SCAN 4.3 - Vol. I

Installation and Orientation: The Neuroscan Systems

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For Technical Support.....

If you have any questions or problems, please contact Technical Support through any of the following routes.

If you live outside the USA or Canada, and purchased your system through one of our international distributors, please contact the **distributor** first, especially if your system is under warranty.

In all other cases, please use **techsup@neuro.com**, or see the other Support options on our web site (*http://www.neuro.com*).

Or, if you live in the USA or Canada, please call **1-800 474-7875**. International callers should use **915-845-5600, ext 324**.

For Sales related questions, please contact your local distributor, or contact us at **sales@neuro.com**.

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Installation and Orientation: The Neuroscan Systems

The purposes of this introduction are (1) to familiarize you with the basic equipment components of the Neuroscan systems, (2) provide installation directions, (3) to give an overview of the software modules and their functions, and (4) take you step by step through the setups for a sample study. Some of this information (3 and 4) is a simplified version of that presented in the various manuals. It is not meant to replace the need for you to acquaint yourself with the information in the manuals; rather, it is intended to provide a quick introduction to the system.

We believe that the Neuroscan systems are the best systems available in terms of *flexibility* in data acquisition and analysis, as well as the *reliability* of the data that is obtained. Hand-in-hand with the increased flexibility and reliability is increased *complexity*. We realize that first time users are eager to "get up and running", and that wading through several manuals beforehand is probably the last thing that you want to do or will do. The large variety of options available with the complete Neuroscan systems, however, necessitates lengthy documentation. As a partial compromise, we have developed these pages to familiarize you with the more prominent aspects of the hardware and software in the Neuroscan systems.

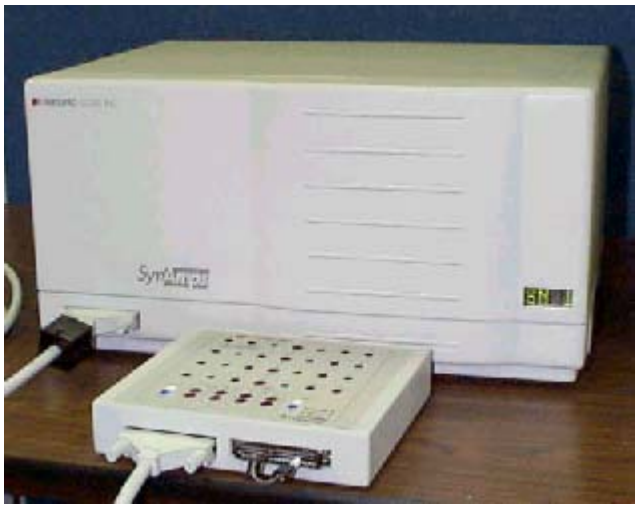
The Basic System Components

Most electrophysiological systems are comprised of three main components: stimulus presentation, signal amplification and digitization, and data acquisition and analysis.

I. *Stimulus presentation unit*. Neuroscan provides STIM as a flexible unit for stimulus presentation, although we can interface with other stimulation software.

STIM PC, Audio System, and Response Pad

II. *Signal amplification and digitization*. The bioelectric signals that are recorded from the surface of the body are small, in terms of voltage, and require considerable amplification on the order of, for example, 20,000 times (non-SynAmps systems). Neuroscan will supply SynAmps, SynAmps^2, or NuAmps



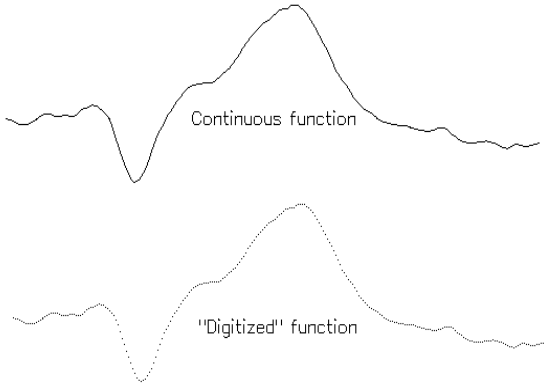
SynAmps

NuAmps

SynAmps^2

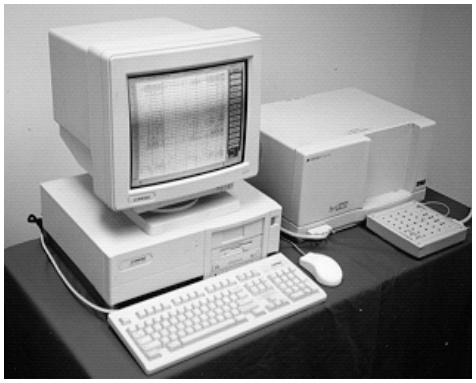
for amplification. EEG activity from the head is *analog,* that is, in the form of a continuous, oscillating function. The analog output must first be *digitized*, or converted to a digital format that the PC can recognize and process. The analog-to-digital, or A-to-D, or A/D, conversion essentially consists of converting the continuous, oscillating function to a series of discrete points that approximate the

original function. Each point may be expressed as an ordered pair of numbers (x,y), where x is voltage (positive or negative), and y is time (usually milliseconds



before or after a defined zero point, such as the point of stimulation). An A/D card accomplishes the A/D conversion. This function resides within the SynAmps, SynAmps^2, or NuAmps units.

III. *Data acquisition and analysis*. The digitized signals are received by the SCAN system.

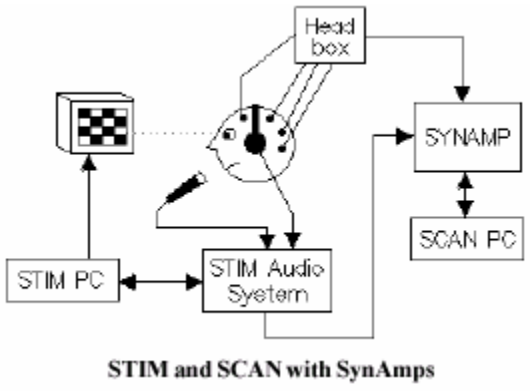


SCAN PC and SynAmps

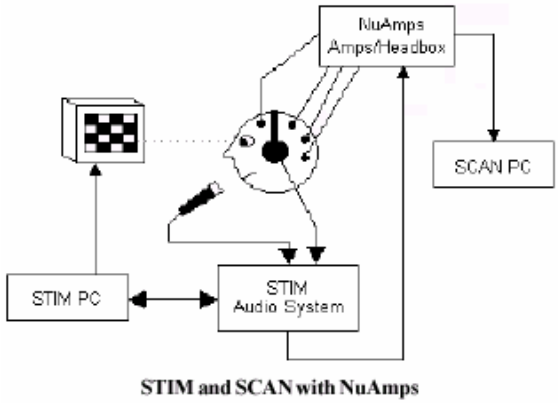
Recordings may be stored in several formats, depending on your needs. If desired, the entire raw data file may be stored for offline analysis. The analysis options typically consist of artifact removal or minimization, averaging, statistical comparisons, graphic display of the results, and so forth.

Common Configurations

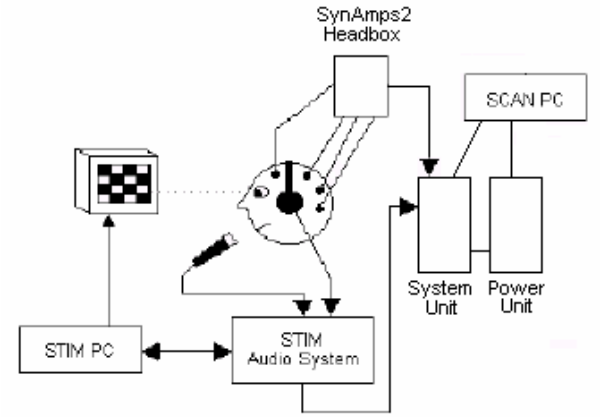
The following diagrams illustrate the most common configurations of systems. The first shows the configuration with the SCAN and STIM systems, with a SynAmps. The second shows SCAN and STIM with NuAmps (the amplifiers and headbox are in the same unit). The third shows SCAN and STIM with SynAmps^2 (the amplifiers and headbox are also in the same unit).



STIM and SCAN with SynAmps



STIM and SCAN with NuAmps



STIM and SCAN with SynAmps2

Some Do's and Don'ts - these are a few of the more common initial mistakes that users have been prone to make.

Do make sure that you have the power cords of all components of the system plugged into the isolation transformer, described below.

Do make sure that the room in which you will be obtaining the recordings has been inspected by a qualified electrician ***before*** you begin collecting data from subjects. All outlets should be grounded, and an electrician should verify that the ground is a true earth ground. If you are using more that one wall plug, the electrician should verify that these have a common ground. ***Failure to use this equipment in an electrically safe environment could put the subjects at risk for physical injury.*** A faulty ground may introduce 50 or 60Hz line noise.

Do make sure you are grounded (to discharge static electricity) when you open your PC to install the cards, and that the PC is off. A static charge may damage the card. If you are uncertain about grounding, please consult with someone in your Computer Department.

Don't connect any other device that is connected to the subject (such as some form of psychophysiological transducer) to the SynAmps amplifiers (unless you have a specially modified SynAmps). Contact the Neuroscan Technical Center regarding other devices that you wish to connect.

Don't turn the SynAmps amplifiers OFF and then ON too quickly. Wait at least 20 seconds after turning SynAmps OFF before turning the unit back ON. Turning the amplifiers ON too soon could damage the unit, necessitating its return to Neuroscan for repair.

Don't unplug the SynAmps headbox from the SynAmps unit if the SynAmps unit is ON.

Don't unplug the SCSI cable unless both the SynAmps and the PC are OFF. The SCSI card may be damaged. The only things that may be connected and disconnected safely while the units are ON are the jumpers, the shorting plug for the head box, and the electrodes or electrode cap.

Don't disconnect either end of the USB cable with NuAmps *during acquisition*.

Do let the SynAmps(s) boot fully to SN1 (SN2, SN3, etc.) before turning on the SCAN PC.

Do turn the STIM Audio System unit on before turning on the STIM PC.

Do set the STIM PC to boot directly to Windows (as is normally the case), DO install the SoundBlaster in Windows, and DO run STIM from an icon created in Windows95/98.

Don't short unused jacks to GROUND on the SynAmps headbox (could create increased electrical noise) - short unused channels to REF. (Unused jacks should be shorted to ground for bench testing; refer to the relevant Appendices in the SynAmps manual).

Don't use SOUND stimuli in excess of 100dB unless you have tested for loudness first (to avoid injury to the ears and/or headphones). It is best to start with lower dB levels and go up.

Do read the parts of the manuals that pertain to your applications. Tutorials and other examples have been included at several places in the manuals. Reading these is the quickest way to become familiar with the more common capabilities of the system. Note that while the tutorials in ACQUIRE may include specific modalities, such as SEPs, ABRs, etc., the procedural information has any number of other applications (i.e., read them all).

Don't install SCAN 4.3 in the same directory in which you have SCAN 4.0, 4.1 or 4.2.

Do make pilot recordings and perform all analyses before you start collecting actual data to make sure that you will be able to analyze the data in the way you desire.

Do make a copy of all the data you collect. Work with a copy and save the original version.

Hardware Installation Guide

STIM Hardware and Software Installation

Directions for the STIM hardware and software installation are found in the beginning of the STIM manual and are not repeated here.

Isolation Transformer (or Power Unit)

With all new SynAmps and NuAmps, systems you will receive one (or more) Isolation Transformers. With SynAmps^2, the Power Unit serves the same function. All Neuroscan equipment, and any other devices connected to the Neuroscan equipment, should be plugged into the transformer(s). The transformer(s) should be plugged into the wall receptacle. It is permissible to plug a power strip into the transformer to allow enough sockets for all the power cords. However, **DO NOT EXCEED THE AMPERAGE SHOWN ON THE TRANSFORMER**. If the amperage is exceeded it is possible to blow out the fuse in the transformer, or to cause internal damage to the transformer. If you do not know how to compute the amperage of your devices, please contact Technical Support.

DO NOT USE THE TRANSFORMER POWER SWITCH OR ANY ATTACHED POWER STRIP SWITCHES TO TURN ON THE NEUROSCAN COMPONENTS. Turn the components on individually using their own power switches. This is to avoid the amperage pull on the transformer encountered when most devices are powered up. If the amperage is exceeded it is possible to blow out the fuse in the transformer, or to cause internal damage to the transformer.

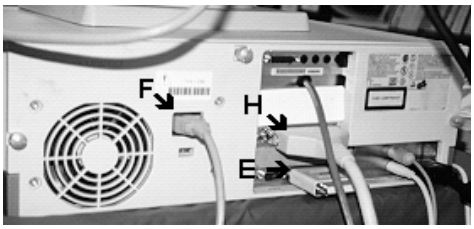
DO NOT PLUG OTHER DEVICES NOT USED WITH THE NEUROSCAN SYSTEM INTO THE TRANSFORMER.

If you add components to your original Neuroscan system, **DO NOT PLUG THEM INTO THE TRANSFORMER** without determining their additive amperage. If you have any questions, please contact Technical Support.

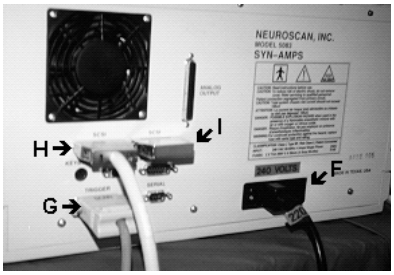
SCAN Hardware Installation

SCAN PC, with a SYNAMPS. If you have a SynAmps, you will have received an Adaptec SCSI Host Adapter card for the SCAN PC.

This is the card that communicates with the SynAmps. Turn the SCAN PC off, ground yourself to discharge any static electricity, and install the card securely in a free PCI slot. With the SynAmps off, connect the SCSI cable between the SynAmps and the Adaptec card, using the SCSI2 to SCSI2 cable (see also the SynAmps manual for more details regarding the SynAmps). Plug the SCSI terminator into the free SCSI connector on the back of the SynAmps - it doesn't matter which connector has the terminator and which has the SCSI cable. *If you have more than one SynAmps, refer to the SynAmps manual for additional connections between the SynAmps*. If you have STIM, plug the STIM-to-SCAN cable (SCAN end) into the Trigger connector on the back of the SynAmps. Connect the head box to the head box cable, and the other end of the head box cable to the front of the SynAmps. The various cable connections are shown in the figures below. Turn the SynAmps on and let it boot to SN1. If it displays SCSI instead of SN1, that is OK. Then turn the SCAN PC on.



SCAN PC



SynAmps

E. Software key (or "dongle"). Newer ones attach to the USB port.

F. Power cable

G. STIM-to-SCAN cable from the STIM Audio System to, in this example, the back of the SynAmps.

H. SCSI cable from back of SynAmps to the SCSI controller card (Adaptec) in the SCAN PC (the picture shows an older Adaptec with a SCSI1 connector - current ones have a SCSI2 connector, as on the SynAmps).

I. SCSI terminator (must be installed on open connector; either connector may be used for the SCSI connector and terminator).

For SynAmps users: always make sure the SynAmps(s) are turned ON and that SN1 (and SN2, SN3, etc.) appears BEFORE you boot the SCAN PC.

Installing the SCSI driver. SCSI adapter cards may change pending availability, and the installation of their software may vary. The Adaptec 2930CU is the current version being used. You will need to install the driver for it. For Windows 2000, the correct driver is **w2ksynamp.sys**. It may or may not be included with the version of Windows you have, but you will receive an Adaptec floppy disk or CD with the driver included.

To install the driver, go first into the Device Manager. For 2000, go to the Control Panel, then click the System icon. Select Hardware, and then see the Device Manager.

In the Device Manager, see the "SCSI controllers" line. Under it you should see the Adaptec SCSI adapter. Highlight that line, and then click the Properties button. Then select the "Drivers" tab, and click the "Update Drivers" button. Follow the directions, and let Windows search for the best driver. If necessary, direct the search to the Adaptec floppy or CD, and verify that the **w2ksynamp.sys** file has been selected (for 2000). Windows should find, register, and install the correct driver. For XP, use the **WHAT** file.

Alternatively, when you reboot the computer after installing the Adaptec card, you may get a message saying that the new hardware was found, and asking if you want to install the software for it. Say yes and follow the directions, directing the search to the Adaptec floppy, if needed.

***SCAN PC, with SynAmps²*.** If you purchased SynAmps² amplifiers, please follow the instructions in the SynAmps² manual for the hardware installation. The installation of the SCAN SW is the same as that described below.

SCAN PC, with NuAmps. If you purchased NuAmps amplifiers, please follow the instructions in the NuAmps manual for the hardware installation. The installation of the SCAN SW is the same as that described below.

SEP Stimulator. If you purchased an SEP stimulator, it connects to the computer's COM port. Please see the SEP Stimulator User Manual for operational details. Be sure to enable the SEP Stimulator option from the Ampinstall.exe program (described below).

Photic Stimulator. If you purchased NuAmps with a photic stimulator, please see the NuAmps manual for installation directions. Be sure to enable the Photic Stimulator option from the Ampinstall.exe program (described below).

Caution

The use of photic stimulation may induce seizure activity in patients with diagnosed or undiagnosed seizure disorders. Be prepared to terminate photic stimulation and to employ appropriate medical intervention techniques should seizures or convulsions occur.

Warning

Do not use full intensity on the photic stimulator if the stimulator is positioned close to the patient and if the eyes are open.

SCAN 4.3 SOFTWARE INSTALLATION

The SCAN 4.3 software is distributed on CDROM. The media contains the executable programs, example data, and support files necessary for correct execution. It is essential that you use this installation program to install SCAN 4.3 correctly. The installation program creates a series of subdirectories, programs the registry, and copies necessary files to appropriate directories. Failure to use the provided installation program will result in unpredictable results in the operation of the program.

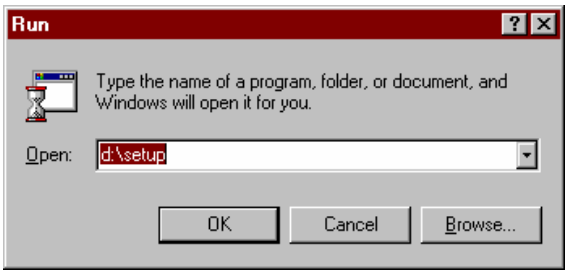
If you already have a version of SCAN software installed, it is normally not necessary to uninstall it. In most cases, you may have different versions of SCAN coexisting (as long as they are installed to separate folders). However, if, during the 4.3 installation, you encounter messages saying that one or more OCX files were not registered, you should uninstall your prior version, then install 4.3.

