

Neuroscan FAQs

Compumedics USA, Inc.

5015 West W.T. Harris Blvd, Suite E
Charlotte, NC 28269
USA
Tel: 877-717-3975 (8am-5pm EST)



Compumedics Germany GmbH
Josef-Schüttler-Str. 2
D-78224 Singen, Germany
Tel: +49 (0) 7731 79 76 9-0
Fax: +49 (0) 7731 79 76 9-99

Internet: sales@neuroscan.com
techsup@neuroscan.com
www.compumedicsneuroscan.com



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1 Introduction

The following list of topics has been compiled from years of experience from our Technical Support team, and it consists of the more common questions and problems that arise. We have tried to arrange these in a way that makes it easy to find the answers to the questions you have.

Realize also that the various user manuals contain abundant information, and often have the answers to your questions. Take a few minutes to look through them before anything else. There exist in electronic form as .chm (standard compiled help manuals) and as Pdf files. These are found in the ...*\Program Files\Neuroscan\Scan 4.3* or *Scan4.5* folders, in the *Help Files* or *Pdf* subfolders.

If you still have questions, the best initial way to reach our Technical Support Department is via e-mail: techsup@neuroscan.com.

1.1 Contact Information

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@neuroscan.com**, or see the other Support options on our web site (www.compumedicsneuroscan.com).

Or, if you live in the USA or Canada, please call **1-877-717-3975**. International callers should use **704-749-3200**.

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

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2 General Questions

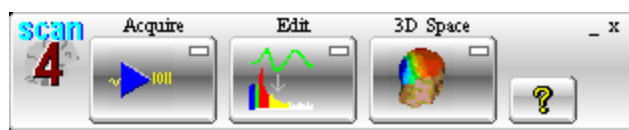
The following are some of the general questions pertaining to the SCAN systems.

2.1 Scan and Windows 7 and 10

Please note that Scan is officially obsolete, in favor of CURRY, which completely replaces it. The last complete validation testing with Scan was in Windows 7, and that was several years ago. There will be no further development of Scan. Support for Scan is limited. We encourage all Scan users to upgrade to CURRY as soon as is feasible (contact sales@neuroscan.com).

No formal testing has been conducted with Scan and Windows 10. We have received reports from users, as well as from our own use, that the analysis part, Edit, works well under Windows 10. We cannot, however, claim that it is OK to use, since we have not done formal testing (nor will we). The real question has to do with the drivers for the amplifiers. The current drivers were developed for Windows 7. Some people have tried them in Windows 10, and say that they are able to communicate with the amplifiers. More often, they have not been able to, as far as we know. If you want to use Scan and Windows 10, follow the steps below for Windows 7. If it does not work, there is little we can do.

Scan 4.3.1 and Scan 4.4 are not compatible with Win7. Instead, you will need to upgrade to Scan 4.5, and then install the Scan 4.5.1 hotfix2 on top of it. The upgrade is free as long as you have a USB dongle with a valid Scan 4.3 license on it.



To download and run Scan 4.5 (and 4.5.1), please follow these steps:

1. Remove the dongle (license key), disconnect the amplifiers, and uninstall any previous Scan version.
2. Download 4.5 from the following link:

<https://www.dropbox.com/s/dj5daxkgs9bo994/Scan4.5%20Release%20Disk.zip?dl=0>.

This is a full installation, compressed into a ZIP archive. If the link does not work, copy the URL and paste it into your browser. Download and save, and then copy over to your destination PC. Unzip the file contents into an empty folder, and then run "launch.exe" to begin the installation. Restart the PC when prompted.

3. Once Scan 4.5 is installed, you will need to run the 4.5.1 Hotfix 2. Download it from:

<https://www.dropbox.com/s/6kmhvrgd98qdvo6/Scan451Hotfix2.exe?dl=0>.

This is a single EXE file; download and save onto your Scan 4.5 PC, and then run the EXE.

4. If you are using this computer for acquisition, or even just for editing of Acquire setup files, make sure you then run the "Amplifier Install" program, and select the appropriate amplifier (**Windows Start → All Programs → Scan 4.5 → Amp Install**). NOTE: The NuAmps may only be used with 32-bit operating systems; there is no 64-bit driver (upgrade to CURRY for this). The SynAmps 2 and SynAmps RT may be used on either 32-bit or 64-bit systems. The original SynAmps 1 model is not compatible with any operating system beyond Windows XP.

5. Once Scan 4.5.1 is installed, you may connect your license key, which should be recognized. If not, you will need to download the latest version of the Sentinel drivers. With your dongle disconnected, click on the link below. Unzip the zip file and run the .exe file.

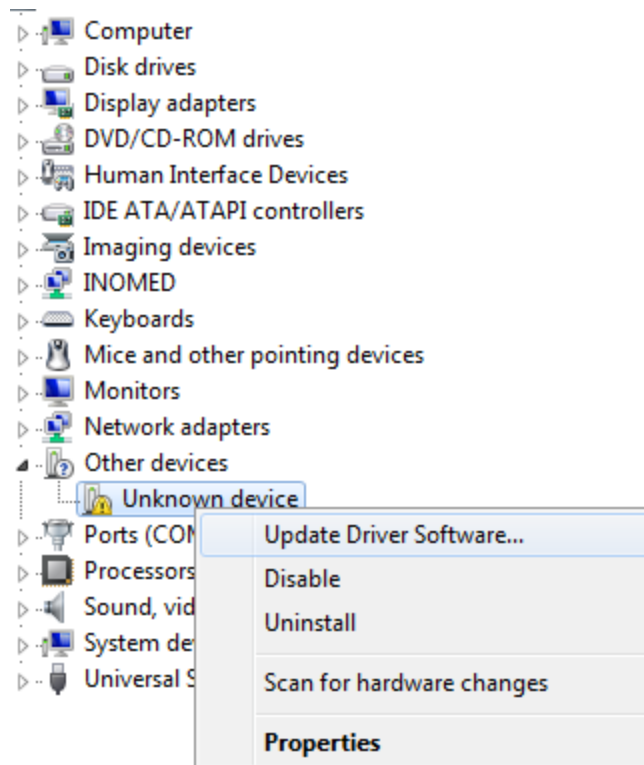
<https://www.dropbox.com/sh/hmx7wlakuz4ytetf/AABYOiazERvyH4Gz0sQCBXE8a?dl=0>

Restart the PC and wait until it has fully booted, then connect the USB key to a different USB port. If the problem continues, contact techsup@neuroscan.com.

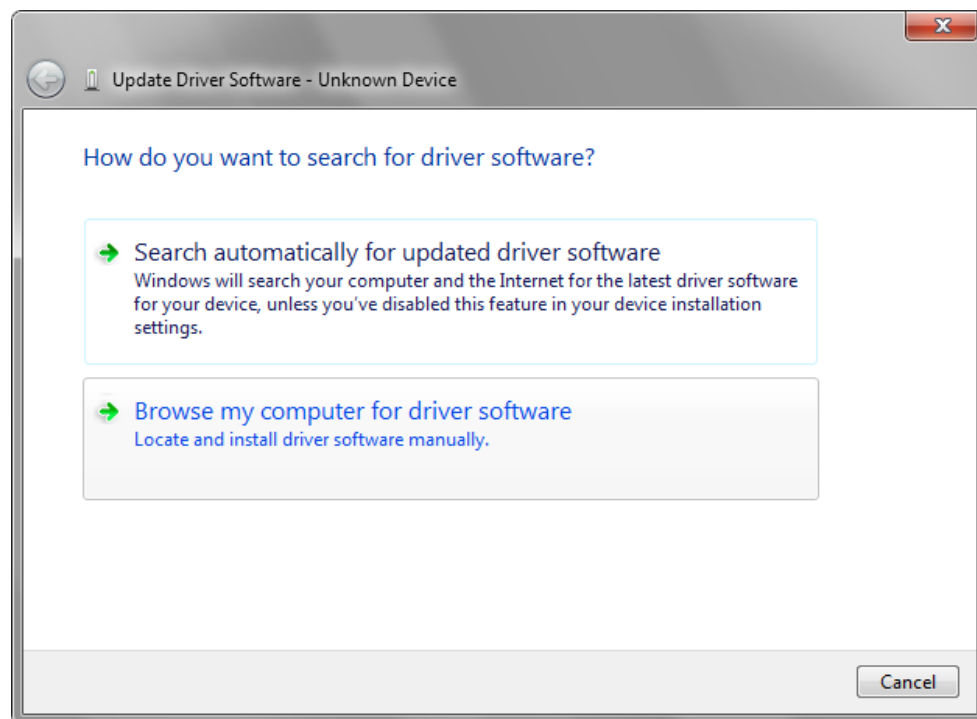
6. You may wish to also download the 4.5.1 Release Notes from:

<https://www.dropbox.com/s/u8ybgrdnur433rb/Release%20Notes%20451.zip?dl=0>.

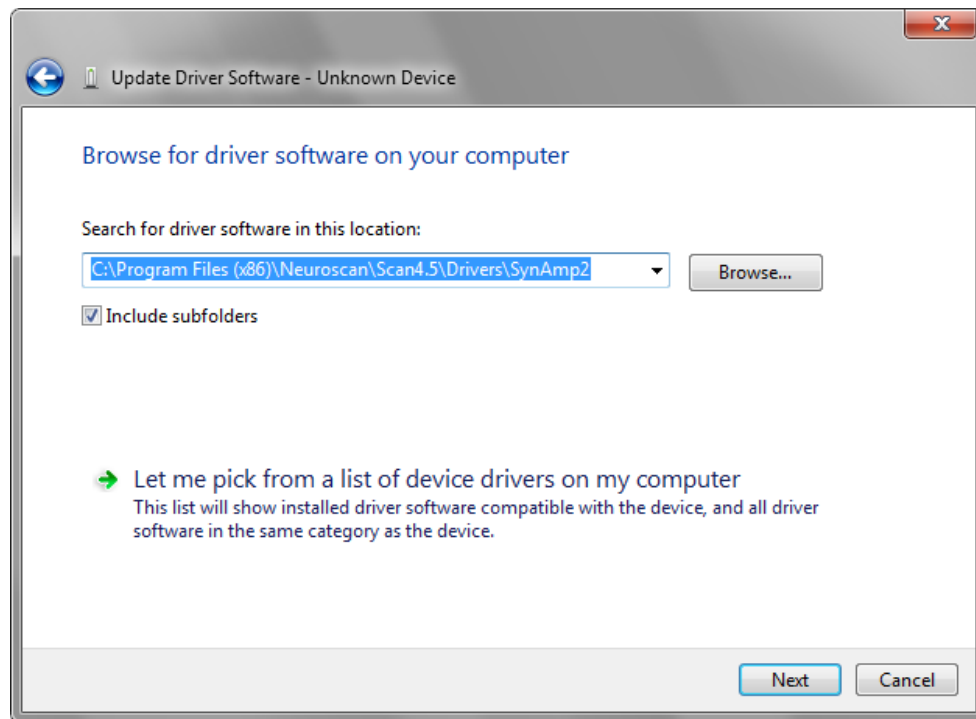
7. At this point, you can connect your Neuroscan amplifier, and the drivers will be installed automatically. In some cases, however, especially with 64 bit operating systems, the driver may not be found automatically. In this case go to the Device Manager, locate the Unknown device, *right click* and select **Update Driver Software**. (These directions are based on Windows 7, 64 bits; in other operating systems, the steps will be similar).



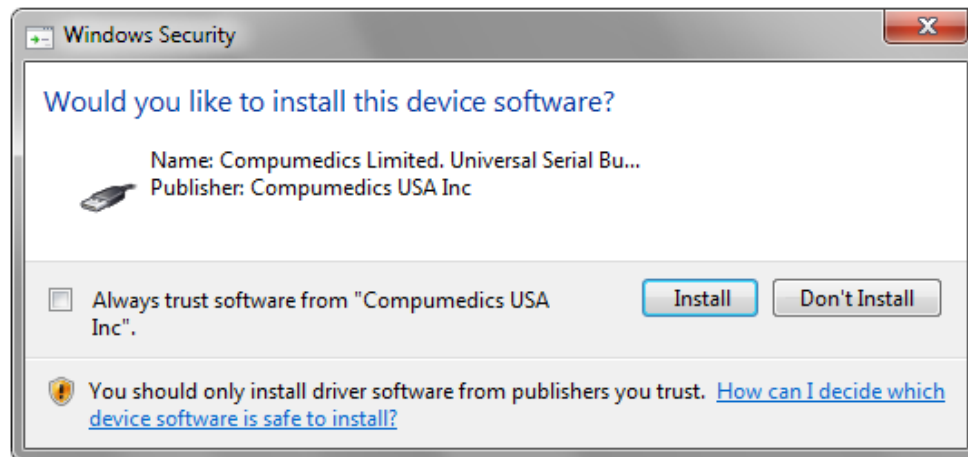
Select **Browse my computer for driver software**.



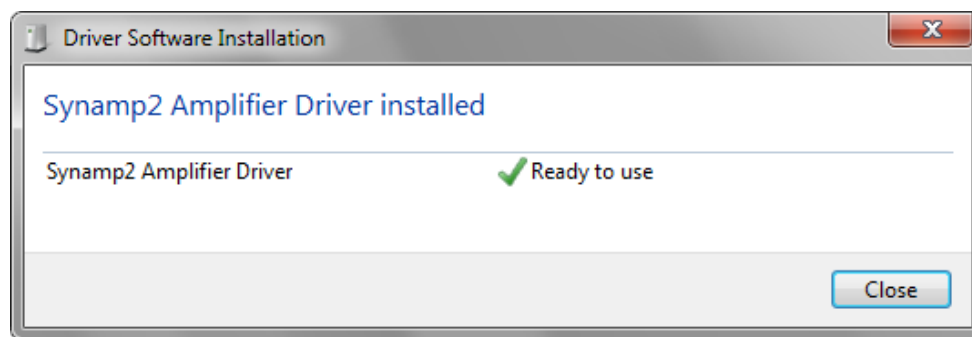
Browse to the folder shown below (*C:\Program Files (86)\Neuroscan\Scan4.5\Drivers\SynAmps2*).



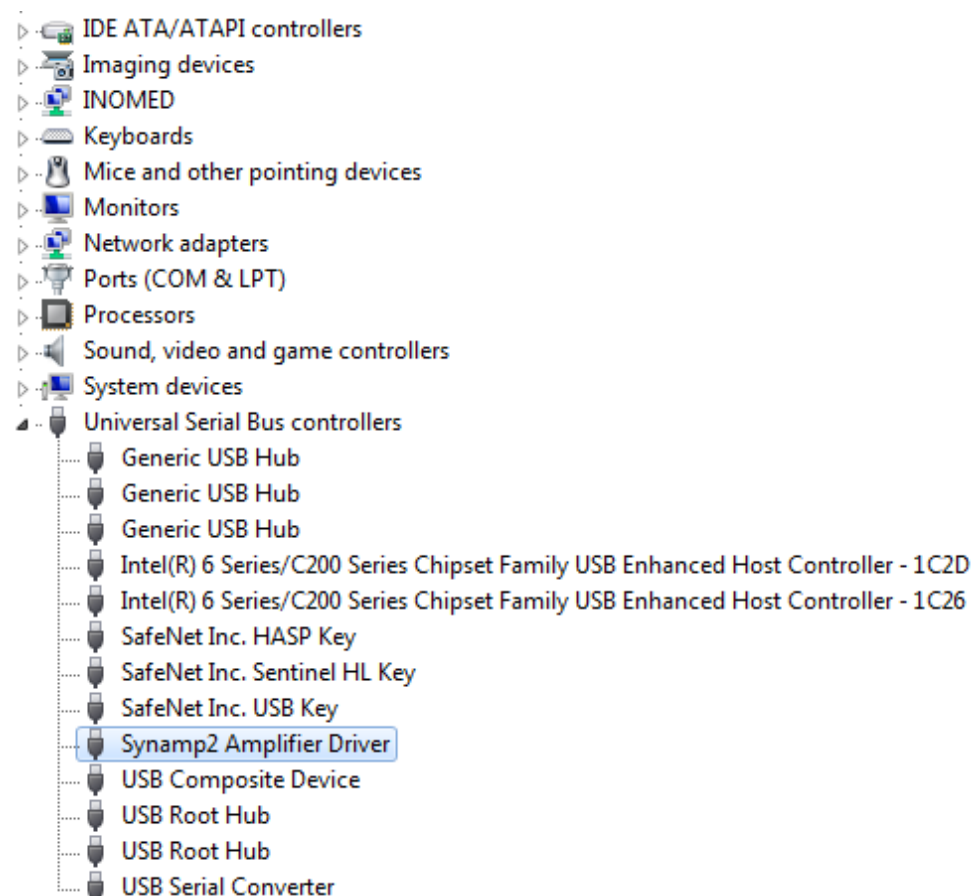
Click **Install**.



