NeuroWorks 8

Reference Manual

natus®
neurology

At the time of printing / transfer to the CD-ROM/DVD, this manual correctly described the device and its functions. However, as modifications may have been carried out since the production of this manual, the system package may contain one or more addenda to the manual. This manual including any such addenda must be thoroughly read before using the system.

The following situation voids any guarantee(s) and obligations for Natus Medical Inc.

The device is not used according to the enclosed manuals and other accompanying documentation.

This system is CE marked in conformity with the requirements in the Medical Device Directive 93/42/EEC.

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

The proper use of this device for its intended purpose can only be assured once all instructions have been read and understood. If there are any questions regarding the operation of this device, please contact your Natus Medical Inc. representative.

Table of Contents

1. Safety Information

1.1 Intended Use Statement

Natus NeuroWorks is EEG software that displays physiological signals. The intended user of this product is a qualified medical practitioner trained in Electroencephalography who will exercise professional judgment in using the information.

The NeuroWorks EEG software allows acquisition, display, archive, review and analysis of physiological signals.

- The Seizure Detection component of NeuroWorks is intended to mark previously acquired sections of the adult (greater than or equal to 18 years) EEG recordings that may correspond to electrographic seizures, in order to assist qualified clinical practitioners in the assessment of EEG traces. EEG recordings should be obtained with full scalp montage according to the standard 10/20 system.
- The Spike Detection component of NeuroWorks is intended to mark previously acquired sections of the adult (greater than or equal to 18 years) EEG recordings that may correspond to electrographic spikes, in order to assist qualified clinical practitioners in the assessment of EEG traces. EEG recordings should be obtained with full scalp montage according to the standard 10/20 system.
- The aEEG functionality included in NeuroWorks is intended to monitor the state of the brain. The automated event marking function of NeuroWorks is not applicable to aEEG.
- NeuroWorks also includes the display of a quantitative EEG plot, Compressed Spectrum Array (CSA), which is intended to help the user monitor and analyze the EEG waveform. The automated event marking function of NeuroWorks is not applicable to CSA.
- This device does not provide any diagnostic conclusion about the patient's condition to the user.

1.2 Warnings

The following Warnings and Cautions apply to Natus Desktop and Laptop systems and accompanying software. The Acquisition LT (laptop) has its own additional system-specific warnings and cautions. If you are uncertain or have any questions about operational safety or about any of the warnings and cautions, please contact Natus Technical Support.

⚠ GENERAL WARNINGS AND CAUTIONS

Federal law restricts the sale, distribution, or use of this software to, by, or on order of a physician.

Proper use of any Natus device depends on careful reading of all instructions and labels

that come with or on the system. Inaccurate measurements may be caused by incorrect application or use.

Natus headboxes are classified as an IP0 – ordinary degree of protection against ingress of water according to IEC 529.

For battery powered headboxes, dispose of used batteries in accordance with local regulations.

The computer used with a Natus headbox must either be approved by Natus and supplied as part of an IEC 601 approved system, or it must be approved to IEC 950 or similar and kept outside of the patient environment (that is, at least 1.5 meters from the patient laterally and not within a height of 2.5 meters from the floor in the area occupied by the patient).

To ensure the validity of signals, do not operate the device near any sources of electromagnetic interference.

Turn off the system power before cleaning. Prevent detergent solution or cold sterilization agents from seeping into the electronics of the system. Be careful around all connectors and edges. Do not use abrasive agents.

Natus systems are not AP or APG rated. DO NOT USE Natus systems in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.

Device accessories may include several kinds of disposable, sterile needle electrodes. These needles are labeled as STERILE and the method of sterilization is documented on the packaging. These electrodes should not be used if the sterile packaging has been tampered with.

The sale, distribution, or use of Natus devices is restricted to, by, or on order of a physician.

⚠ ELECTRICAL WARNINGS AND CAUTIONS

Natus systems are intended for connection to a properly grounded electrical outlet only.

Periodically check the system ground integrity, the system leakage current, and the patient contact leakage current. This should be performed at least ONCE PER YEAR.

Do NOT turn on the system power until all cables have been connected, verified, and visually inspected for any damage. Failure to inspect the cables may result in electrocution.

ELECTRICAL SHOCK HAZARD: Do NOT connect electrode inputs to earth ground. The patient headbox contains warning symbols reminding you that the connections are intended for isolated patient connections only. Connecting an earth ground might result in electrocution.

ELECTRICAL SHOCK HAZARD: Do NOT service the system. Refer servicing to qualified personnel only.

The system uses a three-wire power cord with a hospital grade plug. The system is earth grounded. For grounding reliability, only connect the device to a hospital grade or hospital-only receptacle. Inspect the power cord often for fraying or other damage. Do NOT operate the system with a damaged power cord or plug.

Where local regulations require the use of an isolation transformer, do NOT place the isolation transformer on the floor.

Plug only Natus recommended components into the isolation transformer.

⚠ ELECTRODES AND PATIENTS WARNINGS AND CAUTIONS

Connect all patient electrodes to fully electrically isolated physiological devices only. Connecting patient electrodes to any other device, or an external outlet, may result in personal injury.

Patient headboxes accept only touch-proof style electrode inputs. Do NOT attempt to use any other style of patient electrode input.

The patient event switch attached to Natus EEG headboxes is not intended for critical patient-safety-related incidents.

Patient connections are NOT intended for direct cardiac contact.

The XLDetect montage does NOT work with the numeric labeling system found on some older EMU36 or Ambulatory 28 headboxes. If your headbox has numeric labeling, you MUST use a custom montage.

Do NOT use the XLDetect montage with custom channel labels.

To prevent cabling entanglement/strangulation, ensure no loose cables are accessible to the patient.

⚠ PATIENT ENVIRONMENT WARNINGS AND CAUTIONS

Outside the USA: Any part of the desktop computer that is not IEC 601 approved (and, in Europe, CE marked) must be kept outside of the patient environment (that is, at least 1.5 meters from the patient laterally and not within a height of 2.5 meters from the floor in the area occupied by the patient). However, if the computer has an isolation transformer, and is part of the Natus system, then it can be as close to the patient as needed.

As with all medical equipment, carefully route patient cabling to reduce the possibility of patient entanglement or strangulation.

Any video monitor that is not IEC 601 approved (and, in Europe, CE marked) MUST be kept outside of the patient environment (that is, at least 1.5 meters from the patient laterally and not within a height of 2.5 meters from the floor in the area occupied by the patient).

⚠ ACQUISITION LT SPECIFIC WARNINGS AND CAUTIONS

The following specific Warnings and Cautions for the Acquisition LT (Laptop) are in addition to the General Warnings and Cautions. Please read ALL Warnings and Cautions before operating the Acquisition LT. If you have any uncertainties or questions about operational safety, or about any of the warnings and cautions, do not hesitate to call Natus Technical Support at 1-800-303-0306.

The laptop computer used with the Natus EEG Laptop System MUST adhere to the IEC 601 Standard and in Europe MUST be CE marked.

Outside the USA: Any part of the laptop computer that is not IEC 601 approved (and, in Europe, CE marked) MUST be kept outside of the patient environment (that is, at least 1.5 meters from the patient laterally and not within a height of 2.5 meters from the floor in the area occupied by the patient). However, if the computer has an isolation transformer, and is part of the Natus system, then it can be as close to the patient as needed.

Use only Natus supplied medical grade power supplies for the headbox interface card and the laptop. This system is only designed to work with the approved Natus power supply for the laptop and the AULT SW175 power supply for the PCMCIA card. Do NOT operate the system with any other type of power supply.

Connect only a Natus PCMCIA, ISA, or PCI card (data acquisition card) to the Natus EEG headbox.

The laptop's parallel port is only designed for use with a Natus approved printer. Do NOT use the parallel port for any other purpose.

Do NOT connect the external monitor port, serial port, extender port, or printer port to any device while the headbox is connected to the patient.

The laptop system’s PS/2 port is designed to be used with a PS/2 compatible mouse. No other type of device may be connected to the laptop system’s PS/2 port.

The laptop system's bottom PCMCIA slot is designed to be used with a Natus supplied license key and dongle. No other device may be connected to the laptop system’s bottom PCMCIA slot.

The laptop system's top PCMCIA slot is designed to be used with the Natus PCMCIA EEG acquisition card. No other device may be connected to the laptop system's top PCMCIA slot.

The laptop’s battery may be replaced by a suitable lithium-ION, rechargeable battery.

Only devices that adhere to the IEC 601 standard may be connected to the input or output ports of the laptop system.

There are no waste products or residues to dispose of in conjunction with the operation of the laptop system.

Refer to the user manual for the proper environmental conditions for the use and transport of the laptop system.

1.3 Using the Manual

This manual presents descriptions and step-by-step instructions that take you through the testing, customizing, and operation of the NeuroWorks software and accessories. It guides you through the acquisition of a patient study, its review and storage, and the creation of a study report.

When going through procedures, we recommend that you read the entire section before starting the sequence. Please follow instructions carefully.

Typographical Conventions

Symbol	Description
	**Warning or Caution:** Provides information about serious hazards which could result in injury or death. Provides important information that should not be overlooked.
	**Note:** Provides important supplemental information.
Tip	**Tip:** Provides information that may help you save time or perform a useful function not immediately apparent.
Bold	**Bold** text denotes names of control keys, function keys, options and labels, or key words.
Glossary	A **Glossary** near the end of this document provides definitions of technical terms.

We encourage you to explore the manual and to take advantage of everything that Natus has designed the NeuroWorks system to do.

WARNING: Read all warnings and cautions carefully before starting the system for the first time.

1.4 Recommended User Performed Maintenance

Following a regular schedule of general maintenance will help to prolong the life span of your Natus NeuroWorks system. Maintenance performed by the user does not involve access to the interior of any of the equipment. For service problems that require corrective maintenance and/or internal component service, please contact Natus Technical Support or your local Natus representative.

NOTE: It is recommended that the user perform the maintenance procedures described in this section at least once per year.

User performed maintenance involves regular inspection and cleaning of all system components, including:

- Monitor and CPU (computer console)
- Connectors
- Headbox and Headbox Cable
- Electrodes and Accessories

WARNINGS:

- Disconnect the power cord from the system and the wall before cleaning. Use a lint-free cloth. Do not use abrasive cleaners on any system component.
- Be careful not to allow any excess fluid to seep into the internal electronic components of the system. Be especially cautious with fluids around grills.

Monitor and CPU

The monitor and CPU can be cleaned with a damp cloth, using water, mild detergent or a cold sterilizing agent. Be careful to avoid allowing excess fluid to seep into any internal components.

Connectors

Connectors should only be cleaned with a dry, soft, lint-free cloth.

Headbox and Cable

Check regularly to see if any of the electrode connections have become loose. If this occurs, contact Natus Technical Support. Take care to avoid extreme physical stress to the headbox (for example, dropping). Check periodically to determine cable integrity. The headbox should be cleaned only with a dry, soft, lint-free cloth.

Electrodes and Accessories

Regularly clean all surface electrodes and accessories with warm, soapy water or liquid sterilizing agents. Ensure that all gels and/or pastes are removed from the electrodes and their cables. Follow the electrode manufacturer's instructions for cleaning and/or sterilizing all electrodes and accessories.

While the Natus NeuroWorks system has been carefully designed and manufactured to be as reliable and durable as possible, regular cleaning and inspection of system components supports long term trouble-free operation of the system. As with other types of medical equipment, try to avoid extremes of physical stress (such as rough handling) and sustained exposure to extreme temperatures.

If you suspect any problem that might impact on the safety or effectiveness of your Natus NeuroWorks system, call Natus Technical Support or contact your local Natus representative.

2. Introduction

2.1 Basic Overview

Natus NeuroWorks is electroencephalography (EEG) software that displays physiological signals. The software platform is designed to work with the Xltek line of amplifiers (headboxes). Software add-ons and optional accessories let you customize your system to meet your specific clinical EEG monitoring needs.

Natus NeuroWorks software consists of two parts: the **Natus Database**— where study files are stored, and **NeuroWorks**—the software used to acquire data. Their representative buttons appear on your Windows taskbar when the programs are open.

Natus software runs on the **Microsoft Windows** operating system. It offers true multi-tasking and real-time network communications using standard networking protocols.

Natus provides three acquisition computer systems that deliver affordable, high-end performance combined with the advanced capabilities of Microsoft Windows workstations: Acquisition LT (laptop), Acquisition DT (desktop) and Acquisition All-in-One Panel PC (monoputer).

Your Natus system may be customized to meet your specific needs. It may include any of the following products, which are available to you through Natus:

- Patient amplifier (headbox), headbox cable, patient leads
- Acquisition computer (DT, LT or Panel PC)
- Monitor (for DT)
- Isolation transformer or UPS*
- Cart or trolley (optional)
- Photic stimulator (optional)
- Printer (optional)
- Disk electrodes
- Conductive media and preps
- Review or nurse station (optional)

For more information on Natus accessories, contact a Customer Service Representative at 1-800-303-0306 or visit www.natus.com for a catalog.

WARNING: Xltek EEG systems are required to be connected to a medical-grade isolation transformer or uninterruptible power supply (UPS) in the USA. Follow your local regulations on requirements for powering patient connected medical devices through an isolation transformer or UPS.

2.2 Installation and Upgrade Instructions

Software Installation

New Natus NeuroWorks computer systems are pre-loaded with NeuroWorks software and license activated. The NeuroWorks software requires license activation to be fully functional.

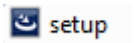
When re-installing software, you must enter the Product Serial number and Option Pack number during the installation process. This generates a Request Code. Provide the Request Code and Serial Number to Natus Technical Support. A Technical Support Representative will provide you with an Activation Code to complete product activation.

For assistance and detailed instructions on re-installing the software, please contact Natus Technical Support.

Software Upgrade

From time to time, Natus may send you software upgrades. Upgrade software is available through an installation CD or via a download link available through Natus Technical Support.

To upgrade software:

1. Activate installation by inserting the installation CD. To install via the software link, click on the link and press **Run**. Press **Run** again after download completes. In the WinRAR self-extracting archive window that appears, select Destination folder by clicking **Browse**, then press **Install**.
2. Open the NeuroWorks folder, then click **Install > NWorks > Setup** 

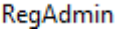
application file.
3. Follow the instructions prompted by the **InstallShield Wizard** for NeuroWorks.
4. Enter the Serial Number and Options Pack number to generate a Request Code.
5. Provide the Request Code to Natus Technical Support. You will be given an Activation Code to re-activate your license and options packs.
6. To restart your computer and complete the installation, click **OK**.

Installing Add-ons

Your system is activated with all optional add-ons and features purchased during your initial order (such as high resolution video, analyzers). If you are re-installing or upgrading your software, the same add-ons can be activated during installation.

If you wish to add additional features, please contact your Natus representative to place your order. A new Option pack serial number will be provided to you.

To activate your new add-on using the new Option pack serial number:

1. Select **Start > All Programs > Excel Tech > Utilities > RegAdmin** 

2. In the Product Registration Maintenance box, click the **View Product Activation** button.

3. In the **Product Activation** box, click **Change Registration**. A confirmation window opens. Click **Yes** to proceed.
4. Enter your new **Options Pack** serial number to generate a new **Request Code**.
5. Provide the **Request Code** to Natus Technical Support. You will be given an **Activation Code** to activate your new option pack feature.

Verifying Serial Number and Available Add-ons

To view your NeuroWorks serial number, Options Pack number and a list of options available on your software:

1. Select **Start > All Programs > Excel Tech > Utilities > RegAdmin** RT RegAdmin
2. In the **Product Registration Maintenance** box, click the **View Current Registration Options** button.

   OR
3. In Natus Databse, click **Help > About Natus Database > More Info**.

2.3 Natus Policy on Installing Virus Protection Software

Purpose and Scope

The purpose of the Anti-Virus and Microsoft Security Updates Policy is to provide our customers with answers to their concerns about the topic and to help them protect their data. This policy is available upon request.

Policy

At Natus, we understand the need to keep security updates installed and to have an anti-virus solution protecting your equipment. We are providing the following recommendations for installation and configuration.

Natus is not responsible for on-going maintenance of Anti-Virus systems and Microsoft Window updates.

Anti-Virus Recommendations:

- Real-Time Scanning should be configured with our file types excluded (AVI, ERD, ETC, SNC, STC, VTC, VTP, VT2, MPG, EPO, IOM, REC, EDF, EEG, ENT, ENT.OLD, ENT.TXT, EPR, VT2, MG2, MG2.INDX, MG2.XML, MG2.BACKFILL, SD4, SD4.INDX, PSX, LAY, TXT, DOC, PDF, TIF, JPG, JPEG). All the study directories (root subfolders in each storage resource - same directory where the DSN file resides) need to be excluded from real-time scanning.
- Virus definitions should not be configured to automatically update.
- Larger sites (five or more computers) should use a corporate product that provides central management from a server.

Microsoft Windows Updates Recommendations:

- Natus systems are shipped with Windows automatic updates disabled. We recommend that customers keep the automatic updates disabled, as installation of unapproved software may destabilize your systems.
- If you are concerned that your systems may inadvertently be exposed to cyber-security threats, then we recommend that customers periodically check with Natus to determine which Windows updates are approved for the Natus product sold, and to download and install only those specific updates.
- For an up-to-date list of the **Windows Service Pack** updates suitable to be installed on Xltek systems, visit the **Technical Support** section of the **Natus** website (http://www.natus.com/index.cfm?page=support_1&crid=135).

2.4 Powering the Acquisition DT System

To power up the Acquisition DT System, follow these steps:

1. Where local regulations require the use of an isolation transformer, make sure that the isolation transformer is plugged into a medical grade power outlet*.
2. Plug in network cable, if available.
3. Turn on the **isolation transformer** if this is part of your system.
4. Turn on the **monitor**.
5. Turn on the **desktop** computer (there is an additional power switch at the back of the unit).
6. Turn on any other equipment (such as photic stimulators).
7. Start the **Natus Database** program.

To shut down the Acquisition DT System, follow these steps:

1. Exit from the Natus Database.
2. Click the **Start** button on the Windows taskbar.
3. Choose **Shut Down** from the **Start** menu.
4. Use the power switch to turn off the computer. There is no need to turn off any of the other components.
5. Unplug the isolation transformer from the power outlet if this is part of your system.

***WARNING:** Xltek EEG systems are required to be connected to a medical-grade isolation transformer or uninterruptible power supply (UPS) in the USA. Follow your local regulations on requirements for powering patient connected medical devices through an isolation transformer or UPS.

2.5 Calibration and Verification

Xltek headboxes are fully assembled, tested, and calibrated before being shipped to you. There is no need to calibrate either Xltek headboxes or software.

To verify that the headbox system is correctly calibrated, perform the following procedure:

1. Connect the headbox to a Natus computer and turn on the system.
2. Start Natus Database.
3. To start a new study, click **New EEG** or **Sleep**.
4. Choose **Edit > Settings > Acquisition**.
5. On the Acquisition tab, set the Reference Electrode to Common.
6. Design a bipolar montage using pairs of the channels to be verified. For example, to verify C3, C4, O1 and O2, use a montage with C3-C4 and O1-O2.
7. Apply a sine wave of 50 microvolts, peak-to-peak amplitude, 10 Hz to all channels of the group using a signal generator. Ensure that there is a 50 Ohm load on the generator output if the generator is designed to deliver the specified level into this load.
8. Set the **LFF** to 0.1, the **HFF** to OFF and the **Notch** filter to OFF.
9. Verify that no sine wave is greater than **50 microvolts** peak-to-peak. 50 microvolts represents gain match to 1%.

2.6 Contacting Technical Support

If you need help and cannot find a solution in this reference manual, first follow these steps.

Step	Description
Step 1: Document the Incident	Carefully document the incident. If possible, note error messages, dialog box names, and what you did before the problem occurred.
Step 2: Restart the Computer	Often restarting the computer will solve a problem. 1. Close all applications. 2. Click the **Windows** button on the taskbar. 3. Click the arrow beside the **Shutdown** button. 4. Select Restart the computer and click **Yes**.

Step	Description
Step 3: Shut Down the Computer	Sometimes you need to shut down the computer completely in order to solve a problem. 1. Click the **Windows** button on the taskbar. 2. Select the **Shutdown** button. 3. Turn off the power to the unit. Wait 10 seconds. Turn the power back on.
Step 4: Contact Technical Support	Write down your computer's serial number (located on the back of the computer). You should also make a note of what version of the software you are using. If you are unsure, click the **Help** button and choose **About Natus NeuroWorks**. Then contact Technical Support.

If you need to contact Natus Technical Support, please call 1-800-303-0306 or e-mail OTS@natus.com. For optimal service, it is recommended that you have access to the internet and are prepared to allow a Technical Service Representative to remotely access your system.

Microsoft Windows is equipped with an **Event Viewer** which keeps a record of your computer's activities and is useful when trying to determine the causes of a program crash or network connection failure.

If a program crash or failure occurs:

1. Make a note of your activities leading up to the crash.
2. Write down error messages displayed in their entirety. Your Natus Customer Service Representative will need to know as much information about your problem as possible.
3. Save the information from Event Viewer onto your hard drive or a floppy disk.
4. Send the information by email to Natus Technical Support if you are asked to do so.

To obtain Event Viewer information and send to Natus:

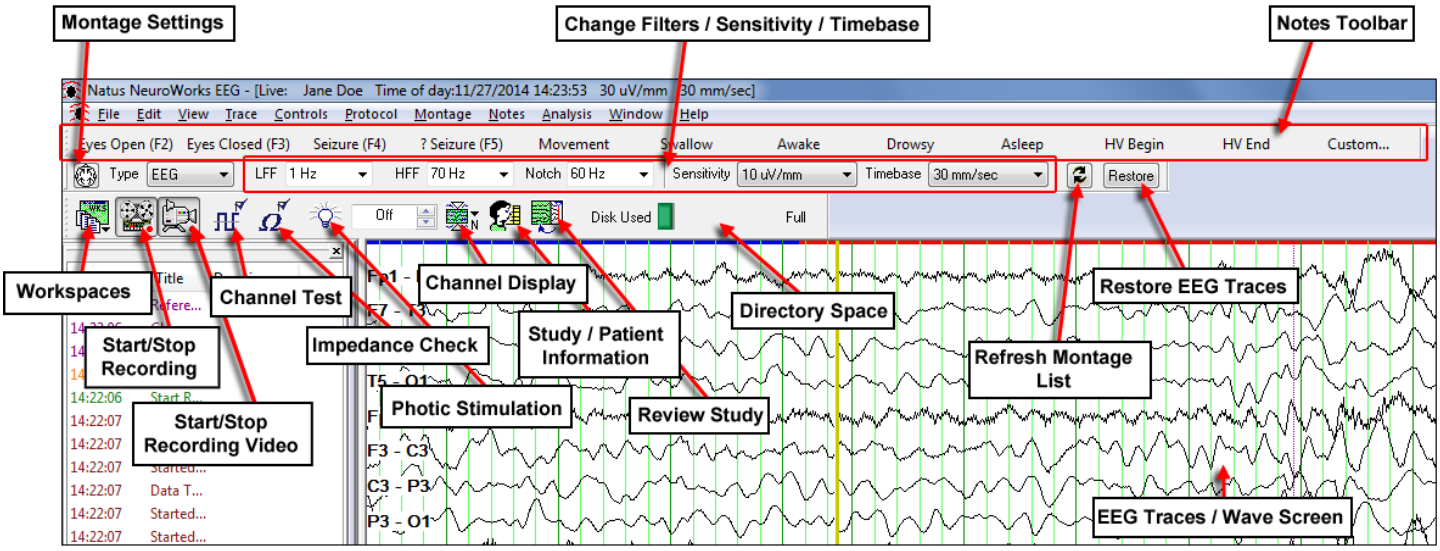
1. Click **Start > Settings > Control Panel > Administrative Tools > Event Viewer**.
2. The **Event Viewer** window opens.
3. Save this information to your hard drive or a floppy disk by choosing **Action > Save Log File As** on the Event Viewer menu bar and saving the file to the appropriate drive.
4. Send this information to Natus Technical Support.

3. Study Acquisition and Features

3.1 Overview

NeuroWorks EEG Acquisition Screen

The following figure displays the basic features and toolbar options on a NeuroWorks EEG Acquisition Window.



NeuroWorks EEG (Wave) Acquisition Window

Quick Guides

Several **Natus NeuroWorks Quick Guides** are available for common procedures and workflows such as acquisition, protocols, reviewing, archiving and video ambulatory studies. For more information, please visit the **Natus Education NERVE Center** on the Natus website (nervecenter.natus.com) or contact Natus Technical Support.

3.2 Performing a Basic EEG Study

Connect the patient to the headbox with the electrodes.

Log on to the system network using your User name and Password. This launches the **Natus Database**. You can also open the Natus Database by clicking the Natus Database icon on the Windows desktop.

Natus Database Icon

Start a New EEG Study

- To start a study click the **New EEG** button (or press **CTRL + N**) to open the **Study Information** dialog box.
- Enter the patient's information. Only the first and the last names are mandatory at this step, the rest can be entered later when the study is running. Click **Start** to begin the study.

Start and Stop the Recording

- To start / stop recording press the **Start / Stop Recording** button or press **CTRL + Space**. When the recording is stopped a red alert sign will flash stating "Not Recording". To stop or restart recording press the same button again.

Impedance Check

- Press the **Check Impedance** button (or press **CTRL + MINUS** or choose **Controls > Impedance Check**). The impedance check will begin. The test will continually cycle until the End button is pressed. Impedance results will be stamped on the record for later review

Starting and Stopping Video Recording

- To start and stop video recording press the **Start / Stop Recording Video** button.

When the video recording is active there will be a blue line drawn above the EEG. Video recording may be started or stopped at any point during the acquisition of the study. Video can only be recorded when EEG recording is active.

Camera Control

- **Moving the Camera:** Systems that are equipped with a non-fixed, pan/tilt/zoom camera enable the user to move the camera from within the application as well as zoom in and out. For systems equipped with fixed cameras and software-controlled zoom, follow the "How to Zoom" instructions below.
- **Panning and Tilting the Camera:** Use the green arrows located on the Camera toolbar.
- **How to Zoom:** Magnifying buttons will zoom in (+) and out (-).

Change Filters / Sensitivity / Timebase

Filters and sensitivity can be changed using the **Montage** toolbar. If the correct setting is not available from the dropdown then the desired value may be typed directly into the field. The

timebase (or “page size”) may be adjusted by pressing the dropdown arrow next to the setting and selecting from the available timebases.

Montage Settings

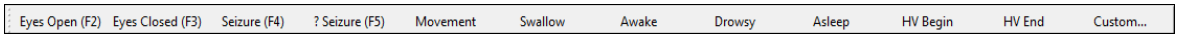
- **Change Properties of an Individual Channel**: Click on the channel label to highlight it make the desired changes in the toolbar.
- **Change Properties of Multiple Channels**: Hold **Ctrl** or **Shift** while clicking on the channel label to select multiple channels and then make the desired changes in the toolbar.
- **Change Sensitivity:** Press the **Up** or **Down** arrow keys on the keyboard to increase or decrease sensitivity (gain) on selected channels.
- **Change timebase (“page size”):** Press and hold **Shift** key and, while still holding it, click **Left** or **Right** arrow keys on the keyboard.

Changing the montage

- Select a different montage by right-clicking on the Wave screen (on the signal traces) and then selecting appropriate montage from the menu.

Enter Comments

- **Pre-programmed comments** may be entered during the recording by clicking the buttons on the “Note” toolbar.

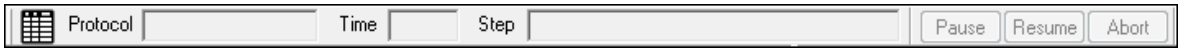


Note Toolbar

- **Free text** notes can be entered by typing on the keyboard while the study is active. This will add a note at the point where typing started. To enter a note at a different point right click and select “Add Note Here…”.

Photic/HV

- **Photic and Hyperventilation (HV)** automatic sequences are selected from the **Protocol Menu**. Select the desired protocol and the sequence will begin automatically.



Protocol Settings

- To pause/resume or stop the protocol, use appropriate buttons on the Protocol toolbar.

- To **manually** adjust the photic frequency, use **Photic Stimulation** control on the toolbar. The light bulb button is used to start and stop the flashing of the photic lamp or adjust the flashing frequency. The frequency may also be adjusted using the up and down arrows to the right of the currently displayed rate.

Review the Current Study

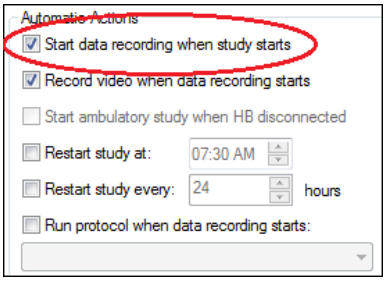
- To review the current study, press the **Review Current Study** button. The currently collecting study will open in the adjacent window. The review window

can be maximized or closed independently of the live recording window.

Close the Study

- To close the recording session, click the **Close X** button in the top right corner of the NeuroWorks window. The **Technologist's Report** dialog box appears. You can fill this in now or later. Click **OK**.

TIP: You can set the system to record automatically when you start a new study. To access this feature, choose **Edit > Settings > Acquisition**.



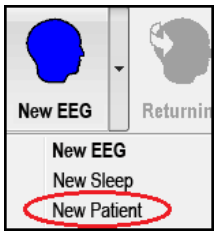
Acquisition tab in Edit Settings dialogue

See also: Editing Acquisition Settings

3.3 Creating a New Patient Record

To create a new patient record:

1. In the **Natus Database** choose **Study > New Patient** (or click the arrow to the right of the New button and choose New Patient from the drop-down list).



New Button Dropdown

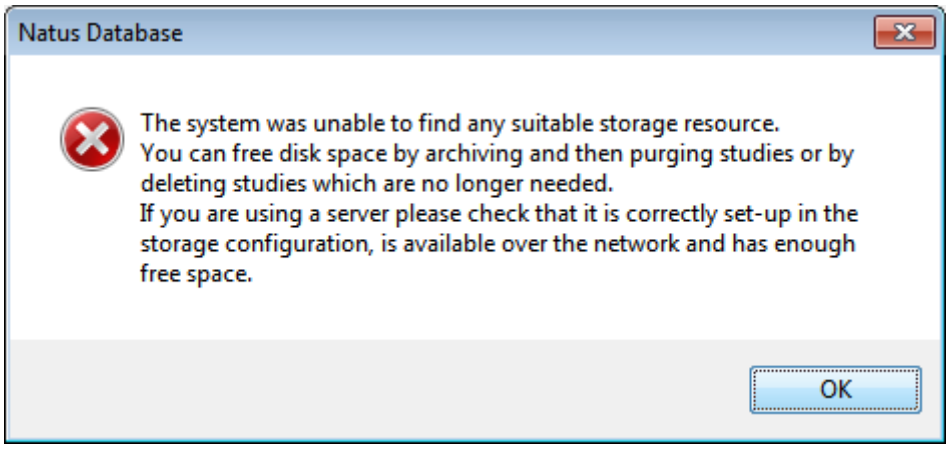
2. Enter patient demographic information and click **OK**.

The patient record will be entered in the database list and marked with a head in profile icon. Only patient information will be displayed (for example, no study duration or start time).

Patient Record in Database List

You can start a study for the patient later by using the **Return** button, or by double-clicking the patient record.

NOTE: If you have switched to a new directory that has available space and the warning message shown below still appears, click OK to close the message box.

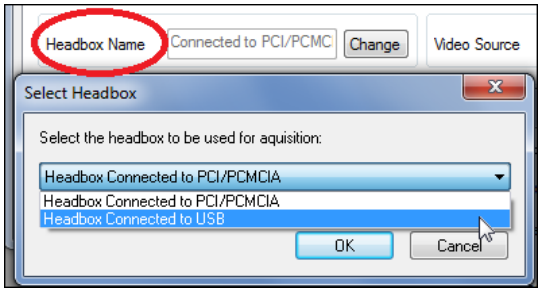


Directory Space Unavailable Warning Message

3.4 Study Information Box

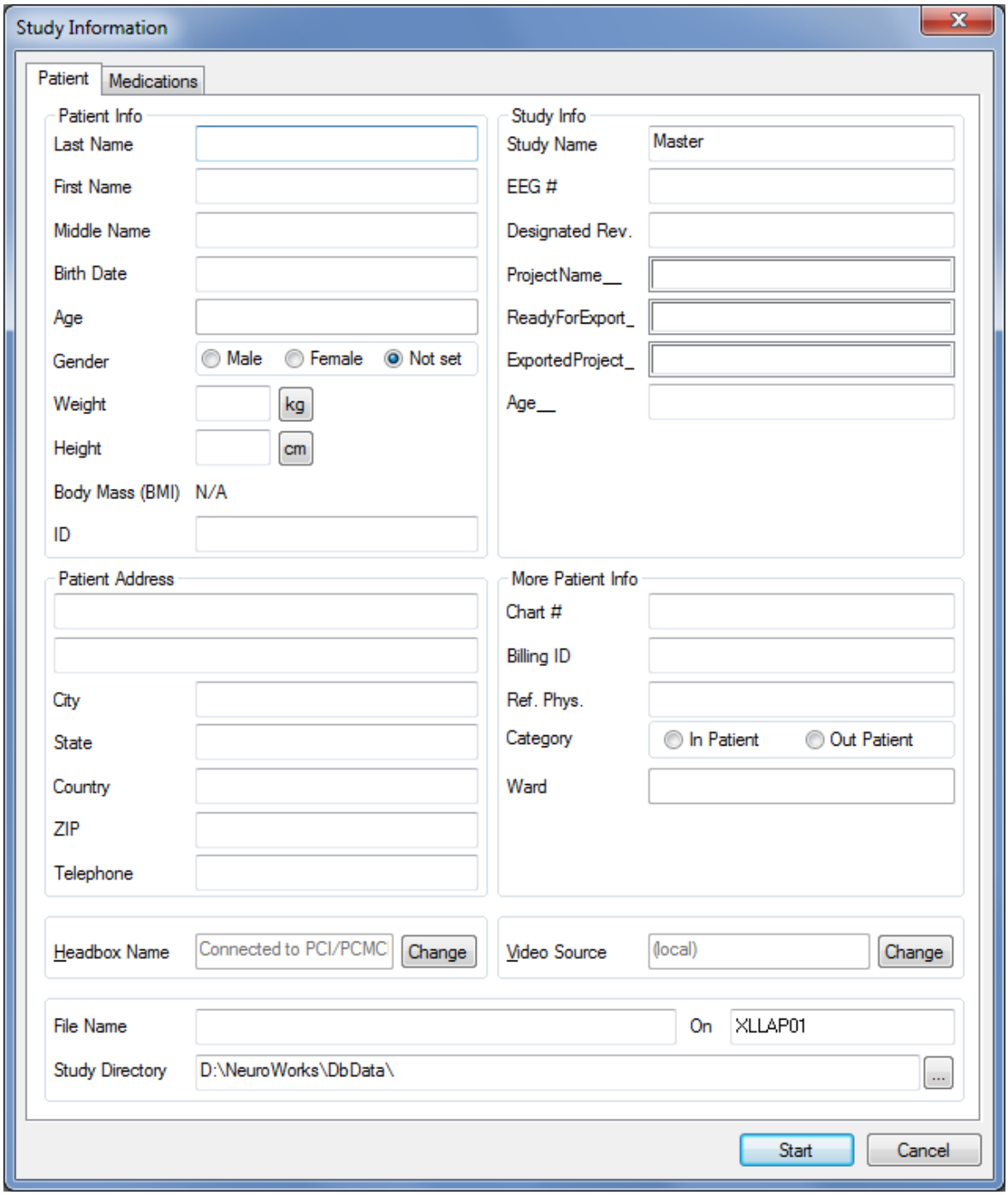
The **Patient / Study Information** dialog box is clearly split into areas which are common to all studies for a given patient and into areas which are specific to each study.

The **Study Information** box appears when you first begin a study. At the beginning of a study, the Study Information box contains two tabs: 1. Patient Tab 2. Medication Information Tab. Also, the Headbox option is only available when you first start a study.

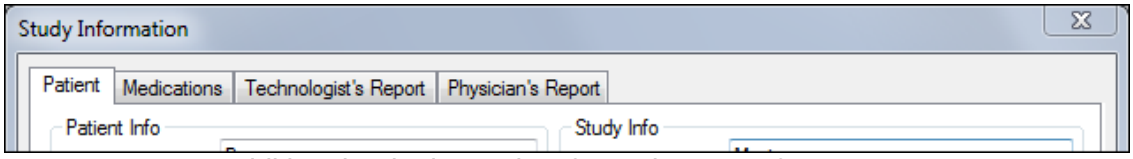


Headbox Option Functionality

The Study Information tab can be accessed during a study by choosing **Edit > Study** Information or pressing **CTRL + I or** pressing the **Patient / Study Information** button. After a study has begun, the dialog contains two additional tabs: 1. Technologist's Report 2. Physician's Report. These tabs can be used to enter notes and information about various study attributes that will later appear in the generated reports.



Study Information Box at Startup

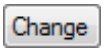


Additional Tabs in Study Information Box after Startup

Patient Tab

The Patient tab is one of the tabs in the Study Information box. It is displayed in the figure *Study Information Box at Startup.*

When adding information to the Patient tab, note the following:

- It is advisable to enter information in all data fields but at a minimum, the patient's first and last name are required.
- **Study Directory box**: Shows the directory on your hard drive or server where the patient's information and data are stored.
- **Change Headbox option**: The EEG32U, Brain Monitor and Trex headboxes can be connected to the computer via a standard USB port. Different connection options for headboxes are available by clicking the **Change Headbox** 

button on the Patient Tab. This option is only available on the Study Information Box at startup.

Medication Information Tab

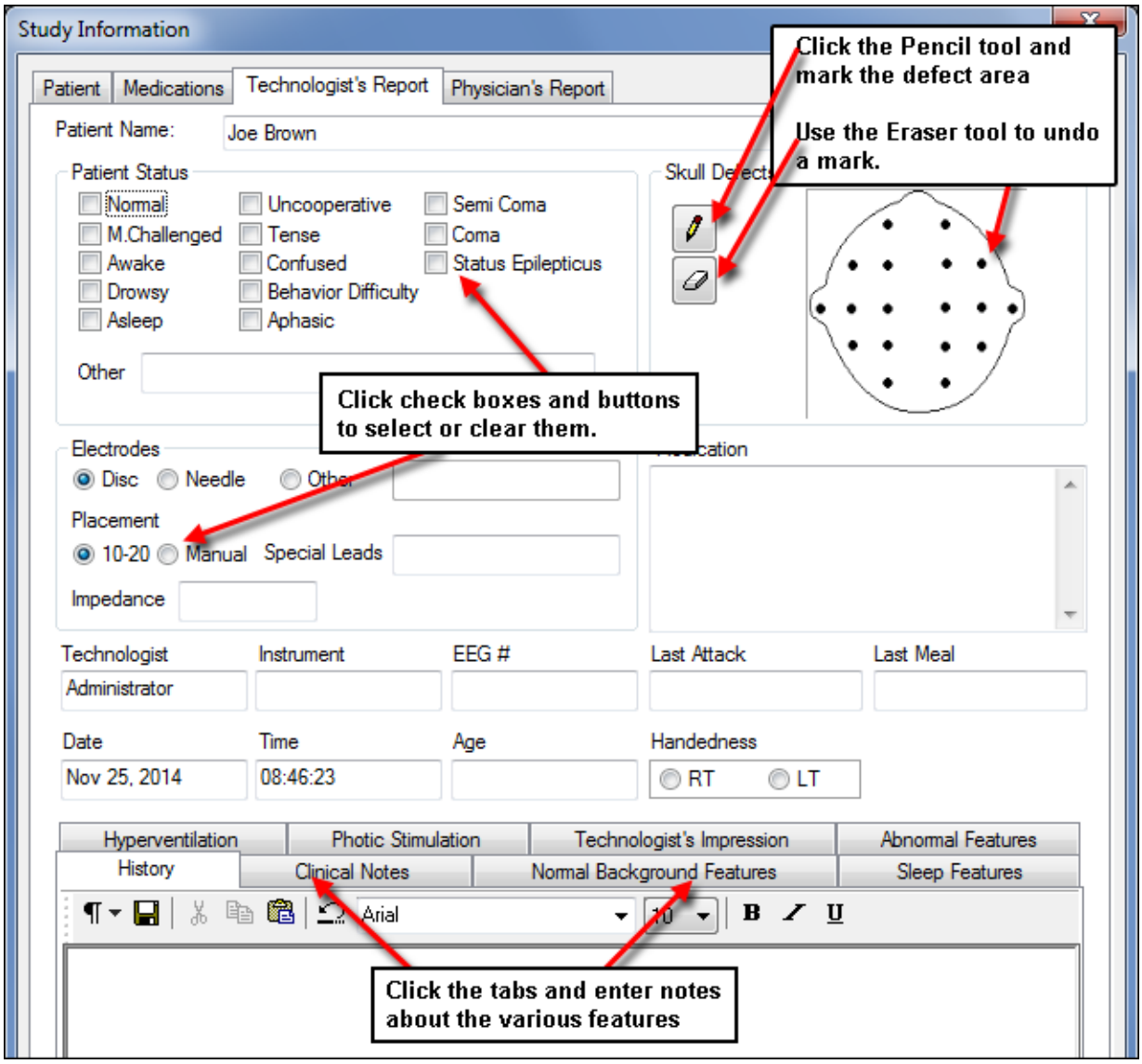
The **Medication Information** tab is one of the tabs in the Study Information box. It can be used input notes about patient medications and dosages.

- To add new information, click the **Add** button. A list of previously entered data appears.
- Click a column title and the **Modify** button to automatically enter information in the Dosage, Date, and Comments fields.
- To add a new item not in the drop-down menu, select **Other** from the **Add** list. Then type the name of the item in the text box that appears. Use the Tab key to navigate from one column to another.
- You can also add or modify data by placing the mouse pointer over a field you want to edit and right-clicking. Right-clicking on a column header will display a list of previously entered items from which you can choose.
- Items in the drop-down lists can be customized by using the **File > Customize** menu option. For example, choose **File > Customize > Dosages** to change the contents of the Dosages drop-down list.

NOTE: Data recorded from previous visits in the Information tab for returning patients are not automatically included in the patient's Study Information. Only demographic information is retained in the Study Information file for returning patients.

Technologist's Report Tab

The Technologist's Report tab is one of the tabs in the Study Information box which is available after study startup. It is used to enter notes and information about various study attributes that will later appear in the generated reports.