The Installation is largely automatic, and varies only slightly across operating systems. SCAN 4.3 now runs under the following Windows operating systems: Windows 2000, and XP Professional. (The XP Home version is discouraged, although it may function fully aside from the networking option). **With Windows 2000, you must install SCAN 4.3 under the Administrator**.

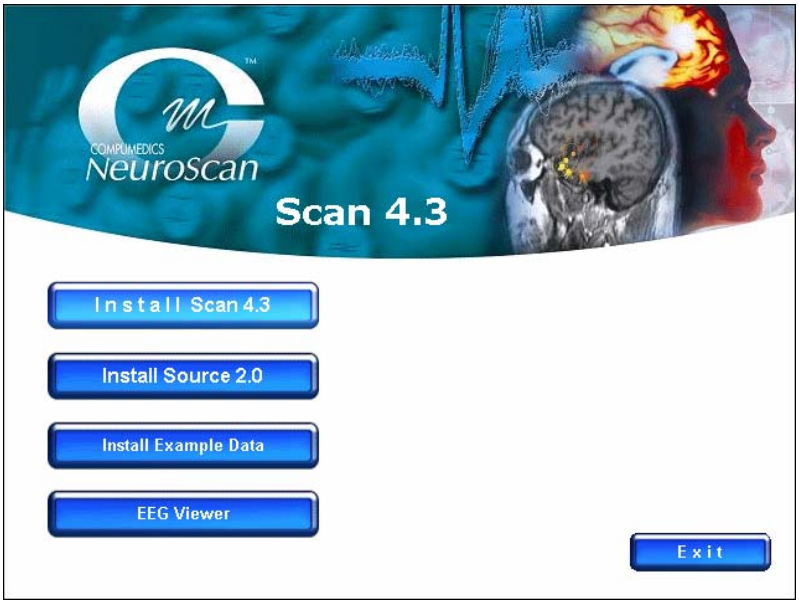
Follow these steps to install SCAN 4.3:

1. If the installation process does not begin automatically after you insert the CD, click on the **Start** 

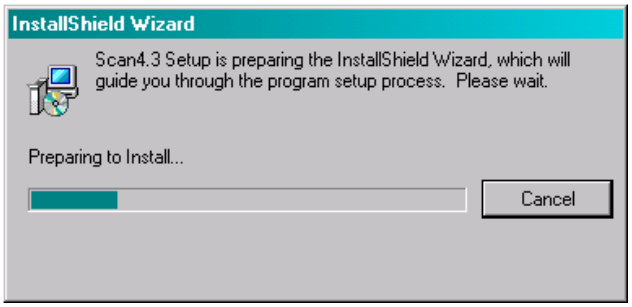
button of Windows. Click on the **Run** option of the task bar, and enter **D:\Setup.exe** for CDROM media (or whatever drive your CD is mapped to).



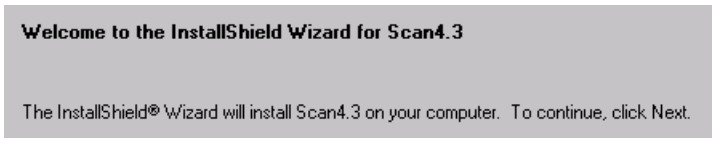
Click OK, and the Scan 4.3 initial screen will appear. You have the choice to install the Scan 4.3 software, the Source 2.0 software (purchased separately), the Example Data, or the free EEG Viewer software.



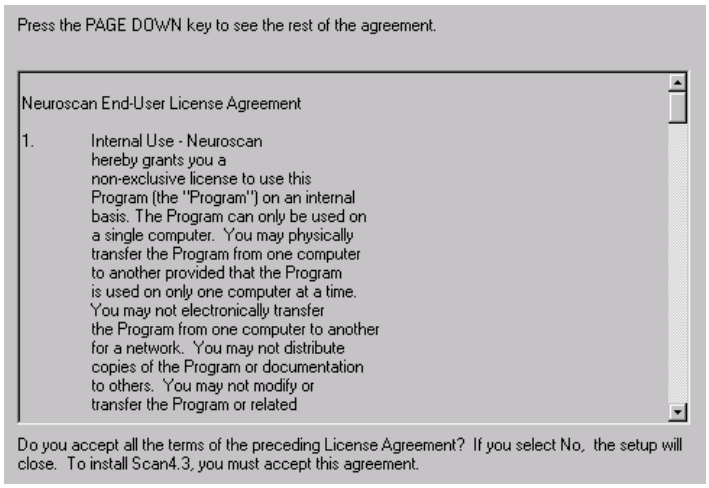
2. Click the Install Scan 4.3 button to install the Scan software. The InstallShield Wizard will appear and prepare for installation.



3. The InstallShield Wizard screen will appear after few moments. Click on the **Next** button.



4. You will then see the Software License Agreement. Read it, and if you agree, click **Yes** to continue. If not, click **No** to exit the setup.

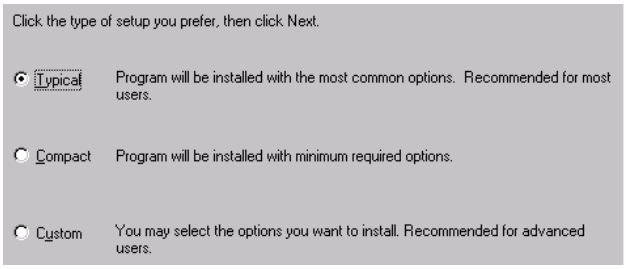


5. Next, the destination directory of SCAN 4.3 will be determined. Under normal circumstances this will be the default c:\Program Files\Neuroscan\Scan4.3 directory. However, it is possible to install into a different directory using the Browse button.

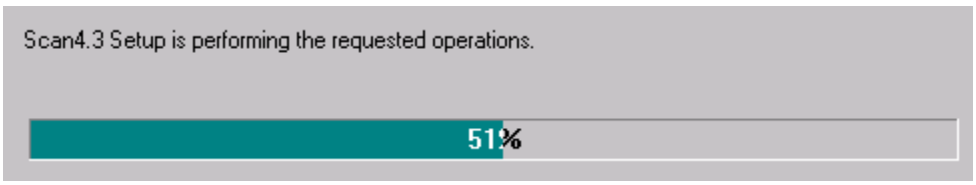
If you already have SCAN 4.3 installed, you should uninstall it via Windows software before reinstalling it in a different directory (do not just move the files to a different directory). Click on the **Next** button again and you will see the Setup Type screen.

6. From the Setup Type screen, you have the option of selecting Typical, Compact, or Custom installation.

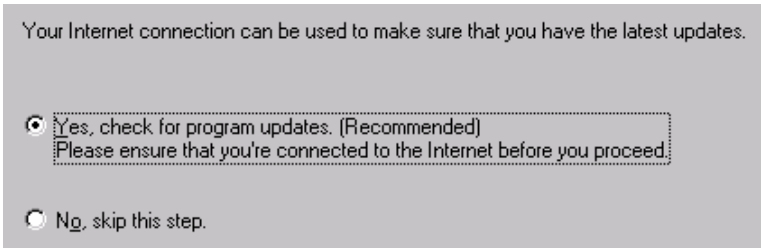
The Typical installation is recommended for most users. The Compact installation will install the program with the minimum required options. The Custom installation allows you to select the options that you desire (advanced users). Select the Setup Type you wish and click the **Next** button.



7. Shortly, you will see a progress indicator showing which files are being decompressed and copied.

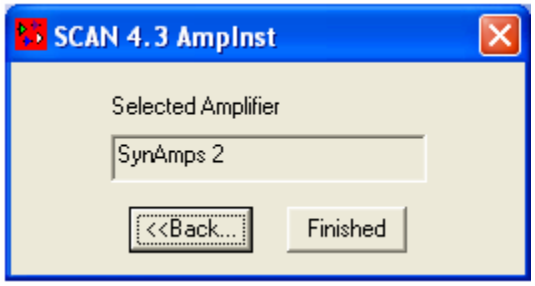


8. Assuming you are connected to the internet, you then have the option to check our website for any program updates (recommended).



9. You will then see the "Select an amplifier" screen. Highlight the amplifiers that you are using, and then enable the option for the video camera if you will be using one. Be sure the camera is connected and functioning. The camera will then be detected when the ampinstall.exe program is run.

10. You will see a confirmation screen to verify the selection you made. Click Finish to complete the installation.



After clicking Finish, you will be returned to the Scan 4.3 initial display so that you can install additional components, if desired.

Source. The Source 2.0 software is separate from SCAN and must be purchased separately. You can install the software, but it will not run until you reprogram your dongle for Source. (If you have an earlier version of Source already, then the new one will work automatically). Click the 

button to install the Source2.0 software. The installation is very similar to the above steps.

Example Data. You will likely want to install the Example Data. Click the 

button, and the installation will be very similar to the one above. It will take a few minutes to install all of the demo data files.

Click the 

button to install the free EEG Viewer software, and follow the installation steps.

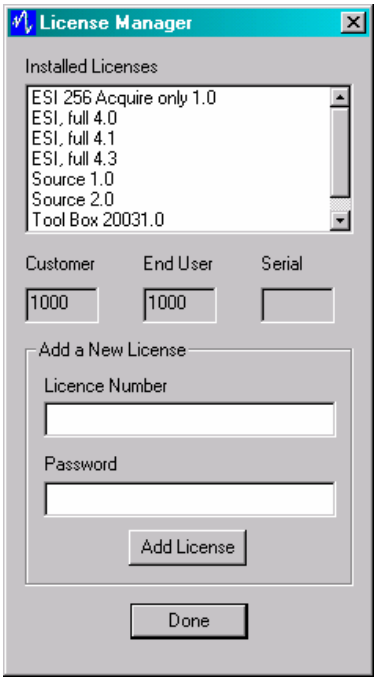
Exit. Click the 

button to leave the Scan 4.3 installation.

License Manager

The License Manager allows you to upgrade your software lock to accommodate new software or a software upgrade.

If you received a new software lock with your software, you still need to run the License Manager and obtain a password to enable it. New dongles are programmed to cease functioning after about 30 days. To activate the dongle, please go to the web site mentioned below, and submit the password request. Do make sure you keep the serial number of the software in a safe place. You will need it for technical support.



When the License Manager is started, the top section will show the programs for which your software lock is currently enabled. It also shows you the software lock's serial number. The License Manager program is called License Manager.exe and is located in the Scan4.3 folder. Double-click on it from the Explorer to run it.

In the lower section, you need to enter the License Number and Password of the NEW software. These will be e-mailed to you when you submit the web request.

If you do not have a License number for the product or upgrade that you want, please contact our sales department at: sales@neuro.com.

Furthermore, you need to enter a password that will allow you to upgrade your key. You can obtain a password by filling out the form on our website at http://www.neuro.com/neuroscan/licreq.htm or by sending an e-mail to licenses@neuroscan.com with the following information:

- Your name
- Your institution
- City and State/Country
- The license number of the new software
- The Serial number of the software lock

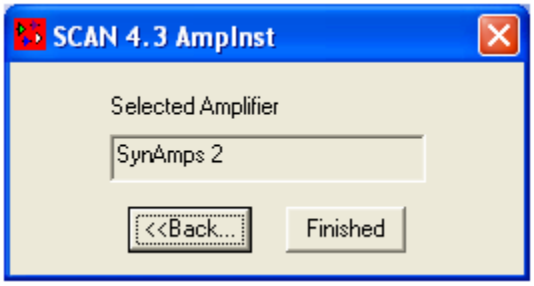
After you enter the license number and password, click the Program button. You should then see a message saying that the processing was successfully completed. For questions about this procedure, e-mail our technical support department at techsup@neuro.com.

Amplifier Software Installation

Some additional information concerning your amplifiers must be entered prior to acquiring data. The Installation program will lead you directly to the AMPINST (Ampinstall) program, or you can come back to it at a later time and run it as a stand-alone program.

If you have not already *installed* your amplifiers, you should do so at this point. Go to the Scan4.3 folder and double click on the AmpInst.exe 28KB program. The "Select an amplifier" window will appear asking which amplifiers you wish to install.

Enable the Video Camera option if you have a camera installed and functioning on your computer. Highlight your selections and click OK. A confirmation screen will appear. You have the choice to go Back and reselect the amplifiers, or else click Finish to complete the process.



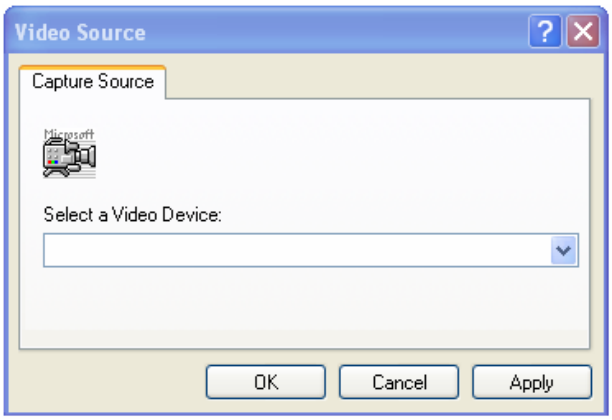
The program takes a fraction of a second to run; it is creating or modifying the scan43.ini file in the \Windows directory. When the SCAN 4.3 Amp/Inst window reappears, click the Done button. If you wish to change the amplifiers, rerun AmpInstall with the new selection.

As part of your initial installation, your amplifier settings should be entered in ACQUIRE. The settings will vary depending on which amplifier is installed. This is described in more detail below.

The software lock provided with the CD should be connected to the parallel port (LPT1) of your computer (newer ones plug into the USB-2.0 port). If you have a printer connected to this port, remove the printer and plug it into the back of the software lock.

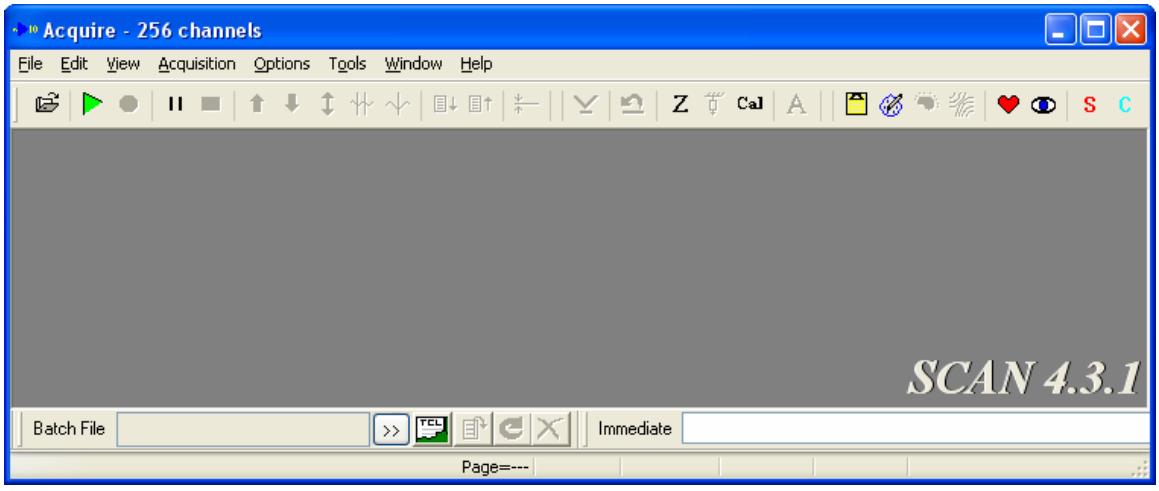
Double-click the SCAN 4.3 icon SCAN 4, and then click on the ACQUIRE icon from the Program Launcher to start the ACQUIRE program.

If you have the Video Camera option enabled, the following display will appear the first time you start ACQUIRE or EDIT.

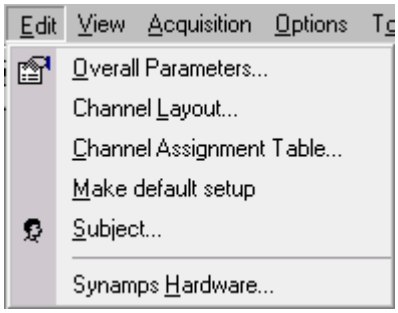


Select the Video Source from the pull-down list, then click Apply and OK.

The Main screen will appear.



Click Edit, and at the bottom of the pull-down menu you should see the option specific for your system, as described above (i.e., SynAmps Hardware, etc.).



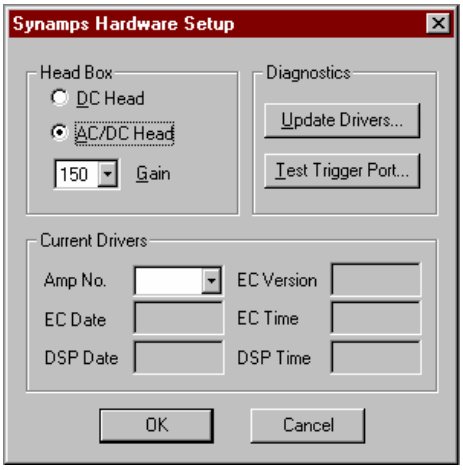
SynAmps

If you have a SynAmps system, select the *SynAmps Hardware* option, and a dialog box will appear. Indicate the appropriate settings for your system (these are not options to select - the information must match your SynAmps):

Head Gain. Select either 30 or 150x gain (SynAmps since approximately 1994 are 150x).

AC/DC. Indicate whether the SynAmps is DC only, or AC/DC (SynAmps since approximately 1994 are AC/DC).

Please refer to the ACQUIRE manual for a description of the *Diagnostics* and *Current Drivers* sections.



For SynAmps users: always make sure the SynAmps(s) are turned ON and that SN1 (and SN2, SN3, etc.) appears BEFORE you boot your PC.

SynAmps²

The installation of SynAmps² is contained in the SynAmps² manual. Operational details specific to SynAmps² are described in the SynAmps² manual. Details in common with other systems are described in the ACQUIRE manual.

NuAmps

The installation of NuAmps is contained in the NuAmps manual. Operational details specific to NuAmps are described in the NuAmps manual. Details in common with other systems are described in the ACQUIRE manual.

This concludes the Software Installation procedure.

3D DIGITIZER

If you have purchased a 3D Digitizer for inputting three dimensional head shapes for the 3DSpaceDx program, please complete the following installation steps. This information is repeated in the beginning of the 3DSpaceDx manual.

HARDWARE INSTALLATION

3DSpaceDx supports only the Polhemus FASTRAK™ device. Described below are the specific interface concerns related to the 3DSpaceDx program. The user is referred to the accompanying 3DSpaceDx manual for all other hardware concerns. Familiarization with this manual and the operation of the device is required before proceeding with the steps listed below.

CAUTION - All Polhemus devices are sensitive to electrostatic discharge (ESD). Be sure to take precautions when following the instructions listed below. Power should not be applied to the device until all connections and all switch settings have been completed.

