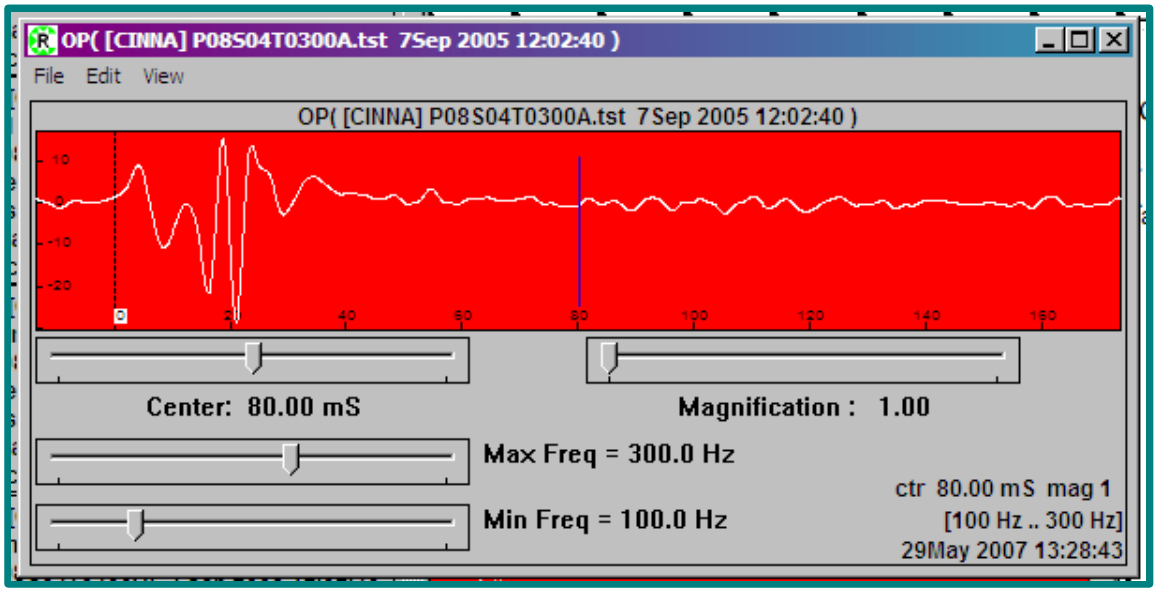

Illustration 56: Oscillatory Potential Graph

The oscillatory potential graph is a display of the ERG waveform which has been processed through a band-pass filter. The vertical axis shows the amplitude of the oscillatory potentials in microvolts and the horizontal axis shows the time after the stimulation flash.

Slider controls are provided to allow the user to manipulate the viewing window, change the center position of the display, change the window magnification as well as the upper and lower cutoff frequencies.

Menu Reference

File > Print

Brings up a print dialog and produces a hard copy of the graph.

Edit > Copy BMP

Puts a bitmap image on the windows clipboard.

Edit > Copy Trace

Puts an image of the displayed trace on the trace clipboard.

{right click} > Copy to Trace Clipboard

Places the OP plot on the trace clipboard.

{right click} > Copy to Measurement Graph

Opens a measurement graph displaying the filtered waveform. This is intended to be used to determine a and b-wave parameters from a filtered waveform (with the minimum frequency set to zero).

Test Locator panel

The Test Locator panel is used to search through the file structure on the PC and select those test files that match a certain search criteria. Searching is done starting at a selected **root** folder and by default includes all sub folders of that selected folder.