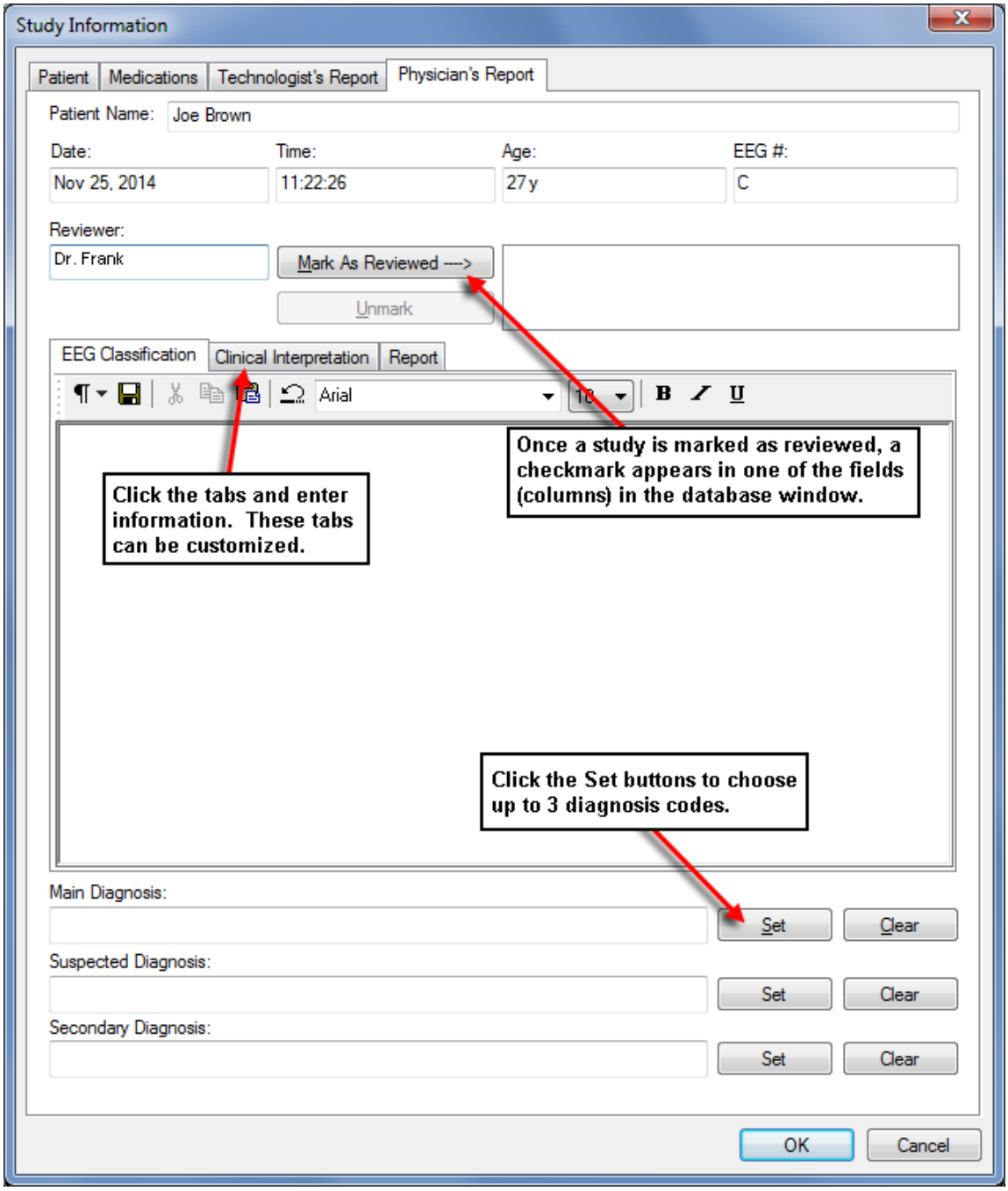


Technologist's Report Tab

Physician's Report Tab

The Physician`s Report tab is one of the tabs in the Study Information box which is available after study startup. It is used to enter notes and/or information such as diagnosis codes for various study attributes which can be recalled in generated reports.

A qualified user can input up to three diagnosis codes on the Physician's Report tab. These code input selections are stored in the database (unless deleted by the user) and can be added to a study report.



Physician's Report Tab

3.5 Channel Test

While in Acquisition mode, a channel test may be performed to verify the integrity of the signal processing from the amplifier input through to the display. A channel test applies a test signal to all channels. This allows you to examine the waveforms on the screen to see if all channels are functioning.

NOTE: A channel test does not validate the connection from the patient electrode to the amplifier input.

Running a Channel Test

To run a channel test:

1. Choose **Controls > Channel Test Signal** to start the channel test. The channel test control bar appears above the waveform window.

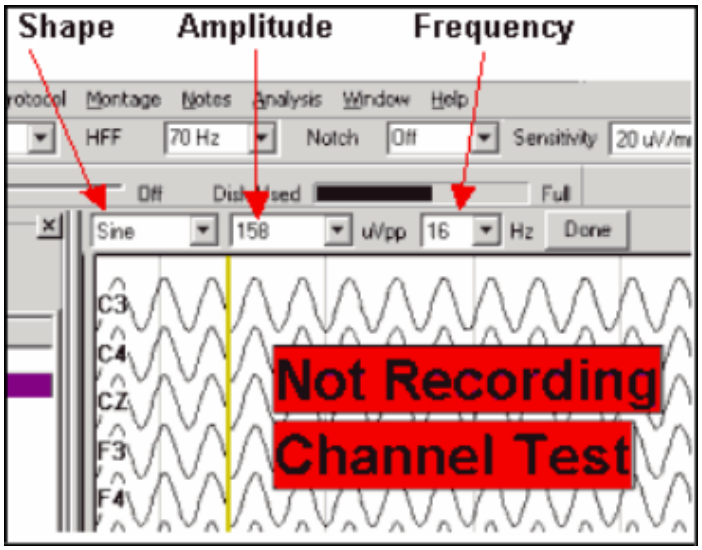
   NOTE: The montage changes to ref-all; however, it changes back later.

2. Using the channel test signal control, select the desired channel test shape, frequency, and amplitude.
3. To stop the channel test and save the current settings, click **Done**.

TIP: A channel test can also be set up through a protocol.

Test Signal Control and Toolbar

The channel test signal control turns on the channel test signal according to the last settings saved and displays a Test Signal toolbar. The toolbar has controls for shape, amplitude and frequency.



Channel Test Signal Toolbar

Available Settings for Channel Test Signal Control

Headbox	Shape	Amplitude (µV peak-to peak)	Frequency (Hz)
Mobee	**Sine**	50, 100, 200, 400, 800, 1600, 3200, 6400	6.25, 12.5, 18.75
	Square	50, 100, 200, 400, 800, 1600, 3200, 6400	0.25, 0.5, 1
Hyppo	**Sine**	50, 100, 200, 400, 800, 1600, 3200, 6400	6.25, 12.5, 18.75
	Square	50, 100, 200, 400, 800, 1600, 3200, 6400	0.25, 0.5, 1
EEG32/EEG32U	**Sine**	79, 158, 316, 632, 1264, 2527.5, 5055, 10110	16, 32
	Square	50, 100, 200, 400, 800, 1600, 3200, 6400	0.25, 0.5, 1
EMU128	**Sine**	79, 158, 316, 632, 1264, 2527.5, 5055, 10110	16, 32
	Square	50, 100, 200, 400, 800, 1600, 3200, 6400	0.25, 0.5, 1
Trex	**Square**	125	0.25, 0.5, 1
Connex & Brain Monitor	**Square**	50	0.25, 0.5, 1

Headbox	Shape	Amplitude (µV peak-to peak)	Frequency (Hz)
EMU 36	**Sine**	50, 100, 200, 400, 800, 1600, 3200, 6400	6.25, 12.5, 18.75
	Square	50, 100, 200, 400, 800, 1600, 3200, 6400	0.25, 0.5, 1
NeuroLink IP	**Square**	10, 20, 50, 100, 200, 500, 1000, 2000, uV peak to peak	0.25, 0.5, 1Hz
Netlink Traveler	**Square**	10, 20, 50, 100, 200, 500, 1000, 2000, uV peak to peak	0.25, 0.5, 1Hz
Natus Quantum	**Sine**	50, 100, 200	5, 10, 20
	Square	10, 20, 50, 100, 200, 500, 1000, 2000	0.25, 0.5, 1

NOTE: Shape, amplitude and frequency settings are saved for each headbox type. If stored settings do not exist, headboxes default to factory settings.

3.6 Impedance Check

An impedance check is performed to ensure that the electrode contact with the patient is satisfactory. Impedance checks can be performed at any time during a study.

NOTE: A minute electric current is transferred during an impedance check. To protect grid patients, impedance checks are disabled for the 128 channel headbox.

To activate an impedance check, do any of the following:

1. On the keyboard, press **CTRL + Minus** key on the number pad.
2. Choose **Controls > Impedance Check**
3. Press the **Impedance** button on the amplifier (if available).

TIP: All controls in the Impedance Check tool are enabled both locally and remotely. Impedance Check works the same on both acquisition and monitoring stations. It is possible to start an impedance check on one station and end it from another station.

Running an Impedance Check

When an impedance check is initiated, the software scans all channels (in auto scan mode). You can monitor the contact of a single channel by locking onto it and then adjusting the electrode contact to acceptable impedance levels. Channel labels correspond to those in the current montage, not the ones on the headbox itself.

To...	Do This...
Lock onto a channel	Click the **Lock Channel** button to the left of the **Channel #** that you wish to lock. This confines the scanning to that channel. You can then make adjustments to the electrode connection until satisfactory levels are achieved.
Allow the system to scan all channels and run a full impedance check	Click **Release Lock**.
Save the impedance check as part of the EEG record	Click **End and Start Recording**.
End the impedance check	Click **End**.

Interpreting an Impedance Check

An impedance check displays bar graphs that show the impedance of each electrode connection. A green bar indicates the reading is acceptable (i.e. below the threshold). A red bar indicates the reading is unacceptable (i.e. above the threshold). To set the impedance threshold, click one of the Threshold buttons in the Threshold Group box on the right side of the Check Impedance screen.

NOTE: If the impedance check is run with a protocol, the threshold is determined in the Action settings on the Protocol tab of the **Edit > Settings** box. Otherwise, the threshold is determined by manually clicking the option buttons in the Threshold section of Impedance Check box.

3.7 Workspaces

About Workspaces

Workspaces allow multiple end users to have the software remember or recall individual preferences regarding certain user interface elements of the application which include:

- **Toolbar**s position
- Size and position of **Annotation Viewer** and the **Trend Summary** toolbar
- Position and visibility of **note filter window** (part of Annotation Viewer)
- Size of **montage pane** (showing sensitivities and filter settings per channel on the left of traces)
- Video window position
- Standard colors (as customized in **File > Customize > Colors (tab)**)
- **Montages** (As Recorded / As Reviewed / Custom setting on **Review** tab of **Edit > Settings** dialog box as well as the Custom montage, if set up). Note that this setting has no effect on the default montage that is used for new live studies (which is set using the **Set as Default** button on the **Montage** page).
- Time base
- Scale Legend visibility
- **Gridlines** frequency
- List of **hidden channels**. This list is maintained even as montages are changed when navigating in **As Recorded** or **As Reviewed** montage modes. When a montage is switched by a user, all channels are set back to be visible.
- Settings of the **Trend Summary** toolbar (list of, position and relative sizes of displayed graphs and axis

Workspaces are stored in **.WKS** files in **NeuroWorks\Settings** directory (or in a private local Windows user profile directory). These files can be saved to a common directory (available to other machines) or locally. Thus the workspaces you create may be made available for use in the whole medical facility (**Common** group) or kept just for the current station (**Local** group).

Each workspace also has **two** faces – one for **reviewing** studies and one for **acquiring**. Each mode remembers its own set of toolbar visibility settings, time base, etc.

Customizing Workspaces

To apply the Workspaces feature:

1. Customize any or all of the attributes described above.
2. When you like the current view, press the **Workspaces** button  or **View > Workspace** or **Ctrl + W** or **Ctrl + Shift + Arrow Down** (similar to how **Ctrl + Arrow Down** opens **Navigation** mode drop-down menu).

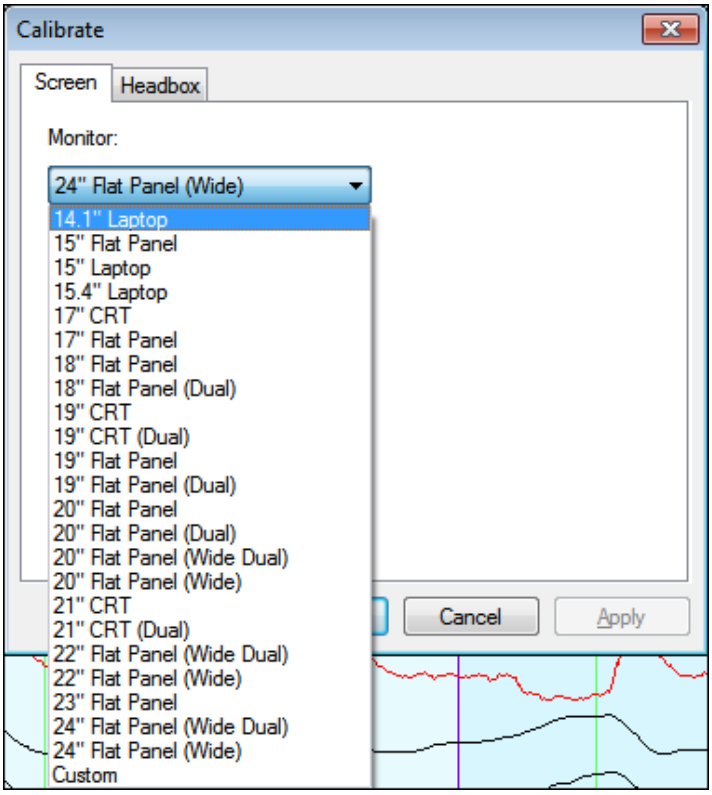
3. In the drop-down menu, select **Save Workspace As**.
4. In the dialog box, type the name of the workspace that you want to save (for example, Review 10 mm Timebase).
5. The workspace will now be available in the drop-down menu, and you will be able to restore the saved settings easily.

The **Default** workspace is always present as a menu item in the Workspaces drop-down menu. This means all the attributes will be automatically saved for all studies when you close the application, and they will be restored next time you open a study for review or run a new live study. This setting effectively **disables** the Workspaces feature.

3.8 Selecting a Monitor

To select a monitor that matches the system monitor:

1. Choose **Edit > Calibrate > Screen** (tab).
2. Click the arrow to the right of the Monitor box to see a drop-down list of available monitors.



Calibrate Screen Dialog

3. Select a monitor and click **Apply** or **OK**.

Dual Monitor Display

For dual monitor configurations, it is recommended to do the following:

1. Choose **Tools > Options > Options** tab.
2. Under **Display Options**, uncheck **Maximize application at start-up**.

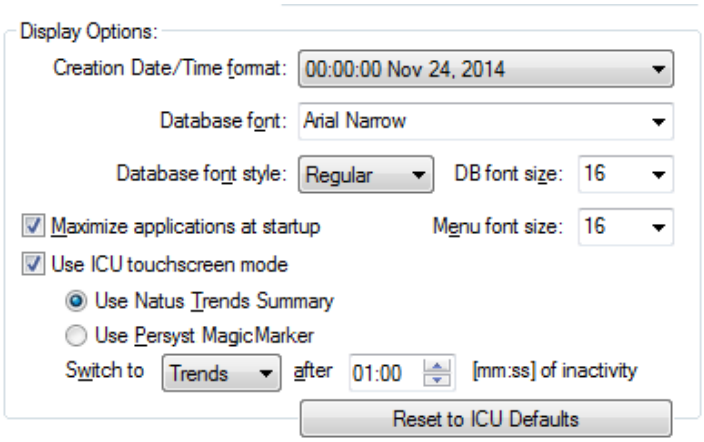
The above option is selected by default. Deselecting the option allows both Natus Database and NeuroWorks EEG to remember their position and size for the next time they are launched. This mode better suits dual monitor configurations

3.9 Touchscreen Operation Mode

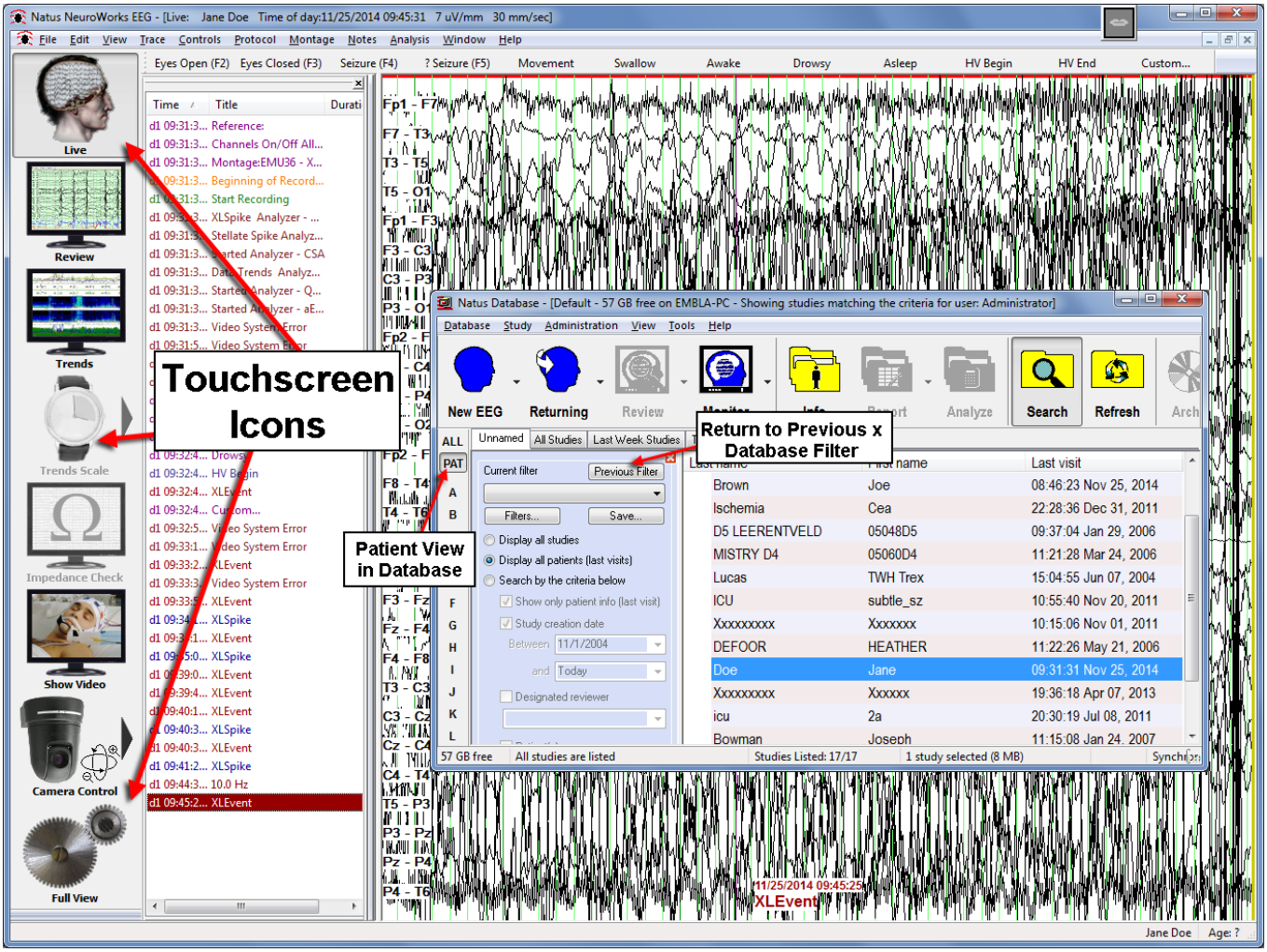
The **Touchscreen Operation** mode is useful when an All-in-One panel PC (touchscreen monoputer) acquisition is used. Once enabled, it displays an ICU Workflow toolbar featuring icons to provide an alternative method to access and activate various functions.

To enable touchscreen mode:

1. In the Database window, select **Tools > Options**.
2. In the Display Options section, put a checkmark next to the **Use ICU Touchscreen mode** option.
3. Select whether you will use the **Natus Trends Summary** or the **Persyst MagicMarker** option to view the study.



Display Options in Natus Database Tools Options Tab



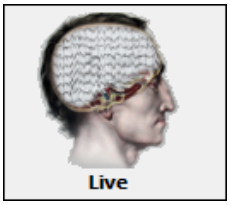
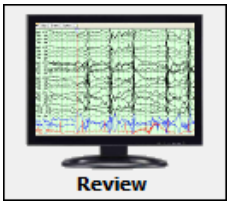
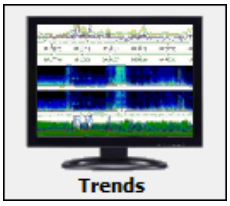
Touchscreen Mode

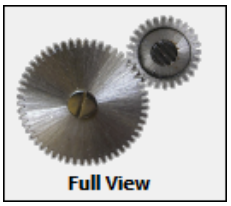
The touchscreen mode differs from the standard display mode:

- **Simplified Start Study dialog:** A study can be started without entering any patient information (“X X” is entered in place of the patient name and can be updated later at any time while study is Live or during Review).
- Once the study is started it will switch to Trends view (or to other mode of user choice) after a period of inactivity. This can be can be configured in **Natus Database > Tools > Options.**

NOTE: To adjust other parameters such as headbox, camera, etc. start study in standard (non-touchscreen) mode.

Buttons in ICU Workflow toolbar

Button	Description
	**View Live recording -** View EEG signals as they come from the amplifier. This is the default view and the system reverts to this view after any period of inactivity.
	**Review Current Study -** This allows user to 'look-back' at the annotation viewer and review previously recorded EEG and video segments.
	**View Trends -** The screen by default shows the currently recording portion of the study but can be scrolled to any time period. After a short period of inactivity the screen locks on the currently recording portion. Double-clicking (or double-tapping) on a trend opens the portion of the study in review corresponding to the time period double-clicked/double-tapped.
	**Zoom -** Changes the time period shown on screen in the Trends view
	**Perform Impedance Check -** activates the impedance testing function
	**View Video Window -** If in live and video recording is not yet started it gets started. In review the video reflects the time shown in waveforms or trends view.

Button	Description
	**Camera Control -** when equipped with a PTZ camera, this allows the user to control the camera's Pan, Tilt, and Zoom options
	**Switch to "Full" view -** when activated, this 'hides' the ICU toolbar and displays the standard software controls

3.10 Checking Recording Station Operation

To check that the recording stations are functioning and recording data:

1. Turn on the monitor using the on/off switch.
2. Lower keyboard tray to a horizontal position using the black locking arm located at the back of the keyboard tray.
3. Log in to unlock the system. For more information, see the XLSecurity Brief Tutorial.
4. A video image and the EEG signals appear in the waveform window. (This could be a good time to remind the patient of the importance of staying in camera range.)
5. Ensure all leads are collecting information and none are in flat line status or amp saturated. If the leads are amp saturated, you will see a message in the left-hand column of the channel labels.
6. Lock the system. For more information, see the XLSecurity Brief Tutorial.
7. Return the keyboard to the upright and locked position using the black lever. This is very important since the keyboard could be damaged when moving beds if left in lowered position.
8. Turn off the monitor using the on/off switch.
9. Notify the appropriate personnel (e.g. EEG technologist or doctor) if you notice anything abnormal and/or respond accordingly as per your site or hospital's policies and procedures.
10. Document your activity as per your site or hospital's policies and procedures.

NOTE: Amp saturated indicates the actual signal is too large for the range of the input channel. Adjusting electrode contact to eliminate unwanted signal or noise may correct the problem.

See also: Recording Video and Audio.

4. Ambulatory Studies

4.1 Overview

During an ambulatory study, EEG data is acquired and stored in a headbox while the headbox is disconnected from the acquisition station. Later, the data is uploaded from the headbox to the Natus Database. Natus offers a variety of headboxes that can be used for ambulatory studies, including:

- Trex HD
- EMU40EX

This tutorial consists of a series of topics designed to teach you how to run an ambulatory study with any one of these headboxes.

The **Ambulatory Headbox Manager** is a separate program for running studies with ambulatory headboxes (Trex, EMU40).

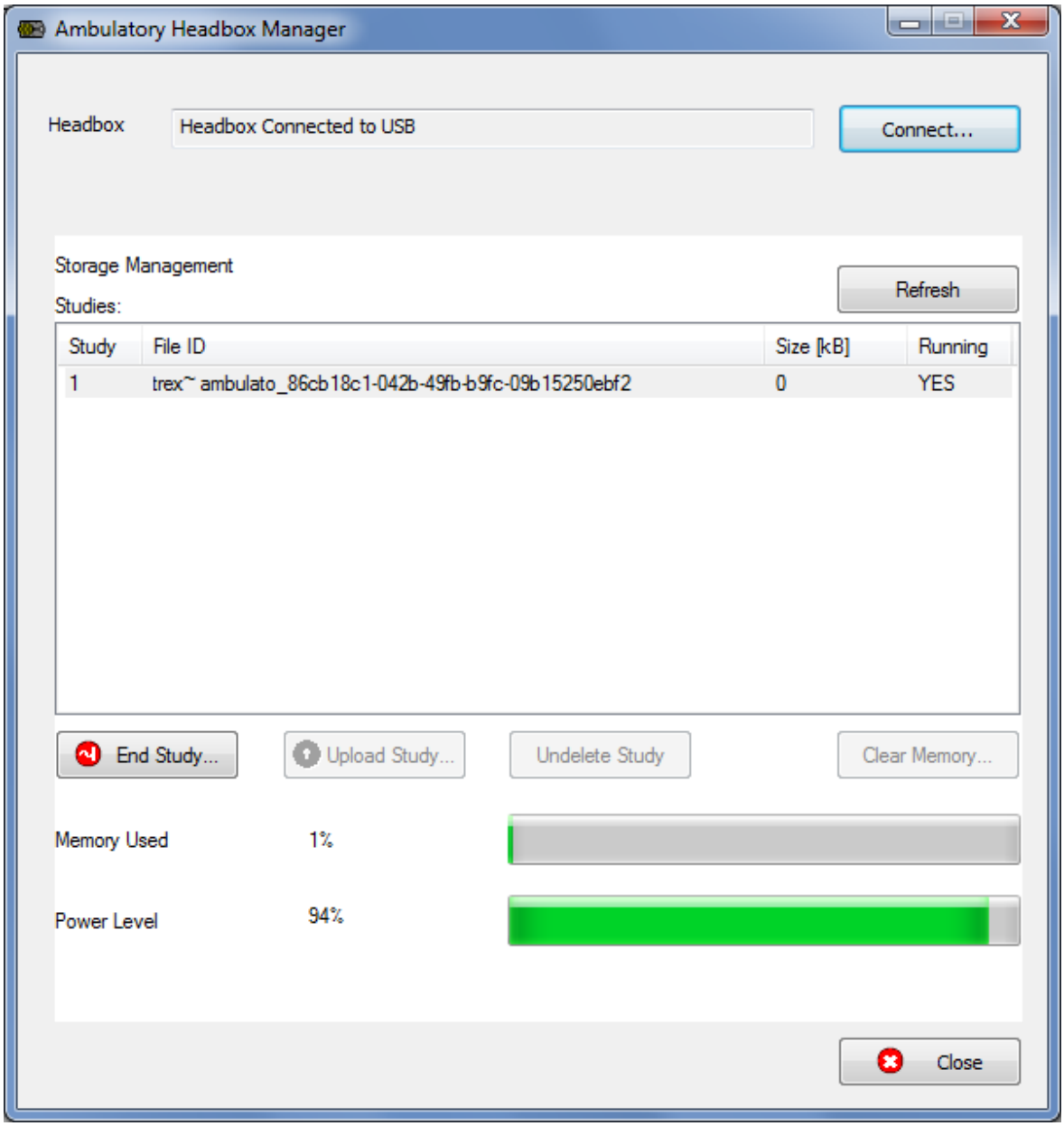
The Ambulatory Headbox Manager window shows information about studies currently stored in the flash memory of the headbox. It also enables you to:

- End a study that is currently being acquired.
- Upload one or more studies from the headbox flash memory to the Natus Database.
- Clear or empty the flash memory of the headbox.
- Refresh the status of study files shown.

To open the Ambulatory Headbox Manager, choose **Tools > Ambulatory Manager** in the Natus Database.

As long as the Ambulatory Headbox Manager is open, the **Ambulatory Headbox Manager** button 

is available on your Windows taskbar. You can click the Ambulatory Headbox Manager taskbar button at any time to bring the program to the foreground.



Ambulatory Headbox Manager – Main Menu Screen

NOTE: For headboxes other than the Trex, multiple studies may be visible. The Trex headbox allows for only one study at a time. To start a new study, an existing study must be deleted.

If a different database has been loaded into the Natus Database since the ambulatory study was started, then the File ID for the study shows a question mark (?) instead of the patient's name.

4.2 Before You Begin

Ambulatory Settings

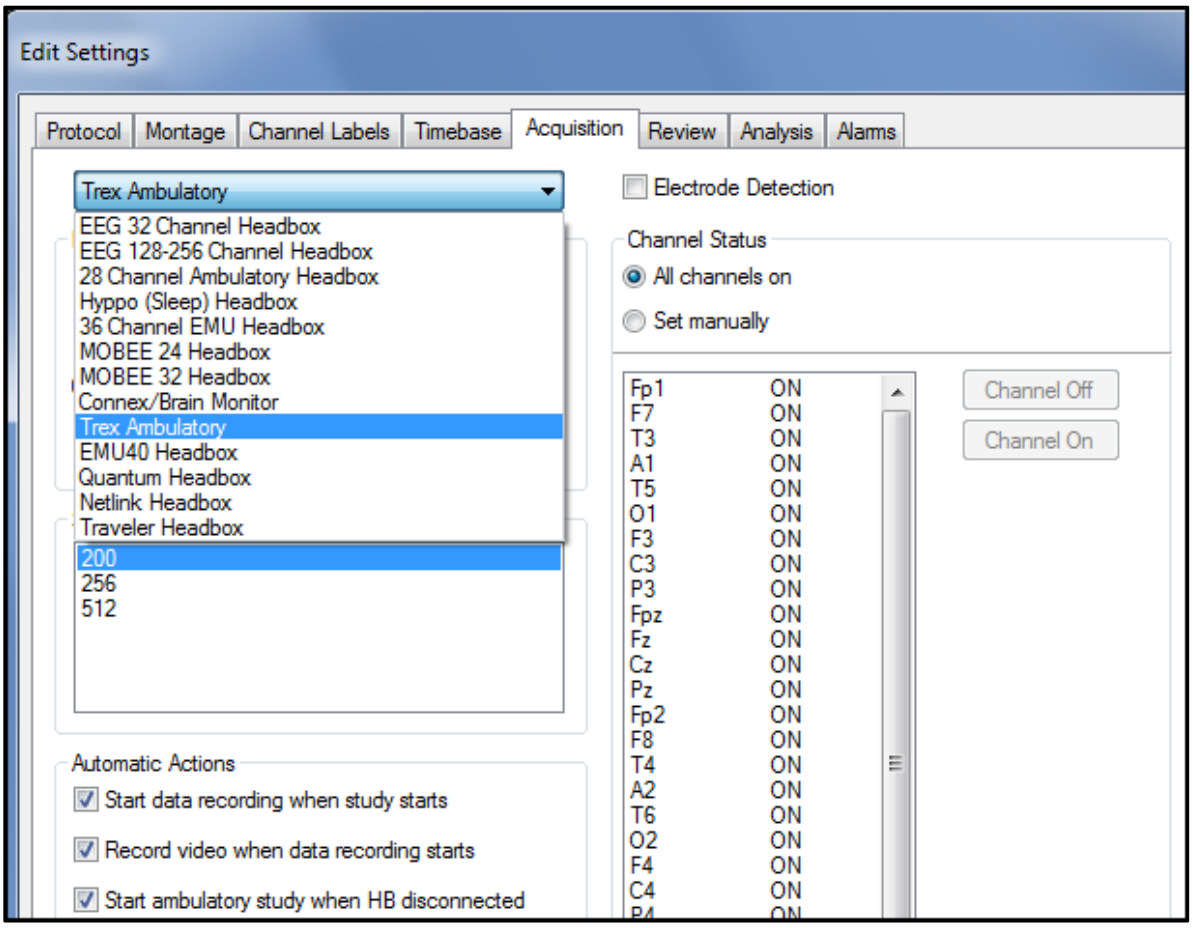
Review the following configuration options before starting a study using the Ambulatory Headbox Manager.

To configure an ambulatory study to start automatically when the headbox is disconnected from the acquisition PC:

1. In NeuroWorks EEG, choose **Edit > Settings > Acquisition** (tab).
2. Choose the headbox from the dropdown menu.
3. To automatically start ambulatory recording when the headbox is disconnected from the computer, ensure that **Start ambulatory study when HB disconnected** is checked.

NOTE: Do not check this option if you need to disconnect the headbox without starting ambulatory recording. In this case, manually start ambulatory recording by choosing **Controls > Start Ambulatory Study** in NeuroWorks before disconnecting the headbox.

4. Choose any other settings required for the study.



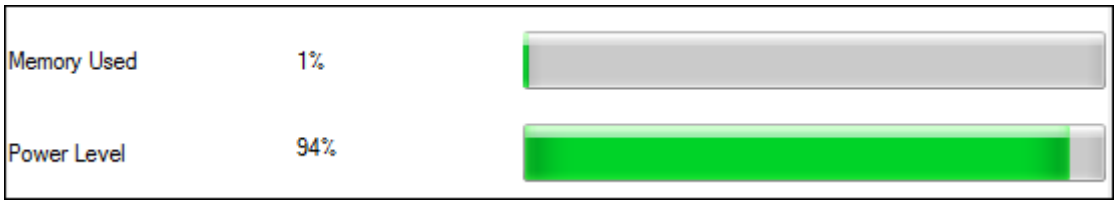
Menu of Headbox Types in Acquisition Tab

Checking Battery Placement

Before beginning an ambulatory study, it is important that you make sure the headbox batteries are fitted properly into the battery compartment. The connection between the batteries' terminals and the battery holder must be firmly established.

The following procedures should be used to verify the placement of the batteries for an ambulatory headbox (Trex or EMU40):

1. Insert new batteries into the battery compartment. Make sure all battery terminals make firm contact with the battery holder terminals.
2. In Natus Database, select **Tools > Options > Ambulatory Manager**. This opens the **Ambulatory Headbox Manager** window.
3. Connect the headbox using USB cable and in Select Headbox dialog, select **Headbox Connected to USB**.
4. Verify that the Power Level indicates a valid power percentage level (100% or very close to 100% for new batteries).



Headbox Flash Memory and Power Level Indicators in Ambulatory Headbox Manager

If a 0% power level for new batteries is displayed, adjust the batteries by pressing or rotating them slightly in the battery compartment. Then repeat Steps 2–4.

NOTES:

- For battery powered headboxes, dispose of used batteries in accordance with local regulations.
- For AA battery-powered ambulatory headboxes such as Trex, we strongly recommend that you use major brand name AA alkaline or lithium batteries. Do not use rechargeable batteries.

4.3 Performing an Ambulatory Study

The following tutorial is for performing a non-video ambulatory study using the Trex and Trex HD. For instructions on Video Ambulatory workflow using Trex HD, refer to Trex HD Technical Guide (p/n 009318) and Trex HD Patient Guide (p/n 009320).

Starting an Ambulatory Study

Starting an Ambulatory Study

Step 1: **Connect the Headbox**	Insert new batteries into the ambulatory headbox. Make sure battery placement has created a firm connection.
Step 2: **Connect the Electrodes**	Prepare the patient and connect the patient leads to the headbox.
Step 3: **Start a New Study**	In the **Natus Database**, click the **New** button. The **Study Information** window appears. Fill in the patient's name and other relevant information about the study. Click **OK**. To begin recording, click **Start** (or press **CTRL + SPACEBAR**).
Step 4: **Begin Acquiring Data to the Headbox**	Choose the headbox and additional settings under **Edit > Settings > Acquisition** (tab). Ensure **Start ambulatory study when HB disconnected** is checked. To begin acquiring data to the flash memory of the headbox, disconnect headbox from acquisition computer. ***Alternative:*** *If* ***Start ambulatory study when HB disconnected*** *is unchecked, start recording to headbox by choosing* ***Controls > Start Ambulatory Study****. The following message appears: An ambulatory study will be started and the current waveform window will be closed. Continue? YES/NO. Click* ***YES****. NeuroWorks closes and data is now being saved on the flash memory of the headbox.*
Step 5: **Disconnect the Headbox**	Disconnect the cable from the headbox and assemble the equipment on the patient. Ensure that the amber light on the side of the Trex headbox is flashing to indicate ambulatory recording mode.

The **Start/Stop Recording** button in NeuroWorks EEG window controls recording only to the NeuroWorks acquisition station. Data is recorded to the headbox once it is disconnected (if the system is configured to record automatically when HB disconnected) or when **Controls > Start Ambulatory Study** is clicked. Ambulatory recording mode on the Trex headbox can be verified by a flashing yellow light on side of headbox.

NOTE: Since the Trex headbox can only manage one study at a time, if you are using a Trex headbox, you need to clear any existing studies before starting a new study.

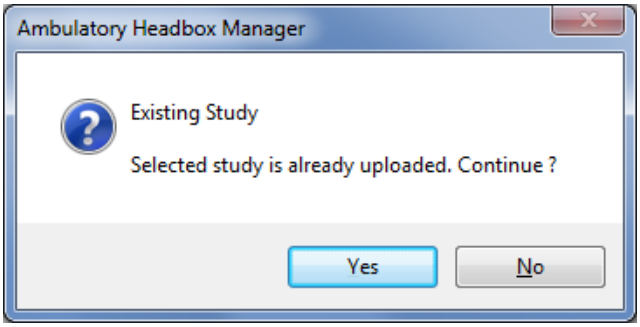
Ending and Uploading an Ambulatory Study

Through the Ambulatory Headbox Manager, you can end and upload an ambulatory study and manage data in the flash memory of the headbox.

To end and upload a study:

1. When the patient returns, connect the headbox to the computer.
2. In Natus Database, select **Tools > Ambulatory Manager**. This opens the **Ambulatory Headbox Manager** window.
3. If you are currently acquiring data to the hard drive, you must close the study. To stop acquiring and saving data to the headbox, select a study with Running status marked Yes. Then click **End Study**. A message appears when the upload is complete. Click **OK**.
4. To upload the ambulatory study from the headbox flash memory to the Natus Database, select the patient's name and click **Upload Study**.

The listing for the study remains in the Ambulatory Headbox Manager window until you clear the study from the flash memory. If you attempt to upload a study that has already been uploaded, the following message appears:



Ambulatory Manager Warning

Three possible options then exist:

- If the selected study was started in the Natus Database, then an entry for this study already exists in the database. In this case, the portion of the study that is stored on the headbox is added to the beginning portion of the study.
- If you are performing a second upload after doing the above (same study , a new study is created in the database which has just the ambulatory portion (uploaded from the headbox).

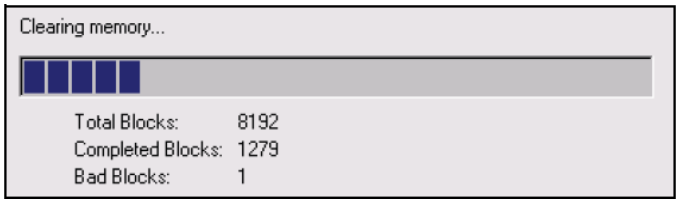
NOTE: The original Live+ Downloaded study already in the data base is not touched after the first upload.

- If the study was started as an ambulatory study and has already been uploaded once, a second version of the study is added to the database.

NOTE: The first uploaded version is NOT overwritten.

Clearing the Headbox Flash Memory

After you have uploaded all of the studies, click **Clear Memory** in the Ambulatory Headbox Manager. This erases the flash memory to make room to record more studies. A progress bar appears as the memory is being cleared.



Progress Bar

When the process is complete, a Memory Contents erased message appears. Click **OK** and then click **Close** 

.

NOTE: No status messages will appear when the flash memory of the Trex is cleared because of the speed at which the operation takes place.

WARNING: The data in the flash memory is PERMANENTLY deleted when you click Clear Memory.

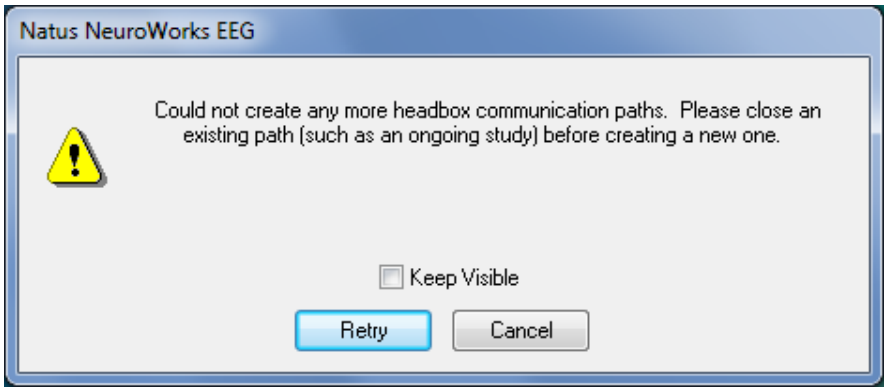
Finding the Study after Uploading

When the study is uploaded from the headbox, the uploaded study may be:

- Listed as a separate study in the Natus Database.
- Appended to a study in the Natus Database. Note that the Duration of the patient's study increases when the uploaded study is appended to it.
- Saved in the patient directory and not yet imported to the Natus Database. This occurs when the database loaded into the Natus Database has changed since the study was started. In this case, you need to import the study.

4.4 Ambulatory Headbox Warnings

Ambulatory Headbox Warning 1



The warning above appears if you have a headbox attached and are running a study, but the data is currently recording to the computer's hard drive.

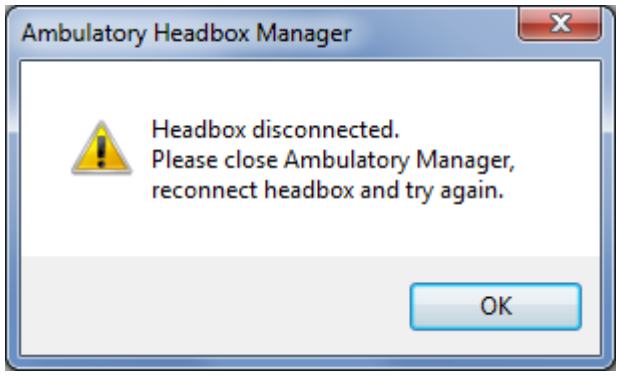
To proceed with the ambulatory study:

- Click **OK** and then close the study.

  OR

- Choose **Controls > Start Ambulatory Study** in NeuroWorks.

Ambulatory Headbox Warning 2



This warning above appears if you click one of the buttons in the Ambulatory Headbox Manager and no headbox is attached.

To proceed with the ambulatory study:

1. Click **OK**.
2. Attach a headbox.
3. Begin the study again.

5. Recording Video and Audio

5.1 About Video and Audio Recording

Natus video EEG monitoring systems are used to monitor patients by recording video, audio and physiologic signals. Natus software offers a robust video and audio recording feature that can be used with data acquisition. Video and audio signals are synchronized with data in real time and can be streamed over an internal network to a remote server or viewing station.

The video option may include an MPEG-4 video grabber, camera with a medical grade power supply, and cables and mounting brackets to attach the camera to the wall, ceiling or cart. The audio option includes a sound card, cables, and a microphone.

This section describes setting up standard video EEG studies in the hospital or clinic. For instructions on Video Ambulatory workflow using Trex HD, refer to Trex HD Technical Guide (p/n 009318) and Trex HD Patient Guide (p/n 009320).

Analog Cameras

For MPEG-4 video, analog cameras require the use of a Natus-supplied USB video grabber to operate. MPEG-4 video EEG systems must meet minimum requirements for computers. Please refer to the **Release Notes** installed with your NeuroWorks software for minimum system requirements.

Release Notes can be accessed by going to **Start > All Programs > Excel Tech > Documentation**.

TCP/IP Cameras

NeuroWorks is compatible with a new generation of TCP/IP streaming cameras which do not require the use of an external USB video grabber. Supported IP cameras are capable of providing up to 1280x720 (High-Definition) resolution.