1. Attach the serial communication cable. A 10 foot serial communication cable is provided. One end of the cable should be plugged into serial communications port COM1 or COM2. The other end should be plugged into the 9 pin connector labeled RS-232 on the digitization unit.

2. Attach the transmitter. The transmitter is a plastic cube, roughly 2" on all sides, with a long cable and connector attached. With the power off, plug in and firmly screw the transmitter cable into the connector labelled **transmitter.** The transmitter should be attached to the head of an aluminum tripod, supplied with the system.

3. Attach the stylus. The digitizing stylus is a pen-like device with a long cable and connector attached. Plug in and firmly screw the stylus cable into the connector labelled **Receiver ONE.** The stylus must at all times occupy the first receiver position. Other positions will result in erroneous data.

4. Attach the power cable. Make sure the power switch on the back panel of the digitizer is in the off position. Remove the power cable from the transformer and plug the circular DIN type connector into the connector labeled **POWER** on the back of the device. Now plug in the power cable into the back of the transformer and the other end into the power socket.

CAUTION - Never plug the DIN connector into the device with power applied to the transformer. Damage to the device may occur!

5. Attach the 3 additional receivers. Attach the three additional receivers. These receivers are used to form a reference plane on the head or object to be digitized. If the device was purchased directly from Neuroscan, the cables will be tied together to form a harness. Plug these receivers in **TWO**, **THREE,** and **FOUR**.

6. Check the serial communication parameters on the 3DSpace device. The 3DSpace system should be set for 57.6 Kilobaud, 1 stop bit, no parity. The appropriate switch settings can be found in the user manual of the device. Lower baud rates are acceptable. The appropriate changes should be made on the switches, within Windows (e.g., from the Device Manager), and in the 3DSpaceDx software (see below). *NOTE: Power to the digitizer should be shut OFF whenever you make switch changes.*

SOFTWARE INSTALLATION

1. Check the serial communication parameters on the host computer. It may be necessary to configure the serial port to the 57.6 K baud rate required by the digitizer.

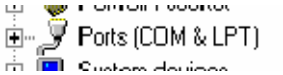
To check and or change the baud rate to these settings click on the 

button and select the **Settings** options and then the **Control Panel** folder. (The following is for Windows 2000; XP will be similar).

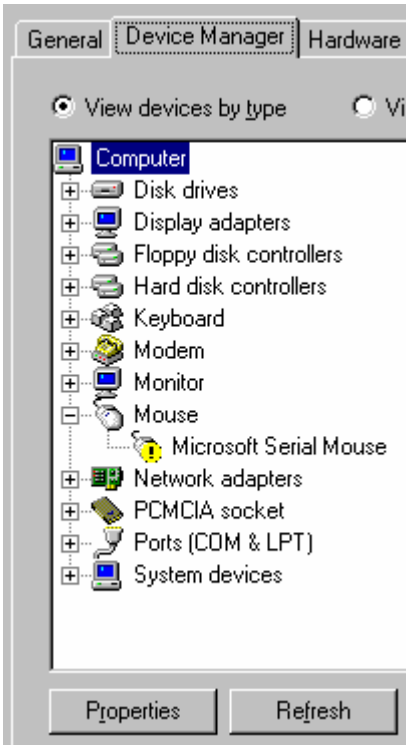
Double click on the 

and the **System Properties** screen will appear. Click the **Hardware** tab. Click on the **Device Manager** button, and a list of the installed devices will appear.

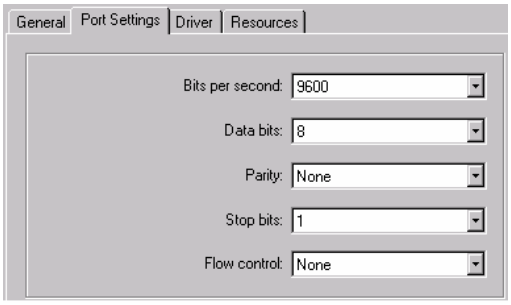
Double click on the Ports icon



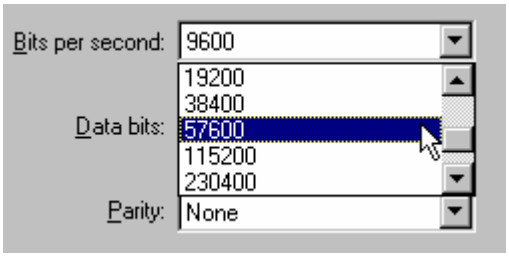
and a device tree will expand to show the installed ports.



Double click on Communications Port (COM1 or COM2) and the Communications Port properties page will appear. In this example the baud rate of the system is set to 9600.



To change the settings, click on the 'pull-down' arrow located to the right of the number. A list box will appear. Select 57600 and click on the OK button to modify the communications values.

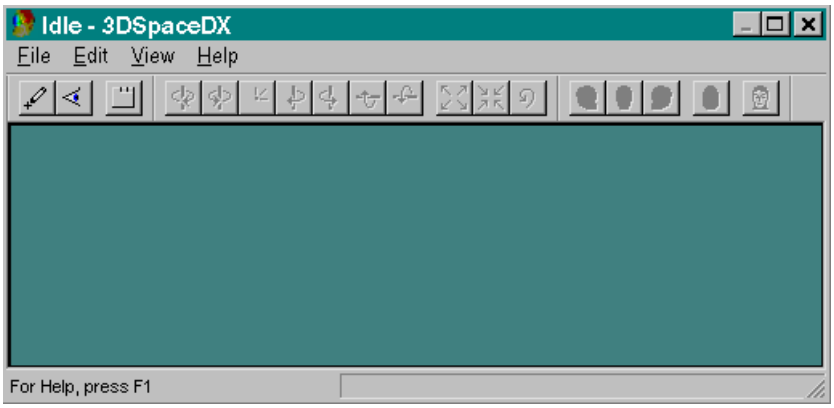


The Communication Properties dialog box will disappear and the System Properties dialog box will reappear. Click on the OK button to close this dialog box.

The host computer is now configured for 57K baud transmission rates.

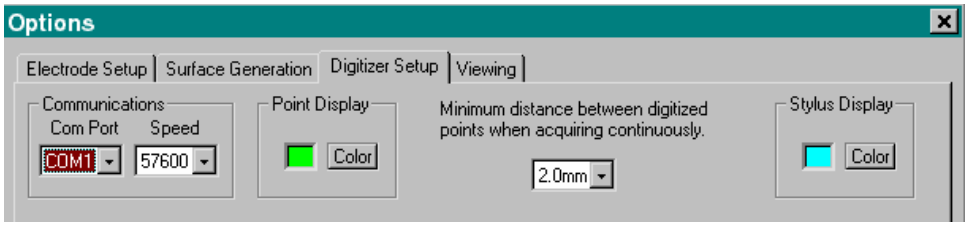
2. Check that the number of receivers for your digitization unit is set correctly. If you purchased the FASTRAK digitizer from Neuroscan, the number of receivers should already be set to **four**. The settings switches on the front of the unit should all be On (down). Three of the receivers (receivers 2-4) are used to form a reference plane and the position of the stylus (receiver 1) is computed relative to this plane. Consult the FASTRAK manual to set the number of receivers to four.

3. 3DSpaceDx installation. The last steps are to enter the necessary settings within 3DSpaceDx. Click on the 3DSpaceDx icon  from the Program Launcher, and the main 3DSpaceDx screen will appear.



Click on the Edit menu item and select the Options menu item. 

The Options window will appear. Click the Digitizer Setup tab, and see the following screen.



Under the Communications section, select the Com Port and Speed (BAUD rate) to match the settings on the digitizer. The remaining options are described in the 3DSpaceDx manual.

This completes the installation of the 3D Digitizer.

SCAN and STIM Software Modules and Their Functions

The SCAN and STIM software packages each consist of several modules, or programs. The SCAN 4.3 system is divided into two modules: ACQUIRE (for acquisition of data) and EDIT (for analysis of data). The STIM system consists of modules for presenting individual neuropsychological tasks, intended for application in EEG and evoked potential recording paradigms, as well as utility programs for creating your own auditory and visual stimuli. Many of the modules are self-contained, preset programs (with some variable parameters), although the Gentask module allows you to create your own stimulus presentation sequence.

SCAN system

SCAN 4

The SCAN programs are accessed from the Program Launcher. First, double-click the SCAN 4 icon, and then see the Program Launcher. Note that a green arrow appears on the Program Launcher when that program has been started. This is just a convenience to let you see what programs you have already opened. Please refer to the respective manuals for complete details for each of the programs.

ACQUIRE module. The ACQUIRE module is used for recording EEG and EP data. It records the data primarily in three formats - continuous stream (appears as scrolling EEG-like record), noncontinuous epochs (stores series of discrete EP epochs), and averaged files. There are advantages and disadvantages to each acquisition type. In most instances you will want to take advantage of SCAN's ability to record the entire raw data file (continuous mode) - as opposed to storing only the *epochs* or *averaged* EP data. This allows you to perform any number of offline analyses, while still having access to the original data.

EDIT module. The EDIT module is used for transforming the data files in a number of ways, including offline filtering, re-referencing, baseline correction, editing the recordings for eye movement and other types of artifact, and manual review of individual sweeps. Spectral analysis (forward and backward FFT), coherence, mean frequency, global field power and compressed spectral arrays are among the types of analyses that may be calculated offline. 2D Mapping and 2D Cartooning are options in the EDIT program, as well as 3D mapping via an interface with the 3DSpaceDx program.

NETWORK ACQUIRE module (no longer accessed from the Program Launcher). Beginning in SCAN 4.3, the Network version of ACQUIRE is part of the ACQUIRE program. It allows you run the acquisition program from a remote computer. (You must have licenses for both computers to use Network ACQUIRE). Details are found in the ACQUIRE manual.

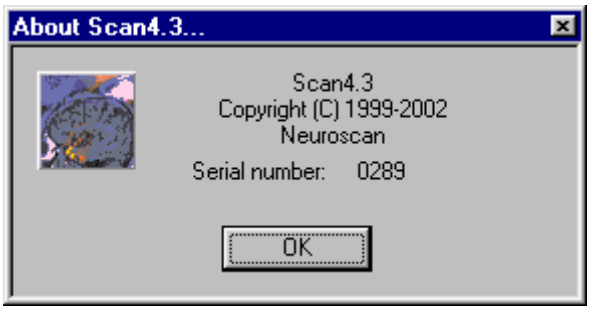
3DSpaceDx module. The 3DSpaceDx module allows you to digitize the subject's head shape and electrode positions, and then map the evoked potential results on a rotating 3-dimensional head.

MAPGEN module (no longer accessed from the Program Launcher). The MAPGEN module is used for creating and modifying the two-dimensional map files used in EDIT and 3DSpaceDx. Beginning in SCAN 4.3, MAPGEN is accessed under Tools in ACQUIRE and EDIT.

AMPINST program. AMPINST.exe (ampinstall) installs the appropriate SCSI controller or USB driver files, and must be run after the initial SCAN 4.3 installation. You can also install the amplifier simulator from the ampinstall.exe program, which is useful for setup file testing. The AMPINST.exe program may be found in the Scan4.3 folder, and may be run by double-clicking it from the Explorer.

WAVEBOARD program. The Waveboard is a program that is useful for displaying multiple waveforms from multiple files, and measuring points and differences between points on the waveforms. It is accessed from the Waveboard icon in ACQUIRE or EDIT.

Version Information. Click the logo section of the Program Launcher to access information about the current version of SCAN 4.3. The serial number is the number of your dongle (hardware lock in the parallel port).



STIM system

The STIM system contains preprogrammed neuropsychological tasks, including a naming task, the Stroop test, the Wisconsin Card Sorting test, Categories, Finger Tapping, a Spatial Memory task, and others. These may be used as stand alone neuropsychological tasks, or in combination with EEG or evoked potential recordings. More typical EP presentation protocols may be found in Contrast (VEP pattern reversal) and Audcpt (auditory resting and P300 EP recordings). In Gentask, users may create an almost unlimited variety of stimulation paradigms that might include, for example, stimuli that you create or import from other sources, and cross-modality stimulation. The Sound and Draw modules were designed to create or import various auditory and visual stimuli.

Getting Started....

To help you get up and running as fast as possible, we have summarized the basic steps that need to be completed before you put the electrodes on. As you are aware, the Neuroscan system is not a "turn key" system. It has been designed for researchers who have a fairly clear idea what they want to do, without the constraints of equipment or programming limitations. In order to have that flexibility, it is necessary for you to tell the system exactly what you want it to do. We have made the interactive process as straightforward as possible, but it will take some time for you to tailor the system for your own particular needs. There are some basic steps that will apply in most situations:

Basic EEG recording...

Setup file. Assuming that the hardware and software have been installed correctly, the typical first step is to create a setup file in ACQUIRE. The steps are described in more detail in the tutorial section at the beginning of the ACQUIRE manual. In essence, the setup file configures the SCAN PC to record from a specified number of channels, label the channels, store the data in a specified format (Acquisition Type), set digitization rates, set filter levels, set automatic artifact rejection criteria, set the duration of the recording epoch, and so forth. The SCAN PC must be configured to your system and needs prior to data acquisition.

MAPGEN file. If you plan on displaying your data in the form of color 2D topographical maps, you may need to create a map "template", again, tailored to your specific number of channels and electrode positions. Standard 10-20 system labels are recognized and mapped automatically.

Basic Evoked Potential recording....

Setup file. In creating the Setup file, you should give some consideration to the *Acquisition Type*, mentioned above. You can record the EPs in a scrolling, "continuous" format, in which all of the data are saved, including the activity between the epochs. In other words, if you present stimuli every 2 seconds, and define the epoch to have a one second poststimulus duration, the full 2 seconds will be recorded. The advantage is that you can reanalyze the data offline any number of times, with redefinition of the pre- and poststimulus time points. You can also record stimulus *and response* event markers that can be used for creating overlapping epochs, or to perform response averaging. The primary disadvantage is that the size of the data files can get very large (although this is becoming less of a concern as improvements in data storage devices occur and as hard drive capacity increases).

With the "epoched" acquisition type, only the recording epochs that you define are stored. If you are certain that you will never want to reanalyze your data using some other epoch span, or if you will not analyze the data according to the response, and if storage space is an issue, then the epoched mode is appropriate. For example, routine VEP pattern reversal works perfectly well in the epoched mode, as does a routine P300 (without response averaging).

In general, routine EEG recordings and more complex evoked potential paradigm recordings work best with the continuous mode; simpler evoked potential recordings work well with either continuous or epoched mode. This is, however, one decision that should be considered carefully when creating your final Setup file(s). We recommend that continuous mode be used whenever possible.

Presentation of stimuli. You have a great deal of freedom with regard to the presentation of auditory or visual stimuli with STIM. While you might find a default file that will let you perform a simple auditory P300, for example, it is worth the time to set up your own stimulus presentation file(s). Through the process, you will see the range of possibilities that exists with the STIM system. With a simple auditory P300, you create configuration files in which you specify the pitch of the tones, their duration, their loudness, left/right or both ears, the interstimulus interval, whether a response is required, and so forth. While it does take a little extra time to set the system to do what you want, you will gain a more complete understanding of the options available with the system.

Gentask is an extremely powerful program for stimulus presentation. In Gentask, you create a Sequence file in which you define the sequence of stimulation - one stimulus at a time. For each consecutive stimulus, you specify the type (auditory or visual, or a mix of the two), duration, position on the monitor (visual), decibel level (auditory), etc., and you can present nearly any type of auditory or visual stimuli that you create (see Gentask in the STIM manual for details). In the sample recording below we will create a sequence file.

Triggering. Lastly, you will need to specify triggering information. Whether you use STIM or some other stimulus presentation unit, the basic procedures are similar. Signals are sent from the stimulus presentation unit to start the acquisition of EP epochs, as well as to signify events in the recording. Both stimulus and response events may be coded in the continuous recording. The events are specified with "type codes" that you designate. For example, in a typical P300 recording, the frequently presented stimuli might be given a type code of 10, and the rare stimuli might be coded as 20. Similarly, a response with the left button of the mouse is coded as 1, and the right button response is coded as 2. Stimulus and response codes appear as different colors in the continuous recording. Stimulus type codes are used with both continuous and epoch-based recording; response event codes are possible with continuous recordings only.

Setting up the triggering and event codes may be fairly straightforward, or rather complex, depending on the complexity of your recording paradigm, and type of stimulus presentation device. This can sometimes be confusing for users who are new to computerized recordings of EEG and EPs. Triggering is well documented in the manuals, and the setup is easily accomplished with a fundamental understanding of the logical processes involved. Please refer to Appendix B for interface options and details.

Once you have set up the stimulation and acquisition parts of the system, you will be ready to test it out. The best pieces of advice we can give to new users are (1) read the manuals - at least the tutorials initially, and (2) be patient. Many of the questions we receive at the Technical Center have answers in the manuals. Most users find that if they take their time and work with the system and with the manuals, they are able to solve

many of the difficulties they encounter. In doing so, they gain a better understanding of how the system works. When you see how it works, you may get additional ideas for more creative applications. If you do get stuck, however, please call the Neuroscan Tech Center.

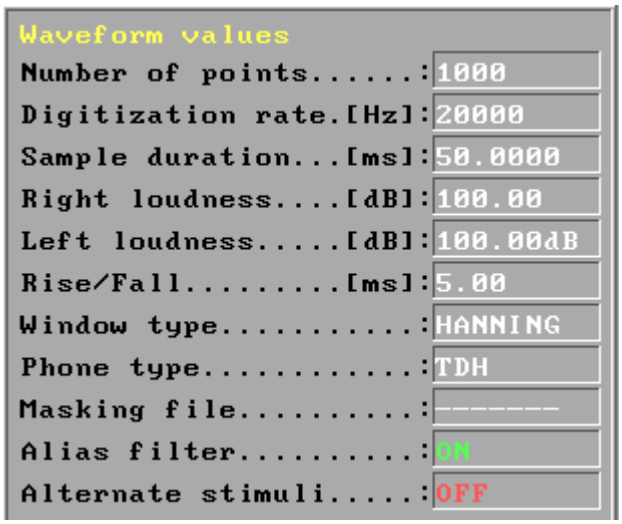
Example of a Simple Paradigm

The purpose of the next section is to walk you through the steps required for setting up all the files needed to run a basic study using STIM and SCAN. In this example, we will design a simple study, create the stimulus files, create the sequence file for use in Gentask, and create a setup file in Acquire to record the data.

