

Getting Started Guide

Version 10

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Getting Started - The Basics

Turning Equipment On and Off

To turn equipment On.

1. Connect the amplifier, stimulators, and other accessories (if not already connected).
2. Turn equipment on in the following order:
 - Sierra Wave base unit
 - Monitor (for desktop configuration only)
 - Printer
 - Computer



If you are using the isolation transformer and cart power switches, you will need to turn on the cart power switch and then the computer.

To turn the equipment Off.



Do not turn the Sierra Wave instrument base on or off while a patient is connected.

Turn off equipment in the following order:

1. Close all programs that are running on the computer.
2. On the Windows taskbar, click Start, Shutdown, Turn Off the Computer.
3. Turn off the Sierra Wave base unit, Monitor (for desktop configuration only), and Printer.



If you are using the isolation transformer and cart power switches, turn off only the cart power switch after you have shutdown the computer. The monitor, printer, Wave base unit, and isolation transformer power switches can remain on. The next time you start the system, turn on the cart power switch and then the computer.



You do not need to disconnect the amplifier, stimulators, or accessories. You can leave them connected.

Starting the Sierra Wave Program

To Start the Sierra Wave program

Start the Sierra Wave software on your computer in one of the following ways:

- Double-click the **Sierra Wave** icon on the Windows desktop.
- Click the Windows **Start button**, select **All Programs, Cadwell**, and then **Sierra Wave**.



If you receive a Communication Error message.

Close the Sierra Wave program and make sure the Sierra Wave base unit is turned On, and that the network cable is attached securely between the computer and the Sierra Wave base unit. Then, restart the Sierra Wave program.



If you are working on a **Reader station** (no acquisition hardware attached) the communication error can be disabled. [Click here](#) for instructions on how to do this.

Starting a New Exam and entering Patient Information

To start a New Exam and enter Patient Information use one of the following methods.

- Press **F1 - New Exam**.
- Select **Enter Patient Info** from the **File Menu**.
- Press the **Patient** key on the Sierra Wave base unit.
- Select a **Study** or an individual **Test Protocol** from the **Study/Test** menu

All of these methods will display the following Patient Information Window.

Patient Information window

A blinking cursor will automatically be displayed in the **Last Name** field. You can use the **tab key**, **mouse**, or **Knob #1** on the Sierra Wave base unit to move from field to field.



At a minimum, you should enter a **Last Name** and **First Name**, this is what the Sierra Wave program uses to create the patient's data file.

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The **Test Date** and **Test Time** will automatically be entered for you, and can be modified if needed.

Height can be entered in the following units:

- **Feet and Inches**



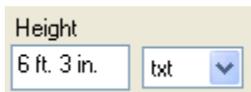
A screenshot of a height input field. It consists of two text boxes: the first contains the number '5' and is labeled 'Height', and the second contains the number '8' and is labeled 'Inches'. Between the two boxes is a dropdown menu with 'ft.' selected.

- **Centimeters (cm)** - required when using the prediction equations in NCV, F Wave, and H Reflex.



A screenshot of a height input field. It consists of a single text box containing the number '172' and a dropdown menu with 'cm' selected. The text box is labeled 'Height'.

- **Text (txt)** - for backwards compatibility with older patient data or when using different measurement units.



A screenshot of a height input field. It consists of a single text box containing the text '6 ft. 3 in.' and a dropdown menu with 'txt' selected. The text box is labeled 'Height'.

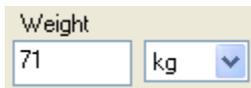
Weight can be entered in the following units:

- **Pounds (lbs.)**



A screenshot of a weight input field. It consists of a single text box containing the number '158' and a dropdown menu with 'lbs.' selected. The text box is labeled 'Weight'.

- **Kilograms (kg)**



A screenshot of a weight input field. It consists of a single text box containing the number '71' and a dropdown menu with 'kg' selected. The text box is labeled 'Weight'.

- **Text (txt)** - for backwards compatibility with older patient data or when using different measurement units.



A screenshot of a weight input field. It consists of a single text box containing the number '159' and a dropdown menu with 'txt' selected. The text box is labeled 'Weight'.

To use the **Custom Information** fields, you will need to click the mouse in the field prior to entering information.

The **Report Header** can be selected from the drop-down list or by clicking on the Browse button. The report header can also be selected from within the System Setup window.

The following buttons are shown at the bottom of the window:

F1- Load Patient Info: Allows previously entered patient information to be loaded from a saved patient information file (*.cpi) or from a patient data file (*.sd).

F2- Close & Save: Allows the entered patient information to be saved in a file, it can later be retrieved using the Load button.

F3 - Start Exam: Saves the entered patient information and then displays the Study Menu. You can then select the Study or individual Test protocol that you would like to use.

F4 - Cancel: Closes the patient information window and discards all information.



The patient information can be edited at any time after starting an exam. Simply press the **Patient** key on the Sierra Wave base unit, or select **Patient Information** from the **Edit** menu.



You can also start an exam without entering any patient information. Simply select **F3 - Start Exam** and go directly into the Study or Test Protocol and begin testing. If you do not enter any patient information during the exam, the program will prompt you for it when you close the patient's exam.

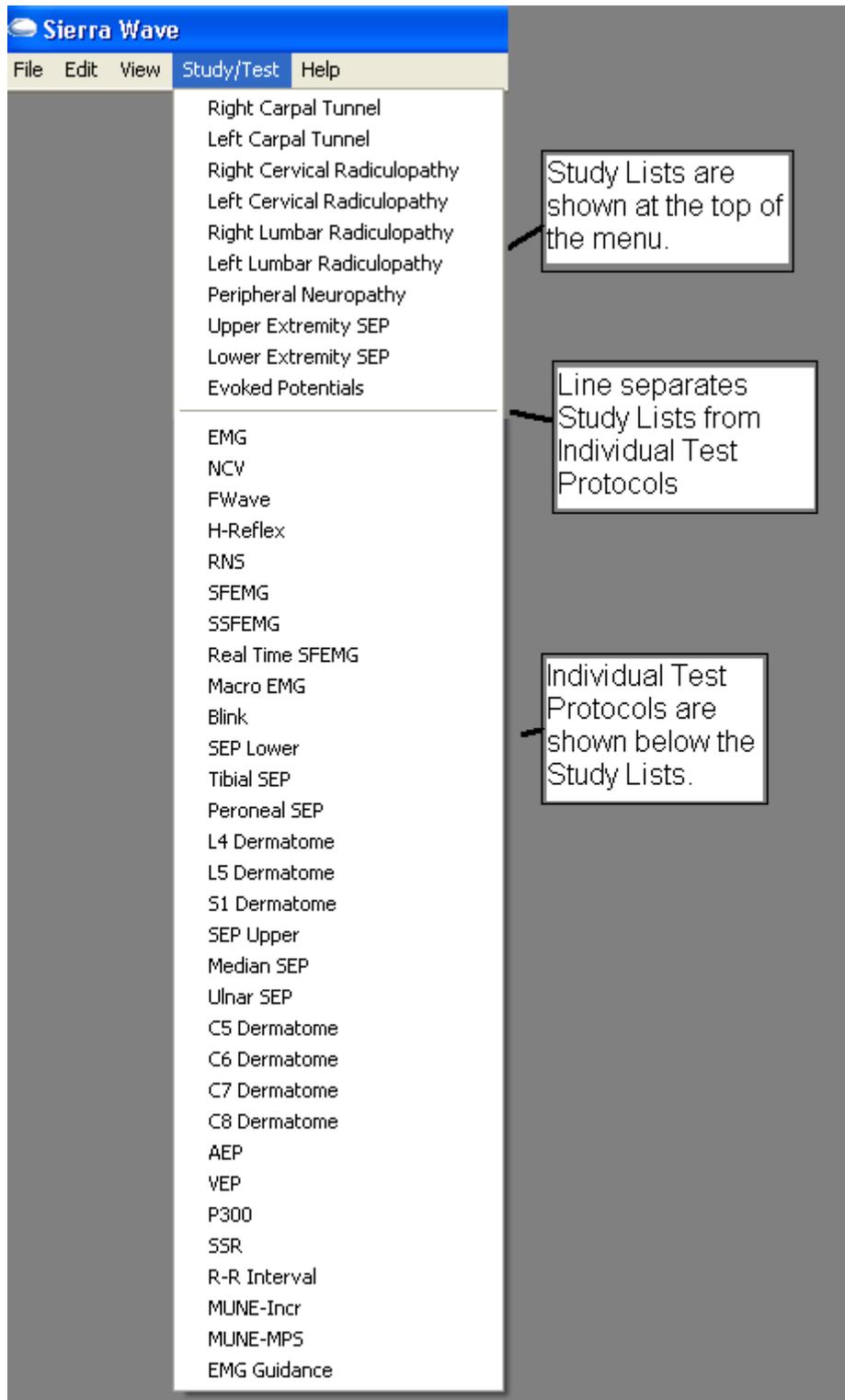
Selecting a Study or Test Protocol

There are various ways to select a Study or individual Test protocol.

From the Patient Information window:

Click the **F3 - Start Exam** button. The patient information will be saved and the **Study/Test** menu will be automatically displayed. Use the **mouse**, or **Knob #1** to select a Study or an individual Test protocol.

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If a Study is selected, all the tests included in the Study will be displayed in the Study window and the first test protocol listed in the Study will automatically be initialized and will be ready for data acquisition.



If an individual Test is selected, the test protocol will be loaded. If the test uses a muscle or nerve list, this list will be displayed so you can choose the muscles or nerves you wish to examine. Once selected, these nerves or muscles will be displayed in the Study window.

Outside the Patient Information window:

Use the **Study/Test** menu or the **Study keys** on the Sierra Wave base unit.

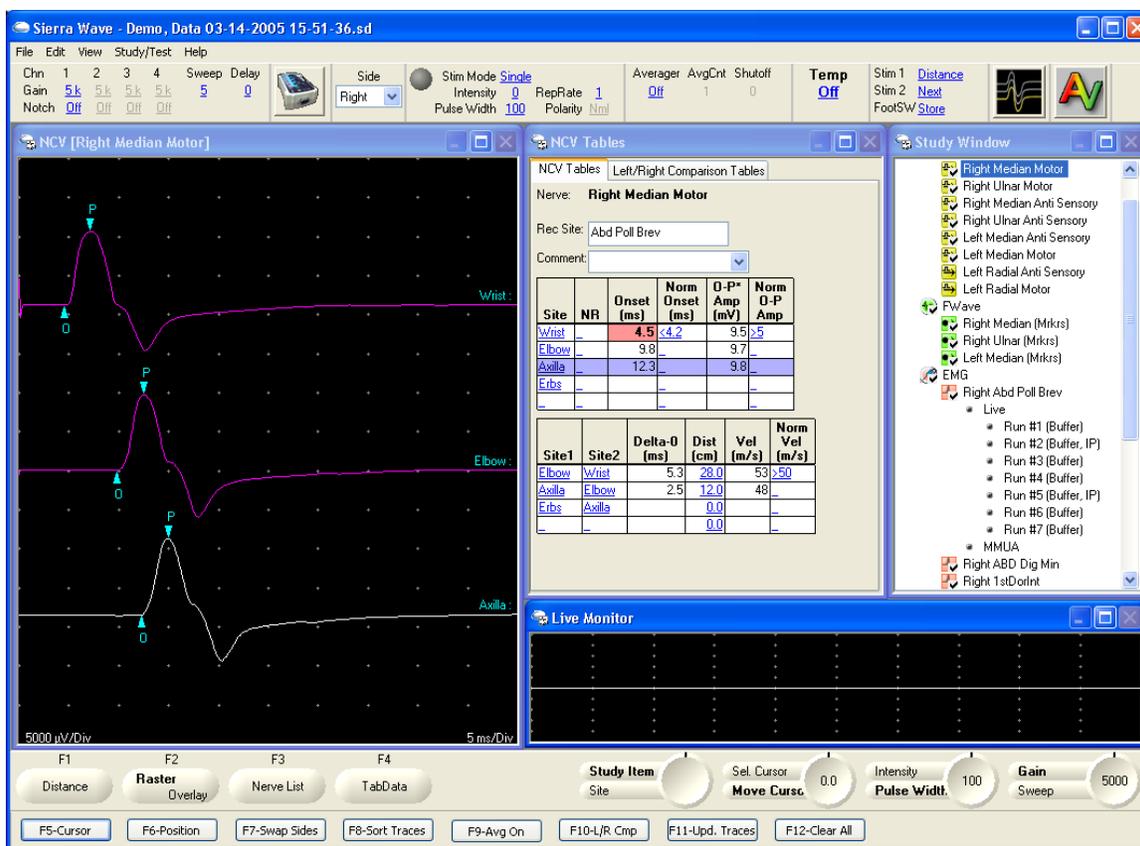
- Click on the **Study/Test** menu with the mouse and then select the Study or Test protocol of interest.
- Press the **Select key** on the Sierra Wave base unit. The Study/Test menu will be displayed, use the **mouse** or **Knob #1** to select the Study or individual Test protocol of interest.
- Press the **S1**, **S2**, or **S3** keys on the Sierra Wave base unit. The Study or Test Protocol assigned to the key will be loaded.

Description of Screen Layout

The Sierra Wave screen is composed of three main windows; the **Trace** window, **Study** window, and **Measurements / Cursor Table** window. The **Amplifier / Stimulator** controls can be displayed in either a window or toolbar format. An optional **Live Monitor** window is available in the NCV, F Wave, H-Reflex, Blink Reflex, and RNS test protocols.

The bottom of the screen shows the current **function key** and **knob assignments** for the Sierra Wave base unit.

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Sierra Wave Screen showing the Trace, Study, and Cursor Table windows, the Amplifier / Stimulator Controls toolbar, and Live Monitor window.

 The **color scheme** used throughout the help topics is **Factory Default 1**. For more information on changing the Sierra Wave's color scheme go to the Color Editor topic.

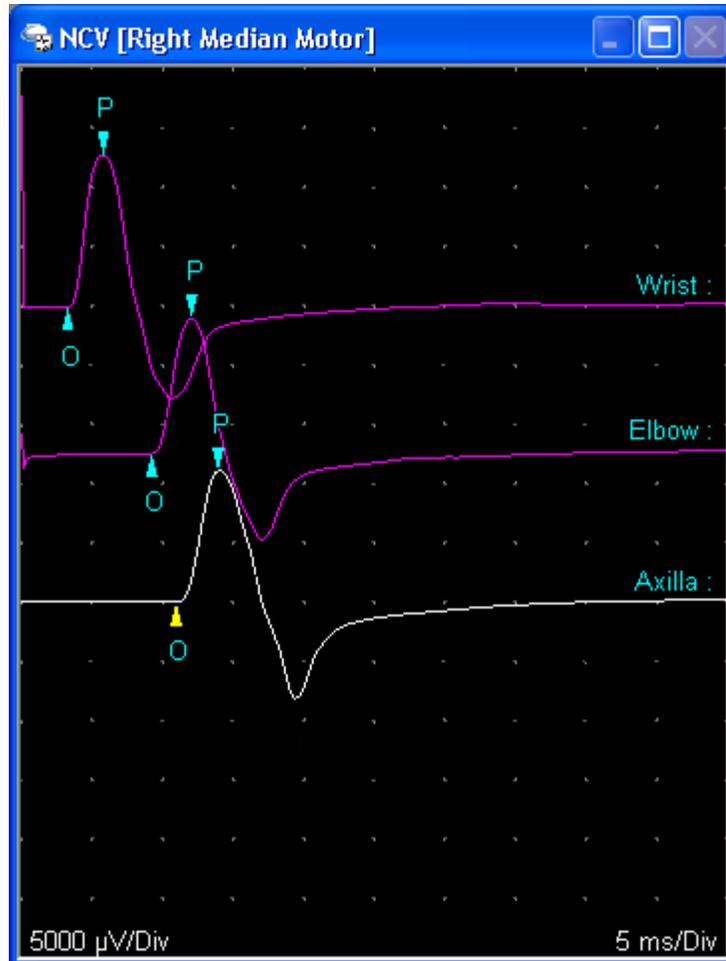
Trace Window

The **Trace** window displays the electromyographic and evoked responses acquired from the patient.

Live or **Averaged** traces are displayed in "**white**" color. **Stored traces** are displayed in "**purple**" color. Traces that have been **selected** for manipulation are shown in "**yellow**" color.

Pressing the **View** key on the Sierra Wave base unit will maximize the Trace window to fill the entire screen. To return the Trace window to its original size & position, press the View key a second time.

The major divisions of this window are displayed in a white grid or dot pattern. The **Display Gain** (vertical scale in microvolts per division) and **Sweep Speed** (horizontal scale in milliseconds per division) are shown in the lower left and right of this window respectively.



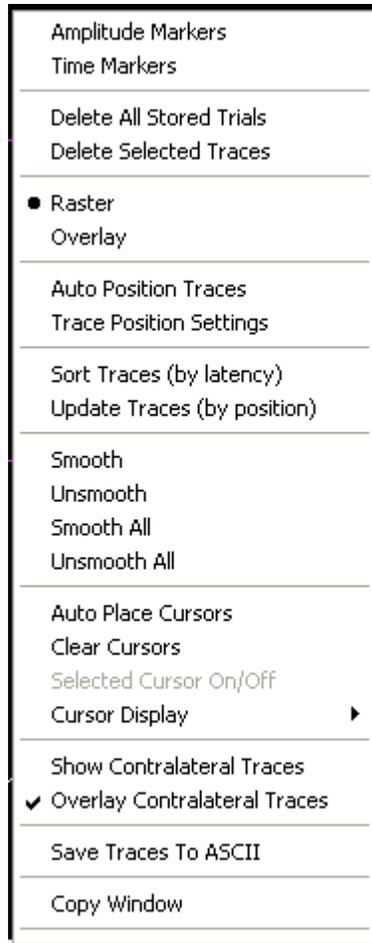
NCV Trace window

Trace Window Context Menu

In true Windows fashion, the Trace window supports a Context menu.

The Context menu, also known as the **right click menu**, is accessed by right clicking the mouse anywhere over the trace window. The functions that are available in the context menu will vary depending on the test protocol that is currently loaded.

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Context menu for NCV Trace window.

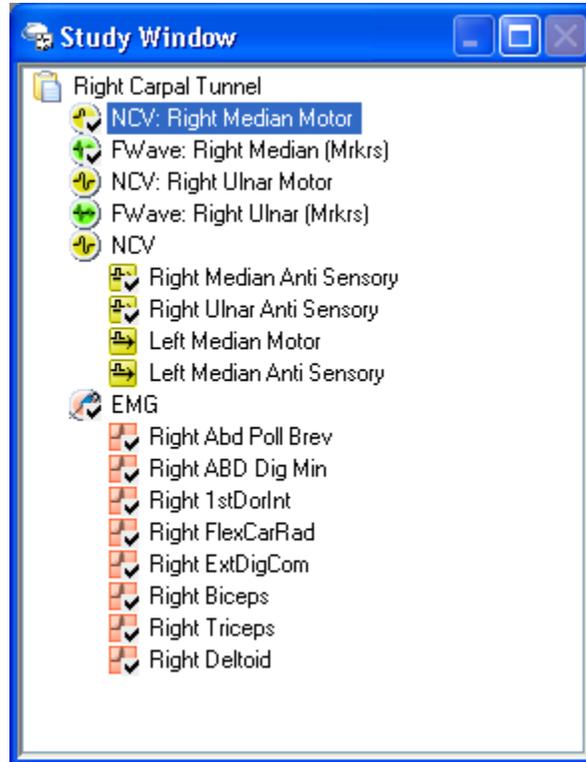
Study Window

The **Study** window has several functions:

- Lists the test protocols that have been pre-selected and grouped into the selected Study List (e.g., lists the tests for the Right Carpal Tunnel Study).
- Automatically adds to the list other test protocols, not originally part of the Study list, as they are selected from the Study/Test menu or nerve and muscle lists.
- Provides an easy way to change from one test protocol to another or go back and review a previous test.
- Shows which test protocols have been completed by placing a checkmark on the test protocol's icon.

Use **Knob #1 (Study Item)**, on the Sierra Wave base unit, to move the highlight up and down through the Study window. If you stop the highlight on a test protocol for more than **1.5 seconds**, that protocol will be loaded.

Alternatively, click on a test protocol with the **left mouse button** to load it.



Study window.

Study Window Context Menu

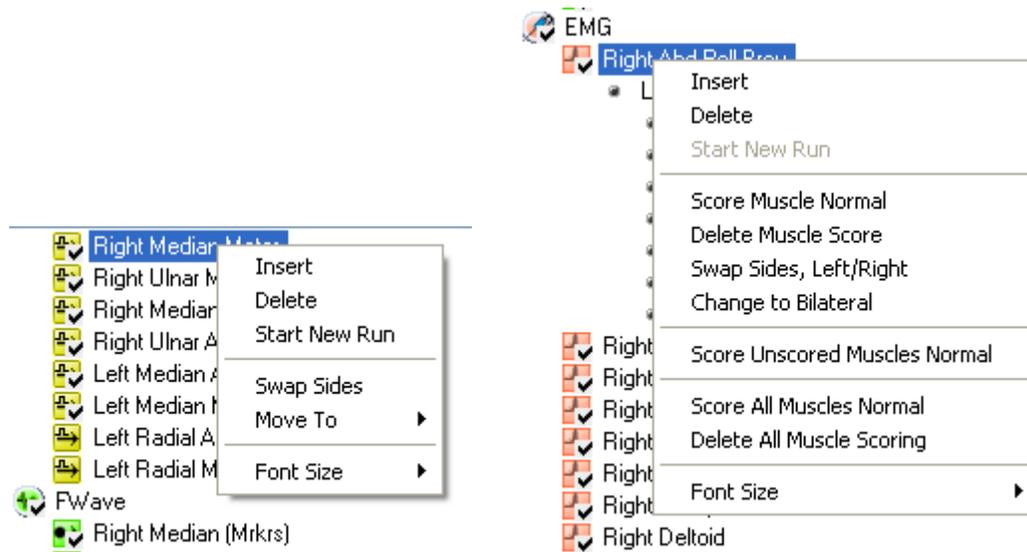
The Study window has a Context menu, also known as the **right click menu**. It is accessed by right clicking the mouse over a blank area within the Study window, or by right clicking over a test protocol name. The functions that are available in the context menu will vary depending on what you right clicked over.

When right clicking over a blank area, not over a test protocol name:



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When right clicking on a test protocol name:



Over an NCV test.

Over an EMG test.

For more detailed information on using the Study Window, see the topic Study Window Overview.

Controls Window or Controls Toolbar

The Amplifier & Stimulator controls can be configured in either a **window** or **toolbar** format. This preference can be saved on a per test protocol basis. In software version 5.5 or higher, the default format is the Controls Toolbar enabled.

To turn the Controls Toolbar On or Off, select the option called "**Test Control Bar**" from the **View** menu.

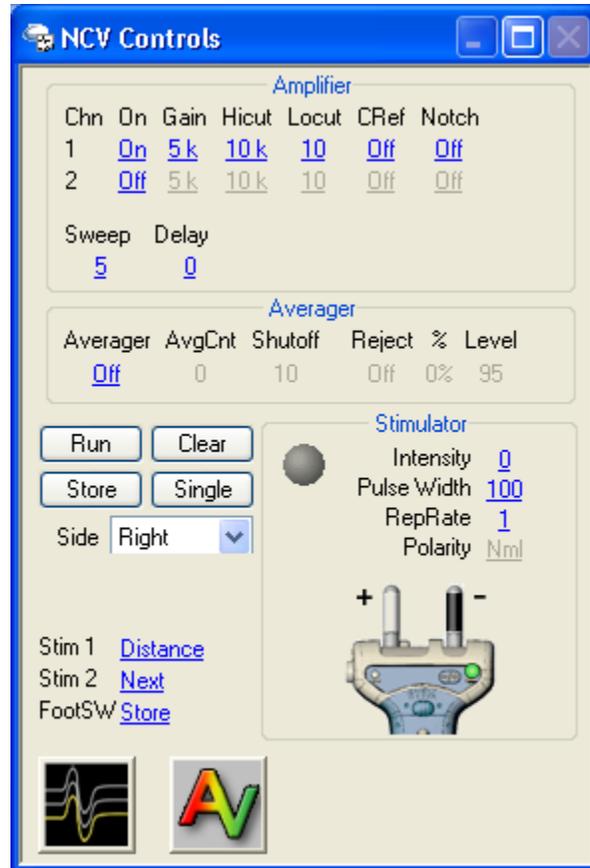
Controls Window

The Controls window displays the **Amplifier**, **Averager**, and **Stimulator** settings for the test protocol. It also contains a **Side control** and buttons representing the same **Acquisition keys** found on the Wave's base unit (i.e., Run/Stop, Single, Store, and Clear). The current settings for the **Footswitch** and **Programmable buttons** on the electrical stimulator can also be found here.