5.2 Video Recording

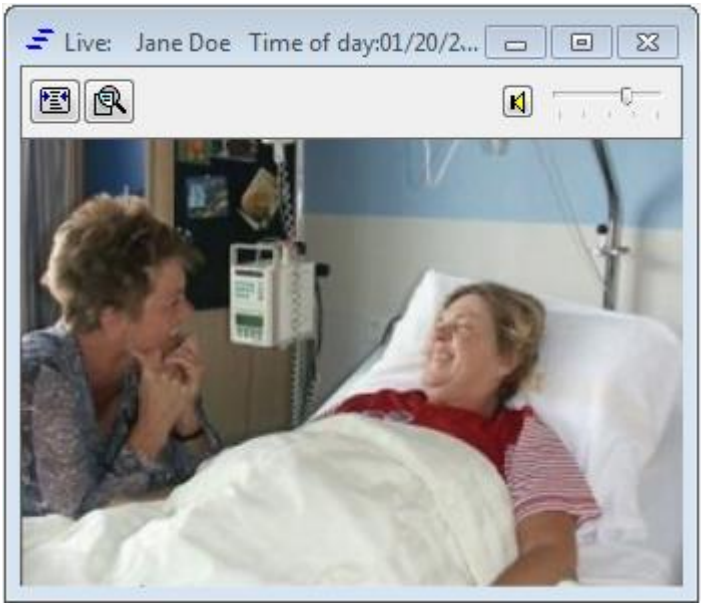
In the NeuroWorks EEG screen, the video window can be shown or hidden independent of video recording. This means that on machines overtaxed by a large number of channels, and/or analyzers, a significant saving in CPU is achieved by hiding the video window.

To show or hide the video window, do any of the following:

- Choose **View > Video**
- Choose **View > Toolbars > Video**
- Press **CTRL + U**
- Click the **Toggle Video On/Off**  button on the toolbar

In the Workflow Toolbar, the pressed Camera button with a red dot indicates that video is being recorded. Showing or hiding the video window will not affect recording functionality.

Record and Camera Buttons on Workflow Toolbar



Video Window

5.3 Audio Recording

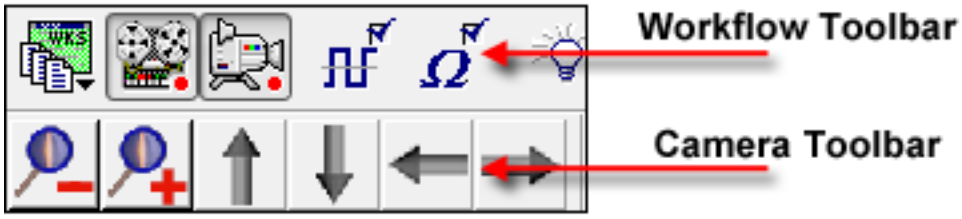
Audio data can be captured and monitored during a study. When video monitoring is started, audio recording (acquisition) automatically starts as well.

When the microphone and speakers are in the same room, feedback can occur. To avoid feedback, place the microphone up to 80 feet from the acquisition unit (or turn off the speakers).

WARNING: The video option must be active to capture or review audio components.

5.4 Remote Camera Control

Cameras can be controlled remotely through the NeuroWorks software. Two remote camera control toolbars are available – Camera and Workflow toolbar – and can be in NeuroWorks EEG by going to View > Toolbars. These moveable toolbars can be placed in any location you desire by clicking the raised line on the left side of either toolbar and dragging it to a new location.



Remote Camera Control using Workflow and Camera Toolbars

See also: Camera Toolbar and Workflow Toolbar.

6. Reviewing a Study

6.1 Overview

You can review a study while it is still being recorded (in Acquisition/Live mode) and after the study has completed (in Review mode).

Reviewing studies involves opening a study, navigating through it, making notes about events that occurred, completing the Physician and Technologist reports, closing the study and marking it as reviewed.

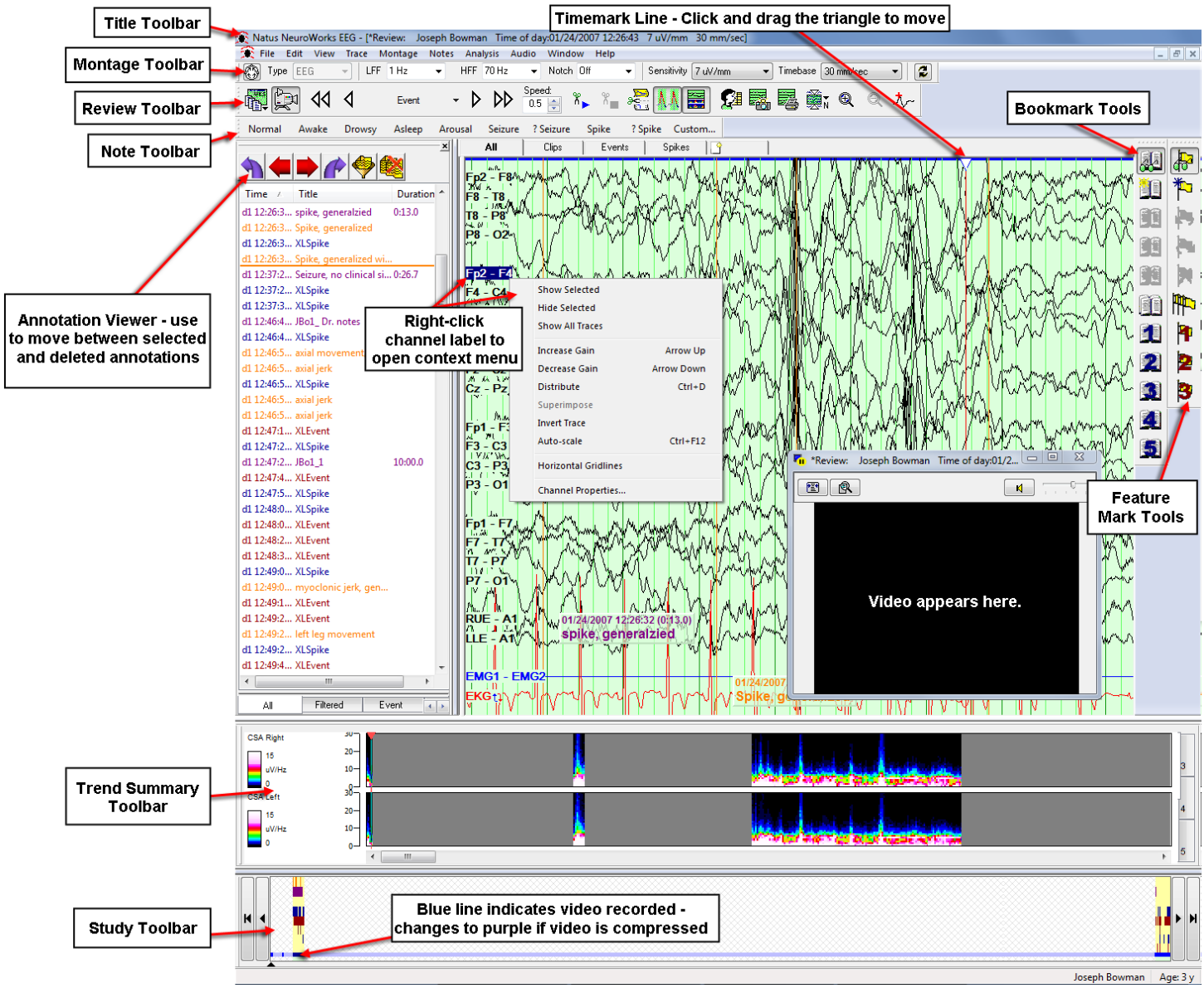
Several tools are available to help you with the review process:

- Screen Capture tool
- Waveform Cursors tool
- Integration with MagicMarker tool
- Instant Pruned View
- Manual and automated clip marking
- Analyzers

NeuroWorks EEG Review Screen

You can display the trace window in full screen mode during Acquisition or Review:

To display the trace window in full screen mode or return it to normal mode, press **CTRL + F11** or choose **View > Full Screen**.



NeuroWorks EEG (Wave) Review Screen

6.2 Opening a Review Study

Opening a Study for Review While it is Being Recorded

It is possible to review a study while the study is still being recorded in Acquisition mode. To do so, choose **Window > Review Current Study** or click the **Review Current Study**  button.

The current study opens in Review mode in a window on the left side of the screen. It also remains open in Acquisition mode in a window on the right. You can **click and drag** the border to resize each window.

Opening a Completed Study for Review

To open a completed study for review:

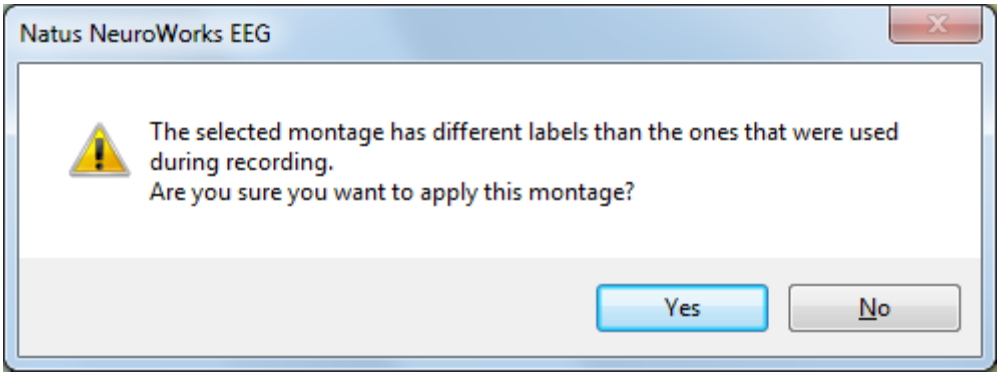
1. Open Natus Database.
2. Select (highlight) the study you want to review.
3. Click the **Review** 

button. NeuroWorks opens and displays the selected study in Review mode.

6.3 Mismatched Labels Warning

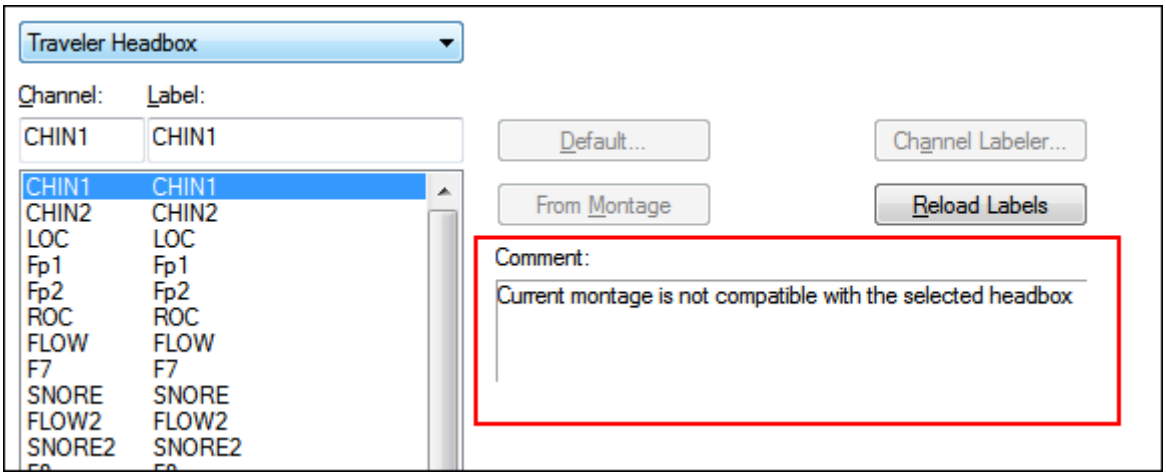
When a recording is made with a multi-channel headbox such as a Quantum or EMU128, labels are typically created for each patient or type of study. It is therefore possible that during **Review** a wrong set of labels may be applied to a study, thus making correct review problematic.

The program gives a clear warning when someone tries to apply a montage with labels that do not match the montage that was used during recording. This warning may appear when either remote monitoring or reviewing a study.



Mismatched Labels Warning

This warning may also appear in the comment section of the Channel Labels tab in the Edit | Settings menu when changing the labels for your montage.



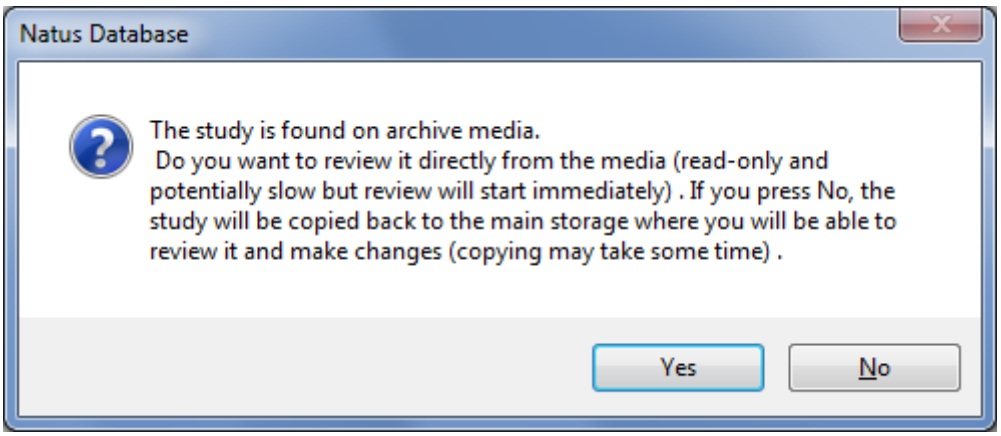
Mismatched Labels Warning – Edit > Settings Menu

6.4 Opening a Study That Has Been Archived on Disk

This section applies to studies that have been purged from the hard drive after archiving. For more on purging, see Purging Studies.

To review a study that is archived on a disk:

1. Open Natus Database.
2. Insert the disk with the study into the CD drive.
3. Locate the study in the Natus Database list. If you are having trouble finding the study in the list, click the **Disk** column heading. All of the archived studies move to the top of the list. If you are still having trouble finding the study, try using the **Search** button to filter the study list.
4. To open the study for review, select the study and click the **Review** button.
5. You are presented with the choice of reviewing directly from the archive medium or copying the study data back to your hard drive.



Retrieve Study Files for Review Box

6. Select **Yes** or **No** to open the study in Review.

6.5 Navigating Through a Study

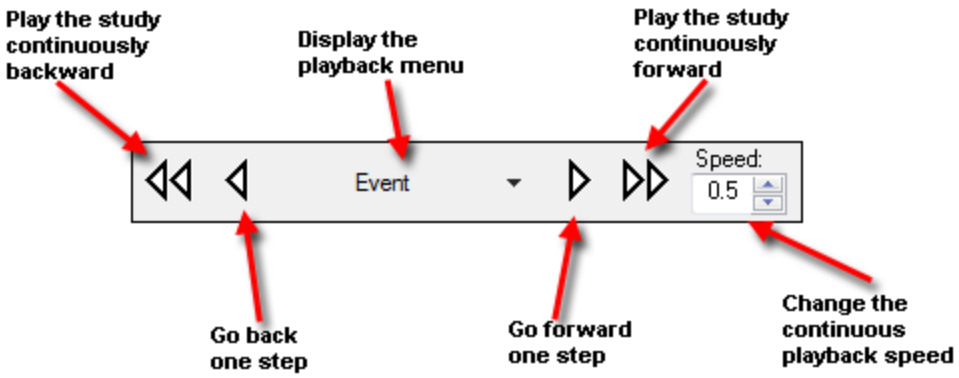
You can use the **keyboard**, the **Review** toolbar, the **Study** toolbar, or the **Trend Summary** toolbar to navigate through a patient study.

NOTE: Although EEG records are large, it is possible to start viewing the study before it is completely uploaded. The **Progress** bar in the Study toolbar indicates how much of the study has been uploaded into memory for viewing. With large files, only the viewed section of a study is loaded into the system.

A. Using the Keyboard to Navigate through a Study

To...	Do this...
Play the study forward or backward continuously	Press **CTRL + F** or **CTRL + R.**
Toggle between play and stop	Press the **SPACEBAR**.
Move the study forward one page	Press the **RIGHT ARROW** key.
Move the study backward one page	Press the **LEFT ARROW** key.
Move the study backward or forward in a series of successive pages	Hold down the **LEFT** or **RIGHT ARROW** keys.

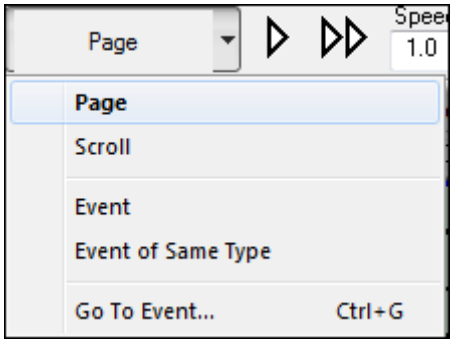
B. Using the Review Toolbar to Navigate through a Study



Review Toolbar

Click the **Event** button (may also appear as Page depending on the selected option) to display navigation options.

Navigation Options

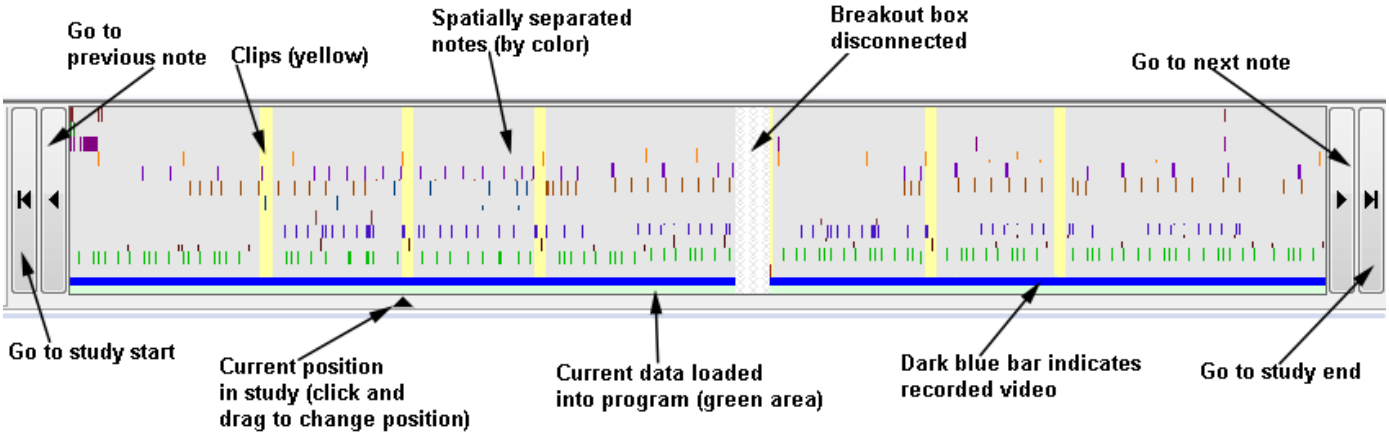
Page	Moves through the study page by page.  When navigating a study by page, the playback speed refers to pages per second. (For example, a playback speed of “2” means 2 pages per second.)
Scroll	**Scroll** navigation mode is supported for single steps and automatic playback. In this mode, the time mark remains fixed while signal traces are scrolled and video is playing at high rate. Scrolling speed is controllable with the same Speed control as the paging rate. Use the spacebar (as with other navigation modes) to start/stop playback. When navigating a study using Scroll, the playback speed refers to the number of times the video is sped up. (For example, a playback speed of “2” means video will play at twice the actual speed.)
Event	Moves to the next note starting at the time marker position and selects the note. When navigating a study by event, the playback speed refers to the number of seconds per event. (For example, a playback speed of “0.5” means each event is displayed for two seconds.)
Event of Same Type	Moves to the next event of the same type (i.e. Spike, Eyes Open).
Go to Event (Ctrl + G)	Allows you choose an event from a list of scored events.

Use the Speed control on the Review toolbar to increase or decrease the playback speed:

Speed Control in Review Toolbar

- Click the **Up/Down** arrow keys to increase or decrease the playback speed.
- Click the displayed number to highlight it and then type a different playback speed.
- Press + or - on the numeric pad on the keyboard to increase or decrease the playback speed.

C. Using the Study Toolbar to Navigate through a Study



Study Toolbar

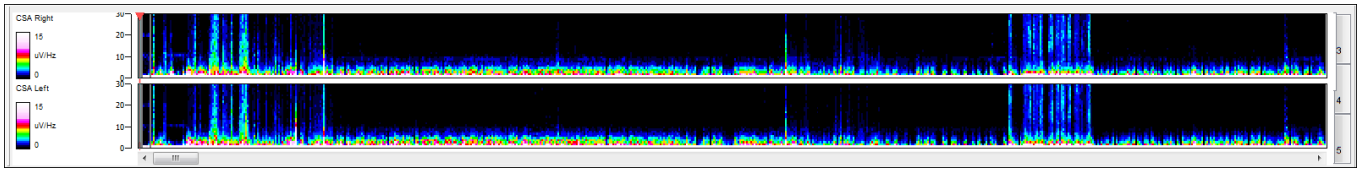
A small Indicator Arrow shows your current position relative to the complete study. The vertical lines (note bands) on the Progress bar indicate the position of Notes in the study.

NOTE: The dark blue bar at the bottom of the Study toolbar changes to purple where there is squeezed video.

D. Using the Trend Summary Toolbar to Navigate through a Study

Use the **Trend Summary** toolbar to quickly identify and navigate to important events within the study, which are shown by spikes. The Trend Summary toolbar is available in both Acquisition and Review modes.

To open the Trend Summary toolbar, choose **View > Toolbars > Trend Summary**.



Trend Summary Toolbar

Several types of trending data are available, including:

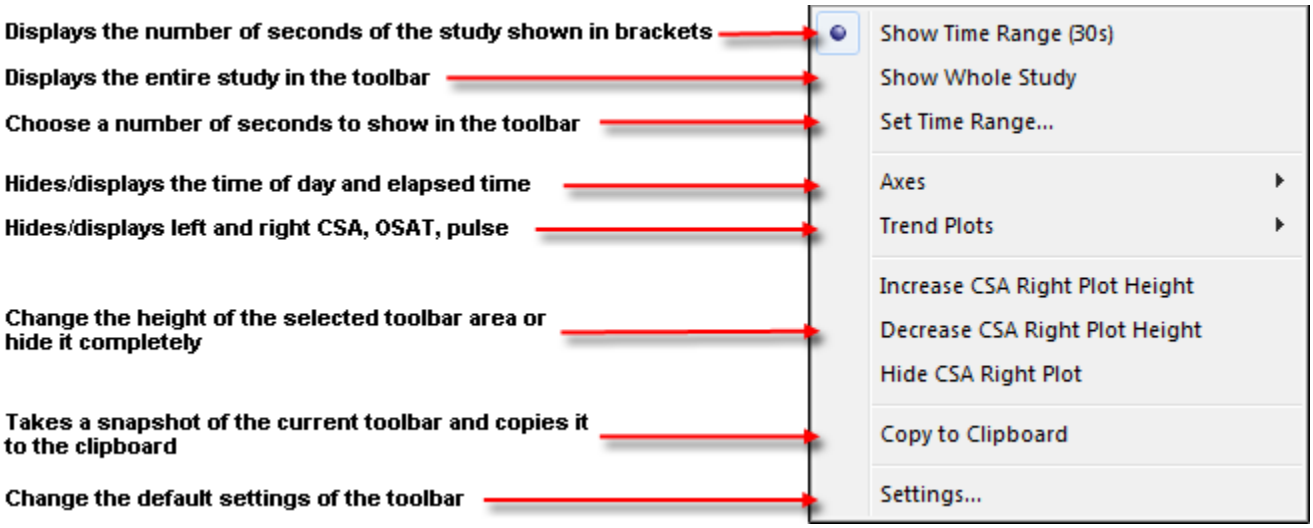
- Compressed Spectrum Array (CSA) for the right and left hemispheres
- Amplitude-Integrated EEG (aEEG)

By default, the two CSA channels appear on the Trend Summary toolbar. Each vertical slice represents a spectrum of a small time window. Different colors represent different power. The X-axis represents time and the Y-axis represents frequency.

During acquisition, the plot normally displays the last hour of the study. During review, the plot normally displays a one-hour window around the currently selected point in time. (A triangular marker indicates the current point in time.) You can quickly jump to another point in time by simply clicking that area of the toolbar (similar to grabbing and moving the positioning triangle). You can display the whole study in the toolbar or choose the number of seconds to display at one time.

To change the settings of the Trend Summary toolbar:

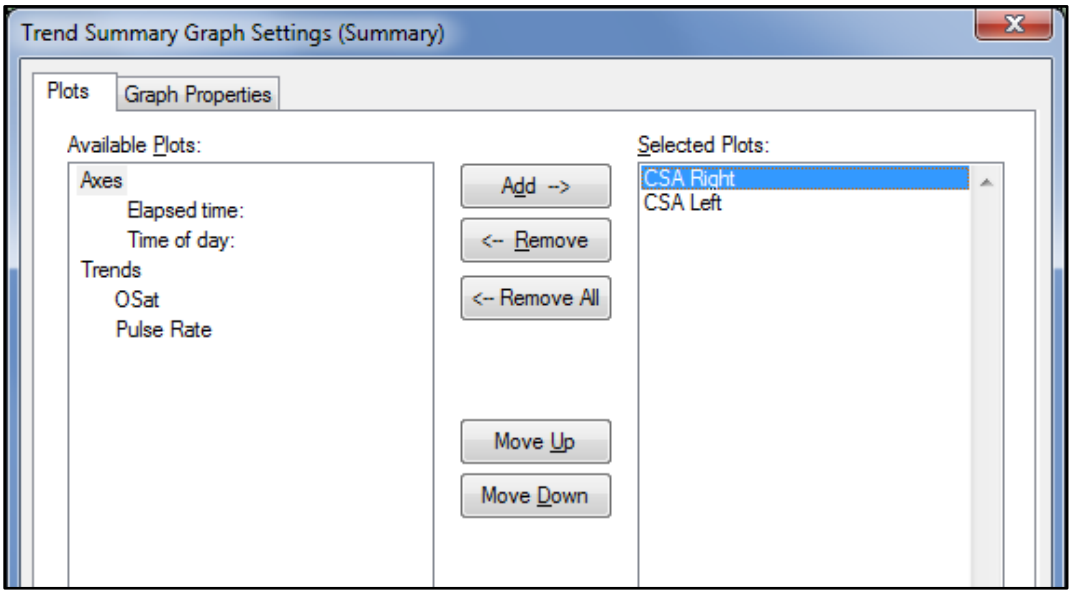
Right-click an area of the toolbar to display a menu:



Trend Summary Menu

NOTE: The menu changes depending on which area of the toolbar was right-clicked.

1. Click Settings to open the Trend Summary Graph Settings box.



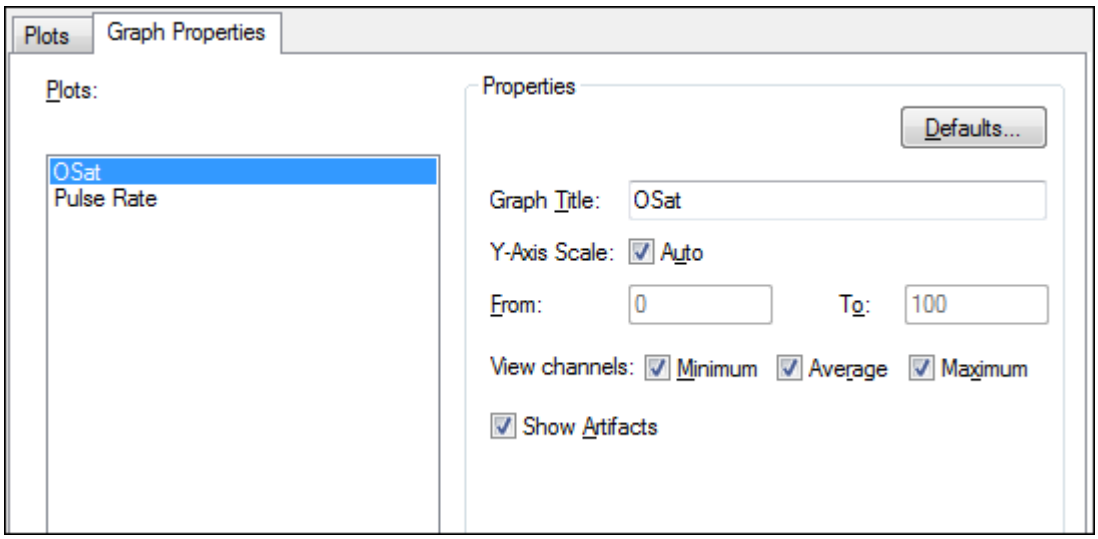
Trend Summary Graph Settings Box

2. To include additional information in the Trend Summary toolbar, click an item in the **Available Plots** box and then click **Add**. The item moves to the Selected Plots box and will now appear in the toolbar.
3. To remove items from the Trend Summary toolbar, click an item in the **Selected Plots** box and then click **Remove**. The item moves to the Available Plots box and will no longer appear in the toolbar.

TIP: Once you have selected which items to include in the toolbar, you can reorder them using the **Move Up** and **Move Down** buttons. Reset returns to the factory defaults.

To change settings for the Osat and Pulse rate graphs on the Trend Summary toolbar:

1. Right-click an area of the toolbar to display a menu and click Settings.
2. When the Trend Summary Graph Settings box appears, click the Graph Properties tab:



Trend Summary Graph Properties Box

3. In the **Graphs** box, select the item (either OSat or Pulse Rate) to change.

NOTE: OSat and Pulse Rate only appear if breathing and pulse rate were monitored during acquisition of the selected study.

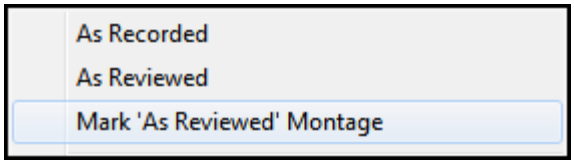
4. If you want to change the title that will appear beside this graph on the Trend Summary toolbar, type a new title beside **Graph Title**.
5. If you want to specify a range for the Y-axis manually, deselect Auto and then type values beside **From** and **To**.
6. If you want to change the plot color, click on the **Colo**r button and select a new color scheme.
7. If you want to change the line style, click on the **Line** button and select a new option.

6.6 As Reviewed Montage Mode

As Reviewed montage mode exists in addition to the **existing montage override** and **As Recorded** montage modes. During a study review, you can now adjust montage and filter settings and save them for future use at a given time in the study. The list of those changes is kept in a way similar to the list of **As Recorded** montages.

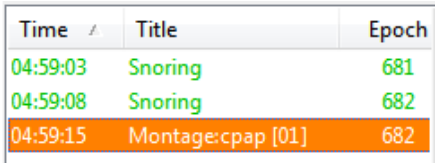
To use the As Reviewed montage mode:

1. Adjust montage, gain and filter settings as you usually do (this will change the montage mode to **montage override**).
2. Right-click the study traces where you want the settings to be changed.
3. Select Mark 'As Reviewed' Montage from the menu.

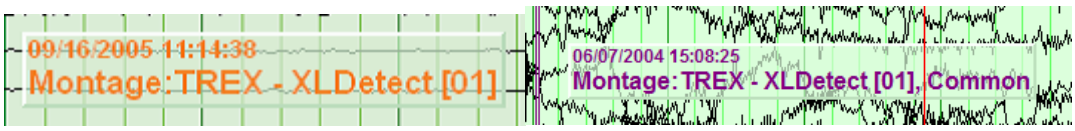


Note the following:

- Alternatively, the Montage menu can be used to perform the same task.
- This will record the settings in a montage change note and switch the current mode to As Reviewed.

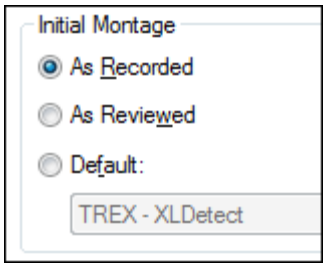


Note in Annotation Viewer



Note on Screen

- At any time during a study review, you can switch to **As Reviewed** mode. This will allow reviewing of the study with montage tracking of the changes and adjustments made during previous review sessions.
- **As Reviewed** mode can be selected to be active whenever you open a study for review. The setting can be found on the **Review** tab of the **Edit > Settings** dialog box.



Review Tab in Edit Settings Dialog

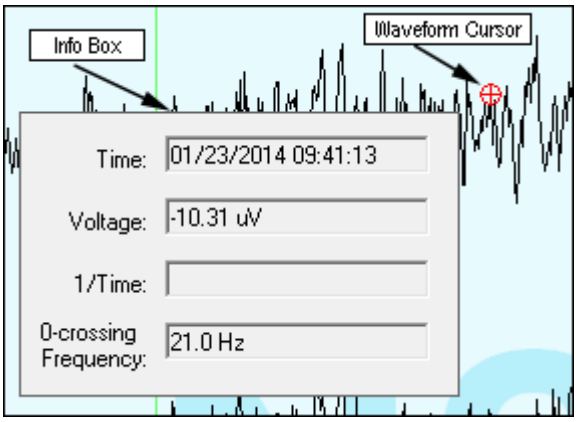
NOTE: Only one **As Reviewed** set of montages is kept and shared by everybody reviewing a given study. Montage changes are kept in the **.ENT file** (notes file).

6.7 Using the Waveform Cursors Tool

The **Waveform Cursors** button on the **Review** toolbar can be used to compare values of a waveform at various points.

To use the waveform cursors tool:

1. Click the **Waveform Cursors**  button.
2. Click a point in a waveform.
3. The waveform cursor and info box appear.
4. Move the **info box** to a convenient viewing position.

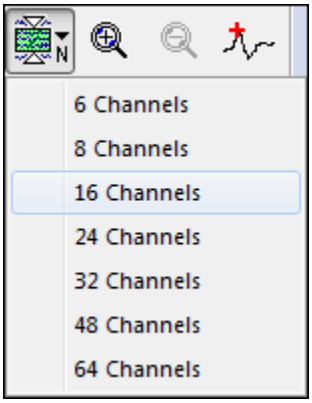


Waveform Cursor and Info Box

5. Move the **waveform cursor** along the wave. As you do, the values in the **info box** update to show those at the point indicated in the waveform.

6.8 Vertical Paging of Traces On-Screen

An alternative to viewing studies with a large number of montage channels is the **Limit N Channels per Page** feature accessible on both the acquisition workflow and review toolbars. Scrolling through sets or groups of channels can be done by clicking on the **Limit N Channels per Page** button from which a user may select to view their desired number of channels from the list of options.



Limit N Channels per Page Options for Vertical Paging

Once you select the desired number of channels to display on-screen, pressing the **[Page Up]** or **[Page Down]** buttons will automatically scroll up or down the next group of channels based on the increment you selected.

The following shortcut keys are also available for use with this feature:

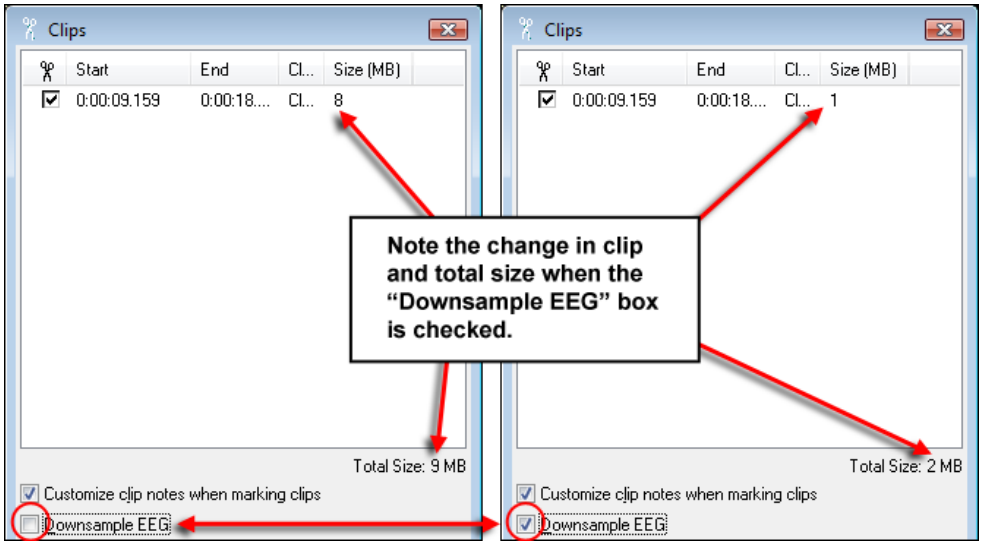
- **[Ctrl + Page Up]** Scrolls traces one channel up
- **[Ctrl + Page Down]** Scrolls traces one channel down
- **[Shift + Page Down]** Switch the vertical limit on and off

6.9 Clipping and Pruning a Study

Typically studies contain items of interest interspersed between periods of inactivity. A **pruned study** is a version of the study that includes only the items of interest.

When you prune a study, the original study file is kept intact - the system saves the pruned version as a separate file that you can view in the Natus Database.

NOTE: When pruning or exporting a study collected at 1000Hz or higher, you can choose to keep only the down-sampled EEG data collected.



Pruning Clips – Showing Both the Full Stream data and Decimated Data Values

Selecting Clips for Pruning

To clip and prune a study, open the study in **Review**  mode and select the clips you want to include in the pruned study.

Proceed using one of the following three methods to prune a study:

Clipping and Pruning a Study Manually
Automated Clip Marking
Using the Instant Pruned View

A. Clipping and Pruning a Study Manually

To manually clip and prune a Review study:

1. Use the mouse pointer to drag the **time-mark line** (vertical place marker line) to the point where you want your clip to begin. Click the **Mark Start**  button (or right-click and choose **Mark Clip Start**).
2. Move the time mark line to the point in the study where you want your selection to end. Click the **Mark End**  button (or right-click and choose **Mark Clip End**).
3. Repeat the above steps to select all clips you want to save from the study.
4. Proceed to the instructions in **Processing Clips in the Clips Box**.

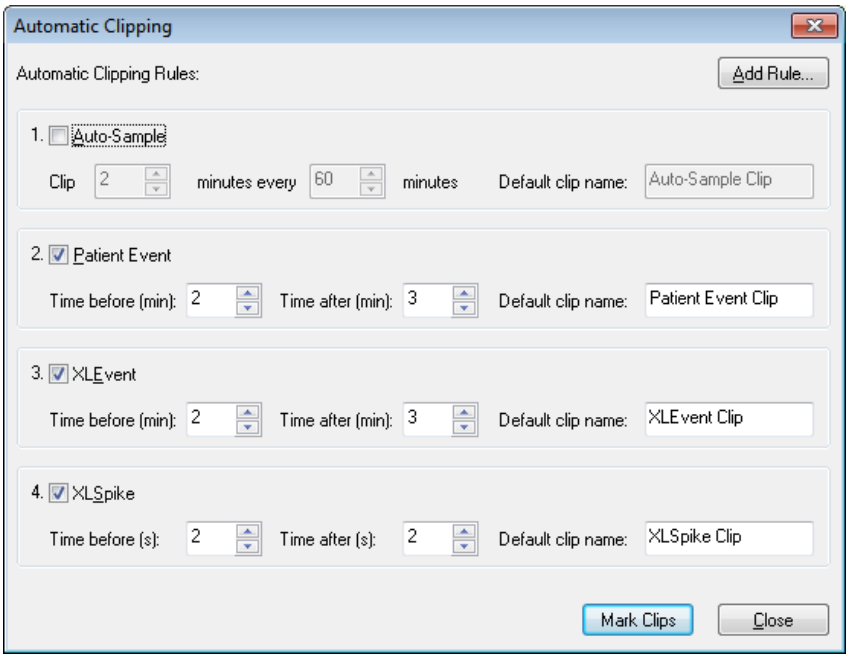
B. Clipping and Pruning a Study using Automated Clip Marking

In addition to or instead of marking clips manually, you can use the automated clip marking feature where the system automatically clips selected events throughout the study.

For example, you can choose to automatically select all events marked by a reviewing technician. Another option could be to have the software automatically mark a clip at specified regular intervals throughout the study (auto-sampling).

To create clips automatically in a Review study:

1. Click **Edit > Clips > Auto Clips** to display the Automatic Clipping box.



Automatic Clipping Dialog

2. Click **Auto-Sample** if you want the system to make a clip at specified intervals.
3. Click **Patient Events**, **XLEvent** and/or **XLSpikes** to specify which event types to clip.
4. Specify the amount of time before and after each type of event that you want to include in the clip. You can also change the default clip names. See below to add custom rules.
5. Click the **Mark Clips** button. If there are any existing auto-clips, the system will delete them before creating new auto-clips based on the current rules (it does not delete clips that were created manually by users). The **Clips** box appears with all the clips.
6. Proceed to the instructions in **Processing Clips in the Clips Box**.

Adding Custom Rules for Automated Clip Marking

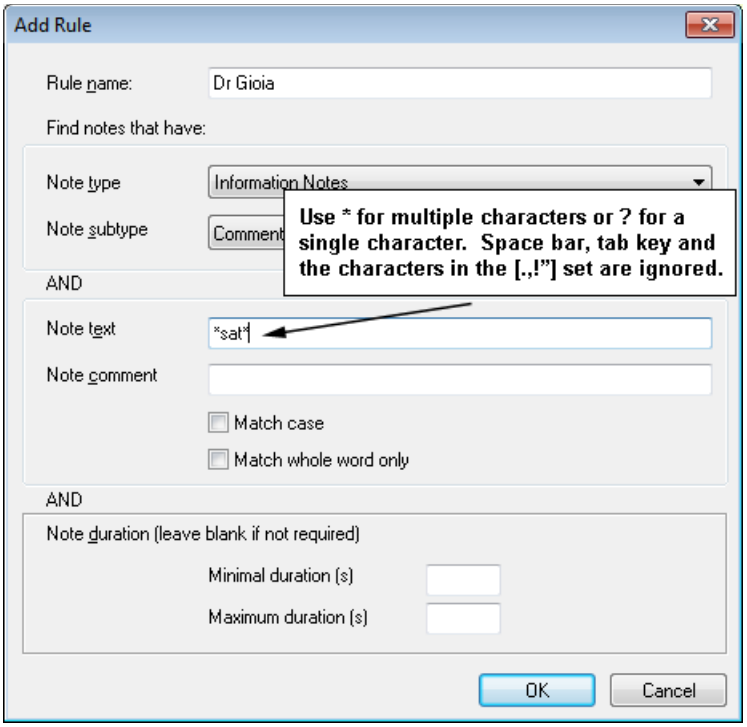
You can create your own custom rules for the auto-clipping function. This can be useful if, for example, you need to mark your own notes with your initials and could add a custom rule that would find all of your notes and clip them.

There is no limit on how many custom rules can be created. The rules are stored locally and are available to all the users on a given station. Each rule is configurable and marks notes based on the criteria explained in the table below. All the set-up criteria has to match in order for the note to be included in a clip.

Custom Clipping Rule added to Automatic Clipping Box

To create a custom rule for clipping a Review study:

1. Click **Edit > Clips > Auto Clips** to display the Automatic Clipping dialog.
2. Click **Add Rule**. The **Add Rule** dialog appears.



Add Rule Dialog

3. Complete the information requested in the **Add Rule** dialog and click **OK**.

Options Available in the Add Rule Box

Option	Function/Description
Rule name	Use to name your rule.
Note type	This type is always assigned by the software. If you select one of the fixed supported types, you can then also select a subtype. For example, selecting Automatic Detections notes allows selecting XLSpike and XLEvent note subtypes.
Note	The list of available subtypes is dependent on the note type. Some note

Option	Function/Description
subtype	types do not have subtypes
Note text	This setting allows you to filter notes based on their caption. For example, in the picture above, a rule is set up to find all **information comment** notes (notes usually entered by typing on the keyboard) and selecting only the notes that contain the sz sub-string. For this rule, notes marked as **szED, sZ1**, etc., will be marked and included in the pruned study. Other info comments will be not.
Note comment	This is an advanced setting that can be used to filter notes based on the comment field. This field is used by ***Natus*** analyzers to associate detections with certain channels, so when you use it, you can filter events marked on these channels only.
Match case	If this setting is selected (checked), text search will be case sensitive.
Match whole word only	If this setting is selected (checked), the pattern will be compared with the whole words. This means, for example, that if **limb** is set as a pattern, it will match only if the note text contains the word **limb**. It will not pick up **limbo** or **climb**.
Note duration	This setting allows for the finding of notes that are at least, or at most, a specified number of seconds in duration. This option is useful for notes that have duration.