After a few moments you will see that the driver was installed.



If you look back in the Device Manager, you will see the Synamp2 Amplifier Driver, now under the Universal Serial Bus controllers.



If you encounter issues, feel free to contact us at techsup@neuroscan.com.

2.2 NuAmps and Windows 7

We do not recommend using NuAmps in any operating system newer than Windows 7 - this has not been tested (see the preceding section regarding the obsolescence of Scan). When first installing a NuAmps, the NuAmps *trigger cable* should not be connected to the

NuAmps until after the NuAmps is successfully detected by Windows. Please use the following order:

1. Install acquisition software (CURRY has 32 and 64 bit drivers for NuAmps; SCAN has only 32 bit drivers). With the latest versions, drivers are installed automatically.
2. Connect ONLY the USB cable to NuAmps and PC. The NuAmps is then detected and installed.
3. Once the NuAmps have been successfully installed, the NuAmps trigger cable can be connected. You do not need to restart the PC.

If the NuAmps connection is lost by the PC, then both the NuAmps trigger and USB cable should be disconnected from the NuAmps. Restart the computer and then follow the instructions starting at #2 above.

If multiple attempts to connect the NuAmps fail, or if an incorrect driver (e.g. generic USB) is used to install the NuAmps, then it may be necessary to install the NuAmps drivers manually. Run the system in admin mode, then go to *C:\Program Files (x86)\Neuroscan\Curry 7\Drivers\Neuroscan* and run *SetupNuAmpsDriver6.0.exe* to install the driver. The "(x86)" in the path will not be seen with 32 bit systems; for XP, the executable file is *SetupNuAmpsDriver5.0.exe*.

2.3 Is there a version of Stim2 for Windows 7?

Yes, but this is not a free upgrade. There are different upgrade paths, depending on what system you have (Software Only or Stim2 Complete), and whether you are upgrading your current computer to Windows 7 or getting a new computer. Contact sales@neuroscan.com for more information.

2.4 What version of Scan should I use?

The current general version of Scan is V4.5.1, with Hotfix2, and we recommend that all users upgrade to this version. See the [Scan and Windows 7](#) section above:

How do you know which version you have? See the [Finding the Software Version](#) section.

2.5 Dongles and Sentinel drivers

The software will not run without the dongle (or software lock) being installed. The older types of dongles connect to a parallel port; the newer ones connect to a USB port. The dongles are made by Sentinel, and they require Sentinel drivers in order to function. The drivers are usually installed automatically during the software installation. If you get a message saying a valid software license, or dongle, is not found, go to the Safenet web site: <http://www.safenet-inc.com/support-downloads/sentinel-drivers/> and download and install the second option.

Driver Name	Version	Products	OS	Includes
Sentinel Protection Installer	v7.6.7	Sentinel SuperPro, UltraPro, SentinelPro, SHK.	Microsoft Windows XP (32-bit and 64-bit), Windows Server 2003 (32-bit and 64-bit), Windows Vista (32-bit and 64-bit), Windows Server 2008 (32-bit and 64-bit), Windows Server 2008 R2 (64-bit), Windows 7 (32-bit and 64-bit), Windows 8 (32-bit and 64-bit), Windows Server 2012 (64-bit), and Windows 8.1 (32-bit and 64-bit).	Sentinel USB driver version 7.5.8.0 Sentinel Parallel driver version 7.5.0.2 Sentinel Protection Server version 7.6.3.0 Sentinel Keys Server version 1.3.4.0 Sentinel Security Runtime version 1.0.1.0
Sentinel Driver	v7.5.8	Sentinel SuperPro, UltraPro, SentinelPro, SHK.	Windows 2000/XP/Server 2003/2008/2012/Vista & Windows 7&8 (32 bit and 64 bit)	Sentinel USB driver version 7.5.8.0 Sentinel Parallel driver version 7.5.0.2
Superpro+/6.6 Compatibility checker utility	v1.0	Sentinel SuperPro	Windows 98/ME/2000, XP (32-bit and 64-bit), Server 2003 (32-bit and 64-bit), Vista (32-bit and 64-bit), Server 2008 (32-bit and 64-bit), Server 2008 R2 (64-bit), and Windows 7 (32-bit and 64-bit).	

The same driver is used for the parallel port dongles.

2.6 Computer Specifications

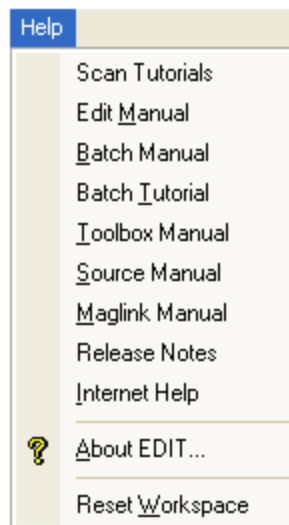
PC's are constantly evolving and becoming more powerful. Operating systems change and new versions are released every few years. The computer demands for recordings made in the MR chamber are greater than other recordings. The capabilities in the SCAN, Stim2 and CURRY software evolve over time, and these may affect the PC specifications. For these reasons, any list of requirements may be out of date months from when it is created. Stim2 PC's should be obtained from Neuroscan, where we can ensure that they will function properly. PC's dedicated to CURRY may be purchased separately; contact techsup@neuroscan.com for the latest requirements.

3 Finding the Software Version

The following sections shown how to determine the version of SCAN or STIM² that you have.

3.1 SCAN

If you are not sure what version of **SCAN** you have, click the **Help** option in either Acquire or Edit, and select **About ACQUIRE** or **About EDIT**.



Then click the  button. The ACQUIRE.EXE file will display the file version.

About ACQUIRE

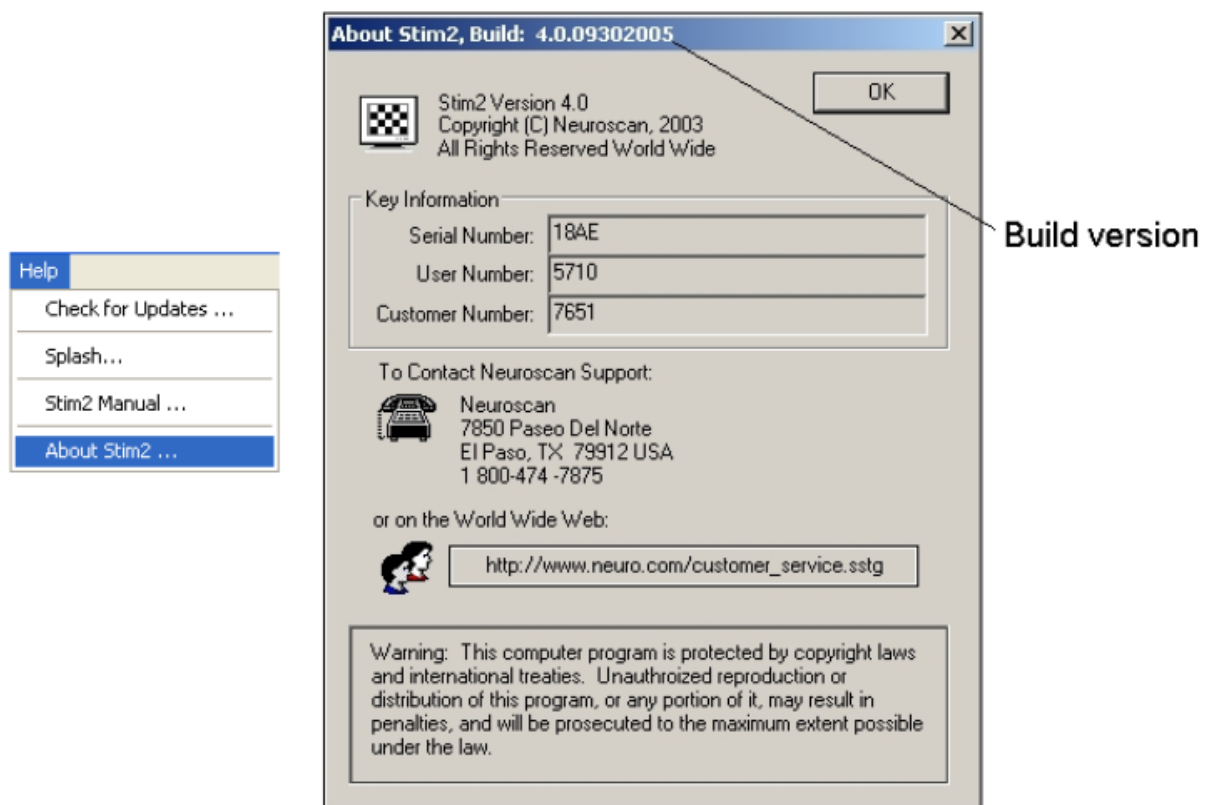
Scan Build Date: 10.05.2014

Module List Information

Filename	File Version	Product Version	File Size (Bytes)	File Modification	File Location
ACQUIRE.EXE	4.5.1.2	4.5.1.2	7512064	October 06, 201...	D:\PROGRAM FILES\N...
TCL83.DLL	8.3.0	8.3.0	474112	November 28, 2...	D:\PROGRAM FILES\N...
_JSOURCE21.DLL	2.1.1.1	2.1.1.1	696320	April 14, 2007 1...	D:\PROGRAM FILES\N...
SQ931KEY.DLL	1.0.1.6	1.0.1.6	57344	December 19, 2...	D:\WINDOWS\SQ931K...
ADVAPI32.DLL	5.1.2600.5755	5.1.2600.5755 (x...	617472	February 09, 20...	D:\WINDOWS\SYSTEM...
AVICAP32.DLL	5.1.2600.0	5.1.2600.0 (xpcli...	64000	August 04, 2004...	D:\WINDOWS\SYSTEM...
CLBCATQ.DLL	03.00.00.4414	2001.12.4414.700	498688	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
COMCTL32.DLL	6.00.2900.6028	5.82 (xpsp_sp3_...	617472	August 23, 2010...	D:\WINDOWS\SYSTEM...
COMPRES.DLL	03.00.00.4414	2001.12.4414.700	792064	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
DNSAPI.DLL	5.1.2600.6089	5.1.2600.6089 (x...	149504	March 03, 2011 ...	D:\WINDOWS\SYSTEM...
DSOUND.DLL	5.3.2600.5512	5.3.2600.5512 (x...	367616	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
GDI32.DLL	5.1.2600.6460	5.1.2600.6460 (x...	287744	October 09, 201...	D:\WINDOWS\SYSTEM...
HNETCFG.DLL	5.1.2600.5512	5.1.2600.5512 (x...	344064	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
IMM32.DLL	5.1.2600.5512	5.1.2600.5512 (x...	110080	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
IPHLPAPI.DLL	5.1.2600.5512	5.1.2600.5512 (x...	94720	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
KERNEL32.DLL	5.1.2600.6532	5.1.2600.6532 (x...	993280	March 12, 2014 ...	D:\WINDOWS\SYSTEM...
MFC42.DLL	6.02.400	6.02.8081.0	978944	February 08, 20...	D:\WINDOWS\SYSTEM...
MPR.DLL	5.1.2600.5512	5.1.2600.5512 (x...	59904	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
MSCTF.DLL	5.1.2600.5512	5.1.2600.5512 (x...	297984	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
MSCTFIME.IME	5.1.2600.5512	5.1.2600.5512 (x...	177152	April 13, 2008 2...	D:\WINDOWS\SYSTEM...
MSIMG32.DLL	5.1.2600.5512	5.1.2600.5512 (x...	4608	April 13, 2008 2...	D:\WINDOWS\SYSTEM...

3.2 STIM

If you are not sure what version of **STIM²** you have, go to **Help** and select **About Stim2**. Here the Build number is what you are looking for.



4 When Contacting Tech Support...

From time to time you will likely need to contact Technical Support with questions or problems. Generally, the best initial contact is via e-mail: techsup@neuroscan.com. Several people will receive the e-mail, and you can avoid the annoyance of calling and getting voice mail if the support people are on the phone.

Moreover, if you provide the critical details, the support people will have a chance to consider the problem and consult with others, as needed. Often, we will need to have some sample files in order to replicate the problem. Sending these in advance will speed up the reply.

The following sections list the main things to provide when contacting Tech Support.

4.1 Reporting problems with acquisition

If you need to report a problem involving data acquisition, please include the following information for the most rapid resolution.

What version of software is being used (e.g., Scan V4.3.1)? See [Finding the Software Version](#) section to find the version you have.

What amplifiers are being used (SynAmps, SynAmps², SynAmps RT, or NuAmps)?

A detailed description of the problem. Is this a new installation, or was the system working and then the problem appeared? In the latter case, did anything else change at the same time? For example, was there a change in the setup file, was any new hardware or software installed on the computer, are there new online features being used?

Any error messages that are seen, as well as the exact time that they are seen.

Include a copy of the .ast setup file.

Is there anything atypical about the system setup? That is, are there any peripheral devices connected to the headbox, or modifications to the trigger input?

4.2 Reporting problems with EDIT

If you need to report a problem involving data analysis, please include the following information for the most rapid resolution.

What version of software is being used (e.g., Scan V4.3.1)? See [Finding the Software Version](#) section to find the version you have.

What amplifiers were used (SynAmps, SynAmps2, SynAmps RT, or NuAmps)?

Are the data files imported from a third party system?

A detailed description of the problem.

Any error messages that are seen, as well as the exact time that they are seen.

Include a copy of the data file(s). If possible, use a shortened version of CNT and EEG files. Where appropriate, send the actual command that was used when the problem occurred: transforms will be displayed in the History and Immediate fields when they are executed. Sending the actual command, with the parameters used, is often useful in solving the problem (as well as identifying the version of the command that is involved).

4.3 Reporting problems with Tcl Batch files

If you need to report a problem involving batch files or commands, please include the following information for the most rapid resolution.

What version of software is being used (e.g., Scan V4.3.1)? See [Finding the Software Version](#) section to find the version you have.

A detailed description of the problem.

Does the problem happen with all data files, or just some of them?

Any error messages that are seen, as well as the exact time that they are seen.

Include a copy of the .tcl batch file and as many data files as are needed to replicate the problem. If possible, use a shortened version of CNT and EEG files. It is almost

impossible to resolve many batch issues without the batch file and sample data file.

In many cases we do not need the entire batch file - it may be sufficient to send just a section that demonstrates the issue.

4.4 Reporting problems with STIM

If you need to report a problem involving Stim1 or Stim2, please include the following information for the most rapid resolution.

What version of software is being used (e.g., Stim1 or Stim2)? See [Finding the Software Version](#) section to find the version you have.

If Stim2, is this a complete Stim2 system (with the audio box), or the software only version?

A detailed description of the problem. Is this a new installation? Was this working correctly, then something failed?

Any error messages that are seen, as well as the exact time that they are seen.

Include a copy of the configuration and sequence files, where relevant, and as many stimulus files as are needed to replicate the problem. It is almost impossible to resolve many STIM issues without these files.