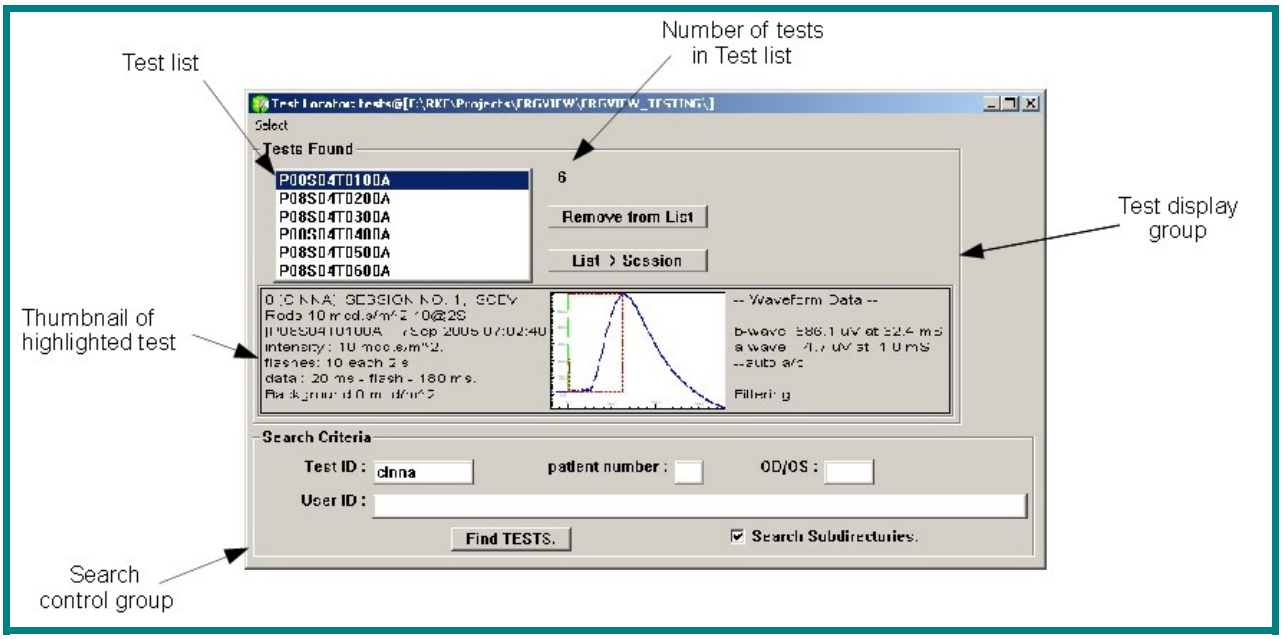

Illustration 57: Major Parts of a Test Locator panel. Results shown after a search for test id "cinna".

Searching can be done using a Test ID, a patient number, an OD or OS selection, or a User ID. More than one search item in which case tests must match all given search items. The Test ID and User ID items may hold a search pattern so that matches to only a part of these items may be used.

Search criteria matching is not case sensitive.

General Procedure for Locating Tests

1) Set the test file root directory path.
   See Selecting a new root test directory below. Once a directory path has been chosen, that path will continue to be used for all following searches.

2) Set the search criteria.
   The test id, patient number, OD/OS , and User ID entries are used for finding tests. See The Format of Search Criteria entries below.

3) Initiate the search.
   Click the Find TESTS button in the search criteria group.

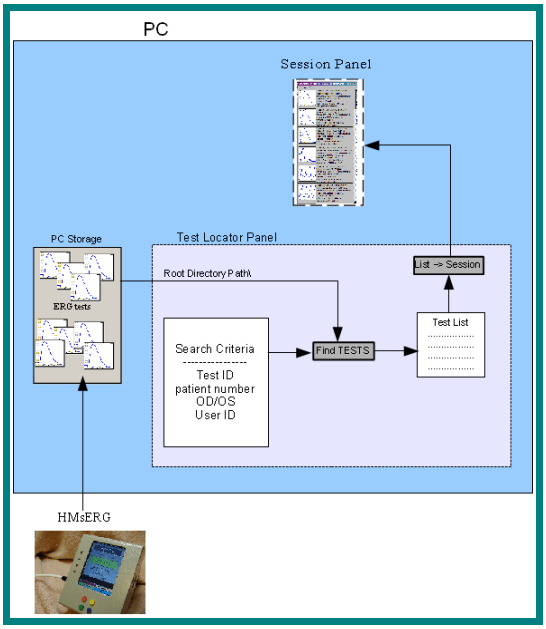

Illustration 58: Loading a Session panel with tests found by the Test Locator panel.

The ERGs found are listed in the Test list. A thumbnail presentation of the currently selected (highlighted) ERG is shown and, by right clicking on the thumbnail, all of the pop-up menu selections that are available on a thumbnail are available here just as if this thumbnail were part of a session window.

Unneeded tests may be pruned from the test list by selecting them and left clicking the **Remove** button. This does not affect the test file on the PC.

What The Search Control group entries correspond to

Test ID, patient number, and OD/OS are entered on the HMsERG unit and their value is stored as part of each test file.

The User ID for a test is entered in the State Information panel that is opened by right clicking on a thumbnail and choosing *Test source info*.

Selecting a new root test directory

Selecting the *Select > New Test Directory* menu selection will open a directory selection window. The one shown to the right is for a computer that has never set the root test directory before. After the first time a root test directory has been selected, the panel will open displaying the current selection. The letters in the curly braces are 'V' for a volume and 'D' for a directory.