We'll create a paradigm to record evoked responses to repeating and alternating auditory and visual stimuli. We want to be able to analyze independently the responses for both modalities. Let's say the auditory stimulus will be a bilateral, 1000Hz tone with a 50ms duration and an SPL (sound pressure level) of 100dB. The visual stimulus will be a large green circle that is presented in the center of the screen with a 30ms duration. To make it interesting, we'll present 25 auditory stimuli, then 25 visual stimuli, then alternate auditory and visual stimuli for an additional 25 presentations each. In the analysis, we want to be able to compare the mixed modality versus the steady modality modes of presentation. We'll say that the EPs will have sweep start and stop points of -100 to 500ms. This needs to be decided in advance so we know what ISI (inter-stimulus interval) limitations there may be for stimulus presentation.

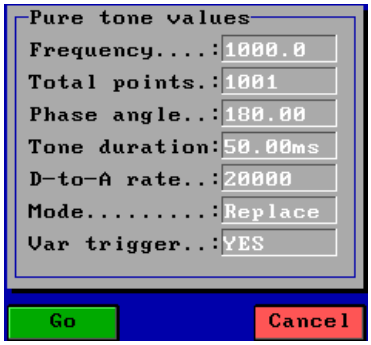
The first step is to create the stimuli. We'll create the auditory stimulus in SOUND, and the visual stimulus in DRAW.

Creating a sound stimulus

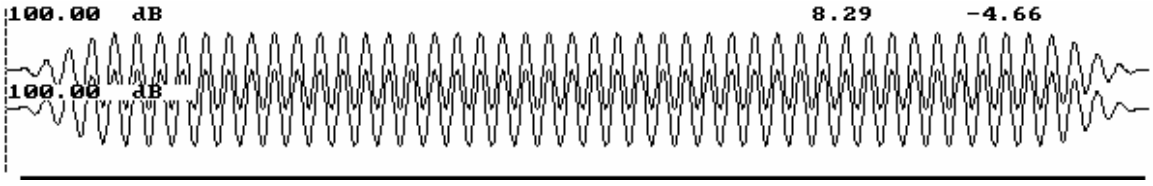


We want to make a bilateral, 1000Hz tone with a 50ms duration and an SPL of 100dB. Go into the SOUND program in STIM, and click on the **Config** button. In the Waveform values area, enter 1000 for the number of points, 20000 for the Digitization rate, and the Sample duration should show 50ms. Set the dB levels in both channels to 100. The Rise/Fall time and the Window type have to do with creating a taper on the ends of the tone we will be creating. Enter 5 for the Rise/Fall time and Hanning for the window type. Leave the rest of the settings in their default positions, and go to the

Main Menu. On the far left button on the Sample Window bar (in the middle of the screen), click the button until it shows **Both** (this will create the tone in both channels). Then click on **Transforms**, then **Pure tone**. The settings that you entered on the

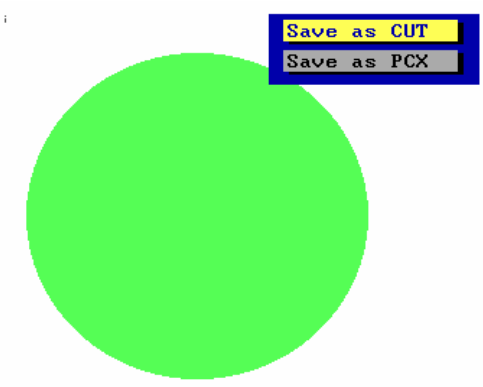


Config screen should appear. Click Go (ignore the other settings for this demonstration). You will see the 1000 wave in the upper display area (or, that part of the wave that is contained in the defined 50ms duration). To taper the ends of the tone, click **Transforms**, then **Window data**. The settings that you entered on the Config screen should appear. Click Go to see the results of the windowing. Play the tone if you wish,



and **Save** it as 1000hz50 (the snd extension is added automatically), with the path set for the \stim\gentask directory. Then **Quit** the **SOUND** program.

Creating a visual stimulus



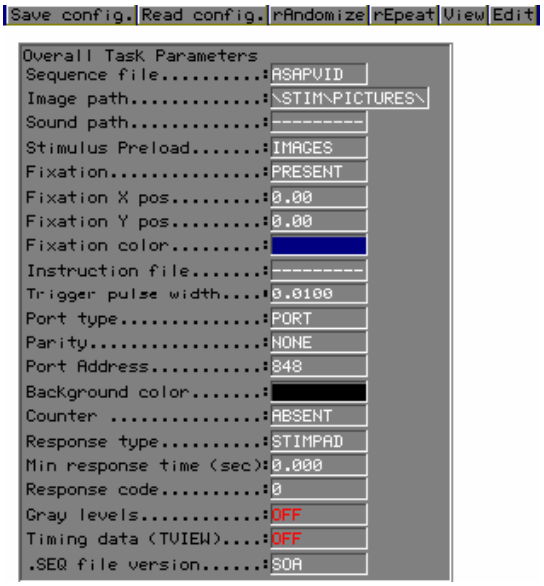
Next, we will make a large green circle to use for the visual stimulus. Go into the **Draw** program, and click the **Fill** button. Click the lighter green in both columns of colors, and click **Return**. Click **Primitives** and **Circle**. Put the mouse in the middle of the screen, hold down the left button, and drag the circle until you get one about 3-4 inches in diameter. Then release the mouse button. Click **Primitives** and **Flood**, then place the mouse within the circle and click the left button once to flood the circle green. To save the green circle, click **Files**, **Save region**, and Save as **CUT** (to save the region as a CUT file). Then the idea is to hold the mouse button down and drag a rectangle/square around the circle so that 1) the circle is centered in the region, and 2) so that the region is only slightly larger than the circle it encompasses. (The region as a whole is displayed in

the other programs. If the circle is off to one side within the region, it will not be centered when you display it. The region should generally be as small as possible, especially if you are presenting the stimuli in rapid order).

When you release the button, the save file screen appears. Give the region a name (GREEN; the CUT extension is added automatically), and set the path for the \stim\gentask directory. Then **Quit** the **Draw** program.

Creating a Gentask sequence file

The next step is to create a Gentask sequence file to present the stimuli exactly as we wish. The Gentask program allows you to have complete control over stimulus presentation by creating a line by line sequencing file. We want to present 25 auditory stimuli, then 25 visual stimuli, then alternate auditory and visual stimuli for an additional 25 presentations each. Visual stimuli will have a duration of 30ms. We also decided we wanted to have epochs of -100 to 500ms. The inter-stimulus-interval (ISI) must exceed the epoch length and allow some time for overhead processing. We'll set the ISI for 1 second. All of the parameters are entered in the Gentask configuration screen and the sequence file.



In STIM, go to the **Gentask** program (click Utilities from the main Stim menu screen). Click the **Config** button, and information from a previous or default setup file will appear (and can be ignored). We'll start by creating a simple sequence file. This is a text file created with a text editor. Click the **Edit** button, and you will be taken to the text editor you specified when the STIM software was installed. If this step was skipped, or was entered incorrectly, you will get a message saying, "Path to editor must be specified...". If that happens, exit STIM and determine which text editor you have, and where the program is located. Typically, the editor is *edit.com* and may be found in the \windows\command directory if you have windows, and the DOS directory if you do not. Then go to the \stim\gentask directory in DOS, and type: *edit gentask.cfg*. Add a line at the bottom of the file that says: *sysedit c:\windows\command\edit.com*, or whatever path and file name are appropriate. Save the file and exit the editor. Then go back to **Gentask** and click **Config**, then **Edit**, and you should be taken to the text editor.

The file you see is the sequence file for the DEFSET setup file. We will create a new sequence file, but it is convenient to use the first three lines of an existing sequence file, rather than have to recreate them. Delete everything from line 4 on (leave the underlines). A complete explanation of the contents of the sequence file may be found in

the Gentask manual (and new features for Gentask are described in a Tech Note on the web site). Briefly, for our purposes, the Event line is for designating line numbers, MODE will be used primarily to indicate that we will present CUT or SND files, and DUR is the duration of the CUT file presentation (SND file durations are set when we created the sound file). Note the DUR is in seconds, not milliseconds. In our example, therefore, the 30ms duration is entered as 0.030 (.03 is acceptable). WIN is the response window, and may be ignored since we are not requiring any subject responses (set to 0).

The next column is either SOA or ISI. SOA stands for stimulus onset asynchrony. The basic difference between SOA and ISI is that SOA is the time from the *beginning* of the previous stimulus to the *beginning* of the stimulus for the line on which the SOA value is contained. ISI is the time from the *end* of the previous stimulus to the *beginning* of the current one. It does not matter which is displayed in the sequence file; the selection of SOA or ISI is made from the **Config** screen (selected below). For our purposes, we'll select SOA and use a value of 1.0 second. That will result in the presentation of a stimulus every second, regardless of the duration of the different stimuli.

The next two columns, xpos/rdB and ypos/ldB, have differing effects for different types of stimuli. For CUT files, these columns control the position of the CUT file on the screen (0 and 0 position the file in the center of the screen). For SND files, they control the dB levels of the sounds. If these are set for -1, then the dB level will be whatever it was when the sound was created. If you enter other values, such as 80 and 0, these will override the existing dB level.

The RESP column allows you to designate what the correct subject response should be. A -1 indicates that no response is expected. TYPE is the trigger type code sent to Acquire (valid values are 1-255). Since we want to be able eventually to sort the sweeps between modalities (CUT and SND), and between presentation conditions (steady and alternating presentation), we'll use several different type codes. For steady visual presentation let's send a type code of 10, for steady auditory let's send 20, for the visual stimuli in the alternating sequence let's send 30, and for the alternating auditory stimuli let's send 40. FILENAME is the name of the file to be presented (omit the extension).

If we start with the steady visual stimuli presentations, the first lines would be:

NUMEVENTS 100

EVENT	MODE	DUR	WIN	SOA	xpos/rdB	ypos/ldB	RESP	TYPE	FILENAME
1	CUT	.03	0	1.0	0	0	-1	10	green
2	CUT	.03	0	1.0	0	0	-1	10	green
3	CUT	.03	0	1.0	0	0	-1	10	green
...									
25	CUT	.03	0	1.0	0	0	-1	10	green

Copy this line until there are 25 such lines.

The auditory stimuli lines would appear as:

```
 26      SND     0.0     0     1.0      -1        -1       -1      20     1000hz50
 27      SND     0.0     0     1.0      -1        -1       -1      20     1000hz50
 28      SND     0.0     0     1.0      -1        -1       -1      20     1000hz50
...
 50      SND     0.0     0     1.0      -1        -1       -1      20     1000hz50
```

Copy this line until there are 25 such lines. Then starting with line 51, start alternating the CUT and SND lines until you get the complete 100 lines (copying blocks of identical lines).

```
 51      CUT     .03     0     1.0       0         0       -1      10     green
 52      SND     0.0     0     1.0      -1        -1       -1      20     1000hz50
 53      CUT     .03     0     1.0       0         0       -1      10     green
 54      SND     0.0     0     1.0      -1        -1       -1      20     1000hz50
 55      CUT     .03     0     1.0       0         0       -1      10     green
 56      SND     0.0     0     1.0      -1        -1       -1      20     1000hz50
...
 99      CUT     .03     0     1.0       0         0       -1      10     green
100      SND     0.0     0     1.0      -1        -1       -1      20     1000hz50
```

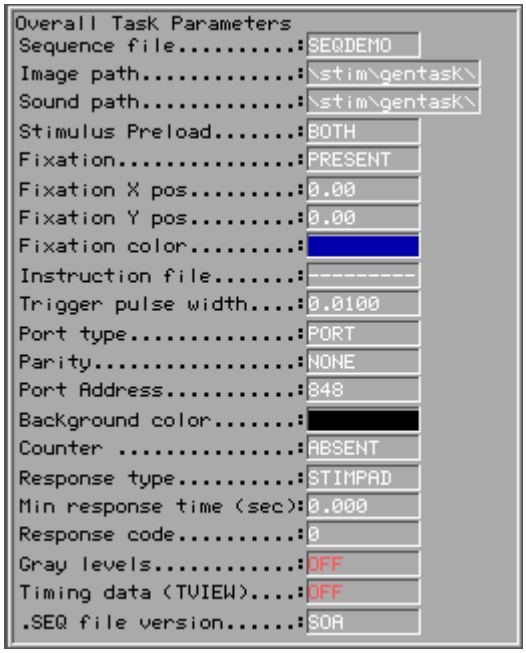
Then, enter 100 for NUMEVENTS at the top of the sequence file. Save the file (call it seqdemo.seq - be sure to include the seq extension), and exit the text editor.

There is a more elegant way to create the same sequence of events. It is included here as an illustration of some of the new features of Gentask (described in a Technical Note on the web site; www.neuro.com, under Support/Technical Notes). Basically we'll add a counter for each presentation condition: the steady visual stimuli, the steady auditory stimuli, and the alternating stimuli. When the visual counter gets to 25 the program will go to the auditory presentations. When the auditory counter gets to 25, the program will go to the alternating presentations. When that counter reaches 25, the program will end. (The actual counter is set for 1 through 24 because the first presentation is prior to the counter. Therefore, there is one presentation plus 24 loops to get 25 stimuli). The complete sequence file would appear as follows:

```
-----  -----    ---   ----  ----  ----   ----  ----  ----  ----
1      reset    all    0     0     0      0     0     0     0          [resets all counters to 0]
10     cut      .03    0     1.0   0      0     -1    10    green
20     cinc     1      1     0     0      0     0     0     0          [sets counter 1 to increment by 1]
30     if       1      1     24    goto   10    next  0     0          [if counter 1 is between 1 and 24, go to
                                                                       line 10; if not, go to the next line]
40     snd      0      0     1.0   -1     -1    -1    20    1000hz50
50     cinc     2      1     0     0      0     0     0     0          [sets counter 2 to increment by 1]
60     if       2      1     24    goto   40    next  0     0          [if counter 2 is between 1 and 24, go to
                                                                       line 40; if not, go to the next line]
70     cut      .03    0     1.0   0      0     -1    30    green
80     snd      0      0     1.0   -1     -1    -1    40    1000hz50
90     cinc     3      1     0     0      0     0     0     0          [sets counter 3 to increment by 1]
100    if       3      1     24    goto   70    next  0     0          [if counter 3 is between 1 and 24, go to
                                                                       line 70; if not, go to the next line]
110    stop     0      0     0     0      0     0     0     0          [ends sequence file]
```

Notice that there are different type codes for the cut and snd stimuli in the alternating section (lines 70 and 80). This will allow us to sort these stimuli separately later on. Notice also that the numbers in the event column do not have to be incremented by 1, but they should be unique and in increasing order (to avoid confusion). If you wish to use this file, be sure to enter 12 in the NUMEVENTS line at the top. Save the file as seqdemo.seq (be sure to add the extension), and exit the text editor.

When you exit the editor, you will be back at the **Config** screen in Gentask. Select the sequence file you just created by clicking on the **Sequence file** field, and select the seqdemo file. The next two lines allow you to specify the paths for the auditory and visual stimuli. For each line, enter: \stim\gentask\, or whatever directory contains the stimuli. Be sure to add the final "\". Click Stimulus Preload until it shows Both (see Gentask manual for when to preload the stimuli).



Set Fixation to Present, with x and y positions of 0, and a color of your choice. Leave the Instruction file blank. Trigger pulse width should be .008 to .01, with Port Type set to Port, and Parity set to None (for standard applications and systems). Port Address should be 848 for SoundBlasterTM systems (new systems), and 1820 for older LabMaster systems. Leave background color black (or change as desired), set the counter to Absent (or Present), and Response type to Stim Pad (doesn't matter since we are not requiring responses). Minimum response time does not matter (no responses expected), leave the Response code at 0, leave Gray levels and Timing data OFF. The final option is to choose between SOA and ISI, as mentioned above. Set this to SOA.

For this demonstration we are not interested in feedback to the subject, so leave the Feedback parameters all OFF. Now save the Config file (the .gen extension is added automatically), and then go to the **Main menu**. We are now ready to test the sequence file we created. Click **Run**, and you will be asked to enter a file name. This is for the behavioral data file that is created any time you run a STIM program. It contains trial by trial subject response information, such as, which button was pressed, whether it was correct or not, the latency of the response, etc. Since we are not requiring subject responses in this demonstration, just enter a JUNK file name (the .dat extension is added automatically).

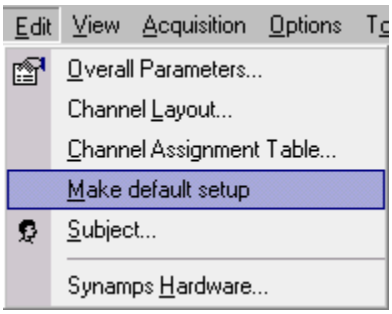
You will then see the Stimulus Preload message, followed by a message to *Press a key to begin*. Press any key, and you will see the visual and hear the auditory stimuli. If something is incorrect in the sequence file, you will get an error message. To make

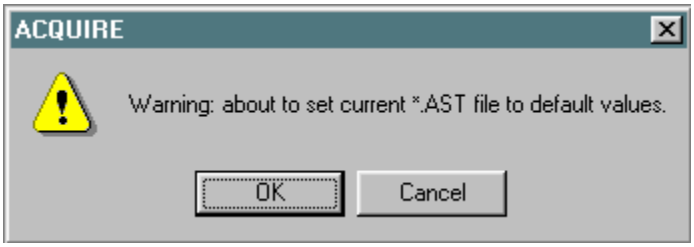
corrections in the sequence file, click the **Config** button, then the **Edit** button to get to the text editor.

Assuming that everything is running on the STIM side, the next step is to create the setup file in ACQUIRE.

Creating an ACQUIRE setup file

On the SCAN PC, start the **ACQUIRE** program. If you are making a new setup file, you can either modify one of the setup files (.ast extension) that we supply, or you may create one from scratch using the default options. To restore the default settings, select **Edit** from the Main Menu bar, then click **Make default setup**, and then click **OK**.

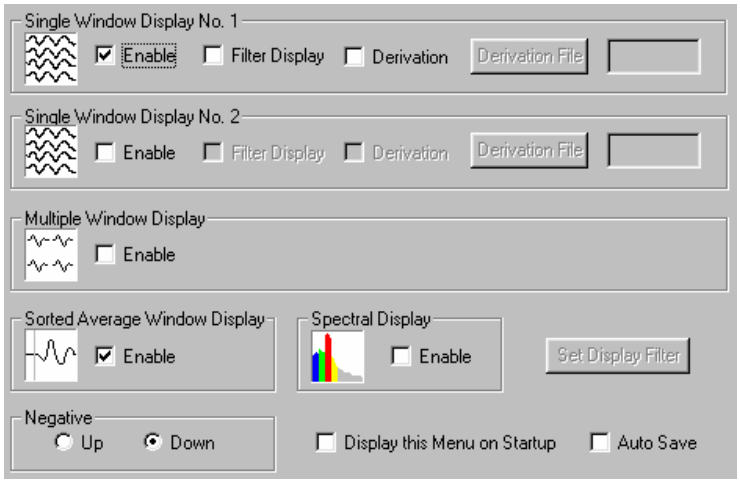




This replaces whatever setup file that had been in residence with the default settings. Then click **Edit/Overall Parameters**. You will see a display with several "tabs" on it (shown below).