4.5 Equipment Failure

From time to time it may be necessary to return some part of the system for repair/replacement. Tech Support will assist in diagnosing the problem and they will ask for the relevant information for creating an RSO (authorization for return of merchandise). Do not send anything in for repair without first obtaining an RSO number from Tech Support.

If not under warranty, there may be a bench fee for diagnosing the problem once the equipment has been received. The user is responsible for this even if you decide not to complete the repair.

We maintain a small loaner stock that can be used when available. Loaners are provided on an "as available" basis, with preference given to those under warranty. Unfortunately, we have had several experiences where users do not return loaners even after their repaired equipment has been received by them. We have been forced to adopt a system that will guarantee a measure of protection, and this will be explained by Tech Support if the issue of loaners arises in your circumstances.

In some cases, repairs are no longer possible, such as, with the original SynAmps amplifiers and other older or discontinued versions of hardware. If parts are no longer available, and our supply of spares has been exhausted, there may be times when there is nothing more that we can do. Tech Support will discuss these occasions with you when you contact them.

In general, you will be much better off if you have maintained warranty coverage for your systems.

4.6 Returning electrode caps for repair/ Repair kits

Returning caps for repair

If you own a Quik-Cap, and wish to send it in for repairs or at least an evaluation, we can certainly evaluate the cap. However, the older the cap, the less likely it is repairable. Even if it is repairable, there is generally an indirect correlation between the age of the cap, and the time between necessary repairs. Thus, while the cap may ultimately be repaired, it is possible that more repairs will be necessary soon thereafter.

That being the case, there is no reason NOT to have the cap returned. There is a charge for the diagnostic evaluation. This charge is for one hour of labor, and the current cost is \$185. This is due when the cap is returned, and this amount is non-refundable under any circumstances. If the cap is deemed irreparable, the \$185 is not refunded. However, this \$185 is not an "extra" charge; when the cap is inspected, the cost of those repairs is tabulated. If the repairs are approved by the person that owns the cap, the \$185 is deducted from the overall repair cost, and the remainder is due. Thus, if the amount due would be \$400, one would then only owe \$215. (These prices are subject to change).

In order to initiate the repair, we need the following:

- 1.) Description of the cap, including size, number of channels, and electrode metal.
- 2.) Serial number of the cap, if available (typically wrapped around the cap cabling, on the connector, or inside the cap).
- 3.) Return shipping information.
- 4.) Payment information, either CC or PO.

The first three items may be emailed to techsup@neuroscan.com; upon receipt, we will contact you with a reference number, or possibly a request for more information. When the reference number is sent, the message will also include instructions for remittance of the initial diagnostic fee, and shipping information for the cap's return.

Electrode Repair Kits

Frequently only a single electrode will become problematic. If the cap is still under warranty, then it can be sent in for repair at no cost (other than the shipping/handling for sending the cap in). While the cap can be repaired even if not under warranty, there is a minimum of one hour labor charged on all repairs. There is an alternative in this case. Compumedics also sells electrode repair kits, which can be ordered from our online catalog:

<http://63.134.192.29/cart/Details.cfm?ProdID=206&category=26>

The most common Quik-caps are the sintered electrode caps. For these caps, order P/N 99000102; one kit will repair one site. If you are unsure of the electrode metal, this can normally be determined by examining the electrode disk color: a metallic appearance is tin; a dull brown color is silver-silver chloride (Ag/AgCl standard); and a ceramic appearance is sintered.

The repair kit contains four parts:

- 1.) solder tube
- 2.) heat shrink
- 3.) o-ring
- 4.) replacement electrode with short length of lead.

Basically, you just cut off the bad electrode, and pull back the o-ring to remove it from the cap. Then, trim the cut wire on the cap, and slide the heat shrink down the wire. Insert the end of the wire into one end of the solder tube. The wire coming off the replacement electrode should be inserted into the other end of the solder tube. The two wires should "meet in the middle" where the solder ring is located. Then, using a heat gun (optimally) or a soldering iron (a little trickier but should work) melt the tube. This will join the two wires together. Then replace the electrode in the hole of the cap, and secure around the rim of the electrode with the o-ring.

5 Issues Relating to Scan

This section contains information about specific issues relating to Scan - including Acquisition and Analysis.

5.1 Acquisition (ACQUIRE)

The following are questions regarding acquisition that occasionally arise.

5.1.1 Is a Faraday cage needed, how should it be grounded?

A Faraday cage may or may not be needed, depending on how excessive the external noise interference is. Many facilities record clean EEG without a Faraday cage. This is due in large part to advancements in amplifier design (such as active noise cancellation). If a Faraday cage is to be used, it should be grounded to a true earth ground if possible, a clean uncontaminated ground. Often, when laboratories are set up, the grounding of the cage is connected to other circuits, including ground integrity circuits that will put a low level signal on the ground periodically to determine the quality that will immensely impact the shielding, and subsequently, the quality of the electrophysiological recordings obtained in that environment (see the Ground Issues also).

5.1.2 Ground Issues

It is important to ensure that all electrical outlets in the lab are on the same ground circuit. Often, and particularly in older buildings that have been remodeled, outlets on one wall may originate from one electrical circuit while outlets from another adjacent wall may originate from another circuit. All of the power (including that for Faraday cages) should be pulled from a single clean source. A standard electrician who will do a ground integrity test will often indicate that the grounds are the same. However, a difference of even 100 microvolts (or 1/10,000 of line voltage) will be enough to cause chaos when the brain's signal of interest is only 10 microvolts.

5.1.3 What causes DC drifting and saturation?

The DC capability of the SynAmps, SynAmps2, SynAmps RT, and NuAmps amplifiers present special requirements that electrophysiologists familiar with AC coupled systems may not have encountered. When the amplifier is placed in the DC mode, battery potentials generated from electrodes are not dissipated by the decoupling capacitors found in AC only systems. Electrode combinations generating battery potentials greater than the dynamic range will saturate the amplifier. Saturation will become evident when the amplifier displays a flat line with no apparent activity. **If your electrodes show a consistent DC shift that climbs quickly to saturation, then your electrodes are not suitable for DC recordings.** There are several rules to follow when selecting electrodes to avoid these problems:

- 1. Never use different combinations of paste/gel and or electrodes.** For example, a common error is to use one type of electrode and paste in a monopolar derivation (i.e., electrode cap and gel) and a different electrode and or paste on the reference lead. By using different metals and electrolytes a battery potential has been created and the electrodes will drift. If you have the same electrode materials and gel and you are still experiencing saturation, then double check your electrodes. They may not be made out of identical material. Measure the DC voltages across these leads and you will find a large offset potential.
- 2. Keep the interface between the skin and electrode consistent.** For example, with an electrode cap the interface with the skin is nonconductive rubber and the conductive gel. The gel makes contact with the electrode. If you place a reference electrode directly on the subject's skin for a reference, you have created a different interface. You now have a gel plus metal to skin interface. The best way to avoid this problem is to obtain a separate but identical electrode to employ as a reference. Another technique is to separate the metal from the skin with an adhesive electrode collar. *Note - drift problems with the reference electrodes in multichannel recordings are usually observed across all monopolar derived electrodes.*
- 3. Select metals that are known to produce the smallest battery potentials.** Sintered Ag/AgCl electrodes are probably the best. We have also found tin electrodes to be acceptable. They will produce more drift, but the drift is monotonic and can be corrected using the DC offset transform in the EDIT module of SCAN.
- 4. The DC level is relatively independent of the electrode impedance.** If you have set your electrode impedances to the standard 5kOhms or less and your electrode is still drifting, additional work on the impedance will usually have no effect (except on the subject!). Since the primary source of battery potentials is the interface between the gel and electrode and not the skin, further work on the gel to skin interface will probably not help. This is a good time to replace the electrode or examine the metal to wire solder joint (another potentially large source of battery potentials).
- 5. Record in a comfortable and cool environment.** Sweat potentials can be a major problem for DC recordings. They produce transient and unpredictable results.

The increased dynamic range in SynAmps2, SynAmps RT, and NuAmps makes DC saturation very unlikely. Generally, there has to be a serious problem with the electrodes in order to exceed the range.

5.1.4 Is there a problem using gold electrodes for recording EEGs?

For AC amplifiers, gold is fine, and preferred in some labs. With DC amplifiers, such as SynAmps, SynAmps2, SynAmps RT, and NuAmps, gold electrodes are often a large problem. Basically, it depends on the quality of the electrodes. Some lower quality gold electrodes create DC offsets and drifting in the recordings. In more severe cases, this can lead to saturation problems for all amplifiers, including SynAmps2 and SynAmps RT, which are very hard to saturate. It is difficult to determine good quality gold electrodes from poor quality ones. In general, you are better off using sintered silver for all electrodes.

5.1.5 What Acquisition mode should I use?

The Acquisition Mode in ACQUIRE (in the Amplifiers dialog under Overall Parameters) determines the type of file that will be saved (CNT, EEG, AVG). We strongly recommend you record in Continuous mode for the following reasons:

You have greater flexibility for creating epochs. You can vary the Start and Stop times, and even have overlapping epochs.

Many of the newer artifact reduction transforms require CNT files - they cannot be applied to other files types. The older Ocular Artifact Reduction transform works better with CNT files (although you can apply it to EEG files).

If you want to merge the behavioral data from Stim (containing Accuracy and Latency information) with the data, this can only be done with CNT files.

CNT files contain all of the data, not just pieces of the data that you would have with epoched files. File sizes are larger with CNT files, but that is generally not an issue with the multi-GB hard drives now available.

5.1.6 What AD rate should I use?

The general rule of thumb is to determine the fastest frequency of interest in the recordings, multiply it by 5, and select the next highest AD rate. In general practice, 1000Hz is a good rate for routine EEG and EP recordings. This gives a data point every millisecond, and will adequately capture EEG, EMG and the middle and late latency EPs. For early latency EPs (as with SEPs), the AD rate should be faster (3000Hz). For brain stem recordings, it should be as fast as possible (20,000Hz). Current MagLink recordings no longer need the very fast AD Rates; you can use the more typical 1000Hz AD Rate. The faster the AD rate, the larger and more cumbersome data processing becomes, so it is not advisable to use faster AD rates than you really need.

5.1.7 Can different filter settings be applied to different channels?

Yes. In ACQUIRE, under **Edit → Overall Parameters, Amplifiers** tab, you can set the high and low pass filters. When you click the Apply to All Selected Channels button, the filter settings will be applied to whichever channels are selected (in green). If you have a

SynAmps (original), you can set the Gain separately for selected channels in the same way. The AD Rate must always be the same for all channels.

5.1.8 Gain, Range and Accuracy

On the Amplifiers display in ACQUIRE, under **Edit → Overall Parameters**, there are fields for Gain, Range and Accuracy (only SynAmps displays the Gain). These are all interrelated. Gain is the measure of amplification of the signals (between the positive and negative poles of the amplifiers). It is like a multiplier for the signal amplitude. Range refers to the Dynamic Range of each amplifier. That is the voltage range within which signals can be received. If a signal has voltages outside of the range (due to extreme amplitude or DC offset or drifting), the signals outside the Range will be lost. The broader the Range, the less the likelihood of encountering DC problems. Within the Range, there are discrete voltage points that are measured. The number of addressable points is a function of the number of bits in the AD converter. A 12 bit AD converter has 212 addressable points; a 24 bit AD converter has 224 addressable points. The closer the addressable points are to each other, the more precise the measurement of the waveforms. Accuracy is the distance between any two adjacent points. The lower the value, the more accurate the measurement.

The relationship among Gain, Range and Accuracy is as follows. Gain and Range are inversely related. The lower the Gain, the broader the Range. The broader the Range, the farther apart are the addressable points, and therefore the greater the Accuracy values (meaning less accurate measurement). The higher the Gain, the lower the Range, and the lower the Accuracy values (more accurate measurement).

SynAmps have user defined Gain, allowing you to increase or decrease the Range, and thereby increase or decrease the distance between points (Accuracy). SynAmps2, SynAmps RT, and NuAmps have fixed Gains, and these are very low. That means the Range is very large (several times larger than the SynAmps), making DC saturation nearly impossible. Both have 24 bit AD converters, which means that the accuracy of measurement is preserved despite the broader Range.

Why is the Gain so low in SynAmps2, SynAmps RT, and NuAmps? The brief answer is that there is no need to have a larger Gain. The low Gain allows the Range to be large, and that greatly reduces DC problems. The 24 bit AD converter allows accurate measurement despite the larger range.

5.1.9 Flickering impedances

You may sometimes see a mild flickering of impedance colors/values, especially for the bipolar channels. That is not necessarily a problem. It has to do with the way the positive and negative sides of the bipolar channels are poled. On the other hand, it can also be an indication of an improperly wired cap. If it only happens consistently with one cap, then it is likely a problem with that cap.

The latest version of Scan fixes the problem, and you should obtain that (see [Scan and Windows 7](#)). You should also try redoing the preparation of the Reference and Ground electrodes. If you continue to have problems, contact techsup@neuroscan.com.

5.1.10 How is the Channel Assignment Table actually used?

The Channel Assignment Table was originally created during a time when many people were using individual electrodes that connected to the face of the SynAmps headbox. It provided the flexibility to, among other things, reassign physical channels. Now, when the vast majority of users use caps, there is less of a need for the Channel Assignment Table. The caps are hard-wired, and reassignment of channels is not possible.

The Channel Assignment Table consists of columns for the Channel Number, the Physical Channel, and the Label. The Label is simply a text field where you can enter or change the electrode label. There is nothing magic about the labels - there is no label recognition.

It is possible to re-map the order in which channels are sampled within a single *SynAmps2* (or *SynAmps RT*). There are several instances in which you might want to do this. For example, the channel order is defined by the hard-wiring in the cap. If you list the channels numerically, in order of the Physical Channel numbers, this might not give you the channel order that you want. You can change the channel order by using the Channel Order option, or you can remap the channels in the Channel Assignment Table. The latter is explained in the SynAmps2 (or RT) manual.

Similarly, you may want to select only some of the channels to use. For example, let's say you have a 64 channel cap, but you only want to record the basic 10-20 system electrodes. From the documentation you received with the cap (or from a setup file that matches your cap), you can see which physical channels carry which electrodes. Select the 10-20 channels, order them as you wish, and save the setup file. (Be sure to set the desired number of channels in the Amplifiers tab first).

Note that if you have more than one headbox, *you must use all of the channels from the first headbox* if you plan to use some or all of the channels from the second headbox. Similarly, if you have more than two headboxes, you must use all of the channels from all of the first headboxes, and then use some or all of the channels from the last one. In other words, you can only leave "holes" (unused channels) in the last headbox.

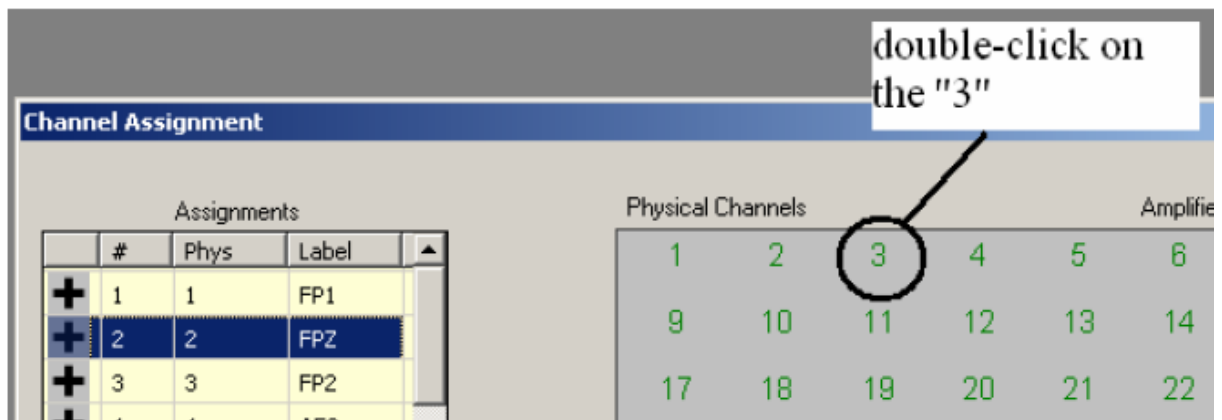
If there are channels in the first headbox you are forced to record, even though you do not want them, record them as "Bad" channels - "Hide" them, if desired - and then use the Delete Bad Channels option in EDIT to create a new CNT file without the Bad channels.