C. Using the Instant Pruned View

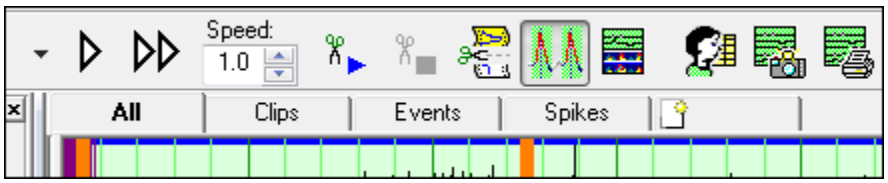
Unlike Automatic Clipping, **Instant Pruned view** does not create clips. Instead, it instantly displays the current study as if you had already clipped and pruned it. Because this view is so quick and easy to create from the original study, there is no need to save a pruned view.

While you are in **Instant Pruned view**, you can navigate through the study, scroll the record, show video, print, and access most of the review functions. Just as with Automatic Clipping, you can set up rules to control the Instant Pruned View.

To display the Instant Pruned view:

1. Select a study in the Natus Database, and click  Review. NeuroWorks opens with the study in **Review** mode.

2. Click the Instant Pruning  button on the Review toolbar (or choose **View > Instant Pruning** or press Alt + L). The Instant Pruning toolbar opens:

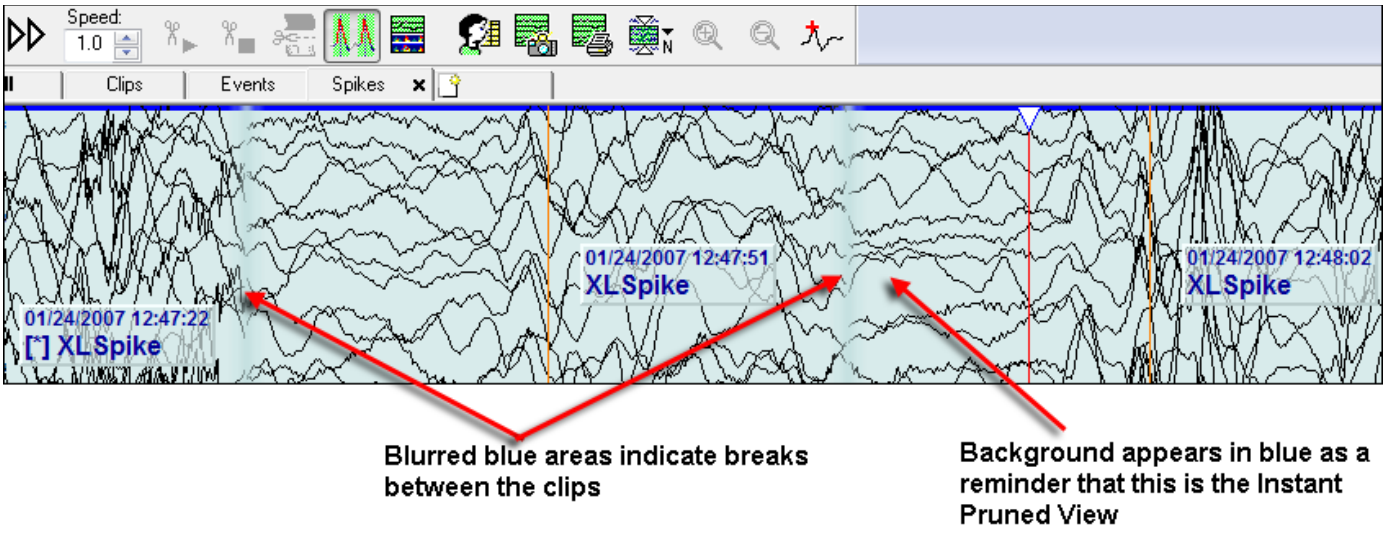


Instant Pruning Toolbar

Instant Pruning Toolbar Buttons

All	**All:** Exits Instant Pruning view and redisplays the normal view.
Clips	**Clips:** Displays only clips that have already been made.
Events	**Events**: Displays only events that occurred during the study.
Spikes	**Spikes:** Displays only spikes that occurred during the study.
	**New Tab:** Opens a dialog box where you can set rules for instant pruning.

3. Click **Clips** Clips or **Events** Events or **Spikes** Spikes. Here is an example of the instant pruned view of spikes in a study:



Instant Pruned View of Spikes

NOTE: The background color changes to blue (or a color configurable using **File > Customize > Colors**) when displaying the **Instant Pruned View**. A blurred area appears between each clip. When you exit Instant Pruned view, the background changes back to yellow.

To exit Instant Pruned view, click again the **Instant Pruning** button on the **Review** toolbar (or **choose View > Instant Pruning** or press **Alt + L**).

Setting Up Rules for Instant Pruned View

You can set up rules to control the way instant pruning takes place. Setting up rules for Instant Pruning is similar to setting up rules for Automatic Clipping. However, the system keeps the two types of rules separate.

To set up rules for Instant Pruned view, open the study in Review mode and:

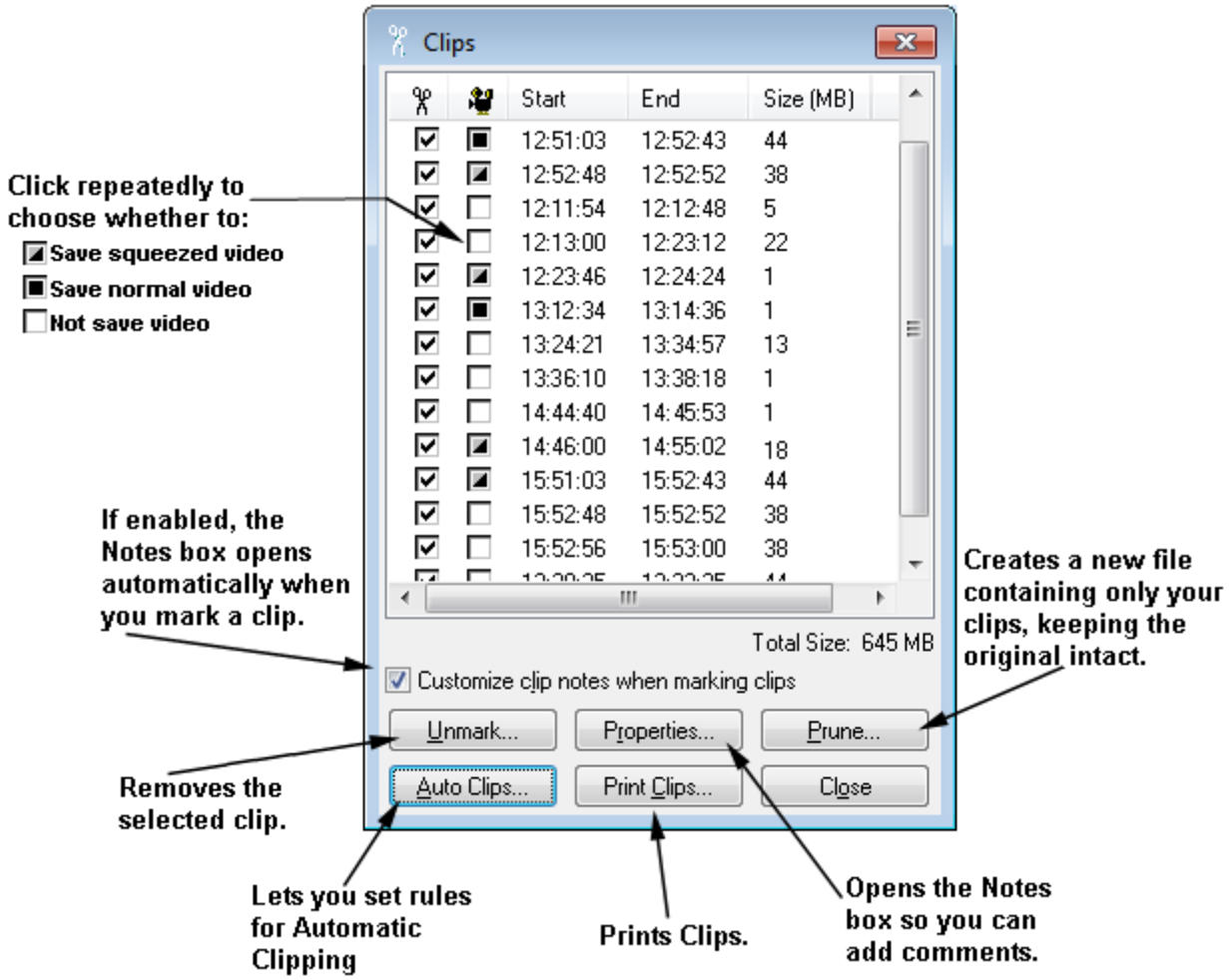
1. Open the **Instant Pruning** toolbar by clicking the **Instant Pruning** button.
2. Click **New Tab** button on the **Instant Pruning** toolbar. The **Instant Pruning Event Selection** dialog appears.
3. Follow the instructions above in **B) Clipping and Pruning a Study using Automated Clip Marking**.

Processing Clips in the Clips Box

Once you have selected clips from a study using one of the methods above, you must process them to create a new pruned study record.

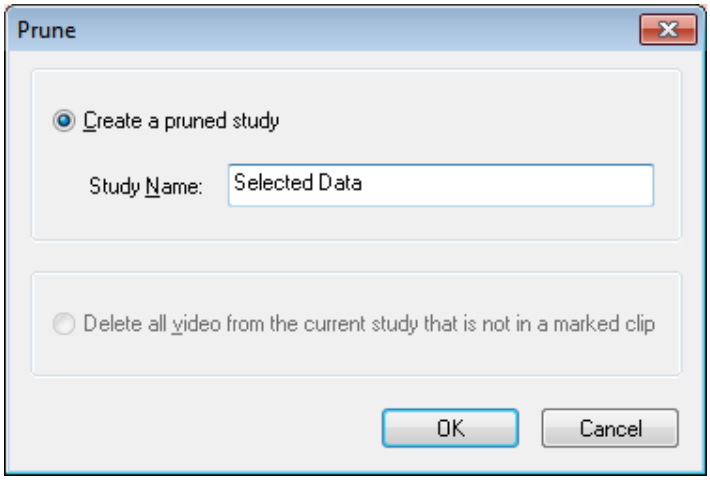
To process clips in the Clips box:

1. Click the **Edit Clips** button on the toolbar (or choose **Edit > Clips** or press **Ctrl + L**). The **Clips** dialog box appears.
2. Choose which clips you want to include with the study by clicking the checkbox under the **Clip** column.
3. Select whether or not include video for each clip. To include video, click the checkbox in the **Video** column.
4. You may also choose to squeeze video (reduce its quality and file size) when including it with a clip. This option is only enabled with the **Squeeze Video** option is selected in the **Edit > Settings > Review** tab in the NeuroWorks EEG Review window (only selectable when no studies are in Live mode). For information about squeezed video, see Editing Review Settings and Configuring Squeeze Recorded Video Options.
5. If the **Squeeze Video** option was selected in the **Edit > Settings > Review** tab, the checkbox in the **Video** column of the **Clips dialog** changes depending on the number of times you click it.
   - Click once to save the video normally.
   - Click again to save squeezed video.
   - Click one more time to not save the video.



Clips Dialog

6. When you have finished selecting clips, click the **Prune**  button in the Clips dialog or right-click and choose **Create Pruned Study**.
7. In the **Prune** dialog box that opens, enter a study name (to distinguish it from the original). By default, the name of the first clip in the study is inserted. Click **OK**.



Prune Dialog

8. A second study appears in the database that contains only the data in the marked clips. The clips are all merged. To see the pruned study listed in the database, return to the Natus Database. If the study does not appear immediately, click the **Refresh** toolbar button.

WARNING: Only **Create a pruned study** creates a second study in the database. **Delete all video** ... does not!

The pruned study is now added to the list of studies in the database and can be identified by a small **scissors** icon in the **folder** column on the left side of the database table. The original study file may be deleted.

NOTE: The pruned file and the original file have the same EEG# in the Natus Database. If you would like the pruned study to have a different number, click the **Info** button on the toolbar to open the **Patient Information** dialog box and type a new name into the EEG# text box. The new number for the pruned segment appears in the EEG# column of the Natus Database.

6.10 Reviewing Video and Audio

You can review video using the same procedures you use to review a study. When you first open a file for review, a **blue line** at the top of the **waveform window** indicates the portions of the study that have recorded video. Initially, the review screen is displayed without the video window.

To show or hide the video:

- Choose **View > Video**
- Choose **View > Toolbars > Video**
- Press **Ctrl + U.**

Video Screen Button Functions

Clipping and Pruning Video

Before archiving a study, you may need to discard unneeded video to reduce file size. For most studies, you will want to keep all waveform data but discard some or most of the video. Pruning creates a copy of the EEG and video sections that you specifically select, leaving the original file intact.

To edit video, use Natus Database to open the study in Review mode. Files with a video component have the **video camera** symbol next to their names.

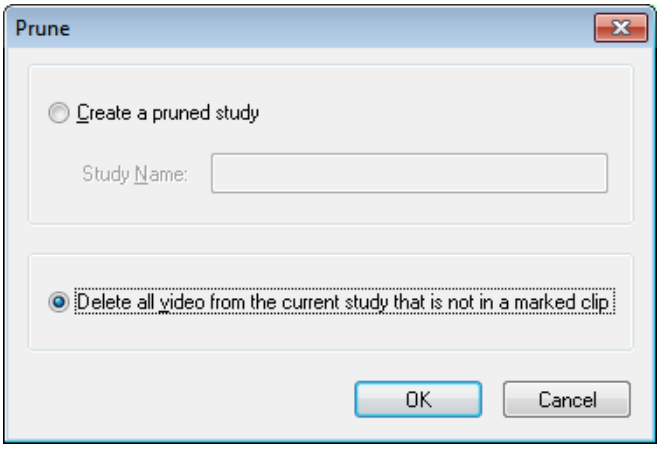
The Review screen will be displayed without video. At the top of the waveform window, there is a **blue line** along the portions of the study with recorded video. To view the recorded video, choose **View > Video (Ctrl + U).**

TIPS:

- Scrolling is quicker when the video is turned off.
- The video can be zoomed or resized as desired.

The procedure for editing a video study is identical to the procedure for clipping and pruning a study that does not contain video. See Processing Clips in Clips Box.

Note that in the **Prune** box, you may select the **Delete all video from the current study that is not in a marked clip**.



Prune Box – Delete All Video Selected

WARNING: The Delete Video action is PERMANENT! You will only retain the selected video clips with the complete EEG study.

The unneeded video has been deleted from the study. To see the new file size, go to Natus Database, click **Refresh**, and select the study. The smaller study size is reported in the Status bar.

6.11 Performing a Screen Capture

To perform a screen capture:

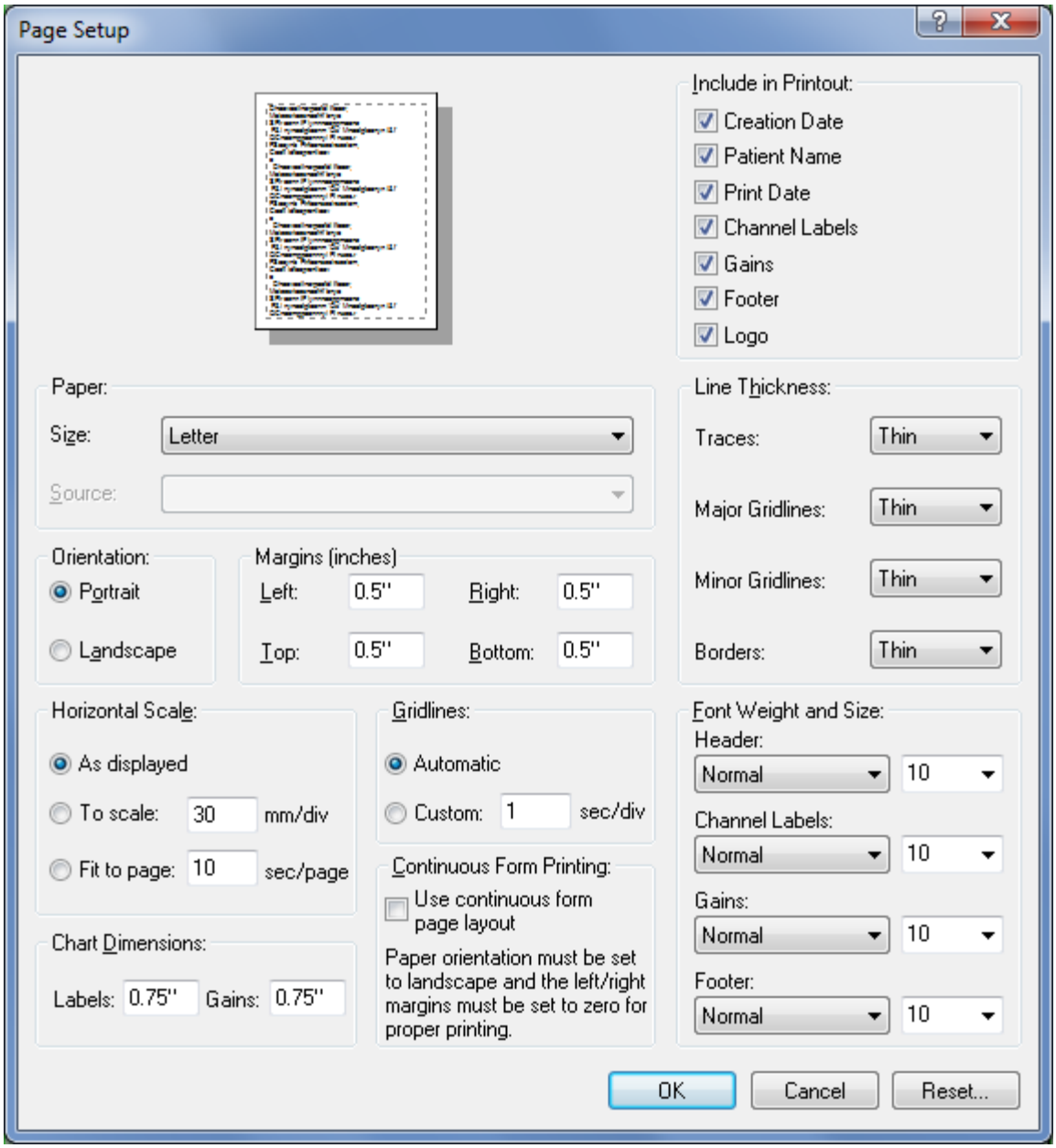
1. Navigate to the screen/page you want to capture.
2. Press the **Screen Capture**  button. The screen capture is stored in the clipboard.
3. Press **Shift + Ins** or **Ctrl + V** or **Right-click > Paste** to paste it into any container that supports **bitmap** images (for example, **Microsoft Word** or **Paint**).

6.12 Printing the Trace Window

You can choose which trace items will be printed, as well as customize the thickness of the lines and the font weights and sizes.

To select which trace items to print:

1. Choose **File > Page Setup**. The **Page Setup** dialog opens.



Page Setup Box

2. Select printing options and click **OK**.

To print the Trace window:

1. Navigate to the place in the Trace window that you want to print.
2. Choose **File > Print**.

6.13 Closing a Study

Once a study has been reviewed, you can save your notes and changes and close the file. To close a file, click the **Close** button that is located in the upper-right corner of the NeuroWorks window or choose **File > Close**.

WARNING: The changes you make while reviewing a study are not saved unless the file is closed properly. To save changes, you MUST click **Yes** when the message box appears asking if you want to save your changes.

Default Report Boxes

- By default, the **Physician's Report** dialog box appears automatically when you close a record you have just reviewed.
- By default, the **Technologist's Report** appears automatically when you close a record after it is initially recorded.
- If you do not want to be automatically prompted for reports, choose **File > Customize > Options** and clear the check box next to **Automatically prompt report forms**.

Closing Procedure

To close a study:

1. Click the **Close** button. If the **Physician's Report** box does not automatically appear, click the **Physician's Report** tab to bring it forward.
2. Type the reviewer's name in the **Reviewer box**.
3. Click **Mark as Reviewed** to enter the reviewer's name and the date of review.
4. Add relevant information to any of the tabbed pages at the bottom of the **Physician's Report** dialog box
5. Click **OK** to close and save the study.
6. A message box appears asking if you want to save your changes. Click **Yes**.

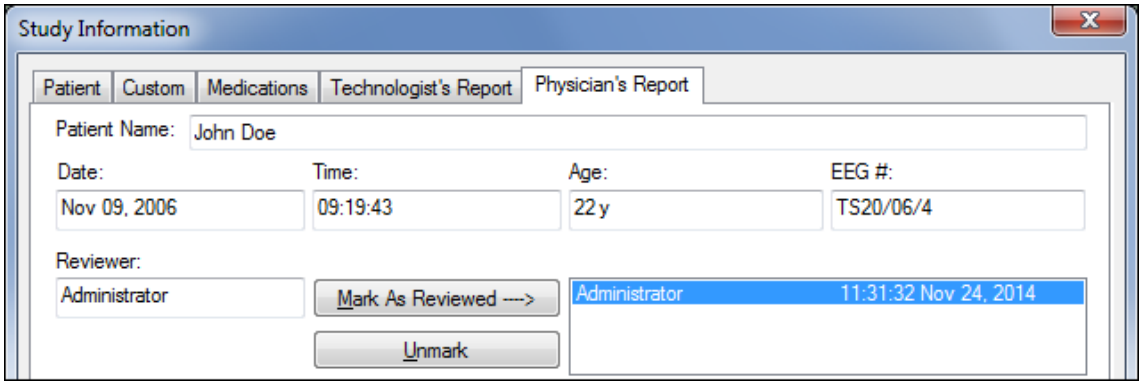
TIP: If the Technologist's Report does not appear when you close a study then choose **File > Customize > Options** and select **Automatically prompt report forms**.

6.14 Marking and Unmarking a Study as Reviewed

To mark or unmark a study as reviewed:

1. Open the Study Information box by choosing **Edit > Study Information** in NeuroWorks or clicking the **Info** button in the Natus Database.
2. Click the Physician's Report tab.
3. Enter a name in the **Reviewer** box and click **Mark as Reviewed**.

8. OR
4. Select the existing reviewer's name and review date and click **Unmark**.
5. Click **OK**.



Physician's Report Tab (detail)

NOTE: When a study is marked as reviewed, a check mark appears beside it in the **Reviewed** ☑ column in the Natus Database. When a study is unmarked as reviewed, the check mark is removed.

6.15 Adding Comments to Report Tabs

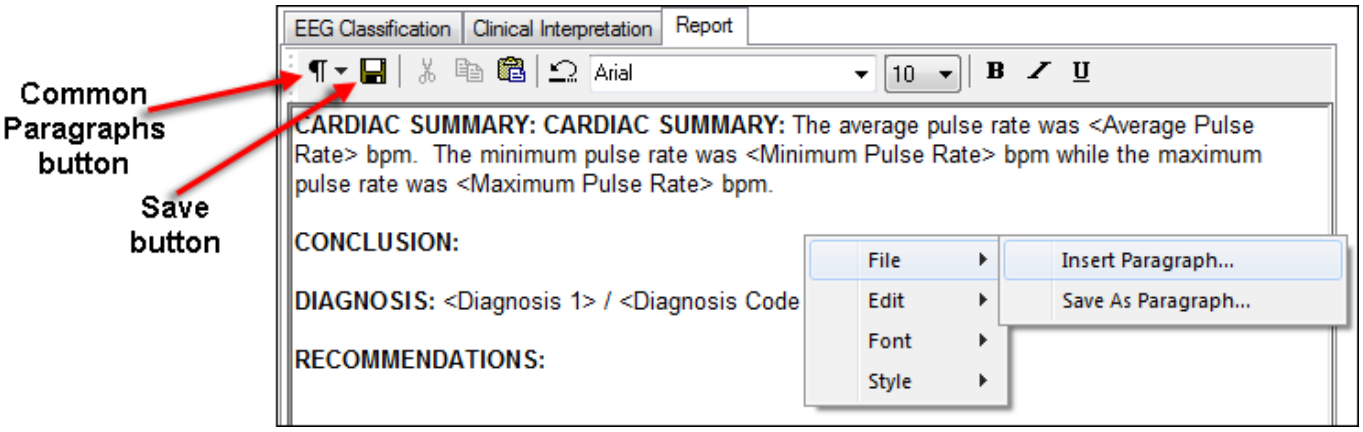
Comments may be typed into the **Study Information** form by selecting any **Report tab** and clicking in the text space area to situate your cursor. Each tab includes a formatting toolbar which can be used to format your text style such as font type and size. **Right-clicking** anywhere in the text space, will also display a formatting menu. In addition to typing in comments unique to the study record, a user is able to save for example, commonly used text statements or “common paragraphs” for quick retrieval and insertion into other study records. Common paragraphs may also contain report tags or fields normally available for use in the report template editor.

To save a common paragraph:

1. Type your comments in the text space of a **Report** tab.
2. To insert a report tag/field, type out the exact syntax of a report tag you want to use (from the **Natus Report Fields** list in the **Report Editor**) remembering to include the angle brackets <>.
3. Highlight your comments and click on the Save button in the formatting toolbar. Save your statement using a unique file name as an RTF (rich text format) file type.

To retrieve and insert a common paragraph:

1. Situate your cursor in a **Report** tab where you want to insert a common paragraph.
2. Click on the **Common Paragraphs** button to display a list of your saved comments and left-click on the common paragraph name (file name) to select and insert your comments into the report tab.



Physician's Report Tab in Study Information Dialog

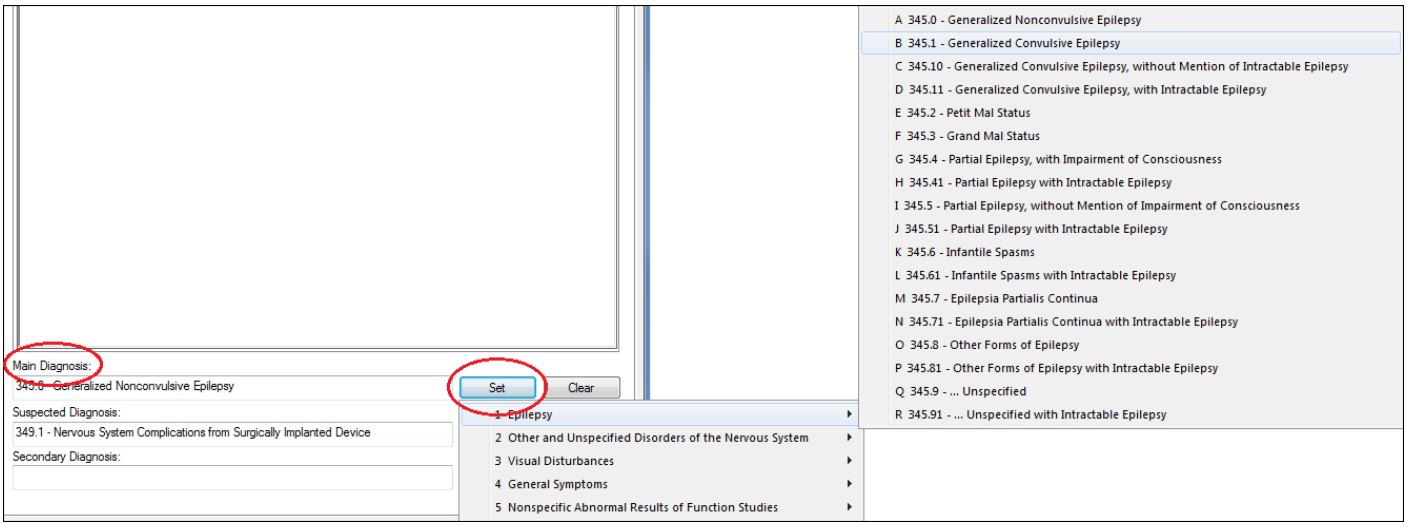
6.16 Adding Diagnosis Codes

A qualified user can use the **Diagnosis Code** fields to input up to three diagnosis codes on the **Physician's Report** tab in the **Study Information** dialog. These code input selections are stored in the database (unless deleted by the user) and can be added to a study report.

To specify diagnosis codes:

1. Open the **Study Information** box by choosing **Edit > Study Information** in NeuroWorks or clicking the **Info** 

button in the Natus Database.
2. Click the Physician's Report tab.
3. Click **Set** to display a list of codes.



Diagnosis Codes

4. Select a code and click **OK.**

6.17 Batch Analyzer

Using the Batch Analyzer

The Batch Analyzer is used to set up an analyzer to run after a study is completed. It allows you to:

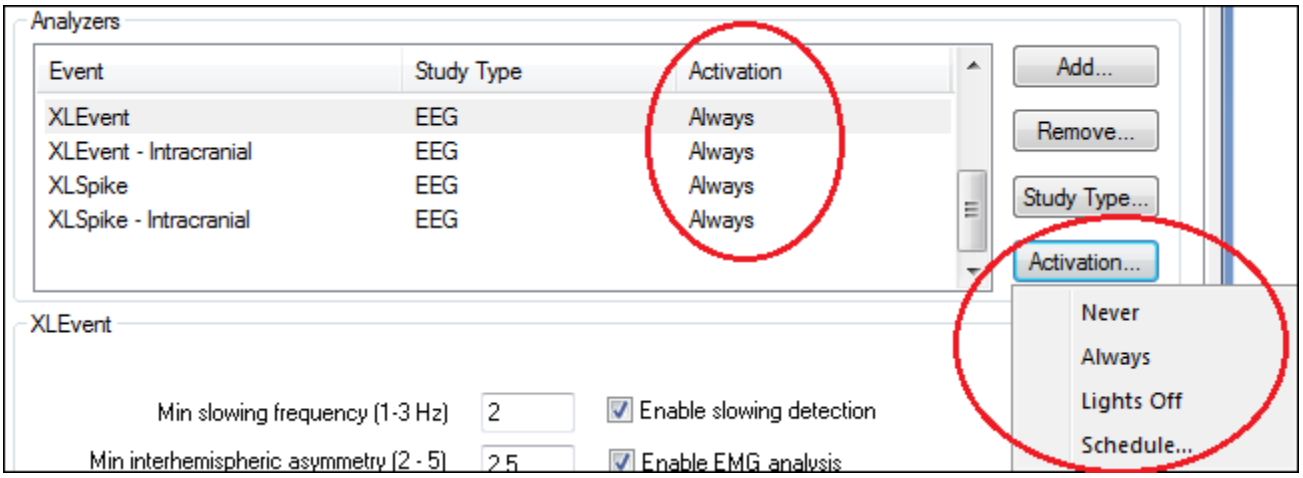
- Select which analyzers you want to run.
- Avoid duplication - automated detections are suppressed if there is a manual event marked in the same spot or close by.
- Display the percentage drop in desaturation events. Oxygen desaturation events detected by the analyzer display in the event comments.

Use the Batch Analyzer to analyze files offline or after an upload. Notes generated by the Batch Analyzer are visible in the waveform window and in the **Annotation Viewer** when the study is opened for Review after being analyzed.

To use the Batch Analyzer:

1. Select one or more studies in the Natus Database.
2. Choose **Tools > Options > Analysis (tab)** to see which (if any) analyzers have been added and what their **Activation** settings are.

NOTE: If you run the batch analyzer and your intended analyzers are set to the Activation option Never, the batch analyzer will not run those analyses on the submitted studies at all.



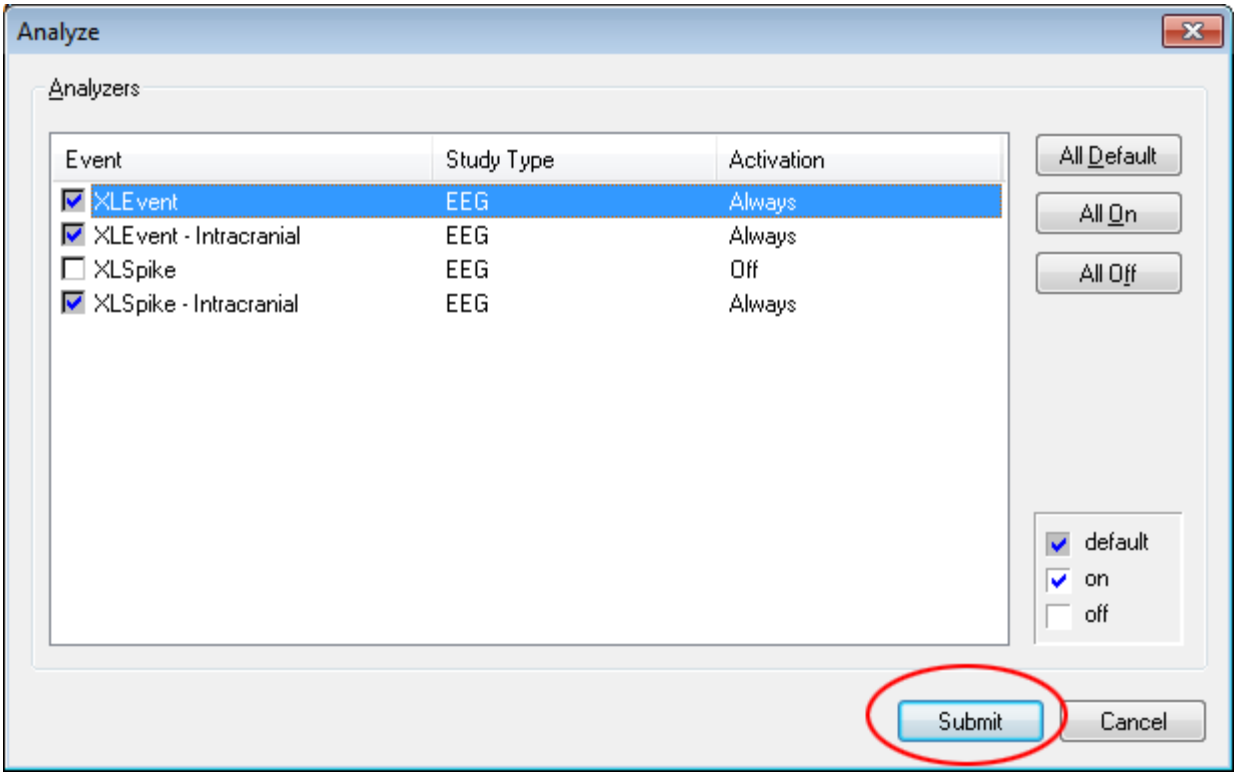
Activation Options Displayed on Analysis Tab

3. To choose the montage for the batch analysis, select the headbox type in the **Montage** pane. Then set the montage by right-clicking in the **Analysis Montage** column, or clicking the **Montage** 

button, and choosing from the montages listed. Click **OK**.

4. Click the **Analyze** 

button, or right-click and choose **Submit for Analysis**.
5. Choose which event analyzers you want to run and click **Submit**.



Batch Analyzer Dialog in Natus Database

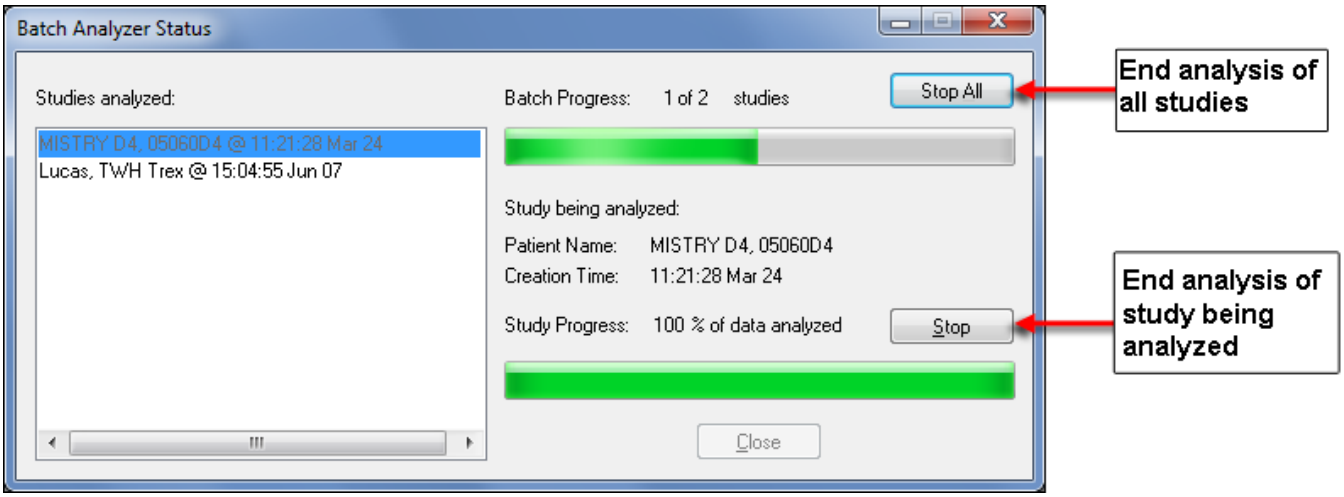
WARNINGS:

- Do not submit any study for batch analysis that is currently open in a Natus program. Batch analysis will fail to start and an error message will appear.
- Once a study is submitted for batch analysis, do not attempt to open it in a Natus program for review before the analysis is complete. Batch analysis will fail with an error message.

You can submit additional studies after the analysis begins. The **Batch Analysis Submission** window appears briefly to acknowledge the addition of the studies to the analysis queue, and the batch analysis progress bar adjusts accordingly.

If you submit multiple studies for analysis, you can stop analysis for one study or all studies at any time.

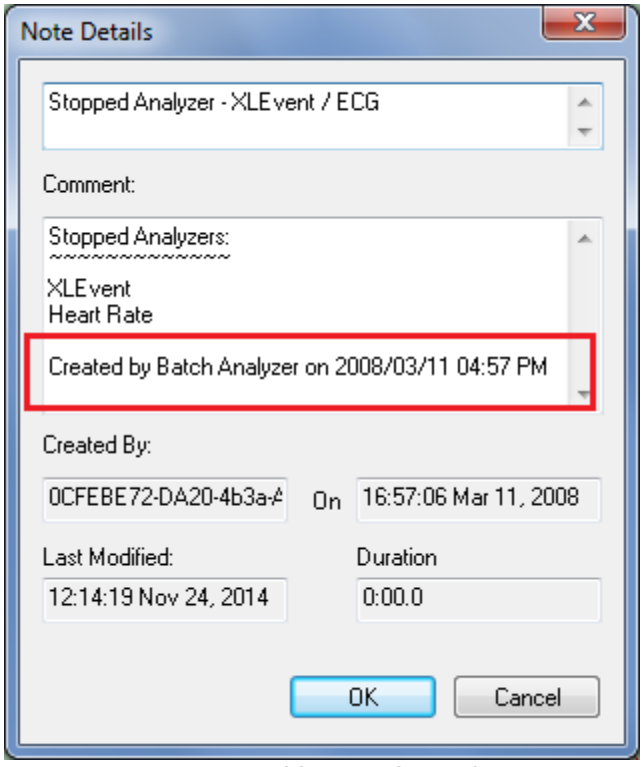
NOTE: If more studies are selected for a batch run, each study (if recorded with a different headbox) needs to have the correctly assigned montage.



Batch Analysis Status Display

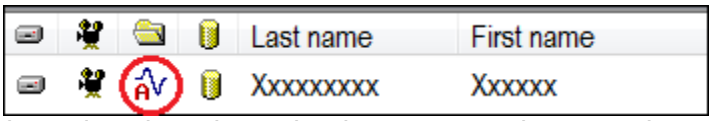
Note the following:

- At the beginning of the analysis for each study, the current settings are used.
- The Batch Analyzer deletes notes from a previous Batch analysis before performing a new analysis; however, the results from an analysis performed during acquisition are retained.
- When you double-click a note in the waveform window, the Note box appears. In the Note box, notes generated by the Batch Analyzer are appended with the text **Created by Batch Analysis** run on <time analysis started> in the **Comment** window. This enables you to distinguish between notes entered personally and those created by the Batch Analyzer.



Note Created by Batch Analyzer

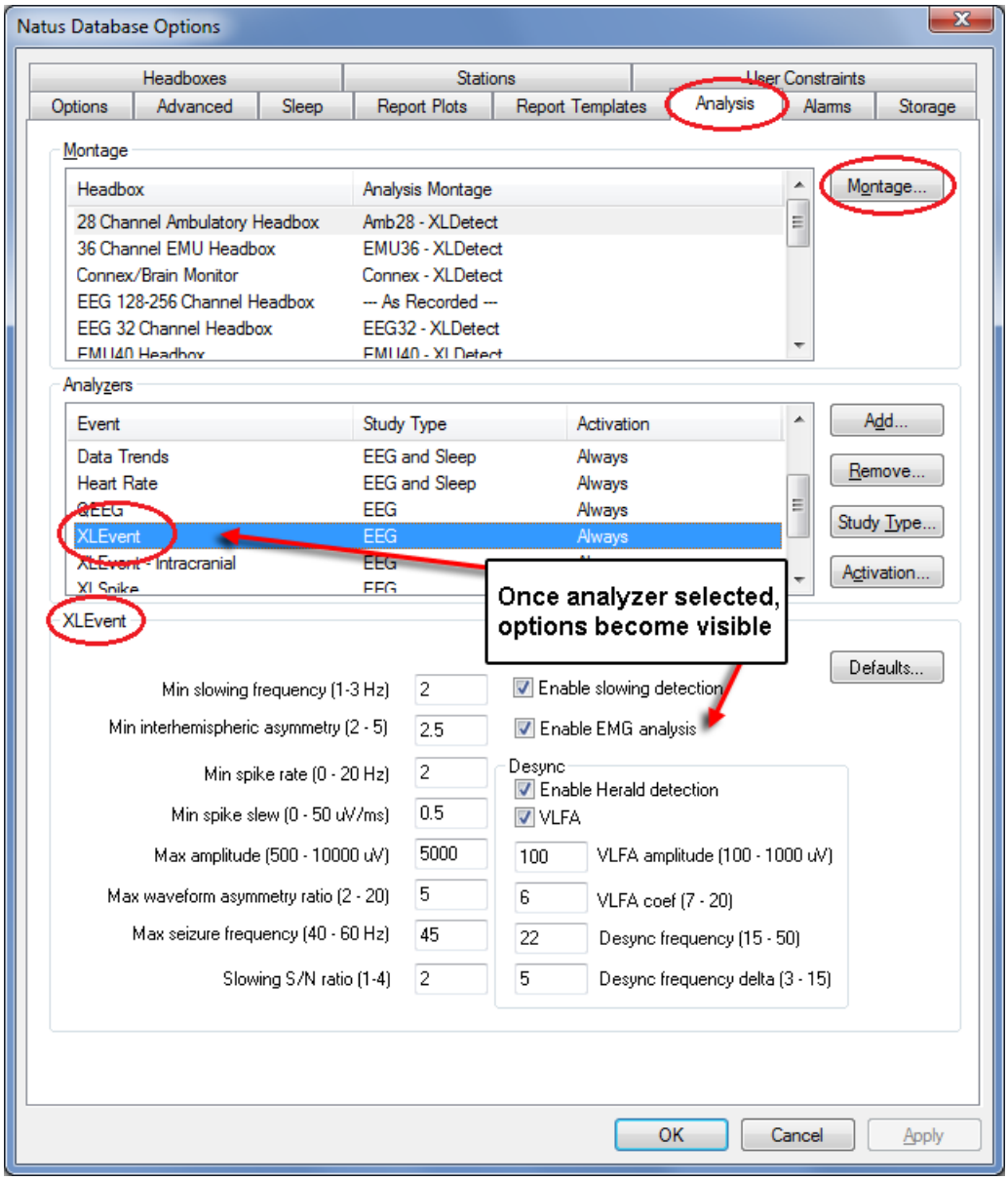
NOTE: The **Batch Analyzed Study** Marker in the Study Contents column of the database indicated studies that have been Batch Analyzed.