Blue colored and underlined items can be changed or edited by clicking on them with the left mouse button. Drop down lists can also be changed by clicking on the drop down arrow .



There is no Context menu for the Controls window.



Controls Window for NCV test protocol.

Controls Toolbar

The Controls toolbar displays the **Amplifier**, **Averager**, **Side**, and **Stimulator** settings for the test protocol in a toolbar format across the top of the screen. The current settings for the **Footswitch** and **Programmable buttons** on the electrical stimulator can also be found here.

Blue colored and **underlined** items can be changed or edited by clicking on them with the left mouse button. Drop down lists can also be changed by clicking on the drop down arrow .



Controls Toolbar for NCV test protocol.

 Right click over the toolbar to turn Off/On various sections of the toolbar controls and to change the **Font Size**.

 Using the Toolbar format allows more room for the remaining windows.

Measurements / Cursor Table Window

The **Measurements / Cursor Table** window has several functions.

- It displays the values for trace features that have been identified after placement of the latency and amplitude markers or auto-cursors. The type of table shown in this window will vary depending on the test protocol that is currently selected.
- It displays the muscle scoring table in the EMG protocol.
- It displays the IP Analysis plots in the Interference Pattern Analysis mode.
- It displays the MUA Table in the Single Motor Unit Analysis (SMUA) mode.

NCV Tables Left/Right Comparison Tables

Nerve: **Right Median Motor**

Rec Site: Abd Poll Brev

Comment:

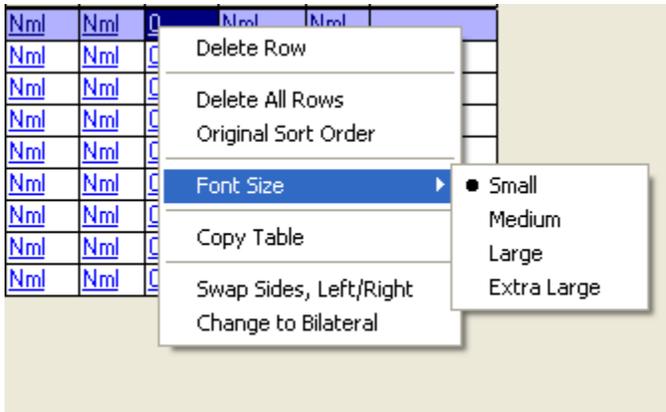
Site	NR	Onset (ms)	Norm Onset (ms)	O-P* Amp (mV)	Norm O-P Amp
Wrist	-	4.5	<4.2	9.5	>5
Elbow	-	9.7	-	9.8	-
Axilla	-	11.9	-	9.9	-
Erbs	-	-	-	-	-
-	-	-	-	-	-

Site1	Site2	Delta-0 (ms)	Dist (cm)	Vel (m/s)	Norm Vel (m/s)
Elbow	Wrist	5.2	28.0	54	>50
Axilla	Elbow	2.2	12.0	55	-
Erbs	Axilla	-	0.0	-	-
-	-	-	0.0	-	-

NCV Tables window.

Measurements / Cursor Table Window Context Menu

In the EMG, NCV, and RNS test protocols the Measurements / Cursor Table window supports the use of the Context menu.



EMG Muscle Score Table Context menu.

Live Monitor Window

A Live Monitor window is available in the NCV, F Wave, H-Reflex, Blink Reflex, RNS, and MUNE test protocols.

When this window is enabled it displays the “Live” activity coming from the recording electrodes. When electrical stimulation occurs, the window will briefly display a stimulus-triggered waveform, and then will go back to display “Live” activity after one second.

This window can be positioned, sized, and saved as part of the default settings for the test protocol.

To Enable the Live Monitor window:

1. Start the Sierra Wave program.
2. Select a test protocol, NCV for example.
3. From the **Edit** menu, select **Current Test**.
4. Click on the **General Settings** tab.
5. Check the box labeled, “**Show Live Monitor**”.
6. Click **OK**.
7. Adjust the size and positions of the windows on the screen.
8. From the **Edit** menu, select **Save Test Parameters** to update the default settings for the test. From now on the test protocol will display the Live Monitor Window.



The Gain and Sweep Speed of the Live Monitor window are the same as the main Trace window.

Function Keys F1 - F4

The bottom left of the screen shows the program functions currently assigned to the **F1-F4** function keys on the Sierra Wave base unit. These functions will vary depending on the test protocol that is currently selected.

These functions can also change with the status of the test protocol. For example, when you Stop the EMG trace, by pressing the Run/Stop button, the functions of the F1 & F2 keys change. When you return to Run mode, by pressing the Run/Stop button again, the functions of these keys go back to their original settings.

In all test protocols, the **F4** function key is reserved for **TabData**. Pressing this key will display the TabData window which includes a list of all the tests performed on the patient as well as various summary tables.

Some function keys toggle back and forth between two functions. The currently selected function is displayed in bold text.



F1-F4 Function Keys for NCV test.

PC Toolbar (Function Keys F5 - F12)

Additional program functions can be accessed using the **F5-F12** function keys on the PC's keyboard. A PC function key toolbar, that shows the current assignments for these additional function keys, can be enabled from the View menu. Simply select **View**, then click on **PC Function Key Menu**.

The PC function key toolbar is displayed below the F1-F4 function keys on the screen.



PC Function Key Toolbar for the NCV test.

In all test protocols the **F5** function key is assigned to **Cursors**, and the **F6** function key is assigned to **Position**. The remaining F7-F12 keys will vary depending on the test protocol that is currently selected.

If you press **F5-Cursors** or **F6-Position** to enter these modes, simply press the function key a second time, or press the **OK** key on the base unit to exit these modes when you are finished using them.

 The PC function toolbar does not have to be visible to use the program functions assigned to it.

Knobs 1 - 4

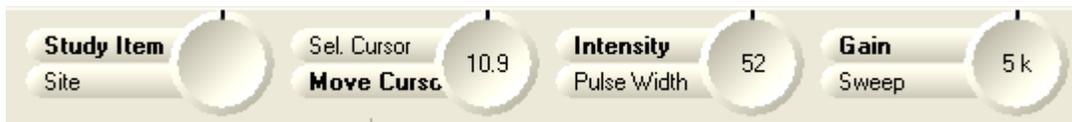
The bottom right of the screen shows the program functions currently assigned to the four **Knobs** on the Sierra Wave base unit. These functions will vary depending on the test protocol that is currently selected and the status of that test (i.e., running or stopped).

The functions of the knobs also change if you enter the **Cursor** or **Position** mode by pressing the **F5** or **F6** function keys.

Many knobs have dual functions. Pressing the knob will toggle back and forth between the two functions. Once the appropriate function is selected, turn the knob to perform that function

Initially in all test protocols, Knob #1 is reserved for selecting tests from the Study window, Knob #4 is reserved for changing Gain and Sweep Speed settings.

Knobs that change parameters such as Gain, Sweep Speed, Intensity, or knobs that move Cursors will display the associated value on the knob graphic.



Knob functions for NCV test.

 All functions that can be done with the knobs can also be done using the mouse.

 Pressing the **ALT** key on the PC keyboard or the **Select** key on the Wave base unit will toggle **Knob #1** to **Select** and **Knob #2** to **Move Left/Right**. This allows the program menus (File, Edit, View, Study/Test) at the top of the screen to be accessed using these knobs. Press the **ESC** key on the PC keyboard or **F4-Close Menu** on the Wave base unit to exit from this mode.



Knob changes as result of pressing ALT key.

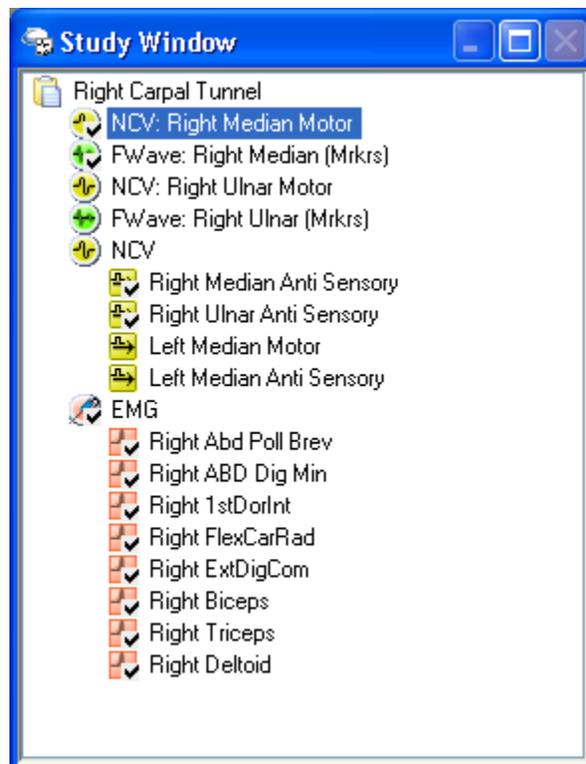
Using the Study Window

The **Study** window has several functions:

- Lists the test protocols that have been pre-selected and grouped into the selected Study List (e.g., lists the tests for the Right Carpal Tunnel Study).
- Automatically adds to the list other test protocols, not originally part of the Study list, as they are selected from the Study/Test menu or nerve and muscle lists.
- Provides an easy way to change from one test protocol to another or go back and review a previous test.
- Shows which test protocols have been completed by placing a checkmark on the test protocol's icon.

To Select a Test within the Study window:

- Use **Knob #1 (Study Item)**, on the Sierra Wave base unit, to move the highlight up and down through the Study window. If you stop the highlight on a test protocol for more than **1.5 seconds**, that protocol will be loaded.
- Alternatively, click on a test protocol with the **left mouse button** to load it.



Study window.

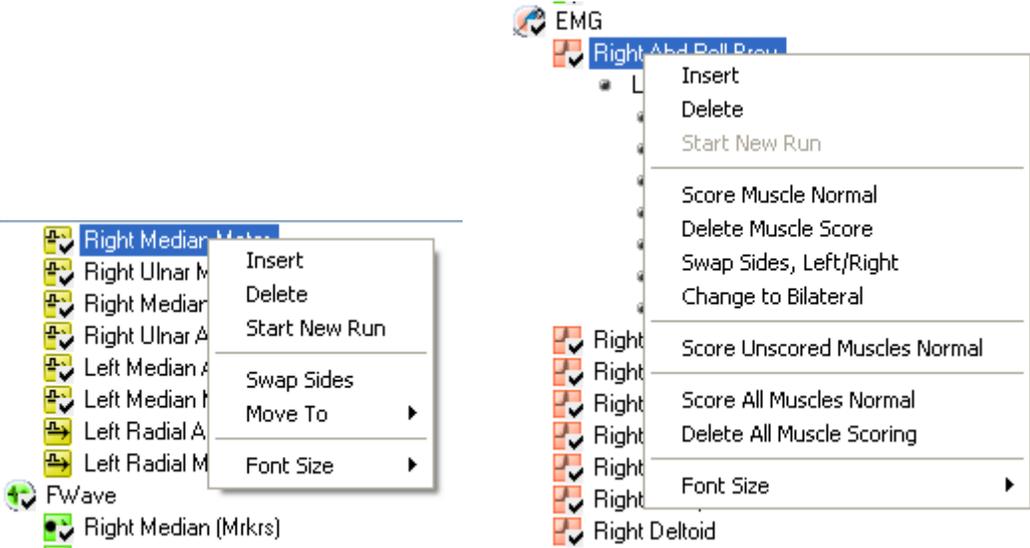
Study Window Context Menu

The Study window has a Context menu, also known as the **right click menu**. It is accessed by right clicking the mouse over a blank area within the Study window, or by right clicking over a test protocol name. The functions that are available in the context menu will vary depending on what you right clicked over.

When right clicking over a blank area, not over a test protocol name:



When right clicking on a test protocol name:



Over an NCV test.

Over an EMG test.

Test Types within the Study Window:

Each test protocol is indicated by a color coded icon. The Table below summarizes the available tests and their associated icon.

Test Type:	Icon:	Description:
EMG		Pink color with blue needle hub.
NCV		Yellow color with CMAP trace.

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F Wave		Green color with F Wave trace.
H Reflex		Orange color with H Reflex trace.
RNS		Violet color with RNS decrementing trace.
Blink		Blue colored eye.
SFEMG		Pink color with red needle hub.
SSFEMG (Stim-SFEMG)		Pink color with violet needle hub.
Real Time SFEMG		Pink color with red needle hub.
Macro EMG		Pink color with red needle hub.
SEP		Blue with bar electrode.
VEP		Blue with checkerboard pattern.
AEP		Blue with headphones.
P300		Blue with target.
RR Interval		Red Heart
MUNE (MPS and Incremental)		Blue color with CMAP trace.
EMG Guidance		Pink color with blue needle hub.

NCV - Basic Operation

Select the NCV  Test:

- **If a Study has already been selected**, simply click on a nerve name (i.e., Right Median Motor) within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the nerve name.
- **If a Study has not been selected, or you don't want to use a Study.** Select the individual NCV test protocol from the Study/Test menu, a nerve list will be displayed allowing you to pick the nerve or nerves that you will be testing on the patient.

Once the nerve has been selected. Follow these steps for performing routine NCV data acquisition:

1. Verify Amplifier Settings

Check the **Gain**, **Hicut**, **Locut**, and **Sweep Speed** settings and make sure they are appropriate for the nerve being tested.

Typical Settings

	Gain (uV/Div)	Hicut (Hz)	Locut (Hz)	Sweep Speed (ms/Div)
Motor Nerves	2k to 5k	10k	10	5.0
Sensory Nerves	10 to 20	2k	10	2.0

2. Verify Side Setting

Make sure the appropriate side, **Right** or **Left**, is selected.

3. Verify Stimulation Sites and Segments

The selected nerve's recording site name, stimulation site names, and defined segments are shown within the **NCV Tables** window.

Nerve: **Right Median Motor** Rec Site:

Nerve name and recording site name.

The **Site table** displays the stimulation site names, one per row. This table will display the onset or peak latency, amplitude measurements, duration and area measurements, and normal values. By default, the first stimulation site's row is highlighted as soon as the nerve is selected. The name of this site also appears on the active (white) trace's label.

Site	NR	Onset (ms)	Norm Onset (ms)	O-P* Amp (mV)	Norm O-P Amp
Wrist	-	3.9	<4.2	13.3	>5
Elbow	-	9.7	-	12.6	-
Axilla	-	11.6	-	12.1	-
Erbs	-	-	-	-	-
-	-	-	-	-	-

Site table with Erbs stimulation site selected.

The **Segment table** displays the segments over which velocity calculations are to be made. Each row in this table represents one segment. This table has a column for entering distances and for displaying the calculated and normal velocity.

Site1	Site2	Delta-0 (ms)	Dist (cm)	Vel (m/s)	Norm Vel (m/s)
Elbow	Wrist	5.8	30.0	52	>50
Axilla	Elbow	1.9	12.0	63	-
Erbs	Axilla		0.0		-
-	-		0.0		-

Segment table.

4. Electrode Placement

Attach the electrodes to the patient.

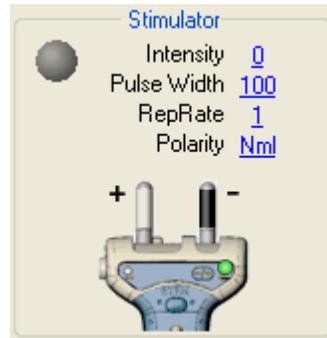
5. Check Stimulator Polarity

For Nerve Conductions Studies, the **Cathode (-)** should be oriented **closest to the recording electrodes**.

The Cathode (i.e., the negative stimulus probe) can be selected by pressing the **Reverse Polarity (+/-)** button on the electrical stimulator handle. A **green LED** indicates the probe that is the Cathode.

Clicking on the **Polarity field** in the **NCV Controls window** or **Controls Toolbar** can also reverse the stimulator polarity. The default (i.e., normal) mode has the right-side probe as the Cathode (if holding the stimulator with the Stim button facing you and the probes up); the reversed state will make the left-side probe the Cathode. The image of the stimulator on the screen updates to indicate the selected polarity as well.

In the **Normal mode**, the electrical stimulator image on the screen will show the **Right-side** probe as the Cathode (-). The polarity field on the screen will indicate **Nml**.



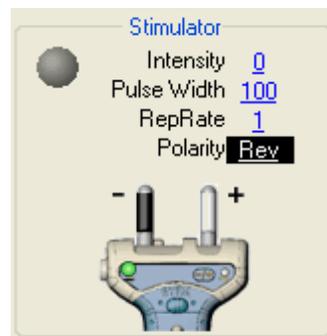
Controls Window.



Controls Toolbar.

Normal mode (right probe is Cathode).

In the **Reversed mode**, the electrical stimulator image on the screen will show the **Left-side** probe as the cathode (-). The polarity field on the screen will indicate **Rev**.



Controls Window.



Controls Toolbar.

Reversed mode (left probe is Cathode).

6. Stimulate the first Site

Increase the stimulus intensity level by turning the **wheel** on the electrical stimulator handle. The **intensity level** (in milliamps) is displayed on the screen in a small pop-up window and also in the Stimulator section. Once you have reached an appropriate starting intensity apply the stimulator to the patient and deliver the stimulus by pressing the **Stim button** on the electrical stimulator handle. The stimulator light, located next to the intensity level on the Screen, will flash Green and the patient's response will be displayed.



The **Single key** on the Sierra Wave base unit can also be used to deliver a single stimulus. Intensity can also be adjusted using **Knob #3 (Intensity / Pulse Width)** on the base unit.

Continue to increase the intensity level and stimulate until a supra-maximal response is acquired. If the response is large and "clips" at the top or bottom, decrease the amplifier sensitivity by adjusting the Gain setting. For example, change gain from 2k to 5k and re-stimulate. Gain can be adjusted easily by using **Knob #4 (Gain /Sweep)** on the Sierra Wave base unit.

8. If necessary, Adjust Auto Cursors

Auto Cursors are placed on the response as soon as it is displayed. The cursors are **Onset (O)**, **Peak (P)**, **Trough (T)** and **Recovery (R)**. The configuration of the Site and Segment tables determines which of the four cursors are placed on the trace. The positions of these cursors can be adjusted by performing one of the following actions;

- By using **Knob #2 (Sel Cursor / Move Cursor)** on the Sierra Wave base unit.
- By clicking on them with the **left mouse button** and dragging them to their new position.

For the correct placement of the auto-cursors the response must meet or exceed certain amplitude and slope criteria. When these criteria are not met the cursors will be placed on the response in the following pattern.



Pattern of auto-cursor placement when amplitude criteria is not met.

The Peak (P) cursor will be positioned at the third division with the Onset (O) cursor placed one-quarter division in front and the Trough (T) and Recovery (R) cursors placed one-quarter and one-half division respectively following it. If you believe that there is a response present you can move the cursors to their appropriate positions, or if there really is no response present, you can mark the response as "NR" in the Site table.

9. Store the Response

To store the response and advance to the next stimulation site, perform one of the following actions;

- Press the **Store button** on the **Electrical Stimulator handle**.
- Press the **Store key** on the **Sierra Wave base unit**.
- Press the **Footswitch** pedal (assuming the pedal has been programmed with the Store function.)

- Click the **Store button** in the **NCV Controls** window.

When the response is stored the color of the trace changes from **white to purple** and the next row in the Site table is automatically highlighted.



If the nerve has only one stimulation site, it is not necessary to store the response. The Sierra Wave will automatically keep the trace when you change nerves or test protocols.

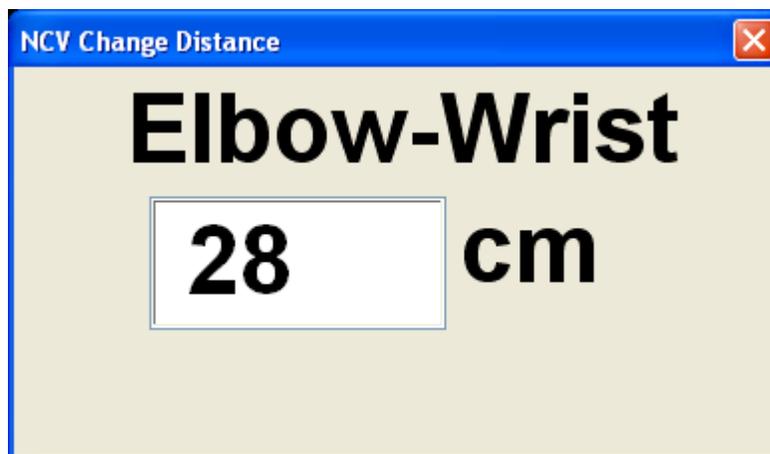
10. Stimulate and Store Additional Sites

Continue to stimulate and store additional sites on the nerve.

11. Enter Distance to calculate Velocity

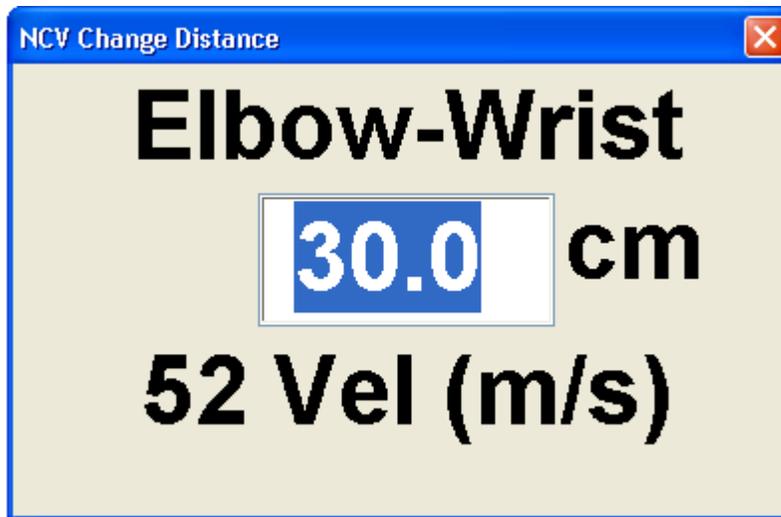
Measure the distances for each segment and enter the values (in centimeters) into the segment table. There are two ways to enter the distance.

- Press the **Distance key** on the **Sierra Wave base unit** or **click** on the appropriate distance field with the **mouse**. The first distance field will become activated and a small pop-up window is displayed showing the segment name and a place for the distance measurement, type the distance value and then press the **Enter key**. *You can also press the Distance key a second time instead of pressing the Enter key.*



Distance pop-up window.

- Press **Programmable button #1** on the **Electrical Stimulator handle**. A small pop-up window is displayed showing the segment name, distance value, and velocity. Now, **turn the wheel on the stimulator handle to increase or decrease the distance value in 0.5 cm increments**. When the correct distance value is reached, press **Programmable button #1** a second time or press the **Enter key**.



Distance pop-up window.

12. Compare Left vs. Right side Data & Traces (optional)

This feature allows for easy comparison of the latency, amplitude, and velocity differences between the left and right sides of a nerve. It also allows for a visual comparison of the traces obtained for each side.

Press the **F10 - L/R Cmp** function key to view the traces acquired for each side and a table of difference values.

Normal values can be entered for the side-to-side difference measurements with abnormal values flagged by the program.

Press the **F10 - L/R Cmp** function key a second time to return to the standard NCV display.

13. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected test's traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

14. Next Nerve or Test

To advance to the Next Nerve:

- Use **Knob #1 (Study Item / Site)** to highlight another NCV nerve in the **Study** window.
- **Click** on another NCV nerve in the **Study** window using the **mouse**.
- **Press** the **F3 (Nerve List)** function key on the **Sierra Wave base unit** and select another nerve from the nerve list.

To change Test Protocols:

- Use **Knob #1 (Study Item / Site)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.
- **Press** the **Select** key on the **Sierra Wave base unit** and select a Test Protocol from the **Study/Test** menu.

EMG - Basic Operation

Select the EMG Test:

- **If a Study has already been selected**, simply click on an EMG muscle name (i.e., Right Deltoid) within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the muscle name. Notice that as soon as any muscle is selected within the EMG test protocol, all the muscles are automatically added to the muscle score table.
- **If a Study has not been selected, or you don't want to use a Study.** Select the individual EMG test protocol from the Study/Test menu, a muscle list will be displayed allowing you to pick the muscle or muscles that you will be testing on the patient. Notice that as soon as any muscle is selected, it is displayed within the Study window and is automatically added to the muscle score table.

 The **Automatic Muscle Scoring** feature can be disabled in the **EMG Test Setup** window. When this feature is disabled the muscles in the Study window are not automatically added to the muscle score table. You will need to use the **F2 (Muscle Sel/Score)** knob or the **Left mouse button** to manually add the appropriate muscles to the scoring table.

Once the muscle has been selected. Follow these steps for performing routine EMG data acquisition:

1. Verify Amplifier Settings

Check the **Gain, Hicut, Locut, and Sweep Speed** settings and make sure they are appropriate.

Typical Settings for EMG

Gain = 100 or 200 uV/Div

Hicut = 10k Hz

Locut = 10 - 30 Hz

Sweep Speed = 10.0 ms/Div

2. Verify the Side

Make sure the appropriate side, **Right** or **Left**, is selected.

3. Insert the Needle Electrode

4. Adjust Volume

Increase or decrease the Sierra Wave's internal speaker by using the **Volume Knob** on the left hand side of the base unit.

5. Select Live or Capture Acquisition Mode

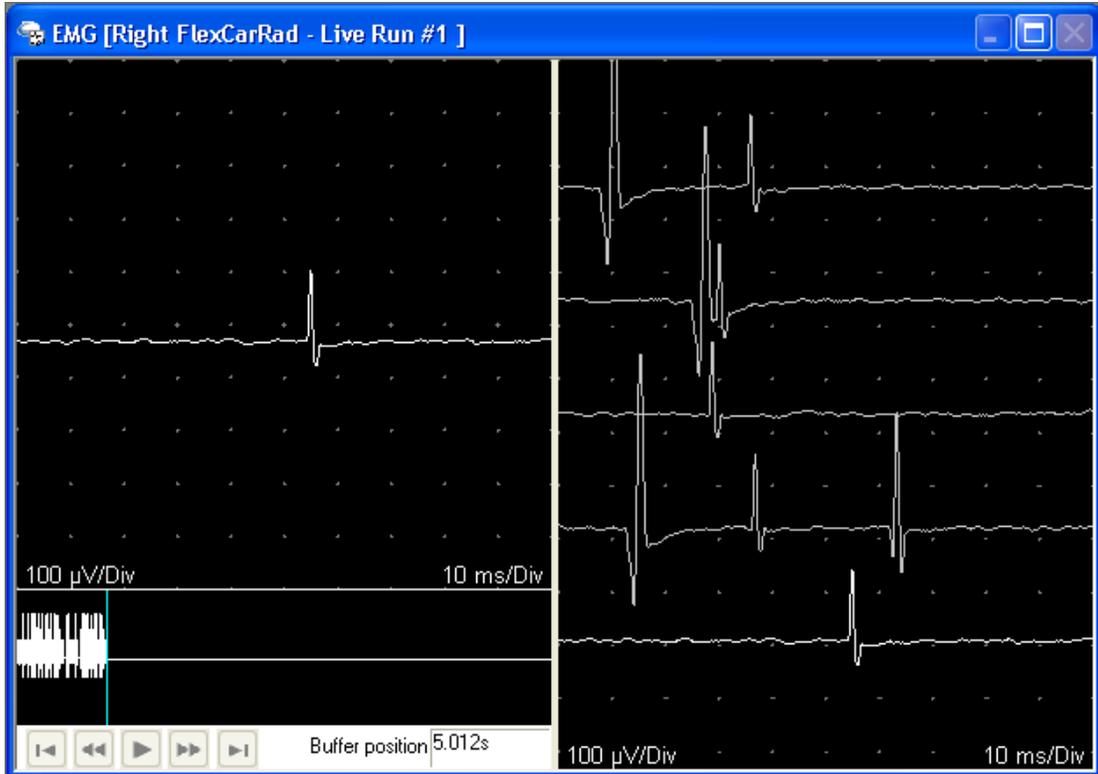
Use the **F1 (Live / Capture)** function key to toggle between these two acquisition modes.

Live Mode: In Live mode free-running EMG is displayed in the Trace window and a compressed view of the EMG Live Buffer is displayed below this. A moving blue marker shows the current position within the buffer. At any time data acquisition can be stopped and the data in the Live Buffer can be reviewed or played back (see step #7 below). The EMG protocol always defaults to the Live data acquisition mode.



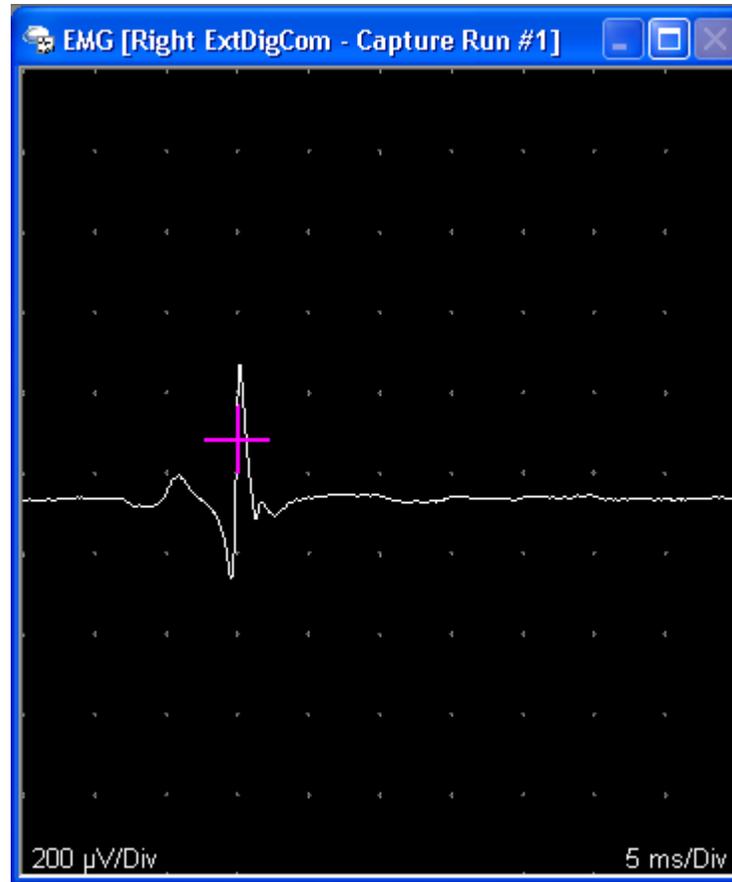
EMG - Live mode

Live Mode with Raster Display: An optional Raster Display can be enabled by pressing the **F11 (Raster)** function key. When this feature is enabled the Trace window is split into two equal sections; the left half showing the live EMG data and the compressed buffer, the right half showing consecutively rastered EMG traces. [Click here for more information on the Raster Display option.](#)



Live EMG mode with Raster Display enabled.

Capture Mode: In Capture mode a voltage level trigger and delay marker are displayed within the Trace window. The level of the voltage trigger can be adjusted using **Knob #3 (Trigger Lvl)**. When EMG activity exceeds the trigger level (in either the negative or positive direction) the sweep is captured momentarily and is repositioned with the crossing point at the delay marker. This allows for easier visualization of motor unit potentials. At any time data acquisition can be stopped and up to 50 captured sweeps can be reviewed (see step #7 below).



EMG - Capture mode

Capture Mode with Capture Window: An optional Capture Window can be enabled by pressing the **F11 (Cap Wnd)** function key. When this feature is enabled the trace window is split into two sections; the top section shows the live EMG trace and the trigger level and delay indicator, the bottom section shows a rastered display of the most recently captured traces. [Click here for more information on the Capture Window option.](#)



Capture Mode with Capture Window enabled.

6. Adjust Gain & Sweep

During EMG data acquisition you can easily adjust the Gain and Sweep Speed by using **Knob #4 (Gain / Sweep)** on the Sierra Wave base unit. Simply turn the knob to adjust the gain, to change the sweep speed, press the knob first to toggle it to the sweep mode, then turn to change the sweep speed.

You can also use the mouse to change these settings in the **EMG Controls window** or **Controls Toolbar**.

7. Stop Data Acquisition and Review (optional)

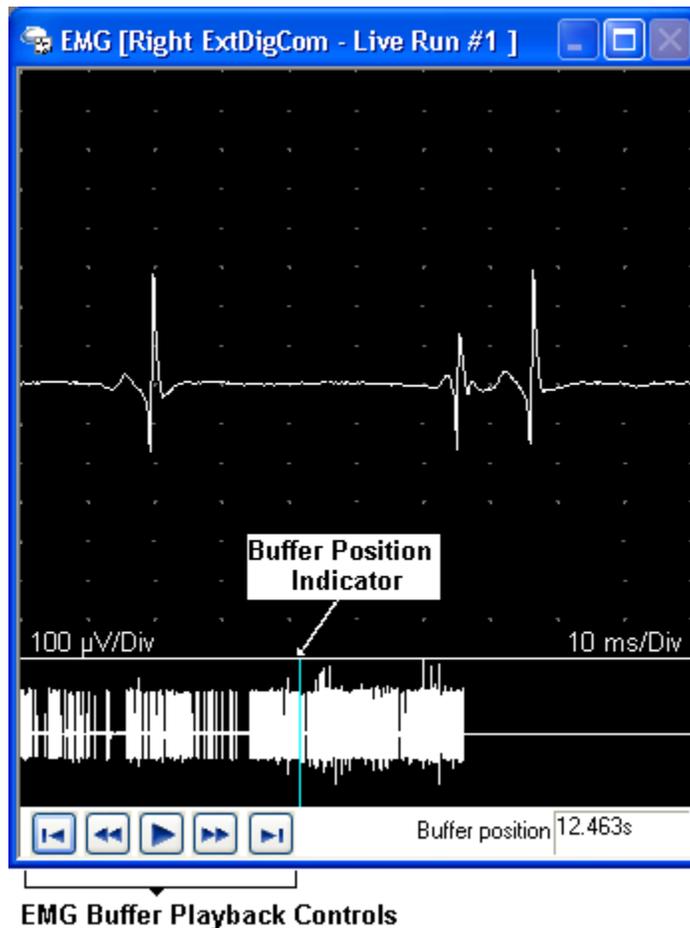
To stop data acquisition perform one of the following actions;

- Press the **Run/Stop key** on the **Sierra Wave base unit**.

- Press the **Stim button** on the **Electrical Stimulator handle**.
- Press the **Footswitch** pedal.
- Click on the **Stop button** in the **EMG Controls** window.

Stopped Live EMG:

Review the Live Buffer - move backwards and forwards in the Live EMG buffer by turning **Knob #1 (Review / Play-Stop)**, press the knob to replay the buffer. You can also review by dragging the blue marker back and forth within the compressed buffer area using the mouse.



EMG - Stopped Live mode

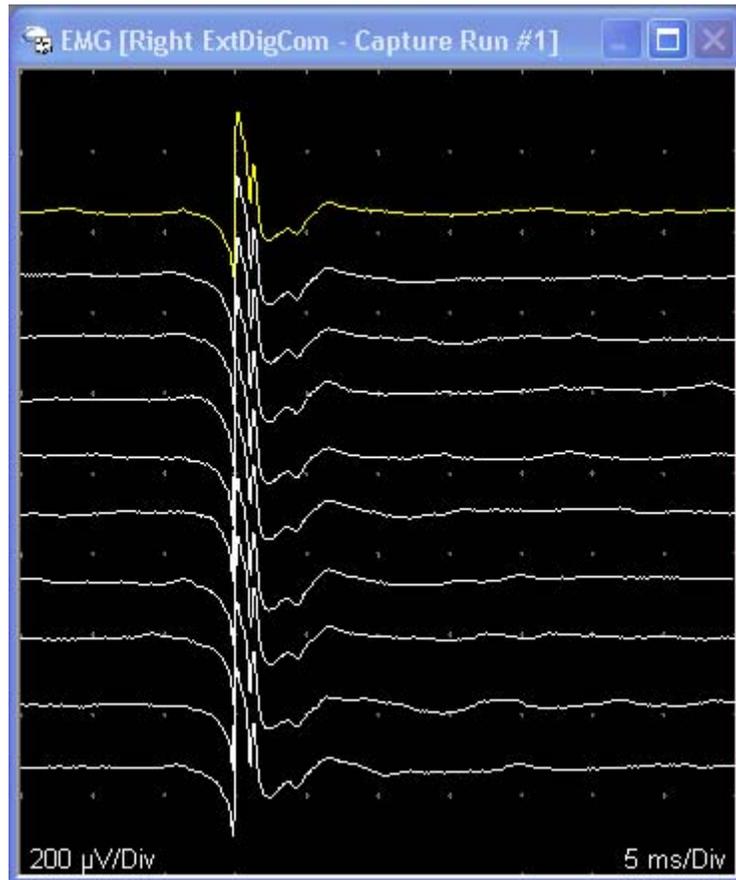
Store a Snapshot - press the **F1 (Store Snap Shot)** function key or the **Store key** on the Sierra Wave base unit to store the currently displayed sweep. The stored sweep will be displayed in purple.

Store the entire Live Buffer - press the **F2 (Store Live Buffer)** function key. The trace will be displayed in blue indicating that the entire buffer has been stored.

Manual MUP Tool - **right click** the mouse over the motor unit potential (MUP) of interest, then select **MUP Tool** from the pop-up menu. The motor unit potential is shown centered within a MUP window and quantitative measurements are shown in the table below. Click **OK** to save the MUP and include it in the final report, click **Cancel** to discard the MUP.

Stopped Capture EMG:

Review Captured Sweeps - use **Knob #4 (Trace Sel /Delete)** to review through the captured traces, press the knob to delete the selected trace (selected trace is displayed in yellow color). Press the **F2 (Raster / Overlay)** function key to superimpose all the captured traces.



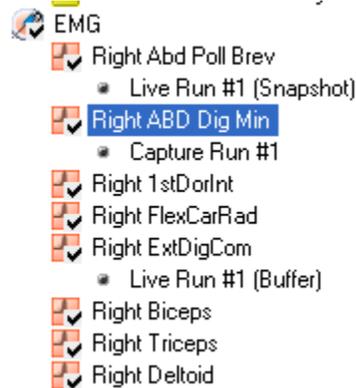
EMG - Stopped Capture mode

Store Captured Sweeps - press the **Store key** on the Sierra Wave base unit or click on the **Store button** within the EMG Controls window. The stored traces will be displayed in purple.



Prior to storing any EMG traces, Use Knob #2 (Muscle Sel) to highlight the correct muscle name in the Study window. This will ensure that the EMG data will be stored with the correct muscle name.

 As EMG is stored, you will see a new **node** appear in the Study window below the muscle name. This indicates what has been stored for this muscle. The example below shows a Snapshot stored for the Right Abd Poll Brev muscle, a Capture run stored for the Right ABD Dig Min muscle, and a Live Buffer stored for the Right ExtDigCom muscle.



Example of stored EMG nodes in the Study window.

8. Return to Data Acquisition Mode

If you stopped either Live or Captured data acquisition, perform one of the following actions to resume data acquisition;

- Press the **Run/Stop key** on the **Sierra Wave base unit**.
- Press the **Stim button** on **Electrical Stimulator handle**.
- Click the **Run button** in the **EMG Controls** window.

9. Modify Muscle Scoring

With the **Automatic Muscle Scoring** feature enabled, as soon as a muscle is selected in the Study window, or added to the Study window using the **F3 (Muscle List)** function key, it is automatically added to the **Muscle Scoring Table** and is scored as normal.

To change the muscle scoring for a muscle:

- Turn **Knob #3 (Score Table / Modify)** until the highlight is over the scoring field that you want to change, press the knob to pop up a list of choices, turn the knob to highlight one of the choices and press again to select it.
- Using the **left mouse button**, click on the scoring field that you want to change. From the pop up list of choices click again to make a selection.

Side	Muscle	Nerve	Root	Ins Act	Fibs	Psw	Amp	Dur	Poly	Rectr	Int Pat	Comment
Right	Abd Poll Brev	Median	C8-T1	Incr	2+	1+	Nml	Nml	0	Nml	Nml	-
Right	ABD Dig Min	Ulnar	C8-T1	Nml	Nml	Nml	Nml	Nml	0	Nml	Nml	-
Right	1stDorInt	Ulnar	C8-T1	Nml	Nml	Nml	Nml	Nml	0	Nml	Nml	-
Right	FlexCarRad	Median	C6-7	Nml	Nml	Nml	Nml	Nml	0	Nml	Nml	-
Right	ExtDigCom	Radial (Post Int)	C7-8	Nml	Nml	Nml	Nml	Nml	0	Nml	Nml	-
Right	Biceps	Musculocut	C5-6	Nml	Nml	Nml	Nml	Nml	0	Nml	Nml	-
Right	Triceps	Radial	C6-7-8	Nml	Nml	Nml	Nml	Nml	0	Nml	Nml	-
Right	Deltoid	Axillary	C5-6	Nml	Nml	Nml	Nml	Nml	0	Nml	Nml	-

Muscle Scoring Table



Depending on your preferences in System Setup, abnormal values can be flagged with a red background color, as bold text, as bold text with an asterisk, or as bold text & background color red.

10. Select Next Muscle

Turn **Knob #2 (Muscle Sel / Delete Score)** to highlight the next muscle in the Study window. If the muscle you want to examine is not displayed within the Study window, press **F3 (Muscle List)** and select the muscle from the list.

Move the Needle Electrode to the new muscle and repeat the above steps as necessary.



It is a good idea to turn Off the preamplifier or turn down the Volume when moving the needle electrode to a new location.

11. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected tests traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

12. Next Test

- Use **Knob #1 (Study Item)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.
- **Press** the **Select** key on the Sierra Wave base unit and select a Test Protocol from the **Study/Test** menu.

F/H Basic Operation

Select the F Wave  or H Reflex  Test:

- **If a Study has already been selected**, simply click on an F Wave or H Reflex nerve name (i.e., Right Median) within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the nerve name.
- **If a Study has not been selected, or you don't want to use a Study.** Select the individual F Wave or H Reflex test protocol from the Study/Test menu, a nerve list will be displayed allowing you to pick the nerve or nerves that you will be testing on the patient.

Once the nerve has been selected. Follow these steps for performing routine F Wave or H Reflex (Markers mode) data acquisition:

1. Verify Amplifier Settings

Check the **Gain**, **Hicut**, **Locut**, and **Sweep Speed** settings and make sure they are appropriate for the test being performed.

Typical Settings

	Gain (uV/Div)	Split Gain (uV/Div)	Hicut (Hz)	Locut (Hz)	Sweep Speed (ms/Div)
F Wave	5k	500	10k	20	5.0 or 10.0
H Reflex	2 - 5k	500	10k	20	10.0

2. Electrode Placement

Attach the electrodes to the patient.

3. Verify Side Setting

Make sure the appropriate side, **Right** or **Left**, is selected.

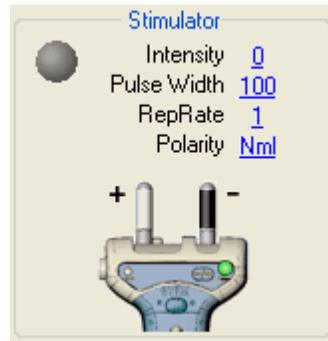
4. Check Stimulator Polarity

For F Wave and H-Reflex Studies, the **Cathode (-)** should be oriented **away from the recording electrodes** (i.e., Cathode proximal, Anode distal).

The Cathode (i.e., the negative stimulus probe) can be selected by pressing the **Reverse Polarity (+/-)** button on the electrical stimulator handle. A **green LED** indicates the probe that is the Cathode.

Clicking on the **Polarity field** in the **F/H Controls window** or **Controls Toolbar** can also reverse the stimulator polarity. The default (i.e., normal) mode has the right-side probe as the Cathode (if holding the stimulator with the Stim button facing you and the probes up); the reversed state will make the left-side probe the Cathode. The image of the stimulator on the screen updates to indicate the selected polarity as well.

In the **Normal mode**, the electrical stimulator image on the screen will show the **Right-side** probe as the Cathode (-). The polarity field on the screen will indicate **Nml**.



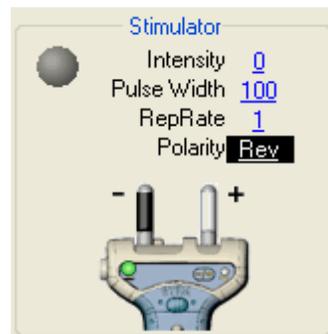
Controls Window.



Controls Toolbar.

Normal mode (right probe is Cathode).

In the **Reversed mode**, the electrical stimulator image on the screen will show the **Left-side** probe as the Cathode (-). The polarity field on the screen will indicate **Rev**.



Controls Window.



Controls Toolbar.

Reversed mode (left probe is Cathode).

5. Stimulate the Nerve

Increase the stimulus intensity level by turning the **wheel** on the electrical stimulator handle. The **intensity level** (in milliamps) is displayed on the screen in a small pop-up window and also in the Stimulator section. Once you have reached an appropriate starting intensity apply the stimulator to the patient and deliver the stimulus by pressing the **Stim button** on the electrical stimulator handle. The

stimulator light, located next to the intensity level on the Screen, will flash Green and the patient's response will be displayed.



The **Single key** on the Sierra Wave base unit, or the **Single button** in the F/H Controls window, can also be used to deliver a single stimulus.



Repetitive stimulation can be delivered by pressing the **Run/Stop button** on the Sierra Wave base unit or by clicking on the **Run button** in the F/H Controls window.

In general, F Waves are performed with supramaximal stimulus intensity, while H Reflex maximum amplitude occurs with sub-maximal stimulation intensity.

If the M Wave or F/H response amplitude is large and "clips" at the top or bottom, decrease the amplifier sensitivity by adjusting the Gain setting. For example, change the gain from 2k to 5k and re-stimulate. Gain can be adjusted easily by using **Knob #4 (Gain M / Gain F or H)** on the Sierra Wave base unit.

6. Store the Response

If the **F1 (Manual / AutoStore)** function key is set to the **Manual** mode you will need to store the response by performing one of the following actions;

- Press the **Store button** on the **electrical stimulator handle**.
- Press the **Footswitch** pedal.
- Press the **Store button** on the Sierra Wave **base unit**.
- Click on the **Store button** in the **F/H Controls** window.

If the **F1 (Manual / AutoStore)** function key is set to the **AutoStore** mode, the trace will automatically be stored immediately after it is acquired.

Stored traces will be displayed in "purple" color on the screen.

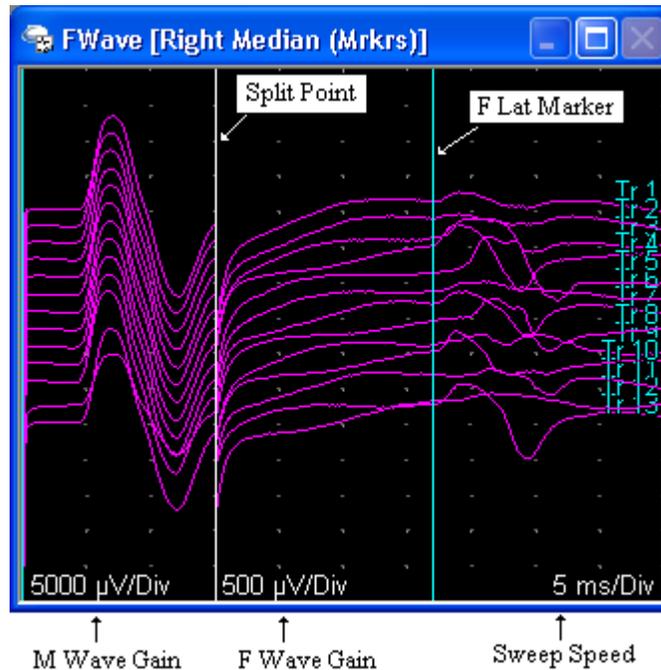
7. Continue to Stimulate and Store until 10 or 20 responses have been acquired.