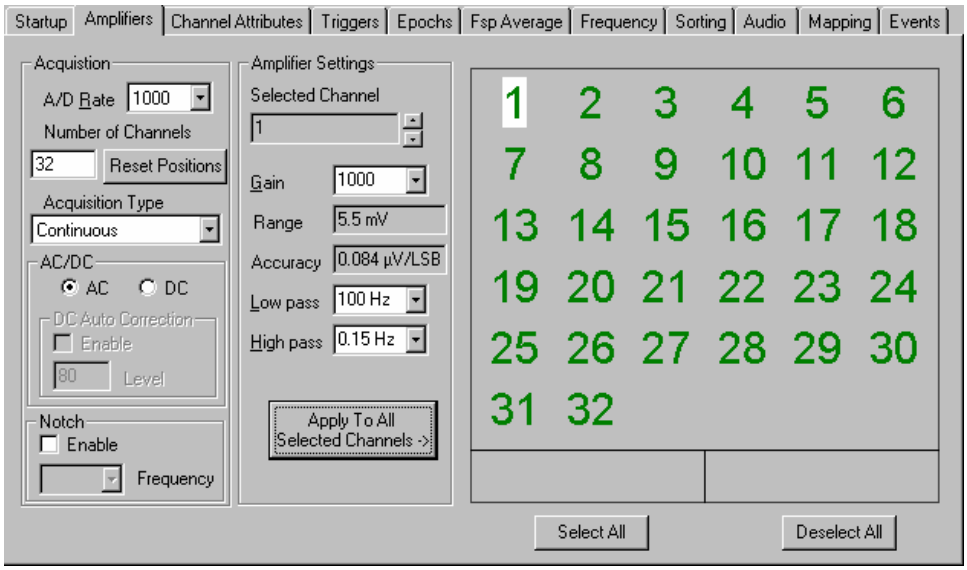
If you have NuAmps, see also the NuAmps manual for options that are specific to NuAmps.

Startup. The top display is the **Startup** screen. It is used to select the type(s) of displays that you will see during data acquisition, as well as for some online filtering and other online options. For this example, enable **Single Window No. 1**. The **Sorted Average Window Display** is enabled automatically when you enable the online average field in the Sorting display, described below (enable it now, if desired). If you have a preference for whether **Negative** voltage is



displayed up or down on the y-axis, select your choice. Leave the other options blank. Now, click the **Amplifiers** tab.

Amplifiers. The first decision is what AD rate to use. This is the sampling or digitization rate (how often the continuous function is sampled). You can also think of this as temporal, or x-axis resolution. If you have epochs from 0-1000ms, and an AD rate of 1000hz, you will have data points every 1ms, or a 1ms resolution. If you are interested in very fast frequencies, such as ABRs or EMG activity, you will want a fast AD rate. The general rule of thumb is: you should 5x oversample the highest frequency of interest. If all you cared about was alpha, you could, theoretically, use an AD rate of 50 (100 is the lowest option). Another point to consider is that as you double the AD rate, you are also doubling the file size. For the basic evoked potential recordings in this demonstration, an AD rate of 1000 will easily give the temporal resolution we need, yet not result in needlessly large data files.



The default number of channels is 32 (leave that for this example). There are four acquisition types, or modes. For this demonstration, select *continuous*. This will record the entire data stream, and we can create epochs offline. Continuous is the preferred acquisition mode because of the increased offline flexibility it allows. If you have a SynAmps or SynAmps^2, select *AC mode* (we are not interested in DC potentials in this example). Leave the 60 Hz (or 50Hz) notch filter disabled. If you have a SynAmps system, you may set the Gain and Filter settings individually for each channel. If you have SynAmps^2 or NuAmps, the Gain is fixed, but you can set the filter settings individually for each channel. The remaining sections of the screen let you select these settings, select the individual channels, and apply the settings to those channels. If you have a non-SynAmps/NuAmps system, the Gain and Filter settings are not accessible. These are set on your amplifiers and entered in the appropriate hardware section under *Setup*.

The first decision is what *Gain* to use. With a SynAmps, Gain will determine two things: the Range of acceptable input signals (how large signals can be before amplifier saturation occurs), and the voltage, or y-axis resolution, or Accuracy. These two factors are inversely related. The greater the Range, the lower the voltage resolution. There are about 65000 discrete points (16 bits) that are available for measuring voltages. If these are spread over a wide range, there is a greater distance between points, and therefore a lower resolution. If the points are concentrated in a narrow range, there is a smaller distance between points - finer resolution. Thus, there is a trade-off between range and resolution. For conventional EP and EEG recordings, a Gain of 500-1000 is a good compromise (select *1000* for this example).

With SynAmps^2, there is no Gain setting. The gain is fixed, but differs between AC and DC modes. In AC mode the Gain is 2966, and in DC mode it is 14.83. With NuAmps, there is a single Gain setting of 19.

For filter settings we recommend recording with as wide a band pass as possible. You can always refilter the data digitally offline. Depending on your particular interests you may wish to filter out faster or slower frequencies that are of no interest and serve only to obscure the online frequencies of interest. (For non-SynAmps systems these values are determined by the actual settings on your amplifiers, and are not accessible after you enter them in the hardware settings display.) Note that there is a relationship between the AD rate and the highest available low pass filter. The program imposes a 5x oversampling rate. For example, if you have an AD rate of 500, the highest available low pass filter setting is 100Hz. If the AD rate is 1000, the highest low pass filter is 200Hz, and so on. For this example, if you have a SynAmps, select a low pass of *100Hz* and a high pass of *.15Hz*.

The montage display allows you to apply the Gain and Filter settings to individual channels (SynAmps only). For this example, we'll leave the settings the same for

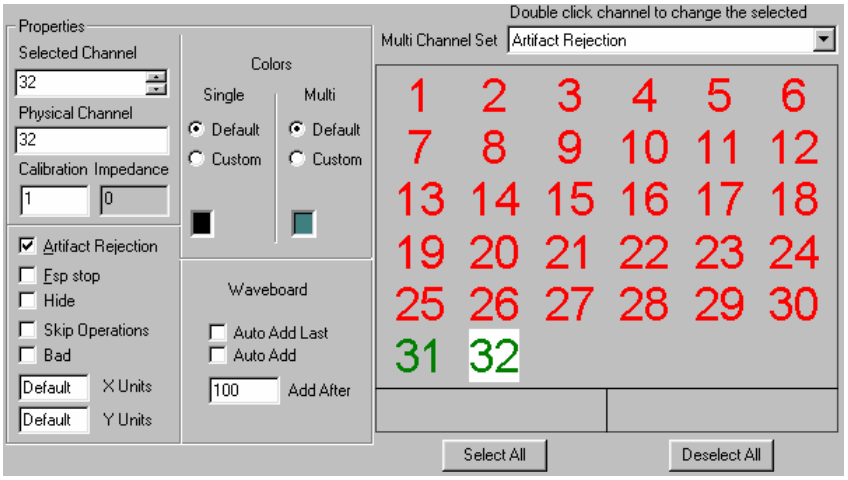
all channels. Make sure that the labels are all green in the montage display (click the Select All button, if needed). Then click the Apply To All Selected Channels -> button to apply the changes to all channels (the channels in green will be affected).

Channel Attributes. Now, click the **Channel Attributes** tab. This screen is used to set a variety of attributes for some or all of the channels. For example, you can relabel the channels, set specific ones to be Artifact Rejection channels, change the color of the waveform for specific channels, and so forth. For this example, let's set the Artifact Rejection channels. Artifact Rejection works as follows, and is essentially the same in both online and offline operations. Channels are designated for artifact monitoring. Voltage threshold values are entered. If the voltage in one of the designated artifact channels exceeds the threshold, the sweep is rejected. Since we elected not to use the online Artifact Rejection for the sorted averages, there will be no online artifact rejection (artifact rejection does not apply to the continuous file we will be storing). Artifact Rejection can be performed offline after you epoch the continuous file. If the artifact electrodes are selected in the setup, that information will be carried with the data file, and you will not have to designate the electrodes later. Assume that channels 31 and 32 are the VEOG and HEOG channels for this example. We will relabel the channels using the **Channel Assignment** display below.

Typically, the VEOG and HEOG channels are the artifact rejection channels, but other ones may be used depending on your particular needs. Make sure that the Multi Channel Set field is displaying Artifact Rejection

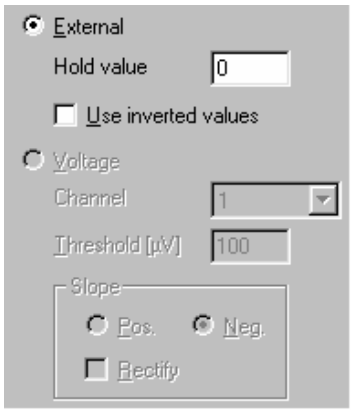
Multi Channel Set | Artifact Rejection

. The channels in the montage display are all Deselected by default. Double click channels 31 and 32 to Select them. They will turn green and a check mark will appear in the ☑ Artifact Rejection field. You can identify Artifact Channels in the data file - online or offline - by the asterisk that will appear after the electrode label VEOG*.



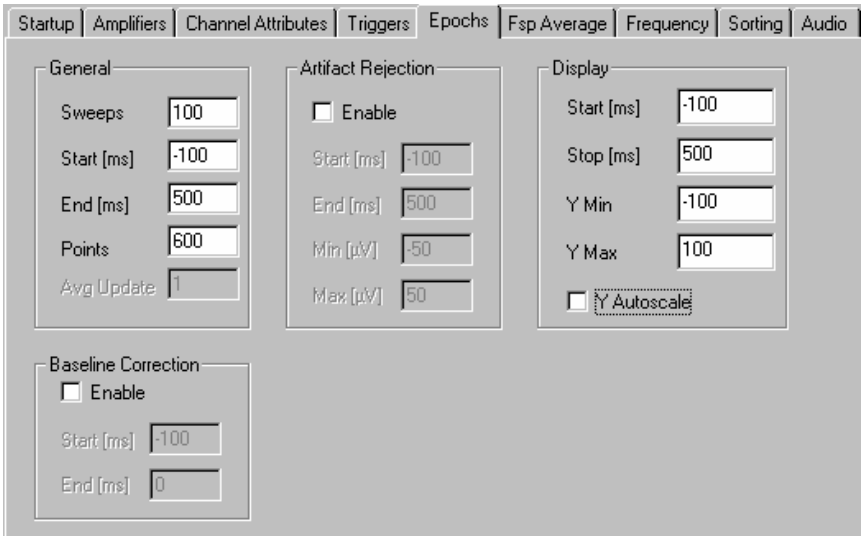
These channels are now designated Artifact Rejection channels.

Triggers. Now go to the **Triggers** screen. With a STIM system, select **External** with a **Hold value** of *0*.



Whether you **Use inverted values** depends on several things, including which type of STIM system you have. There is no simple way to determine what the setting should be for every possible equipment configuration. The best thing to do is to try it without inverting the triggers (with SoundBlaster STIM systems), and, if you do not see any triggers during acquisition, then try it again with inverted values. For a SynAmps system with the current STIM system that is being shipped, the Invert box should be *off* (not checked).

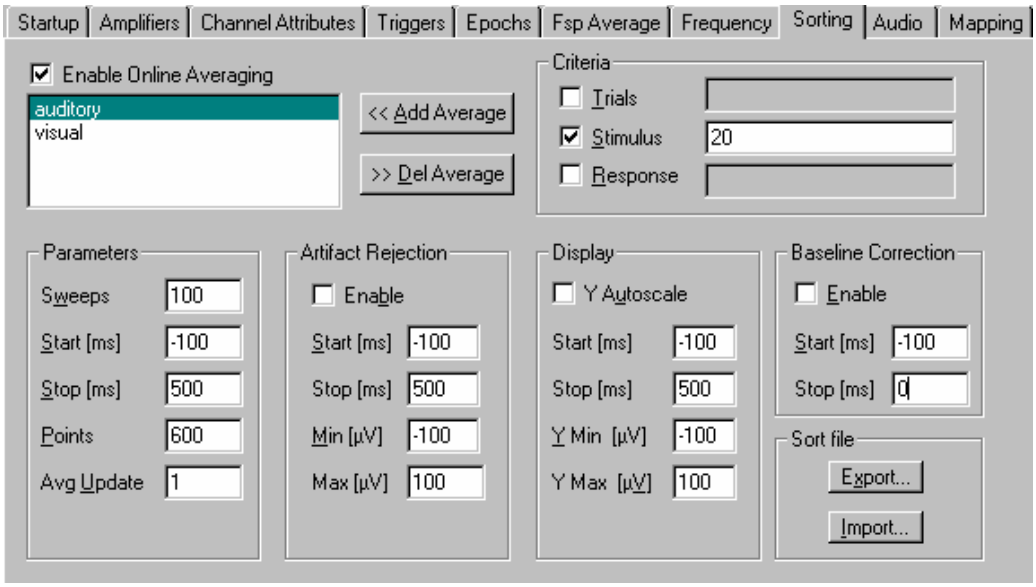
Epochs. Next, go to the **Epochs** screen. In continuous mode the epochs settings have no direct effect. However, the settings that are entered here are carried over



when you do the epoching offline. Therefore, it will save some steps later to enter the information here. **Sweeps** really has no effect either online or offline in continuous mode (enter *100*). At the beginning of this example, we said that the eventual sweeps will range from -100 (100ms pre-stimulus) to 500ms. Enter those values for the **Start** and **End** points. The **Points** value should be calculated automatically (600, with an AD rate of 1000). Leave the **Artifact Rejection** and **Baseline Correction** *off* (unchecked) for this example, and use the **Display** values that appear.

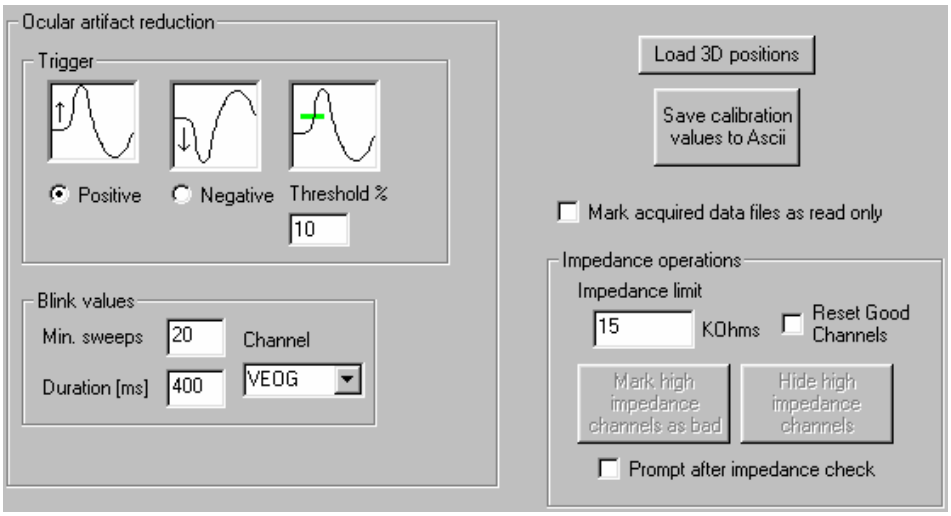
Sorting. It might be useful to display the auditory and visual EPs online as they develop - at least in the steady presentation condition - to insure that we are

obtaining good responses. Go to the **Sorting** screen, and click the **Enable Online Averaging** field.



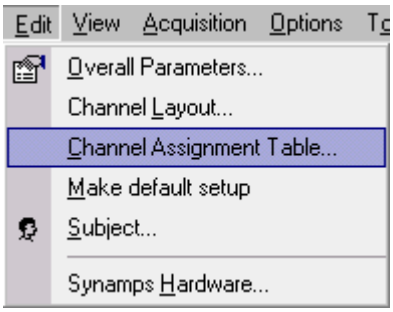
Click on **Add Average**, and the Save File utility will appear. Enter a file name for the responses to the visual stimuli (call it *Visual*), and note or change the path where the file will be saved. In the **Criteria** field, click the **Stimulus** field on (so that the check mark appears), and enter *10* - the type code we set in the sequence file for the first 25 visual stimuli. Under **Parameters**, verify that **Sweeps** is *100*, **Start** is *-100*, **Stop** is *500*, and **Points** is *600*. **Avg Update** lets you set how often the online average wave form display gets updated. To update with every stimulus, enter *1*. Leave the remaining fields off (not enabled). Next, click the **Add Average** button again, and enter a file name for the responses to the auditory stimuli (call it *Auditory*). In the **Stimulus** field in the **Criteria** section, enter a *20* (as specified in the sequence file). Verify that the remaining settings are as desired. By highlighting the Auditory and Visual file names under the Enable Online Averaging line, you can see the settings for each average file. When these are correct, click the **Export** button in the **Sort file** area, and enter a file name.

Misc. The miscellaneous tab lets you enter several settings that may be useful. Entering settings in the setup file means you do not have to reenter the settings for each file when you analyze them.

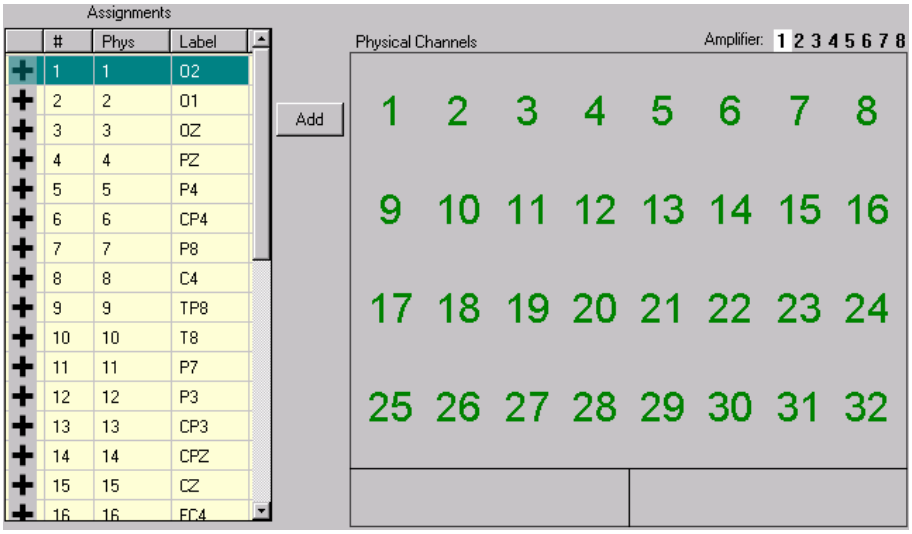


For example, you can set the Ocular artifact reduction parameters, load 3D position data, save the calibration values to a text file, set the files as Read Only, and automatically mark as Bad or Skip any channels that have unacceptable impedances. These options are all described more completely in the ACQUIRE manual.