Batch Analyzed Study Marker in Natus Database Study Record

Detector Settings for Batch Analyzer

The detector uses the settings that were in effect at the time of study submission. All detector settings are controlled on the Natus Database **Analysis** tab (**Edit > Settings > Analysis tab**).



Analysis Tab

Montages Used by the Batch Analyzer

- If **Analysis Montage** is set to **As Recorded** on the **Analysis** tab of the **Edit Settings** box, then the montage applied while recording the study is tracked and used for the analysis.
- If the montage is set to a specific montage, then this montage is used for analysis.

6.18 Integration with MagicMarker

NeuroWorks is fully integrated with the **MagicMarker**[1] application from Persyst Corporation and now runs in a built-in synchronized frame (side-by-side with the trace EEG view) rather than as a separate application. This enables easier access to MagicMarker analysis tools.

The MagicMarker application from Persyst Corp. allows trending of virtually any EEG parameter with advanced analysis instruments to see where changes occur. The MagicMarker application can be launched directly from NeuroWorks.

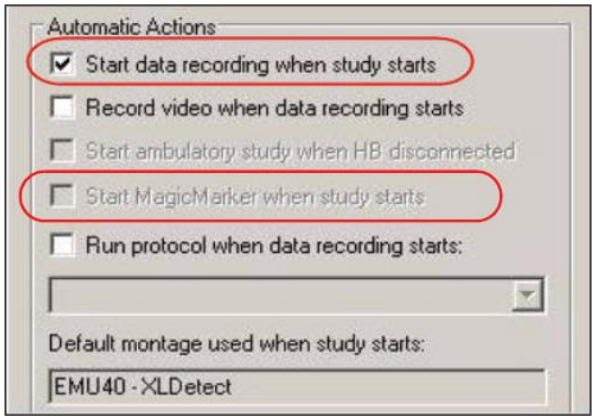
NOTE: For more information about MagicMarker please visit www.persyst.com. NeuroWorks 8 is compatible with Persyst 11, or builds dated after 2011.11.22.

MagicMarker trends and spike and seizure detectors (Reveal™ Rosetta) can be viewed in the NeuroWorks EEG application during Acquisition and Review modes.

If you have **MagicMarker** installed, it will be available in Review mode. Choose **View > Toolbars > MagicMarker** OR right-click with the mouse pointer on a toolbar area and select the **MagicMarker** option.

You can also run MagicMarker automatically in Acquisition mode as follows:

1. Choose **Edit > Settings > Acquisition** on the Acquisition tab below Automatic Actions.
2. Select the **Start MagicMarker when study starts option** (by default, this option is not selected).



Enabling MagicMarker in Acquisition using Edit Settings Dialog

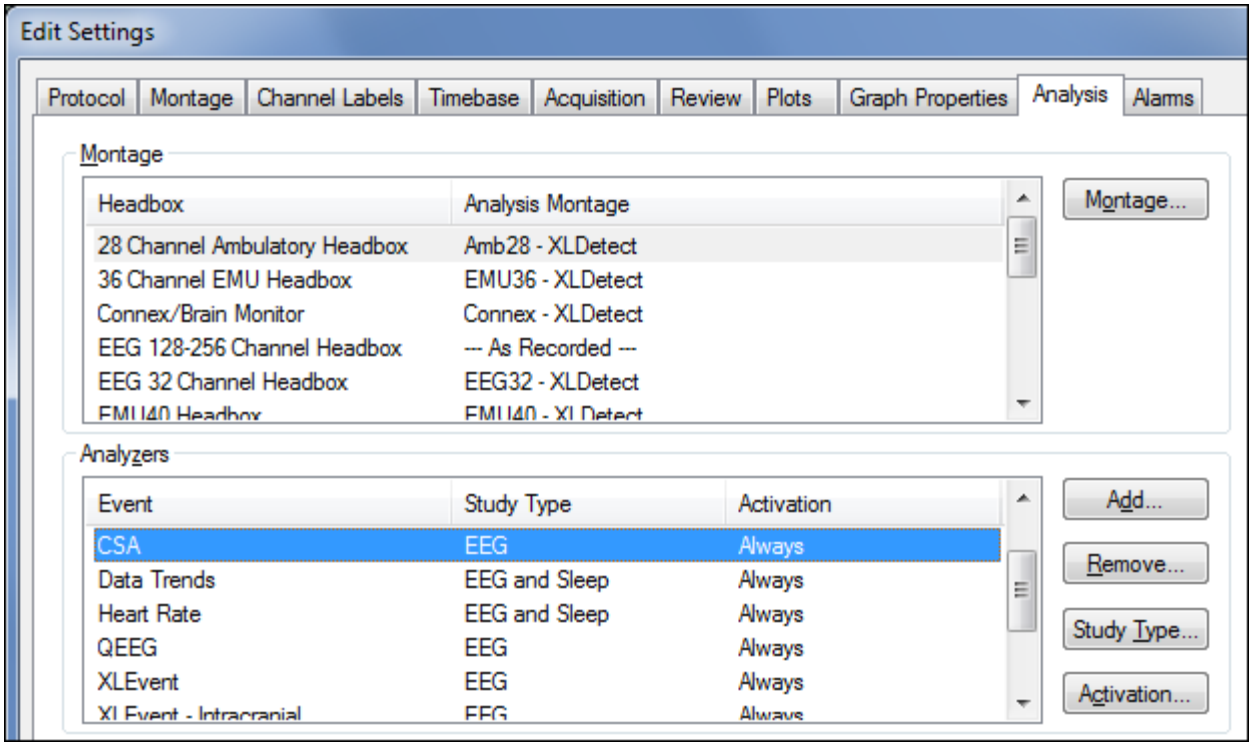
[1] *MagicMarker is not available in all markets*

NOTE: During live acquisition, MagicMarker trends are only available after the study recording has been started.

Adding MagicMarker Trends to Review a Study

To generate MagicMarker trends, you need to install the Persyst EEG suite and add the **Persyst** analyzer to the running list of analyzers. This allows the MagicMarker trend to be generated and EEG event detection (Reveal) to be active during acquisition.

TIP: Separating analysis and trends generation on one side and the trends graphical display on the other side promotes system stability.



Analysis Tab in Edit Settings Dialog

MagicMarker Bedside

MagicMarker Bedside allows quick access to Adaptive Artifact Reject (AAR), EEG Asymmetry Index (EASI) and other advanced features offered by Persyst. It is available in Acquisition and Review modes.

The MagicMarker toolbar can be added in NeuroWorks EEG by selecting **View > Toolbars > MagicMarker** or by right clicking on any toolbar and selecting MagicMarker.

7. Using Analyzers to Review a Study

7.1 Types of Analyzers Available with NeuroWorks

NeuroWorks offers several types of analyzers to help users review studies. These are available as separate options that must be purchased and added to your system:

- Compressed Spectrum Array (CSA)
- Quantitative EEG (qEEG) – a Natus package that includes amplitude integrated EEG (aEEG), CSA, and power and frequency trending
- Spike Detectors (XLSpike, Stellate Gotman ICTA-S, Persyst)
- Event Detectors (XLEvent, Stellate Gotman ICTA-S, Persyst)
- Event Detectors for Depth/Grid (Stellate Gotman ICTA-D)

CSA and qEEG analyzers identify trends in the EEG.

Spike and Event detectors highlight particular events in the EEG. These automatic detectors help users to efficiently process large amounts of EEG data using different detection algorithms. A detector takes as input EEG signal and outputs detected events, by marking them on the traces. You can use a combination of multiple detectors during a live study (online) or during review (offline).

If used online, specified detectors are activated automatically once the data is being recorded. They can also be enabled and disabled manually during data acquisition

If used offline, you may submit one or more studies for analysis directly from the Natus Database by specifying which detectors are to be used. Each detector can be configured with its own configuration UI interface.

7.2 Installing Optional Analyzers

NeuroWorks analyzers are available as **Option Pack** add-ons. Your system is activated with all add-ons purchased during your initial order. If you are re-installing or upgrading your software, the same add-ons can be activated during installation.

If you wish to add additional analyzers, please contact your Natus representative to place your order. A new **Option pack serial number** will be provided to you.

For information on installing and activating add-ons, see the topic Installing Add-ons.

Persyst analyzers, when purchased with a new order, are installed and activated on your shipped system. Persyst analyzers are available for purchase through Natus if you wish to add them later. For assistance on installing and activating Persyst analyzers to your existing system, please contact **Persyst** at support@persyst.com.

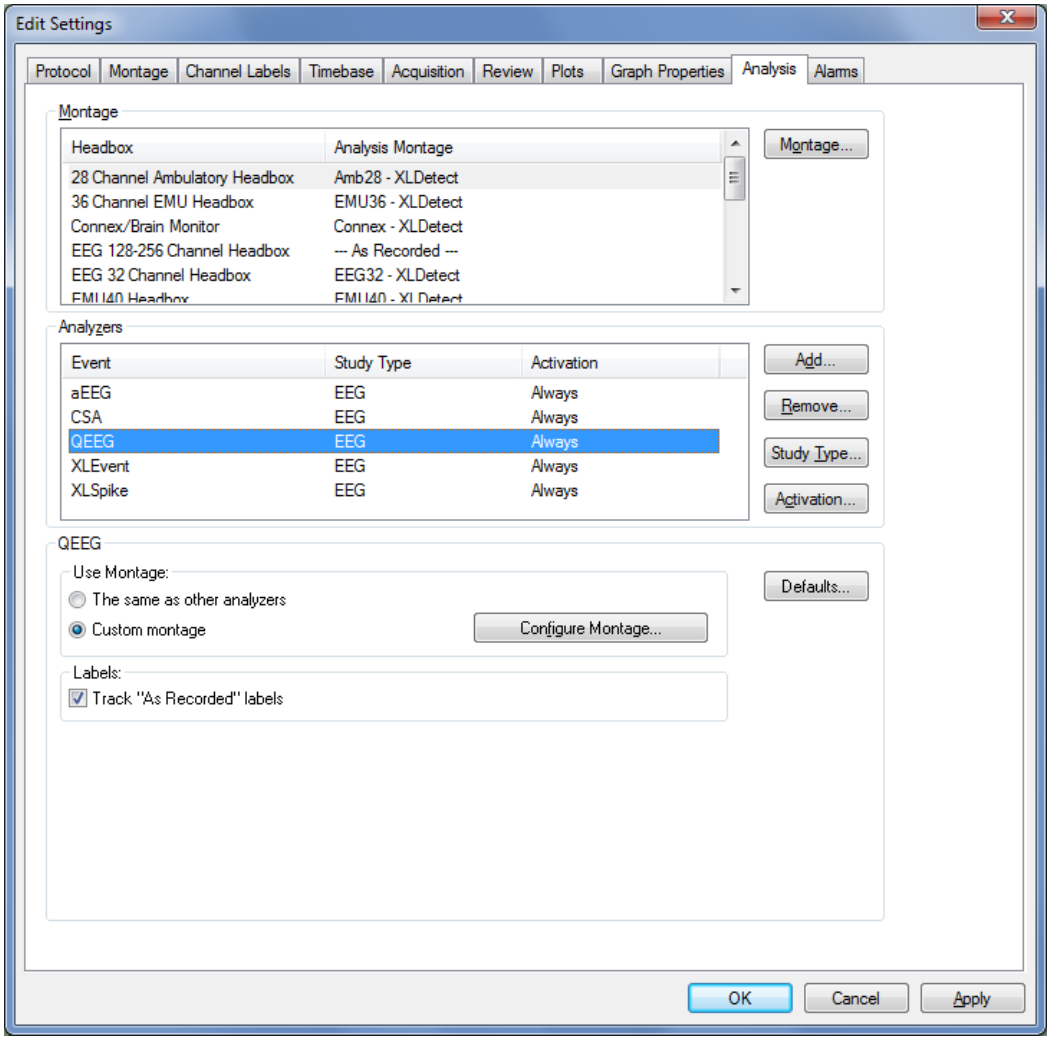
7.3 Using Analyzers

Analyzers can be initiated during study acquisition. They can also be disabled during acquisition and run manually by submitting a completed study for analysis.

Configuring Analyzers to Run During Acquisition

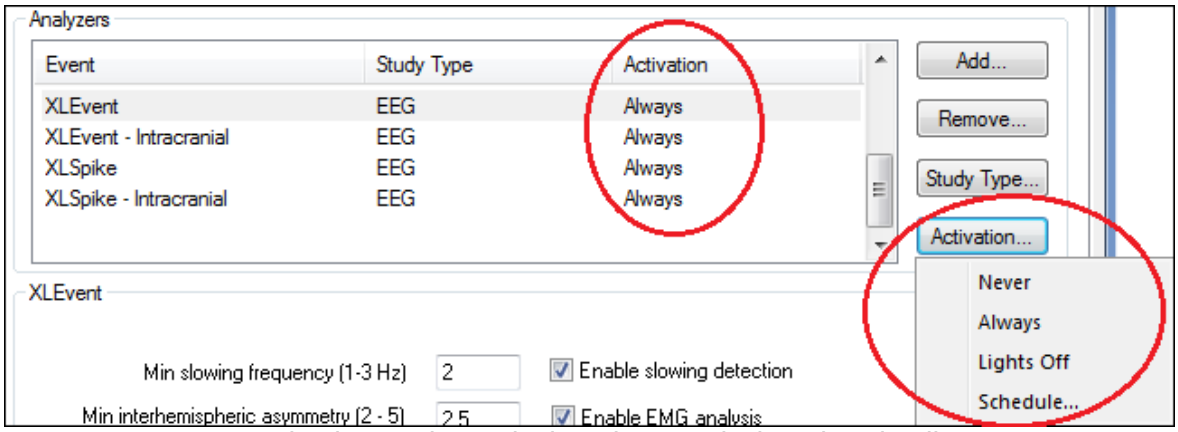
To configure analyzers to run during acquisition:

1. Open Natus Database and click **Tools > Options > Analysis** (tab). You can also access the Analysis tab in NeuroWorks EEG by choosing **Edit > Settings > Analysis** (tab).



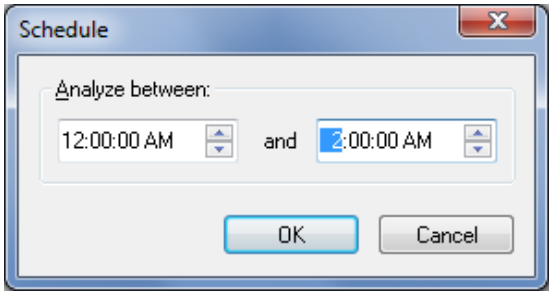
Analysis Tab

2. Click **Add** to add an analyzer that is available but not visible on the Analysis tab.
3. Once you have added a detection type, you can set its **Activation** option. This can be done two ways:
    a. Right-click in the Activation column.
    b. Click the **Activation** button.



Activation Options Displayed on Analysis Tab – detail

Spike and Event Actions

To...	Do this...
Manually start analysis by selecting detection options from the **Analysis** menu in **NeuroWorks** (for example, **Analysis > XLSpike** or **XLEvent**).	Select **Never**.
Start detection immediately once the study begins recording and/or use the **Batch Analyzer** to analyze studies offline (the **Natus Database > Tools > Submit for Analysis**).	Select **Always**.
Schedule detection and/or use the Batch Analyzer to analyze studies offline (the **Natus Database > Tools > Submit for Analysis**).	1. Select **Schedule**. The Schedule box appears. 2. Set times by clicking and entering values or using the up and down arrows. 3. When finished, click **OK**. 

4. Select and click the analyzer to select other properties available for configuration.

Displaying Trends during Live Monitoring

Analyzers and trends can be displayed during live monitoring. When the monitoring window is opened it shows the history of trends up to the point of opening the monitoring session and will keep updating it at the edge as long as the data is recorded.

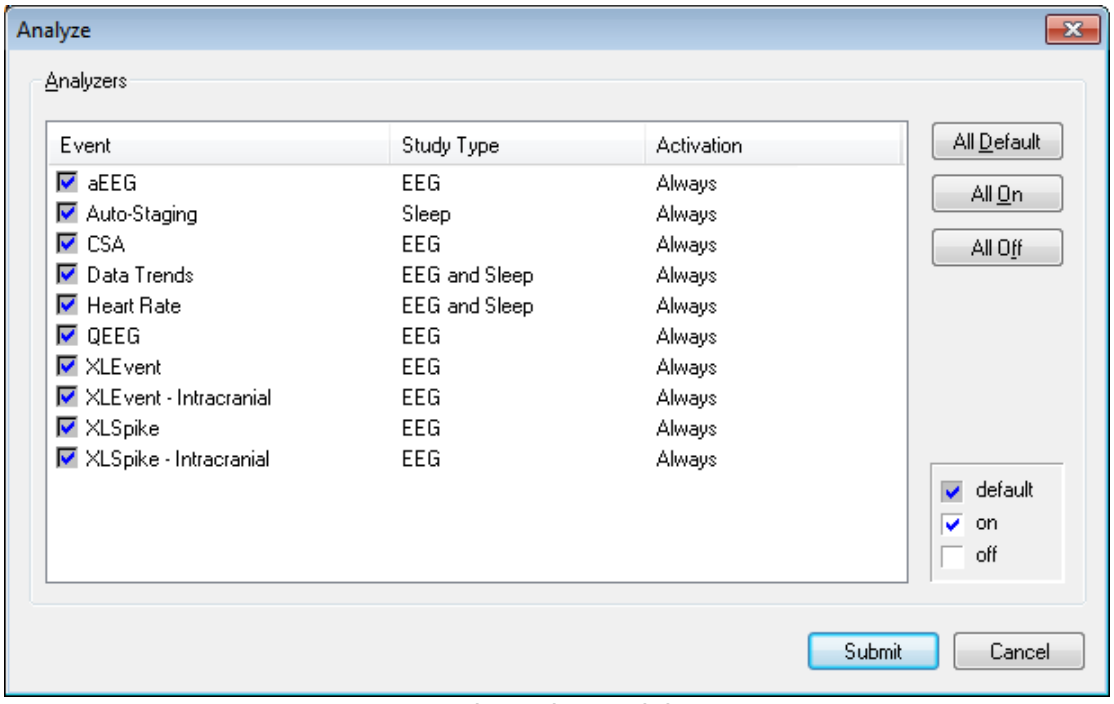
Ability to see the history (portion of trends collected while monitoring session was not yet open) may depend on having working file connectivity to the recording storage resource where the study resides. This cannot be guaranteed during monitoring (which generally relies on pure TCP connection) but will work on a correctly configured system with file sharing enabled.

Configuring Analyzers to Run Manually after Acquisition

To submit a study for analysis after the study has been acquired, ensure that the desired analyzers have been added to the **Analysis** tab. Before you can submit a study for analysis, the study must first be **closed** and not open for review on any computer.

1. In Natus Database, left-click to select and highlight the study (or multiple studies).
2. Click the **Analyze** 

button in the toolbar to open the **Analyze** dialog.



Batch Analyzer Dialog

3. The **Analyze** dialog only display analyzers which are in display in the **Analyzer** tab (**Tools > Options > Analysis**). If these analyzers were run during study acquisition or previous Batch analysis their output will be preserved.
4. Press **Submit** to send the selected study for **Batch analysis**.

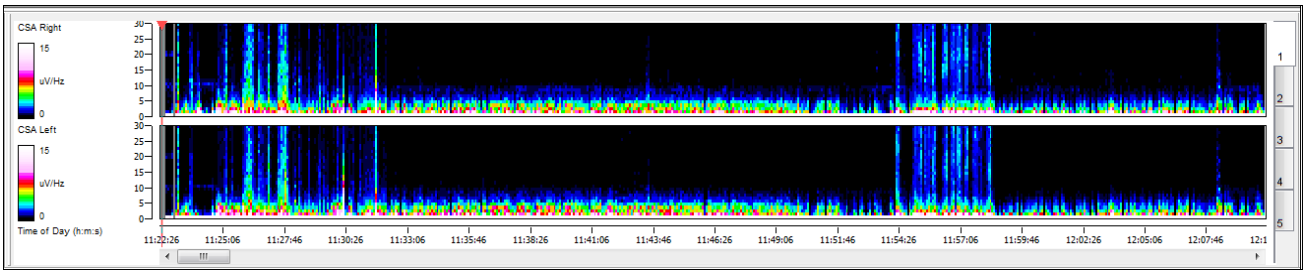
5. After analysis is completed the study can be open for Review to see the newly created trend data.

See also: Batch Analyzer

7.4 Compressed Spectrum Array (CSA)

CSA is a widely used graphical depiction of EEG data obtained from Fourier analysis. NeuroWorks can display acquired EEG waveforms in CSA view to help the qualified medical practitioner quickly navigate long EEG recordings and identify events of interest that would require close inspection of the corresponding raw EEG data.

The CSA plot appears in the Trend Summary tool. Each vertical slice of the CSA view represents a spectrum of a small time window. Different colors represent different power, the X axis represents time and the Y axis represents frequency. Two spectral channels are created for the left and right hemispheres.



CSA Analyzer in Trend Summary

Selecting a Montage for the CSA Analyzer

By default, the NeuroWorks CSA analyzer uses the following channels for CSA analysis and display:

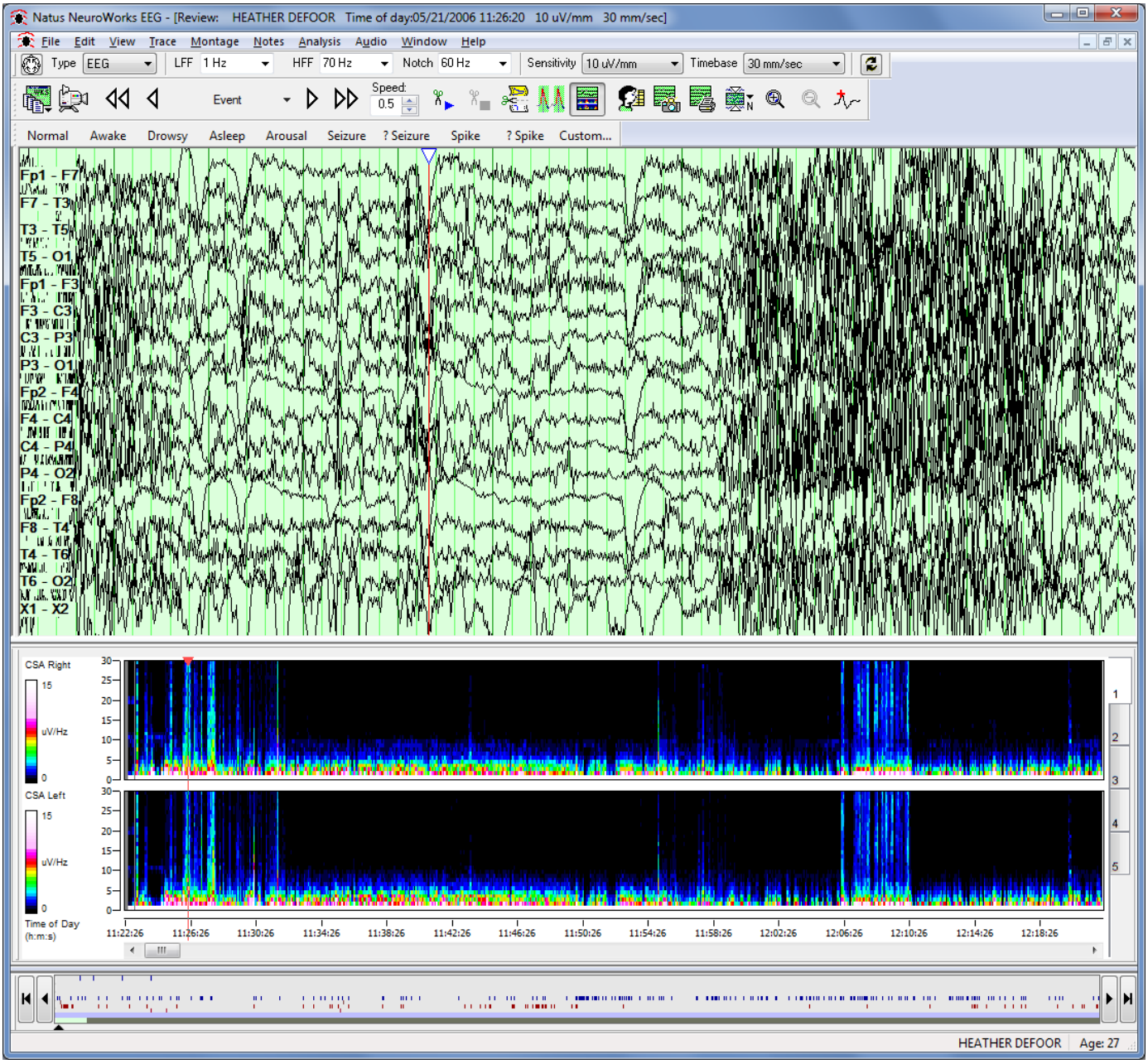
Channel Pairings

LEFT Hemisphere	RIGHT Hemisphere
F7-T3	F8-T4
T3-T5	T4-T6
F3-C3	F4-C4
C3-P3	C4-P4

Qualified users can change the montage channels used for CSA analysis using the Configure Montage option.

About the CSA Display Screen

The CSA analyzer creates two CSA traces, as shown in the picture below. The first trace shows CSA for the channels of the left hemisphere and the second trace shows CSA for the channels of the right hemisphere.



CSA Display Screen

The plot is scaled to display a one hour window around the current point in the trace view. A marker indicates current review position in the study. The position of this marker is kept in sync

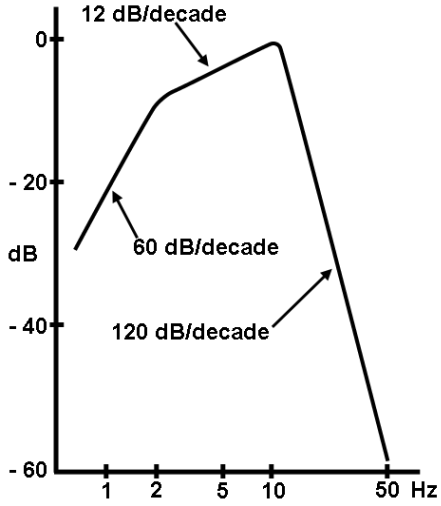
with the current position in the trace view. This allows the reviewer to quickly jump to the point of interest. Resolution of XLTEK CSA implementation is quite high - 5 seconds in the time domain, 1-2 Hz in the frequency domain and only microvolts/Hz in signal power.

7.5 aEEG

The aEEG analyzer provides a long-term compressed graphical view of processed EEG data, usually from one or two EEG channels. The trend shows the amplitude variations in the EEG.

The aEEG method is based on a time-compressed semilogarithmic (linear 0 to10 µV, logarithmic 10 to 100 µV) display of the peak-to-peak amplitude values of a filtered and rectified EEG. The EEG is passed through an asymmetric band pass filter that strongly enhances intermediate EEG frequencies. Most EEG activity below 2 Hz and above 15 Hz is suppressed. It is possible to display aEEG using any time scale -- 30 seconds per screen up to 24 hours per screen or up to whole study. Left and right hemisphere aEEG trends can be displayed separately.

The specification of the aEEG filter implemented in NeuroWorks is shown below:



aEEG Filter Specifications as Used in NeuroWorks

Selecting a Montage for the aEEG Analyzer

By default, NeuroWorks will use two EEG channels for aEEG analysis:

- C3-P3
- C4-P4

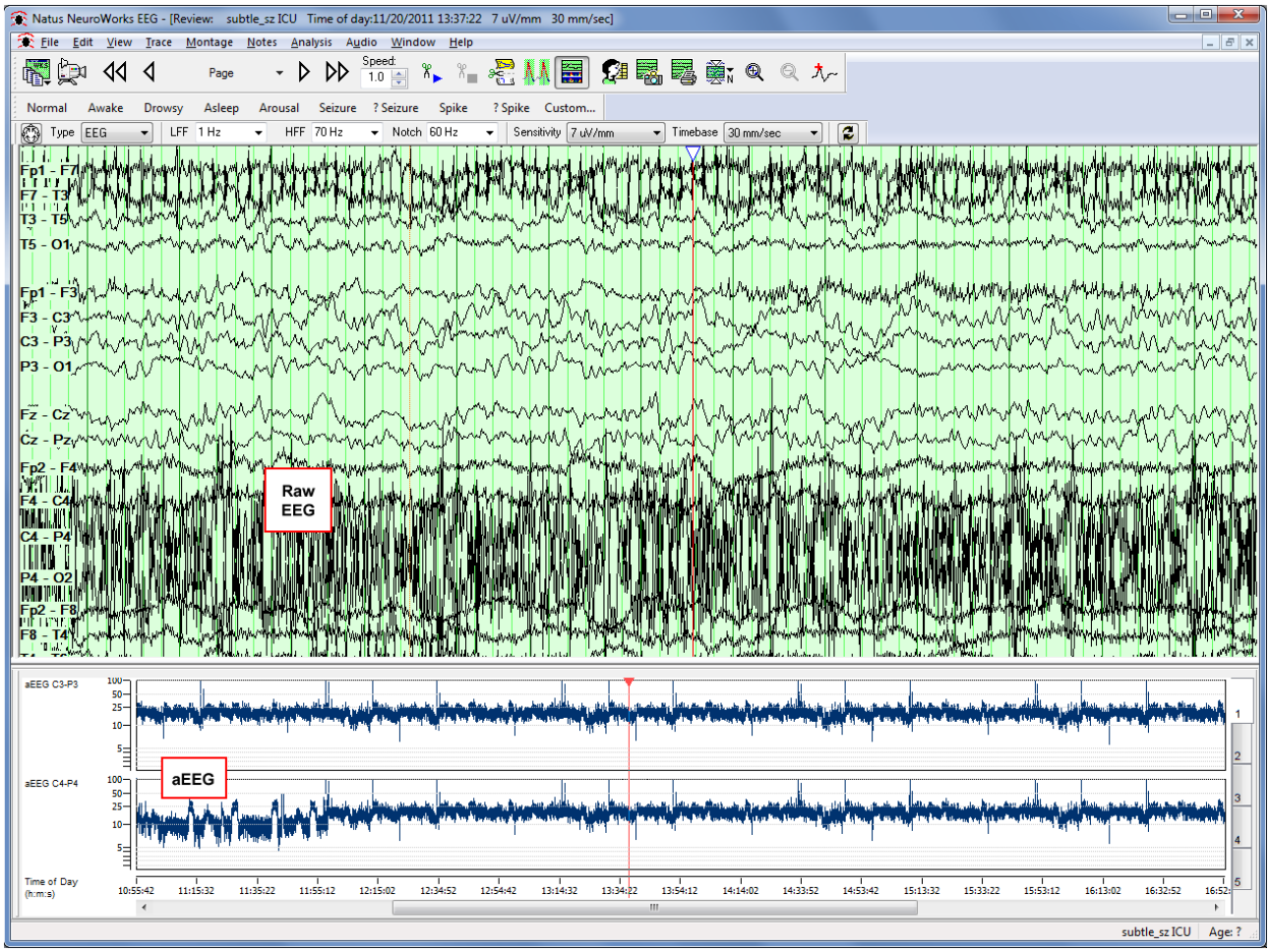
A software configuration tool is available to allow qualified users to change montage channels used for aEEG analysis. For example, users can generate aEEG for the P3-P4 montage channel (widely used in clinical practice).

WARNING: No specific clinical value for aEEG derived from any channel except P3-P4 has been demonstrated for any disease states or conditions.

NOTE: NeuroWorks DOES NOT include any automatic marking functionality that interacts with the aEEG analyzer.

About the aEEG Display Screen

- The NeuroWorks EEG screen can display data at less than 1 second per screen up to several hours per screen. The standard setting is 1 sec of EEG per 3 cm.
- The EEG amplitude scale ranges from 1 microVolt per cm to 50000 microVolts per cm.
- Users can move one or more EEG screens forward and backward.
- The NeuroWorks screen contains a navigation toolbar and menu. Users can scroll by page or by user-defined markers.
- Raw EEG data, from which the aEEG is derived, is available at all times.
- An aEEG graph in NeuroWorks shows the name of the channel used to create the aEEG trace, as shown in the picture below.



aEEG Trace

To choose whether to display a time range or the whole study:

- Right-click on the aEEG trace.
- Select either Show Time Range (1500s) OR Show Whole Study.

If you chose **Show Time Range (1500s)** above, continue with these steps to choose the number of seconds in the range:

- Right-click on the aEEG trace.
- Select Set Time Range.
- When the **Set Time Range** dialog box appears, enter the number of seconds to be displayed.

Setting a Time Range

7.6 Absolute and Relative Power in Spectrum Bands

Power spectrum is analyzed with the optional Quantitative EEG (qEEG). The spectrum bands may be analyzed during a live study or during review. Position in the spectrum power view is synchronized to the position in the EEG trace view and other views (i.e. annotation viewer, study bar).

Spectrum analysis plots may be added when reviewing study without a need to re-analyze. The configuration of spectrum display is persistent and can be distributed to other machines on the network using XLSync (Centralized Settings Caching).

The power spectrum analyzer generates data and displays power in various pre-defined spectrum bands (α, δ, etc.) on a line and area plots. Multiple plots for different bands can be generated displayed simultaneously. You can also analyze spectrum content of a specific area of the brain. The following areas are configured “out of the box”, but it is possible to configure additional location areas (“channel sets”). The default channel sets are:

- Left
- Right
- Posterior
- Anterior
- Left anterior
- Left posterior
- Right anterior
- Right posterior

Following frequency bands are provided “out of the box”:

- Alpha (8-13 Hz)
- Beta (14-30 Hz)
- Delta (1-4 Hz)
- Fast (8-30 Hz) – Alpha + Beta
- Total (1-30 Hz)

Additional frequency bands can be designated, and multiple line or area plots in the same set of axis can be configured. In this case the line plots are always displayed on top of the area plots.

7.7 Natus Spike and Event Detection

The Xltek / Natus Spike and Event detectors are analyzers designed to help medical professionals monitor and review EEG recordings by identifying spikes and electrographic events of interest (EOI). The settings described in this document pertain to version 7.1 of the NeuroWorks software.

The software requires the setup of user-defined parameters. The software marks the detections with detailed notes on the study record. The clinical relevance of EOI is determined by the professional judgment of a medical practitioner trained in EEG analysis. No clinical or diagnostic claims are made. The output of the algorithm shall always be reviewed by qualified personnel. Natus detection has been validated for use in the adult population only (18 years and older). Overall performance of XLEvent and XLSpike detectors (compared to majority rule of a panel of 3 EEG experts) is shown in the following table.

	Positive Percent Agreement	False Percent Agreement
XLEvent	76%	0.6 FD/h
XLSpike	60%	5 FD/h

WARNING: Do not rely solely on the detectors for review of the study. The detectors are tools used to assist the qualified practitioner with the analysis and diagnosis of the patient.

NOTE: Natus detection has been validated for use in the adult population only (18 years and older). For more information please contact Natus Technical Support.

Selecting a Montage for Spike and Event Detection

For optimal performance with Natus Detection, we recommend that you use an XLDetect montage.

WARNINGS:

- The XLDetect montage does NOT work with the numeric labeling system found on some older EMU36 or Ambulatory 28 headboxes.
- Do NOT use the XLDetect montage with custom channel labels.

XLDetect Montage

The XLDetect Montage is the recommended montage when running XLTEK detectors. It is a combination of traditional longitudinal and transverse montages, including 19 electrodes that conform to a bipolar 32 channel montage. The combination of traditional longitudinal and transversal montage derivations were chosen as a means to improve performance of the detectors.

Channel Line-Up

The channel line-up included in the XLDetect montage, along with default settings for filters and gain, is shown.

	Input 1	Input 2	Type	LFF	HFF	Notch	Gain	Set	Color	Detectio	Polarity	Grid
1	Fp1	F7	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
2	F7	T3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
3	T3	T5	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
4	T5	O1	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
5	Fp1	F3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
6	F3	C3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
7	C3	P3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
8	P3	O1	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
9	Fp1	Fz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
10	Fz	Cz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
11	Cz	Pz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
12	Pz	O1	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
13	Fp2	F4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
14	F4	C4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
15	C4	P4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
16	P4	O2	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
17	Fp2	F8	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
18	F8	T4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
19	T4	T6	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
20	T6	O2	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
21	F7	F3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
22	F3	Fz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
23	Fz	F4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
24	F4	F8	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
25	T3	C3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
26	C3	Cz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
27	Cz	C4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
28	C4	T4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
29	T5	P3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
30	P3	Pz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
31	Pz	P4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
32	P4	T6	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off

Channel Line-up in XLDetect Montage

Which montage should you use for optimal Spike and Event Detection?

- If your headbox has standard 10-20 input labels, and you do not plan to use custom channel labels, use the XLDetect montage. Choose **Montage > [headbox]-XLDetect**.
- If your headbox has standard 10-20 input labels, and you plan to reassign channels and/or use custom labels, use a custom montage.
- If your headbox has numeric input labels, use a custom montage. **Choose Edit > Settings > Channel Labels** and select the Numeric option button in the Ambulatory / EMU Default Labels section.

Creating a Custom Montage for Spike and Event Detection

When you create a custom montage for Spike and Event Detection, for best results use a bipolar montage with as many of the following channel pairings as possible.

NOTE: Detectors cannot be run on Referential montages.

Channel Pairings

FP1-F7	**FP1-FZ**	**FP2-F8**	**T3-C3**
F7-T3	**FZ-CZ**	**F8-T4**	**C3-CZ**
T3-T5	**CZ-PZ**	**T6-O2**	**CZ-C4**
T5-O1	**PZ-O1**	**T4-T6**	**C4-T4**
FP1-F3	**FP2-F4**	**F7-F3**	**T5-P3**
F3-C3	**F4-C4**	**F3-FZ**	**P3-PZ**
C3-P3	**C4-P4**	**FZ-F4**	**PZ-P4**
P3-O1	**P4-O2**	**F4-F8**	**P4-T6**

NOTE: An XLDetect default montage is not available for the Quantum Amplifier or EMU128 headbox. Each setup for a grid patient is unique, so it is not possible to create an appropriate default montage. If you are using a Quantum Amplifier or an EMU128, you should establish a new bipolar montage for the patient. For more information on creating a montage for grid patients, refer to the service manual for the EMU128 headbox or contact Technical Support.

	Input 1	Input 2
1	Fp1	F7
2	F7	T3
3	T3	T5
4	T5	O1
5	Fp1	F3
6	F3	C3
7	C3	P3
8	P3	O1
9	Fp1	Fz
10	Fz	Cz
11	Cz	Pz
12	Pz	O1
13	Fp2	F4
14	F4	C4
15	C4	P4
16	P4	O2
17	Fp2	F8
18	F8	T4
19	T4	T6
20	T6	O2
21	F7	F3
22	F3	Fz
23	Fz	F4
24	F4	F8
25	T3	C3
26	C3	Cz
27	Cz	C4
28	C4	T4
29	T5	P3
30	P3	Pz
31	Pz	P4
32	P4	T6

10-20 Labels in Bipolar Montage

Setting the Detection Option

To access the Detection option choose **Edit > Settings > Montage.**

The Detection option is used to determine:

- Which montage channels are analyzed by the detector(s) you have enabled.
- Which type of study the montage channel is enabled in.

Detection choices are:

- **EEG** (used when analysis on the channel has to be enabled only in EEG studies)

- **Artifact** (used for an EEG channel with eye blink artifact [EOG])
- **Disabled** (used for a non-EEG channel)

The following table shows the detection settings for a standard NeuroWorks study.

Standard NeuroWorks Detection Settings

Type Column Setting (Channel Type)	Detection Column Setting
EEG Channel	EEG
EEG Channel with Eye Blink Artifact (EOG)	Artifact
Non-EEG Channel	Disabled

NOTE: If you select (check) the Auto Detect EOG general option when adding **XLEvent** detection on the **Analysis** tab, it is not necessary to set **EOG** channels in the montage.

Natus Spike Detection Algorithm (XLSpike)

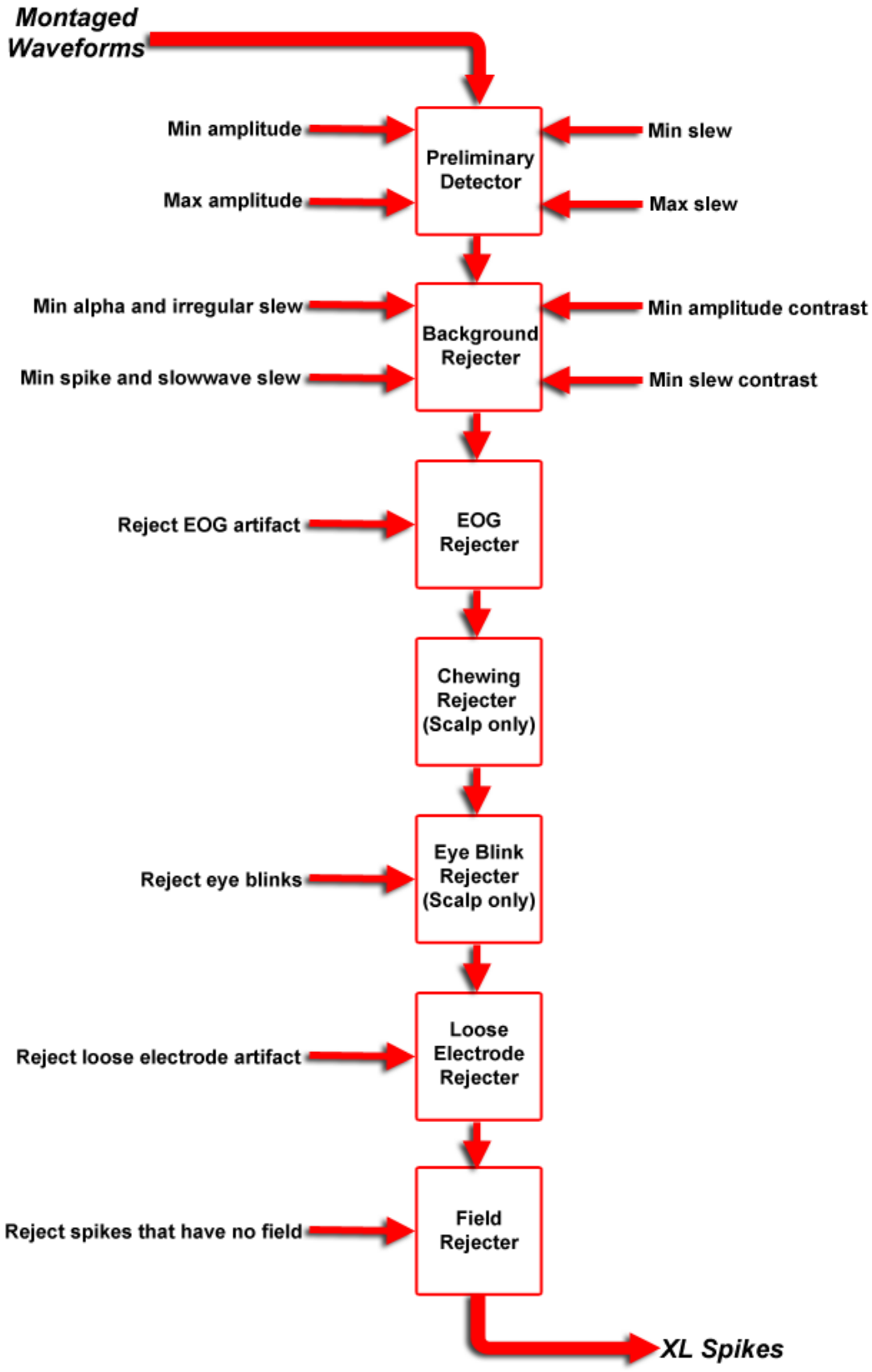
The Xltek / Natus spike detection algorithm can be described as a multi-stage classification system through feature selection that uses a morphological approach to extract intuitive parameters from the waveform. Parameters such as the relative amplitude, sharpness and duration of different segments are used in the classification of wave segments.