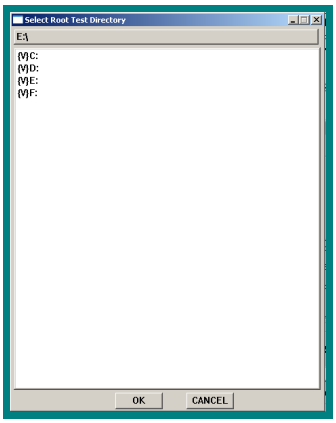

Illustration 59: Directory selection window.

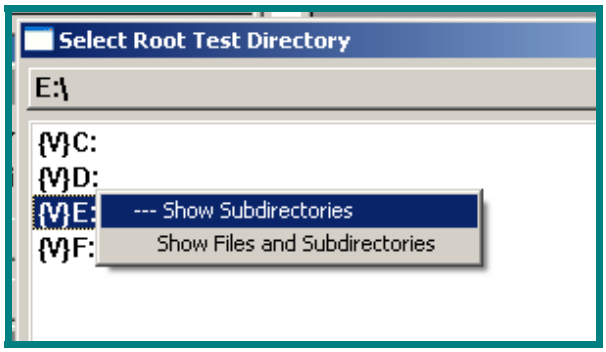

Illustration 60: Directory selection pop-up.

Left click on a directory or volume to select it and then right click to open a pop-up menu. For our use, only the 'Show Subdirectories' selection will be used. Left clicking on the Show Subdirectories selection will open up a list of folders under the directory or volume chosen. Again, cursor at the item to open, left click, right click, cursor on Show Subdirectories, left click.

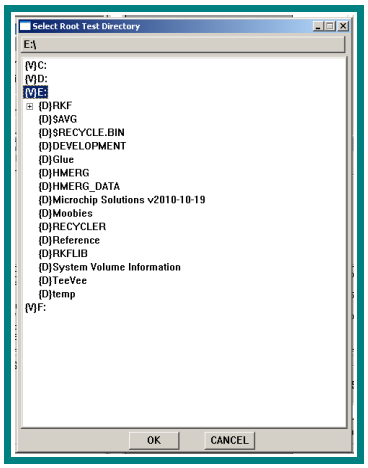

Illustration 62: First subdirectory display.

This process is repeated until the desired root directory is found and highlighted by left clicking on it. The path to that directory will be displayed in the edit panel just below the title bar.

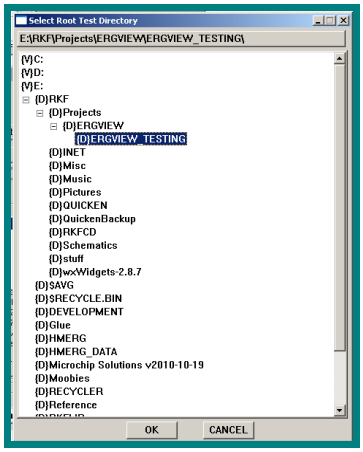

Illustration 61: Final directory selection.

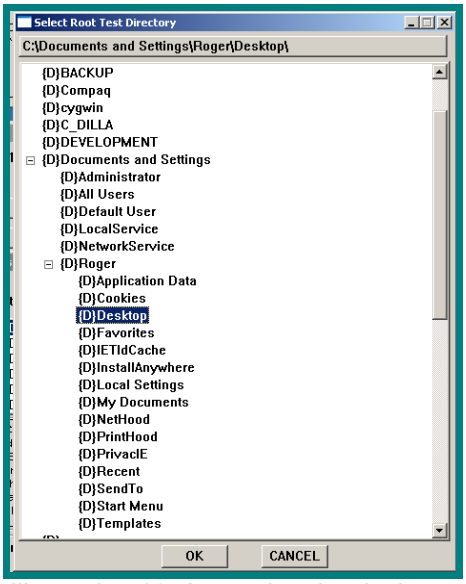

Illustration 63: Accessing the desktop.

The Format of Search Criteria entries

Search criteria may be entered into the fields of the search criteria group so that **ERGVIEW** can find the desired files and/or patient data from the search path root directory.

Entries left blank are not used for ERG selection. Otherwise, entering a search pattern in the appropriate field entries will provide patterns to guide a search of the ERG files on disk. For ERG test searching, the Test Id, Patient Number, User Id, and OD/OS fields are used. For Patient record retrieval, the Test Id, Patient Number, Patient Id, and Owner Id fields are examined. Records or tests selected will be those that match all used search criteria fields. For an ERG to be selected, all of the search criteria field entries must be satisfied simultaneously.

Patterns for search control group entries.

Alphanumeric fields are matched without regard to case. Leading and trailing blanks are not included in comparisons.