8. Adjust Latency Marker

To adjust the latency marker, perform one of the following:

- Turn **Knob #2 (F/H Lat / M Wave Lat)** on the Sierra Wave base unit to move the F/H latency marker to the minimal F Wave latency or H Reflex onset latency. Changing the **F2 (Raster / Overlay)** function key to **Overlay mode** can be helpful when positioning the latency marker. The latency value is displayed in the **F/H Table** window.
- Press the **F8 (Auto F-Lat / Auto H-Lat)** function key. The program will automatically move the latency marker to the earliest onset latency. In addition, a pop-up window will show the latency value and the wheel on the

stimulator handle can be used to adjust the position of the marker. Once the marker has been positioned, press the F8 function key a second time to exit this mode.



Example F Wave Trace window.

9. Compare Left vs. Right side Traces (optional)

Press the **F10 - L/R Cmp** function key to view the traces acquired for each side.

The traces for each side are displayed in separate windows, stacked vertically on the screen. The top window contains the traces for the current side.

Press the **F10 - L/R Cmp** function key a second time to return to the standard F/H display.

10. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., F Wave Markers, Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected test's traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

11. Next Nerve or Test

To advance to the Next Nerve:

- Use **Knob #1 (Study Item / Site)** to highlight another F/H nerve in the **Study** window.
- **Click** on another F/H nerve in the **Study** window using the **mouse**.
- **Press** the **F3 (Nerve List)** function key on the **Sierra Wave base unit** and select another nerve from the nerve list.

To change Test Protocols:

- Use **Knob #1 (Study Item / Site)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.
- **Press** the **Select** key on the **Sierra Wave base unit** and select a Test Protocol from the **Study/Test** menu.

RNS - Basic Operation

Select the RNS Test:

- **If a Study has already been selected**, simply click on the RNS muscle name within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the test.
- **If a Study has not been selected, or you don't want to use a Study.** Select the RNS test protocol from the Study/Test menu, a muscle list will be displayed allowing you to pick the muscle or muscles that you will be testing on the patient.

Once the muscle has been selected. Follow these steps for performing RNS data acquisition:

1. Verify Amplifier Settings

Check the **Gain**, **Hicut**, **Locut**, and **Sweep Speed** settings and make sure they are appropriate for the test being performed. RNS typically uses the same settings as a motor NCV.

2. Verify Side Setting

Make sure the appropriate side, **Right** or **Left**, is selected.

3. Electrode Placement

Attach the electrodes to the patient.

Active 1 Input: Belly of the muscle.

Reference 1 Input: Tendon of the muscle.

Ground Electrode: On stimulated limb or forehead.

4. Check Stimulator Polarity

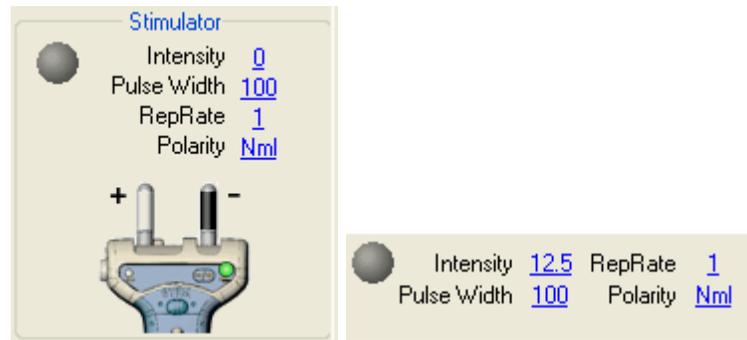
For RNS Studies, the **Cathode (-)** should be oriented **closest to the recording electrodes**.

The Cathode (i.e., the negative stimulus probe) can be selected by pressing the **Reverse Polarity (+/-)** button on the electrical stimulator handle. A **green LED** indicates the probe that is the Cathode.

Clicking on the **Polarity field** in the **RNS Controls window** or **Controls Toolbar** can also reverse the stimulator polarity. The default (i.e., normal) mode has the right-side probe as the Cathode (if holding the stimulator with the Stim button facing you and the probes up); the reversed state will make the left-side probe the Cathode. The image of the stimulator on the screen updates to indicate the selected polarity as well.

Getting Started Guide

In the Normal mode, the electrical stimulator image on the screen will show the Right-side probe as the cathode (-). The polarity field on the screen will indicate **Nml**.

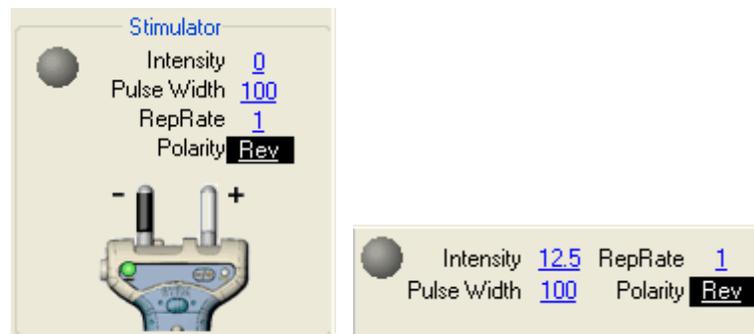


Controls Window.

Controls Toolbar.

Normal mode (right probe is Cathode).

In the Reversed mode, the electrical stimulator image on the screen will show the Left-side probe as the cathode (-). The polarity field on the screen will indicate **Rev**.



Controls Window.

Controls Toolbar.

Reversed mode (left probe is Cathode).

5. Check the RNS Table

The RNS test protocol supports a preprogrammed stimulus train table. This table controls the number of stimuli presented in each train, the repetition rate for the stimuli, the amount of time to pause before proceeding to the next stimulus train, and it also provides a convenient way to label each stimulus train.

The program allows for either manual or automatic delivery of the stimulus train table.

Trial #	Label	Amp 1 (mV)	Amp 5 (mV)	Amp % Dif	Area 1 (mV·ms)	Area 5 (mV·ms)	Area % Dif	Rep Rate	Train Length	Pause Time (min:sec)	Comments
Act:	Baseline							3.00	10	00:30	-
1	Post Exercise							3.00	10	01:00	-
2	1 min Post							3.00	10	01:00	-
3	2 min Post							3.00	10	01:00	-
4	3 min Post							3.00	10	00:00	-

RNS Table.

If your stimulus train table is undefined, select **Current Test** from the **Edit** menu. Fill in the **Sequencer Setup** table in the lower left corner of the setup window, then click **OK**.

6. Check the General and Stimulator Settings

General Settings

Mode: Choices are **Train** or **Single**.

- **Train** - When the Stim button on the handheld stimulator or the Run/Stop button is pressed, a train of stimuli, corresponding to the highlighted row in the RNS Table, will be delivered.
- **Single** - When the Stim button on the hand held stimulator or the Single button is pressed, a single stimulus will be delivered. This mode is useful for determining supramaximal stimulation prior to delivering a train of stimuli.

Train #: The total number of stimuli that will be delivered to the patient when the program is set to the Train mode. The typical setting is four to eight. The maximum setting is 150. This value is updated from the RNS Table.

Spread: This is the distance (in horizontal divisions) that will separate the individual traces within the train. If this value is set to zero, the traces will be superimposed upon one another.

Response 1: Select the first response in the train that will be analyzed for amplitude and area measurements. Typically this is always set to number 1.

Response 2: Select the second response in the train that will be analyzed for amplitude and area measurements. In addition, the percentage difference between this response and the trace selected for Response 1 will be computed. This is typically set to number 4 or 5.

Auto Seq: Allows for either manual or automatic sequencing through the RNS Table. When set to **On**, the program will automatically deliver the trains specified in the RNS table (automatically pausing for the specified time after each train).

When set to **Off**, the user must manually start each train after the appropriate pause time, by pressing the Run/Stop key for each train.

Stimulator Settings

Pulse Width: Set the electrical stimulus pulse width, also known as pulse duration, in microseconds (*usec*).

Rep Rate: Set the repetitive stimulus rate, in pulses per second (Hz). This is typically set to 3 Hz. This setting only applies when delivering repetitive (i.e., Train) stimulation, it does not apply during manual Single stimulus delivery.

7. Check Recording Setup

Press the **F1 (Train/Single)** function key to select **Single** mode. Increase the stimulus intensity level by turning the **wheel** on the electrical stimulator handle.

The **intensity level** (in milliamps) is displayed on the screen in a small pop-up window and also in the Stimulator controls section. Once you have reached an appropriate starting intensity apply the stimulator to the patient and deliver the stimulus by pressing the **Stim button** on the electrical stimulator handle. The stimulator light, located next to the intensity level on the Screen, will flash Green and the patient's response will be displayed.



The **Single key** on the Sierra Wave base unit or the **Single button** within the on-screen RNS Controls window can also be used to deliver a single stimulus. Intensity can also be adjusted using **Knob #3 (Intensity / Pulse Width)** on the base unit.

Continue to increase the intensity level and stimulate until a supra-maximal response is acquired. If the response is large and "clips" at the top or bottom, decrease the amplifier sensitivity by adjusting the Gain setting. For example, change gain from 2k to 5k and re-stimulate. Gain can be adjusted easily by using **Knob #4 (Gain /Sweep)** on the Sierra Wave base unit.

8. Deliver Stimulus Trains

Press the **F1 (Train/Single)** function key to select **Train** mode. Follow the instructions below for either Manual or Automatic Stimulus Train delivery.

Manual Stimulus Train Delivery:

Highlight the first row in the RNS Table. Press the **Stim button** on the electrical stimulator handle. A train of stimuli will be delivered to the patient and a trace will be displayed for each stimulus within the train. The traces are stacked in a horizontal fashion (see Spread setting above).

After the Train is completed the program will automatically store the train and it will be displayed in a "purple" color.

 The **Run/Stop key** on the Sierra Wave base unit or the **Run button** within the on-screen RNS Controls window can also be used to deliver a train of stimuli.

 20 milliseconds is acquired after each stimulus. This allows for a maximum repetition rate of 50 Hz during train stimulation.

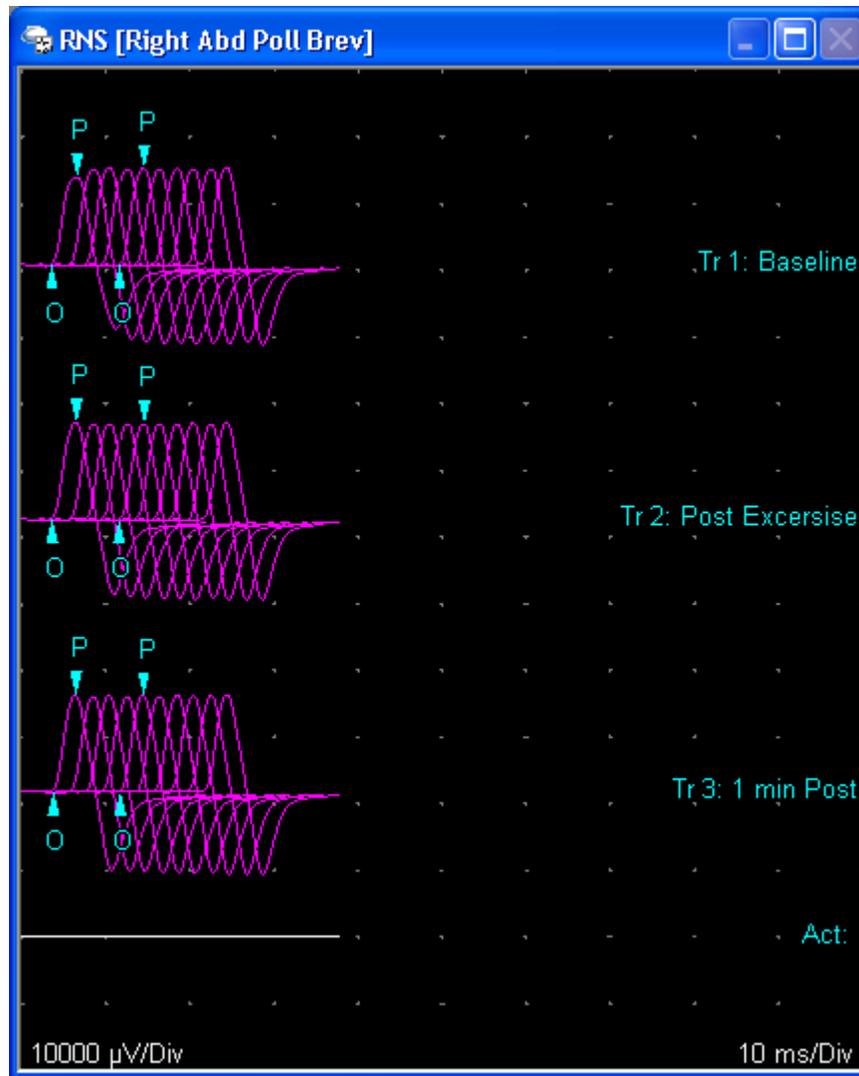
After a train is automatically stored, a timer is started. The timer is displayed just below the side field in the RNS Controls window or at the top of the screen in the Controls Toolbar.

Use the timer to measure the time elapsed while the patient exercises the muscle or the time elapsed between successive stimulus trains. Typically, the patient will exercise the muscle for 30 seconds after the first train is delivered then another train will be delivered immediately after completion of exercise.

Additional trains are then typically delivered at 1 minute intervals after this.

Press the **Run/Stop** key again to deliver the second stimulus train. Proceed in this fashion until all stimulus trains have been acquired.

 The timer automatically resets to zero after each train is stored. You can also manually reset the timer to zero by pressing the **F2 (Reset Timer)** function key on the Sierra Wave base unit.



Example RNS Traces

Automatic Stimulus Train Delivery:

Change the **Auto Seq.** control from **Off** to **On**. The first row in the RNS Table will be automatically highlighted.

Press the **Stim button** on the electrical stimulator handle. A train of stimuli will be delivered to the patient and a trace will be displayed for each stimulus within the train. The traces are stacked in a horizontal fashion (see Spread setting above).

After the Train is completed the program will automatically store the train and it will be displayed in a "purple" color. At this point the timer is started. The timer is displayed just below the side field in the RNS Controls window or at the top of the screen in the Controls Toolbar.

Once the timer reaches the preprogrammed pause time for the stimulus train, the program will automatically deliver the next stimulus train in the RNS Table.

Stimulation will continue in this manner until the last stimulus train is delivered.



You can stop the automatic sequencer at any time by changing the **Auto Seq.** control from **On** to **Off**.

9. Adjust Cursors (optional)

Onset (O) and **Peak (P)** cursors are automatically placed on the selected responses (see Response 1 and Response 2 settings above) as each train is acquired. The amplitude (onset to peak) and area (negative peak) of each response is calculated and displayed in the RNS table window.

The positions of these cursors can be adjusted by performing one of the following actions;

- By pressing the **F5 (Cursor mode)** function key and then using **Knob #1 (Sel Cursor / Move Cursor)** on the Sierra Wave base unit.
- By clicking on them with the **left mouse button** and dragging them to their new position.

The difference for both amplitude and area, between the two marked responses, is also automatically calculated and is displayed as a percentage (%). The equation used for this calculation is as follows;

$$D = (VR2 - VR1) / VR1 \times 100\%$$

Where D = decrement or increment

V = value (amplitude or area)

R1 = response 1

R2 = response 2

A decrement is displayed as a negative number, typically more than a **-10%** decrement is considered abnormal. An increment is displayed as a positive number.



Peak-to-Trough amplitude measurements can also be selected in the RNS protocol's test setup window. In this case, **Peak (P)** and **Trough (T)** cursors will be automatically placed on the responses.



Use the **Comment** field in the RNS table to enter a notation for the train.

Trial #	Label	Amp 1 (mV)	Amp 5 (mV)	Amp % Dif	Area 1 (mV·ms)	Area 5 (mV·ms)	Area % Dif	Rep Rate	Train Length	Pause Time (min:sec)	Comments
Tr 1	Baseline	13.20	14.41	9.2	41.01	41.43	1.0	3.00	10	00:30	-
Tr 2	Post Exercise	14.47	14.33	-0.9	42.40	40.69	-4.0	3.00	10	01:00	-
Tr 3	1 min Post	14.37	14.30	-0.5	40.76	39.67	-2.7	3.00	10	01:00	-
Tr 4	2 min Post	9.62	13.27	37.9	31.56	38.77	22.9	3.00	10	01:00	-
Tr 5	3 min Post	12.99	14.43	11.1	37.78	39.72	5.1	3.00	10	00:00	-

RNS Cursor Table

10. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected test's traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

11. Next Muscle or Test

To advance to the Next Muscle:

- Use **Knob #1 (Study Item / Site)** to highlight another RNS muscle in the **Study** window.
- **Click** on another RNS muscle in the **Study** window using the **mouse**.

- **Press** the **F3 (Muscle List)** function key on the **Sierra Wave base unit** and select another muscle from the muscle list.

To change Test Protocols:

- Use **Knob #1 (Study Item / Site)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.
- **Press** the **Select** key on the **Sierra Wave base unit** and select a Test Protocol from the **Study/Test** menu.

Blink - Basic Operation

Select the Blink  Test:

- **If a Study has already been selected**, simply click on the Blink test protocol within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the test.
- **If a Study has not been selected, or you don't want to use a Study.** Select the Blink test protocol from the Study/Test menu.

Once the test has been selected. Follow these steps for performing Blink data acquisition:

1. Verify Amplifier Settings

Check the **Gain**, **Hicut**, **Locut**, and **Sweep Speed** settings and make sure they are appropriate for the test being performed.

Typical Blink Settings

Gain = 200 uV/Div

Hicut = 5k Hz

Locut = 10 Hz

Sweep Speed = 10.0 ms/Div

2. Electrode Placement

Attach the electrodes to the patient.



Connect the electrode leads from the patient's **left** side to the **Channel 1 inputs** on the amplifier, and connect the electrode leads from the **right** side to the **Channel 2 inputs**. Electrodes must be connected to the amplifier in this configuration to ensure proper display of test data.

Active 1 Input: Belly of the Left orbicularis oculi muscle below the eye.

Reference 1 Input: Left side of nose.

Active 2 Input: Belly of the Right orbicularis oculi muscle below the eye.

Reference 2 Input: Right side of nose.

Ground Electrode: Forehead or cheek.

3. Select Side of Stimulation

Select the side, **Left** or **Right**, that will be stimulated first.

Trials collected during left-side stimulation are displayed in the top half of the screen with the response recorded on the ipsilateral side (e.g., Ch1 : L) positioned above the response recorded on the contralateral side (Ch2 : L).

Responses collected during right side stimulation display in the bottom half of the screen. Eliminating the need to change electrodes at the amplifier, the Sierra automatically inverts the order in which trials collected during right side stimulation are displayed so that the ipsilateral response (Ch2 : R) appears above the contralateral response (Ch1 : R).

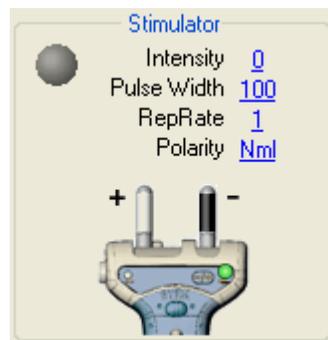
4. Check Stimulator Polarity

For Blink Reflex Studies, the **Cathode (-)** should be oriented **closest to the recording electrodes**.

The Cathode (i.e., the negative stimulus probe) can be selected by pressing the **Reverse Polarity (+/-)** button on the electrical stimulator handle. A **green LED** indicates the probe that is the Cathode.

Clicking on the **Polarity field** in the **Blink Controls window** or **Controls Toolbar** can also reverse the stimulator polarity. The default (i.e., normal) mode has the right-side probe as the Cathode (if holding the stimulator with the Stim button facing you and the probes up); the reversed state will make the left-side probe the Cathode. The image of the stimulator on the screen updates to indicate the selected polarity as well.

In the Normal mode, the electrical stimulator image on the screen will show the Right-side probe as the cathode (-). The polarity field on the screen will indicate **Nml**.



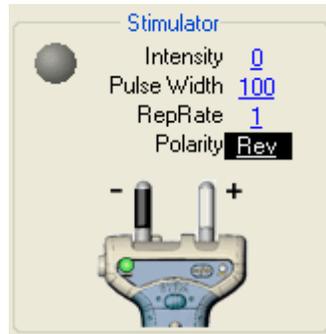
Controls Window.



Controls Toolbar.

Normal mode (right probe is Cathode).

In the Reversed mode, the electrical stimulator image on the screen will show the Left-side probe as the cathode (-). The polarity field on the screen will indicate **Rev**.



Controls Window.



Controls Toolbar.

Reversed mode (left probe is Cathode).

5. Stimulate

Increase the stimulus intensity level by turning the **wheel** on the electrical stimulator handle. The **intensity level** (in milliamps) is displayed on the screen in a small pop-up window and also in the Stimulator section. Once you have reached an appropriate starting intensity apply the stimulator to the patient's supra-orbital nerve and deliver the stimulus by pressing the **Stim button** on the electrical stimulator handle. The stimulator light, located next to the intensity level on the Screen, will flash Green and the patient's response will be displayed.



The **Single key** on the Sierra Wave base unit can also be used to deliver a single stimulus. Intensity can also be adjusted using **Knob #3 (Intensity / Pulse Width)** on the base unit.

6. Store the Response

To store the response, perform one of the following actions;

- Press the **Store button** on the **electrical stimulator handle**.
- Press the **Store key** on the Sierra Wave **base unit**.
- Press the **Footswitch** pedal.
- Click the **Store button** in the **Blink Controls** window.

When the response is stored the color of the trace changes from **white to purple**

7. Repeat Stimulation & Store additional responses

Generally, two trials are acquired per side.

8. Move Latency Markers (R1, R2i, R2c)

Three latency markers are utilized in the Blink test protocol. R1 is positioned at the onset of the ipsilateral R1 response. R2i is positioned at the onset of the ipsilateral R2 response. R2c is positioned at the onset of the contralateral R2 response.