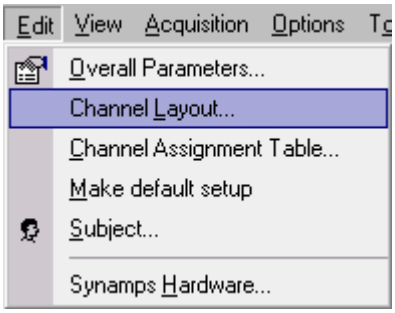
Channel Assignments. Then go to **Edit\ Channel Assignment Table...**. This screen allows you to enter the labels for the electrode positions (FP1, FP2, etc.).



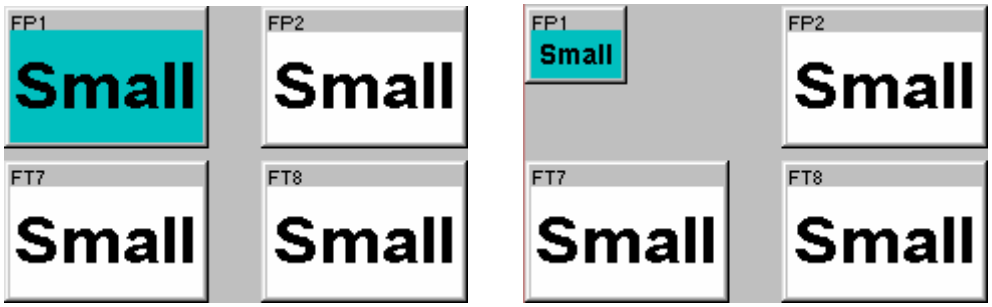
If you are remapping the channels, you may set the new order using this screen (SynAmps; refer to the SynAmps and/or ACQUIRE manuals for more details).



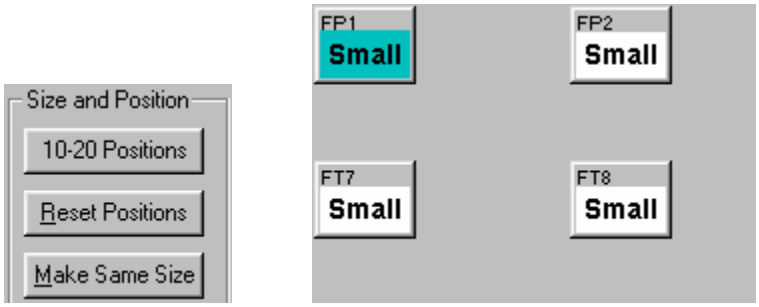
If you have more than 32 channels, use the fields at the top of the display to access the additional amplifiers. In the display above we have entered in some modified 10-20 system labels. When you are finished, click **OK**. Note: if you start with an existing setup file (similar to the one you want to use), rather than the **Make default setup** option, you can avoid having to enter in all the labels (and positions). We supply a number of setup files for use with different caps. One of these may work "as is" with your system, or may require only minor modification.



Channel Layout. Next, go to **Edit\Channel Layout...**. Here we will arrange the channels to approximate the extended 10-20 system montage and create a second display page. It is often easier to arrange the individual channels by decreasing the size of the displays, moving them into position, and then enlarge them to a size that fits the window. To do this, highlight an electrode by clicking on the colored bar at the top of the display where the label is (the display will change colors).



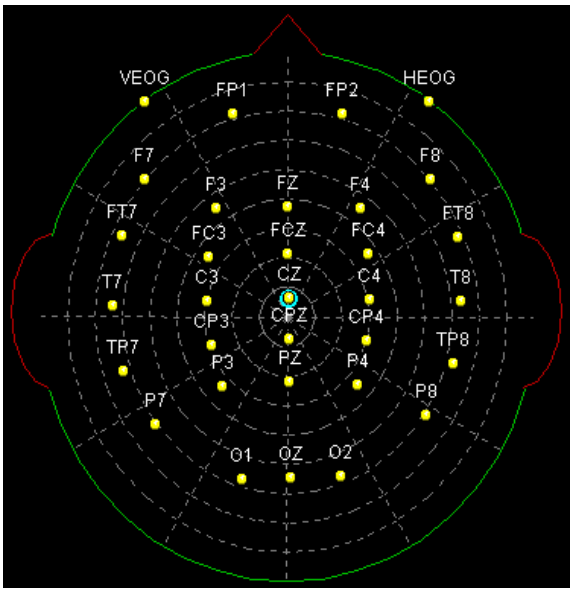
Position the mouse at one of the lower corners of the electrode display, and it will change to a bidirectional arrow pointer at a 45 degree angle. Click and hold the left mouse button to drag the window into a smaller size (same as resizing most windows in Windows). Then look on the Channel Layout... screen, and click the **Make Same Size** button. This will resize all the electrode displays.



You can then easily position them into whatever arrangement makes sense for your setup, leaving room to enlarge them as space allows. If desired you can

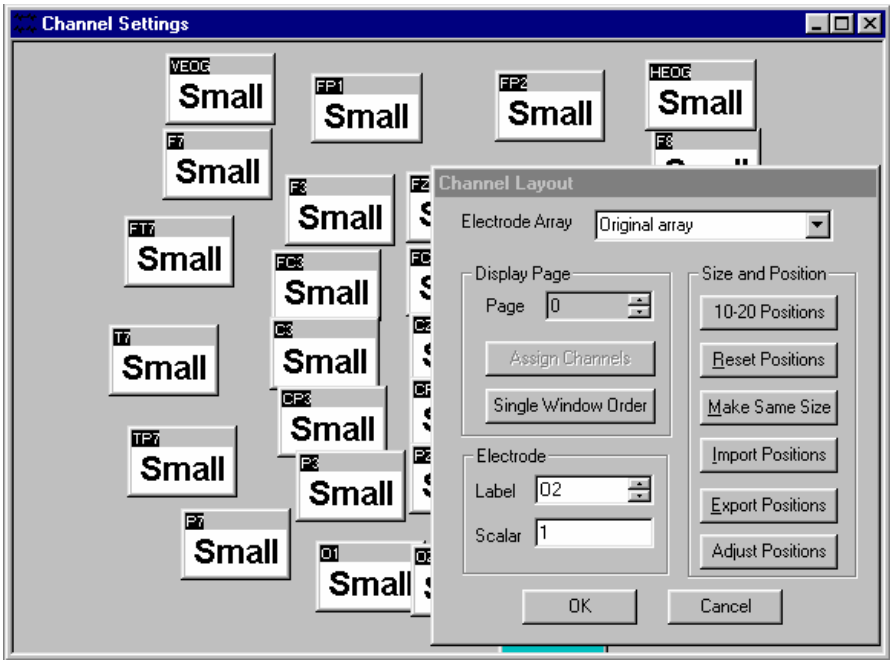
move the Channel Layout display almost completely off the screen to have more room. You may find it useful to use the Adjust Positions option, which will let you reposition and resize the windows automatically.

If you are using conventional 10-20 System electrode labels, the program will position the electrodes automatically. Click the 10-20 Positions button, and you will see the following display.



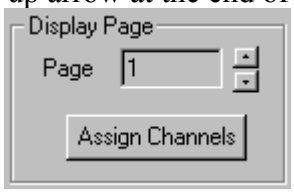
You can reposition the electrodes manually, or click the Match Labels button to do it manually (for the electrode labels that are recognized). Then click OK to close the screen and transfer the positions to the Multiple Windows display. (See the ACQUIRE manual Channel Layout section for complete details).

When you are finished, be sure to click OK to save the positions. Then reenter Channel Layout..., highlight one display, enlarge it, and use the **Make Same Size** button to make them all the same size (and/or use the Adjust Positions button adjustments).



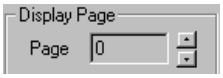
Note: if you have more than 32 channels, but only 32 are displayed, click the ***Reset Positions*** *button on the Channel Setup display.*

Lastly, for demonstration purposes, we will create a second display page. Since we will be looking at AEPs and VEPs, perhaps it would make most sense to display the primary midline and artifact channels on the second display page (FZ, CZ, PZ, OZ, VEOG and HEOG).

Click the up arrow at the end of the Page field under Display Page, so that a 1 appears. 

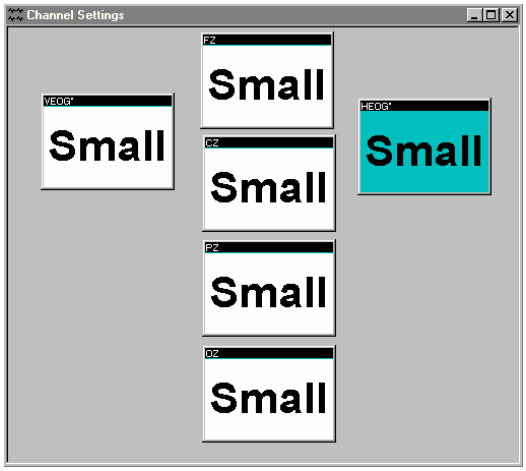
Then click the 

button. You will see the montage display with all channels in red (deselected). Double click on the channels you want to be displayed on the "Next display page" (FZ, CZ, PZ, OZ, VEOG and HEOG), and click OK. You may then resize and reposition the electrode displays as desired. The final layout may look similar to the following.

Click the down arrow 

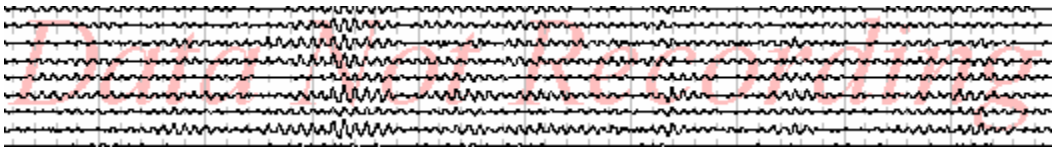
to return to the original display page.

When you are finished, click OK, then go to **File\Save Setup...** and resave the final setup file (the .ast extension is added automatically).

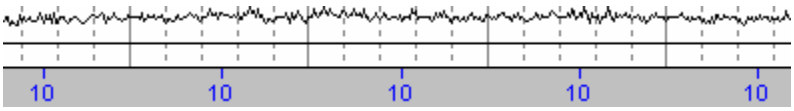


Stimulation and acquisition.

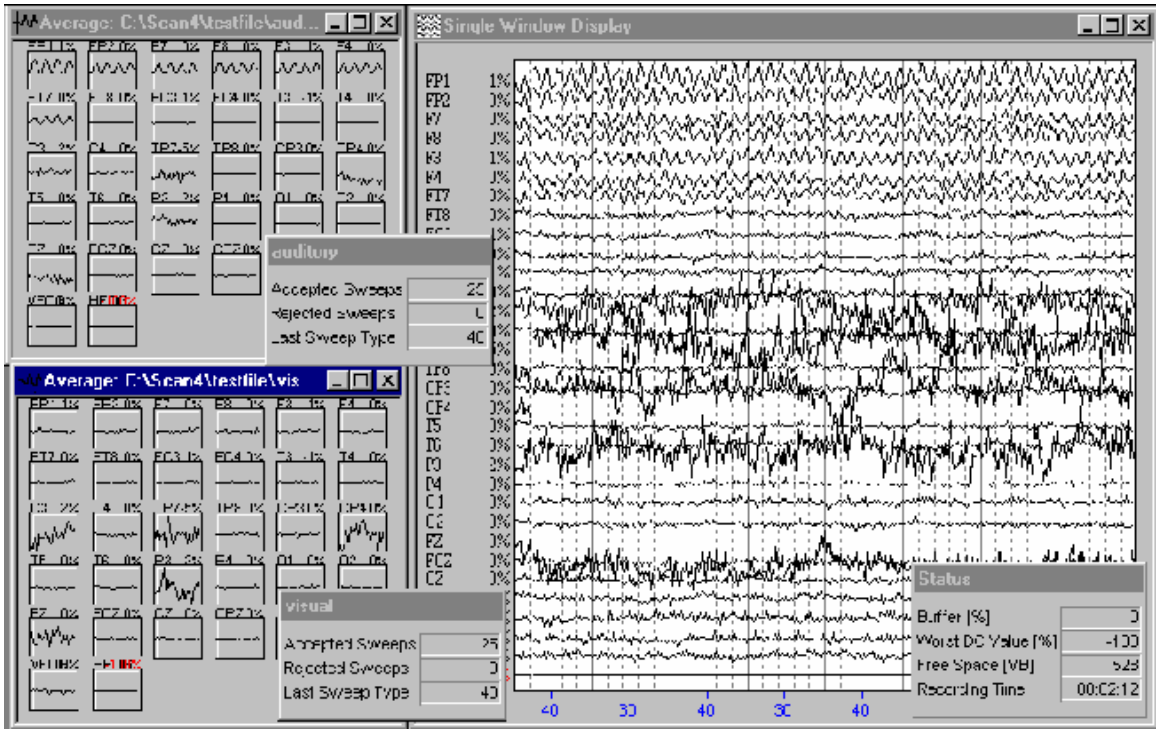
Now, we should try out what we have created so far. Always test your various setup and sequence files before trying to record from a subject. On the STIM PC, set Gentask so it is ready to run the sequence file we created ("*Press a key to begin*" message). Then, on the SCAN PC in ACQUIRE, click the green arrow  on the Tool Bar to begin acquisition. You will be asked to enter a file name for the two sorted average .avg files, then the acquisition screens will appear. You will see a reminder message that the data are not being recorded - it will disappear when you begin data storage.



Resize and reposition the windows and status boxes, as desired. Click on the **Record** icon  and enter a file name for the continuous (.cnt) recording. Then press a button on the STIM PC to begin stimulation. You should see the trigger type



codes from Gentask appear as blue numbers on the bottom of the Single Window Display in ACQUIRE. The entire screen might be set to appear as (open noise recording):



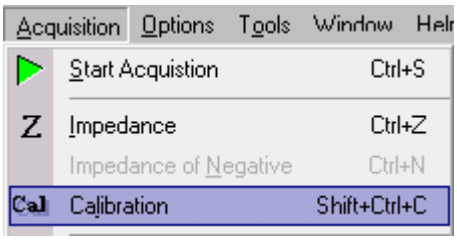
During acquisition, if you want to see the channels that were placed on the second display page, just click on the Display Next Page icon  on the Tool bar. To go back to the previous display page, click on the Previous Display Page button  .

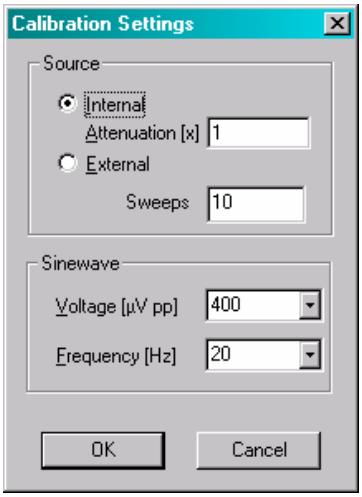
Go ahead and save the continuous file for the duration of the sequence file in Gentask. You can use it later in Edit to do a mock analysis.

Calibration

Before recording genuine data you should perform an amplifier *calibration* (for more details, please see the Calibration section in the ACQUIRE manual, and the SynAmps manual). The current versions of NuAmps and SynAmps² have no calibration

option (the amplifiers are set in the factory, and no adjustments are needed). Click **Acquisition\Calibration** (or click the Cal icon from the Toolbar). If you have a

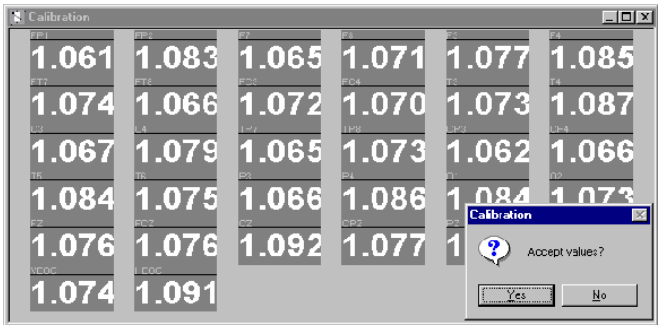




SynAmps, make sure the shorting plug is in the head box, then use the default settings on the calibration screen (Internal, Attenuation X1, 10 sweeps, 400uV, and 20Hz).

The shorting plug is a connector with a plastic loop on it, and a jumper between two jacks. It plugs into the side of the SynAmps head box, adjacent to where the head box cable to the SynAmps plugs in. Its purpose is to short all the channels together. Remove it after Calibration, or else you will see nothing but flat lines when you try to acquire data.

Click OK, and the system will pass a 20Hz sine wave through all channels. If the display shows a flat line, click the Up arrow a few times. After the 10th sweep, you will see the calibration values for all channels. These should be approximately 1.0 (with a SynAmps, they usually run a little higher, about 1.05 to 1.1).



Accept the values, and then save the setup file again before you start acquisition.

Impedance testing

If you were running a real subject, you would typically do an impedance test to make sure the electrodes were on securely. These steps are discussed in more detail in the ACQUIRE manual, and, if applicable, the SynAmps manual. With a SynAmps, there are some additional considerations. The SynAmps is a full range, true DC capable amplifier, meaning that you can record signals ranging from slow DC, to fast EMG, to

very fast ABR frequencies. Because it is a true DC amplifier, you need to pay more attention to *battery potentials* that may build across electrodes (see also the "DC electrode considerations" section of the SynAmps manual, and the "Battery Potentials and DC Offsets...." Technical Note on the web site).

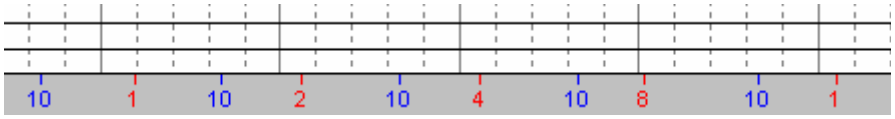
One of the common problems new users encounter is the inability to get acceptable impedances (e.g., below 5kOhms). If your impedances are high in all channels, and you are fairly certain that the reference and ground electrodes have good contact with the skin, *DO NOT KEEP DIGGING IN THE SUBJECT'S SCALP*. There may be a battery potential difference between the EEG electrodes and the reference electrode(s). This can happen if you mix metals, use different conductants, have scratched or pitted electrodes, or electrodes made of inferior quality metal. Using a DC voltage meter, measure the DC potential between electrodes, as described in the Tech Note. If it is too high (greater than 18mVs), you have a problem with your electrodes which needs to be resolved before you make a recording.