- Patient number :

This is the patient number as entered on the HMsERG and as recorded in the test file name (Pnn).

A valid patient number is an integer from 1 to 99. If one of these numbers is entered, only records/tests with that patient number will be found. If this field is blank, or zero, it will not be used for record selection.

- OD/OS :

Either ‘OD’, ‘OS’, or blank is acceptable.

- Test Id and User Id:

These are alphanumeric fields and, for a given entry, the patterns specified guide the search of that field for a match. Asterisks (*) and question marks (?) are wild cards; the first matching any string up to the character following it, the second matching any single character.

Pattern variations may be:

1) a string of characters without any asterisks (*) or question marks (?). This pattern must be matched exactly by the corresponding test file or patient record field.

2) a string of characters, some of which are replaced with question marks. All non-question mark characters must be matched exactly. In the places where there is a question mark, there

may be any character (including a space).

3) an asterisk followed by a character string. A match is obtained if a record string of n characters matches the last n characters of the pattern. Any partial match that is not an exact match is considered not to be a match.

4) a character string followed by an asterisk. In this case, the character string must be a prefix string to the record entry.

5) an asterisk followed by a character string followed by another asterisk. This pattern will match any record where the character string exists at any point in the field. A non-exact partial match is a fail.

For 3), 4), and 5) the character string may also contain question marks.

If a question mark or asterisk is part of a character string to be matched, enclose the character string in double quotes (“).

Examples for test id and user id searches:

‘TEST’ Finds tests/records with the test id exactly equal to ‘TEST’

‘TEST*’ Finds tests/records starting with the letters ‘TEST’ and having any characters following.

‘*TEST*’ Finds all tests/records that have the string ‘TEST’ in them anywhere.

‘*T*’ Finds all tests/records with a ‘T’ in them.

‘TEST?’ Finds all tests/records with a 5 character field starting with ‘TEST’.

‘?TEST’ Finds all tests/records with a 5 character field ending with ‘TEST’.

Test Locator Control Reference

Test Locator Controls

Find TESTS (button)

Uses the Test Id, patient number, User Id and OD/ID fields to find test files under the test directory path.

Search Subdirectories (check box)

Allows the searching of sub directories of the root directory folder.

- Test list:

Note : these push buttons are hidden when there is no entry selected in the list they refer to.

Remove from List (button)

Removes the currently selected test list entry from the test list. It is <u>not</u> removed from the **PC**.

List –> Session (button)

Creates a session window containing all the tests currently listed in the test list. Session windows created in this way will remain open even after the test locator window is closed.

Select Menu

Select > Test Directory

Allows for selection of a <u>folder</u> containing the test records that are to be searched for listing in the test list.

GLOSSARY

What follows are definitions of terms used in this manual. They are to be interpreted within the context of the **ERGVIEW** program.

average waveform

Each ERG test data set contains the data points for two waveforms: the average of all data and the last data points taken. The most generally useful one is the average of all the data taken for that ERG; although, for single-flash tests the average waveform and the last waveform will be identical.

a-wave

ERGVIEW locates the a-wave by first finding the b-wave and then backing up to the most negative point of the ERG waveform.

b-wave

ERGVIEW finds the location of the b-wave by finding the most positive portion of the ERG.

default path

Also called default file path. The file path remembered by the ERGVIEW program and used to find an initial instance of a file. The program has default paths for sessions, special sessions, xy, and csv files. Default file paths are updated whenever a new path is selected for opening or saving.

directory

A container for files or other directories on a computer. Also called a folder.

eti

The elapsed time indication (eti) entries are time values measured from the start of the test or session till the point of ERG data storage. The eti is reset to zero at the start of either a session or a test that is not part of a session. Elapsed time is shown on Summary windows.

folder

A container for files or other folders on a computer. Also called a directory.

ERGVIEW

The **PC** program for viewing ERG waveforms recorded by the **HMsERG**.