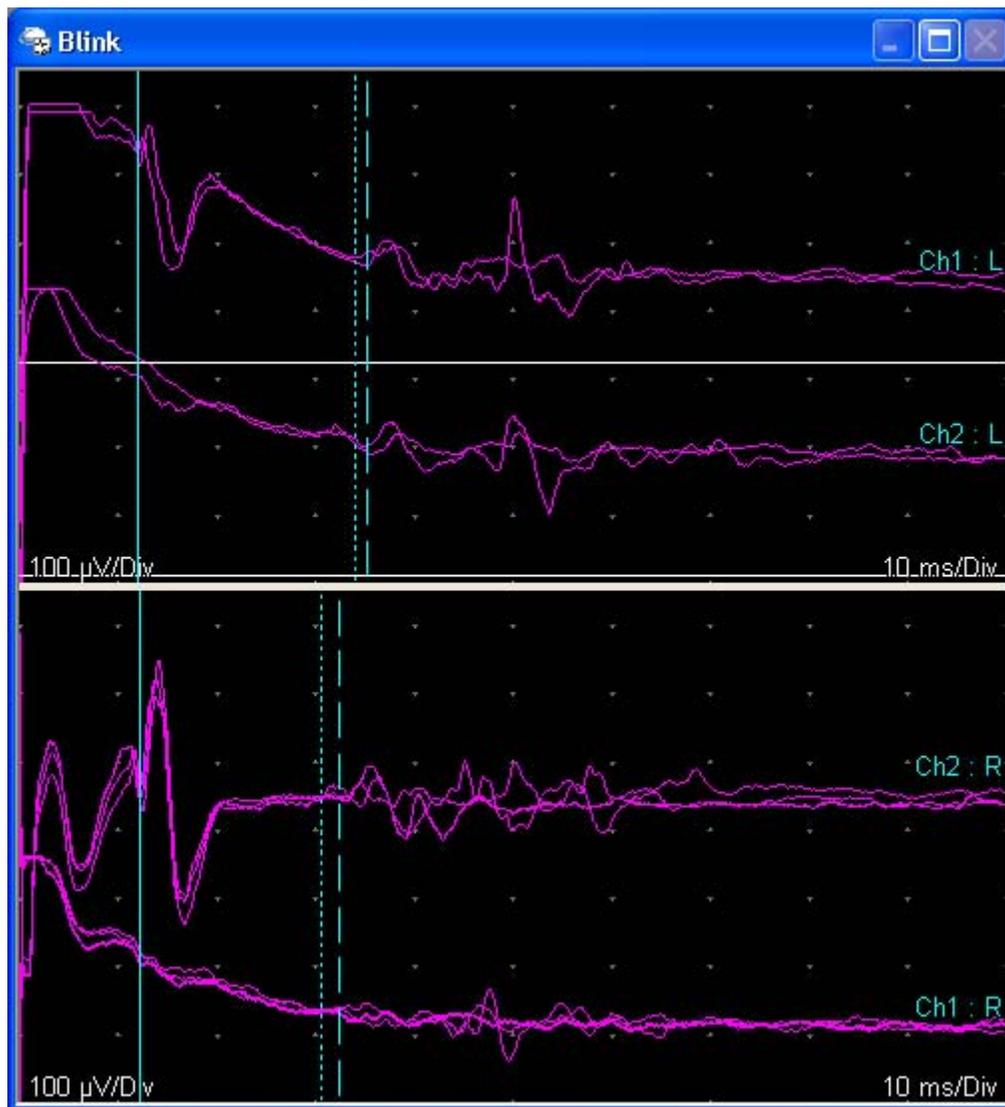
Each of the three markers has a different line pattern.

To move the latency markers:

- Use **Knob #2 (R1)** to move the **R1** marker, use **Knob #3 (R2i /R2c)** to move the **R2i** and **R2c** markers.
- Use the **mouse** to click and drag the appropriate marker to the desired location.

9. Change the Side and Repeat steps 4 - 8.

Selecting a different side automatically stores the currently active (white) traces.



Blink Example.



The program will automatically calculate the R2i-R2c difference for each side. It will also calculate the Left minus Right differences for R1, R2i, R2c, and R2i-R2c.

Side	R1	R2i	R2c	R2i-R2c
L	11.96	34.95	34.13	0.82
R	12.10	33.28	32.37	0.90
Diff(L-R)	0.14	1.68	1.76	0.08

Blink Cursor Table

10. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected test's traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

11. Next Test

To change Test Protocols:

- Use **Knob #1 (Study Item / Site)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.
- **Press** the **Select** key on the **Sierra Wave base unit** and select a Test Protocol from the **Study/Test** menu.

SEP - Basic Operation

Select the SEP Test:

- If a **Study has already been selected**, simply click on the SEP test protocol within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the test.
- If a **Study has not been selected, or you don't want to use a Study**. Select the SEP test protocol from the Study/Test menu.

Once the SEP test has been selected. Follow these steps for performing data acquisition:

1. Apply electrodes to the patient and connect to amplifier

Determine the number of channels that will be recorded and the electrodes that will be required for each channel. Apply the recording electrodes and ground electrode to the patient and connect to the Sierra Wave amplifier.

2. Verify Amplifier Settings

Check the **Gain**, **Hicut**, **Locut**, and **Sweep Speed** settings and make sure they are appropriate for the selected SEP test.

Typical Settings

	Gain (uV/Div)	Hicut (Hz)	Locut (Hz)	Sweep Speed (ms/Div)
Upper Limb SEP	1 to 5	3k to 500	10	5.0
Lower Limb SEP	1 to 5	3k to 500	10	10.0

A **Common Reference (CREF)** input is available on the 4 Channel Amplifier. The status of the CREF input, **Off** or **On** for each channel, will depend on the montage chosen for the test. If the amplifier channel should use its corresponding individual reference input (i.e., reference 1, 2, 3, or 4) the CREF setting should be set to **OFF**.

If the channel should not use its individual reference input, but should use the CREF input in its place, then the CREF setting should be set to **ON**.

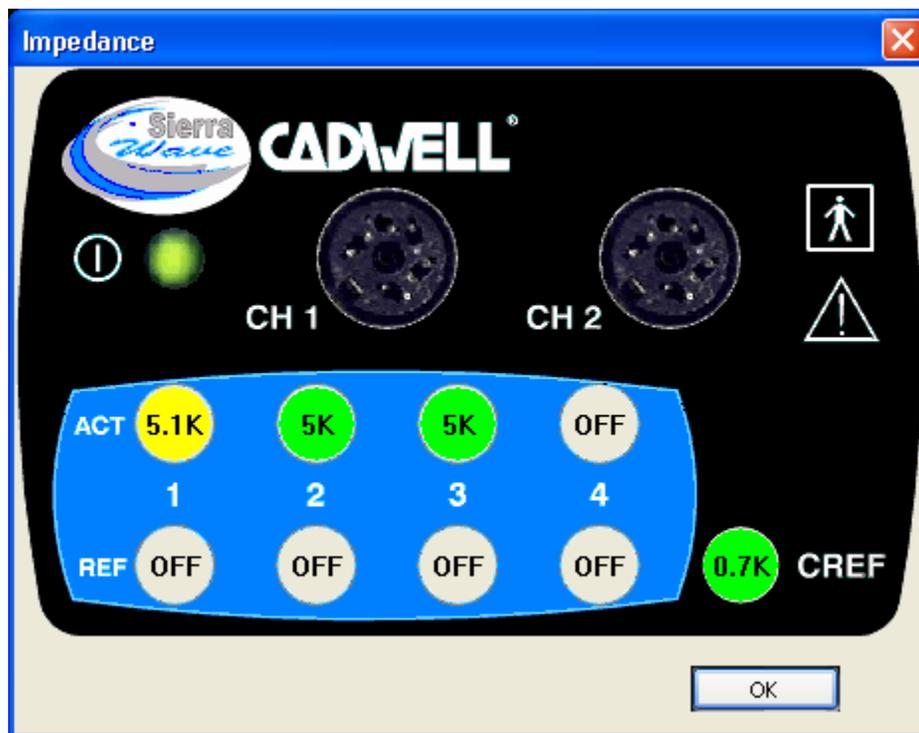
The **Notch** filter is typically not used during SEP recordings and should remain **OFF**.

Amplifier							
Chn	On	Amp Gain	Disp Gain	Hicut	Locut	CRef	Notch
1	On	10	2	500	10	On	Off
2	On	10	2	500	30	On	Off
3	On	10	2	500	30	On	Off
4	Off	10	2	500	10	Off	Off
All		10	2	500	10	On	Off
Sweep		Delay					
5		0					

Median SEP default Amplifier Settings.

3. Check Impedances

Press the **Imped** key on the Sierra Wave base unit. The impedance window displays a picture of the front of the amplifier.



Impedance window. Channels 1, 2 and 3 have the CREF input enabled, channel 4 is turned Off.

The **Active** (black) and **Reference** (red) inputs are displayed for each channel as well as the **CREF** input (4 Channel Amplifier only). The **Ground** input is not included in impedance measurements.

If a Channel is turned Off, no impedance values will be calculated for either the active or reference inputs and the word "Off" is displayed over the inputs of that channel.

When the CREF input is enabled (i.e., ON) for a channel, that channel's reference input will not show an impedance value and will have the word "Off" over the reference input. An impedance value for the CREF input will be displayed.

Impedances less than 5k Ohms (kilo-ohms) are displayed in green. Values between 5.1 and 20 are displayed in yellow. Values greater than 20 are displayed in red.

To close the impedance window, press the **Imped key again** or click the **OK** button.



When performing evoked potential studies all impedances should be **less than 5k Ohms**.

4. Select Side of Stimulation

Make sure the appropriate side, **Right** or **Left**, is selected.

5. Check Stimulator Settings and Polarity

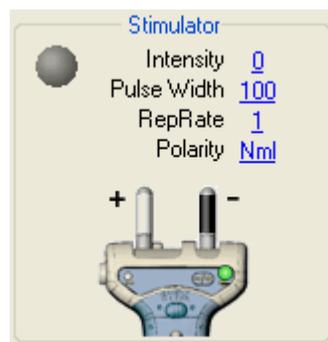
Apply the stimulating electrodes (bar electrode or individual electrodes) to the patient. Connect the stimulating electrodes to the end of the hand-held electrical stimulator (remove the probe tips from the end of the stimulator). The **proximal** stimulating electrode should be connected to the **Cathode (-)** and the **distal** stimulating electrode should be connected to the **Anode (+)**.

Intensity - start at zero milliamps and after data acquisition is started increase slowly until a visible muscle twitch is seen.

Pulse Width - typically set to 100 or 200 microseconds.

Rep Rate - typically between 2 to 5 Hz and not directly divisible into 60 (e.g., 2.11, 2.66, 4.77).

Polarity - set to **Normal (Nml)** mode. The green LED indicates the Cathode (-).



Controls Window.



Controls Toolbar.

SEP Stimulator Controls

6. Verify Averager Settings

Shutoff - This is the number of responses that will be averaged together to produce the final results. When the shutoff count is reached stimulation will automatically be stopped.

Reject On / Off - When this feature is turned **On** the program will monitor the **Live** un-averaged data and will not include (i.e., will reject) high amplitude artifacts from the running average. During data acquisition the percentage (%) of stimuli/sweeps that have been rejected from the total delivered will be displayed on the screen.

Level - This is the reject sensitivity level, it is shown as a percentage of full amplifier scale. Choices are 30 to 100 % in increments of 5. 100% equals full scale, smaller numbers will make the reject more sensitive.

Averager					
Averager	AvgCnt	Shutoff	Reject	%	Level
On	0	200	On	0%	95

Example SEP Averager settings.



Reject is based on the **Live** un-averaged data and the **Amp Gain** setting. Every channel has 5 divisions above and below its initial baseline. So, if the Amp Gain is set to 10 uV/Div this means that the Live trace has an amplitude window of 100 microvolts (10 vertical divisions times 10 uV/Div) with 50 uV above the baseline and 50 uV below the baseline. If the reject level is set to 100% (i.e., full scale), then the amplitude of the live data must be below +/- 50 uV to be included in the running average. Should it exceed +/- 50 uV the trace will be rejected from the running average. If the reject level is set to 50% (i.e., half of full scale), then the amplitude of the Live data can't exceed +/- 25 uV (2.5 divisions above or below the baseline) or it will be rejected from the running average. The lower the reject level setting the more sensitive the program will be in rejecting large artifacts.



You can check the **Amp Gain** setting by pressing the **F1 (Avg / Live)** function key to switch to the **Live** mode. Press the function key again to return to the **Avg** mode and view the **Display Gain** setting.

7. Acquire Responses

A. Start Data Acquisition.

Press the **Run/Stop key** to start stimulus delivery and data acquisition. **Slowly turn up the stimulus intensity level** until a visible muscle twitch is observed.

The average count (**AvgCnt**) should start to increment and the traces will begin to take shape.

Adjust the vertical size of the all traces by turning **Knob #4 (Gain)**. To adjust the gain of an individual trace, change the corresponding gain setting in the amplifier section of the **EP Controls** window.

Press the **F3 (Smooth)** function key during acquisition to remove high frequency noise from the active (white) traces.

B. Store the first trial.

When the Shutoff count is reached, stimulation will stop automatically. Press the **Store key** to store the active (white) traces. A copy of the active traces will appear on the screen and are displayed in a purple color.



The **Store key** can be pressed before the Shutoff count is reached. This will cause the currently active traces to be stored, the average count will be reset to zero, and stimulation will continue automatically on a new set of traces.

C. Clear the Average Count.

Press the **Clear key** to reset the average count (AvgCnt) back to zero. The active (white) traces will be reset to flat lines.

D. Acquire a second Trial

Press the **Run/Stop key** to start stimulus delivery and data acquisition again. Generally, two trials should always be acquired when performing evoked potentials to show replication of the traces.

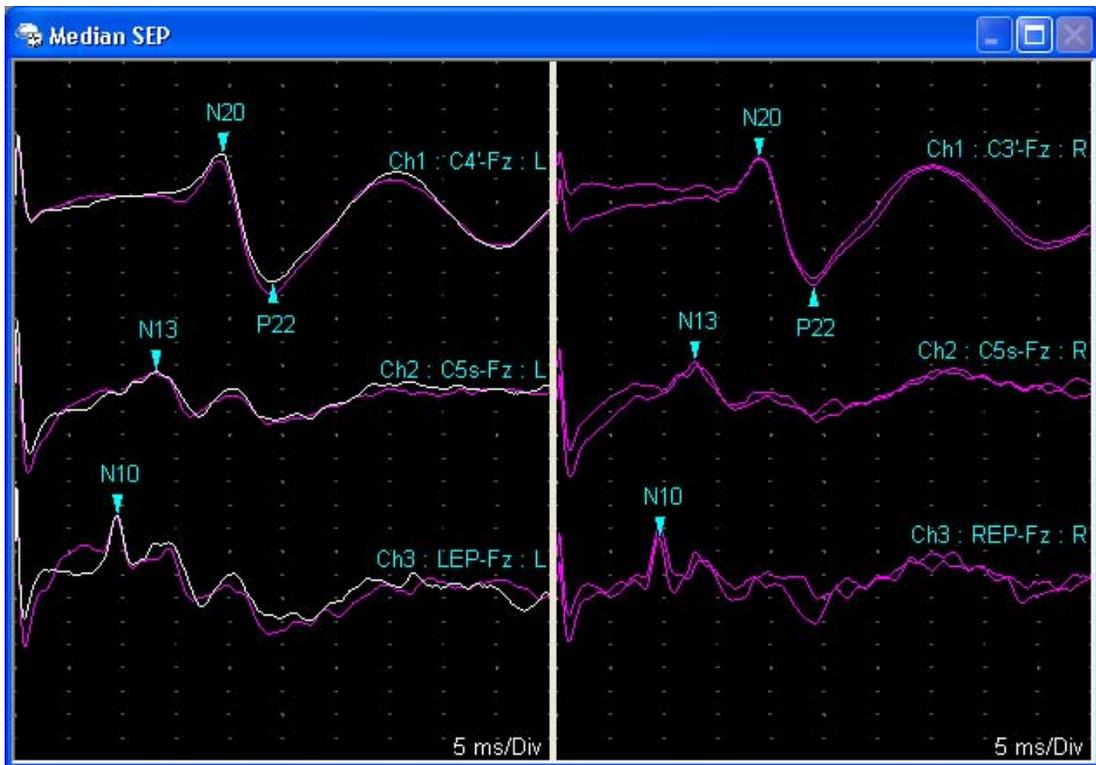
E. Store second trial and Clear.

After the Shutoff count is reached for the second trial, press the **Store key** to store the active (white) traces. Press the **Clear key** to reset the average count to zero.

F. Change Side of Stimulation.

To acquire traces for the opposite side, change the **Side** setting in the **EP Controls** window. If you are using the Split Screen feature the active (white) traces will automatically move to the opposite side of the Trace window.

G. Repeat steps A - E and collect data for the opposite side.



Example 3 Channel Median SEP, Left and Right.

8. Trace Positioning (optional)

If the position of the traces needs to be adjusted, follow one of these procedures.

- **Using the Mouse** - simply click on the Trial you want to move with the left mouse button and drag the trial to its new location. If you want to move an individual Trace, not the entire Trial, first right-click the mouse over the Trace window and remove the check mark in front of "Trial Selection Mode".
- **Using the Knobs** - press the **F6 (Position)** function key on the PC's keyboard. The program's knob and function keys will change to reflect the position mode controls. Use **Knob #1 (Sel Trial / Move)** to select and move trials. To move individual traces, first press the **F4 (Trial / Trace)** function key to change the selection mode.

When positioning is completed, press the **F6 (Position)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Position mode.

- **Using the Trace Position Settings** - right-click the mouse over the Trace window and select **Trace Position Settings** from the pop-up menu. Change the settings for **Start Position**, **Trial Offset**, and **Channel Offset** and click **OK**.

9. Place Auto Cursors

To place Cursors on the important trace features, follow one of these procedures.

- **Using the Mouse** - simply **left-click on a trial to select it**, the trial will be displayed in yellow. Now, **right-click** the mouse and select **Auto Place Cursors** from the pop-up menu. Cursors will be placed on the selected trial and the values (latency, amplitude, etc.) derived from the cursors will be displayed in the **EP Cursor Table** window.
- **Using the Knobs** - press the **F5 (Cursor) function key** of the PC's keyboard. The program's knob and function keys will change to reflect the cursor mode controls. Use **Knob #3 (Sel Trial)** to select a trial, when selected the trial will be displayed in yellow. Once the appropriate trial is selected, press the **F2 (AutoPlace Cursors) function key** and cursors will be placed on the selected trial. The values (latency, amplitude, etc.) derived from the cursors will be displayed in the **EP Cursor Table** window.

After cursors have been placed, press the **F5 (Cursor)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Cursor mode.



For information on configuring the Auto Cursors, see the SEP Test Protocol setup topic.

To Adjust the positions of the Cursors, follow one of these procedures.

- **Using the Mouse** - simply click on the Cursor you want to move with the left mouse button and drag the cursor along the trace to its new location.
- **Using the Knobs** - press the **F5 (Cursor) function key** of the PC's keyboard. The program's knob and function keys will change to reflect the cursor mode controls. Use **Knob #3 (Sel Trial)** to select the trial with the cursors you need to adjust, when selected the trial will be displayed in yellow. Once the appropriate trial is selected, use **Knob #1 (Sel Cursor / Move)** to select and move the desired cursor.

After cursor positions have been adjusted, press the **F5 (Cursor)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Cursor mode.

Defined Measurements

	Trial	N20 (ms)	N13 (ms)	N10 (ms)	N20-N13 (ms)	N13-N10 (ms)	N20-N10 (ms)	N20-P22 (µV)
Normal Values →	Norm	<22	<16.3	<12.0	<6.8	<5.2	<10.9	
Results for Right Side →	Trial1 - R	20.9	15.0	11.6	5.9	3.4	9.3	7.55
Results for Left Side →	Trial3 - L	21.1	15.6	12.9	5.5	2.7	8.2	3.66
L - R Normal Values →	L-R Norm	<1.8	<1.5	<0.7	<1.1	<0.7	<0.8	
Calculated L - R Values →	L-R	0.2	0.6	1.3	0.4	0.7	1.1	3.89

Red color indicates abnormal value.

Example Median SEP Cursor Table.

 The program will calculate the left minus right difference values for each defined measurement after cursors have been placed on **one left** and **one right** side trial.

 Depending on your preferences in System Setup, abnormal values can be flagged with a red background color, as bold text, as bold text with an asterisk, or as bold text & background color red.

10. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected test's traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

11. Next Test

To change Test Protocols:

- Use **Knob #1 (Study Item / Site)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.
- **Press** the **Select** key on the **Sierra Wave base unit** and select a Test Protocol from the **Study/Test** menu.

AEP - Basic Operation

Select the AEP Test:

- **If a Study has already been selected**, simply click on the AEP test protocol within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the test.
- **If a Study has not been selected, or you don't want to use a Study.** Select the AEP test protocol from the Study/Test menu.

Once the AEP test has been selected. Follow these steps for performing data acquisition:

1. Apply electrodes to the patient and connect to amplifier

Determine the number of channels that will be recorded and the electrodes that will be required for each channel. Apply the recording electrodes and ground electrode to the patient and connect to the Sierra Wave amplifier.

2. Verify Amplifier Settings

Check the **Gain**, **Hicut**, **Locut**, and **Sweep Speed** settings and make sure they are appropriate for the selected AEP test.

Typical AEP Settings

Gain = 0.2 to 0.5 uV/Div

Hicut = 3k Hz

Locut = 100 Hz

Sweep Speed = 1.0 ms/Div

A **Common Reference (CREF)** input is available on the 4 Channel Amplifier. The status of the CREF input, **Off** or **On** for each channel, will depend on the montage chosen for the test. If the amplifier channel should use its corresponding individual reference input (i.e., reference 1, 2, 3, or 4) the CREF setting should be set to **OFF**.

If the channel should not use its individual reference input, but should use the CREF input in its place, then the CREF setting should be set to **ON**.

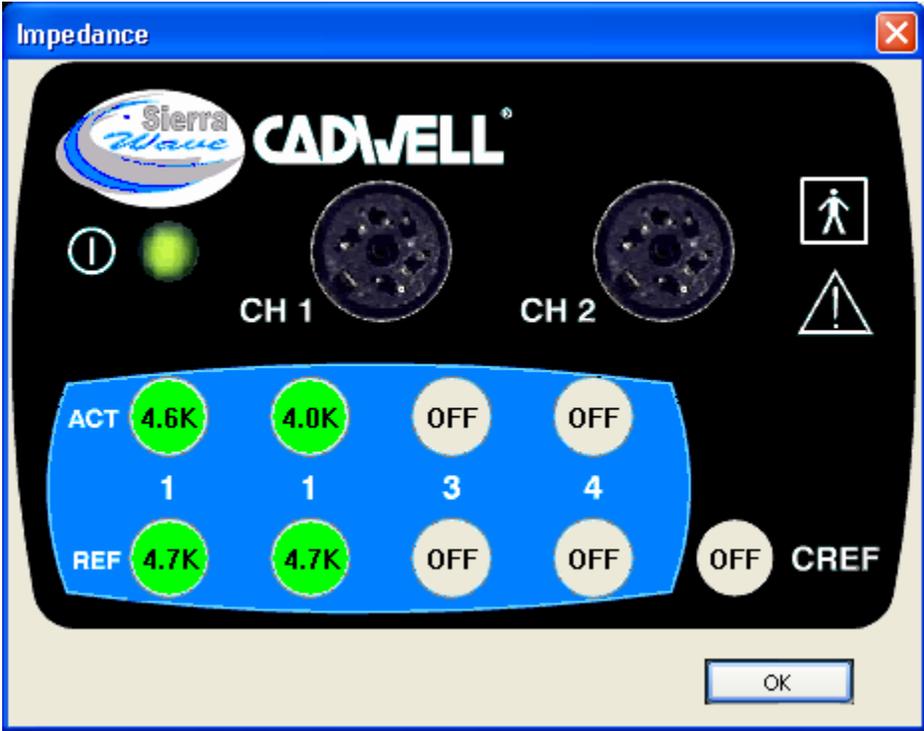
The **Notch** filter is typically not used during AEP recordings and should remain **OFF**.

Amplifier							
Chn	On	Amp Gain	Disp Gain	Hicut	Locut	CRef	Notch
1	On	10	0.3	3 k	100	Off	Off
2	On	10	0.3	3 k	100	Off	Off
3	Off	10	0.3	3 k	100	Off	Off
4	Off	10	0.3	3 k	100	Off	Off
All		10	0.3	3 k	100	Off	Off
Sweep		Delay					
1		0					

2Ch. AEP Default Settings.

3. Check Impedances

Press the **Imped** key on the Sierra Wave base unit. The impedance window displays a picture of the front of the amplifier.



Impedance window. Channels 3 & 4 are turned Off. CREF is turned OFF.

The **Active** (black) and **Reference** (red) inputs are displayed for each channel as well as the **CREF** input (4 Channel Amplifier only). The **Ground** input is not included in impedance measurements.

If a Channel is turned Off, no impedance values will be calculated for either the active or reference inputs and the word "Off" is displayed over the inputs of that channel.

When the CREF input is enabled (i.e., ON) for a channel, that channel's reference input will not show an impedance value and will have the word "Off" over the reference input. An impedance value for the CREF input will be displayed.

Impedances less than 5k Ohms (kilo-ohms) are displayed in green. Values between 5.1 and 20 are displayed in yellow. Values greater than 20 are displayed in red.

To close the impedance window, press the **Imped key again** or click the **OK** button.