Generally we suggest that before you perform the actual Impedance measurement, you monitor the signals from all channels in a Single Window Display, in DC mode. Touch up the channels that are saturated, popping, or have a high percentage of DC offset. If necessary, reduce the Gain (under Edit\Overall Parameters). This increases the range, and will thereby accept signals with a greater DC offset (before saturation occurs). When all of the channels look good, with acceptable DC offsets, then do the Impedance measurement. If there is a DC problem you will see it, and thereby avoid needless discomfort to the subject from pointless scraping of the scalp. ***Also make sure the shorting plug is out when you do Impedance testing.*** If it is in, all channels will be shorted, and you get essentially 0 Ohms from all electrodes.

In this demonstration we created some simple stimuli, a sequence file to control their presentation, and a setup file in ACQUIRE to record the evoked responses. If you were able to perform all of these steps, and were able to see triggers in ACQUIRE, then your system is configured correctly. One more thing to test are the responses from the STIM response pad.

Response pad test

To perform a quick test of the response pad, start the same setup file used above. It is not necessary to be running the Gentask sequence file - just press the response pad buttons (you do, however, need to have started at least one STIM task after switching the STIM box on to activate the response pad). You should see type codes of 1, 2, 4 and 8 corresponding to response pad buttons 1, 2, 3, and 4. These will appear in red at the



bottom of the Single Window Display, similar to the blue stimulus triggers displayed above.

This concludes the overview demonstration. If you are interested in performing a mock analysis of the file you recorded, please see the VISCPT tutorial in the beginning of the Edit manual, and other sections in the manual. Steps that you might select include epoching the continuous file, offline filtering, baseline correction, artifact rejection, artifact reduction, sorting for the desired type codes, and averaging the sweeps.

Appendix A

Resource Identification and Conflict Resolution for STIM

A common problem that may occur with a new installation is a resource conflict between one of our cards and some other card or device in the PC. While we assume that the STIM PC is dedicated for the Neuroscan system, there can still be problems arising from resource conflicts.

Required Resources

For this section we are assuming you have the newest version of the STIM system (SoundBlaster™). If you have older components, please refer to the Technical Note on the web site entitled ***PC Resources***.

SoundBlaster™ STIM systems use the SoundBlaster™ AWE 64 sound card and the P I/O 24 card. Use only the cards supplied by Neuroscan. The following list displays the default/preferred resources for these cards:

Card	Base I/O	IRQ	DMA
SoundBlaster™	220h 330h MIDI	5	1 (low) 5 (high)
P I/O 24	350h	3	none

Notes:

1. The Metrabyte DAS and P I/O 24 cards will not appear in the Device Manager in Windows.

2. A common conflict occurs on the STIM PC if there is a second serial port (COM2). COM2 typically uses the same IRQ as the P I/O card (IRQ 3). It is frequently necessary to disable COM2 to resolve the conflict.

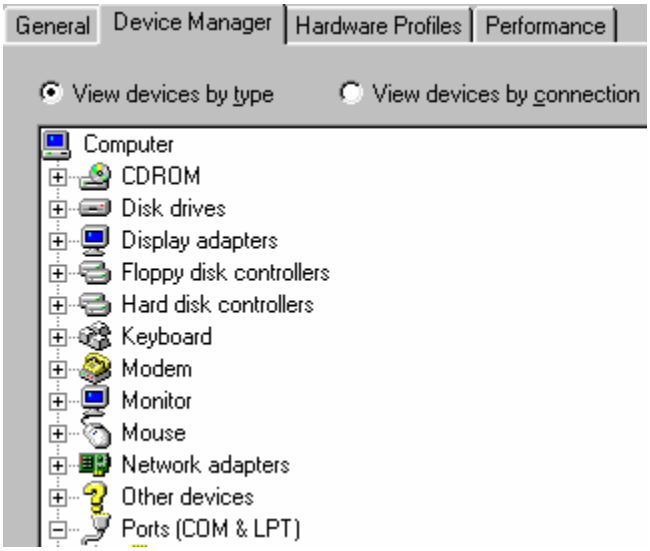
3. PCs often arrive with their own sound cards. These may or may not be on the motherboard. The SoundBlaster™ that comes on the motherboard is not the same as the SoundBlaster™ we provide. The one on the motherboard typically needs to be disabled (on the STIM PC).

Resolving Conflicts

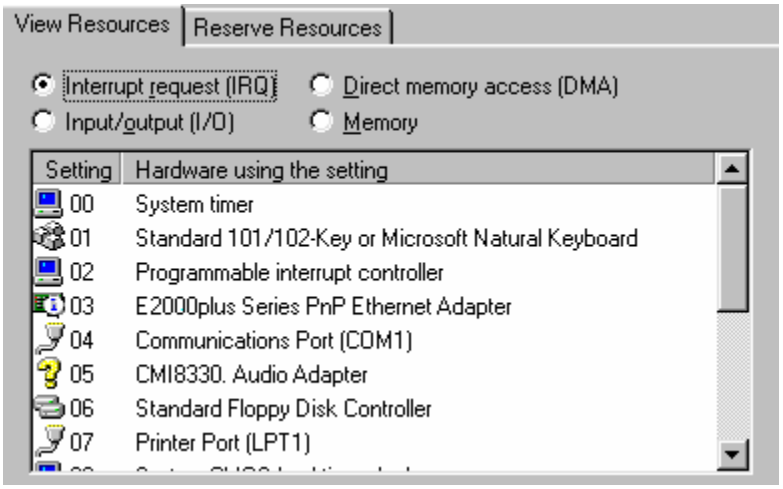
We recommend that you check for potential resource conflicts even before you install the cards. The easiest way to see if there are going to be problems is to do the following (in Windows 98; other operating systems will be similar):

Click on the **My Computer** icon with the *right* mouse button, and select **Properties**.

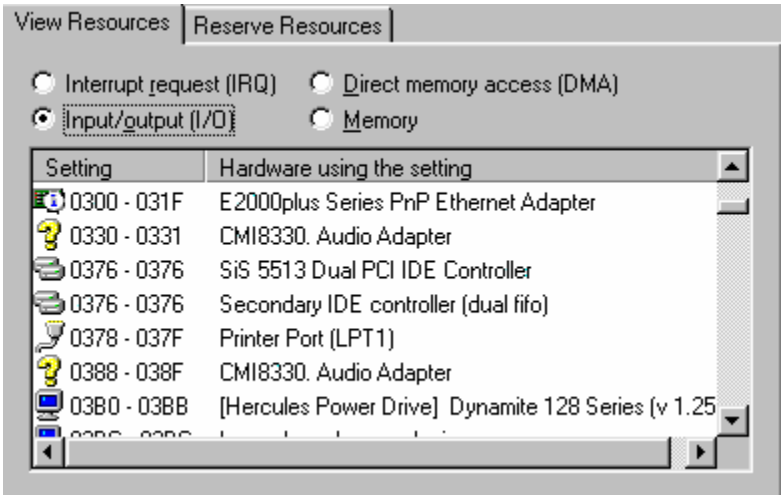
Then Click on the **Device Manager** tab to see a list of detected devices in the PC.



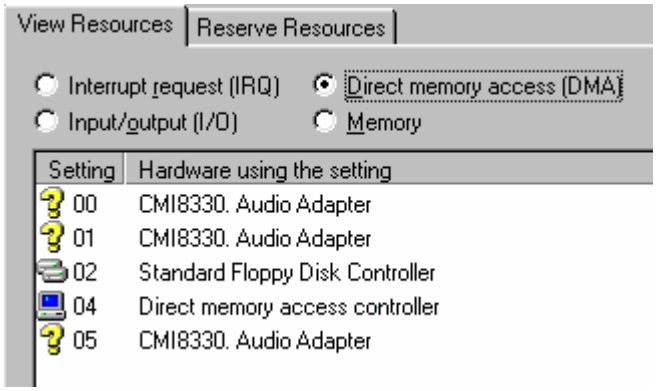
With the *left* mouse button, double-click where it shows Computer, and you will see something similar to the following screen with IRQ allocations.



At this point you just want to see if there are free IRQs for the cards you are installing. Check the STIM PC for the IRQ settings you will need. Then click the **Input/Output** button at the top of the display to see the base addresses.



Check the base I/O addresses for the STIM cards you will be installing. For example, see that nothing is occupying the 350 range if you are installing the P I/O 24 card. Then click the **Direct memory access** button to see the DMA channels that are being used.



The SoundBlaster™ (STIM) will need DMA channels 1 and 5, and the Metrabyte DAS will need DMA 6 (or 5).

If all of the resources are free you should have no problems with resource conflicts. If there are potential conflicts, the next section provides suggestions for how to resolve them. It is not possible to give precise directions for every possible conflict that could occur. Instead, we have listed the approaches that are generally used to resolve the conflicts.

What are the symptoms of a resource conflict? The symptoms can range widely depending on what cards are involved. For example, if you do not see any stimulus and/or response triggers in ACQUIRE, this could be due to a conflict between the P I/O card and COM2. If you are having trouble playing and/or recording sound files in STIM, there could be a conflict with the SoundBlaster™ card. If you cannot vary the dB level in STIM, there could be a conflict with the P I/O-24 card.

What if you do not have Windows 95/98 on your STIM PC? Since the current version of STIM must run in DOS (not in the MS-DOS shell of Windows), some people elect not to install Windows on the STIM PC. Older versions of DOS had a program called

MSD.exe (MicroSoft Diagnostics), which was useful in conflict resolution. We have not seen this with newer versions of DOS. The PC setup programs may or may not provide this information. The alternative then is to just install the cards and then deal with conflicts if they appear. If you can determine the resources used by other cards/devices in the PC, that will also be helpful. For example, COM2 typically uses IRQ3, which is needed by the P I/O card on the STIM system. In most of these instances it is necessary to disable COM2 in the PC setup, since there are rarely free IRQs in the range the P I/O card can use.

The remaining option is to remove the cards that are not essential for the PC's basic operation, leaving only the SoundBlaster™, P I/O 24, and video cards (and other essential cards). See if STIM functions properly. If so, begin adding the cards you removed, one at a time, checking the operation of STIM after adding each card. Eventually one, or more, cards will cause the STIM problem. See the section below for resolving the conflict.

How do I resolve the conflict? Resource conflicts may be resolved in a number of ways. (For Windows documentation and assistance, go to the Windows Help file and look under the Topics called "Hardware Conflict Troubleshooting" and "IRQ"). The options for resolving conflicts include reassigning the resource settings using software options, making jumper or switch changes on the cards, disabling a card/device and removing its software from within Windows, disabling a card in the PC setup, and physically removing a card and removing its software. What options are available depends on the cards/devices that are involved. The following list shows what resources can be modified, and the means through which to make the modifications, for the cards we provide. It may be helpful to obtain the same information for the other cards/devices that are involved.

> *IRQ conflict (STIM only)*. The IRQ setting is controlled by a jumper on the card. To change it you must turn the PC off, ground yourself, remove the card, and move the jumper. The set of IRQ pin pairs is labelled from 3 to 9, and moving the jumper will change the IRQ setting. IRQs of 3-9 are possible. The default is IRQ 3, and this is typically used by the second serial port (COM2). Frequently, there are no free IRQs between 3 and 9. It is sometimes possible to move the SoundBlasterTM to a higher, available IRQ (e.g., 10 or 11), and move the P I/O card to 5. You should then run STIMTYPE.exe to make the changes throughout the STIM programs. Contact Neuroscan Technical Support if you have any questions.
>
> The only other recourse is to disable COM2. This is generally done from the PC's setup. The method for entering the PC setup varies from computer to computer. Sometimes you will see the key to press during the boot messages. If you do not see this, consult your PC manual to determine how to get into the setup and disable the port.

SoundBlaster™ card. The SoundBlaster™ is a Plug and Play card that can be seen in the **Device Manager**, thus making it easy to see if there are conflicts. However, if Windows95/98 is not installed on the STIM PC, this can get a little more difficult to resolve.

Base address conflict. The base addresses cannot be changed (I/O at 220h and MIDI at 330h). If they conflict with another card, it will be necessary to change the other card, or remove it (and remove its software, if necessary).

IRQ conflict. It is best to leave the IRQ at 5. It can be changed by adding a line to the autoexec.bat file (in the root directory) using the following convention:

set blaster=A220 I5 D1 H5 P330 T6,

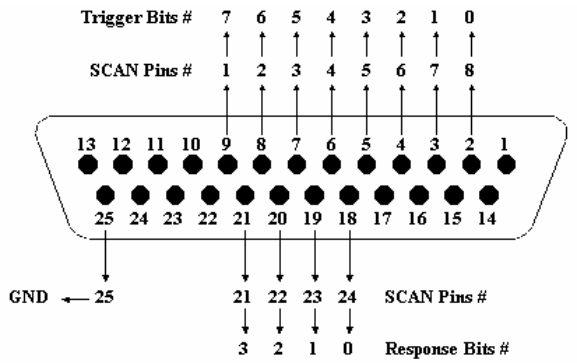
where the I is the IRQ setting. It may also be possible to make the change from within Windows. You will need to enter the new IRQ value when you install the STIM software. If you have already installed the STIM software, you can use STIMTYPE.exe to make the changes throughout the *.cfg files in STIM. (Note: the "set blaster" line does not configure the SoundBlaster™ card. It only lets programs that use the SoundBlaster™ know what resources have been allocated for it. Configuration of the SoundBlaster™ is accomplished with the ctcm.exe program (described above).

DMA conflict. DMA conflicts are fairly rare. It can be changed on the *set blaster* line just above. The D and H are the low and high DMA channels.

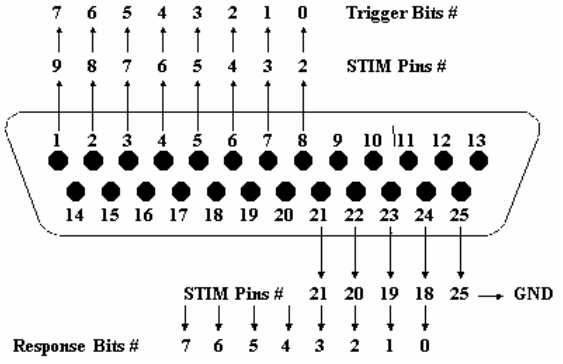
Appendix B
Trigger Port Interfacing

SCAN and STIM can each be interfaced with external devices, including, for example, other stimulation devices or systems. STIM can be used to trigger an external device, or it can be triggered by an external device. SCAN can be triggered by external devices or software independent from STIM. Any of these can be accomplished by mimicking the TTL signals sent by the STIM or expected by the SCAN systems.

In a normal configuration, the method of triggering between the SCAN and STIM systems is to connect the Parallel I/O ports on the back of the SCAN and STIM interfaces by means of a STIM-to-SCAN cable. This cable is provided to customers who purchase STIM systems. A STIM-to-SCAN cable is a grey, 25-line cable with a female connector at the end marked SCAN and a male connector at the end marked STIM. Below is a diagram of the connections within a STIM-to-SCAN cable.



Back of STIM Connector



Back of SCAN Connector

Response pad pins

On the back of the STIM connector the response pad lines are 21, 20, 19 and 18, carrying response bits 3, 2, 1 and 0. On the back of the SCAN connector the response pad lines are 21, 22, 23, and 24, carrying response bits 3, 2, 1 and 0.

For the purposes of this section, we will be concerned only with mimicking the stimulus triggers (and not the response triggers). These are 8-bit, positive logic TTL pulses. Positive logic is defined as a transition from the zero state (ground) to a one state (5 volts TTL). The duration of the pulses can range from 1 to about 10ms, or slightly longer. As you can see from the diagram above (Back of STIM connector), bit 0 is carried on pin 2, bit 1 on pin 3, and so forth. When bit 0 is high, a 1 will be seen in ACQUIRE (in continuous mode). When bit 1 is high, you will see a 2. When both are high, you will see a 3. Bit 2 gives a 4, bit 4 gives an 8, bit 5 give 16, and so on, ending with a 128 trigger type code in ACQUIRE when bit 7 is high. When all bits are high you see 255 in ACQUIRE.

The following methods of triggering are possible:

Triggering an external device with STIM: An external device can be triggered independently from acquisition in SCAN, or in conjunction with triggering in SCAN. The latter is more common. How you split the STIM-to-SCAN cable will determine the control you have over the device and the ACQUIRE software. Let's say you wish to trigger the devices independently, that is, you want to trigger an external device at certain time points, and you want to send triggers to Acquire during the intervening time spans.

To do this you will need to split the output from the STIM-to-SCAN cable. Let's say that the other device needs only a 1-bit TTL pulse for triggering. One branch of the STIM-to-SCAN cable should go from pin 2 (on the back of the STIM connector) and GROUND (pin 25) to the external device trigger input. The remaining leads, plus GROUND, go to the SynAmps or P I/O-24 card, as usual. When you send a type code of 1 from STIM, the external device will read that as its trigger. Since the output from bit 0 (type code of 1) is no longer going to ACQUIRE, you cannot use a type code of 1 in STIM as a trigger for ACQUIRE. Moreover, you cannot send any odd numbered type code to ACQUIRE, because any odd number type code must use bit 0. To send triggers to ACQUIRE only, use any even numbered type codes. If you want to send triggers to both devices at the same time, send a type code of 3 from STIM. ACQUIRE will receive it as a 2 and the other device will receive the single bit trigger.

The BYTE command in the Gentask sequence file provides another way to control triggering. This command will send out a pattern of bits from the triggering port on the back of the STIM Audio System (using the STIM-to-SCAN cable). For more information, please refer to Page 57 of the Gentask manual. (Note: with a SoundBlasterTM system the TTL signal uses positive logic, not inverted as it says in the manual). You can specify the control byte to be sent (0-255), the duration of the pulse, and the state the port is left in after the pulse has been sent. A typical line from the sequence file might appear as:

```
100    BYTE    .01    0    0    0    0    0    20    0
```

This will send a 10ms type code of 20 out of the triggering port. The 5th field will determine the state of the port after the duration of the pulse (refer to the Gentask manual for details).

Much of the time *you can use a "dummy" stimulus to control external triggering* instead of the BYTE command. For example, create a blank CUT file, and insert it when you want to

```
100    CUT    .01    0    1.0    0    0    0    25    dummy
```

send a trigger. The TYPE field will let you specify the type code that is sent (e.g., 25). The duration (DUR), .01in this example, is the duration of the stimulus presentation. The duration of the trigger pulse is set on the Config. screen.

When do you use the dummy file, and when do you use the BYTE command? Some considerations are: The dummy CUT line will appear in the behavioral data file (.DAT file) in STIM; the BYTE command will not have a line in the DAT file. The BYTE command allows you to vary the duration of the trigger pulse independently from the duration you set in the Gentask Config. screen. The BYTE command gives options for how you leave the port's state, depending on your needs.