Various classes of spikes are detected:

Class	Description
Irregular	Simple monophasic spikes
Spike-and-slow-waves	Monophasic or multiphasic spikes followed by slow waves
Bursts	Series of grouped stereotyped wavelets

The spike detector is designed to find a representative sample of spikes in the study. A spike is considered a waveform that passed all preliminary detection criteria, and was not rejected by any of the rejection criteria. The preliminary criteria apply to all varieties of spikes detected.

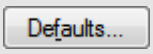
Block Diagram of the XLSpike Detector



XLSpike Detection Settings

The preliminary settings apply to all candidate spikes. After segmentation of the EEG signal various parameters of the wavelets are computed. A wavelet is considered a segment of the EEG signal between two consecutive deflections of the same polarity. A positive wavelet is flanked by two negative wavelets and a negative wavelet is flanked by two positive wavelets.

XLSpike Detection Settings

Setting	Description/Function/Adjusting
Max amplitude	This defines the physiological range of the signal. If the signal exceeds this threshold, there will be no detections in an exclusion window of 1 second. The default value is 5000 µV.
Min amplitude	This is the minimum amplitude required of a wavelet to be considered a spike. The default setting is 30 µV for scalp recordings.
Max spike slew	The slew is the slope of the waveform in µV/ms. The default setting for maximum spike slew is 20 µV/ms for scalp recordings. After the preliminary wavelets are isolated the detection continues on this reduced set.
Min slew	The default setting is 0.3 µV/ms for scalp recordings. When the slew of a waveform exceeds this value the wavelet is considered to be a spike candidate.
Detect Burst	When this setting is on, the detector is looking for short stereotyped bursts of activity. The burst has to have either amplitude or slew contrast to the preceding and following background.
	Clicking restores all settings to factory defaults.

XLSpike Rejection Settings

The classification follows a morphological approach. Simple monophasic spikes are called irregular. Monophasic or multiphasic spikes followed by slow waves are called spike-and-slow-waves. Series of grouped stereotyped wavelets are called bursts. Each class has rules for the rejection of certain wavelets.

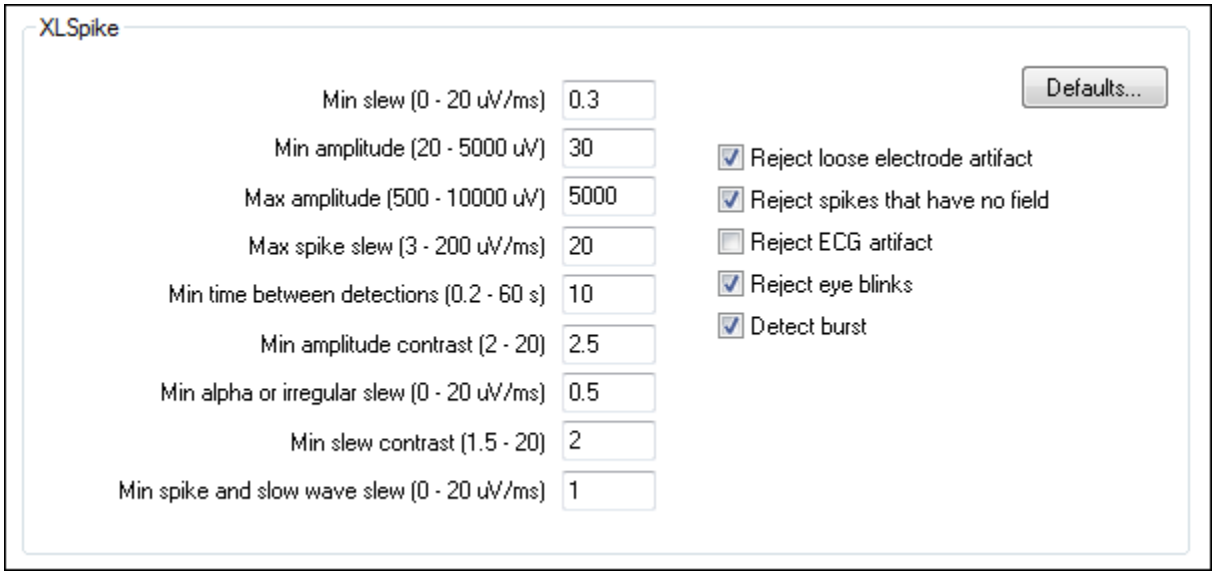
XLSpike Rejection Settings

Setting	Description/Function/Adjusting
Min Amplitude Contrast	This is the minimum amplitude for monophasic spikes or spike-and-slow-waves. It is measured as the ratio of the spike amplitude to the maximum neighborhood amplitude. The neighborhood is 1 second on both sides of the candidate wavelet for irregular wavelets. For spike-and-slow-waves the amplitude contrast is considered relative to the preceding 300 milliseconds preceding the first monophasic wave of a spike-burst-and-slow-wave or the first monophasic wave of the spike-and-slow wave complex. If the candidate wavelet is preceded closely by a valid spike-and-slow-wave this requirement is ignored. In this case the candidate wavelet is compared to parameters of the preceding valid spike-and-slow-wave. If they are similar the wavelet continues to remain a spike candidate. If the amplitude contrast is not as large as the **Min amplitude contrast** the wavelet may still be considered based on the slew contrast. The default value for the amplitude contrast is 2.5.
Min Alpha or Irregular Slew	This is the minimum slew required for wavelets to be considered irregular spikes. The default value is 0.5 µV/ms for scalp recordings.
Min Slew Contrast	This in the minimum slew (µV/ms) required for monophasic spikes as compared to a one second neighborhood around the candidate wavelet. If there is not enough slew contrast, the wavelet may still be detected as a spike if there is enough amplitude contrast. The default value is 2.
Min Spike and Slow Wave Slew	This in the minimum slew required for wavelets that occur as part of a spike-and-slow-wave complex. The slew refers to the first monophasic wavelet of the complex. The default value is 1 µV/ms for scalp recordings.
Min Time between Detections	This is the minimum interval allowed between detected spikes. Typically this is set to 10 seconds, so there will not be more than one spike marked on any given page. Setting this value lower will cause more spikes to be displayed. However, with patients who generate large numbers of spikes, this may produce an excessive number of notes and result in performance problems.

Setting	Description/Function/Adjusting
Reject ECG Artifact	When this setting is enabled, spikes that may be caused by propagated ECG onto the EEG channels are rejected. It is not necessary to have ECG channels in the montage for this feature to work. Instead, the analyzer looks for periodic spikes in the physiological range of ECG and excludes them from detection.
Reject Eye Blinks	When this setting is on, the eye blink rejecter is enabled.
Reject Loose Electrode Artifact	Spikes that occur on channels determined to be contaminated with loose electrode artifact are rejected. When this setting is applied, the spatial regularity of the signal is checked and, if a minimum degree of regularity is not observed, the channel is considered as presenting at least one loose electrode and the detection is discarded. If the signal recovers, future detections will be marked.
Reject Spikes that have no Field	The field of a spike refers to the area in which it is present. When the field detection is on, a spike must appear as part of a spatial field. When the field detection is off, a spike that occurs on only a single channel and thus has no visible field will be detected.

XLSpike Default Settings

The following illustrates the default values for XLSpike:



Default Settings for XLSpike

About/Adjusting XLSpike Settings

WARNING: The performance presented in this manual can only be obtained using the default settings of the Spike and Event Detector algorithm. Changing the default settings should be done with caution.

A spike is considered a waveform that passed all preliminary detection criteria, and was not rejected by any of the rejection criteria. The preliminary criteria apply to all varieties of spikes detected.

The spike detector is designed to find a representative sample of spikes in the study. It will not necessarily detect all of the spikes in a study.

Positive Percent Agreement

The Natus Spike detection algorithm has been developed and validated on 300+ long-term EEG recordings (approximately 1600 spikes) obtained from subjects over 18 years of age. The detection Positive Percent agreement of the algorithm when used in subjects with comparable demographic characteristics has been determined to be 60%. No intracranial studies were used.

Users should be aware that the algorithm, however, may fail to detect certain events. This is known as a false negative. It can occur for a variety of reasons described below.

False Detection Rate

The algorithm has been adjusted for high specificity so that only events of interest are detected. Occasionally detections occur where there is no true event. This is known as a false positive. There are several mechanisms in the detector designed to minimize false positives, such as the EMG artifact, eye blink artifact, chewing and alpha activity. The False Detection Rate is 5 FP/hour.

Typical situations where spikes are not detected are:

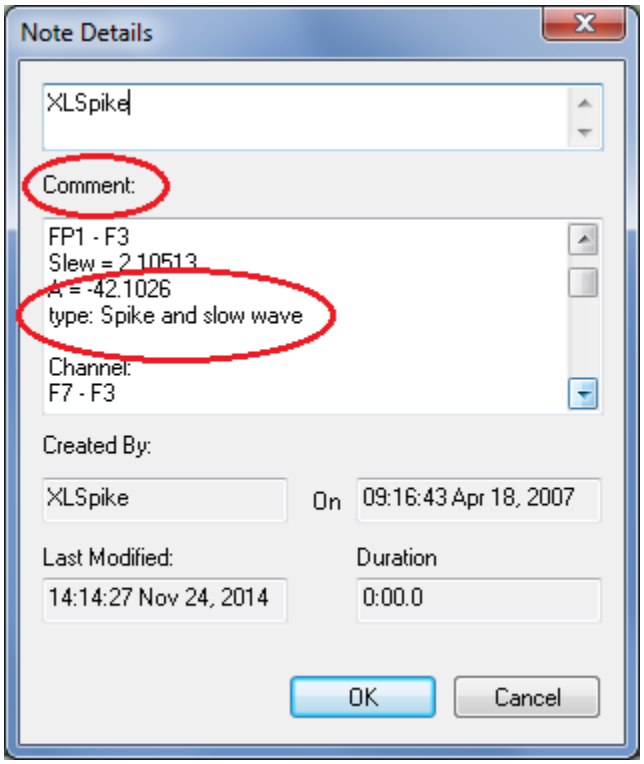
- Spikes are not marked during events.
- Groups of spikes that are close together are marked only once (as determined by the Min Time Between Detections setting).
- Spikes that appear on only a single channel (i.e. those that have no field) are not detected (unless the field rejecter is disabled).

Decreasing False Positive Detection

The XLSpike settings (**Edit > Settings > Analysis**) relate directly to the statistics displayed in the Spike and Event review notes. Performance of the algorithm using parameters other than default parameters may affect performance results.

To view and evaluate note statistics and adjust settings, follow these steps:

1. Choose **Window > Review Current Study**. The study opens in review mode on the left side of the screen.
2. In the **Annotation Viewer**, click the **spike note** that corresponds to the false positive. The waveform window displays the page in the study with the note.
3. Observe the waveforms that occurred at the time of the spike. Decide which characteristic is not consistent with a true detection. For example, the amplitude may be too low to constitute a spike.
4. To view the settings for the false positive, **double-click** the note in the **waveform window**. The **Comment** section of the **Note** box shows the statistics for every channel with spike activity.



Note Box – Comment Section

5. Notice the **type** classification in the Note box. Decide which value needs to be increased in the XLSpike detection settings. For example, if the **type** is **Spike and slow wave**, then either **Amplitude** or **Slew** is too high.
6. In the live study, choose **Edit > Settings > Analysis > XLSpike**. The XLSpike options appear.
7. Adjust the threshold that caused the false positive.

WARNING: The performance presented in this manual can only be obtained using the default settings of the Spike and Event Detector algorithm. Changing the default settings should be done with caution.

Terms and Definitions

Term	Definitions
Channel	The montage channel on which the spike was detected.
Amplitude	The number of times bigger a wave is than the **local background**.
Slew	Measures the steepness of the leading edge (up or down) of a spike.
Local background	Median average of the surrounding waves.
Type	The background in which the spike is detected: Irregular, Spike-and-Slow-Wave, Fast or Slow.

Sources of Error in XLSpike

The quality of the recording (electrical noise, artifacts, loose electrodes) may be too low. The detector is designed to compensate for a certain level of poor signals, such as a single loose electrode, but will fail if multiple channels are affected.

Performance of the algorithm using parameters other than default parameters may affect performance results.

Natus Detection Troubleshooting Checklist

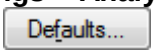
If the detector is not picking up real spikes and events, or if the detector is picking up too many false positives, try these solutions:

A. Are you using a bipolar montage for scalp recordings?

If you are using a referential montage, common mode signals will affect the accuracy of the results, especially with spike detection. In cases of rhythmic common mode signals, rejection mechanisms could remove almost all detections.

Natus provides a default detection montage for all headboxes (except for the Quantum Amplifier and the EMU128). The montages are named **[Headbox]-XLDetect**. For example, the montage for the EEG32 headbox is named **EEG32-XLDetect**. For older versions of the NeuroWorks software (3.1.0 or below), use a bipolar montage with the FP channels set as Artifact and any non-EEG channels set as **Disabled**.

B. Are you using the default detection settings?

If your settings are not those described in the documentation, try using the Natus Detection default settings. Choose **Edit > Settings > Analysis** to access the **XLSpike** and **XLEvents** options pages and click the **Defaults**  button. Then, try analyzing the same patient using the Batch Analyzer with the restored default settings.

C. Are you running a batch analysis on multiple recordings?

- Since custom montages are created for each patient, before running a batch analysis for an individual patient make sure that the analysis montage is set to the custom montage that the study was recorded with (or a specially revised version of this montage that you have created – such as one with the same electrode placement but with fewer channels).
- In Natus Database, select the patient's studies. Then choose **Tools > Options > Analysis (tab)**. Click the **Montage** button, and choose either the name of the patient's custom montage, revised custom montage or **As Recorded**.
- However, if you are going to include different patients in the same batch analysis, make sure you choose only **As Recorded**.

Natus Event Detection Algorithm (XLEvent)

The Xltek / Natus event detector identifies electrographic events of interest (EOI), which are defined as: “Transient electrographic patterns, clearly distinguishable from the background EEG activity, that evolve over time with a change in the frequency, amplitude, and distribution, and are of possible encephalic nature and variable duration.” The following section describes Natus XLEvent in more detail. For a detailed description of Persyst analyzers, refer to Persyst documentation.

NOTE: XLEvent detections are marked with an XLEvent annotation placed near the start of the suspected abnormal EEG section.

The event detection algorithm can be described as a multi-stage classification system through feature selection that uses a morphological approach to extract intuitive parameters from the waveform. Parameters such as the relative amplitude, sharpness and duration of different segments are used in the classification of wave segments.

The event detector pre-qualifies EEG sections containing electrographic patterns that:

- are clearly distinguishable from the background EEG activity
- evolve over time with a change in the frequency, amplitude, and distribution
- are of possible encephalic nature and variable duration

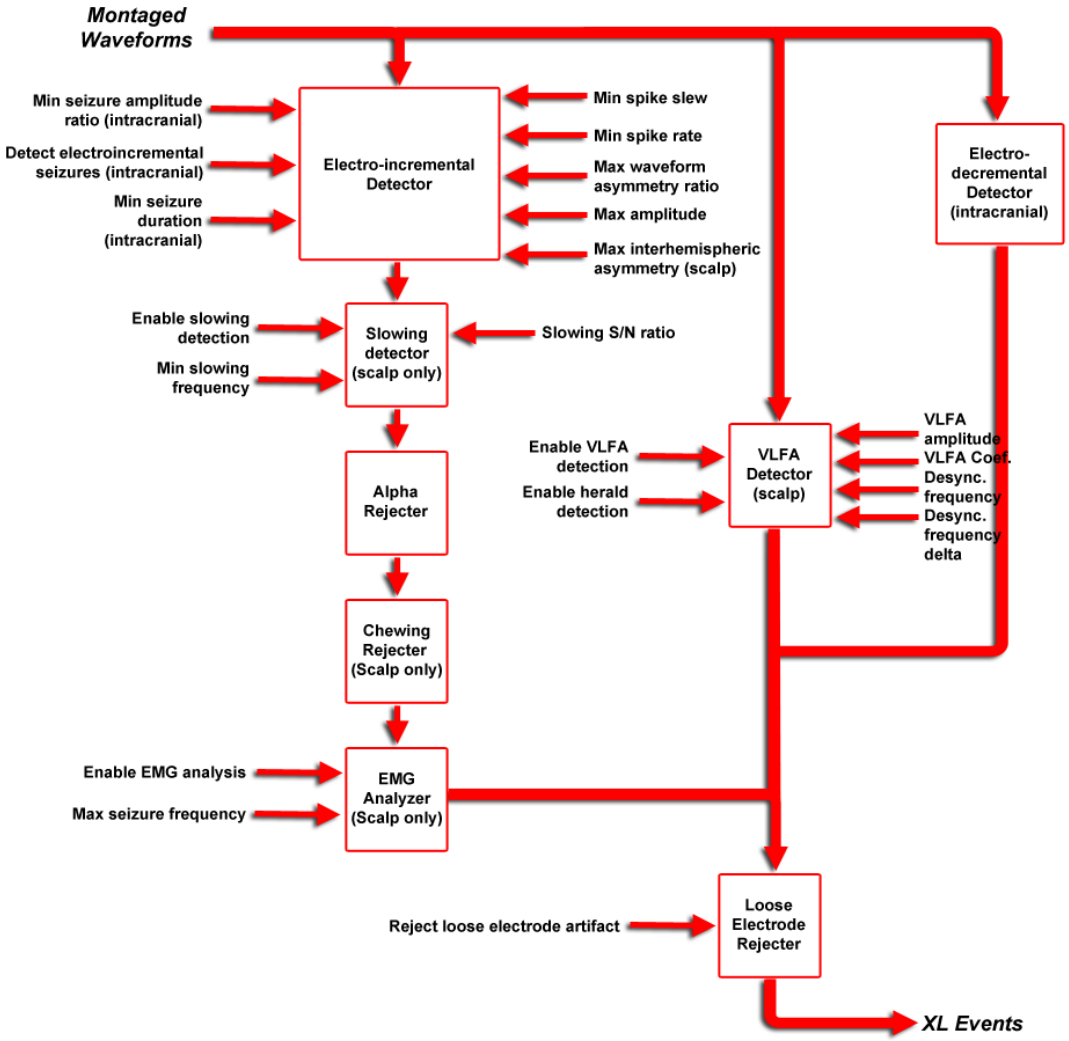
Once a section of EEG has been pre-qualified as "EVENT", the analyzer checks the background for alpha activity, chewing and EMG. If a detection of any kind has been made and no artifacts are detected by the methods indicated above, the detector checks if every channel included in the detected section contains loose electrodes or not. If no artifacts are detected the event is marked.

Another pattern detected by our analyzer is VLFA (Very Low Frequency Activity). This pattern represents activity that is lower than 0.3 Hz and of amplitude that is at least 100 µV. This type of pattern has been reported to correlate with several types of electrographic events. This pattern can be used alone or in conjunction with other indicators, such as Herald spikes or high frequency activity, for the identification of events of interest. Herald spikes can be used in conjunction with desynchronization of the EEG if the Herald spikes precede the desynchronization of the EEG.

The event detector uses ECG analysis if an ECG channel is available and properly set up to enable ECG analysis. The ECG analysis is not by itself enough to mark an event. We recommend that the ECG channel be set up at all times according to the manual to enable ECG analysis while events of interest detection is running. This will occasionally permit earlier identification of events of interest. The absence of an ECG channel or failure to set up the channel for analysis will not impede the function of the rest of the detectors.

VLFA detection, Herald-Desynchronization, EMG and ECG analysis are not used by any competitor. The detector uses all available means to detect events of interest.

Block Diagram of the XLEvent Detector

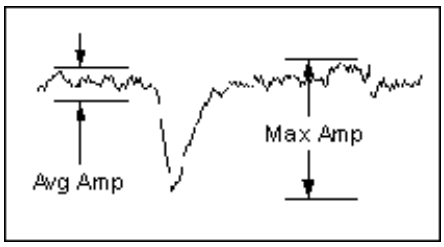


XLEvent Settings

XLEvent Detection Settings

Setting	Description/Function/Adjusting
Min Spike Rate	There is an event if the spike rate (spikes per second) exceeds this value over the minimum event duration and there is no corresponding rejection.
Min Spike Slew	The slew is the slope of the waveform in µV/ms. When the slew of a candidate wavelet exceeds this value it is considered to be a spike. A series of spikes can be considered an event if the sequence contains the number of spikes specified in the **Min Spike Rate** setting and are distributed evenly over a duration of at least 2 seconds.
Defaults...	Clicking restores all settings to factory defaults.

XLEvent Rejection Settings

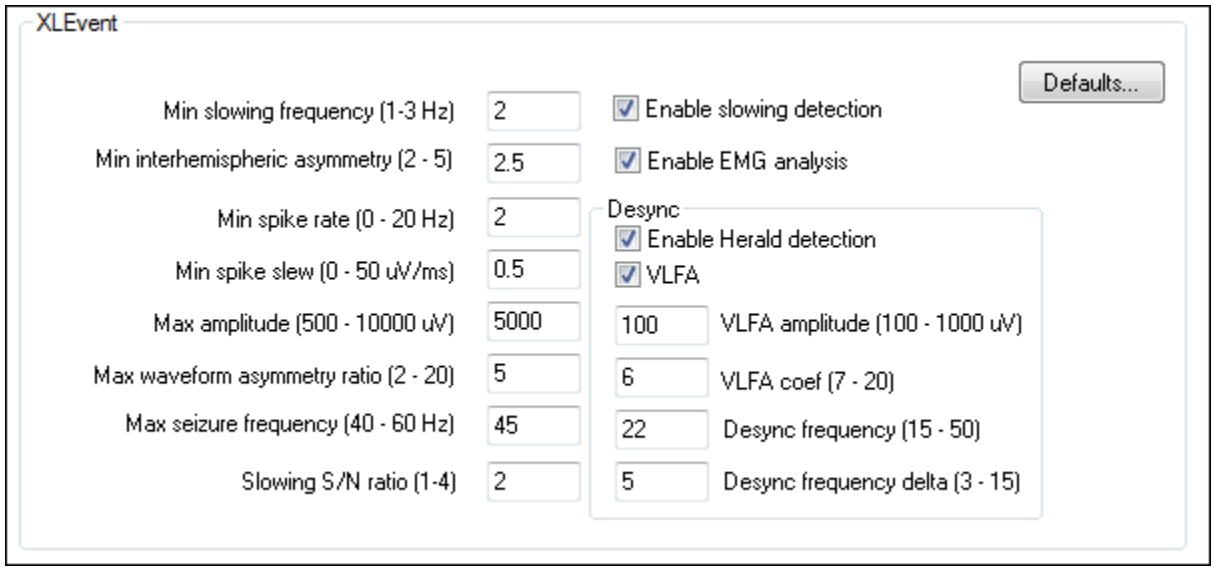
Setting	Description/Function/Adjusting
Max Amplitude	This defines the physiological range of the signal in microvolts. If the signal exceeds this threshold, there will be no detections in the vicinity.
Maximum Event Frequency	This is the frequency of activity above which the waveform is considered to be an artifact. A preliminary event is rejected if the frequency exceeds this threshold.
Max Waveform Asymmetry Ratio	This Waveform asymmetry refers to the balance of the individual waveforms. It is calculated as the ratio of the maximum amplitude to the average amplitude of the waveform over the minimum event duration. A preliminary event is rejected if the waveform asymmetry exceeds this value. 

Setting	Description/Function/Adjusting
Min Interhemispheric Asymmetry	Regular rhythmic activity that is asymmetrical between hemispheres is detected. This setting adjusts the minimum detectable amplitude asymmetry. The asymmetry is considered the ratio of the highest to the lowest amplitude between averages over two contralateral channels.
Min Event Amplitude Ratio	The ratio of the amplitude relative to the background. There is an event when the relative amplitude of the signal exceeds this number for the minimum event duration and there is no corresponding rejection. The background amplitude is computed based on the average of the preceding EEG corresponding to 10 times the minimum event duration (typically 20 to 40 seconds). To increase the number of detections, decrease amplitude. To lower the number of false positives, increase amplitude.
Min Event Duration	Allows you to set the minimum detectable event length. The default setting allows detection of events longer than 3 seconds. The minimum value for this setting is 2 seconds.
Enable Slowing Detection	Intermittent activity in the delta and theta range is detected considering the topography.
Min Slowing Frequency	Sets lower boundary for the detectable delta-slowing. This setting does not affect the detection of theta slowing (4-7 Hz).
Slowing S/N Ratio	Affects the appearance of the detected slow waves. Slowing activity with wavelets that present a S/N ratio larger than this setting are detected.
Enable EMG Analysis	This setting turns on the EMG analysis. This analyzer monitors the evolution of the EMG activity. If the EEG activity of cerebral origin is totally obscured by EMG activity, this detector is capable of detecting events of interest by monitoring the EMG activity on the scalp.
Enable VLFA Detection	This setting enables VLFA monitoring.
Enable Herald Detection	This setting enables Herald Spike detection.

Setting	Description/Function/Adjusting
VLFA Amplitude	Sets the minimum detectable VLFA amplitude.
VLFA Coef.	Sets the minimum signal/noise ratio of a VLFA wavelet. A VLFA wavelet is like a very large spike.
Desync Frequency	Sets the post Herald minimum frequency. After a Herald spike is detected, high frequency activity with a minimum frequency of Desync. Frequency and a frequency differential to the background of at least Desync. Frequency Delta (see next setting) is detected as an event.
Desync Frequency Delta	Set the minimum frequency differential for a Herald-Desynchronization event.
Reject Loose Electrode Artifact	Artifacts due to loose electrodes present as high amplitude signals on channels that share the same input. When this setting is applied, the spatial regularity of the signal is checked and, if a minimum degree of regularity is not observed, the channel is considered as presenting at least one loose electrode and the detection is discarded. If the signal recovers, future detections will be marked.
Automatic Mechanisms	Several mechanisms run with no direct input from the user: • Eye blinks are detected on channels that are labeled as frontal or frontal-parietal. • Potential spikes are rejected if they are considered eye blinks (duration greater than 150 milliseconds). • Channels marked as "artifact" in the detection montage are always analyzed for eye blinks.

XLEvent Detector - Default Settings

The following illustrates the default values for XLEvent detection:



XLEvent Default Settings

Adjusting XLEvent Detector Settings

WARNINGS:

- The performance presented in this manual can only be obtained using the default settings of the Spike and Event Detector algorithm. Changing the default settings should be done with caution.
- The Natus Event Detection Algorithm should be used with a full-montage electrode array (21 recording electrodes or more). Using reduced montages may negatively impact the performance of the algorithm and has not been validated.

Positive Percent Agreement

The Natus Event detection algorithm has been developed and validated on 231+ long-term EEG recordings (approximately 600 events) obtained from subjects over 18 years of age. The detection Positive Percent agreement of the algorithm when used in subjects with comparable demographic characteristics has been determined to be 76%. No intracranial studies were used.

Users should be aware that the algorithm, however, may fail to detect certain events. This is known as a false negative. It can occur for a variety of reasons described in Sources of Error in XLEvent.

Please consult the Natus Detection Troubleshooting Checklist on how to increase the sensitivity of the event detector.

False Detection Rate

The algorithm has been adjusted for high specificity so that only events of interest are detected. Occasionally detections occur where there is no true event. This is known as a false positive. There are several mechanisms in the detector designed to minimize false positives, such as the EMG artifact, eye blink artifact, chewing and alpha activity. The False Detection Rate is 0.6 FP/hour.

NOTE: Events that last less than the minimum duration are not detected.

Sources of Error in XLEvent

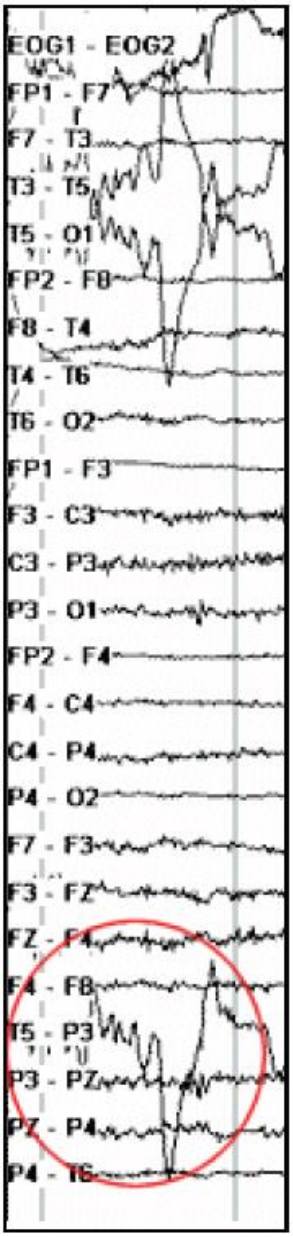
Some possible sources of error are:

- The quality of the recording (electrical noise, artifacts, loose electrodes) may be too low. The detector is designed to compensate for certain levels of poor signals, such as a single loose electrode, but will fail if multiple channels are affected.
- The detection settings may be adjusted incorrectly. The default settings have been determined during validation of the algorithm. Positive Percent Agreement and False Detection Rates reported here were obtained during validation using the default settings.
- The wrong detection montage may have been used. A bipolar montage with both longitudinal and transverse channels works best for scalp recordings. Referential montages do not adequately cancel the common mode noise and may produce false detections.
- Is there a break or montage change in the data before a missed event? The detector needs a minimum of 40 seconds of baseline data prior to the first detection.
- The patient may have abnormally sharp alpha activity, resulting in a high false positive rate. Increasing the Min spike slew setting will compensate for this.

Reject Loose Electrode Artifact

The illustration below shows a portion of a study that was recorded with the **Reject Loose Electrode Artifact** option turned on (**Edit > Settings > Analysis > XLEvent**).

NOTE: The high amplitude activity caused by loose electrode **T5** does not result in a false positive detection.



Example of Waveform with Reject Loose Electrode Artifact Option Enabled

7.8 Persyst Analyzers

EEG studies recorded with Natus proprietary hardware can be analyzed using Persyst software from Persyst Corp. Analysis performed by Persyst and its output is in no way related to the NeuroWorks Spike and Event detection module. See Persyst documentation for information on how to conduct analysis or visit www.persyst.com.

When Persyst software is installed and a valid Persyst license is obtained from Persyst, NeuroWorks makes the Persyst analyzer available as an additional choice for the user.

Configuring Persyst Detectors

For a complete and accurate description of Persyst settings, default values, features and functionalities, please refer to Persyst documentation or visit www.persyst.com.

7.9 Stellate Gotman Analyzers

ICTA-D

The **ICTA-D Seizure Onset Detector** is a probability-based processor for detecting seizures in depth EEG as close to their onset as possible. The ICTA-D Seizure Onset Detector can used online or offline.

For every 4-second epoch of EEG data, the algorithm derives two detection variables based on the probability that the epoch contains seizure activity. A detection is made when either of these variables exceed its respective threshold. You can adjust these tunable thresholds to control false detections in patients with elevated rates. Tuning is not mandatory to use the processor, rather it is a feature available to those who wish to optimize performance during long term monitoring.

About Spatial and Temporal Detection Variables

A detection variable is derived for two detection types: spatial and temporal.

The spatial detection variable is derived for each epoch, using the channels with the three highest probabilities in that epoch. These are the probabilities that the activity in each channel is seizure activity. For a spatial detection, three single-channel, instantaneous markings are made at the end of each detection epoch to signify a seizure and to highlight the three channels most involved in the detection.

The temporal detection variable is derived for each channel using five consecutive epochs of data. The markings made in the signal file at the time of detection reflect the detection type. For a temporal detection, a single instantaneous marking is made at the end of the current epoch on the channel that caused the detection.

ICTA-S

The **ICTA-S Seizure Onset Detector** is a probability-based processor for detecting seizures in scalp EEG as close to their onset as possible.

For every 2-second epoch of EEG data, the algorithm derives a detection variable based on the probability that the epoch contains seizure activity. A detection is made when this variable exceeds a user-defined threshold. This tunable threshold can be adjusted by the user to control false detections in patients with elevated rates. Tuning is not mandatory to use the processor, rather it is a feature available to those who wish to optimize performance during long term monitoring.

The final detection variable is derived using the channels with the six highest probabilities in a particular 2 second epoch. These are the probabilities that the activity in each channel is seizure

activity. The events marked in the signal file at the time of detection reflect the influence of these individual channel probabilities. Six single-channel, instantaneous markings are made at the end of each detection epoch to signify a seizure detection, as well as to highlight the six channels most involved in the detection.

Each 2-second epoch that causes a detection is marked with six individual, instantaneous detection markings at the end of the epoch, on the channels responsible for the detection.

Factors that Influence Detection

Detection variable influenced by current epoch: The detection variable is influenced by the current epoch, as well as by the two preceding epochs, to incorporate the temporal evolution of EEG events into the detection scheme. A high value in one epoch will carry over into the next two epochs and can cause detections in those epochs. In other words, at times it can appear that detections are made in extra epochs after an event has passed, but it is in fact due to this inherent design characteristic.

Number of channels used in detection: The use of the six most significant channels in the creation of the detection variable does not ensure that all six channels are involved in the activity responsible for the detection. For example, only three of the channels might be significant enough to raise the value of the detection variable above threshold and cause a detection, while the other three channels in the top six might be insignificant. When a detection occurs, all six channels are marked nonetheless.

Detection caused by other activity: The individual channel data is processed using spectral methods (frequency analysis). A detection may be caused by activity that is not apparent upon inspection of the signal data, because it is associated with a particular inherent component of the EEG signal.

8. Working with Reports

8.1 NeuroWorks Report Generation

About Reports

From the information contained in a NeuroWorks study, you can generate three reports:

- Technologist's Report
- Physician's Report
- Study Report

Natus Database uses **Microsoft Word** to perform the report generation tasks.

The Natus Database collects content for the reports from the following dialog boxes in NeuroWorks EEG:

- Technologist’s Report
- Physician’s Report
- Study Information

You can track multiple generated reports and choose the one that you want to open for editing.

To track a report:

1. In the Natus Database, choose **Study > Edit Report**.
2. The resulting dialog box will list all reports created for a given study along with the names of the templates used to generate those reports.

Editing the Content of a Report

Although all reports can be edited in Microsoft Word, changes made in the Word documents are not stored in the database.

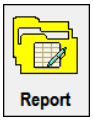
To change the information in the database and the report, do the following:

1. Choose **Edit > Study Information**. The Study Information window appears.
2. Click any or all (successively) of these tabs:
    a. Patient
    b. Medication Information Technologist's Report
    c. Physician's Report

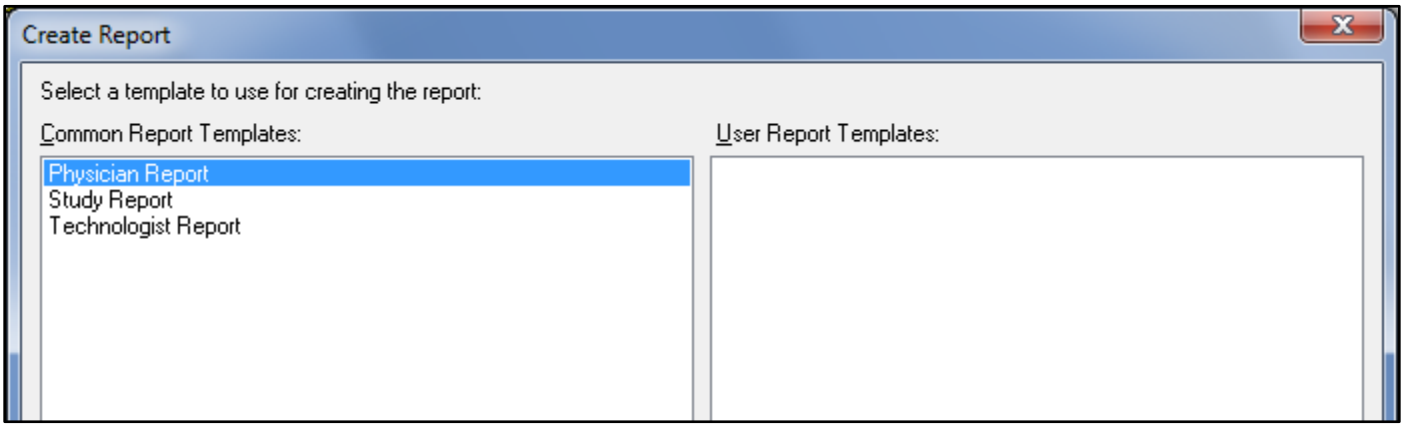
Edit the information on these pages as required. NeuroWorks stores information from the dialog boxes on these pages in the database and then uses this information to generate reports.

Generating a NeuroWorks Report

To generate a NeuroWorks report:

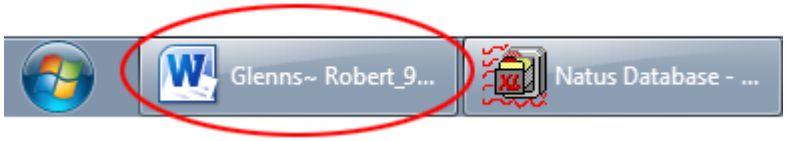
1. In the Natus Database, select (highlight) a study. Then click the **Report** 

button.
2. This opens the **Create Report** box.



Create Report Box

3. Select the report template you want to use for your report and click **OK**. The system generates a report in Microsoft Word that includes information from the study based on the fields in the report template.
4. The report should open automatically. If it does not, click the study name button on the Windows taskbar to open the report.



Study Name Button on Taskbar

NOTE: The user can select the template on which to base a report every time a report is generated. Only one report can be generated at a time.

8.2 Report Templates

What is a Report Template?

NeuroWorks generates reports from templates. A template is a **Microsoft Word** file that is saved with a **.dot** file-name extension. The template contains the document settings for the report such as fonts, macros, menus, page layout, special formatting and styles. Each template contains fields that extract information from the database when you generate a report. The report templates in NeuroWorks are designed to extract information from:

- Patient dialog box

- Information dialog box
- Technologist's Report dialog box
- Physician's Report dialog box

These dialog boxes are found as tabbed pages in the **Patient Info** box in the Natus Database (**Study > Info…**).

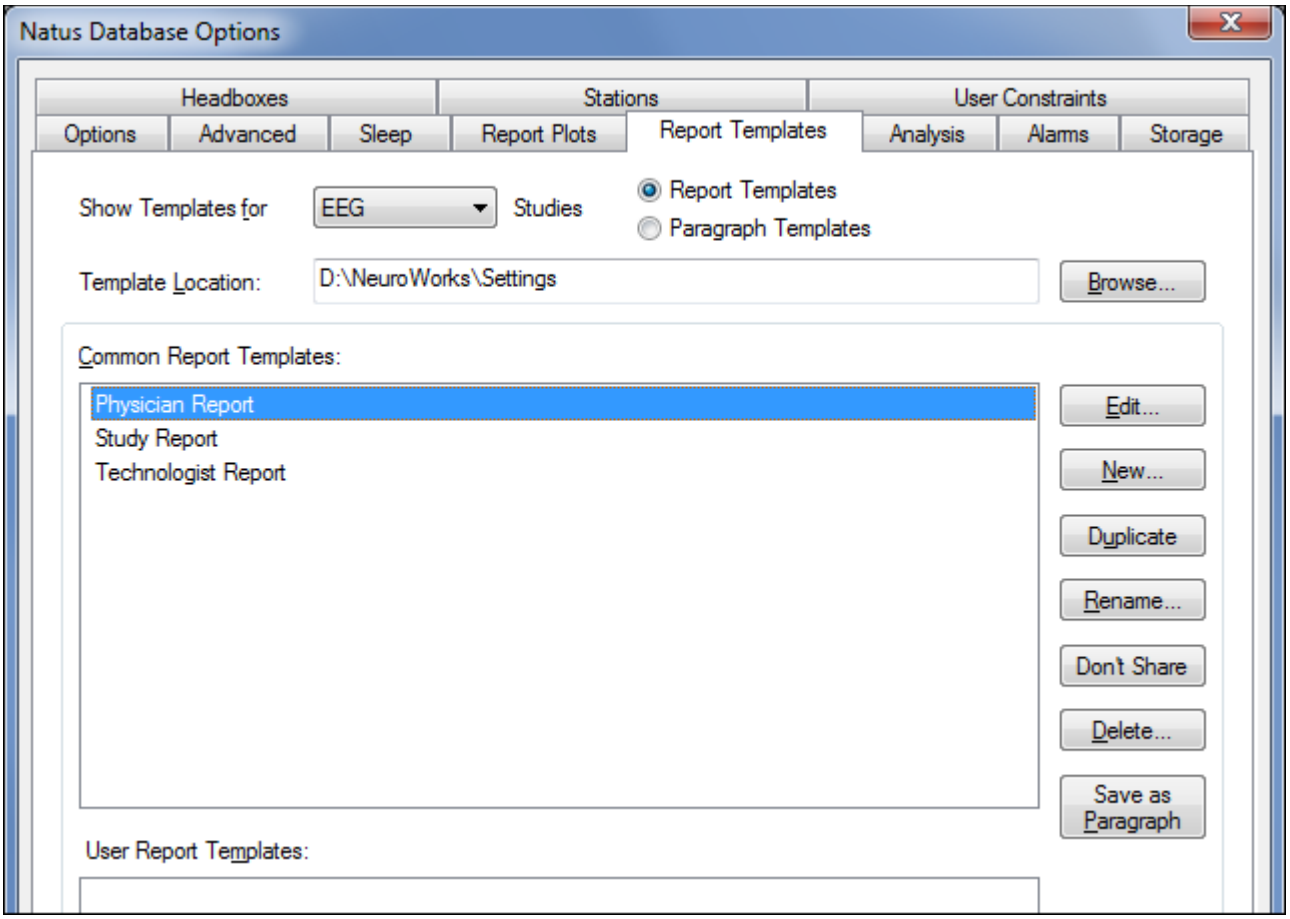
The file names for the report templates are:

- Physician Report.dot
- Study Report.dot
- Technologist Report.dot

The default location for the templates is **D:\NeuroWorks\Settings**.

Working with NeuroWorks Report Templates

NeuroWorks enables you to create custom templates in **Microsoft Word** that automatically insert data from a study. This way, you can create reports to show only data that is relevant in each particular study.