When performing evoked potential studies all impedances should be **less than 5k Ohms**.

4. Select Side of Stimulation

Make sure the appropriate side, **Right** or **Left**, is selected.

5. Check Stimulator Settings

Apply the stimulator (headphones or inserts) to the patient, the red headphone/insert should be placed on the patient's right side, the blue headphone/insert should be placed on the left. Connect the stimulator to the back of the Sierra Wave base unit.



AEP Stimulator Settings - Controls Window



AEP Stimulator Settings - Controls Toolbar

Mode: Click here to select the auditory stimulus type, choose either **Click**, **Tone**, **Pip202**, or **Pip212**.

- **Click** - this is a 100 microsecond click stimulus.
- **Tone** - this is a 10-30-10 tone burst stimulus. It has a 10 millisecond rise time, a 30 millisecond plateau, and a 10 millisecond fall time. This stimulus is typically used for long latency auditory evoked potentials.
- **Pip 202** or **Pip 212** - these are also tone stimuli but their rise, plateau, and fall times are measured in cycles rather than milliseconds. The 2-0-2 Pip has a 2 cycle rise, 0 cycle plateau, and 2 cycle fall. The 2-1-2 Pip has a 2 cycle rise, 1 cycle plateau, and a 2 cycle fall.

- **Frequency** - when Tone, PiP202, or PiP212 are selected a Frequency setting will be displayed. Click here to select the frequency of the tone/pip. The choices are 250, 500, 750, 1000, 2000, 3000, 4000, 6000, and 8000 Hz.

Type: Click here to select the type of stimulus delivery hardware, choose either **Phones** or **Inserts**.



When **Inserts** are selected the program will **automatically subtract 1.0 milliseconds** from all latency calculations to compensate for the delay produced by the plastic tubing. The displayed trace is not shifted by 1.0 millisecond.

Polarity: Click here to set the stimulus polarity, the choices vary depending on the stimulus type.

- **For Click** - choose either **Rarefaction**, **Condensation**, or **Alternating** polarity.
- **For Tone or Pip** - choose either **Negative**, **Positive**, or **Alternating** polarity.

Intensity L-R: Click here to set the starting stimulus intensity value. The first column is for the left side, the second column is for the right side.



To avoid excessive auditory stimulation, ensure that the stimulus intensity never exceeds 75 dB above the hearing threshold.

Threshold L-R: Indicates the behavioral threshold value. The first column is for the left side, the second column is for the right side. During data acquisition the Threshold values are added to the Intensity values to produce the stimulus at the headphones/inserts. See step #6 for instructions on determining thresholds.

Intensity Units: Choose either **nHL** (normalized hearing level) or **SPL** (sound pressure level). When SPL is selected the Threshold settings are disabled.

Mask: Click here to set the "white" noise masking as either **On** or **Off** and to set the level for the non-stimulated ear. The amount selected is the number of dB's below the Intensity value. This is known as differential masking and allows the intensity of the masking noise to decrease automatically as the intensity of the stimulus is decreased.

Rep Rate: Click here to set the repetitive stimulus rate, in pulses per second (Hz).

6. Determine Behavioral Threshold Levels (optional)

There are two specially designated knobs for setting the behavioral threshold levels. **Knob #2 (L Thresh/Off)** and **Knob #3 (R Thresh/Off)**. To determine the threshold levels follow these steps.

- I. **Turn Knob #2.** Stimuli will be automatically delivered to the left ear and the threshold value for the left ear will turn "yellow".

- II. **Continue to turn** Knob #2 until the patient can definitely hear the stimulus.
- III. Slowly turn Knob #2 in the reverse direction to **decrease** the threshold level. Keep decreasing the level until the patient signals that they can no longer hear, or can just barely hear, the stimulus.
- IV. **Press Knob #2** to stop stimulus delivery and set the threshold value for the left ear.
- V. **Repeat** the above steps for the right ear using **Knob #3**.



The threshold value is automatically added to the intensity value to obtain the output level for the stimulator. For example, if the left intensity was set to 70 dB and the left threshold was determined to be 12 dB, the actual output intensity from the stimulator would be 82 (70 + 12).

7. Verify Averager Settings

Shutoff - This is the number of responses that will be averaged together to produce the final results. When the shutoff count is reached stimulation will automatically be stopped.

Reject On / Off - When this feature is turned **On** the program will monitor the **Live** un-averaged data and will not include (i.e., will reject) high amplitude artifacts from the running average. During data acquisition the percentage (%) of stimuli/sweeps that have been rejected from the total delivered will be displayed on the screen.

Level - This is the reject sensitivity level, it is shown as a percentage of full amplifier scale. Choices are 30 to 100 % in increments of 5. 100% equals full scale, smaller numbers will make the reject more sensitive.

Averager					
Averager	AvgCnt	Shutoff	Reject	%	Level
On	0	2000	On	0%	50

AEP Default Averager Settings.



Reject is based on the **Live** un-averaged data and the **Amp Gain** setting. Every channel has 5 divisions above and below its initial baseline. So, if the Amp Gain is set to 10 uV/Div this means that the Live trace has an amplitude window of 100 microvolts (10 vertical divisions times 10 uV/Div) with 50 uV above the baseline and 50 uV below the baseline. If the reject level is set to 100% (i.e., full scale), then the amplitude of the live data must be below +/- 50 uV to be included in the running average. Should it exceed +/- 50 uV the trace will be rejected from the running average. If the reject level is set to 50% (i.e., half of full scale), then the amplitude of the Live data can't exceed +/- 25 uV (2.5 divisions above or below the baseline) or it will be rejected from the running average. The lower the reject level setting the more sensitive the program will be in rejecting large artifacts.



You can check the **Amp Gain** setting by pressing the **F1 (Avg / Live)** function key to switch to the **Live** mode. Press the function key again to return to the **Avg** mode and view the **Display Gain** setting.

8. Acquire Responses

A. Start Data Acquisition.

Press the **Run/Stop key** to start stimulus delivery and data acquisition. The average count (**AvgCnt**) should start to increment and the traces will begin to take shape.

Adjust the vertical size of the all traces by turning **Knob #4 (Gain)**. To adjust the gain of an individual trace, change the corresponding gain setting in the amplifier section of the **EP Controls** window.

Press the **F3 (Smooth)** function key during acquisition to remove high frequency noise from the active (white) traces.

B. Store the first trial.

When the Shutoff count is reached, stimulation will stop automatically. Press the **Store key** to store the active (white) traces. A copy of the active traces will appear on the screen and are displayed in a purple color.



The **Store key** can be pressed before the Shutoff count is reached. This will cause the currently active traces to be stored, the average count will be reset to zero, and stimulation will continue automatically on a new set of traces.

C. Clear the Average Count.

Press the **Clear key** to reset the average count (AvgCnt) back to zero. The active (white) traces will be reset to flat lines.

D. Acquire a second Trial

Press the **Run/Stop key** to start stimulus delivery and data acquisition again. Generally, two trials should always be acquired when performing evoked potentials to show replication of the traces.

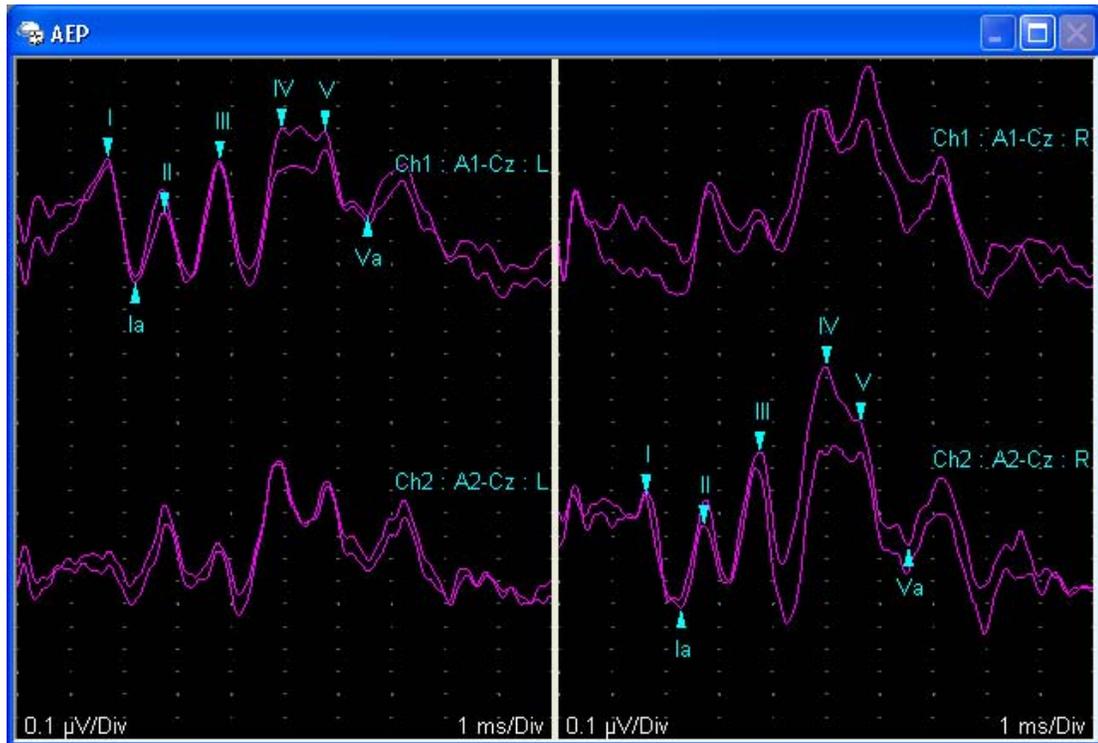
E. Store second trial and Clear.

After the Shutoff count is reached for the second trial, press the **Store key** to store the active (white) traces. Press the **Clear key** to reset the average count to zero.

F. Change Side of Stimulation.

To acquire traces for the opposite side, change the **Side** setting in the **EP Controls** window. If you are using the Split Screen feature the active (white) traces will automatically move to the opposite side of the Trace window.

G. Repeat steps A - E and collect data for the opposite side.



Example 2 Channel AEP, Left and Right.

9. Trace Positioning (optional)

If the position of the traces needs to be adjusted, follow one of these procedures.

- **Using the Mouse** - simply **click on the Trace you want to move with the left mouse button** and drag the trace to its new location.
- **Using the Knobs** - press the **F6 (Position)** function key on the PC's keyboard. The program's knob and function keys will change to reflect the position mode controls. Use **Knob #1 (Sel Trace / Move)** to select and move traces.

When positioning is completed, press the **F6 (Position)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Position mode.

- **Using the Trace Position Settings** - right-click the mouse over the Trace window and select **Trace Position Settings** from the pop-up menu.

Change the settings for **Start Position**, **Trial Offset**, and **Channel Offset** and click **OK**.

10. Place Auto Cursors

To place Cursors on the important trace features, follow one of these procedures.

- **Using the Mouse** - simply **left-click on a trace to select it**, the trace will be displayed in yellow. Now, **right-click** the mouse and select **Auto Place Cursors** from the pop-up menu. Cursors will be placed on the selected trace and the values (latency, amplitude, etc.) derived from the cursors will be displayed in the **EP Cursor Table** window.
- **Using the Knobs** - press the **F5 (Cursor) function key** of the PC's keyboard. The program's knob and function keys will change to reflect the cursor mode controls. Use **Knob #3 (Sel Trace)** to select a trace, when selected the trace will be displayed in yellow. Once the appropriate trace is selected, press the **F2 (AutoPlace Cursors) function key** and cursors will be placed on the selected trace. The values (latency, amplitude, etc.) derived from the cursors will be displayed in the **EP Cursor Table** window.

After cursors have been placed, press the **F5 (Cursor)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Cursor mode.



For information on configuring the Auto Cursors, see the AEP Test Setup topic.

To Adjust the positions of the Cursors, follow one of these procedures.

- **Using the Mouse** - simply click on the Cursor you want to move with the left mouse button and drag the cursor along the trace to its new location.
- **Using the Knobs** - press the **F5 (Cursor) function key** of the PC's keyboard. The program's knob and function keys will change to reflect the cursor mode controls. Use **Knob #3 (Sel Trace)** to select the trace with the cursors you need to adjust, when selected the trace will be displayed in yellow. Once the appropriate trace is selected, use **Knob #1 (Sel Cursor / Move)** to select and move the desired cursor.

After cursor positions have been adjusted, press the **F5 (Cursor)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Cursor mode.

Defined Measurements

Trace	I (ms)	II (ms)	III (ms)	IV (ms)	V (ms)	I-III (ms)	III-V (ms)	I-V (ms)	V-Va (µV)	I-Ia (µV)	V-Va/I-Ia
Normal Values → Norm	<2.0		<4.5		<6.2	<2.4	<2.3	<4.5			
Results for Right Side → Ch2 : A2-Cz : R	1.64	2.77	3.69	4.92	5.66	2.05	1.97	4.02	0.54	0.49	1.10
Results for Left Side → Ch1 : A1-Cz : L	1.69	2.75	3.78	4.92	6.05	2.09	2.27	4.36	0.10	0.55	0.18
L - R Normal Values → L-R Norm						<0.28	<0.32	<0.33			
Calculated L - R Values → L-R	0.05	0.02	0.09	0.00	0.39	0.04	0.30	0.34	0.44	0.06	0.92

Red Color indicates abnormal value

AEP cursor table example.

 The program will calculate the left minus right difference values for each defined measurement after cursors have been placed on **one left** and **one right** side trace.

 Depending on your preferences in System Setup, abnormal values can be flagged with a red background color, as bold text, as bold text with an asterisk, or as bold text & background color red.

11. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected test's traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

12. Next Test

To change Test Protocols:

- Use **Knob #1 (Study Item / Site)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.
- **Press** the **Select** key on the **Sierra Wave base unit** and select a Test Protocol from the **Study/Test** menu.

VEP - Basic Operation

Select the VEP Test:

- **If a Study has already been selected**, simply click on the VEP test protocol within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the test.
- **If a Study has not been selected, or you don't want to use a Study.** Select the VEP test protocol from the Study/Test menu.

Once the VEP test has been selected. Follow these steps for performing data acquisition:

1. Apply electrodes to the patient and connect to amplifier

Determine the number of channels that will be recorded and the electrodes that will be required for each channel. Apply the recording electrodes and ground electrode to the patient and connect to the Sierra Wave amplifier.

2. Verify Amplifier Settings

Check the **Gain**, **Hicut**, **Locut**, and **Sweep Speed** settings and make sure they are appropriate for the selected VEP test.

Typical VEP Settings

Gain = 5 uV/Div

Hicut = 200 Hz

Locut = 1 Hz

Sweep Speed = 25 ms/Div

A **Common Reference (CREF)** input is available on the 4 Channel Amplifier. The status of the CREF input, **Off** or **On** for each channel, will depend on the montage chosen for the test. If the amplifier channel should use its corresponding individual reference input (i.e., reference 1, 2, 3, or 4) the CREF setting should be set to **OFF**.

If the channel should not use its individual reference input, but should use the CREF input in its place, then the CREF setting should be set to **ON**.

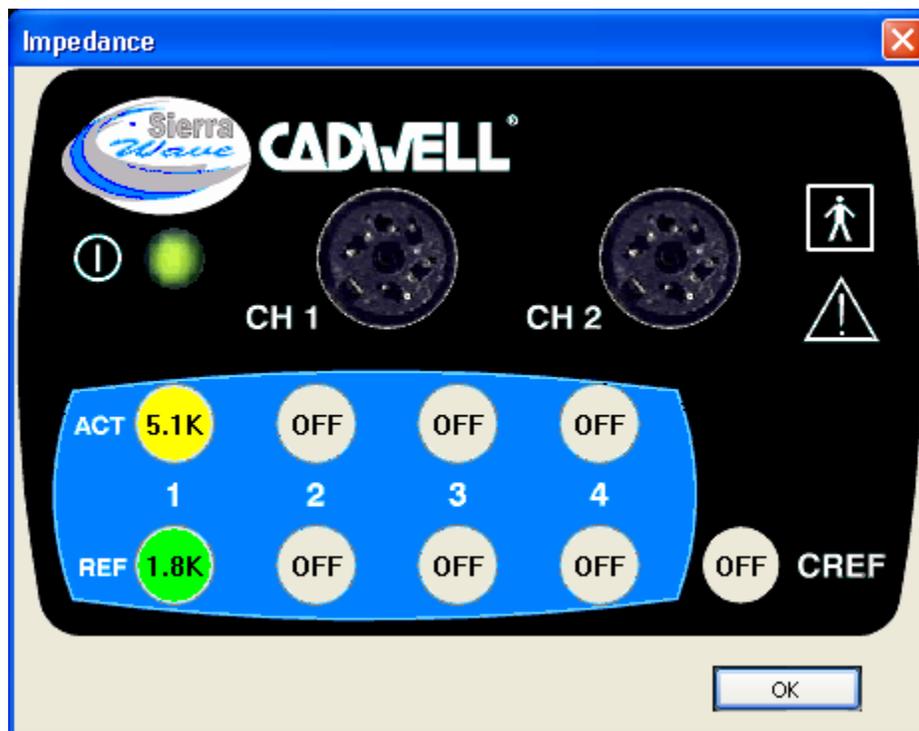
The **Notch** filter is typically not used during VEP recordings and should remain **OFF**.

Amplifier							
Chn	On	Amp Gain	Disp Gain	Hicut	Locut	CRef	Notch
1	On	10	5	200	1	Off	Off
2	Off	10	5	200	1	Off	Off
3	Off	10	5	200	1	Off	Off
4	Off	10	5	200	1	Off	Off
All		10	5	200	1	Off	Off
Sweep		Delay					
		25	0				

Default VEP Amplifier Settings.

3. Check Impedances

Press the **Imped** key on the Sierra Wave base unit. The impedance window displays a picture of the front of the amplifier.



Impedance window. Channels 2, 3, & 4 are turned Off. CREF is turned Off for Channel 1.

The **Active** (black) and **Reference** (red) inputs are displayed for each channel as well as the **CREF** input (4 Channel Amplifier only). The **Ground** input is not included in impedance measurements.

If a Channel is turned Off, no impedance values will be calculated for either the active or reference inputs and the word "Off" is displayed over the inputs of that channel.

When the CREF input is enabled (i.e., ON) for a channel, that channel's reference input will not show an impedance value and will have the word "Off" over the reference input. An impedance value for the CREF input will be displayed.

Impedances less than 5k Ohms (kilo-ohms) are displayed in green. Values between 5.1 and 20 are displayed in yellow. Values greater than 20 are displayed in red.

To close the impedance window, press the **Imped key again** or click the **OK** button.



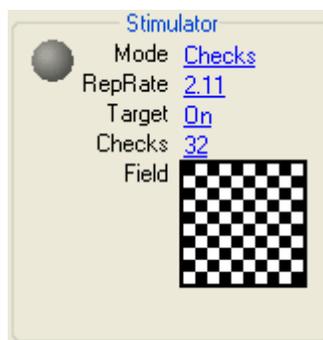
When performing evoked potential studies all impedances should be **less than 5k Ohms**.

4. Select Side of Stimulation

Make sure the appropriate side, **Right** or **Left**, is selected.

5. Check Stimulator Settings

Connect the VEP stimulator to the appropriate connector on the back of the Sierra Wave base unit. Position the stimulator at the required distance from the patient. Cover the non-stimulated eye.



VEP Default Stimulator Settings - Controls Window



VEP Stimulator Settings - Controls Toolbar

Mode: Click here to select the type of visual stimulus. Choices are **Checks**, **Goggles**, **LED**, and **Flash**.

- **Checks** - selects a reversing black & white checkerboard pattern. When checks are selected as the stimulus type the following additional parameters are available.
 - **Target** - select either On or Off. When turned On a small target is positioned in the center of the black & white monitor, the patient should focus on this target during data acquisition.

- **Checks** - click here to select the number of checks displayed across a horizontal row. The choices are 1, 2, 4, 8, 16, 32, 64, and 128 (default is 32 checks with monitor positioned about 1 meter from patient).
- **Field** - click in this area to select the field of stimulation. The choices are Full Field, Upper Half, Right Half, Lower Half, Left Half, Left Upper Quarter, Right Upper Quarter, Right Lower Quarter, and Left Lower Quarter (default is Full Field).
- **Goggles** - selects the LEG Goggles.
- **LED** - selects the 3 inch hand held LED checkerboard stimulator.
- **Flash** - selects the strobe flash stimulator.

Rep Rate: Click here to set the repetitive stimulus rate, in pulses per second (Hz).

6. Verify Averager Settings

Shutoff - This is the number of responses that will be averaged together to produce the final results. When the shutoff count is reached stimulation will automatically be stopped.

Reject On / Off - When this feature is turned **On** the program will monitor the **Live** un-averaged data and will not include (i.e., will reject) high amplitude artifacts from the running average. During data acquisition the percentage (%) of stimuli/sweeps that have been rejected from the total delivered will be displayed on the screen.

Level - This is the reject sensitivity level, it is shown as a percentage of full amplifier scale. Choices are 30 to 100 % in increments of 5. 100% equals full scale, smaller numbers will make the reject more sensitive.

Averager					
Averager	AvgCnt	Shutoff	Reject	%	Level
On	0	100	On	0%	95

VEP Default Averager Settings.



Reject is based on the **Live** un-averaged data and the **Amp Gain** setting. Every channel has 5 divisions above and below its initial baseline. So, if the Amp Gain is set to 10 uV/Div this means that the Live trace has an amplitude window of 100 microvolts (10 vertical divisions times 10 uV/Div) with 50 uV above the baseline and 50 uV below the baseline. If the reject level is set to 100% (i.e., full scale), then the amplitude of the live data must be below +/- 50 uV to be included in the running average. Should it exceed +/- 50 uV the trace will be rejected from the running average. If the reject level is set to 50% (i.e., half of full scale), then the amplitude of the Live data can't exceed +/- 25 uV (2.5 divisions above or below the baseline) or it will be rejected from the running average. The lower the reject level setting the more sensitive the program will be in rejecting large artifacts.



You can check the **Amp Gain** setting by pressing the **F1 (Avg / Live)** function key to switch to the **Live** mode. Press the function key again to return to the **Avg** mode and view the **Display Gain** setting.

7. Acquire Responses

A. Start Data Acquisition.

Press the **Run/Stop key** to start stimulus delivery and data acquisition. The average count (**AvgCnt**) should start to increment and the traces will begin to take shape.

Adjust the vertical size of the all traces by turning **Knob #4 (Gain)**. To adjust the gain of an individual trace, change the corresponding gain setting in the amplifier section of the **EP Controls** window.

Press the **F3 (Smooth)** function key during acquisition to remove high frequency noise from the active (white) traces.

B. Store the first trial.

When the Shutoff count is reached, stimulation will stop automatically. Press the **Store key** to store the active (white) traces. A copy of the active traces will appear on the screen and are displayed in a purple color.



The **Store key** can be pressed before the Shutoff count is reached. This will cause the currently active traces to be stored, the average count will be reset to zero, and stimulation will continue automatically on a new set of traces.

C. Clear the Average Count.

Press the **Clear key** to reset the average count (AvgCnt) back to zero. The active (white) traces will be reset to flat lines.

D. Acquire a second Trial

Press the **Run/Stop key** to start stimulus delivery and data acquisition again. Generally, two trials should always be acquired when performing evoked potentials to show replication of the traces.