The STROUT mode command in Gentask can be used to control an external device by sending a string via the serial port. You can send a string from the

```
100    STROUT    0    0    0    0    0    0    5    trigger
```

COM port (trigger) and a TTL trigger (5) from the trigger port (i.e., to ACQUIRE) at the same time. If you use this option be sure to add the COM information in the Gentask.cfg file. Please refer to the "New Features of Gentask" Technical Note on the web site for more details.

The SOUND program can also used to trigger external devices. In the typical case a click is created with the dB set to the maximum value. The trigger output is the voltage pulse sent out the headphone jack on the STIM Audio System unit. The duration and the ISI are controlled in the SOUND software, as well as the number of triggers that are sent. Please refer to the SOUND manual for more details, and contact Neuroscan Technical Support if you encounter any problems.

Triggering STIM from an external device: STIM can receive external pulses through the phone jack where the STIM response pad is connected to the STIM Audio System. The idea is to mimic the signals from the response pad, and use the RESP field in the Gentask sequence file to register the pulses. For details about the Response Pad specifications, please refer to the Technical Note on the web site entitled "Response Input Interface Guide". In Gentask, there are a couple of ways that the responses may be registered. One way is to use the WAITFOR command (see page 62 of the Gentask manual). The line in the Gentask sequence file might look something like:

```
100    waitfor    0    0    0    0    0    1    0    0
```

The Gentask sequence will wait for a pulse mimicking button 1 on the response pad.

The other way is to use the IF mode (see the New features of Gentask Technical Note on the web site). This adds the option for conditional branching. The lines in the sequence file might look something like:

```
 90     cut     0     wait     1.0     0      0      1      10      message
100      if    resp    1        1     goto   110    goto   150       0
```

"Message" in line 90 might be a cut file you create that says something like "Waiting for External Device Input". The program will display the message one second after the previous stimulus (5th column), send a type code of 10 to ACQUIRE (9th column), and wait (4th column) for a pulse mimicking button 1 on the response pad (8th column). Line 100 translated literally means: If the response is from button 1 (literally, range of button 1 to button 1), go to line 110, which could initiate the next sequence of events. If the response is not from button 1, go to line 150, which might end the sequence. This approach assumes you have the capability of sending more than a 1 bit trigger from the external device.

Triggering SCAN from an external device: ACQUIRE can receive triggers from an external device, such as a different stimulus presentation software package, by mimicking the expected TTL pulses. To register a type code of 1 in ACQUIRE, you would need to send the pulse to bit 0 (pin 8), and connect the GROUND pin to ground on the other device. Use the same TTL pulses as described above (duration should be at least 1ms, and up to about 10ms). Be sure to short any unused stimulus trigger pins to GROUND (to avoid possible spurious triggers). If the other stimulus package will send more than a 1-bit TTL pulse, ACQUIRE can receive more than just a type code of 1 (up to 8 bits, yielding types codes up to 255).

If you are connecting an external stimulation system to SynAmps/NuAmps, you will also need to mimic the expected inputs from the Response lines. Unlike the positive logic used with the stimulus lines (where the resting state is 0Vs), the response lines use negative logic, where the resting state is high (5Vs, or logic level of 1 in Test Trigger Port). If you are having problems getting triggers from your own stimulus system, please see the next appendix for troubleshooting tips.

We do NOT recommend sending voltage triggers through the head box. The external mode for triggering, using voltage thresholds on a designated channel, is designed for psychophysiological activity (such as blinks, etc.). Connecting an external device creates a potential risk to the subject. **Do NOT connect any peripheral devices without contacting Technical Support first.**

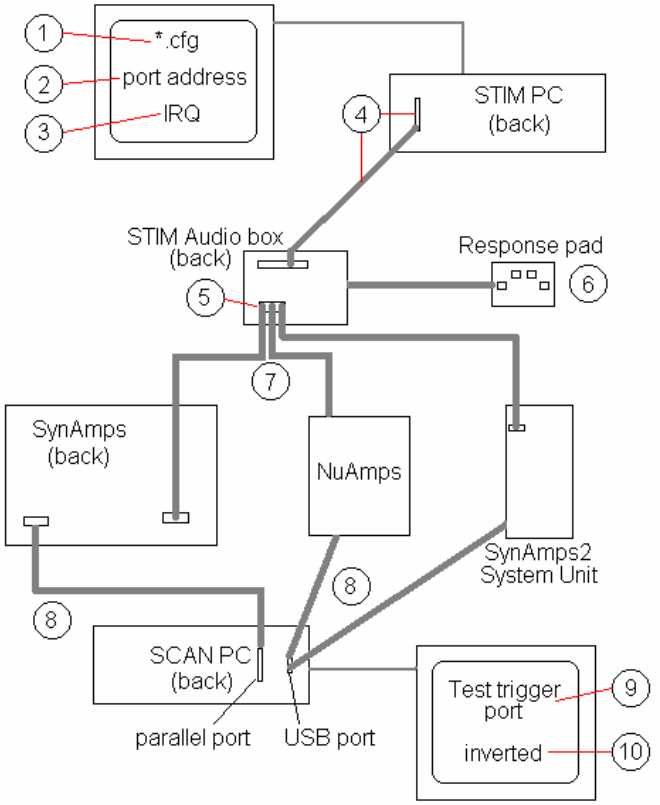
Appendix C
Troubleshooting Triggering Problems

One of the problems that arises occasionally involves the loss of triggers seen in ACQUIRE. This can be due to errors in one or more of several settings, configurations, or connections. The following information will help determine where the problem is, and what to do to fix it. The first section shows the points where the breakdown can occur. The second section is for troubleshooting.

I. Triggering Check Points.

In the diagram, we start on the STIM side, and point out possible sources for the loss of triggers through to the SCAN side of the system.

Note: the information below pertaining to Metrabyte AD and I/O boards is relevant to the current ISA bus boards, and is in use up to and including SCAN 4.2. The Metrabyte and LabMaster AD cards are not supported under version 4.3



1. **Incorrect setting in the *.cfg files**. Open the stim.cfg file (in the c:\stim folder) using a text editor program, such as edit.exe (in DOS). The ADDRESS line should read 848 for Soundblaster (SB) systems, or 1808 for the older Labmaster (LM) systems. Each of the programs in STIM has its own folder, and its own *.cfg file. The same ADDRESS should appear in each *.cfg file. Check, for example, the gentask.cfg file (in the c:\stim\gentask folder), and make sure the ADDRESS is 848 (or 1808).

2. **Incorrect setting in the Port Address setting in the STIM software**. Open the STIM program(s) that you are using, retrieve a setup file, and go to the Config screen. Make sure that the Port Address setting is 848 for SB systems, and 1820 for LM systems (not 1808). Every setup file must have the correct address.

3. **IRQ conflict**. Probably the most common cause of lost triggers is an IRQ conflict with the PI/O board. The PI/O board uses IRQ 3 (on the STIM PC *only* - no IRQ is used

on the SCAN PC), which is typically used by COM2. The easiest solution is to disable COM2 in the computer setup. Rarely does anyone have a use for it. Otherwise it means reassigning IRQs so that there are no conflicts (see the Tech Note at http://www.neuro.com/neuroscan/resource.htm for more information). If you happened to install the SW for the PI/O card, delete it (it is not needed, and it can render the card unusable for STIM).

One quick test is to run the demo program in Gentask called ASAPAUD. You should hear relays clicking in the STIM Audio system unit as the program runs. The relays are controlled by the I/O card, and this will let you hear whether at least that much is functioning. If you hear no relay clicks, look more into problems with the PI/O board.

4. **PI/O cable connection**. Make sure the ribbon cable is well connected to the PI/O card on the back of the STIM PC and STIM Audio system unit.

5. **STIM-to-SCAN cable connection** - STIM side. Make sure the stim-to-scan cable is connected to the back of the STIM audio unit - NOT the parallel port on the back of the STIM PC. *Make sure the STIM Audio unit is turned on*.

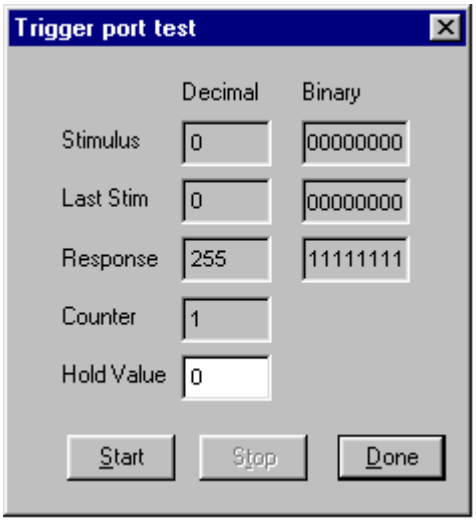
There is one configuration where the cable may be plugged into the STIM PC. This is when you do NOT have the STIM audio box, but DO use STIM for presentation of video images. In this case, make sure the CFG files, and the setup files for the STIM modules (e.g. the .GEN files in Gentask) read the port address as 888, AND that the response lines in the STIM-to-SCAN cable have been cut.

6. **Response pad testing**. Testing the response pad is a quick way to see if triggers are being generated in the STIM side. Run the DOS utility program called tstpad.exe (in the c:\stim folder). Start the program and press the buttons on the response pad. You should see a reaction in the tstpad program for each press - what the numbers actually mean is not really important here. Also, run, for example, the P300 demo program in AUDCPT. When it asks for a DAT file name, give it one you can find. Run the program, pressing the response pad buttons to the stimuli (it doesn't matter if they are correct or not). Then retrieve the DAT file, and see if the responses were registered. If so, the triggers are probably OK on the stim side.

7. **STIM-to-SCAN cable connection** - SCAN side, with SynAmps/SynAmps^2/NuAmps. Make sure the SCAN side of the stim-to-scan cable plugs into the trigger port on the back of the SynAmps, the System Unit for SynAmps^2, or the amplifiers/headbox with NuAmps - NOT to the parallel port on the back of the SCAN PC.

8. **SCSI/USB connection**. Make sure the SCSI cable is secure between the SynAmps and the SCAN PC, or the USB cable with NuAmps and SynAmps^2. (This is an unlikely cause of triggering problems, since there would be more significant problems on the SCAN side if the SCSI or USB was not connected).

9. **Using Test Trigger Port**. Test trigger port reads the values at all of the bits at the trigger input level, and it is often the most useful method for diagnosing lost trigger problems. If you have multiple SynAmps/SynAmps^2, note that you select the unit that you wish to test. Test Trigger Port is run from the SynAmps Hardware screen in ACQUIRE (see the ACQUIRE manual for complete details). Briefly, *with the STIM system turned on and the stim-to-scan cable connected*, go to Test trigger port, and click its Start button. The figures below are for SynAmps. The displays for SynAmps^2 and NuAmps are nearly identical, and the functioning is the same. You should see:



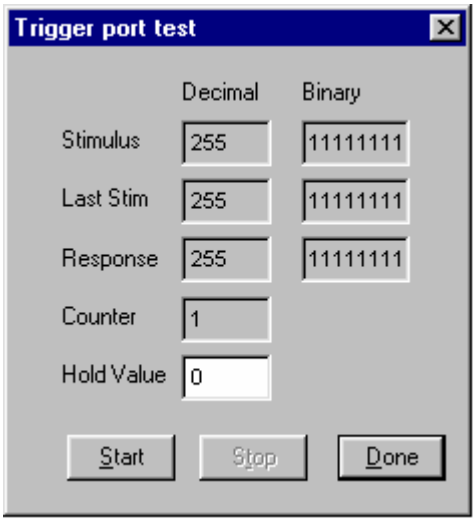
In its "resting" state, note that the Stimulus bits are at zero, and the Response bits are held high (all 1's). Summing the 8 response bits gives the 255 Decimal value. The Hold Value should be 0.

If you see, for example, one (or more) of the stimulus bits held high (1), that will cause all other incoming triggers to be ignored (no triggers). A workaround is to take whatever number it shows in the Stimulus field, and enter that as the Hold value. For example, if the 4th bit is stuck (8), enter 8 as the Hold value. (The events seen in ACQUIRE will be altered accordingly - this is a temporary workaround until the real problem is repaired). The cause could be a problem in the STIM box, the stim-to-scan cable, or the trigger input board on the SynAmps.

With other stimulus systems connected, you might see all response bits at 0, or maybe the four left bits at 0. They all need to be high in the resting state. Then it is a question of whether you want to record responses or not. If you do not want responses, then you should not plug anything into those pins on the trigger connector in the back of the SynAmps (pins 17-24). The natural resting state of the SynAmps is high, so they will be OK. If you do want responses, they must use inverted logic, where the resting state is high, and the trigger pulse goes to zero. If pins 17-20 are zero, clip whatever lines are going into those pins - they are not needed for responses (but they do need to be held high).

To help isolate the cause of abnormal bits, disconnect the stim-to-scan cable from the back of the SynAmps (and Start Test trigger port). You should see:

All of the bits should be high. If any are at zero, that points to a problem in the SynAmps (and a probable return to El Paso). If this looks normal, connect the stim-to-scan cable to the SynAmps, and disconnect it from the stim box. It should still look like the picture above. If it doesn't, there is a problem in the cable. If it still looks normal, then the problem is likely on the STIM side.



When you are testing for triggers in ACQUIRE, using the Single Window display to see the triggers in a continuous file, be sure you have NOT enabled the "Use inverted values" field in the setup file (look under Edit, Overall Parameters, Triggers).

10. **Disable "Use inverted values"**. With all Neuroscan amplifiers, be sure you have set NOT enabled the "Use inverted values" field in the setup file - if you are using a more recent Soundblaster STIM system (look under Edit, Overall Parameters, Triggers). The old LabMaster STIM system will likely need to have the "Use inverted values" option enabled. The very first few SoundBlaster systems may also need to have the field enabled.

11. **SND file port address.** This is one of the rarer situations we have encountered, but sometimes everything else will check out, yet the system will still present no triggers. In this case (if you are presenting SND files), the problem may lie in the port address listed in the configuration settings of the SND file itself. To check this, start the SOUND utility, open the SND file, and go to the config screen (in SOUND). On the left-hand side, it will indicate the port address of the file; make sure it says 848 (or 1820 for Labmasters). Go back into the main window of SOUND, and re-save the SND file. We have encountered this with SND files created with QuickTrace that were subsequently played in the regular STIM system (this may or may not apply to non-QuickTrace systems).

To avoid further complexity, we have not addressed problems that may be encountered with the LabMaster 330 AD cards in SCAN (Windows or DOS), the LabMaster 100 AD card (DOS only), or the DOS versions of SCAN in general. These systems are becoming increasingly rare, and they will eventually disappear altogether. Resources used by these cards are summarized at http://www.neuro.com/neuroscan/resource.htm. The DOS version of SCAN uses the scan.cfg file, in which the correct port address must appear, as well as other commands such as INVERT and SNDBLAST, depending on the systems involved. If you encounter triggering problems with one of these systems, please contact Technical Support.

II Troubleshooting.

The most common causes of the trigger problems are #2 and #3 above. After that come problems where stimulus presentation systems other than STIM are used.

Connecting other stimulus presentation systems to SCAN. Connecting to other stimulus systems is essentially a matter of making the other system emulate the TTL pulses from STIM, including the response lines. Test trigger port MUST look the same for the other system as it does for STIM (see #9 above). Typically, it is the response bits that cause problems. Even if they are not being used, the response lines at the port must be held high. This is most easily done by not connecting anything to the response lines. They will then be held high at the SynAmps/SynAmps^2/NuAmps port. If you want responses, you will need to invert the logic for those response lines you wish to use (so they function like STIM response lines).

Another option is to enable the "Use inverted values" field. If your STIM system uses inverted logic for the stim triggers (resting state is at 5Vs), then you should try "Use inverted values". In Test Trigger Port, you would see 255 in the Stimulus Decimal field, and all 1's in the resting state. Enter 255 for the Hold value, and try testing that way.

Some general testing tips. The information above is presented to show where triggering problems can occur. It does not necessarily mean that you should go through the entire list to find where the problem is.

If you contact Technical Support, you will likely be asked the following kinds of questions.

Is this our STIM system or some other system? If it is some other stimulus presentation system, then usually the best way to proceed, if you have SynAmps/NuAmps, is to see how Test Trigger Port differs from the figures above. If you don't have SynAmps/NuAmps (no Test Trigger Port), then the problem is usually due to a less than perfect emulation of the STIM TTLs.

Is this a new STIM installation? Usually trigger problems with a new STIM system are due to an IRQ conflict with COM2 (disable COM2). Or, you have installed the Metrabyte I/O software, and that has altered the card configuration (there is no need to install the I/O software).

If it is our STIM system, is it a LabMaster or SoundBlaster STIM system? This is needed to know how to set the "Use inverted values" field in ACQUIRE.

Was it ever working, and if so, what, if anything, changed between the time it was working and the time it stopped? If the system was moved, you may have inadvertently reconnected the stim-to-scan cable to the parallel port (on either the STIM or SCAN computers). If you moved STIM to a new computer, it is probably the IRQ conflict with COM2. If you haven't used it in a while, you may be trying to run STIM from a DOS-

prompt in Windows. Did you run STIMTYPE.exe on the STIM computer (you may have entered the wrong model of STIM)? Do ANY of the setup files in ANY of the STIM programs work (if so, it is a port address problem in the CFG files or in the setup files).

Do you see ANY triggers at all - even a single trigger - in ACQUIRE? This usually means that the STIM software settings are OK, and the problem may be a stuck bit in the STIM box (see #9). If it is not a STIM system, you could see a single trigger and then no more, due to an unexpected value remaining "on" at the SynAmps/NuAmps trigger port. Use Test Trigger Port to see what is wrong at the trigger port.

Still having problems? If the problem remains unclear, it is helpful to narrow the cause to the STIM side or the SCAN side. A good way to do this is to see if there are TTL triggers at the SCAN end of the stim-to-scan cable. Use a meter or scope to measure the pins against ground. (See Appendix B above for pin out diagrams of the cable). You can make this easier by going into, for example, the P300 setup in AUDCPT in STIM (make sure the port address is correct), and then increase the pulse duration to, for example, 500ms. Then start the program. This will make it easier to see the TTL pulses.

If you can show that the correct triggers are at the end of the cable, then the problem is on the SCAN side (check Use inverted values, and use Test Trigger Port with the cable connected AND disconnected).

It does sometimes happen that the cause is a hardware problem in the STIM box, or with the SynAmps trigger port. Generally that means a return of the unit to El Paso for repairs. In the majority of trigger related problems, however, it is not a HW problem with STIM or the amplifier units, but rather a software setting, cable connection, or imperfect emulation of the STIM TTLs.