Options on Report Templates Tab

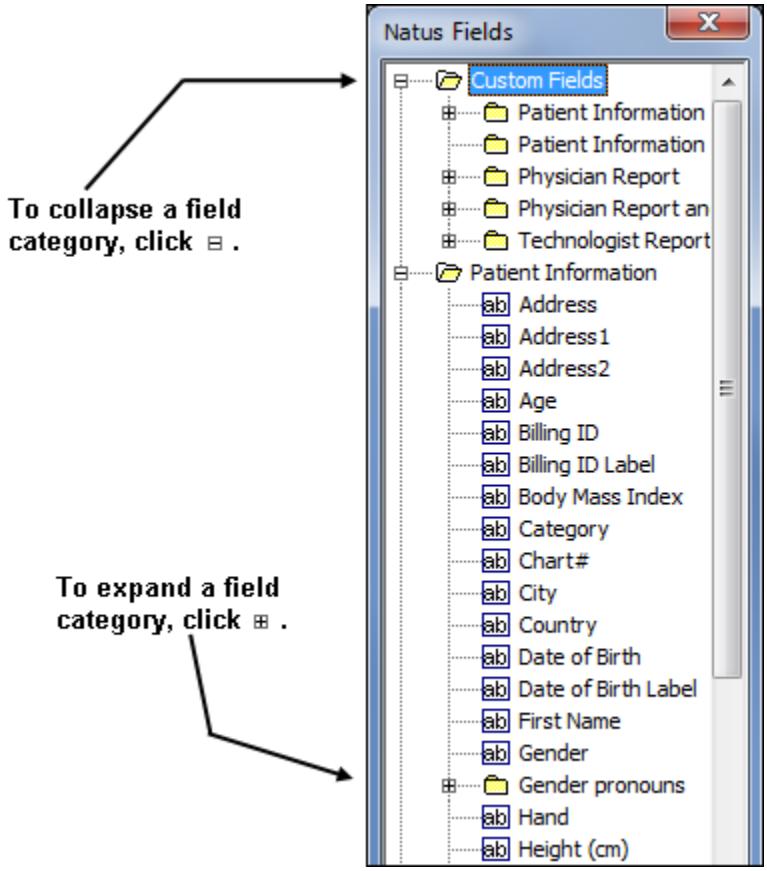
NOTE: If central settings cache is enabled, the **Template Location** is fixed.

To...	Do This...
Access the Report Templates tab	In the **Natus Database**, choose **Tools > Options > Report Templates.**
Edit a template	Select an existing template and click **Edit**. **Microsoft Word** launches with the selected template loaded.
Create a New template	Click **New**. The **Template name box** appears. Type a name and click **OK**. Microsoft Word launches with the new (and blank) template loaded. You must now **edit the template** and add your own headings, information fields, and overall formatting. **NOTE:** A basic understanding of **Microsoft Word** is required to create a report template.
Duplicate an existing template	Select an existing template and click **Duplicate**. A template called **Copy of (template)** is added to the **User** list. Select the **Copy of (template)** and click **Rename**. The **Template name** box appears. Type a new name for the template and click **OK**.
Rename a template	Select an existing template and click **Rename**. The **Template name** box appears. Type a new name for the template and click **OK**.
Share/Don't Share a template	Selecting a template in the **User Templates** section and clicking **Share** moves it into **Common Templates** section and makes it available to all users. Conversely, selecting a template in the **Common Templates** section and clicking **Don't Share** moves it into **User Templates** section and makes it only privately available.
Delete a template	Select an existing template and click **Delete**.

Editing a Report Template

To edit a NeuroWorks report template:

1. In the Natus Database, choose **Tools > Options > Report Templates** (tab).
2. Select a report and choose **Edit**. The selected template opens in Microsoft Word with the **Natus Fields** box floating above the template.



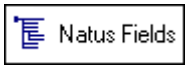
Natus Fields Box

3. To add a field to the template, type a heading and then position the cursor where you want to insert the field. Lastly, click the field that you want to add (for example, Address).

NOTE: You must add and format your own template sections and headings. Adding a field adds generated study information only.

4. To save the template, choose **File > Save**. Do not change the name of the template.

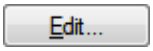
TIPS:

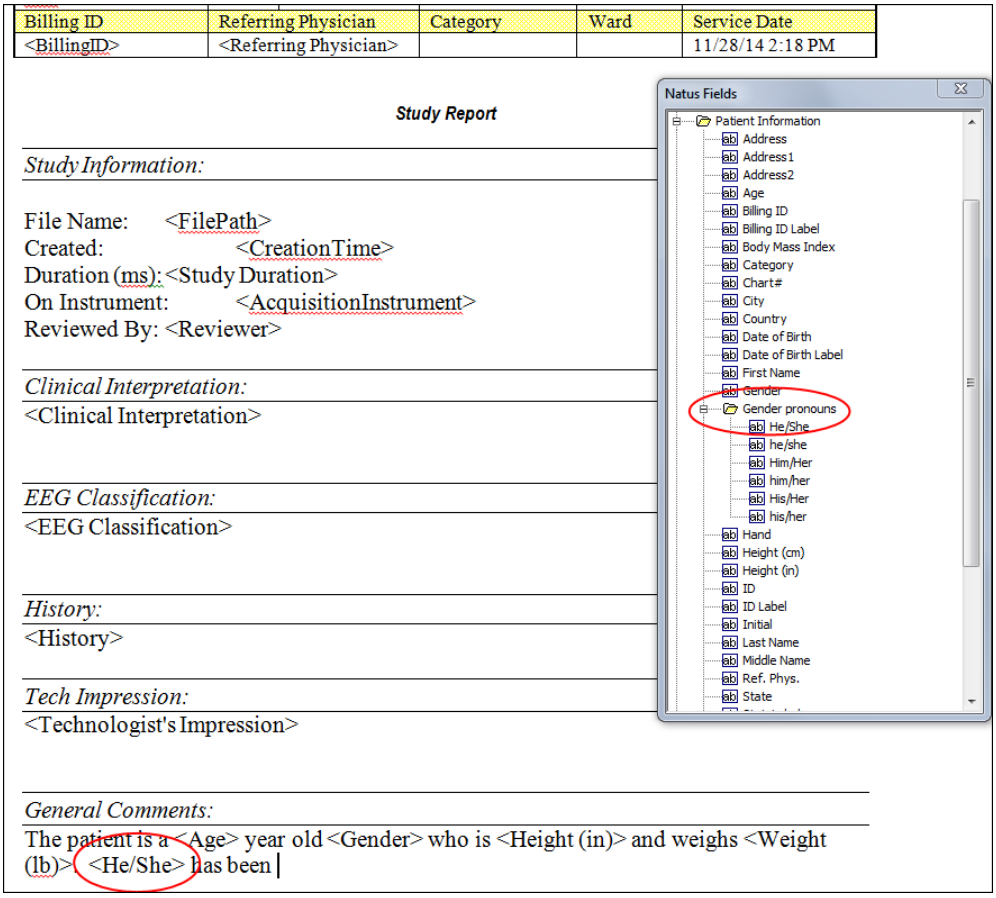
- All Microsoft Word functionality can be used to customize the content and appearance of the template.
- If you try to use the TAB key to insert a tab space, your cursor will jump to the next cell because you are in a table. Instead, to insert a tab space, copy and paste a tab space from a neighboring cell.
- Default report templates installed with NeuroWorks are read-only and cannot be edited unless the read-only attribute is removed. These templates serve as examples and help with troubleshooting. If you want to edit a read-only template, create a copy of it and add the copy to the User list (rather than the Common list).
- To show or hide the Natus Fields box, click the Natus Fields  button on the Microsoft Word toolbar.

Using Gender Pronouns in Reports

You can set up a report template that includes personal pronoun references and it will be filled in at report generation time with the appropriate pronoun depending on the patient's gender.

To insert gender pronoun fields:

1. Switch to the Natus Database application.
2. Choose **Tools > Options > Report Templates** (tab).
3. Select the report template you want to modify.
4. Click the Edit  button.
5. The report template opens with the **Natus Fields** box floating above it.
6. Click the plus sign beside Patient Information to open the folder.
7. Click the plus sign beside Gender pronouns to open the folder.
8. Click where in the report template you want to insert a particular field.
9. Click the particular field in the Natus Fields box.
10. The field is inserted in the report template.
11. When you have finished adding gender pronoun fields, close the Natus Fields box.
12. Save the template



Inserting Gender Pronouns in a Typical Report

8.3 Using a Word Macro to Customize Reports

A Word macro named **XLTEK_OnReportGenerated** is automatically invoked between the time a report is generated and the time it is displayed. You can customize this macro to place additional calculations in the report using the **Microsoft Word Basic language**.

8.4 Attaching External Documents to a Study

It is often useful to attach external documents (such as reports from other sources) to patient records. External documents that you can import into the NeuroWorks system and attach to studies include Word documents and scanned documents in **TIFF** or **PDF** format.

You can display these attached documents just as you would other NeuroWorks reports, using **Study > Edit Report**.

To attach a document to a patient record:

1. In the Natus Database, select (highlight) a study.
2. Choose **Study > Attach Reports**.
3. In the dialog box that appears, locate the file to attach and click **Open**.
4. Type a name for this report and click **OK**.

9. Working with Notes

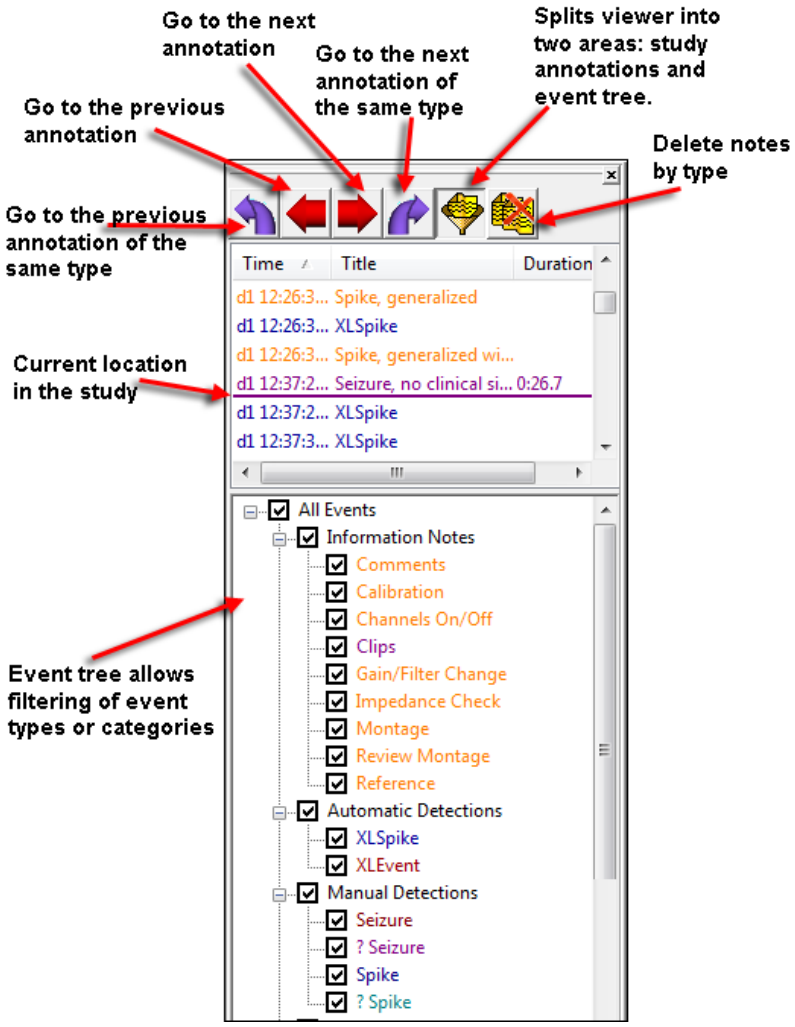
9.1 Annotation Viewer

Overview

The Annotation Viewer lists all of the **Notes, Bookmarks** and **Feature Marks** in a study in consecutive order and enables you to quickly navigate from note to note. Notes and comments added by the technologist, the reviewer and the NeuroWorks system are recorded automatically. When you review a study, the arrow buttons allow you to navigate between annotations.

The Annotation Viewer is displayed in view-only mode during **Acquisition** (recording), but it is editable in **Review** mode.

To open the Annotation Viewer, choose **View > Annotation Viewer**.



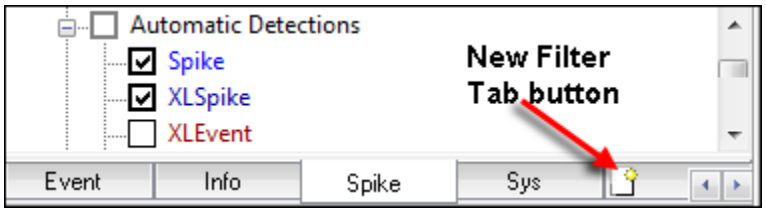
Annotation Viewer

NOTE: The Annotation Viewer on the **monitoring station** automatically scrolls to and selects a new event when it is added from the acquisition station (both manual and auto-detected).

The Annotation Viewer allows you to turn on or off visibility of various events and whole event groups.

Click the **Select Annotation Types** button to split the annotation viewer into two areas. The area at the top will show study annotations. The area at the bottom will show the event-type tree so that individual types or categories of events can be filtered. You can also adjust the split and allocate more screen real estate to the filter or to the event list.

You can create and save multiple filters by clicking on the new **Filter tab** button on the bottom of the Annotation Viewer and typing in a name for your new filter. Once created, your filter settings shall be saved within the newly created filter tab so that you can easily load any previously defined filter view setting by clicking on the appropriate filter tab.



Filter Tabs in Annotation Viewer

The Annotation Viewer can be used to **Review notes.**

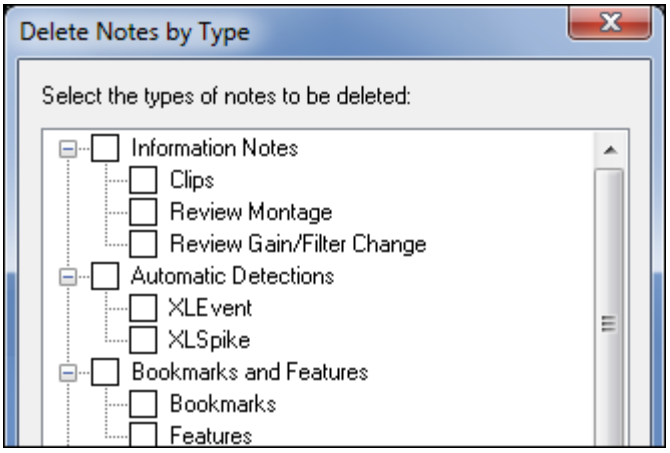
Note the following:

- Click the title area of an annotation to select it.
- Drag the title of the annotation to change the position and the time.
- Press the **Delete** key to delete the annotation.
- To open a dialog box with more detailed information about the annotation, double-click the annotation title to open a **Note dialog** box.
- To hide the vertical time bar beside a note, right-click the time-sweep triangle at its top.

Support for Bulk Event Deletion

The software allows for the quick deletion of multiple events by type. To activate this functionality, press the **Delete Notes by Type** button in the **Annotation Viewer.** This functionality can be used to remove all automatically detected events, clip marks, etc.

NOTE: Notes placed manually and automatic detections are categorized separately.



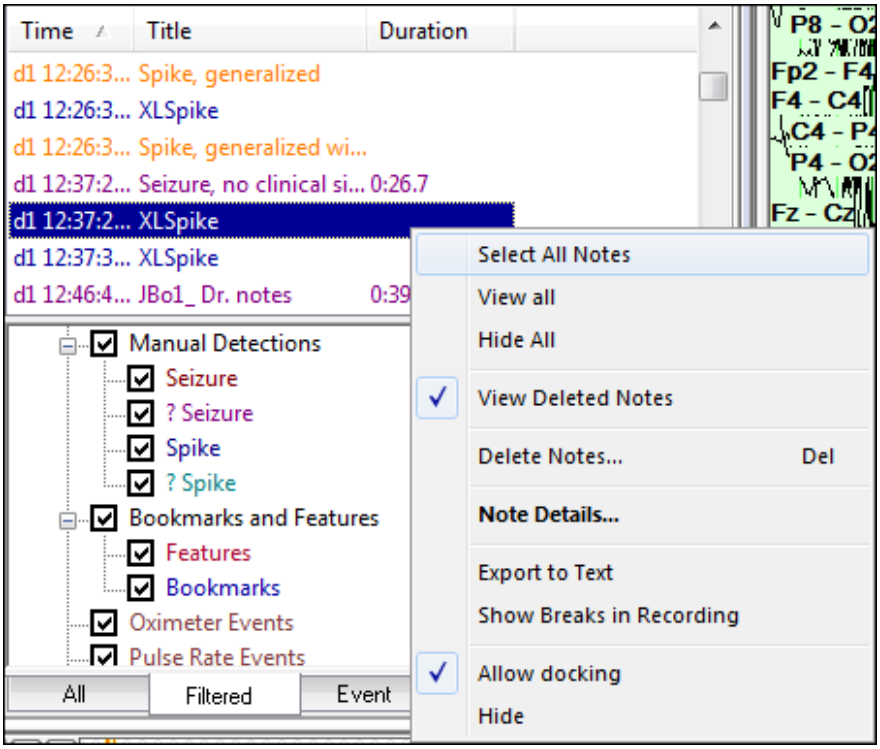
Delete Notes by Type Option in Annotation Viewer

Selecting and Modifying Multiple Events

It is possible to select multiple events in the Annotation Viewer using standard multiple selection (using **Ctrl** or **Shift** keys combined with the mouse clicks). Click on the first that you want to select, then use **Ctrl + click** to select or unselect individual notes. Use **Shift + click** to select a range between the originally selected first note and the note that you click on.

To select **all** notes right click in the Annotation Viewer and select **Select All Notes**.

The multiple selection is only shown in the Annotation Viewer. The Trace view displays a single note as selected. This is the note that has “focus” rectangle in the annotation viewer.



Selecting Multiple Notes in Annotation Viewer

Several operations can be performed on multiple notes:

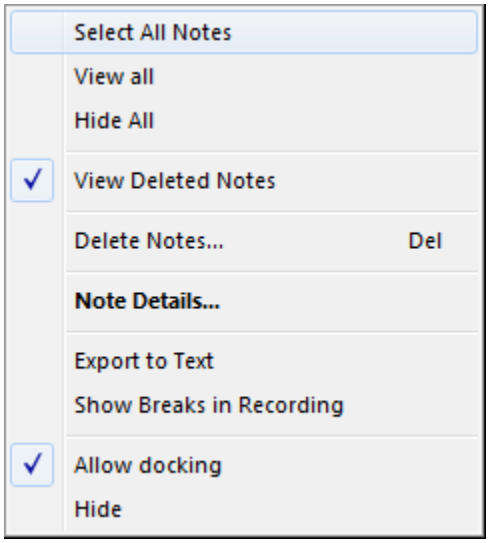
- Change Notes Type
- Accept Events (auto-detections)
- Delete Notes

To change type of multiple events, select multiple events (using Ctrl or Shift and a mouse click) and select a new type from **Change Note Type** menu. This may be easier to do by using Filter tabs or sorting events by title. This option may save time when you want to change type for multiple auto-detections or correct scoring done by a different user.

Note: Only sleep events are affected by Change Type operation. Other annotations (information, system events, etc.) are not modified.

Exporting Annotations

Right-clicking in the Annotation Viewer provides additional options to customize or alter the annotations in the viewer. The **Export to Text** options allows you to export all displayed notes into a text file. The text file is stored in the study directory as a **.TXT** file.



Options in Right-click Dropdown Menu of Annotation Viewer

9.2 Displaying/Hiding/Deleting/Restoring Notes

Adding a Note

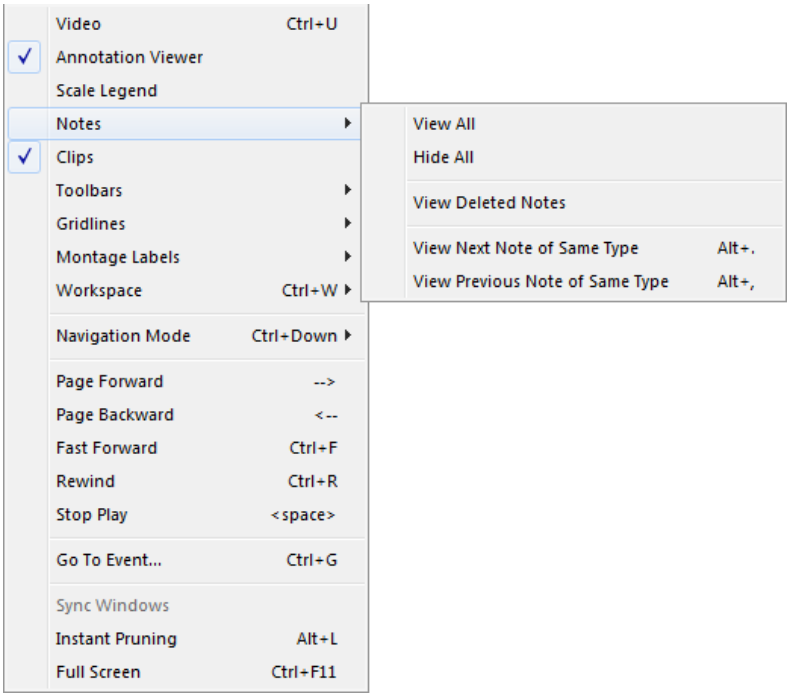
To quickly add a note during a live study:

1. Start typing the note using the keyboard.
2. The **Note** dialog box opens.
3. Finished typing the note, then click **OK**.
4. The note is placed in the waveform window and in the Annotation Viewer at the time that you started typing.

Hiding or Displaying All Notes

To hide or display all annotations:

1. Open the **View** menu and select **Notes**.



Notes Menu Items

2. Select View All or Hide All.

For information on displaying or hiding individual note types or whole event groups, see Annotation Viewer.

Deleting Notes

To delete or restore notes:

- To delete a note from the **trace display**, click the note to select it. Then press the **Delete** key on your keyboard.
- To delete a selected Bookmark or Feature Mark, click the **Delete** icon on the **Bookmark** or **Feature Mark toolbar**. This will not affect the selection of the notes in the trace display.

To view notes that have been deleted from the study:

- Choose **View > Notes > View Deleted Notes**.

Restoring Deleted Notes

To restore previously deleted notes:

1. Make sure deleted notes are shown using the menu option cited above.
2. Double-click on a note to get to the **Note Details** dialog box.

3. Press the **Restore** button.

9.3 Adding Notes and Custom Notes on the Fly

Notes can be added anywhere on screen in NeuroWorks EEG **Live** or **Acquisition** mode.

Adding a Note by Clicking

To add a note by clicking:

1. **Left-click** anywhere on the study traces (except for other mouse-sensitive areas such as the labels or the scale legend).
2. The acquisition **Notes** menu opens.
3. Choose **Custom** or a pre-defined note.
4. If you choose **Custom**, fill in your information in the **Note box**.

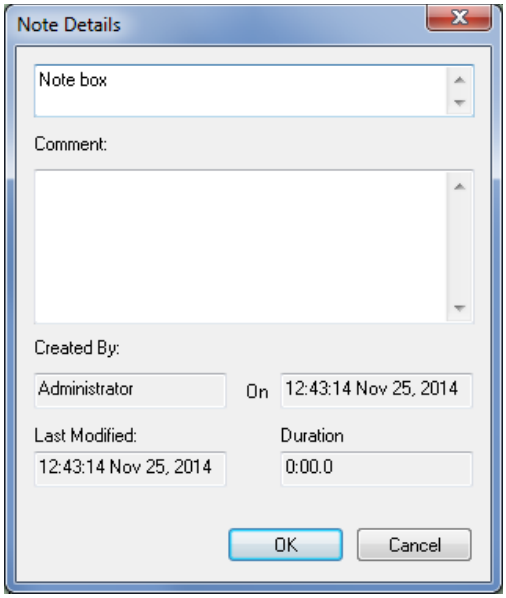
When a selection is made, the note will be put at the place in a study where the mouse was clicked (*not* at the current time location). This allows you to align the notes with the events of interest on the traces during live recording and eliminates the need for further adjustment in review.

Adding a Note by Typing

You can quickly add custom notes on the fly when a study is being recorded.

To add a note on the fly:

1. Begin typing the note on the keyboard.
2. The **Note box** opens.



Note Box

3. When you have finished entering the note (and any comments you would like to make), click **OK**.

The note is placed on the waveform window and in the Annotation Viewer at the time you started typing.

9.4 Bookmarks

When you add a bookmark to a study, NeuroWorks saves a view of exactly what that whole page of data looks like, including montage settings and filter settings. In other words, a bookmark saves a page of a study including the context at the time that the bookmark was selected.

This is useful when, for example, a doctor adjusts the montage and filter settings in order to bring out a particular clinical feature of the EEG and wants to save that exact page of EEG data, using the exact montage and filter settings currently being displayed. Then, another doctor or technologist can navigate to the saved Bookmark and see the EEG in the exact same way that the initial doctor saw it. When you insert a bookmark, a bookmark icon is placed on the trace display to mark the saved page and an annotation is added to the Annotation viewer.

NOTE: A limit of 20 bookmarks can be added to a study.

If the bookmark icon is an open book, then the bookmark is currently being viewed in the same context in which it was recorded.

If the bookmark is a closed book then the bookmark is currently being viewed in a different context. In this case, you can double-click the bookmark icon to restore the saved context of the bookmark.

Bookmarks Toolbar

The **Bookmarks toolbar** manages the creation of and navigation through created feature marks. To open the Bookmarks toolbar, open the **View** menu in NeuroWorks EEG, select **Toolbars** and select **Bookmarks**.

Bookmarks Toolbar

TIP: To see the function of each button on the toolbar while using NeuroWorks, point to a button and a ToolTip with the purpose of that button will appear.

9.5 Feature Marks

A **feature mark** is a tool that enables you to select (by dragging a rectangle with the mouse) and save a region of interest in a study. This is useful when, for example, a doctor adjusts the montage and filter settings in order to bring out a particular clinical feature of the EEG and wants to save a view of a region of EEG data, using the exact montage and filter settings currently being displayed.

NOTE: The region of interest of a feature mark has a rectangle drawn around it with the background of the EEG within the feature mark changed to a light blue.

Later another doctor or technologist can navigate to the saved feature mark and see the EEG in the exact same way that the initial doctor saw it. Feature marks can be fully annotated and have many comment fields that can be filled out from either pre-configured menus or with custom information.

When you add a feature mark to a study, a feature mark icon is added to the trace display in the upper-left corner of the selected region. During review, the appearance of this icon indicates whether the feature mark still has the same context as when it was originally selected:

If the feature mark icon is an upright yellow flag then the feature mark is currently being viewed in the same context in which it was recorded.

If the feature mark is a tilted white flag then the feature mark is currently being viewed in a different context. In this case, you can double-click the feature mark icon to restore the saved context.

NOTE: A limit of 20 feature marks can be added to a study.

The region of interest of a feature mark has a rectangle drawn around it with the background of the EEG within the feature mark changed to a light blue.

Feature Marks Toolbar

The Feature Marks toolbar manages the creation of and navigation through created feature marks. To open the Feature Marks toolbar, open the View menu in NeuroWorks, select Toolbars and select Feature Marks.

Feature Marks Toolbar

NOTE: To see the function of each button on the toolbar while using NeuroWorks, point to a button and a ToolTip with the purpose of that button will appear.

10. Channel Labeler

10.1 Overview

The Channel Labeler is commonly used with the Natus Quantum, and Xltek's EMU128 or NeuroLink IP headboxes. It provides:

- An easier way of assigning channel labels for 128+ channel grid patients.
- A way of visualizing the placement of the grids on the patient's brain.
- A way of labeling montages with the new channel labels.

Installing Channel Labeler

The Channel Labeler application may be installed, if available, during the NeuroWorks installation as an Add-On option. It may also be installed after NeuroWorks and the SQL Server have been installed. For this option, browse to the installation location. If browsing from CD:

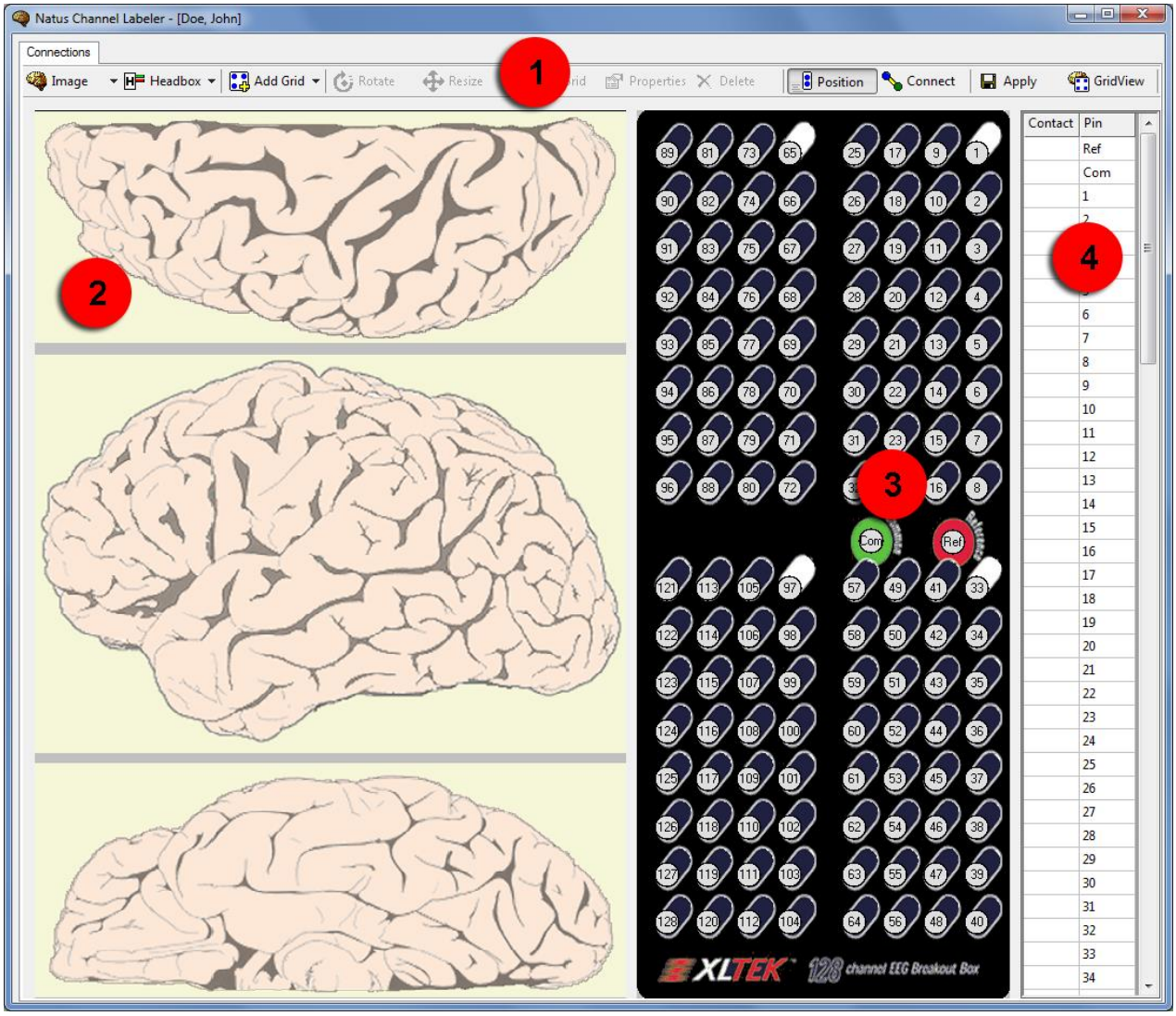
1. Open Windows Explorer.
2. Browse to the CD.
3. Double click on the **SwitchMatrix** folder.
4. Double click on **Setup.exe**.

The installation will install to the directory where NeuroWorks is installed. This directory is typically **D:\Neuroworks\SwitchMatrix**. The installation will copy all application files, brain image files and set up the database. This database is used to store grid definitions and patient information.

Channel Labeler Interface

The Channel Labeler interface is divided into 4 sections:

A. Control Toolbar
B. Brain Image
C. Headbox Pins
D. Contact to Headbox Pins Table

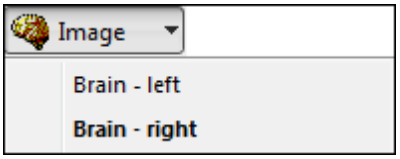


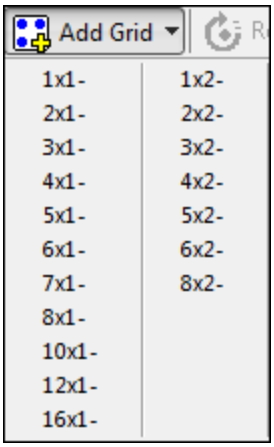
Channel Labeler User Interface

Control Toolbar

The Control toolbar allows you to change the brain image, add and manipulate grids and set new labels.

Channel Labeler Control Toolbar Buttons

Button	Description
	Click on the arrow to select between right and left images of the brain.

Button	Description
	Click on the arrow to select a grid to add to the brain image.
	Select a grid and click **Rotate** to rotate the grid to the correct angle. To stop the grid from rotating further, click **Rotate** again. To rotate the grid in the opposite direction, click **Rotate** again.
	Select a grid and click **Resize** to change the grid's size. To stop the grid from resizing further, click **Resize** again. To resize the grid in the opposite direction, click **Resize** again.
	Select a grid and click **Properties** to change the grid's name and color.
	Select a grid and click **Delete** to remove the grid from the brain image.
	There are two modes of operation: **Position** and **Connect**. To add, position and rotate grids, first click Position. To connect grids to pins in the breakout box, first click Connect.
	If a study is running, click **Apply** to set the new channel labels. These channel labels can then be used in a montage.
	Selecting GridView opens the Stellate GridView software. Refer to Stellate GridView for additional information.
	Click **Exit** when you are finished assigning labels. Exit will set the new channel labels and close the **Channel Labeler**.

Brain Image

To set which brain image to use, click on **Select Image**. You can select between right and left images.

When adding grids, they will be placed on the brain image.

In **Position** mode, you can rotate and move the grids around the brain image.

In **Connec**t mode, you can connect an individual contact or an entire grid on the brain image to the headbox pins.

Headbox Pins

In **Connect** mode, you can select a pin and determine which contact is plugged in.

This area is not used in **Position** mode.

Contact to Headbox Pin Table

Contact to Headbox Pin table matches contacts to pins. It displays the specific contact name and its corresponding pin number. This pin number indicates the pin on the headbox.

10.2 Using Channel Labeler

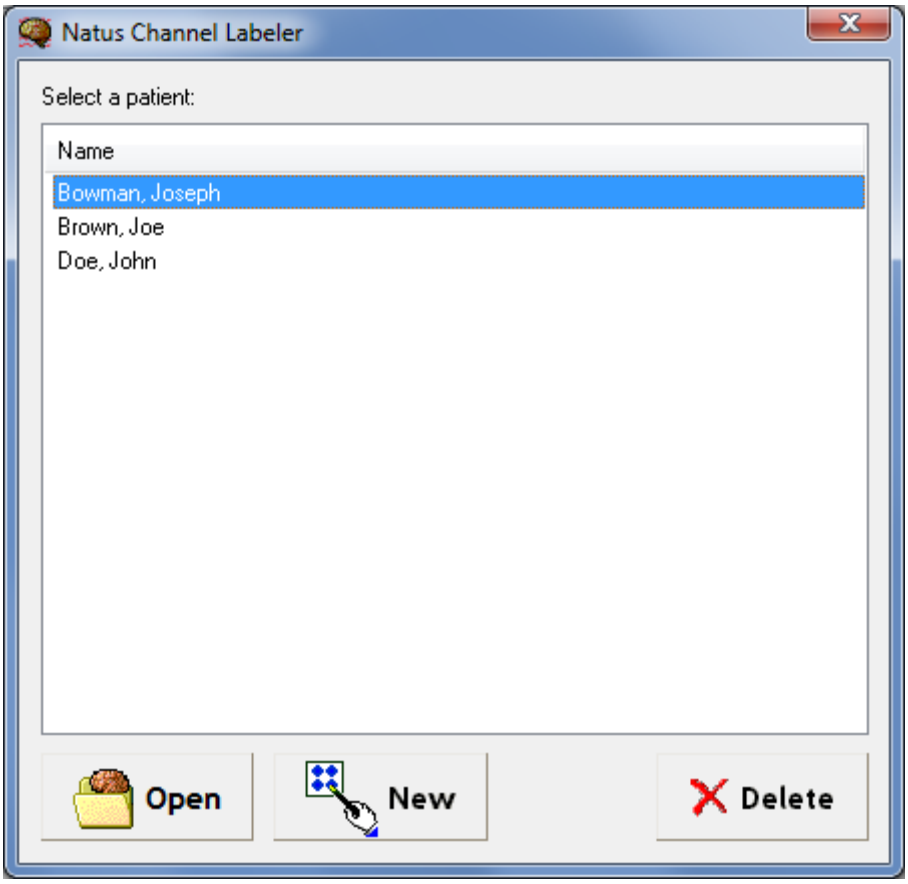
The Channel Labeler can be used during study acquisition or before a study has started.

To apply a grid in Channel Labeler:

1. In **Natus Database**, right-click on a the patient or study record and select **New Channel Labeler Session** (NeuroWorks 7.1 or later)

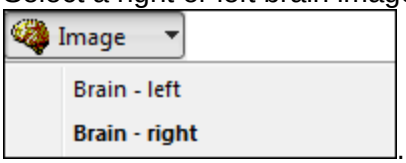
   OR

   In NeuroWorks EEG, select **Edit > Settings > Channel Labels** and press **Channel Labeler** button (NeuroWorks 7.1 or later).
2. When Channel Labeler opens, you can work with a previous patient or create a new patient. You must always enter a patient name even if a study is running.
3. To select a new patient, click the **New** button, enter the patient's name and click **OK**. To select an existing patient, click on the patient's name and click **Open**. After choosing a patient, the session loads.

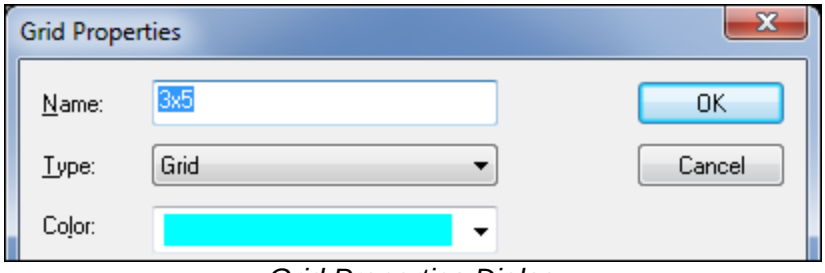


Selecting a Patient in Channel Labeler

4. Select a right or left brain image by clicking on the **Select Image** dropdown button



5. Add a grid to the brain image:
   a. Click on **Add Grid** dropdown button.
   b. Click on the grid that most closely matches the grid in the patient's head.



Grid Properties Dialog

   c. In the **Grid Properties** dialogue box, enter the name of the grid. Start typing if you want to give the grid a new name. Use the right arrow key if you want to add to or change the name. This name becomes the prefix for all contacts on this grid. That is, if you have a 3x3 grid and enter a name of LT, the contacts will be

named LT1, LT2 through LT9. If you name the grid LT-, the contacts will be named LT-1, LT-2 through LT-9.

d. Choose a color for the grid. This is the color that the grid will have on the brain image.

e. Click **OK**.

6. Position the grid by moving and rotating it to the proper location:

a. Click on **Position** to ensure that you are in Position mode. If you are in Position mode, the Position button is depressed 

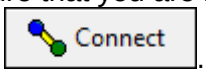
.

b. Left-click on the grid, hold the left mouse button down and drag it to the proper position. Your mouse cursor will change to a hand.

c. Left-click on the grid to select it. Use the rotate button or the mouse wheel to rotate the grid. Or click on the mouse wheel to start automatic rotation. Release the mouse wheel to stop rotation.

You can add as many grids as you need and connect them. The connections must match the physical connections used from the patient's electrodes to the breakout box. Once all of the grids are added, they can be connected to specific pins.

Connecting Grids

To connect multiple grids, click on **Connect** to ensure that you are in Connect mode. If you are in Connect mode, the Connect button is depressed 

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There are four different ways to connect the grid to pins.

Method 1: Connecting Entire Grid Starting at First Available Pin

To connect the entire grid at the first available pin:

1. Right click on the grid.
2. Click Connect Grid.

NOTE: If any of the contacts on the grid are connected to pins, you must disconnect these contacts before the entire grid can be connected.

To disconnect a grid:

1. Right click on the grid.
2. Click Disconnect Grid.

Method 2: Connecting the Entire Grid Starting at a Specific Pin

To connect the entire grid at a specific pin:

1. Left click on contact 1 of the grid.
2. Hold the left mouse button down and drag to the specific pin.

3. When prompted, for example, **"Do you want to auto-connect grid "LT"?"** Click **Yes** to auto-connect the grid. Clicking **No** will connect only Contact 1 to the specific pin.

NOTE: If any of the contacts on the grid are connected to pins, you will not be prompted to auto-connect the grid. You must disconnect these contacts before the entire grid can be auto-connected.

To disconnect a grid and continue:

1. Right click on the grid.
2. Select Disconnect Grid.
3. Left click on contact 1 of the grid.
4. Hold the left mouse button down and drag to the specific pin.
5. Click **Yes** to auto-connect the grid.

Method 3: Connecting a Specific Contact to a Specific Pin

To connect a specific contact to a specific pin:

1. Left click on the specific contact.
2. Hold the left mouse button down and drag to the specific pin.

Method 4: Connecting a Specific Pin to a Specific Contact

To connect a specific pin to a specific contact:

1. Left click on the specific pin.
2. Hold the left mouse button down and drag to the specific contact.

Once a connection is made between a specific contact and pin, it can be changed by using Method 4.

To disconnect a specific contact:

1. Left click on the specific contact. You will see a connection line between the contact and pin.
2. Right click on the specific contact.
3. Select Disconnect Contact.

To disconnect a specific pin:

1. Left click on the specific pin. You will see a connection line between the pin and contact.
2. Right click on the specific pin.
3. Select Disconnect Contact.

You can also use the **Contact to Headbox Pin** table to select a contact-pin pair.

Changing the Grid Name or Color

To change the grid name or color:

1. Left click on the grid to select it.
2. Right click and select **Properties**.
3. Change the grid name or color.
4. Click **OK**. If any contacts on the grid are connected, the Contact to Headbox Pin table is automatically updated with the new contact names.

Setting Ground (Common) and Reference

The ground and reference can be set from contacts on grids or with new grids.

To add a new grid for ground or reference:

1. Click on **Add Grid**.
2. Select **1x1**.
3. Change the grid name to your name for ground or reference.
4. Click **OK**.

To set the ground or reference from a contact on a grid:

1. Left click on the contact.
2. Hold the left mouse button down and drag to the ground or reference location on the **Headbox Pin** image.

The ground and reference do not appear in the montage. They are set here for record keeping purposes.