5.1.11 How do I use a subset of the cap electrodes?

It is frequently the case that users may want to use a subset of electrodes in a cap, and would prefer not to have the unused ones designated as Bad and Hidden channels. The Channel Assignment Table is used to assign the channels (see the previous question). If you want to use, for example, 20 channels from a 64 channel Quik-Cap, open the standard 64-channel setup file in Acquire, and then go to the Channel Assignment Table. You will see a list of channels, in order of physical channel, from 1 to 64 (or up to 70).

Basically, you want to assign all the channels you want to use within the top number of rows, where "number of rows" equals the number of channels you want in this file. The left column is the row number; the middle column is the specific physical channel; and the label is the electrode assigned to that physical channel. In the above example, you will be using rows 1-20. You need to "assign" the appropriate physical channel within those rows. Let's say you want to keep channels FP1 and FP2, but not FPZ. You want FP1 in row 1, and FP2 in row 2 (instead of FPZ). In row 3, we want FZ. To do this, highlight row 2, and

note the physical channel that FP2 is mapped to - physical channel 3. With row 2 highlighted, double-click on the "3" in the Physical Channels layout on the right. Fp2 is then the second channel in the order, but it is still using Physical Channel #3 (as it must).



You can then place channels FZ, F3, and F4 in rows 3, 4, and 5 respectively by highlighting the row, and simply double-clicking the appropriate physical channel for that particular electrode (channel 10 for FZ, channel 8 for F3, and channel 12 for F4). Repeat until the desired electrodes are in rows 1-20. Upon completion, click OK and go into **Edit** → **Overall Parameters** and select the **Amplifiers** tab. Change the number of channels to 20, and click **Save As** to save this as a *new AST file*. Whenever you modify the setup files we supply, we recommend that you save the modifications to a new file, and preserve the original setup file for future use.

	#	Phys	Label	
+	1	1	FP1	
+	2	3	FP2	
+	3	10	FZ	
+	4	8	F3	
+	5	12	F4	

5.1.12 Can the channels saturate in AC Mode?

Yes. When you record in AC mode, the AC coupled filters are added as a secondary step. The DC filtering still occurs first, and the issues that affect DC recordings are still present when you record in AC mode. You can therefore still saturate the channels in AC mode. It will appear, however, as a flattening out of the signal, rather than a drifting of the signal out of range. This applies to SynAmps, SynAmps2, SynAmps RT, and NuAmps (although saturation is less of an issue with the latter two SynAmps amplifiers).

5.1.13 What is Deblocking?

Deblocking is a procedure that can be used online (SynAmps, SynAmps2, and SynAmps RT) to temporarily suspend acquisition (typically for a few milliseconds). The purpose is to avoid large stimulus artifact, as seen with SEPs and TMS, by not recording it. Deblocking

can also be performed offline in EDIT to remove the stimulus artifact. See the *ACQUIRE*, *amplifier*, and *EDIT* manuals for details).

5.1.14 What are High Level Inputs (HLIs)?

HLIs provide a safe way to input the voltage signals from peripheral devices (such as, a pulse oximeter, GSR device, etc). These cannot be inputted safely as regular EEG channels. SynAmps2 and SynAmps RT, include 2 HLIs per headbox. The HLIs are configured in ACQUIRE, under **Edit** → **Overall Parameters** → **High Level Inputs** tab, and are explained in the SynAmps and ACQUIRE manuals. HLIs are not available for NuAmps.

5.1.15 Is it better to apply the artifact reductions online or offline?

The fMRI, EKG/BCG, and Blink Reduction corrections can be applied online during acquisition, and saved, or offline in EDIT. Generally, the corrections can be applied more effectively offline, where you can fine tune the corrections by trying different parameters until the best combination is found. On the other hand, the online corrections are important for verifying that you are obtaining valid data, especially for EEG recorded in the magnet. If you want to get a good idea of the quality of the data during acquisition, use the artifact reduction methods online. You can save the raw data and the corrected data, if desired (the raw data are always saved). For the most effective corrections, apply the transforms offline (to the raw data).

5.1.16 How do you calibrate SynAmps2 and RT (and NuAmps)?

SynAmps2, SynAmps RT and NuAmps, unlike the original SynAmps, are factory calibrated, and there is no need for calibration. Older versions of SCAN had a Calibration Check button. This has been removed in later versions and should not be used if encountered. SynAmps2, SynAmps RT, and NuAmps amplifiers either work or they don't - there is no fine adjustment calibration.

5.1.17 Trigger Issues

General triggering information. In otherwise correctly functioning systems, the majority of trigger problems occur because the port logic rules are not being followed. If you are using a stimulus presentation system other than Stim2, or the pulses are being sent from the MR scanner or other device, you must match the logic for stimulus and response TTL pulses. The SCAN system is expecting the following triggering convention.

Stimulus triggers. Stimulus events use positive logic TTL pulses, usually with 1-10ms duration. Positive logic means that 0V is the resting state, and 5V (at least 3.5V) is the "on", or high state.

Response triggers. Response events use negative logic TTL pulses, usually with about a 5ms duration. Negative logic means that the resting state is at 5V, and the "on" state is 0V. The amplifiers hold the response lines at 5V when no triggers are being received.

One of the more common causes for a failure to see triggers is that the response lines have an input where the **resting** state is **0V**. For example, if a peripheral device is sending a *positive* logic trigger to one of the *response* lines (as is the case with some

scanners), that line will remain "on" most of the time. This will block other events from being registered. The signal must first be inverted to match the negative logic. Whenever you use the stimulus and/or response lines to input triggers into SCAN, you must follow the *stimulus/positive logic* and *response/negative logic* rule, or else there will be triggering problems.

The Test Trigger Port option (in ACQUIRE, go to **EDIT → SynAmps Hardware → Test Trigger Port** button) is a very useful tool for determining the cause of blocked triggers. Please refer to Appendix A and Appendix B of the *Installation and Orientation* manual for more details.

Triggering with E-Prime. In E-Prime, the typical command to use is WRITEPORT, followed by the hex address of the port being used for triggering, then followed by the number of the trigger being sent. The latter number does NOT need to be in binary. The command would look like the following (if triggering through the parallel port):

```
WRITEPORT 378 1
```

Typically, the hex address of most parallel ports on desktops is 378. Before a trigger can be read, a previous WRITEPORT line needs to be implemented, sending a 0, to pull all the lines low on the SynAmps2 end. A WRITEPORT 378 0 would need to be sent before any additional WRITEPORT line. This is true for EVERY trigger being presented within an experiment; if 40 triggers were to be sent, it would require 80 WRITEPORT lines.

Trigger input, stim-to-scan cable. The stim-to-scan cable transmits the TTL triggers from STIM to SCAN. It has a parallel port connection on each end, but *it does not connect to either the STIM or SCAN computer parallel ports (with one exception)*. On the STIM side, it connects to the STIM Audio System Unit. The exception occurs when you have a software only system, in which case the parallel port on the Stim computer is used. On the SCAN side, it connects to the amplifiers (NuAmps has a short parallel-to-serial adapter cable). Even if you are using a different stimulus presentation system (such as, E-Prime), the trigger pulses are input into the amplifiers, not a port on the computer.

Note that the stim-to-scan cable is not a standard parallel cable - it is wired in a specific manner. A regular parallel port cable will not function properly. The stim-to-scan cable can be ordered from Compumedics, if necessary (one end should be labeled "Stim" and the other "Scan"). If you have the resources, you can build your own. Start with a blank male db25 (plugs into the parallel port of your stimulation PC) and a blank female db25 (plugs into the SynAmps system unit). Then, certain pins in the male need to be wired to certain ones in the female, according to the following table:

MALE DB25 --> FEMALE DB25

```
-----
pin 2 --> pin 8
pin 3 --> pin 7
pin 4 --> pin 6
pin 5 --> pin 5
pin 6 --> pin 4
pin 7 --> pin 3
pin 8 --> pin 2
```

pin 9 --> pin 1
pin 25 --> pin 25

If you are using a stimulus presentation other than Stim2, and have built or bought the stim-to-scan cable, you will need a certain *command structure* to make the system work. Basically, once the connection is established, there are commands that need to be structured in a certain way, depending on the program being used. First, the program needs to write the trigger number to the necessary port, and the port is probably indicated by its input/output (I/O) hex address. A LPT1 port is typically 378 hex. Second, for the first trigger, it is necessary to send a trigger value of "0" to set the zero-point of the port; then, a second command is necessary to send the nonzero number, i.e., the desired event marker value. The nonzero number is what will show up in Scan. Thus, for each trigger, two trigger commands are essentially required: a zero, followed by the nonzero.

5.2 Error Messages

The more commonly seen error messages during acquisition are listed below.

5.2.1 Buffer overrun

This is a message that may be seen during acquisition. Basically it means that the data are being acquired faster than they can be written to the hard drive. There are several possible causes. One is that the hard drive is getting full, and ACQUIRE is having trouble locating free sectors. Another cause is trying to save the data to an external drive or across a network (during acquisition).

5.2.2 Read data from device error

This is an error seen either when ACQUIRE is started or when acquisition is started. It means there is a communication problem between the PC and the SynAmps² or RT. There are multiple causes: the headbox, the System Unit, the USB cable, USB port on the PC, permissions, and other software running on the PC. The following are some things to try to help isolate or solve the problem.

DO NOT HOT SWAP the headboxes or USB cable - **turn the System Unit and PC off when swapping components**. Damage to the system may result, necessitating its return for repairs.

For one initial step, make sure that the software was installed when logged on as administrator, with full rights. The drivers will not install properly otherwise, and the error message will be seen. Try also logging on as the administrator in regular operation.

There are 4 headbox connections on the back of the System Unit. Try moving the headbox(es) to a different one. If that works, it is an indication of a problem with the System Unit, which would necessitate its return (this is not a permanent workaround).

If you have multiple headboxes, try using them individually (with an appropriate setup file). If the problem is isolated to a headbox, it will need to be returned for repair.

Make sure you are using the USB 2.0 port on the computer. If there are USBs on the front and back of the PC, typically - but not always - the USB 2.0 ports are on the back. If there are more than one USB 2.0 port on the back, try a different one.

With the System Unit off, go into the Device Manager in Windows, and expand the USB list. Turn on the System Unit and verify 1) that it is a USB 2.0 port, and 2) that the System Unit is being found.

Disable any other software that may be running on the computer, especially, instant messaging, e-mail, auto-updates, active virus scans, etc.

Our experience has been that in some cases the solution is a simple one that can be applied locally, or it may necessitate the return of the headbox and/or System Unit for repair. If the above suggestions do not solve the problem, contact Technical Support.

5.2.3 Low (High) pass values have been modified to match amplifier capabilities

ACQUIRE forces you to oversample the data by a factor of 5. That means, for example, if you select an AD Rate of 1000, the fastest frequency you can safely sample is 200Hz. Say you have selected an AD Rate of 1000 and a Low Pass filter of 200Hz, then you lower the AD Rate to 500Hz. The 200Hz Low Pass filter is no longer valid - the fastest frequency you can accurately measure is 100Hz. You will see the message appear, and the program will automatically reset the Low Pass filter to 100Hz. The same autocorrection happens if you select DC mode with a DC High Pass filter, and then change to AC mode. You cannot have a DC High Pass in AC mode. You will see a similar message, and the High Pass filter will be set automatically to 0.05Hz.

You can also see this and other similar messages if you switch setup files, where one setup was created for a particular amplifier and the new one is for a different amplifier having different capabilities.

5.2.4 Amplifier not found

This error can have 1 of 2 origins – Software and Hardware.

Software. The error occurs most commonly after a fresh installation of Scan in a Windows 7 environment. The error message is encountered more in the 64bit version of Windows 7 than the 32bit version.

In such cases, it is likely that the amplifier driver did not install properly. To remedy the situation, make sure the amplifier is connected to the PC and turned on. Next, go to **Control Panel → System → Device Manager** to confirm that the hardware is listed as an 'Unknown Device'. *Right click* on the 'Unknown Device' and select 'Update Driver'. Next, you should direct the wizard to install the driver manually from *C:\Program Files(x86)\Neuroscan\Scan4.5\Drivers\Synamp2* (or *C:\Program Files\Neuroscan* ... if this is the 32bit version of Win7). Ignore any warning that the driver is not signed by Microsoft and select 'Continue Anyway'. This should take care of the problem. Run Acquire to verify that the problem has already been fixed.

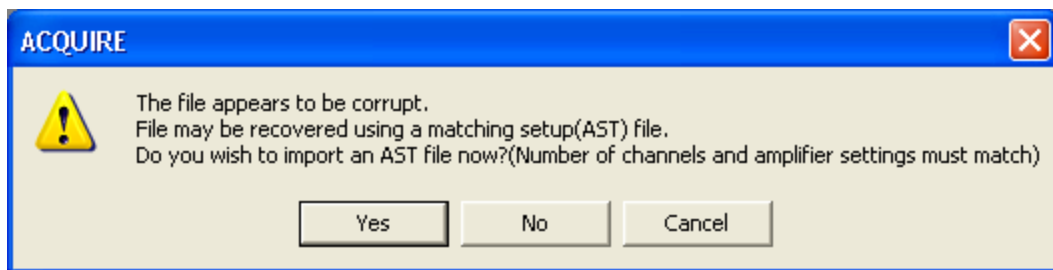
Hardware. If the problem persists after manually installing the driver, it is likely that one of the components of the amplifier system is malfunctioning and may require repair. In this

case, contact techsup@neuroscan.com to arrange for the system to be returned to Neuroscan for evaluation.

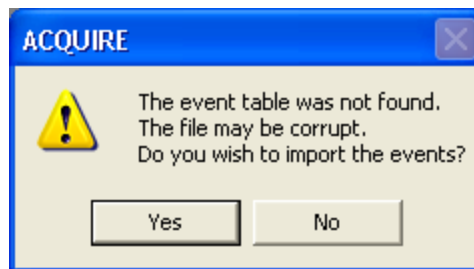
5.2.5 Corrupt data files

From time to time, and for a variety of reasons, acquisition of the data file may be terminated abnormally. In that case, EDIT will attempt to salvage as much of the data file as possible. Prior to 4.5, the event table was written at the end of acquisition, so if acquisition ends abnormally, the event table cannot be added to the file. From 4.5.1 on, the events are written as they are encountered, so you will not lose more than the last minute or so.

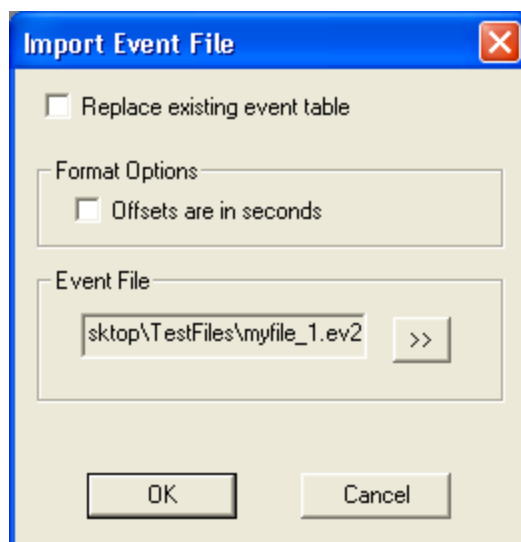
When you attempt to open the file in EDIT (using 4.5), you will see the following message, or one similar.