HMsERG or **HMsERG unit**

This is the device used to record ERG waveforms.

last waveform

Each ERG test data set contains the data points for two waveforms: the average of all data and the last data points taken. The most generally useful one is the average of all the data taken for that ERG; although, for single-flash tests the average waveform and the last waveform will be identical.

left click

With the windows cursor positioned in the appropriate area depress and release the left mouse button. Selection of an item by mouse is generally a matter of left clicking on that item.

right click

With the windows cursor positioned in the appropriate area depress and release the right mouse button.

sample (or data sample)

A single capture of data when running a test on the HMsERG unit. Each ERG test is comprised of one or more samples. Normally only the last sample taken and the average of all samples is available in a test (tst) file. If 'Save all Samples' is set to yes on the unit then any other samples takes will be stored in sample files with the extension 'spl'.

session window

The session window contains a group of ERG tests that the user has determined are related in some way. The default grouping is to all tests that have the same patient and sequence number as the initial test file selected. ERG tests may be added or removed from session windows at the user's discretion. The term "session" used here is synonymous with "session window"; references to a "session" on the HMsERG will be so indicated to avoid confusion.

special session

A session composed of tests selected by the user and given a special session name. Special sessions can be opened just like regular sessions and have a default path independent of the one for regular sessions.

test or **ERG record**

The data collected when a test is run on the **HMsERG**. This includes not only the ERG data but information about the test parameters, test id, patient number, a flicker flag, OD/OS, etc.

test id

The 10 digit field entered into the Test id panel when preparing the **HMsERG** for testing.

test waveform or **ERG** or **ERG waveform**

The data collected for a test. What is plotted on the measurement or comparison graph.

text file format

Text files (as in "save as text") are stored with tab characters separating fields and carriage returns terminating each line. The "XY" data format is in text file format.

thumbnail

A representation for an ERG test showing the average waveform and descriptive information for that specific test. Thumbnails are used in session windows and test locator windows. There is a one to one correspondence between ERG tests and thumbnails.

trace

A "trace" refers to the information necessary to display data points on a graph. It includes not just the data points but information about color, symbols, line type, etc. Traces can be copied from various places in **ERGVIEW** onto a comparison graph. You can copy traces from thumbnails, measurement graphs, oscillatory graphs, and comparison graphs.

User ID

This is a user determined field of the Test Source Info window. It is specific to the ERG of a thumbnail panel and can be used by the Test Locator window for finding ERG's.

XY data format

A text format for recording plot data onto disk. **ERGVIEW** stores one data point per line as 'x-value' <tab> 'y-value'<return>.

window

My definition of a 'window' is essentially that used by Microsoft; a screen entity that can be moved, resized, minimized, etc. as a whole. This term is included here because the term 'panel' has also been used in the same context as window. The term panel will be used to specify a section of a window or a 'child window' of a window. A graph (as in measurement graph) is also a window.

APPENDIX A

Getting Test Files from HMsERG to ERGVIEW

Test data files are stored on a compact flash card by the **HMsERG unit**. They can be accessed by

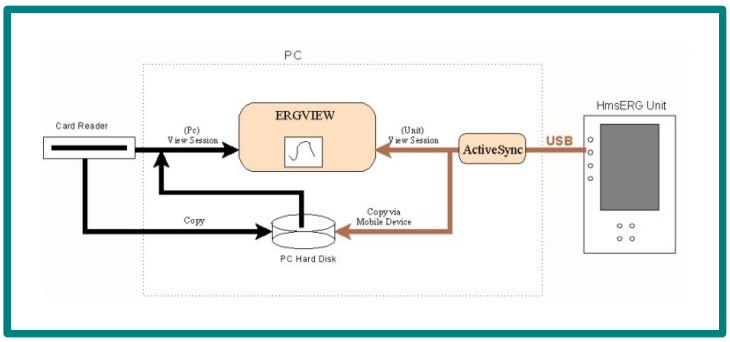

Illustration 64: Test data flow from the HMsERG to the viewer program.

ERGVIEW in one of two ways. By reading tests from the **CF** card using either a card reader or a USB connection.

If a compact flash card reader is available the **CF card** can be removed from the unit, and installed in the **reader**, and accessed directly by **ERGVIEW** . The **flash card** will show up on the **PC** as just another storage device. This storage device can be accessed by **ERGVIEW**. Alternatively, the test files can be copied to a folder on the **PC** and accessed by **ERGVIEW** from there.
The individual test files stored on the **CF** are located in directories that were given names that were derived from the current test date and from the id of the compact flash card.

ERGVIEW requires that the host **PC** have a software application named Microsoft **ActiveSync**. This is a program that is used with **Windows CE** based **PDA**'s and other Mobile devices. Since the **Unit**'s operating system is based on **Windows CE**, **ActiveSync** can be used to copy the files from the **Unit** to a **PC** using a USB connection.

1. Start the **HMsERG** program.
2. Connect the USB cable between the **PC** and the **HMsERG** unit.
3. Observe "WOULD YOU LIKE TO SET UP A PARTNERSHIP?"

   Mark the radio button indicating "No". click NEXT.