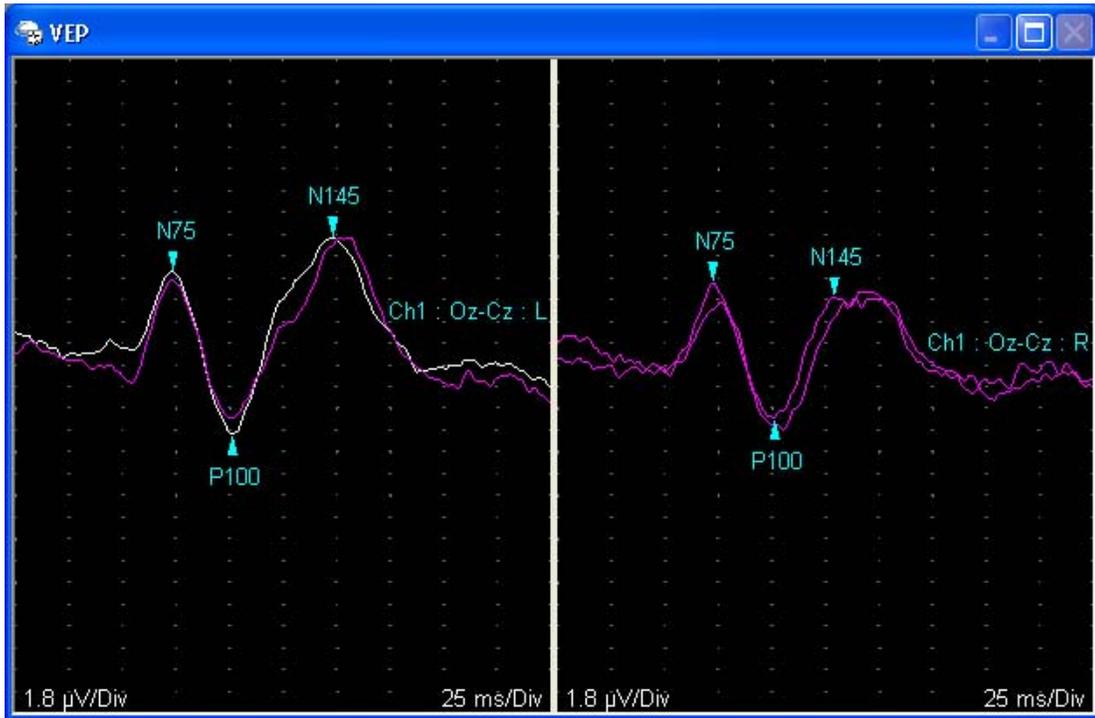
E. Store second trial and Clear.

After the Shutoff count is reached for the second trial, press the **Store key** to store the active (white) traces. Press the **Clear key** to reset the average count to zero.

F. Change Side of Stimulation.

To acquire traces for the opposite side, change the **Side** setting in the **EP Controls** window. If you are using the Split Screen feature the active (white) traces will automatically move to the opposite side of the Trace window.

G. Repeat steps A - E and collect data for the opposite side.



Example VEP, single channel recording, Left & Right.

8. Trace Positioning (optional)

If the position of the traces needs to be adjusted, follow one of these procedures.

- **Using the Mouse** - simply click on the Trace you want to move with the left mouse button and drag the trace to its new location.
- **Using the Knobs** - press the **F6 (Position)** function key on the PC's keyboard. The program's knob and function keys will change to reflect the position mode controls. Use **Knob #1 (Sel Trace / Move)** to select and move traces.

When positioning is completed, press the **F6 (Position)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Position mode.

- **Using the Trace Position Settings** - right-click the mouse over the Trace window and select **Trace Position Settings** from the pop-up menu.

Change the settings for **Start Position**, **Trial Offset**, and **Channel Offset** and click **OK**.

9. Place Auto Cursors

To place Cursors on the important trace features, follow one of these procedures.

- **Using the Mouse** - simply **left-click on a trace to select it**, the trace will be displayed in yellow. Now, **right-click** the mouse and select **Auto Place Cursors** from the pop-up menu. Cursors will be placed on the selected trace and the values (latency, amplitude, etc.) derived from the cursors will be displayed in the **EP Cursor Table** window.
- **Using the Knobs** - press the **F5 (Cursor) function key** of the PC's keyboard. The program's knob and function keys will change to reflect the cursor mode controls. Use **Knob #3 (Sel Trace)** to select a trace, when selected the trace will be displayed in yellow. Once the appropriate trace is selected, press the **F2 (AutoPlace Cursors) function key** and cursors will be placed on the selected trace. The values (latency, amplitude, etc.) derived from the cursors will be displayed in the **EP Cursor Table** window.

After cursors have been placed, press the **F5 (Cursor)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Cursor mode.



For information on configuring the Auto Cursors, see the VEP Test Setup topic.

To Adjust the positions of the Cursors, follow one of these procedures.

- **Using the Mouse** - simply click on the Cursor you want to move with the left mouse button and drag the cursor along the trace to its new location.
- **Using the Knobs** - press the **F5 (Cursor) function key** of the PC's keyboard. The program's knob and function keys will change to reflect the cursor mode controls. Use **Knob #3 (Sel Trace)** to select the trace with the cursors you need to adjust, when selected the trace will be displayed in yellow. Once the appropriate trace is selected, use **Knob #1 (Sel Cursor / Move)** to select and move the desired cursor.

After cursor positions have been adjusted, press the **F5 (Cursor)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Cursor mode.

Defined Measurements

	Trace	N75 (ms)	P100 (ms)	N145 (ms)	N75-P100 (μV)
Results for Right Side →	Ch1 : Oz-Cz : R	72.3	101.2	128.9	11.18
Results for Left Side →	Ch1 : Oz-Cz : L	73.4	101.2	148.0	13.39
Calculated L - R Values →	L-R	1.2	0.0	19.1	2.21

VEP cursor table example.



The program will calculate the left minus right difference values for each defined measurement after cursors have been placed on **one left** and **one right** side trace.



Depending on your preferences in System Setup, abnormal values can be flagged with a red background color, as bold text, as bold text with an asterisk, or as bold text & background color red.

10. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected test's traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

11. Next Test

To change Test Protocols:

- Use **Knob #1 (Study Item / Site)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.
- **Press** the **Select** key on the **Sierra Wave base unit** and select a Test Protocol from the **Study/Test** menu.

P300 - Basic Operation

Select the P300  Test:

- If a **Study has already been selected**, simply click on the P300 test protocol within the Study window or turn **Knob #1 (Study Item / Site)** to highlight the test.
- If a **Study has not been selected, or you don't want to use a Study**. Select the P300 test protocol from the Study/Test menu.

Once the P300 test has been selected. Follow these steps for performing data acquisition:

1. Apply electrodes to the patient and connect to amplifier

Determine the number of channels that will be recorded and the electrodes that will be required for each channel. Apply the recording electrodes and ground electrode to the patient and connect to the Sierra Wave amplifier.

To view a common **3 Channel P300** setup, Click [here](#).

2. Verify Amplifier Settings

Check the **Gain**, **Hicut**, **Locut**, and **Sweep Speed** settings and make sure they are appropriate for the selected P300 test.

Typical P300 Settings

Gain = 2.0 uV/Div

Hicut = 30-100 Hz

Locut = 1 Hz

Sweep Speed = 75 - 100 ms/Div

A **Common Reference (CREF)** input is available on the 4 Channel Amplifier. The status of the CREF input, **Off** or **On** for each channel, will depend on the montage chosen for the test. If the amplifier channel should use its corresponding individual reference input (i.e., reference 1, 2, 3, or 4) the CREF setting should be set to **OFF**.

If the channel should not use its individual reference input, but should use the CREF input in its place, then the CREF setting should be set to **ON**.

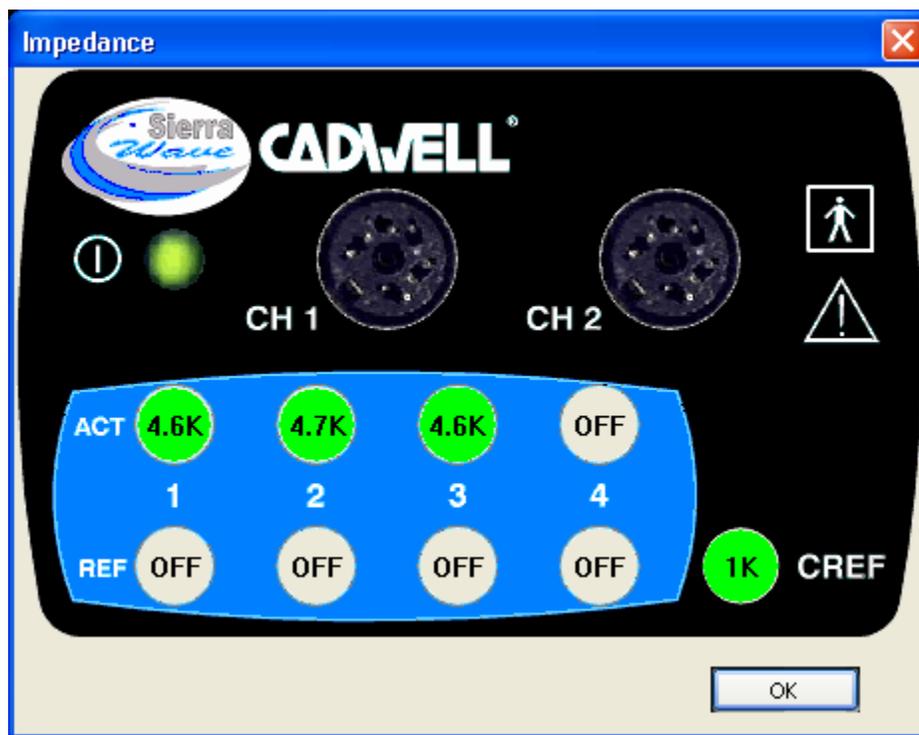
The **Notch** filter is typically not used during P300 recordings and should remain **OFF**.

Amplifier							
Chn	On	Amp Gain	Disp Gain	Hicut	Locut	CRef	Notch
1	On	20	2	100	1	Off	Off
2	Off	20	2	100	1	Off	Off
3	Off	20	2	100	1	Off	Off
4	Off	20	2	100	1	Off	Off
All		20	2	100	1	Off	Off
Sweep Delay		100	0				

3 Ch. P300 Settings.

3. Check Impedances

Press the **Imped** key on the Sierra Wave base unit. The impedance window displays a picture of the front of the amplifier.



Impedance window. Channel 4 is turned Off. CREF is turned ON for Channels 1 & 2 & 3.

The **Active** (black) and **Reference** (red) inputs are displayed for each channel as well as the **CREF** input (4 Channel Amplifier only). The **Ground** input is not included in impedance measurements.

If a Channel is turned Off, no impedance values will be calculated for either the active or reference inputs and the word "Off" is displayed over the inputs of that channel.

When the CREF input is enabled (i.e., ON) for a channel, that channel's reference input will not show an impedance value and will have the word "Off" over the reference input. An impedance value for the CREF input will be displayed.

Impedances less than 5k Ohms (kilo-ohms) are displayed in green. Values between 5.1 and 20 are displayed in yellow. Values greater than 20 are displayed in red.

To close the impedance window, press the **Imped key again** or click the **OK** button.



When performing evoked potential studies all impedances should be **less than 5k Ohms**.

4. Check Stimulator Settings

Clinical recordings of the P300 are generally performed using a binaural auditory tone stimulus, commonly referred to as the auditory odd-ball paradigm. Typically, two easily discriminable tones of different pitches are presented in random order.

One of the two tones occurs more often than the other and is designated the Common tone. The other tone is designated the Rare tone. This outline will assume that an auditory stimulus will be used for both the Common and Rare stimuli.

Apply the stimulator (headphones or inserts) to the patient, the red headphone/insert should be placed on the patient's right side, the blue headphone/insert should be placed on the left. Connect the stimulator to the back of the Sierra Wave base unit.

RepRate	0.97	Common Stim	Int	65	Rare Stim	Int	65
Rare %	20	Type	Audio	Freq	1000	Type	Audio
		Mode	Tone	Side	Bilateral	Mode	Tone
						Side	Bilateral

P300 Stimulator Controls Toolbar

Common Stim: These settings are used to configure the Common stimulus.

- **Type** - can be set to Audio, Visual, Electrical, or '.Wav' file. Audio is the default setting.
- **Mode** - can be set to Click, Pip 202, Pip 212, or Tone. Tone is the default setting and it is a 10-30-10 tone burst. It has a 10 millisecond rise time, a 30 millisecond plateau, and a 10 millisecond fall time.
- **Int** - sets the intensity of the common stimulus in nHL values. 65 dB is the default setting.
- **Frequency** - click here to select the frequency of the tone. The default setting is **1000** Hz.
- **Side** - can be set to Right, Left, or Bilateral. The default setting is Bilateral.

Rare Stim: These settings are used to configure the Rare stimulus.

- **Type** - can be set to Audio, Visual, Electrical, or '.Wav' file. Audio is the default setting.
- **Mode** - can be set to Click, Pip 202, Pip 212, or Tone. Tone is the default setting and it is a 10-30-10 tone burst. It has a 10 millisecond rise time, a 30 millisecond plateau, and a 10 millisecond fall time.
- **Int** - sets the intensity of the common stimulus in nHL values. 65 dB is the default setting.
- **Frequency** - click here to select the frequency of the tone. The default setting is **3000** Hz.
- **Side** - can be set to Right, Left, or Bilateral. The default setting is Bilateral.

RepRate: Click here to set the repetitive stimulus rate, in pulses per second (Hz). The default setting is 0.97.

Rare %: Click here to set the percentage of Rare stimuli that will be delivered. The default setting is 20 %.



To avoid excessive auditory stimulation, ensure that the stimulus intensity never exceeds 75 dB above the hearing threshold.

5. Verify Averager Settings

AvgCnt - The second number displayed here is the total number of stimuli (Common + Rare) that will be delivered. When this number is reached stimulation will automatically be stopped. The default is 200 (160 Common, 40 Rare).

Reject On / Off - When this feature is turned **On** the program will monitor the **Live** un-averaged data and will not include (i.e., will reject) high amplitude artifacts from the running average. During data acquisition the number of stimuli/sweeps that have been rejected for both the Common and Rare stimuli will be displayed on the screen.

Level - This is the reject sensitivity level, it is shown as a percentage of full amplifier scale. Choices are 30 to 100 % in increments of 5. 100% equals full scale, smaller numbers will make the reject more sensitive.

AvgCnt	0 / 200	Bank	AvgCnt	RejCnt
Reject	Off	Common	0	0
Level	95	Rare	0	0

P300 Default Averager Settings.



Reject is based on the **Live** un-averaged data and the **Amp Gain** setting. Every channel has 5 divisions above and below its initial baseline. So, if the Amp Gain is set to 10 uV/Div this means that the Live trace has an amplitude window of 100 microvolts (10 vertical divisions times 10 uV/Div) with 50 uV above the baseline and 50 uV below the baseline. If the reject level is set to 100% (i.e., full scale), then the amplitude of the live data must be below +/- 50 uV to be included in the running average. Should it exceed +/- 50 uV the trace will be rejected from the running average. If the reject level is set to 50% (i.e., half of full scale), then the amplitude of the Live data can't exceed +/- 25 uV (2.5 divisions above or below the baseline) or it will be rejected from the running average. The lower the reject level setting the more sensitive the program will be in rejecting large artifacts.



You can check the **Amp Gain** setting by pressing the **F1 (Avg / Live)** function key to switch to the **Live** mode. Press the function key again to return to the **Avg** mode and view the **Display Gain** setting.

6. Acquire Responses

A. Start Data Acquisition.

It is important that the patient attend to the stimuli. This is facilitated by having the patient keep a mental record of the number of Rare tones (i.e., higher pitched tones) that are presented during the test. Drowsiness should be avoided, as well as distracting noises.

Press the **Run/Stop key** to start stimulus delivery and data acquisition. The average count (**AvgCnt**) should start to increment and the traces will begin to take shape.

The P300 program has dual averager banks. The Common stimuli are averaged in the first averager bank and the corresponding traces are displayed in the left half of the trace window. The Rare stimuli are averaged in the second averager bank and the corresponding traces are displayed in the right half of the trace window.

Adjust the vertical size of the all traces by turning **Knob #4 (Gain)**. To adjust the gain of an individual trace, change the corresponding gain setting in the amplifier section of the **EP Controls window** or **Toolbar**.

Press the **F3 (Smooth)** function key during acquisition to remove high frequency noise from the active (white) traces.

B. Store the first trial.

When the Shutoff count is reached, stimulation will stop automatically. Press the **Store key** to store the active (white) traces. A copy of the active traces will appear on the screen and are displayed in a purple color.



The **Store key** can be pressed before the Shutoff count is reached. This will cause the currently active traces to be stored, the average count will be reset to zero, and stimulation will continue automatically on a new set of traces.

Ask the patient how many Rare stimuli they counted. Compare this with the number shown in the AvgCnt column.

C. Clear the Average Count.

Press the **Clear key** to reset the average count (AvgCnt) back to zero. The active (white) traces will be reset to flat lines.

D. Acquire a second Trial

Press the **Run/Stop key** to start stimulus delivery and data acquisition again.

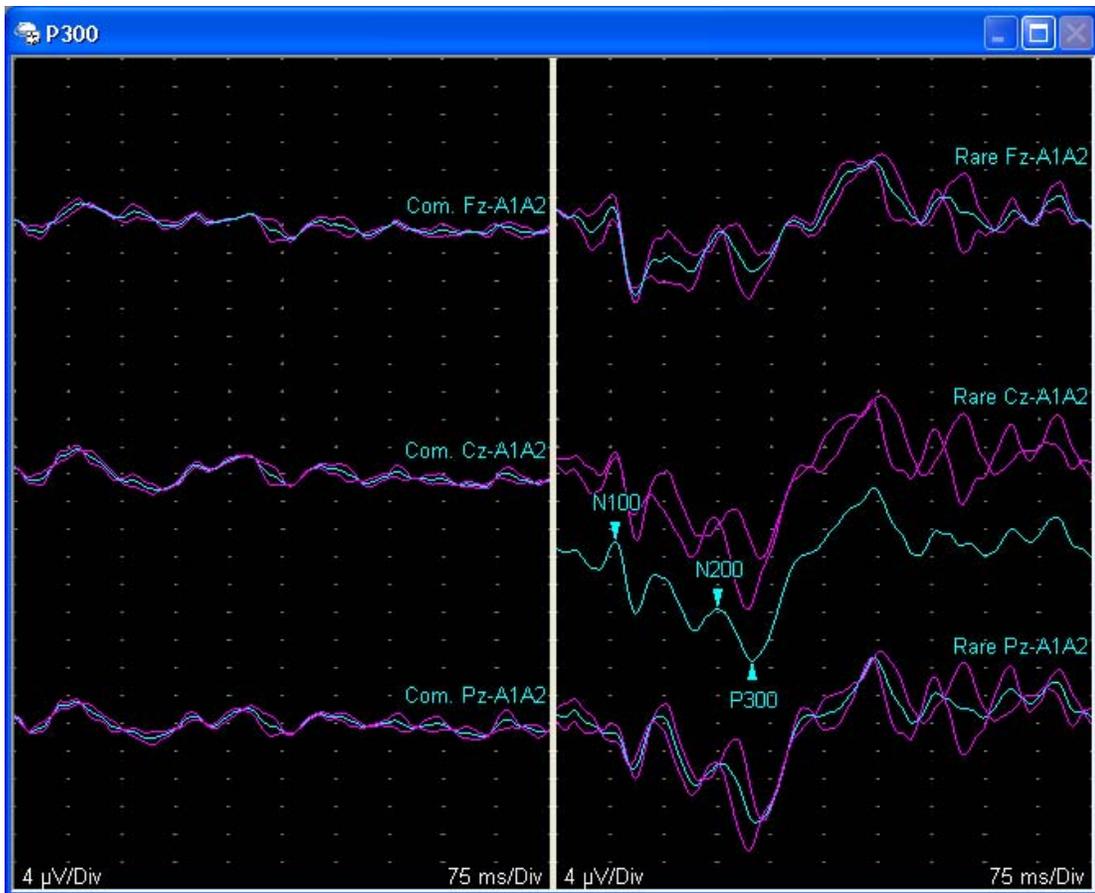
Generally, two trials should always be acquired when performing evoked potentials to show replication of the traces. Again, ask the patient to count the Rare stimuli.

E. Store second trial and Clear.

After the Shutoff count is reached for the second trial, press the **Store key** to store the active (white) traces. Press the **Clear key** to reset the average count to zero.

F. Perform a Grand Average (Optional)

Press the **F7 (Grand Avg)** function key. Performing a Grand Average can enhance the principle peaks. A 'blue' trace, representing the grand average of all traces acquired from that channel, will be shown for each channel in the montage.



Example 3 Channel P300. Cursors have been placed on the Grand Average trace for the Cz-A1A2 channel.

7. Trace Positioning (optional)

If the position of the traces needs to be adjusted, follow one of these procedures.

- **Using the Mouse** - simply **click on the Trace you want to move with the left mouse button** and drag the trace to its new location.
- **Using the Knobs** - press the **F6 (Position)** function key on the PC's keyboard. The program's knob and function keys will change to reflect the position mode controls. Use **Knob #1 (Sel Trace / Move)** to select and move traces.

When positioning is completed, press the **F6 (Position)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Position mode.

- **Using the Trace Position Settings** - right-click the mouse over the Trace window and select **Trace Position Settings** from the pop-up menu. Change the settings for **Start Position**, **Trial Offset**, and **Channel Offset** and click **OK**.

8. Place Auto Cursors

To place Cursors on the important trace features, follow one of these procedures.

- **Using the Mouse** - simply **left-click on a trace to select it**, the trace will be displayed in yellow. Now, **right-click** the mouse and select **Auto Place Cursors** from the pop-up menu. Cursors will be placed on the selected trace and the values (latency, amplitude, etc.) derived from the cursors will be displayed in the **EP Cursor Table** window.
- **Using the Knobs** - press the **F5 (Cursor) function key** of the PC's keyboard. The program's knob and function keys will change to reflect the cursor mode controls. Use **Knob #3 (Sel Trace)** to select a trace, when selected the trace will be displayed in yellow. Once the appropriate trace is selected, press the **F2 (AutoPlace Cursors) function key** and cursors will be placed on the selected trace. The values (latency, amplitude, etc.) derived from the cursors will be displayed in the **EP Cursor Table** window.

After cursors have been placed, press the **F5 (Cursor)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Cursor mode.



For information on configuring the Auto Cursors, see the P300 Test Setup topic.

To Adjust the positions of the Cursors, follow one of these procedures.

- **Using the Mouse** - simply click on the Cursor you want to move with the left mouse button and drag the cursor along the trace to its new location.
- **Using the Knobs** - press the **F5 (Cursor) function key** of the PC's keyboard. The program's knob and function keys will change to reflect the cursor mode controls. Use **Knob #3 (Sel Trace)** to select the trace with the cursors you need to adjust, when selected the trace will be displayed in yellow. Once the appropriate trace is selected, use **Knob #1 (Sel Cursor / Move)** to select and move the desired cursor.

After cursor positions have been adjusted, press the **F5 (Cursor)** function key again or press the **OK** key on the Sierra Wave base unit to exit from Cursor mode.

Trace	N100 (ms)	N200 (ms)	P300 (ms)	N200-P300 (µV)
Rare Cz-A1A2 GAvg	81.3	225.0	273.4	7.48

P300 cursor table example.



Depending on your preferences in System Setup, abnormal values can be flagged with a red background color, as bold text, as bold text with an asterisk, or as bold text & background color red.

9. TabData (optional)

To view a Summary window of all the tests done on the patient, press the **F4 (TabData)** function key on the **Sierra Wave base unit**.

The left hand side of the **TabData** window shows all the tests that were performed on the patient. It also has entries for Summary Tables (i.e., Motor Summary table, Anti Sensory table, Muscle Scoring table).

To view the results for an individual test:

Highlight the test by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the test with the mouse. The selected test's traces and cursor information will be displayed on the right hand side of the window.

To view a Summary Table:

Highlight the table by turning **Knob #1 (Select / Open)** on the **Sierra Wave base unit** or by clicking on the Summary Table with the mouse. The selected table will be displayed on the right hand side of the window.

To print a Report:

Click on one of the report buttons at the bottom of the TabData window, or press the corresponding function key on the **Sierra Wave base unit**.

10. Next Test

To change Test Protocols:

- Use **Knob #1 (Study Item / Site)** to highlight another Test Protocol in the **Study** window.
- **Click** on another Test Protocol in the **Study** window using the **mouse**.

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- **Press the **Select** key on the **Sierra Wave base unit** and select a Test Protocol from the **Study/Test** menu.**

The TabData Window

The **TabData** window provides an overview of all tests completed on the patient as well as summary tables for test protocols such as NCV, F/H, and EMG. An optional Sentence Generator is available to create sentences describing the EMG and NCV results.