If you have the setup file (.ast), click **Yes** and supply the file when prompted. If not, EDIT will attempt to recover the file anyway. You may see the following second message.



ACQUIRE (4.5.1) writes a temporary event file that will have a "_1.ev2" extension (e.g., myfile_1.ev2). Older versions do not do this, and the events are lost. That file will be placed in the same folder as the original data file. If you select "Yes" to the above question, you will see the **Import Event File** dialog, where you can import that file.



Selecting or not selecting the **Replace the existing event table** option makes no difference, since the event file does not exist. Do not select the **Offsets are in seconds** option. Then select the "_1.ev2" file. This is a temporary file that will be deleted automatically when acquisition terminates normally.

After importing the events, be sure to resave the .cnt file (or **Update** it) to make the change permanent.

The recovery procedure is not 100% successful, but it is worth trying it to see.

5.3 Analysis (EDIT)

The following are questions regarding analysis that occasionally arise.

5.3.1 Why am I seeing alternating flat lines in data files?

If you try to open a 32 bit data file (created with SCAN V4.3.1 or newer) using an older version of the software, you will see flat lines alternating with the real data. The 16 bit software cannot read the newer 32 bit data files. Routines that convert 32 bit files to 16 bit files are not accurate and should not be used.

5.3.2 Can I read data files from other sources into EDIT?

Yes. EDIT will read CNT files in EDF format, as well as ASCII files. Please see the ASCII Import and Export section of the EDIT manual for details. Stimulus and response information is not imported directly, but may be added (to CNT files only) in a secondary operation by importing a compatible event file (using **Import Event File** in Scan 4.5).

5.3.3 Problems importing and exporting ASCII files

AVG, EEG, and CNT files are basically in two parts: the header and the data. The header contains information such as, the file type, the number of channels, the AD Rate, the channel labels, etc. CNT files have a third part: the event table. The event table contains the stimulus and response event information. It is **not** included in the export or import of CNT files. The event information may be added (to CNT files only) in a secondary operation by importing a compatible event file (using **Import Event File** in Scan 4.5).

There are several commands and modifications of commands related to exporting an importing data files (e.g., EXPORTAVG, EXPORTAVG_EX, EXPORTAVG_EX2). Depending on the software version, and whether you intend to import the files back again, you may or may not need to include the electrode Labels when you export the files. This can become confusing, and problems with importing and exporting data files often relate to the changes in commands and contingencies. The **ASCII File Exporting and Importing** section of the Scan V4.5 *EDIT* manual explains all of the details.

5.3.4 Why do I lose the Standard Deviations after filtering AVG files?

If you select the *Compute Standard Deviation* option when averaging sweeps, the SDs are computed across sweeps for each time point. If you Filter the file after averaging, the waveforms will change, and the SDs become meaningless (and are removed). You should filter the epoched file before averaging, if you plan to compute and use the SDs.

5.3.5 What is the difference between FIR and IIR filters?

There are two classes of filters: Finite Impulse Response (FIR) and Infinite Impulse Response (IIR). SCAN 4.2 and earlier versions used FIR; IIR was introduced with version SCAN 4.3. FIR is a non-recursive filter in which only previous and current input values are included in the calculation of the new output values from the filter. FIR is therefore fundamentally phase blind to output since it does not consider the previous output in the generation of the next output. The nature of the FIR filter permits a linear, predictable phase *error* that does not occur with IIR.

IIR is a recursive filter (in essence, a filter that runs backward), which keeps track not only of previous and current input values, but also the previously calculated output values. It is therefore less prone to phase mismatches.

Be careful when using the IIR filter with slopes steeper than 12dB, especially with faster sampling rates. For example, the filter may become unstable with a 20kHz AD file, when using a 24dB slope and a high pass up to 1.3Hz.

5.3.6 What are Linear Derivation (LDR) files?

Most simply described, LDR files are used to create new channels, or modify data in existing channels, that are linear combinations of existing channels. Data from one, some, or all channels are multiplied by a value, and the results are summed across channels to create a new or modified channel. For example, the Ocular Artifact Reduction transform creates an LDR. Each data point in the VEOG channel is multiplied by a weight (from the prior regression/covariance analyses), and that value is subtracted from the particular EEG channel. This happens in all channels for all time points. LDR files are also used in the Spatial Filter transform, and can be used to create bipolar montages and to rescale

channels. See the **Linear Derivation** section in the *Edit* manual and the *Montage Editor* manual for more details.

5.3.7 Is there a way to re-reference data?

Yes. If you have recorded the data with one reference (say CPZ) and you wish to re-reference the data to linked ears (or mastoids), you can do that with an [LDR file](#), assuming you have recorded the ears (or mastoids) as regular EEG channels.

The following section appears in the Linear Derivation description in the *Edit* manual.

Re-referencing with LDR files. One of the more common uses of LDR files is in re-referencing (see also the [GFP/Reference](#) command). Let's say you recorded a file with all channels referenced to A1 (left ear), and you also recorded A2-A1 as a separate channel. You want to re-reference the data to have a linked ears reference. For a given channel, such as CZ, you recorded CZ-A1 and A2-A1, and what you want is CZ-(A1+A2)/2. The solution is simple mathematics and an LDR file that combines the existing CZ-A1 and A2-A1 channels using a multiplier for the A2-A1 channel to give the desired linked ears reference. In other words:

$(CZ - A1) + x(A2 - A1) = CZ - (A2 + A1) / 2$, where x is the value of the multiplier representing the recomputation needed for the new reference.

$$\begin{aligned} CZ - A1 + x(A2 - A1) &= CZ - .5A2 - .5A1 \\ x(A2 - A1) &= -.5A2 + .5A1 \\ x(A2 - A1) &= -.5(A2 - A1) \\ x &= -.5(A2 - A1) / (A2 - A1) \\ x &= -.5 \end{aligned}$$

The scalar for the (A2 - A1) channel is therefore -.5. The LDR file is the regular identity matrix (1's down the diagonal), with a -.5 in the column under A2. You might want to relabel the new channels to reflect the linked ears reference (CZ - A1A2). A section of the final LDR file should be similar to:

	CZ	PZ	CPZ	CP4	FC4	TP8	OZ	FT8	A2
CZ-A1A2	1	0	0	0	0	0	0	0	-0.5
PZ-A1A2	0	1	0	0	0	0	0	0	-0.5
CPZ-A1A2	0	0	1	0	0	0	0	0	-0.5
CP4-A1A2	0	0	0	1	0	0	0	0	-0.5
FC4-A1A2	0	0	0	0	1	0	0	0	-0.5
TP8-A1A2	0	0	0	0	0	1	0	0	-0.5
OZ-A1A2	0	0	0	0	0	0	1	0	-0.5
FT8-A1A2	0	0	0	0	0	0	0	1	-0.5

5.3.8 Merging behavioral data from non-Neuroscan sources

The Stim2 system creates a behavioral data file (.dat extension) that contains line by line results, including all stimuli and responses, as well as accuracy and latency of the responses. If you have a similar summary output file from another stimulus presentation system, you can use that in *Edit* as long as it conforms to the expected format.

The output file from the presentation system must be modified so that it matches the format of a Stim2 .dat file. This format includes a header, and then the actual event data. If the Scan demo data have been installed (typically in C:\ScanData), there is a subfolder called "Visual Attention" that contains both a .cnt file and a .dat file generated by Stim (both are named "viscpt"). The header from the viscpt.dat file can be copied into the output file being created. Basically, one would need to copy/paste the header of the file, and then order the columns containing the event information in the same way. The Stim2 .dat file has 5 columns:

1st column: ordinal number of event, i.e. "1" for first event, "2" for 2nd event, etc.

2nd column: code of the response made by the subject; this has to be a numeric code in the range of 1-4.

3rd column: code of the stimulus event.

4th column: accuracy of the response; three values are recognized - "1" for correct response, "0" for incorrect response, and "-1" for false rejection

5th column: latency of the response, typically in seconds.

Once this .dat file has been created, you can use the "Merge Task Data" transform found in Edit. Basically when this is selected, it checks the number and order of events in the .dat file, and ascertains whether it matches the number and order of *Stimulus events only* (not response events!) in the .cnt file. Assuming a match, the file will merge. Thus, it is not necessary to have any response codes in the .cnt file itself.

Occasionally you may see an error message saying that the merging failed. The error message occurs when the user attempts to merge a STIM2 behavioral file with the CNT file. The error message is due to a mismatch in stimulus triggers between the triggers in the STIM2 behavioral data (DAT file) and those triggers in the CNT file.

The way to fix the problem is to create an event file from the CNT file (Event File transform), then open both the DAT file and the EV2 file in EXCEL and perform a 1 to 1 comparison until the row with the mismatch is located. A common cause for the mismatch is a random trigger that is detected by the amplifier and which does not represent in reality an actual stimulus. To fix the mismatch, simply delete the 'extra' row(s) and realign them so they match between the DAT file and the EV2 file. Next, Re-import the modified EV2 file into the CNT file, making sure the triggers of modified EV2 file replace the existing triggers. Once complete, perform the merging process again.

5.3.9 Which eye blink correction should I use?

There are several offline artifact reduction methods that can be used to remove blinks. The main ones are:

Ocular Artifact Reduction. This is the oldest and most used method. It is based on an EEG-VEOG covariance analysis, a linear regression procedure, and the creation and use of an LDR file to perform a point-by-point proportional subtraction of the blinks. Blink activity - even small eye blinks - will be reduced throughout the file.

Blink Noise Reduction. This is the same procedure that is used online, and it is very similar to the Ocular Artifact Reduction (OAR) transform. The main difference is

that, in the OAR method, blinks throughout the file are averaged, and a single LDR file is applied to the entire file. In Blink Noise Reduction, you select how many blinks will be averaged. The average is a rolling one, based on the N most recent blinks. An internal LDR file is used, and it is updated in the same rolling fashion.

Spatial SVD/Spatial Filter. This method uses the Singular Value Decomposition transform (SVD; similar to Principle Component Analysis) to identify the blink component. An LDR file that reflects the spatial distribution of the blink is created. The Spatial Filter uses that LDR file to remove the blinks. This is the only method of the three that corrects the blink channel as well as the EEG channels. The main disadvantage is the number of steps required to use it (you have to insert triggers for the blinks, and create the average artifact manually, then perform the SVD and Spatial Filter).

In the comparisons we have performed with using these methods, there is very little difference among them - all are very effective in removing the blink artifact. We recommend you experiment with the methods and adopt the one that works best in your particular situation.

While one might be tempted to try the EKG Noise Reduction transform, or the separate Correlate Peaks / Subtract Average transforms to remove blinks, we do not recommend this approach. The blinks tend to be far more variable in amplitude than heart beats. The average blink, therefore, will quite likely be different from any given individual blink. If you use the Dilate option, this method can work quite well in stable places in the file, but the correction becomes more erratic in places where there is, for example, DC drifting. Small blinks that are below the voltage threshold will not be corrected (as they are in the other methods).

6 Issues Involving Batch Files

The following are questions that occasionally arise regarding Tcl Batch files.

6.1 Should I use Batch files or Script files?

EDIT provides two ways to automate the analysis of your data files: batch files or script files. In general, we recommend using Tcl batch files whenever possible. In the developmental history of EDIT, script files were implemented only as an interim approach to automated analysis while the Tcl files were being developed. Tcl files are somewhat more difficult to create, but they are far more flexible. In addition to the 150+ batch commands in SCAN, you also have access to the complete Tcl language. The batch files can be fairly simple (the commands are written for you in EDIT), or they can be very complex. Script files are easier to set up for beginners, but there is limited functionality and eventually people switch to batch files because of the greater capability. Support for script files has been greatly reduced in the latest versions of EDIT, and not all script functionality may be retained. To learn about Batch files, see the *Tcl Batch Tutorial.pdf* file in the Pdf folder.

6.2 Is it possible to apply a batch file to all files in a folder?

Yes. There are several ways to do it. The most flexible is the glob command (TCL command). Please refer to the Tcl batch manual (Scan 4.5 version) for details of the various ways.

6.3 Is it possible to add or modify events in a CNT file using batch?

First, there are several ways to add, remove, or change stimulus/response events in a CNT file. You can use the Insert Stimulus Event button on the Toolbar (SCAN 4.4) to insert stimulus events at manually selected locations. You can use the INSERTSTIMEVENT and INSERTRESPONSEEVENT Batch commands to insert the events at defined locations. You can create an event file, edit it manually, and import the events using the Import Event File transform (SCAN V4.4). You can delete selected stimulus or response events by using Mark Block to define the section, then use the Clear Events or Clear Specific Events to remove the ones you do not want. You can use the REMOVEEVENT batch command to delete a defined event.

If you want to use Batch to change existing events in the CNT file, use GETEVENTINFO and SETEVENTINFO to change the event (or accuracy, latency, or other information associated with a specific event). An example is given in the Tcl Batch Tutorials pdf file (in your pdf folder).

6.4 Invalid parameter count

If when running a batch file or single command you see a message saying "Invalid parameter count", that means that there is an incorrect number of parameters in the indicated batch command. Generally, this is caused by a typo, by omitting a parameter, or by omitting a space between parameters. It can also happen when you switch from one command to a newer version of the same command (an "_EX" command). The newer versions often have a different number of parameters. Therefore, you cannot just change the command in your batch file (e.g., from EPOCH to EPOCH_EX) without also checking that the parameters are correct.

7 3DSpaceDx

The following questions regarding 3DSpace occasionally come up.

7.1 What exactly is 3DSpaceDx used for?

The primary purpose of 3DSpaceDx is to digitize the three dimensional positions for the electrodes and at least three landmarks on the head. A digitizer is required (Polhemus Fastrak). The electrode position information is used in the PCA/ICA analyses and in CURRY and SOURCE. Having the exact positions of the electrodes improves the accuracy of the principle or independent component analyses and the dipole solutions. The landmarks are used to coregister the functional data with the image data (MRI, CT, etc.).

7.2 Which cable: USB or RS-232?

For many years, the Fastrak digitizer from Polhemus came with an RS-232 cable only. Recently, they have also included a USB cable. 3DSpace does not recognize the USB cable, so please continue to use the RS-232 cable instead.

7.3 Is there a way to modify the 3dd files?

Yes. In 3DSpaceDx, retrieve the 3dd file and save it (export) as a dat file. Open the dat file in a text editor, such as Wordpad, and make the modifications. Save the file and import the dat file into 3DSpaceDx. Save it as a new 3dd file. (See Tutorial 3 in the 3DSpaceDx manual).

7.4 Is it necessary to digitize the head shape?

3DSpaceDx can digitize the head shape as well as the electrode and functional landmark positions. The head shape is converted to a triangulated surface file (.tri). That file can then be used in EDIT for mapping results on the subject's 3D head shape, as opposed to the 2D maps. If you do not intend to map the EEG or EP results on the subject's own 3D head shape, there is no need to digitize the head shape.

If you are using Curry, the segmentation algorithm will segment the skin surface, so all that is needed from 3DSpace are the electrode positions and landmarks.

7.5 "FCT6NN files not available" message

This is a known problem in Scan 4.3.1 that has been corrected subsequently. The problem is that one of the subfolders under the Scan 4.3 folder is named incorrectly: the "ftc6nn" folder should be "fct6nn". If you copy and paste the folder (simply renaming the folder will not work) into the Scan4.3 folder, and then rename the pasted folder to "fct6nn", this should resolve the problem.

7.6 3DSpace does not open

There are at least two reasons for 3DSpace not opening.

If you click on the 3DSpace button on the Program Launcher, and all you see are a few obscure error messages, check to see if you have a 4.4 (or newer) license on your dongle (use the License Manager program to see what is on the dongle). The 4.4 license is not needed and it has been discontinued. Nevertheless, it has mistakenly appeared on a few dongles, and the main problem with that specific license is that 3DSpace will not open. Contact Technical Support if you encounter this problem. (Scan 4.4 runs with a 4.3 license).