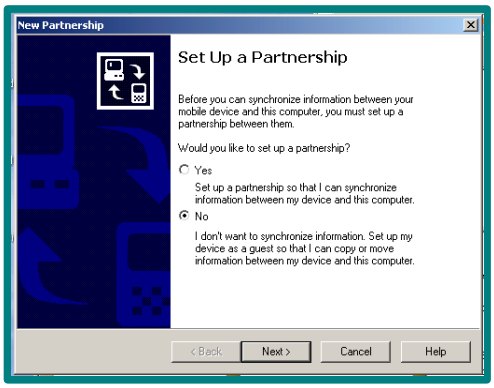

Illustration 65: Active sync Partnership window.

4. The panel MICROSOFT ACTIVESYNC is displayed showing "CONNECTED".

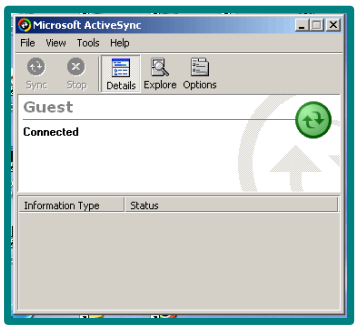

Illustration 66: Active Sync Connection window

5. A green double-arrow circle shows up in the task bar.

You can now use either **ERGVIEW** or the file icon 'Mobile Device' to access files from the **HMsERG** unit

a) Transferring files from the **HMsERG** to the **PC** using 'Mobile Device'.

Once a connection is made, on the **PC** go to My Computer or some other file viewer and look for the files on your Unit by clicking on the Mobile Device icon. This is much like looking for files on a CD-ROM or floppy drive. To see the files on the **CF** card, click on **Storage Card**. You will see test files in directories named by the date of the test, just as when using a card reader. These files can be copied to your desktop or any other directory on your **PC**.

b) Opening files from the **HMsERG** using **ERGVIEW**.

Start **ERGVIEW** (if it is not already running) and select **(Unit)View Session**.. Once a connection is established, the **HMsERG** program is no longer needed; if the unit times out it will not affect file access by **ERGVIEW**.

The USB cable should be disconnected before rebooting the **HMsERG** program, it can be reconnected after the reboot; this will prevent an 'unknown device' error message on the PC.

APPENDIX B

FILE TYPES USED BY ERGVIEW

--- HMsERG test files (extension '**tst**')

These are files produced by the HMERG program containing the last data sample taken, an average of all data samples taken, and identifying information about the test.

--- HMsERG test sample files (extension '**spl**')

These are individual data samples saved by the HMsERG when 'Save all Samples' is turned on in the System Parameters panel of the HMsERG.

--- Test 'state' files (extension '**st_**')

Information that shows up on the Test Source Info panel is stored here.

--- Special session files (extension '**s_f**')

These are files created by ERGVIEW when the 'File>Save as a special session' menu of the Session panel is used. These files contain information to reconstruct the session window they were created from.

--- Text files in <xvalue><tab><y value> format (extension '**xy'**)

These files can be used to transfer graphs (that is, the data points used) between ERGVIEW and a spreadsheet program.

--- Text files in <xvalue>,<y value> format (extension '**csv**')

These files can be used to transfer graphs (that is, the data points used) between ERGVIEW and a spreadsheet program.

--- Text x-y file extra information (extension '**cv_**')

Information pertaining to the corresponding text x-y file is stored. Currently graph x and y units are the only entries.

APPENDIX C

WORKING WITH DATA SAMPLES

Most tests that the HMsERG executes take multiple data samples and averages them to produce the resultant ERG test file seen by the user. Starting with S/W VERSION 3.225 the HMsERG unit can be instructed to save all samples taken and these samples can be examined by ERGVIEW versions 4.000 and above.

- On the Unit:

To save all samples, go to the System Parameters panel on the unit and select "Save all Samples". Set the parameter value to 1 (yes) to save samples and 0 (no) to continue operation as before.

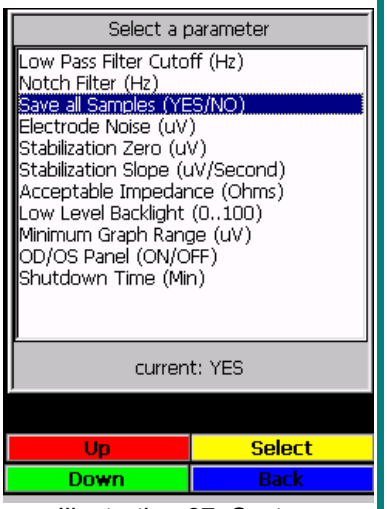

Illustration 67: System Parameters Panel

When samples are being saved, all but the last data sample taken will be stored on the compact flash card in files named after the test file they are a part of with the addition of a "-NN" where NN is a sample number including any leading zero and an extension 'spl'. The final sample taken was always stored in the test (tst) file[3] and this has not changed.