To open the TabData window press the **F4 (TabData)** function key from within any test protocol or select TabData from the **View** menu.

Completed test protocols are listed down the left-hand side of the window. To select a test protocol or summary table perform one of the following actions.

- Turn **Knob #1 (Select / Open)** to move the blue highlight to the desired test protocol or table.
- **Click the left mouse** button on the test protocol or table.

The highlighted entry's results are displayed on the right-hand side of the TabData window.

The screenshot shows the TabData window with the following content:

Motor Summary Table

Site	NR	Onset (ms)	Norm Onset (ms)	O-P Amp (mV)	Norm O-P Amp	Site1	Site2	Delta-0 (ms)	Dist (cm)	Vel (m/s)	Norm Vel (m/s)
Left Median Motor (Abd Poll Brev)											
Wrist		3.4	<4.2	12.2	>5	Elbow	Wrist	5.7	30.0	53	>50
Elbow		9.1		12.0		Axilla	Elbow	2.3	12.0	52	
Axilla		11.4		12.9							
Right Median Motor (Abd Poll Brev)											
Wrist		4.5	<4.2	9.5	>5	Elbow	Wrist	5.2	28.0	54	>50
Elbow		9.7		9.8		Axilla	Elbow	2.2	12.0	55	
Axilla		11.9		9.9							
Right Ulnar Motor (Abd Dig Minimi)											
Wrist		3.0	<4.2	5.5	>3	B Elbow	Wrist	4.5	25.0	56	>53
B Elbow		7.5		6.2		A Elbow	B Elbow	2.7	15.0	56	>53
A Elbow		10.2		5.0							

Anti Sensory Summary Table

Site	NR	Peak (ms)	Norm Peak (ms)	P-T Amp (µV)	Norm P-T Amp	Site1	Site2	Delta-P (ms)	Dist (cm)	Vel (m/s)	Norm Vel (m/s)
Left Median Anti Sensory (2nd Digit)											
Wrist		3.8	<3.6	35.8	>10	Wrist	2nd Digit	3.8	14.0	37	>39
Right Median Anti Sensory (2nd Digit)											
Wrist		4.2	<3.6	29.3	>10	Wrist	2nd Digit	4.2	14.0	33	>39
Right Ulnar Anti Sensory (5th Digit)											
Wrist		3.5	<3.7	54.4	>15.0	Wrist	5th Digit	3.5	14.0	40	>38

NCV, F, H Sentence

Evaluation of the right median motor nerve showed prolonged distal onset latency (4.5 ms). The left median sensory and the right median sensory nerves showed prolonged distal peak latency (L3.8, R4.2 ms) and decreased conduction velocity (Wrist-2nd Digit, L37, R33 m/s). All remaining nerves (as indicated in the following tables) were within normal limits. Left vs. Right side comparison data for the median motor nerve indicates abnormal L-R latency difference (1.1 ms). The median sensory nerve indicates abnormal L-R latency difference (0.4 ms).

All F Wave latencies were within normal limits. All F Wave left vs. right side latency differences were within normal limits.

Change Columns ...

Sentence Setup

Reports

F2 - Menu F3 - Full Report with S... Report Options Swap Sides Open Test F4 - Close

TabData window with All NCV summary tables selected.

Actions that can be performed in the TabData window:

Adjusting Auto Cursor Positions

Begin by highlighting an individual test protocol, such as Right Median Motor. The test's traces and cursor table will be displayed on the right-hand side of the window.

Click on a cursor using the left mouse button and drag it along the trace to its new location. The information in the cursor table will be updated to reflect the new position.

Trace Context (pop-up) Menu

Whenever traces are displayed in the right-hand side of the TabData window you can right-click the mouse over the trace area to display the same context menu that is available during data acquisition.

Use this context menu to delete traces, smooth traces, etc.

Change Muscle Scoring

If an EMG Muscle Scoring Table is selected you can change the muscle scoring selections for a muscle simply by clicking with the left mouse button within the table.

Sorting Muscle Scoring Table

If an EMG Muscle Scoring Table is selected you can click the mouse at the top of any of the table's columns to sort the table according to that column's information.

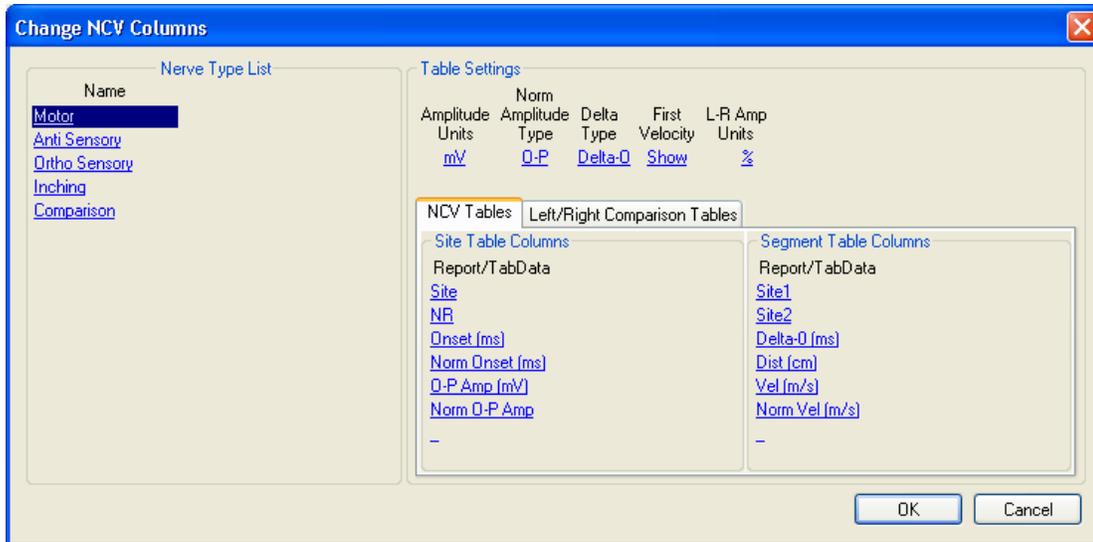
To reverse the sorting, right-click the mouse over the muscle scoring table and select "Original Sort Order" from the pop-up menu.

NCV Column Setup

When a NCV Summary table or individual nerve test protocol is selected the **Change Columns** button is available.

Clicking on **Change Columns** allows you to specify how the NCV results will be shown in your reports. *This does not change how the results are displayed during data acquisition.*

Click on the nerve type you want to change. To include information in reports, click at the bottom of the displayed column, or within the column, and then select **Insert** from the pop-up menu. Select the value you want to include in the report from the displayed list of choices. To remove information in reports, click on the value displayed in the column, then select **Delete** from the pop-up menu.



NCV - Change Columns window.

Swap Sides

When an individual NCV, F Wave, or H Reflex test protocol is selected the **Swap Side** button can be used to swap the side parameter of the selected test.



If the side you are swapping to doesn't already exist within the Study window, then that nerve will automatically be added.



If the side you are swapping to already has stored traces, then a second run will be automatically added to that existing nerve.

Override an Abnormal Value

When an individual test protocol is selected you can **right click** over an abnormal value and then select **Set As Normal** from the pop-up menu. The abnormal value flag will be removed from that value. To reset the abnormal value flag, right click over the value a second time and click on Set As Normal to remove the check mark.

Left Median Motor (Abd Poll Brev)						
Site	NR	Onset (ms)	Norm Onset (ms)	O-P* Amp (mV)	Norm O-P Amp	Neg Dur (ms)
Wrist	-	12.0	12.0	15.5	>5	5.31
Elbow	-					6.41
Axilla	-	12.0				6.41

Assign an Abnormal Severity Meaning

If you have the optional integrated sentence generator enabled, you can right click over an abnormal value to display a list of possible meanings. An asterisk indicates

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the sentence generator's currently assigned default meaning for the value. You can override the default meaning by selecting one of the additional meanings from the list.

Right Median Motor (Abd Poll Brev)											
Site	NR	Onset (ms)	Norm Onset (ms)	O-P Amp (mV)	Norm O-P Amp	Site1	Site2	Delta-0 (ms)	Dist (cm)	Vel (m/s)	Norm Vel (m/s)
Wrist	-	4.2	4.2	1.0	1.0	FL	VL	5.5	28.5	51	>50
Elbow	-	9.1	9.1	1.0	1.0	FL	VL	2.2	12.0	54	-
Axilla	-	12.1	12.1	1.0	1.0	FL	VL				

Playback an EMG Buffer

When a stored EMG Buffer is selected, the compressed buffer trace will be shown in the right hand portion of the TabData window. Use the playback controls to replay the buffer without having to open the EMG test protocol.

View the Custom Fields from the Patient Information window

Clicking on the **Patient Info / Report** node will display the custom fields from the patient information window as well as the findings sentences (if enabled). If a QuickReport Item has been assigned to a custom field, it can be processed in this view. For more information on using custom fields, click here.

Print a Report

Two buttons, representing the Print and Report keys on the Sierra Wave base unit, are displayed at the bottom of the TabData window. The name of the report template that is currently assigned to these buttons is displayed as the button's label.

To initiate a report.

- **Click** on one of these two buttons with the mouse.
- Press the **F2** or **F3** function keys.
- Press the **Print** or **Report** keys on the Sierra Wave base unit.

Change Report Options

The Report Options button allows you to remove some elements from generated reports without removing them from the data acquisition screen or the TabData Summary view.

- **Flag Abnormals in Reports** - when this box is checked abnormal values will be indicated in reports, usually as red colored boxes or bolded numbers.

- **Show Comments (NCV, F, H)** - when this box is checked comments entered during NCV, F Wave, or H Reflex data acquisition will be displayed in the data tables of generated reports.
- **Show Norm Columns (NCV, F, H)** - when this box is checked the normal value columns for NCV, F Wave, and H Reflex tests will be included in the data tables of generated reports.
- **Show Column Header Shading** - when this box is checked the column headings at the top of each table are shaded gray.
- **Show Outside Table Lines** - when this box is checked a line is drawn between each nerve and a box is drawn around the entire table. If this box is unchecked, only the column heading row will remain underlined.

Open a Test Protocol

To open a test protocol and display the acquisition screen (this would be necessary to re-stimulate or collect additional traces).

- Highlight the test protocol by turning **Knob #1 (Select / Open)** and then **press** to open.
- Highlight the test protocol and then click the **Open Test** button.
- **Double click** on the test protocol with the mouse.

Close the TabData window

To close the TabData window and return to the previous test protocol screen.

- Click on the **F4 (Close) button**.
- Press the **F4 (Close) function key** on the Sierra Wave base unit.
- Click on the TabData window's **red X**  .

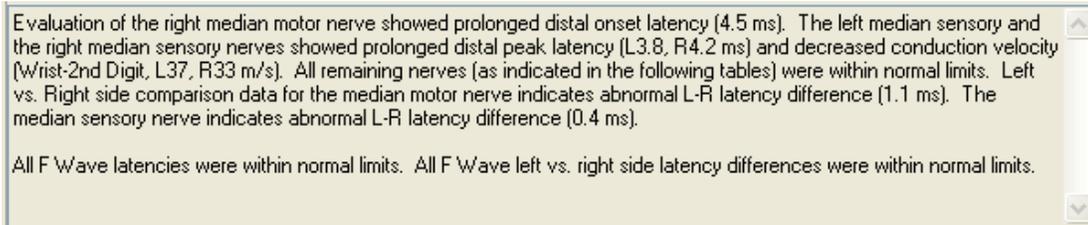
Integrated Sentence Generator for Findings:

The TabData window features an optional Sentence Generator which can build findings sentences to describe NCV, F Wave, H-Reflex, EMG, and EP data.

To Enable the Sentence Generator:

- Start the Sierra Wave program.
- Select **System Setup** from the **Edit** menu.
- Place a check mark in the box labeled "**Show Sentence Generator in TabData**".
- Click **OK**.

When an NCV, F Wave, or H-Reflex table node is highlighted in the TabData window, the findings sentences for those test protocols will be displayed below the summary tables.

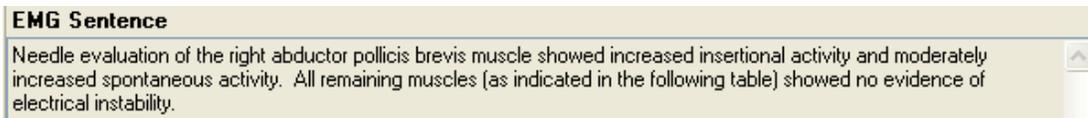


Evaluation of the right median motor nerve showed prolonged distal onset latency (4.5 ms). The left median sensory and the right median sensory nerves showed prolonged distal peak latency (L3.8, R4.2 ms) and decreased conduction velocity (Wrist-2nd Digit, L37, R33 m/s). All remaining nerves (as indicated in the following tables) were within normal limits. Left vs. Right side comparison data for the median motor nerve indicates abnormal L-R latency difference (1.1 ms). The median sensory nerve indicates abnormal L-R latency difference (0.4 ms).

All F Wave latencies were within normal limits. All F Wave left vs. right side latency differences were within normal limits.

NCV, F, H findings sentences.

When the EMG Scoring Table is highlighted in the TabData window, the findings sentences for the muscle scoring will be displayed below the scoring table.

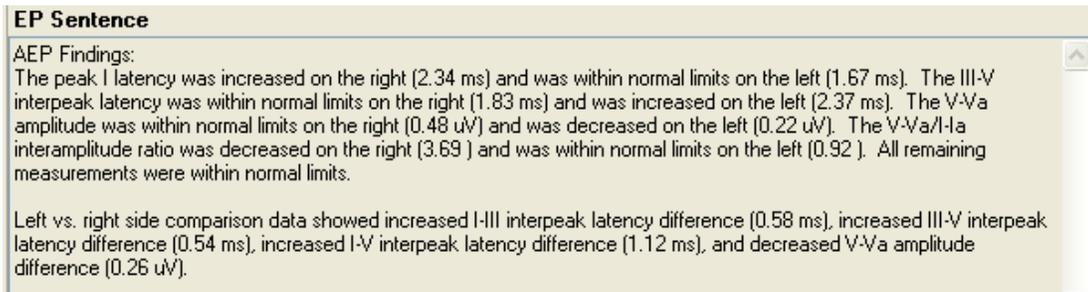


EMG Sentence

Needle evaluation of the right abductor pollicis brevis muscle showed increased insertional activity and moderately increased spontaneous activity. All remaining muscles (as indicated in the following table) showed no evidence of electrical instability.

EMG findings sentences.

When an EP node is highlighted in the TabData window, the findings sentences for that evoked potential protocol will be displayed below the summary tables.



EP Sentence

AEP Findings:
The peak I latency was increased on the right (2.34 ms) and was within normal limits on the left (1.67 ms). The III-V interpeak latency was within normal limits on the right (1.83 ms) and was increased on the left (2.37 ms). The V-Va amplitude was within normal limits on the right (0.48 uV) and was decreased on the left (0.22 uV). The V-Va/I-Ia interamplitude ratio was decreased on the right (3.69) and was within normal limits on the left (0.92). All remaining measurements were within normal limits.

Left vs. right side comparison data showed increased I-III interpeak latency difference (0.58 ms), increased III-V interpeak latency difference (0.54 ms), increased I-V interpeak latency difference (1.12 ms), and decreased V-Va amplitude difference (0.26 uV).

AEP findings sentences.

Generating A Report

The Sierra Wave uses a separate program for report generation, this program is called **QuickReport**.

To initiate a report you must select a template from within the Sierra Wave program. Once a template is selected the QuickReport program will start automatically.



QuickReport is a Microsoft Word™ based application and includes such Word features as spell check, grammar check, table formatting, and graphics support.



QuickReport can be run stand-alone to edit and create the report templates used by the program.

To Select a Report Template

From within the TabData window:

- **Click** on **one of the two report buttons** shown within the TabData window. The buttons are labeled with the name of the template currently assigned to them.
- **Press** either the **Print** or **Report** key on the Sierra Wave base unit.

From within a Test Protocol screen:

- **Press** either the **Print** or **Report** key on the Sierra Wave base unit.
- Use the program's **File Menu** to select one of the following.

Launch QuickReport & Select Template - this will start the QuickReport program and allow you to select any report template available on the system.

Print "*Template Name*" for Print key - the template name currently assigned to the Print key on the Sierra Wave base unit is displayed here. Clicking this entry will select this template and start QuickReport.

Print "*Template Name*" for Report key - the template name currently assigned to the Report key on the Sierra Wave base unit is displayed here. Clicking this entry will select this template and start QuickReport.

Description of the Factory Default Report Templates

Current Test - use this template to print the results for the individual Test Protocol that is currently displayed on the screen. For example, use this to print the results

for a single NCV nerve test or a single Evoked Potential test. It also includes the Chief Complaints, Medications, Physical Exam / History, and Impression custom fields from the Patient Information window.

Full Report (manual Findings) - this template includes all the test protocols within the TabData window (tables & traces). It also includes the Chief Complaints, Medications, Physical Exam / History, Impression, and Recommendation custom fields from the Patient Information window as well as an interactive Findings item for manual creation of findings sentences.

Full Report with DataLAB - this template includes all the test protocols within the TabData window (tables & traces). It also includes the Chief Complaints, Medications, Physical Exam / History, Impression, and Recommendation custom fields from the Patient Information window. A Findings section automatically imports the text from the Sentence Generator feature of the TabData window. The results of the DataLAB feature are also included in this report.

Full Report with Sentence Gen - this template includes all the test protocols within the TabData window (tables & traces). It also includes the Chief Complaints, Medications, Physical Exam / History, Impression, and Recommendation custom fields from the Patient Information window. A Findings section automatically imports the text from the Sentence Generator feature of the TabData window.

Full Report with SG and AV - this template includes all the test protocols within the TabData window (tables & traces). It also includes the Chief Complaints, Medications, Physical Exam / History, Impression, and Recommendation custom fields from the Patient Information window. A Findings section automatically imports the text from the Sentence Generator feature of the TabData window. The AnatomyVIEW graphic is also included in this report.

Injection Report - this template to print the injection log table from the EMG Guidance protocol. It also includes an injection diagnosis and procedure code table.

MMUA Report - this template includes the summary tables and MUP waveforms from Multi-Motor Unit Analysis. It also includes the Chief Complaints, Medications, Physical Exam / History, Impression, and Recommendation custom fields from the Patient Information window.

TabData w/ Traces - this template includes all the test protocols within the TabData window (tables & traces). It also includes the Chief Complaints, Medications, Physical Exam / History, Impression, and Recommendation custom fields from the Patient Information window.

TabData w/o Traces - this template includes all the test protocols within the TabData window (tables only). It also includes the Chief Complaints, Medications, Physical Exam / History, Impression, and Recommendation custom fields from the Patient Information window.

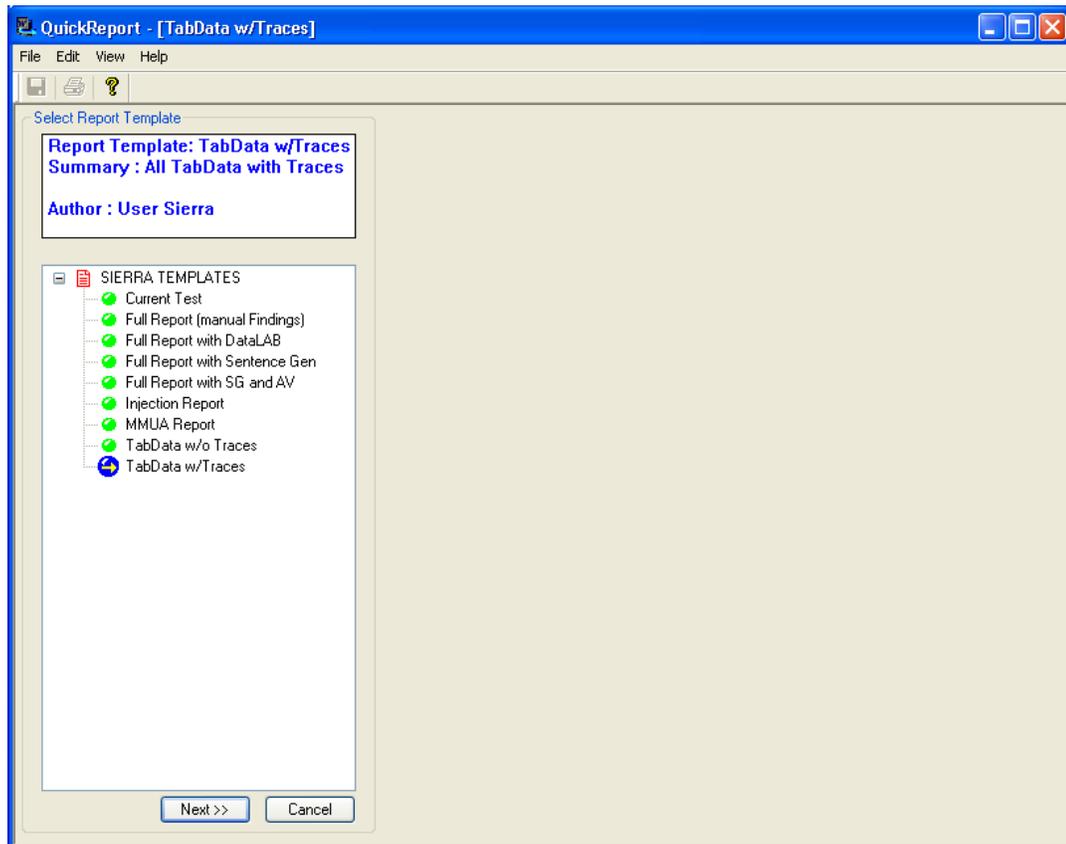
Overview of QuickReport

QuickReport has **three main views**.

Select Report - the program will go to this view if you select "Launch QuickReport & Select Template" from the Sierra Wave's file menu. This view allows you to choose any template on the system. This view is initially displayed if you start QuickReport outside of the Sierra Wave program. To select a template, either double click on it or single click on it and then click the Next button.

Fill In Report - the program will go to this view if you select a report template that requires user input. For example, the "Full Report (manual Findings)" template will go directly to this view so that the user can make manual selections for the Findings section of the report.

Document - this view shows the generated report in Word format. The program will automatically go to this view if you select a report template that does not require any user input, the "Current Test", "TabData w/ Traces", and "TabData w/o Traces" templates are examples. The program will also switch to this view when all selections are complete on the Fill In Report view.



QuickReport - Select Report view.

To Print the Report

From the **Document** view,

- click on the **Printer icon**  at the top of the screen. The report will be sent to your default printer.
- select **Print** from the **File menu**.

To Save the Report

From the **Document** view,

- click the **Finish** button, you will be prompted to save the report.
- click on the **Diskette icon** .
- select **Save** from the **File menu**.

The report is saved to the user's Data directory with the filename of "*lastname, firstname, date, time.doc*".

To Close QuickReport

From the **Document** view,

- select **Exit** from the **File menu**.
- click the **Finish** button at the bottom left of the screen.
- click the **Red X**  in the top right-hand corner.

If the report has not been saved the program will ask you if you would like to save the report before exiting.



To get a simple printout of the current test screen, select **Print Screen** from the Sierra Wave **File** menu.



For more detailed information on QuickReport and report templates, see the Help Topics from within the QuickReport program.

Closing the Patient Exam

To close the patient's exam, click on the **File menu** and select **Close Exam**.

- The program will automatically display the **Patient Information** window if you did not enter a **Last Name** for the patient prior to starting the exam. Enter the Last Name in the Patient Information window and click **F3-OK** to close the exam.

 You can also click on the **red X**  in the upper right hand corner. This will close the patient's exam first, then the Sierra Wave program will be exited.

Closing the Sierra Wave Program

To close the Sierra Wave program.

- Click on the **File menu** and select **Exit**.

OR,

- Click on the **red X**  in the upper right hand corner of the screen.

 The program will automatically display the **Patient Information** window if you did not enter a **Last Name** for the patient prior to starting the exam. Enter the Last Name in the Patient Information window and click **F3-OK** to close the exam. The Sierra Wave program will then close immediately after this.