If you get no error messages, yet the program does not open, the most likely cause is a setup file where one or more of the multiple windows are outside of the display area. When you open 3DSpace, it accesses the most recent setup file (*.ast) that was loaded. If you modified that file in such a way where one or more of the Multiple Windows in Channel Layout are outside of the display area, that will cause 3DSpace not to open.

Using that setup file in Acquire, go to Channel Layout, and make sure all channel windows are within the display region. You may need to shrink the display considerably to find the outliers. If you have used the "10-20 Positions" button in the Channel Layout dialog, followed by the Match Labels button, it is quite likely that some windows may be moved outside of the display area. After bringing those windows into range, and resaving the setup file, you should be able to open 3DSpace.

You can also locate and open the 3DSPACEDX.INI file in the Windows folder. go down to the SetupFile line and change the setup file there to a known good file. That should allow 3DSpace to open. Alternatively, you can delete the INI file, and it will be recreated when you open 3DSpace (it will use the default.ast file). This will work as long as you have not altered the default.ast file so that it has windows out of the display range.

8 Issues Specific to MagLink RT

The following are questions have occasionally arisen regarding MagLink RT (or any MagLink system).

8.1 Trigger problems

The triggering situation may vary from site to site depending on the trigger pulses sent from the scanner to SCAN. The Trigger Issues section below explains the characteristics of the pulses that are required. In the most common case, the output from the scanner is a positive logic TTL pulse. The input into the back of the SynAmps2 or SynAmps RT, however, is in an unused response line, and the response lines must use negative logic. If the scanner pulses are sent through the supplied MRI Trigger Interface, there is a switch that inverts the logic. That converts the scanner's positive logic pulse to the expected negative logic pulse, and the triggers should then be seen. The actual response line that is used is the 64 bit line (so the response would be seen as a red 64 in the CNT file). However, the current software converts the red type 64 response to a red type 5 response, and this is what should be seen in ACQUIRE in the CNT file.

8.2 Should I record in AC or DC mode?

DC mode is required. In AC mode the filters can ring, causing a distortion of the artifact such that the accurate subtraction of it is nearly impossible.

8.3 What acquisition mode should I use?

Continuous mode is required for the online and offline artifact removal procedures.

8.4 What filters should I use?

The High Pass filter should be DC, and the Low Pass should be the maximum that is available with the AD Rate you are using (the widest possible band pass). Do NOT use the 50 or 60Hz notch filter, as it tends to ring from the high amplitude artifact.

8.5 Problems removing the artifacts completely

The expected artifacts are the MR gradient and ballistocardiogram artifact (BCG; exaggerated EKG artifact due to micromovements in the cables caused by the heart beating). In both cases, artifact sweeps are averaged together and subtracted from individual artifacts. If the average artifact is the same as the individual instance, the subtraction will be perfect. The extent to which the two differ will determine the effectiveness of the subtraction. The MR artifact is usually quite stable and consistent from block to block, or slice to slice. BCG will have some variability. With experience, you can achieve the best possible correction. If you are recording evoked potentials, our experience has been that slight residual artifact will tend to average out when the EP sweeps are averaged. We recommend that you record more EP sweeps that you would normally do to maximize the signal to noise ratio (at least twice as many).

It can be more difficult if you are looking at individual epileptic spikes. One parameter that will make a difference is the number of Averages. This is the number of artifact sweeps that are averaged together. The average artifact is created for each channel. Realize that each average artifact in the EEG channels contains two parts: the average of the artifact and the residual EEG that does not cancel out when the sweeps are averaged. If there is a relatively large amount of residual EEG in the average artifact, that will affect the genuine EEG in the single sweep from which the average artifact is subtracted. While even a low number of Averages (e.g., 3) will be sufficient for subtracting out the artifact, it is not enough for adequate cancellation of the EEG in the artifact sweeps, especially if the amplitude of the EEG is high. Averaging more sweeps (e.g., 10 or more) may help preserve the spike waveforms.

If the data files contain VEOG artifact as well, it is sometimes more effective to remove the VEOG (if present) before removing the BCG. The order would be: MR artifact, VEOG, then BCG removal. That is because the EKG/BCG Reduction routine can be affected by any larger artifacts (e.g., blinks) in such a way as to actually add the blink artifact to the frontal channels in sections following where the actual blink occurred.



Note

The artifact reduction software is constantly evolving. As new features are added and new techniques are explored, the above information may become outdated from time to time. Contact Technical Support for the latest information.

8.6 Is it necessary to use a pulse oximeter?

Generally, yes. Removal of BCG in files recorded in the magnet can be challenging. Part of the reduction algorithm requires accurate placement of triggers at the peak of each BCG instance. The regular EKG channel often contains a large amount of BCG artifact, such that it is difficult to mark the peaks reliably. The pulse oximeter signal is unaffected in the magnet, even during episequencing. It is therefore generally the best trigger channel to use in BCG Noise Reduction. The exception would be if you are able to obtain reliable BCG correction using the EKG artifact channel alone.

9 QuikCap and QuikGel Tips

Here are few steps to ensure you get the most out of your **Quik-Gel**:



- Ensure your refrigerator temperature is not near freezing. Leave the jar in the fridge at all time and take it out about half an hour before use, then leave it in a bath of warm water.
- Depending on the Quik-Gel turnover-rate or size of jar that you purchased, you may wish to split the amount into 2 containers. You might wish to fill up an individual 50ml syringe with Quik-Gel and leave the main jar in the fridge at all times until the 50ml syringe has been used up (still put the 50ml syringe in the fridge when not in use). Cut off the tip of the 50ml syringe to make a bigger hole, wipe the outside of the syringe with alcohol, withdraw the needed amount of Quik-Gel, then use this syringe to feed 10 ml syringes through the back (after removing the plunger) and use the 10ml syringes with a blunt needle to prep the subject. Once the 50ml syringe is empty, dispose of it and use a new one to dip in the jar.
- Use a sterile approach at all time when handling the Quik-Gel jar. In other words, avoid double-dipping especially if the syringe has been touched by someone's hand. Keep the jar closed when not in use. Any bit of contamination regardless of how small it is may generate mold, especially during the summer.
- The person prepping the subject will almost unavoidably end up with Quik-Gel on his/her hands or gloves. This also applies if using Quik-Cells. In such situations, care must be taken to avoid handling sensitive hardware components, such as the Quik-Cap connector or the amplifier itself. Quik-Gel and other electrolytes contain corrosive salts that can permanently damage these sensitive components.

Here are some tips for **Quik-Cap** maintenance:



Do not soak in water post-use for more than 45 mins.

- Use lukewarm water.
- When cleaning/soaking the cap, the user should ensure that water/disinfectant does not get in to the cap connector. Also, make sure there are no open connections, such as open drop down leads while the cap is soaking.
- Avoid putting tension on the wires, especially when cleaning.
- After soaking in water, run under tap to wash away the Quik-Gel. If using Quik-Cells, skip this step.
- Any stubborn Quik-Gel remnants can be gently cleaned/removed with a Q tip.
- Avoid harsh disinfectants - Always dilute to specifications. We recommend Envirocide in water diluted with 1:4 ratio. Do not leave the cap soaking in such solution for more than 5 minutes.
- Dry as quickly as possible, preferably in front of a blow fan.

Here are some tips for **cap application** and other related information. The content below assumes you are using Quik-Gel. If you are using Quik-Cells, substitute those steps instead.

Subject Scalp Preparation and QuikCap Application

1. The night/day before scheduled testing, contact the subjects and make sure that they wash their hair the morning of testing. They should wash their hair with a normal shampoo that does not contain any conditioner. Conditioner coats the scalp and makes it much more difficult to obtain low impedance connections. After

shampooing, the subject should not use any conditioners or styling gels that would also coat the scalp and hair.

2. Once arriving at the laboratory for testing, have the subject vigorously brush their hair and scalp with an old-fashioned bristle hairbrush for 3-5 minutes. This will help to exfoliate the scalp surface and will dramatically reduce (any in some cases eliminate) the need to abrade the scalp surface after loading the electrodes with gel.
 3. Prepare the skin areas where drop electrodes will be located. It is usually sufficient to clean these areas with an alcohol or acetone swab. It is important that these areas are clear of makeup and foundation to ensure low impedances. Since good impedances depend greatly on the REF and GND electrodes, you can estimate the locations of these electrodes PRIOR to placing the cap. Using a QTip or small dressing bearing some Nuprep, prep these locations for added security.
 4. Position the cap on the head of the subject. This is typically a two-person process, one of which may be the subject. While standing behind the subject, have a second assistant (or the subject) place their thumbs under the front edge of the Quik-Cap. Then pull the cap onto to the head, slowly, carefully ensuring that midline row of electrodes is properly aligned on the head.
 5. Attach all drop electrodes. If necessary, use o-rings or butterfly tape to make sure the electrodes are in secure contact with the skin. Or, try Cover-Roll stretch tape (<http://63.134.192.29/cart/Details.cfm?ProdID=145&category=11>). This comes in one long roll, which you can cut as small as needed. It is a one-sided adhesive and sticks incredibly well. It is intended for sensitive skin. It is stretchable which helps applying it on top of the electrode with gentle pressure to keep contact with the skin. All you need is a small rectangular piece spanning the width of the electrode and a little bit on each side to anchor it against the skin. Peel the small piece off on the adhesive side, and then stick the tape to the back of the electrode. PRIOR to applying it onto the subject, pierce the tape with the blunt needle to create a hole for dispensing the electrolyte or the Quik-Gel (avoid piercing it AFTER it has been applied).
 6. Load all electrodes with electrode gel beginning with the ground and reference electrodes. *Remember*, the electrode gel is used to build a column of conductive medium between the scalp and the surface of the electrode. If too little gel is loaded, this conductive column will contain gaps. Consequently, contact between the scalp and the electrode will be intermittent. If too much gel is loaded, it will spread beyond the proximity of the electrode reservoir and (with high density electrode arrays) could result in a salt bridge with other electrode locations.
 7. If all electrodes are reading high impedances, this usually reflects high impedance at either the ground or reference electrode location. After loading the ground and reference electrodes, load all remaining cap and drop electrodes. It is a good idea to let the gel soak in before testing the impedances; the gel will lower the impedances significantly on its own without abrading.
 8. Perform the first impedance test. If the subject has clean hair and a well prepared scalp, many of the electrodes will have impedances that are sufficiently low ($< 5\text{-}10\text{k}\Omega$) so that no further preparation is required.
-

9. When abrading is necessary, always begin with the ground and reference electrodes. Do not direct force down on the needle toward the scalp. It is usually sufficient to make sure that the needle has contact with the scalp, and then simply rotate the needle in a circular manner (rotate the needle in an arc). Place light pressure down the electrode holder with one hand while abrading with the other hand. This will ensure that the electrode gel remains confined to the reservoir of the electrode holder. Run the acquisition module of the software while preparing the subject. Watch the impedances while abrading. As soon as the impedance for an electrode begins to decrease, stop abrading and remove the preparation needle from the electrode. Usually the impedance will continue to fall. An immediate increase in electrode impedance after removing the preparation needle usually indicates that the column of gel in the electrode reservoir is intermittent - the preparation needle is thus the conductor between the scalp and the electrode. In this situation, inject a little more gel into the electrode holder. Slightly withdraw the needle while injecting the gel. This will help to construct a column of conductor that is uniform and will last throughout the recording sessions. Use the extra gel that flows out of the top of the electrode reservoir to seal the opening - this will keep air out of the electrode and prevent the gel in the reservoir from drying out.

Take your time and try to get all impedances $<5k\Omega$, and balanced across electrodes. This is especially critical for obtaining clean recordings in the MR. Generally, it is better to have impedances that are somewhat higher, yet within the same range, than to have a broader range with some very low and other relatively high impedances.

IMPORTANT - Always use a clean blunt-end needle when abrading. Never reuse syringes and blunt needles for more than one subject. Use a "sharps" dispenser to dispose of blunt needles, if available.

10. Heads vary greatly in both size and shape. While we endeavor to make Quik-Caps that snugly conform to the surface of the head, some electrodes may not always be in good contact with the scalp. In these cases, we recommend using the wound gauze mesh over the top of the Quik-Cap. The mesh can be cut into lengths of 10-15 cm in length and then pulled over the top of the Quik-Cap. Under most conditions it is not necessary to place the gauze mesh over the frontal pole electrodes as the cap is typically quite snug at these locations. Subjects/patients are likely to experience excessive pressure and some discomfort if the gauze is placed over these electrodes.

Of special importance for EEG recordings in the MR is the placement of electrodes to record the electrocardiogram (EKG). This is critically important as this data will be used as a trigger for extracting the ballistocardiogram. Optimally, the EKG electrodes should be placed in locations above and below the plane of the heart. For ease of placement, these electrodes may be placed along the midline of the chest. Because of the location of these electrodes, it is important to clearly explain the need for these electrodes to the patient, particularly to female subjects.

Critical Tips for Subject Comfort

1. **Prepare in advance.** If recording in a magnet, time is extremely valuable. Optimize testing procedures by preparing all electrode application materials in advance. Prior to subject arrival, load the necessary number of needles with gel to complete the

entire cap (32-40 channels, 2 syringes; 64 channels, 3-4 syringes, etc.). Have gauze mesh cut to length (10-12 cm). Have all butterfly tapes available and ready for placement. Have the acquisition software open and ready for testing electrode impedances.

2. **Do not** place the mesh over the frontal pole electrodes Fp1 and Fp2 (or other frontal pole electrodes). These electrodes typically do not require any additional force to be firmly in contact with the scalp. Placing mesh over these electrodes may result in discomfort to the subject.
3. **Do not** place a drop electrode under the edge of the Quik-Cap. This will result in discomfort for your subject. At frontal electrode locations, this discomfort can rapidly advance to nausea and/or headache.
4. **Check for special medical conditions.** The Quik-Cap is secured to the head using a fairly snug chin strap, which can cause discomfort. This discomfort can be particularly acute for individuals with temporal-mandibular joint disease (TMJ - disease). Ask your subject in advance if they are affected by TMJ. If such individuals are to be tested, perform a recording sequence outside the MR environment to determine their tolerance (including time of comfort). Prolonged testing of TMJ subjects with the Quik-Cap can result in acute discomfort.
5. **Subject Comfort is a Priority.** Routinely inquire about your subject's comfort during preparation and during testing. EEG recordings in MR environments are qualitatively different from those performed in the relative comfort of a testing lab.

9.1 General advice regarding electrode caps

Electrode caps represent a considerable investment. The best advice we can give is to treat them carefully - they are delicate instruments. Don't handle them roughly, don't stress the soldered connections, don't use harsh detergents, and don't use high heat to dry them. Read and follow the cleaning and maintenance recommendations in the cap manual. While we constantly strive to develop the most reliable and durable caps we can, they do have lifespans, and they will eventually need to be repaired or replaced. The more carefully they are treated, the longer they will last.

9.2 Cap Repairs

The following information applies to Quik-Caps only and not to Micro/MagLink Caps.

Sintered electrodes are made differently from standard metallic disc electrodes. With the latter, the electrode is soldered onto the conducting fiber in the lead cable, and the connection is then over-molded so that the junction essentially never breaks (assuming the electrodes are not abused, of course). With sintered electrodes, the electrode disc is created by compressing silver-silver chloride powder together, and the conducting fiber is inserted into the compression mold prior to compression. Thus, there is no way to solder the conducting fiber onto the sintered electrode. The junction is then covered with an epoxy to stabilize as much as possible.

Since there is no solder making the connection between the electrode and lead cable, over time the conducting fiber can lose connectivity with the electrode. Essentially, the fiber is inside a cavity of the disc, and over time and repeated usage, the cavity can become slightly larger - but large enough that the fiber sits in it, without connecting at all to the electrode. Or, the connection is intermittent. But once you start to encounter an issue with an electrode sight, even if it's only intermittent, that usually indicates that the electrode will eventually die and then need to be replaced.