3 The last sample is accessible using the Measurement graph as before.

- Using ERGVIEW to work with samples:

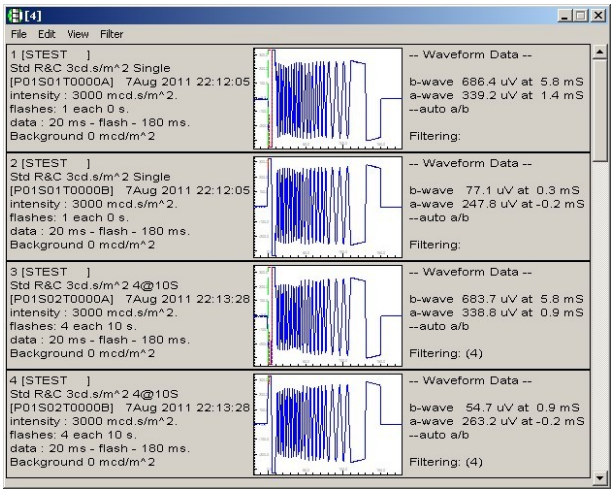

Illustration 68: Session panel showing two Thumbnails without samples and two with four samples each.

Individual data samples can be accessed by Thumbnail panels and Comparison graphs.

When ERGVIEW finds sample files associated with an ERG test file it places the number of samples found to the right of the "Filtering:" label enclosed in parenthesis.

The graphical display on the thumbnail defaults to the average of all samples taken whether samples were recorded or not. If samples were recorded they can individually be selected for inclusion in the average by opening a Sample Selection window and adding or removing check marks on individual samples.

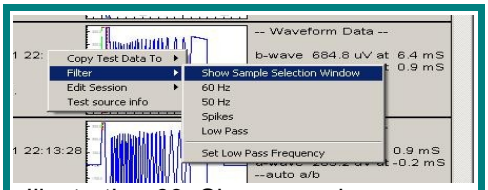

Illustration 69: Show samples pop-up

Right click on the thumbnail and select *Filter* > *Show Sample Selection Window* (illustration above). The Sample Selection window is shown below.

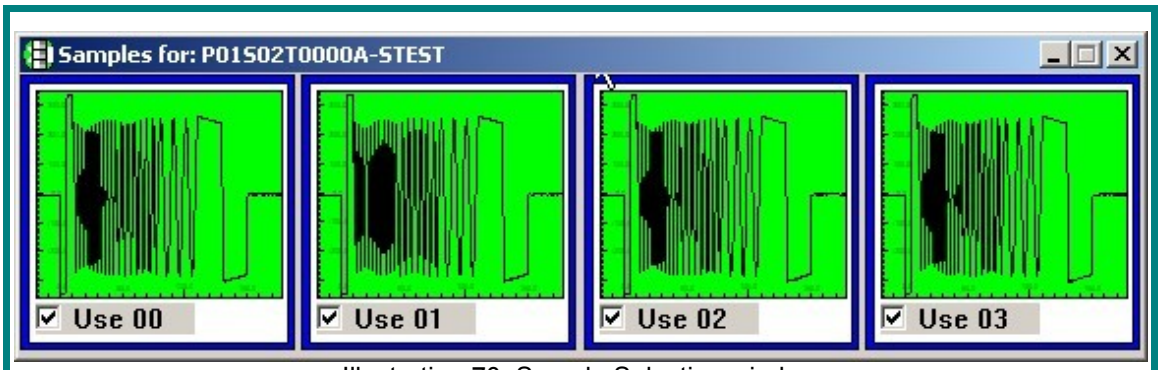

Illustration 70: Sample Selection window

Once the Sample Selection window is open, click on the check boxes to toggle the check marks. The graph in the thumbnail will be modified each time there is a change on the Sample Selection window.

Sample selections from thumbnails will be saved in the state file for the thumbnail so whatever selections are made by the user will be preserved the next time the thumbnail is opened.

Any item chosen on the *Copy Test Data To* > thumbnail pop-up will incorporate the current sample selections.

APPENDIX D

Program Changes

Version 4.380

14SEP2012 -Corrected a labeling problem in that, when a file name contained a test id the name in comparison graphs always said it was channel 'B'.

-Added the capability to insert a trace indicating the average of all the other traces on a comparison graph.

- Moved the text 'x-y' file type selection (csv, xy) from program menus to the file selection dialog.