In terms of the electrode itself becoming flaky, that typically does not happen. If you are finding flakes, that is most likely dried gel. This is a big advantage of the Quik-gel over other gel! Since Quik-gel is water based, it is much easier to "flush out" and completely clean the electrode cup. Other gels may be oil-based, and thus if you are not careful, it's easy to accidentally leave a thin film on the electrode. Over time, this builds up. If you are using the Quik-cells, the flakes are probably salt water, which wasn't adequately flushed out during cleaning. If there is dried salt from either the Quik-gel or Quik-cell saline solution, try soaking the cap in warm soapy water for 5 minutes, and then use a Q-tip or soft-bristle toothbrush to gently swab out each electrode. Then, use a water pick or a running tap to flush out the electrode.

The way to test caps is with a multimeter, and with the cap plugged into the headbox. Here is the process:

- 1.) Place one probe into the appropriate individual physical channel on the headbox, which corresponds to the electrode being tested. Typically, on a 128-channel cap, the electrode label will correspond with the physical channel, e.g. electrode 10 is wired to physical channel 10.
- 2.) Place the tip of the other probe in the aperture of the electrode being tested, and then tilt the probe so it is at an angle. This will insure maximum connectivity between the probe tip and electrode disc.
- 3.) On the meter, set it to show actual resistance. Note this is different from just the connectivity test; the latter is binary. What we need is an objective measurement of the actual resistance. This value should be under 5 Ohms (not kOhms) and is usually 2.0 +/- 0.5 Ohms. This is why the binary test is insufficient; a measured resistance of 50kOhms, for instance, would still return positive connectivity.
- 4.) On the meter, the measurement should stabilize after 2-3 seconds (depending on your model). If the measurement never stabilizes, and seems to fluctuate between low and high values, this is symptomatic of a bad electrode. If the measurement stabilizes, but the value is > 5 Ohms, this is also symptomatic of a bad electrode.

Once you identify an electrode as bad, use the repair kit. Here is the process:

- 1.) Cut off the bad electrode, typically about 0.5-1" from the electrode-lead junction. To remove the electrode from the cap, remove the o-ring (needle-nose pliers work best here) and pull the electrode through the inside portion of the cap. In other words, you would be pulling the electrode towards the subject's head, instead of away from the head. The reason for this is it is much easier to remove (and then insert) a cap electrode through the underside of the cap. This means that when you follow the procedure below, you will need to fold the cap back towards the cable bundle. Note you don't have to do it this

way, but we have replaced hundreds of cap electrodes, and find this is the easiest process.

2.) The gauge of the lead cable is small, so you can either use a very small gauge wire stripper; or, simply use a small set of wire cutters. You can use the same tool for both cutting and stripping. One thing to note when stripping; you want to make sure you expose conducting fiber, which will appear as a shiny, metallic wire. Sometimes, this is buried within the yellowish Kevlar fiber. If, after stripping, all you see is yellow fiber, then cut the wire again right where the fiber meets the outer, black sheath, and strip again.

3.) Do the same with the lead cable attached to the replacement electrode.

4.) Once you have conducting fiber exposed, insert the replacement electrode's fiber into one end of the solder tube (also part of the replacement kit). Make sure the exposed conducting fiber reaches the middle of the tube, where the solder ring is. Use a soldering iron to then melt the end of the tube, to mold with the fiber. On the solder tube, you will see a ring of solder in the middle, and two rings, one on each end. The "end rings" are basically clamps that, when melted, will fuse with the wire. At this point, **DON'T MELT THE SOLDER RING YET!**

5.) Next, slide the black heat shrink onto the cap's cable (where the bad electrode was cut off); this is used later. Then, insert the cut end into the other end of the solder tube, and make sure the conducting fiber "meets in the middle" under the solder ring. The two conducting fibers overlap. Then, melt the other "clamp", and finally the solder ring.

6.) To "melt" the ends, you can use a standard soldering iron from Radio Shack, such as, a 30W model. You will need to make contact between the tube and the iron to melt the tube, but you want to constantly keep the tube in motion by moving the area being melted back and forth. If you don't move it, you risk completely melting the tube. Use a vise clamp, which holds the iron onto a desk or table, with the soldering iron tip facing toward you. This way, you can hold the two things you are joining together. This is a much easier way to solder, then trying to hold the soldering iron itself.

Feel free to contact techsup@neuroscan.com if you have any issues with the repair. If, after application of a repair kit, the site still tests as bad, this means the problem is most likely in the cap connector (that inserts into the headbox). In this case, you would need to return the cap to us for inspection and repair.


10 Stim2


The following questions regarding Stim2 occasionally come up.

10.1 No triggers in Gentask

If you have created .wav files in the Sound Editor in Stim2, and there are no triggers seen when you play the files in Gentask, the most common cause is the absence of the .trg file. The .trg file contains the position of the trigger event.

Do the following whenever you create .wav files in the Sound Editor.

With your .wav file open, click the Insert Trigger icon  on the Toolbar. This places the trigger at the beginning of the file. Move the mouse to the left edge of the file, and it will change to a grabbing hand shape. You can then grab a vertical dashed line and move it into the wave file. Letting go of it will change it to a green line. This is the position of the

trigger. Click the blue arrow  on the Toolbar to open the Play Configuration window. The Trigger Onset field shows the position of the trigger.

When you save the .wav file, the .trg file will be created automatically, using the same file name (.trg extension). If you move the .wav file to a new location, be sure to move its .trg file with it.

Generally, when no triggers are seen from Gentask (assuming all else is set up properly), it is because the .trg file was not created, or the .wav file was moved without its associated .trg file.

10.2 Is it possible to present audio and video files at the same time?

Yes, using the Build command in Gentask. For example, in the sequence file below, pictures are presented, and remain on the screen while a sound file is played. Both end at the same time. The third field (Duration) in the SND event line controls the time between the onset of the image and the delayed onset of the sound.

label	mode	dur	win	iti	rdB	ldB	resp	type	filename
----	----	---	----	-----	-----	-----	-----	-----	-----
0	IMAGE	BUILD	0	66.67	0	0	0	1	C:\picture1.bmp
0	SND	706.67	0	3000	75	75	0	2	C:\sound1.wav
0	IMAGE	BUILD	0	66.67	0	0	0	1	C:\picture2.bmp
0	SND	706.67	0	3000	75	75	0	2	C:\sound2.wav
0	IMAGE	BUILD	0	66.67	0	0	0	1	C:\picture3.bmp
0	SND	706.67	0	3000	75	75	0	2	C:\sound3.wav

Please refer to the Stim2 manual and Build demo file in Gentask for more information.

10.3 Why can't I present visual stimuli at very fast rates?

The fastest presentation rate in Stim2 is twice the refresh rate. Two refresh cycles are required to draw the initial stimulus, and then to erase the stimulus. The actual time will vary depending on your monitor's refresh rate.

10.4 Why does the ITI change with audio files?

In Gentask, in the ITI field, you will see that the number you enter may be changed to a different value. For visual stimuli, this is based on the screen refresh rate, as it must be. Why does it change for audio stimuli? The screen is always refreshing, even during audio presentation, and therefore the refresh rate applies to audio files as well.

10.5 Is it possible to play AVI files or other movies (DVDs) in Stim2?

No, not currently, although these capabilities are under development.

10.6 Is it possible to use a joy stick with Stim2?

No, currently only the mouse cursor position is recognized.

10.7 Migrating Stim2 to a new computer

We do not recommend moving an existing Stim2 system to a different computer. The audio and video boards are installed in the factory, and the complete system is used to calibrate the audio output. If you move the audio and video boards to a new computer, that computer (and the audio box, etc.) will need to be returned for recalibration.

If you do need to move to another computer, that will usually mean a change to the Windows 7 operating system. This will require a new version of Stim2, which is not a free upgrade. Please see the [section](#) above for important information.

10.8 Embedded trigger offset problem in Gentask with 3rd party files

If you are using audio files created by 3rd party software, where you have one or more embedded triggers in the files (other than at the beginning), and you are presenting the files in Gentask, the position of the triggers may be shifted in time.

In order to maintain synchronization between triggers and audio (as well as audio and visual stimuli), certain data format structures must be observed. Audio, in particular, has become a particularly volatile media - it can be recorded and stored in an enormous number of formats with respect to sampling rate, bit rate, number of channels, not to mention the most difficult factor of all to deal with, compression.

For Gentask to maintain the triggers in the proper location, the following criteria must be followed:

- 1) The data must be stored in *uncompressed* format.
- 2) The data should be stored in *16 bit* format.
- 3) Sampling rate of *22* or *44 kHz* is permissible.
- 4) The data must be stored in *stereo* format.

Stereo format is a critical factor. The trigger position is based on the overall file length, and in order for Gentask to handle not just mono but also stereo files, a stereo file format is required for all audio input when the trigger location is to be determined from the .trg file.

If 3rd party software is needed, we strongly encourage people to use the WaveStudio package that comes with the Stim2 system (it is the software that comes with the Audigy 2 sound card). This package has very nice editing facilities.

If the 3rd party files already exist, and the user needs to convert them in order to have accurate triggering in Gentask, they should do the following:

- 1) Open WaveStudio on the Stim2 computer.
- 2) Open the file in WaveStudio.
- 3) Under **Window**, select **Convert Format**.
- 4) Convert the format to **22 or 44 kHz 16 bit stereo**, then press ok.
- 5) The converted file will appear on the screen.
- 6) Click **File** → **Select Save As** and enter the desired file name.

11 SynAmps2 and SynAmps RT

The following are questions that occasionally arise with the SynAmps2 and SynAmps RT amplifiers.

11.1 Setting the input and output voltages on the Power Unit

When setting up the SynAmps2/RT, *make sure you have the input and output voltages set correctly for 115 or 230V on the Power Unit. If you have the output voltage set to 230 for a 115V device, damage may occur to that device.* To set the input voltage, you will need to use a small pin to gently pry open the black panel. The red fuse assembly can be removed and rotated such that the desired setting is displayed in the small window in the panel. The correct fuses should be installed: 10A for 115V, and 5A for 230V. The output voltage is set with the switch on the back of the Power Unit. Both the Input and Output voltages should match the voltage of the facility you are in (115 or 230).

11.2 What do I do with unused channels?

If you are using fewer than the 64 channels in the headbox of the *SynAmps/RT*, you should either leave the unused ones open, or else jump them to Reference, depending on the situation.

1. Under normal recording conditions, that is, normal background environmental noise conditions for recording EEG, it is NOT necessary to short the unused channels to Reference. There is no impact if the unused channels are left open. The amplifier was constructed to handle normal environmental (radiated) noise impinging on open channels without any impact on the quality of the recordings in the used channels.
2. In more hostile recording environments, or when the signals to be recorded are small (as in near threshold auditory brainstem response recordings, or in many cases where ABRs are recorded in non-Faraday cage surroundings), it is often essential to terminate the unused channels by shorting those connections back to Reference.

At all times in the *SynAmps2*, all amplifier channels are active regardless of the number selected for use in a recording. Therefore it is essential in environments that contain unusually high levels of radiated noise (or conversely very low-level sub-microvolt EEG/ERPs such as auditory brainstem responses) that the un-terminated channels be prevented from free floating, especially if there are open channels such as in a situation, for example, when fewer than 64 channels are gelled on a 64 channel MagLink system. With the *SynAmps2* in the MRI, for example, RF generated during a Scan sequence is radiated back into the amplifier down the non-terminated channels and can be effectively de-modulated down into the EEG frequency range of interest. The upgrade from the

SynAmps2 to the *SynAmps RT* minimizes this issue by adding two layers of additional filtering on each channel to minimize this effect; (a) RF filtering at the front of each channel and (b) additional maximum cutoff low pass filtering on each monopolar channel.

11.3 Why is there no manual DC Correction with a SynAmps2/RT?

The original SynAmps had a manual DC Correction button that could be used during acquisition to correct DC offset and drifting before the channels saturated. SynAmps2/RT do not have that option because, most simply explained, it is not needed. There is an inverse relationship between Gain and the Dynamic Range of the amplifiers. SynAmps2/RT have a very low Gain, meaning that the Range is very broad. That makes saturation nearly impossible. SynAmps2/RT can accommodate the very broad Range because they use 24 bit AD conversion. This allows accuracy or measurement to be preserved even though the Range is many time broader. No manual DC Correction is needed because the technology used in SynAmps2/RT makes saturation nearly impossible.

11.4 Can I use QuikCell solution for some electrodes and gel for others?

No. Occasionally, users will want to use gel for the artifact channels and the QuikCell solution for the EEG channels. Never mix the types of conductants. If it is possible to saturate a SynAmps2/RT, that would be one way to do it. Mixing electrode metals would be another. Use the same conductant for all electrodes.

11.5 Excessive 60Hz noise in all channels

There are multiple causes for excessive 50/60Hz noise in the EEG recordings. If it is in a few channels, it usually means there are high impedances for those channels. If it is in all channels, there may be high impedances in the Reference or Ground channels. There could also be an external noise source in the vicinity, and these are not always obvious (such as power cables in the floor). Try repositioning the cables away from power sources, including the SynAmps2/RT power cables. There could be a poor earth ground in the building (try recording in a different location). There could be a bad headbox - certain problems in the headbox(es) can produce large 60Hz noise. That is the least likely cause, and should be pursued when all other causes have been eliminated.

12 SOURCE V2

The following questions regarding Source V2 occasionally come up. Note that all further development of SOURCE has ceased in favor of CURRY.

12.1 I only see one vertical line in Source

When defining the time range for analysis in Source, you need to position the two vertical lines in the data file window in EDIT. If you only see one vertical line, then click the right mouse button inside the data display, and select **Use Interval Mode for Source**. You will still see one line, but when you move it, it will become two lines (the second was on top of the first).

12.2 What is the difference between Source and Curry?

Source and Curry are both used to determine the source localizations for features seen in the EEG and EP recordings. There are two versions of Source (V2 and V5). Source V2 runs within the SCAN software, and can be used offline and online. Source V2 is the only source localization version that can compute dipoles online during acquisition. Source V5, like Curry, is a stand-alone program, and does not require the SCAN software. V2 reads only SCAN data files (or file imported into EDIT). Source V5 and Curry read many file types. Both versions of Source contain subsets of the capabilities found in Curry. The main differences are that in Source you are limited to single equivalent dipole solutions. Curry contains more source localization options (e.g., scan deviations and current source density). In Source, you may import the subject's image data (MRI, CT), but the image data are not used to create a volume conductor. An average MR data set is used instead. In Curry, you can use the subject's image data to create the most realistic (accurate) volume conductor. Curry has more data pre-processing options than either version of Source. There are other differences, but those are the main ones. Source V5 has a user interface very similar to Curry's. Both versions of Source, but especially the V5 version, are intermediate steps to the complete source localization package of Curry.

Most importantly, further development of Source V2 and Source V5 - and SCAN for that matter - have ceased in favor of the focus on CURRY. CURRY has now replaced all of SCAN and SOURCE.

13 SynAmps (original)

The following are questions that occasionally arise with the original SynAmps amplifiers.

13.1 What do I do with unused channels?

Unused channels, in normal acquisition, should be shorted to Reference, not to Ground. Use the touch-proof jumpers to short out the unused channels.

13.2 Migrating SynAmps to a new SCAN computer

The SynAmps communicates with the SCAN computer using a SCSI adapter that is installed in the SCAN computer. If you are moving the SynAmps to a new computer you must move the SCSI adapter also. If you have an older SCSI adapter, it may be difficult if not impossible to obtain the required drivers. It may be easier to get a new SCSI Adapter. The current one we recommend is the Adaptec 2930 Ultra. Please follow these steps when setting up the new computer. Even then, it is not possible to get drivers for Windows 7.

1. Install the SCAN software on the new computer.
2. Install the SCSI adapter board, but *do not yet attach the SynAmps*.
3. Turn on the SCAN computer. Windows should find the new board and install the drivers.
4. Turn the computer off, and connect the SynAmps.
5. Turn everything on as usual, with the SynAmps first, then the computer. The SynAmps should be found as usual.

6. If you have multiple SynAmps, you will need to repeat the process, adding in the next SynAmps in line, and rebooting each time. I.e., connect SN1, then shut down. Connect SN2, then shut down. Connect SN3, and so on. It may not be necessary in XP. SynAmps cannot be used with Windows 7.

Please realize that it has become nearly impossible to support the original SynAmps, due to the inability to obtain vintage parts. All new development is with the SynAmps RT, and you are encouraged to upgrade to current amplifiers. If the original SynAmps should fail mid-study, there is likely nothing we will be able to do about it.

13.3 Common problems encountered

Support for the original SynAmps has become nearly non-existent as it is no longer possible to get parts for the hardware this old. You are encouraged to upgrade to newer amplifiers if at all possible.

The following is more or less vintage information regarding the original SynAmps. There is not a lot that we can add to this if problems arise.

Some of the more commonly encountered SynAmps problems, and their solutions and some testing advice are listed below. As there may be a few very old SynAmps still in use, the information below goes back a number of years. Parts may not be relevant for newer SynAmps running in Windows XP.

Loose board or cable connections or oxidized connections. Over time, or from repositioning the SynAmps, the internal board connections may become oxidized or become loose.

Analog\Digital connections. The connection between the analog and digital boards is particularly susceptible to becoming dislodged during relocation. Symptoms may vary, but a common one is to see CALx when the SynAmps boots. The "x" will point to the pair of boards that may have a bad connection (CAL 3 implies the third analog/digital pair). If all channels are involved during calibration and impedance testing, try the auxiliary boards. Steps have been taken to reduce the incidence of this problem, but it may still occur.

To reseal the boards, open the SynAmps, ground yourself, and remove the CE mesh. With the analog/digital boards, the idea is to wiggle/push the analog and digital boards toward each other. You may not notice any drastic movement, but subtle and simple reseating is often all that is needed. While you are inside the SynAmps, check all the board and cable connections you can get to. If the forces were enough to loosen one set, others may be close to becoming disconnected.

Internal SCSI cable connection. With a SynAmps that boots normally but shows no indication of SCSI communication with the SCAN PC, it is possible that the internal SCSI cable has become disconnected. Typically the problem occurs where the cable connects to the Ampro board, rather than the SCSI board. Steps have been taken to reduce the incidence of this problem, but it may still occur.

Boot sequence errors. The boot sequence errors described below can have more than one cause, and the solution depends somewhat upon the age of the SynAmps. In some cases, the solution will involve a trial and error approach, and, particularly with older SynAmps, the solution may require sending the SynAmps in for repairs (in case it is necessary to put in a video card to see what is actually happening). Note: in many cases it is very helpful to know the history prior to the problem: Was the system working, then moved, then not working? Is the problem intermittent (not a hardware failure, but could be a failing Ampro board - or loose connection)? Were there any power failures, surges, etc.? Did someone turn it off and on too fast? Did someone disconnect the SCSI cable with the system on? Did the user have the SynAmps open for any reason (possible board damage from a static discharge)? Knowing these kinds of things can save a lot of time. Sometimes users will not admit to their own culpability, and it may require asking more than once.

Normal boot sequence. The normal boot sequence, seen on the LED of a 32 channel SynAmps, is: BOOT, DLP1, DLP2, DLP3, DLP4, CLS1, CLS2, CLS3, CLS4, CAL, SCSI (very brief), and SN1.

BOOT indicates that the Ampro board is actually executing programs its autoexec.bat file. This is a good sign because it means that it passed the Power On Self Test (POST), which is when the memory, ports, etc. are checked.

DLPs are indicators that the digital board programs are being downloaded.

The CLSs are internal checks of the digital boards, and may indicate a failure of the digital board to talk to the EC program on the Ampro board. A CLS failure can occur if the connections between the backplane board and the digital board(s) have come loose. It can also happen if a digital board has been addressed incorrectly. This can occur if the SynAmps is bumped hard enough to change the switch settings on the board, or if someone swapped the digital boards without changing the switch settings (shown below).

CAL performs a quick check of the communication between the analog and digital boards. If one of them does not respond, you will see a CALx error on the LED, where x is the pair that failed (1-4). This is often caused by oxidation or a loose connection between the analog and digital boards - reseating the boards may solve it. If not, the board will need to be repaired or replaced.

SN1 is the end of the normal boot procedure (or SN2, SN3... depending on which SynAmps this is in a chain of them).

SynAmps hangs with all LED lights lit. The user may report that all lights on the LED light up after turning the SynAmps on, and that the SynAmps hangs at that point. Typically this is caused by turning the SynAmps off and then back on too fast (corrupted or blown setup). There are a number options for restoring lost or corrupted software or the setup on the SynAmps, depending on its age. Some may be possible to do on site, others require a video card, and in some cases the only option may be to return the SynAmps for repair. Contact Technical Support when you encounter this problem.

SynAmps hangs on BOOT. "BOOT" on the LED happens before the EC and DSPSYNAM programs are run, and it is the first step in the autoexec.bat file. All the other messages are generated from the EC program. When the boot sequence hangs at BOOT, it usually implies that the EC or DSPSYNAM programs have become corrupted. If this is a newer SynAmps (since about 1996), it is possible to restore the software from backup version stored on the flash disk. Set up and run Procomm, in DOS, from the SCAN PC, with the serial cable connected and a key board plugged into the back of the SynAmps (refer to Appendix C in the current SynAmps manual for details). Turn the SynAmps on, and watch the boot sequence in procomm. When you see "True F-disk bios detected", press "F5" 2-3 times on the keyboard plugged into the SynAmps. This causes the boot sequence to bypass the autoexec.bat and config.sys files, and continue to boot up. When it is completed, press ESC on the SynAmps keyboard (2-3 times may be needed). Change Directories to the EC directory, and type - "back" <ret>. This should restore the backup versions of the software. Then reboot the SynAmps. It should boot up normally. If this sequence does not work, or if the SynAmps is older than about 1996, contact Neuroscan Technical Support.

SynAmps hangs on DLP, CLS or CAL. One cause for this is that an internal board connection has been jarred loose (or become faulty due to oxidation). It can also indicate the failure of one or more components on one or more boards. Note the number where the system hangs, for example, CLS3. Note also if one of the steps is skipped over (CLS2 to CLS4). That will point to the board that is suspect. Try reseating the boards first (analog to digital, or backplane to digital, described above). If that doesn't solve it, try swapping the suspect board with another like board in the same SynAmps, or from a like version SynAmps (if this is a digital board, be sure and set the ID switches correctly, as described below). See also the diagnostic strategies described below. If you can determine with certainty which board is bad, it may be possible for us to send just that one board, and avoid having to send the SynAmps in for repair. Depending on a variety of circumstances, we may opt to have the complete SynAmps returned at our discretion.

SynAmps hangs on SCSI. The typical cause of this error message is that the SCAN PC is not turned on, or the SCSI cable is not connected. If not that, then there is some fundamental loss of SCSI communication.

SynAmps shows BOxx on LED (buffer overflow). With some versions of the SynAmps software, you may see the Buffer Overflow status on the LED display. This is not necessarily an indication of a problem, unless the BOxx number increments to BO99. This is an indication that the SCSI card is having difficulty servicing the output from the SynAmps.

SynAmps not found in Acquire - SCSI communication problems. When Acquire gives you the message that no amplifiers can be found, the problem can be at different stages. First we assume that the SynAmps is connected via the SCSI cable through the PC and that the SynAmps is switched on and ready (message WAIT or SNx). If you see any other message, reboot the SynAmps (remember to wait 5-10 seconds before turning it back on).

A common cause of the problem may be that the SynAmps was not booted when the PC was booted. As soon as the PC boots, the SCSI card in the PC checks if there are any devices it needs to handle. If it does not find any, maybe because the SynAmps was not switched on or still booting, it does not activate itself and the SynAmps is not reported to the computer. So, always switch on the SynAmps first and let it boot before switching on the PC. On older SynAmps and with some SCSI cards it may be that the SynAmps halts the booting with the error message SCSI on the display. In that case you have to switch on the PC at that time. Depending on the situation, it may or may not be necessary to reboot the PC after the SynAmps has completed booting.

When the PC boots, normally you will see boot messages from the SCSI card. They should report the devices that were found. In the case of the SynAmps, you will see it being found by the card. Should this not be the case, that means that the SCSI card does not see the SynAmps. Then check the cable connection. Also make sure that the SCSI card does not have a resource conflict in the PC (IRQ, DMA, I/O). In rare cases a conflict of SCSI ID may be the case. Make sure that there are no other devices in the SCSI chain except the SynAmps. The SynAmps have SCSI ID's corresponding to their number, i.e., SN1 has a SCSI ID of 1, etc. The SCSI controller in the PC should normally have an ID of 7. It can NOT have the same ID as the SynAmps! If all this is not the case, it may be that the problem lies with the SynAmps. Open the SynAmps, and check if the cable connecting the SCSI connector on the back of the SynAmps with the AMPRO PC board is still in place. It may be moved due to transport. If this checks out, then it may be that the SCSI circuitry on the Ampro board has failed and a replacement may be necessary.

If the SCSI card sees the SynAmps, then the problem may lie within the operating system. Make sure there are no resource conflicts with other devices in the PC. In the control panel, under devices, you can check the status of the SCSI board. Is the proper driver installed for the card? Does the card show up in the list of devices? And does the SynAmps show up (either in unknown devices or under tape devices). See that you get the latest driver for your SCSI card. Note that the Buslogic card does not have a driver for Windows NT. We recommend that you replace the older Buslogic card with more modern PCI bus SCSI cards in newer PC's anyway, to avoid problems. However, this is only possible if the customer uses Scan 4. Scan 3 still requires the Buslogic card.

One of the Symptoms that may also turn up using the older Buslogic card under Windows is that the communication is lost during acquisition. This usually demonstrates itself by a freezing acquisition screen. On the SynAmps, you may see B0xx messages, which means that data is no longer being collected from that SynAmps. That is an indication that you should replace the Bustek with a more modern card.

Symptoms of analog board failure (or auxiliary analog). A 32 channel SynAmps has 4 analog boards. A failure in one of those boards can result in one or more bad channels. If single channels show only big noise, very likely the optocoupler has failed for that channel. Other problems may be bad calibration values for those channels. Each analog board takes care of 7 monopolar channels and 1 bipolar channels, so if you see that channels 8-14 and channel 30 are bad, chances are very big that the second analog board has a defect (or has become disconnected from the digital board).

Symptoms of digital board failure (or auxiliary digital). A bad digital board usually shows itself when booting and the SynAmps hangs at DLPx or CLSx. In that case make sure the backplane is in place, and that the dip switches of each digital board are still correct.

Calibration problems. The internal calibration of the SynAmps can be a very useful tool. The problems that one detects with a bad calibration are usually due to either a bad analog board or a problem in the headbox. However, the headbox cable may sometimes be the problem. Be sure to look at the connectors and if they are properly seated. A bad connection may give strange effects in only a few channels. The last possible cause of problems may be the input connector board, where the headbox cable connects to the SynAmps. An important indicator of where the problem lies, is which channels are affected. Remember that the channels are grouped in groups of 8 channels, each of which consists of 7 monopolar channels and 1 bipolar channel. If these problems turn up, check cable and connections. Maybe try a replacement headbox. Open the SynAmps and reseal the analog board. Check its power connections. Maybe switch two analog boards to see if the problem moves. If you suspect the input connector board, you can switch two of the cables that run from the input connector board to the analog board.

Impedance problems - impedance values cannot be reduced. If the user ever comments that they cannot get their impedances down, encourage them NOT to use excessive abrading. It should not be necessary to do more than normal abrading to get the impedances down. If they do not come down, it is an indication that something else is wrong. Determine whether it is all, some, or one channel that is bad. If all channels are involved, have them check the reference electrode(s), or the ground, and try using different electrodes for these sites. Make sure they are not using a different metal for the reference or ground electrodes, or a different conductive gel. These can set up DC voltage offsets, and that can impact impedance testing. What do the signals look like during acquisition? If they look basically normal, there could be a DC offset problem. This can be measured with a DC meter. Anything more than about 18mV can cause problems. If the signals look noisy during acquisition, check for bad or shorted connections at the electrodes or cable connectors. Check also to see if calibration is affected - these are closely linked in the SynAmps hardware. If there is a hardware problem, calibration is usually affected as well. If only one channel is involved, and adding more conductive gel doesn't lower it, there is likely a DC offset with that electrode. If several channels are affected, note which ones they are, and check them during acquisition. If this happens with a cap, does the EXACT thing happen with a different cap (If not, it is likely a cap problem; if so, it is likely a SynAmps or headbox problem)?

What to do depends on what the cause of the problem is. If there is a DC offset, and they have silver/silver chloride electrodes (or cap), it may help to rechloride and rebalance the electrodes. If they measure impedances with some other means, such as a hand held impedance meter, and find they are normal, this is almost always an indication that there is a DC offset problem. If the electrodes are tin or gold, they should try different electrodes (sintered silver). If the signals are noisy, check for bad or shorted connections that are introducing noise. Don't mix metals or conductants. This is rarely a hardware problem with the SynAmps - check other causes first.

Some diagnostic strategies. Since not every distributor has a complete set of spare parts, and sending back the SynAmps may mean a long downtime for the customer, it may be important to make an exact diagnosis, so that only the proper parts can be ordered.

Moving analog boards. By swapping two analog boards in the same system and seeing if the problem follows the board or not, one can easily establish if the analog board is defective or not, even when one does not have a spare.

Moving digital boards. What we can do for analog boards, we can also do for the digital boards. However, apart from switching their position, we also need to change the dip switches to correspond.



The proper dip switch settings can be found in the following table.

		_A4	_A5	_A6	_A7	_A8	_A9	Address
Aux		off	on	on	on	on	off	
Board	1	on	on	on	on	on	off	200
Board	2	on	on	on	on	off	off	300
Board	3	off	on	on	on	off	off	310
Board	4	on	on	on	off	off	off	380

The auxiliary digital board has a jumper which is jumped at IRQ 9

Swapping components with other SynAmps. If there is a working SynAmps available, it is very easy to swap suspected parts to see if it solves the problem. Note that parts have changed over time, so make sure you have the correct revision of the board available. The serial number on each board includes the part number and revision (A, B).

You can swap headboxes of 150 gain with those of 30 gain. However, without changing the setting for the headbox in Acquire, you will find calibration factors which are off by a factor of five. But otherwise this is not a problem. Note that older headboxes were not AC capable. (Be aware of Rev differences, head box differences, AC/DC and gain differences, analog outputs, high level inputs, etc.).

Swapping SynAmps. On multi-SynAmps systems, it may be advantageous to swap complete SynAmps to see if the problem follows the suspected SynAmps. This tells us to look for the problem in the original SynAmps (if the problem moves), or in the software (if the problem did not move). In this situation it is also useful to test the SynAmps as a stand-alone system (it needs to be renamed to SN1).

To rename a SynAmps (from SN1 to SN2, etc.) do the following:

Connect a keyboard into the back of the SynAmps. Boot the SynAmps. When the SynAmps is booted, press ESC. The front display should now show EXIT. Type SN1 (or SN2 etc. depending on which SynAmps you want it to be) and press enter. The SynAmps should now reboot and come up with it's new designation. You do not need to swap the SCSI cables, but you DO need to swap the Sample/Hold cable. Note: With older SynAmps, there may be no "SN1.bat" file to run. There are other more laborious ways to rename the SynAmps in these cases (contact Technical Support).