Version 4.365

20JUN2012 -Added a visible baseline and the ability to manually adjust it to the Measurement graph.

-Added a View menu to the Measurement graph to allow a selection of items to be shown or hidden on the screen and on the printout.

03FEB2012 -Rearranged comparison graph menus.

Version 4.135

31JAN2012 Summary panel now updates when a/b wave values change due to a sample selection change.

Version 4.130

02Jan2012 Modified placement of samples window.

19Dec2011 Reversed the a-wave/b-wave display lines on thumbnails so that a and b wave values are displayed in the same sequence as on measurement graphs.

19Dec2011 Changed thumbnail, comparison, and measurement graphs so that

they keep the waveform after a change in filtering in the visible area. Removed automatic 'align at flashpoint' from comparison graphs.

19Dec2011 Corrected flashpoint calculation that was causing bad a-wave values to be reported.

Version 4.115

- Added the ability to modify the low pass frequency all thumbnails of a session at once.
- Added trace copy from a thumbnail and paste to a comparison graph by using the cursor in a drag and drop fashion.

Version 4.055

- Added capability to examine individual test samples and print out their graphs.
- Added a log intensity column to the Summary window.
- Added Optical filtering information to Thumbnail panels.

Version 4.000

- Changed opening window to a normal window that allows drag and drop operations.
- Added attributes panel to the comparison graph.
- Removed the Patient ID information from the Test Locator window.

Version 3.225

- Low filtering frequency was not retained unless a filtering mode was changed.

Version 3.204

- Session panel and printouts were changed to show waveform a and b wave values along with the waveform peak to peak value.

Version 3.200

- Sessions can be customized through the thumbnail cut/copy/paste operations and saved as a group.

Version 3.111

- A and b-wave indicator circles were added to the measurement graph to allow clicking w/in a circle and using the arrow keys to adjust the value.

- A ‘Trace Separation’ entry was added to the measurement graph ‘Graph’ menu.

Version 3.107

- The user may enter notes and individual test identification strings for test files stored on the PC. This test identification may be used to search for test files using the test

locator panel.

- Restored the filtering option to the thumbnail and, separately, to the session window.

Changes from version 2.5.7 to version 3.104.

- The Database window has been renamed Test Locator window.
- Test files can now be dropped from a windows explorer window onto a comparison graph.
- User annotations can be added to Comparison graphs.
- Test times now come from information in the test files instead of from the operating system file time.
- Multiple traces can be saved in one operation from Comparison graphs.
- Moved filtering from thumbnail to Comparison graph.
- Multiple individual files may be selected for a Session window.
- The flashpoint voltage calculation for calculating the a and b-wave amplitudes was changed from using the data point at time zero to using the intersection of the regression line for the pre-flash values.

APPENDIX E

LIMITED WARRANTY

OCUSCIENCE LLC, a subsidiary of Xenotec Inc., a Missouri corporation ("Seller") warrants to the original purchaser of this product that this product will be free of defects in materials and workmanship for a period of one (1) year from the original date of purchase. If the product should become defective within the specified warranty period, Seller will repair or replace, at its option, any parts that appear, to its satisfaction, to have been defective in material or workmanship. Seller will refund to the purchaser the purchase price if the defect in the product is one covered by this warranty, and Seller is unable, by repair or replacement, to make the product perform the work for which it is designed. This warranty does not obligate Seller to bear any transportation, removal, or installation charges in connection with the inspection, repair, or replacement of defective parts. The limited warranty contained herein is the purchaser's exclusive remedy.

To obtain warranty service, the purchaser must deliver the product or the defective parts to Seller's service facility or other point designated by Seller. Shipping expenses are the purchaser's responsibility. The purchaser should contact Seller at the following address for instructions on where to obtain warranty service:

Ocuscience LLC.
8609 Jarboe St.
Kansas City, MO 64114

This warranty does not cover any defects or costs caused by: (1) modification, alteration, repair, or service of this product by anyone other than Seller; (2) physical abuse to, or misuse of, the product or operation thereof in a manner contrary to the accompanying instructions; (3) any use of the product other than that for which it was intended; or (4) shipment of the product to Seller for service.

This warranty does not apply to component parts of this product that were not originally

manufactured by Seller; such items are sold to purchaser on an "AS IS" basis. This warranty also excludes all costs arising from routine maintenance, including the replacement of any parts required by such maintenance. Seller reserves the right to modify, alter, or improve this product, or parts thereof, at any time without incurring an obligation to modify, alter, improve, or replace any product, or parts thereof, previously sold.