Setting Channel Labels

While a study is running, channel labels can be set for a montage. To set channel labels, click **Apply** 

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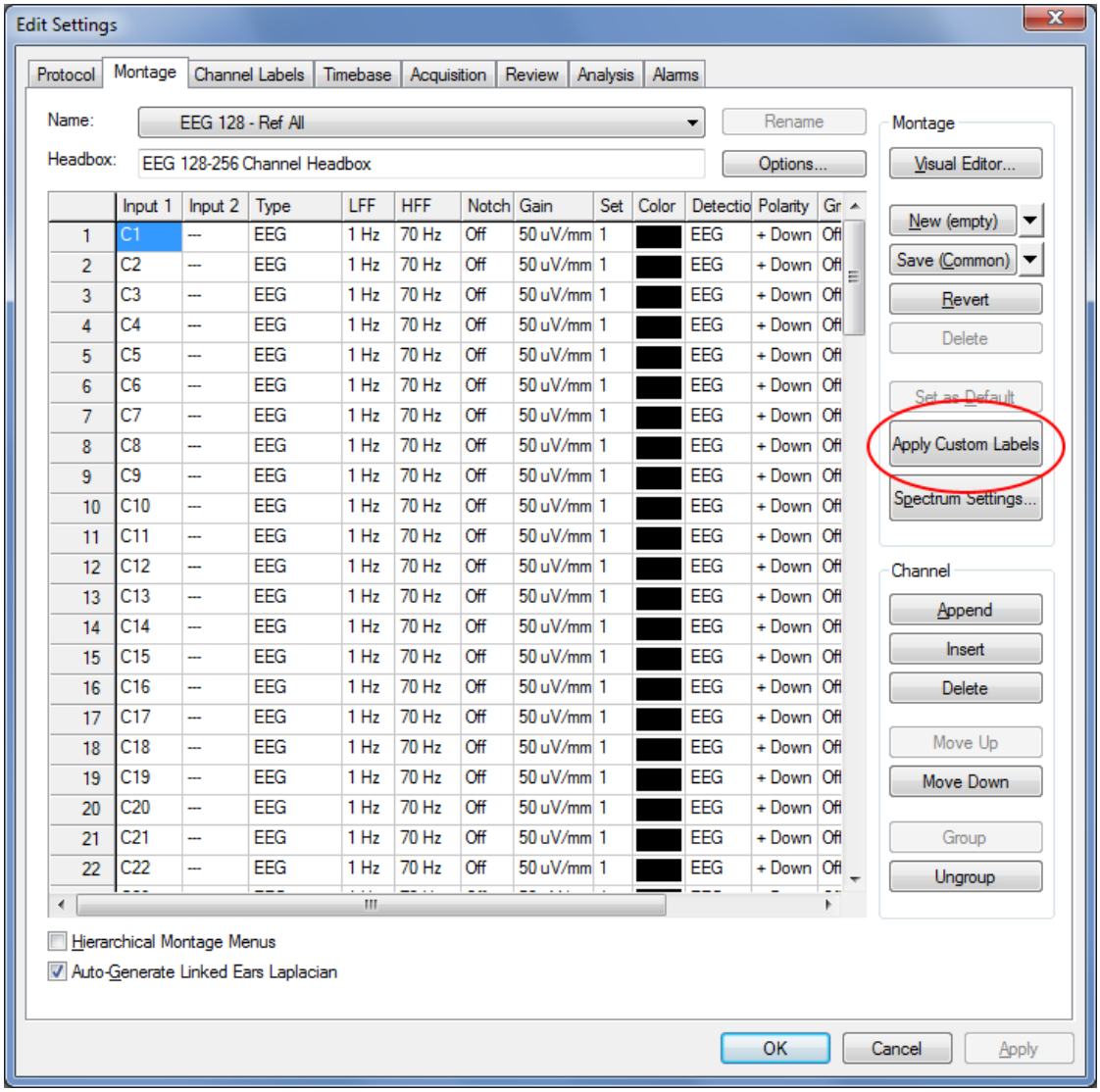
The existing montages or the traces on the screen will not be updated automatically. To update the current montage, from the **NeuroWorks EEG** application:

1. Select **Edit > Settings**.
2. Select the **Montage** page.



NeuroWorks EEG Montage Editor

3. Click on the **Apply Custom Labels** button. The montage labels will be changed to reflect the new channel labels.
4. To save the montage with the new channel labels, click on the **Save** button. The montage can be saved into a common montage repository or with the patient.
5. To apply the new montage labels to the traces, click **OK**.

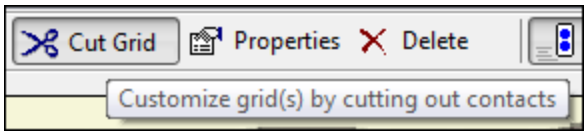
If a study is not running, the labels will be set and can be used when a montage is created or changed.

Grids Customization

Often intra-cranial electrode grids are customized (cut) to conform to the exact brain surface and / or the surgical procedure. This may affect how the individual electrodes are numbered. To facilitate accurate documentation of the procedure and proper mapping of the channels, Channel Labeler allows disabling single electrodes on any standard grid to account for any electrodes that have been cut (NeuroWorks 7.1 or later).

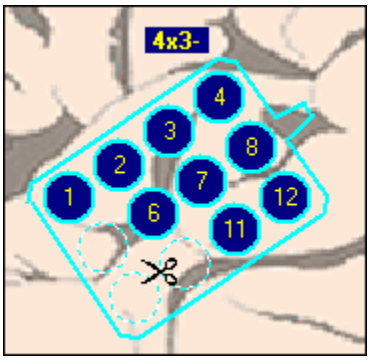
To customize grid:

1. Open Channel Labeler and open an existing session or start a new session
2. Go to **Position** mode.
3. Press the **Cut Grid** button to activate grid customization mode. The cursor turns into scissors.



Cut Grid Button in Channel Labeler

4. Click sequentially one by one on every grid electrode that was cut out. The cut electrodes are marked as disabled and cannot be connected to the headbox pins.



Cutting Grids in Grid Customization Mode

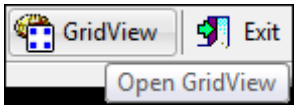
5. To revert the electrode to “active” state, click it again while the scissors cursor is active.
6. Un-press **Cut Grid** button again to cancel this mode.

Stellate GridView

NeuroWorks is now integrated with the optional **Stellate GridView** software. GridView is an integrated platform of intracranial electrode localization and 3D brain / electrode visualization. It provides an efficient way to visualize and convey your intracranial findings, with functionality specific to intracranial EEG studies.

When GridView is purchased and installed on a NeuroWorks computer, it allows easy importing of electrode data from NeuroWorks software.

GridView software can be launched directly from a **Channel Labeler**. To launch GridView, open an existing Channel Labeler session or create a new one, and configure the grids providing dimensions. Ensure the grid contact numbering corresponds to the actual labels on the electrodes. Press the **GridView** button to transfer the session information and open GridView.



GridView Button in Channel Labeler

For more information on installing and using Stellate GridView with NeuroWorks software, see the **Stellate GridView User Manual** p/n DOC-UG-GV20.

10.3 Channel Labeler FAQs

1. How do I change the brain images?

To select between the brain images, click on the **Select Image** button on the **Control** toolbar.

Your own images can be added or the default images manipulated. Images are stored in <Install Directrory>\Brains (typically D:\Neuroworks\SwitchMatrix\Brains). The default images are 545x870 pixels at 72 pixels/inch.

2. What happens if the grid that I want is not in the list?

You can use a grid that most closely matches your criteria and then disconnect the extra contacts. That is, if you need a 7x6 grid, you can add a 8x6 grid, connect it and then disconnect contacts 43 through 48.

3. How do I add strips or depths?

Strips or depths can be added using the 1xn series of grids.

4. Why can't I move or rotate a grid?

Ensure that the grid is selected. The contacts and name are highlighted if the grid is selected.

Ensure that you are in **Position** mode. 

5. Why can't I change connections for a grid?

Ensure that the contact is selected. The contact will appear in a different color than its neighbors and if already connected, will have a connecting line.

Ensure that you are in **Connec**t mode. 

6. How do I change the name of an individual contact?

Specific contact names cannot be changed through the Channel Labeler. To change the name of the entire grid, select the grid and choose properties.

7. Does the grid color change the color of the traces in my montage?

The montages traces do not automatically reflect the grid color. In order to change the trace color, open the montage editor in **NeuroWorks EEG** through **Edit > Settings**. Select the group of traces corresponding to a specific grid, right click in the color column and select the new color.

8. Why aren't my labels appearing in NeuroWorks EEG?

Click **Apply** in the Channel Labeler application if a study is running.

11. Label Factories

11.1 Overview

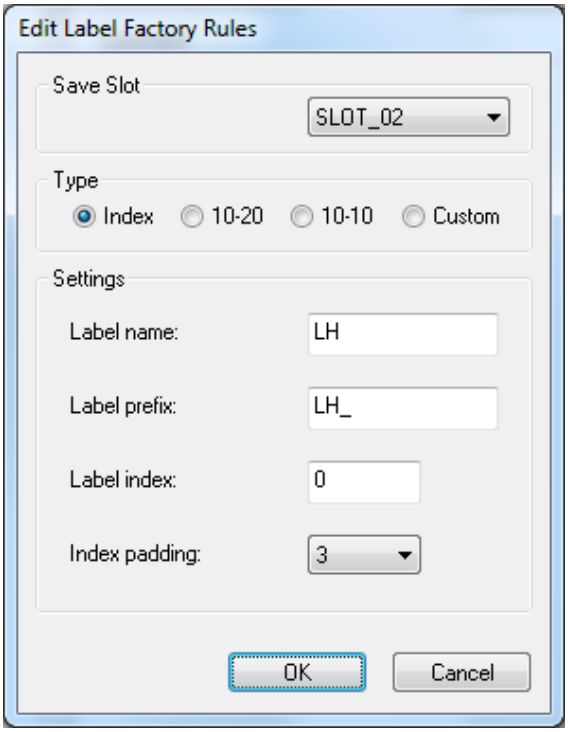
NeuroWorks currently has two methods for labelling channels. For grid studies with 128 or more channels, a dedicated Channel Labeler utility addresses the complexities of grid placement and mapping of grids to physical headbox channels. For other headboxes, with considerably fewer channels, a manual method is provided within the NeuroWorks / SleepWorks software. The manual method involves selecting each physical channel, one at a time, and entering a new label, advancing to the next channel and so on.

The **Channel Labels** tab has been enhanced to address this issue using **Label Factories,** which are components that generate labels with a sequential index in a pre-defined format. Label factories can be applied to multiple selections in the channel label list. Up to 10 label factories can be defined and accessed using the context menu. Each label factory is stored in a **Save Slot** which are numbered 1 to 10.

11.2 Creating or Editing Label Factory Rules

To create or edit Label Factory Rules:

1. In NeuroWorks EEG, select **Edit > Settings > Channel Labels** (tab).
2. Right-click on the **Channel List** and select **Edit…**. The **Edit Label Factory Rules** dialog displays.



Edit Label Factory Rules Dialog

3. Select a save-slot to use for the desired label factory settings from the drop-down list.
4. If Label Factory settings were previously saved to this slot, they will populate the Label Factory elements. These are defined in the following table:

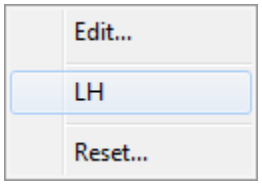
Label Factory Elements

Element	Description
Save Slot	Up to 10 different label factories can be created and saved, each to a **Save Slot**. 
Type	There are several types of label factories including **Index**, **10-20**, **10-10**, and **Custom**. 
Label name	This is the tag displayed in the context menu (e.g., LH in the example below). 
Label prefix	Each **Index** type factory label is created with a prefix followed by an index value. The prefix can be up to 5 characters long and may be made of alpha-numeric values, the underscore and a few other characters. If an illegal character is entered, it will be stripped out as the focus is moved from this field. For **Custom** labels, this prefix is the name of the label package. (e.g., LH_ in the example below) 
Label index	For **Index** type factories, the most recent index value. The next label will be generated with an index equal to this value plus 1. 
Index padding	For **Index** type factories, the numeric index of the label can be padded by up to 3 characters. Zero padding is the same as padding by 1. Examples of padding by 3 -> 001, 011, 111, 1111. Examples of padding by 2 -> 01, 11, 111. Zero padding (default) -> 1, 11, 111... 

Note: If the **Label name** is empty, the factory will not be available from the context menu even though other values may be saved and be available between sessions. This behavior can be utilized to de-clutter the context menu.

5. Make the required changes and click **OK** to save the Label Factory.

When you right-click in the Channel Labels list, the new label factory will be displayed in the context menu in the order of save slots 1 through 10.

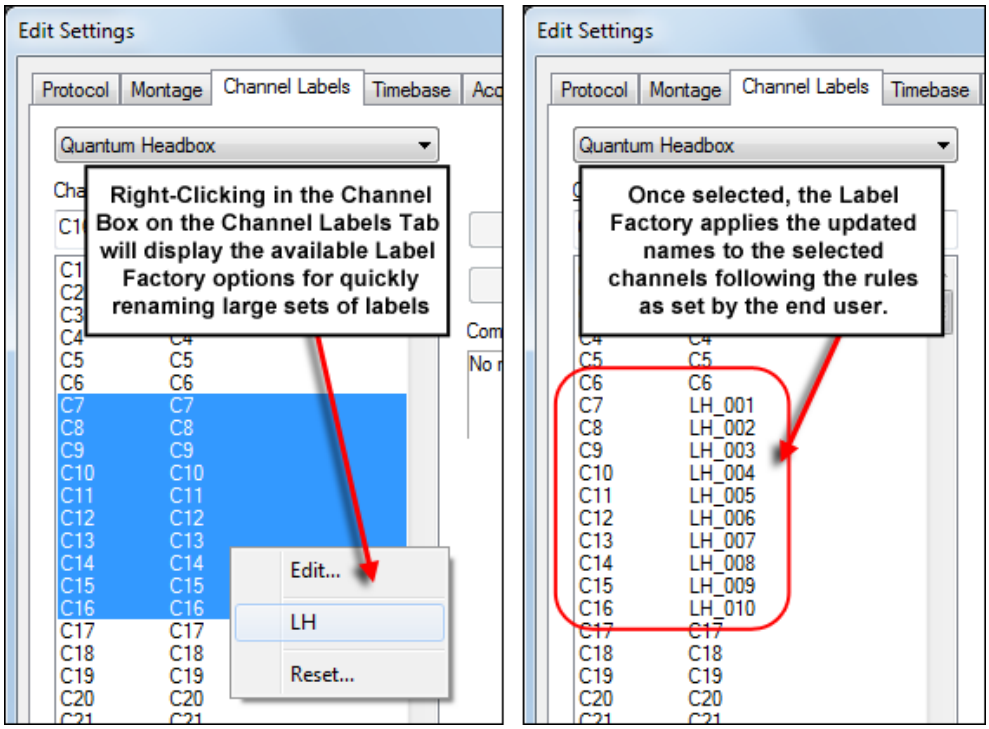


Label Factory – Context Menu

11.3 Applying a Label Factory to a Channel Selection

To apply a label factory to a channel selection:

1. In NeuroWorks EEG, select **Edit > Settings > Channel Labels** (tab).
2. Right-click on the **Channel List** and select the label factory from the list. The channel names are automatically updated according to the rules set.

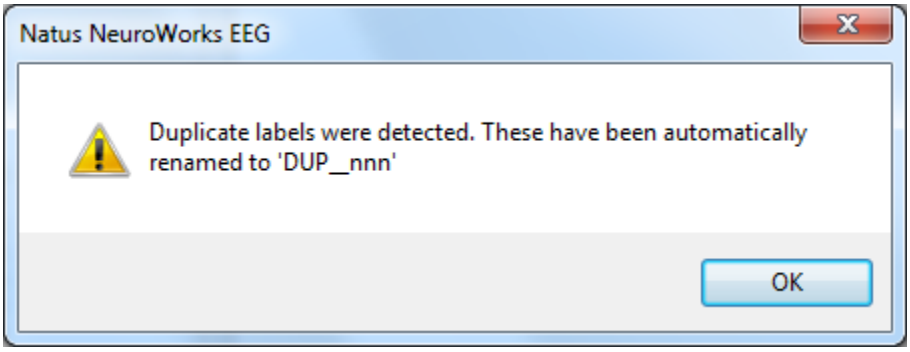


Selecting Label Factory in Channel Labels Tab

You can apply a label factory multiple times to a channel list by selecting additional channels and following the above steps as many times as required to rename the channels. The index numbering of the subsequent selections continues from the last index of the previous application of the Label Factory.

Note: Holding the **CTRL** key on the keyboard while selecting a Label Factory from the context menu, resets the factory index. This means that applying the label factory to selected channels will begin with the number 1.

Note: Duplicates in the channel list are automatically detected and renamed to 'DUP_nnn' as seen by the warning dialog, below:



The numeric extent of each DUP_nnn label is indexed for each duplication detected in the current Settings session.

11.4 Restoring Original Channel Names as Labels

If you are relabeling channels and need to restore the original channel name:

1. Highlight the channels that need restoration and right-click for the context menu.
2. Select **Reset…**.
3. A confirmation dialog displays. Selecting **Yes** restores the original channel name label.

11.5 Label Factory Packages

By default, Label Factory Packages are stored in files named **NWLF_<name>.LFP**. They are persisted into the file system under **Neuroworks\Settings** or **Neuroworks\SettingsSleep**, depending on the modality. These are normal INI-style files with the following format:

```
 [HEADER]
  Schema=1
  Count=<number of labels>
[LABLE_LIST]
  L001=<label for channel 1>
  L002=<label for channel 2>
  Lnnn=<label for channel 'Count'>
```

For example, the 1020 Label Factory Package is called "NWLF_1020.LFP". Its contents are as follows:

```
[HEADER]
  Schema=1
  Count=25

[LABLE_LIST]
  L001=XX1
  L002=Fpz
  L003=Fp2
  L004=F7
  L005=F3
  L006=Fz
  L007=F4
  L008=F8
  L009=T3
  L010=C3
  L011=Cz
  L012=C4
  L013=T4
  L014=T5
  L015=P3
  L016=Pz
  L017=P4
  L018=T6
  L019=O1
  L020=Oz
  L021=O2
  L022=A1
  L023=A2
  L024=Pg1
  L025=Pg2
```

11.6 Creating a Custom Label Factory Package

The 1020 and 1010 packages are pre-defined by NeuroWorks. If these packages do not exist, NeuroWorks / SleepWorks creates them, and auto-populates their contents. However you also have the ability to create a custom label factory package.

To create a file-based custom label factory package:

1. Create an empty text file and rename its extension to LFP.

Note: Explorer must be configured to view file extensions to perform this task.

2. Name the file **NWLF_<name>.LFP** giving the **<name>** portion of the file a short, meaningful identifier to a maximum of 10 characters.
3. Copy this file to either the **Neuroworks\Settings** or **Neuroworks\SettingsSleep** sub folder depending on the modality (EEG or Sleep).
4. Open the file using **Notepad**.
5. Create sections for the **HEADER** and **LABEL_LIST**. Add the **Schema (=1)** and **Count** values in the header section. Refer to the above section under File Persistence for exact details.
6. Set the **Count** value equal to the number of labels to be defined in this package.
7. Under the **LABEL_LIST**, create L001 through Lnnn entries as L001=. To each of these, assign the custom label strings to a maximum of 8 characters.
8. **Save** and **close** the file.
9. Return to the NeuroWorks / SleepWorks Software, and open the **Edit > Settings > Channel Labels** (tab) ensuring that it is running in the modality of interest – either EEG or Sleep.
10. Right-click on the labels list, and select **Edit...**.
11. Specify the **Save Slot** and select the **Custom** type.
12. Give this factory a meaningful name so it is easily identified in the context menu.
13. In the **Label prefix** field, enter the name of the **<name>** portion created in step 2. This is how the custom factory knows which package to associate with the label generation.
14. Use the **<TAB>** key to leave the **Label prefix** field and select **OK** to save the Label Factory.

To apply the custom labels, follow the exact same steps as defined in *Section* ***Error! Reference source not found. Error! Reference source not found.***.

Placeholder Label

The asterisk is used as a placeholder label in a custom label factory definition. The asterisk will be replaced by the channel string. For example:

L001=*
L002=*
L003=*

Applied to C1, C2 and C3 will replace the labels for these channels with C1, C2 and C3, respectively.

11.7 Selecting a Custom Label Factory Package

When working with file persistence of Label Factory Packages, the Label Factory Dialog automatically locates all **NWLF_<name>.LFP** files and builds a drop-down list for the **Custom** factory type. This allows for convenient selection of a particular package from existing packages. In the following example, a file named **NWLF_TEST.LFP** was located in the current Settings folder and the package name **TEST** was extracted and added to the drop-down list.

When a new package is selected, the factory index is automatically reset to 0 so that the first application of the label factory will start at the label corresponding to L000.

11.8 Copying Labels to the Clipboard

Labels can be copied to the clipboard and then pasted into a text document to be used by the clinician as a guide when applying leads to a patient.

To copy all channels, select one of the channels in the list and then use the key combination <CTRL + A> (Select All). This will select all the channels. Next, use the key combination <CTRL + C> (Copy). Open an RTF or TXT document and use either Edit > Paste or the key combination <CTRL + V> (Paste) to copy the channel names and associated labels into the document. The document can be saved or printed.

The pasted channel labels will then be pasted as is shown below:

C1 L1
C2 L2
C3 L3

12. NeuroWorks EEG Menus

This chapter describes Menus in the NeuroWorks EEG (Wave) window. For Menus in Natus Database, see the Menus topic in the Natus Database chapter.

12.1 File Menu

The following table lists and describes the options available on the File menu.

File Menu Options

Option	Function/Description
Review (Ctrl + O)	Opens a selected study for review.
Monitor (Ctrl + M)	Displays the live data of another acquisition machine that is currently acquiring a study.
Close	Closes a study that you are currently recording or reviewing.
Save (Ctrl + S)	Saves changes made while reviewing a study. Studies are automatically saved after being recorded, so the Save function is only available in review mode.
Export	Creates a plain text version of a study and saves it in the location of your choice. This can be useful if you want to export EEG data to analyze in another software program
Create Report	Available on review stations that do not have the Natus Database installed. Allows users to create reports.
Edit Report	Available on review stations that do not have the Natus Database installed. Allows users to edit reports.
Delete Report	Available on review stations that do not have the Natus Database installed. Allows users to delete reports.
Report Options	Available on review stations that do not have the Natus Database installed. Allows users to change report options.

Option	Function/Description
Print (Ctrl + P)	Prints a study.
Print Preview	Displays a preview the print format of a study before printing.
Page Setup	Sets the page properties for printing.
Customize	Opens the **Customize** window. The **Customize** window contains tabs that allow you to customize NeuroWorks options.
Exit	Exits the program.

12.2 Edit Menu

The following table lists and describes the options available in the Edit menu. Options available vary depending on whether you are in Acquisition or Review mode.

Edit Menu Options

Option	Function/Description
Settings (Ctrl + T)	Opens the **Edit Settings** dialog box where you can: Set up a Protocol (**Protocol** tab) Create or apply a Montage (**Montage** tab) Set Channel Labels (**Channel Labels** tab) Set Timebase (**Timebase** tab) Set the Reference Electrode (**Acquisition** tab) Turn channels on or off (**Acquisition** tab) Set Play, Montage, and Save features (**Review** tab) Show Trend and Event plots on the Summary toolbar (**Plots** tab) Create and view Staging Sets (**Staging Sets** tab) Control the view of plots on the Summary toolbar (**Graph Properties** tab) Set parameters and scheduling for analyzers (**Analysis** tab)

Option	Function/Description
Calibrate	Enables you to select a monitor that matches the system monitor.
	NOTE: The **Headbox** calibration dialog box (which is dimmed) is used in-house by ***Natus*** engineers. All ***Natus*** headboxes are delivered to you fully calibrated. However, to find out how to test the calibration, see the topic Calibration and Verification.
Study Information (Ctrl + L)	Opens the **Study Information** window so you can add to or edit study information.
Increase Timebase (SHIFT + RIGHT Arrow)	Increases the speed of the **sweep edge** on screen simulating actual paper movement as data is recorded.
Decrease Timebase (SHIFT + LEFT Arrow)	Decreases the speed of the **sweep edge** on screen simulating actual paper movement as data is recorded.
Note Details	Displays details regarding the selected note.
Delete Note	Deletes the selected note.
Delete Notes by Type	Calls up a dialog box that lets you choose which note types you want to delete, then lets you delete them.
Mark Clip Start	Marks beginning of clip at time mark line. Also calls up **Note** dialog box that lets you name the **clip note** and enter **comments**.
Mark Clip End	Marks the end of clip at time mark line.
Clips (Ctrl + L)	Opens the **Clips** dialog box so you can clip and prune a study file. This option is only available in **Review** mode.

12.3 View Menu

Use the View menu to add and remove toolbars and features in the NeuroWorks window. Menu items with check marks are visible on the screen. If there is no check mark beside an item, it is hidden. Click any item in the View menu to add or remove a check mark and hide or display a feature.

View Menu Options

Option	Function/Description
Video (Ctrl + U)	Hides or displays the video window. For example, if the video window is currently hidden (unchecked), click **Video** to show the Video window.
Clips	Use to turn clip background color coding on or off.
Notes	Hides or displays all the notes of a certain kind of event or episode. A check mark appears beside each kind of note that is currently displayed. Available in **Review** mode only.
Annotation Viewer	Hides or displays the Annotation Viewer which shows a list of all **Notes**, **Bookmarks** and **Feature Marks** in a study.
Sentry	Hides or displays the Sentry - Live dialog box. The Sentry keeps track of all EEG program activities. This option is only available during a live acquisition or when a live acquisition is being monitored.
Scale Legend	Hides or displays an optional check on the speed and sensitivity of the recording. To change the placement of the scale legend, click and drag it to the desired location.
Toolbars	Enables you to determine which toolbars appear on the screen. Clicking a specific toolbar toggles its visibility on or off.
Gridlines	Hides or displays major and minor gridlines. Select an option to enhance the recording or avoid cluttering the waveform window.

Option	Function/Description
Montage Labels	Montage labels can be hidden, placed on top of the trace, or displayed as a side bar. Select **Options** to open the **Montage Label Options** dialog box and modify the size and placement of the channel labels on the montage. This option determines whether montage settings are displayed in the sizeable Montage Settings pane to the left of the waveform window.
Navigation Mode (Ctrl + Down)	Choose to navigate by: **Page**, **Scroll**, **Event** or **Event of Same Type**.
Page Forward	Moves one page forward in the record. Available only in **Review** mode.
Page Backward	Moves one page backward in the record. Available only in **Review** mode.
Fast Forward (Ctrl + F)	Scrolls forward in the record. Available only in **Review** mode.
Rewind (Ctrl + R)	Scrolls backward in the record. Available only in **Review** mode.
Stop Play <space>	Stops playback of the study. Available only in **Review** mode.
Go to Event (Ctrl + G)	Calls up an event list allowing you to jump to an event. Available only in **Review** mode.
Sync Windows	Applies to **two review sessions** of the same study. Open the same study twice from the **Natus Database** or use **Window > New Window** from **NeuroWorks**. Once you have two windows open (each with its own set of toolbars and tools), the **Sync Windows** option is enabled. You can then use it to synchronize navigation between windows. Available only in **Review** mode.
Instant Pruning	Displays the trace window as if you had already made clips and pruned the study.

Option	Function/Description
Full Screen	Displays only the trace window using the full screen and returns the view to normal again.

12.4 Trace Menu

The Trace menu contains options that control the display of electrode channels.

Trace Menu Options

Option	Function/Description
Select All (Ctrl + A)	Allows you to modify the settings of all channels at once.
Switch Set (Ctrl + `)	Permits you to switch from one combination of channels to another. For example, if you are running a study using the 128 channel headbox, you can customize the channels so that the first 32 channels are in set 1 and subsequent channels are in set 2. **Switch Set** is used to switch between the two sets of channels. This feature is useful when you have a large number of channels to display that cannot be displayed effectively at the same time. To select sets, choose **Edit > Settings > Montage**.
Show Selected	Shows the waveforms of the channels you have highlighted.
Hide Selected	Hides the waveforms of the selected channels.
Show All	Shows all waveforms.
Increase Gain (Arrow Up)	Increases gain (sensitivity) of the trace for selected channels.
Decrease Gain (Arrow Down)	Decreases gain (sensitivity) of the trace for selected channels.

Option	Function/Description
Distribute (Ctrl + D)	Returns waveforms to their original position before they were rearranged. To change the distribution of waveforms to enable comparison with other waveforms, click a channel label and drag it to a new position.
Superimpose	Superimposes selected waveforms.
Invert Trace	Flips the polarity of a displayed EEG or other signal trace.
Pen Response	Influences how closely the waveform shown on screen simulates a mechanical pen tracing. **Damping** slows pen response. **Resonance** controls how quickly a pen "settles down" after a disturbance. Clicking **Disable** returns the on-screen waveform to the program's default view.
Channel Properties	Calls up the **Channel Properties** box which lets you view and adjust channel properties.
Overlap	Allows channel traces to overlap (or, when not selected, prevents them from overlapping) each other on the screen. If **Overlap** is off, traces will be cut off if they get too big.

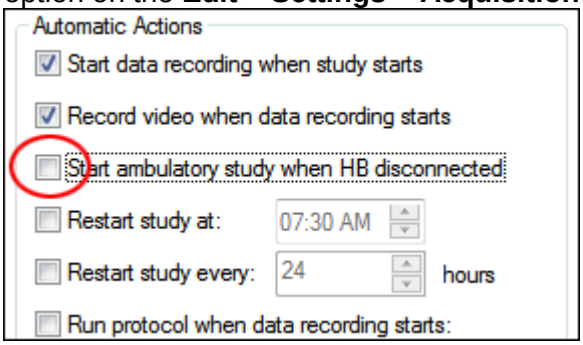
12.5 Controls Menu

This menu is available only in Acquisition mode.

Controls Menu Options

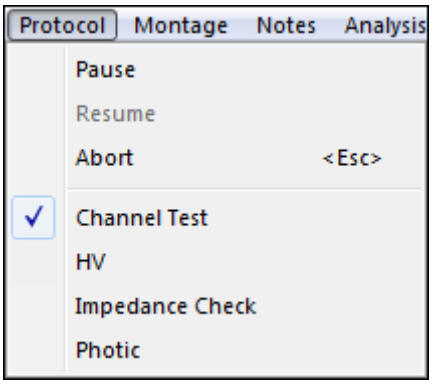
Option	Function/Description
Record (Ctrl+<space>)	Begins recording.
Stop Recording (Ctrl+<space>)	Stops recording.

Option	Function/Description
Record Video	Use to initiate or end video recording. When checked, video recording is enabled.
Impedance Check **(Ctrl + minus)**	Initiates an Impedance Check.
Lock Out Headbox Impedance Button	Disables the headbox impedance button on the headbox.
Channel Test Signal	Opens the **Channel Test** toolbar and initiates a Channel Test to verify the quality of signals from the headbox to the display. Applies an internally generated sine waveform to all channels.
Activate Channels	The Activate Channels tool in the Controls menu links to **Edit Settings > Acquisition** (tab) where available functionality lets you easily turn on all the channels in the active montage and turn off all other channels. The tool does not do the change itself but makes the task of selecting the right channels easier. The final decision is still yours.
	 **NOTE:** When channels are turned off, they will not be recorded and will be unavailable for review even if a montage that uses them is selected in Review.
Photic Stimulation	Turns the Photic Stimulator on.
Photic Stim OFF (Esc)	Turns the Photic Stimulator off.
DSM Stimulation	Turns on DSM (Digital Switch Matrix) Stimulation and opens the DSM toolbar.
	 **NOTE:** This selection is available only if the optional Digital Switch Matrix functionality has been purchased. Otherwise, it is disabled. As well, it is only functional with the **EMU128** and Quantum headboxes attached.

Option	Function/Description
Start Ambulatory Study (Ctrl + B)	Starts an ambulatory study. See also: Ambulatory Studies.
Start Ambulatory When Disconnected	This option is available only when using the **Trex** headbox. When enabled, the Trex begins recording an ambulatory study to its internal flash memory once it is disconnected from the main computer. If you do not want to run an ambulatory study and are using the Trex only in a clinical environment, disable this option.
	NOTE: This option works in tandem with a parallel option on the **Edit > Settings > Acquisition** (tab). 

12.6 Protocol Menu

The Protocol menu is available only in Acquisition (recording) mode. Protocol options are shown at the top of the menu. Available protocols are listed at the bottom.



Protocol Menu - Channel Test Protocol Selected

The following table lists describes the items available in the Protocol menu and what they are used for. Protocols listed are NeuroWorks default protocols.

Protocol Menu Items

Option	Function/Description
Pause	Pauses a protocol.
Resume	Resumes a protocol.
Abort (<Esc>)	Aborts a protocol.
Protocol	
Channel Test	Select to run the Channel Test.
HV	Select to run the Hyperventilation protocol.
Impedance Check	Select to run the Impedance Check
Photic	Select to run the Photic Stimulator protocol.

12.7 Montage Menu

Each headbox has a default montage. When NeuroWorks begins a new study, the default montage is automatically loaded for the attached headbox.

To set the montage, open the **Montage** menu and select an appropriate montage. This does not set the selected montage as the default. For further information, see Creating and Editing a Montage.

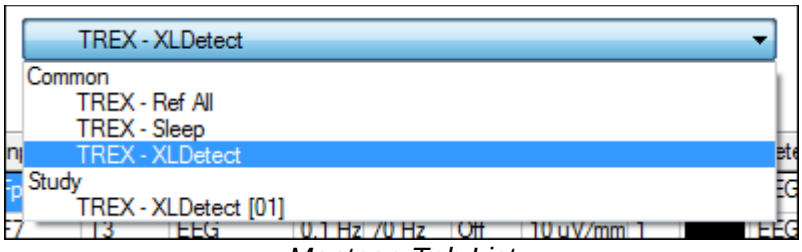
Montage Menu Groups

Group	Description
Common	Lists montages that are typically saved to a non-local drive. These montages can be accessible to everyone on the network.

Group	Description
User	Lists montages that are saved in the local directory.
Patient	Lists montages that have been created and saved for a **specific patient** whose study is currently being viewed. The montages listed in this section are part of the **Patient Information** saved in the database. If you use the **Returning** button when initiating a study from the **Natus Database**, then these patient-specific montages will be available in the **Montage** menu.
Study (visible in Review mode)	Lists montages that are saved with the current study. Montages that are used to acquire a live study are embedded in the study file to make these montages available on remote machines. If you review the study on a remote machine, the montages that were used during acquisition will also be available.

NOTE: When no study is open in Review or running in Acquisition, only montages that are compatible with the headbox are shown in the Montage menu. However, ALL montages are shown in the Montage tab list (**Edit > Settings > Montage**).

Montage Menu (Review Mode)



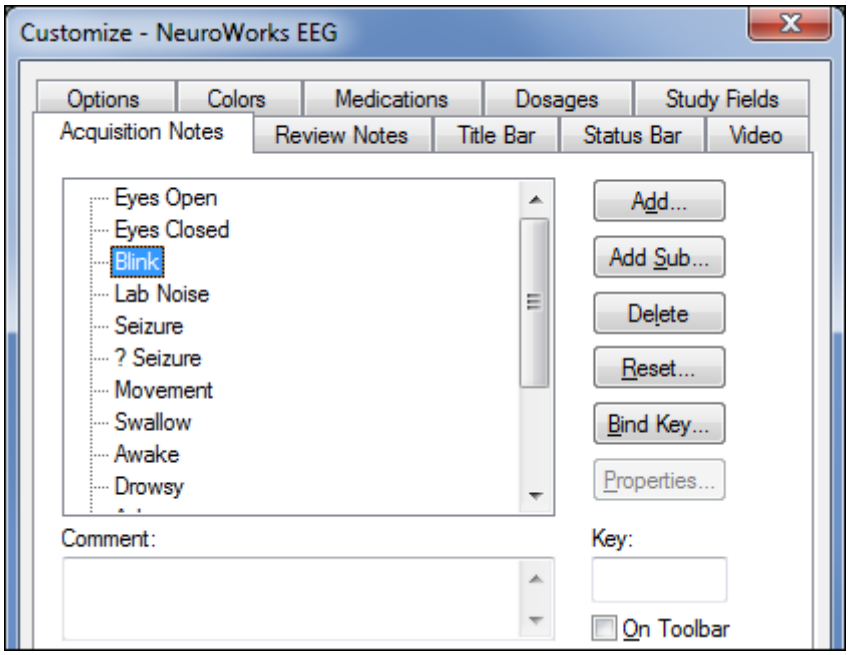
Montage Tab List

12.8 Notes Menu

The Notes menu lists preset notes that can be manually added to your study by qualified practitioners. Selecting an item from the menu adds the note. The items on the Notes menu vary depending on whether you are in **Acquisition** or **Review** mode.

To customize the selections that appear on the Notes menu:

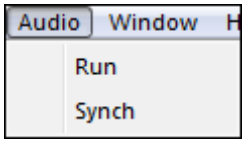
- Choose **File > Customize > Acquisition Notes**.



Customize Box—Acquisition Notes Tab

12.9 Audio Menu

The Audio menu is present only in **Review** mode.



Audio Menu

- The **Run** command on the Audio menu opens the **Audio Control Panel**.
- The **Synch** command synchronizes audio playback to the current position of the time-mark line in the waveform window.

Run Audio Playback

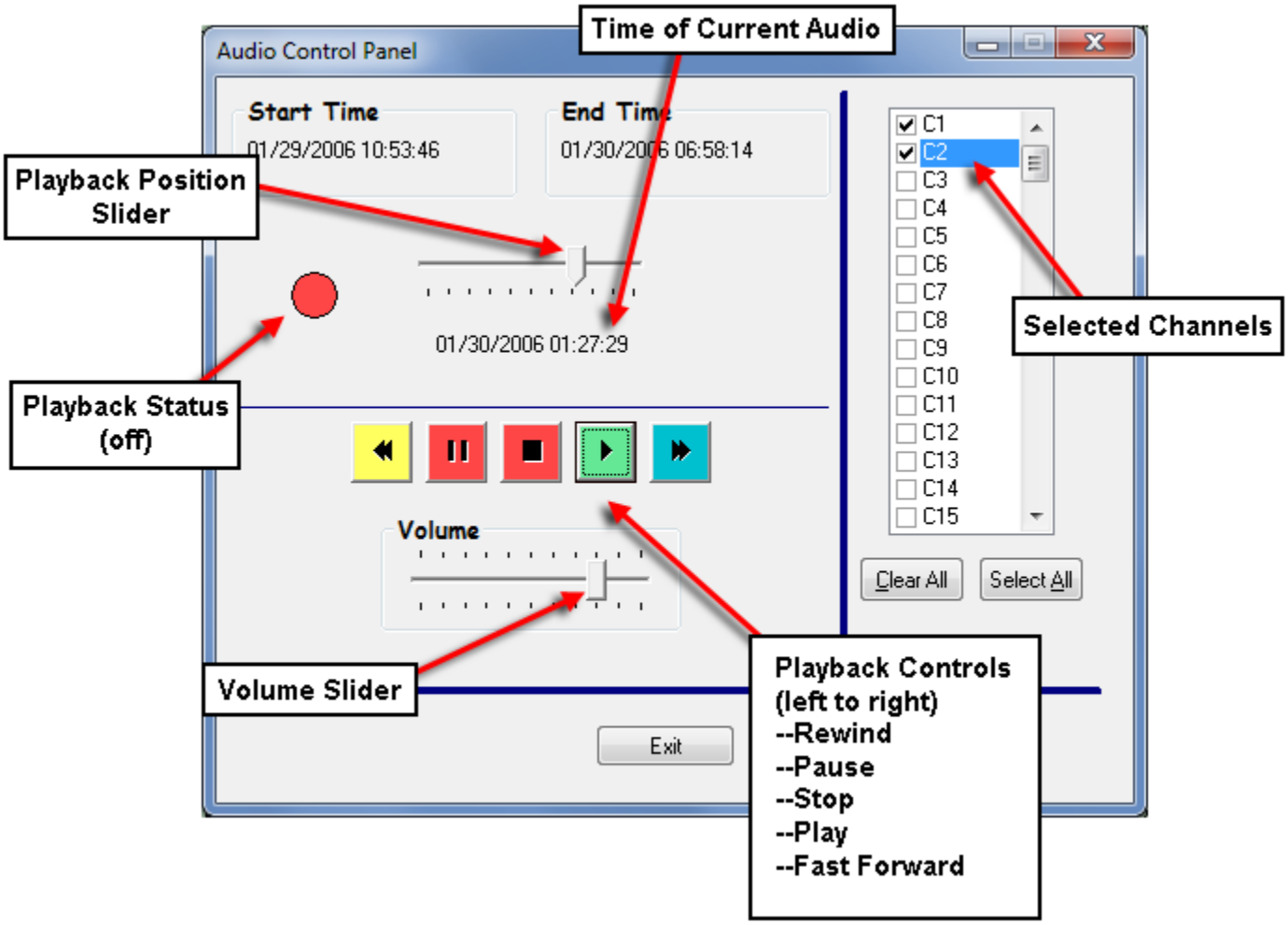
The **Run** command opens the **Audio Control Panel** so you can control audio playback of EEG data.

To open the Audio Control Panel:

1. Choose **Audio > Run**.
2. Select one or more channels to be included in the audio playback.
3. Use the **Review** toolbar to navigate to a point of interest in the study.
4. To start audio playback of the selected channels, click **Play**  .

Synchronize Audio Playback with Waveform Window Data

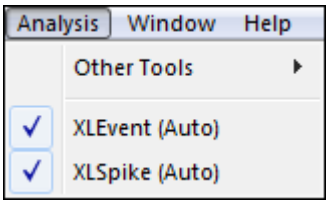
The **Synch** command on the Audio menu allows you to synchronize data played by the **Audio Control Panel** with the data displayed in the waveform window. For example, use the Review toolbar to move to a different location in the study. Then click Synch to synchronize audio playback with the data currently being displayed.



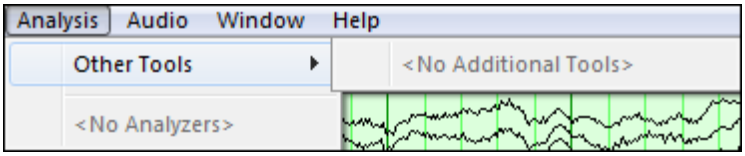
Audio Control Panel

12.10 Analysis Menu

The **Analysis** menu is visible in both the **Acquisition** and **Review** modes. However, in the majority of cases, it only shows items in Acquisition mode.



Analysis Menu – Acquisition



Analysis Menu – Review

The **Analysis** menu is used to manually activate detection systems (or analyzers) that have been added to the Analyzers pane on the **Analysis** tab (**Edit > Settings > Analysis**). In the illustration above, typical NeuroWorks analyzers have been added to the Analysis menu. If an item in the Analysis menu is checked, that type of analysis is currently running.

- **MagicMarker** is available under **View > Toolbars** dropdown menu if you have the latest version installed AND if the registry has been configured to allow integration. MagicMarker toolbar can also be added by clicking on **View > Toolbars > MagicMarker**.
- For more information on adding analyzers, see Installing Add-ons.

12.11 Window Menu

The **Window** menu contains options that let you split the screen and view two studies, or two versions of the same study, at the same time. This is can be done for comparison or in a consultative or quality management role

Window Menu Options

Option	Function/Description
Tile Vertical	Divides the screen into two windows vertically when reviewing a current or previous study.
Tile Horizontal	Divides the screen in two windows horizontally when reviewing a current or previous study.

Option	Function/Description
Arrange Icons	If two or more studies have been minimized to icons on the NeuroWorks program screen, and these icons moved about, clicking **Arrange Icons** lines the minimized icons up horizontally from the bottom left corner of the screen.
New Window	Splits the screen and displays the current acquisition in two windows. The highlighted window is the active (live) study. The **color** of the active study title will stand out according to your Windows desktop settings. Opening a new window of the current study allows you to **change the montage** in the **second** window and **compare** it with **original montage**.
Review Current Study	Splits the screen and lets you review saved sections of current study while you are still acquiring data.
Monitor Current Study	Available in **Review** mode only. Launches monitoring from initial **Review** machine of an **Acquisition** taking place on a **second machine** on the **network**. Lets you monitor while reviewing a prior study. Option is dimmed unless second machine is available.
Size to Ten Divisions	Sizes all visible windows to ten major grid lines in width.

13. Acquisition Profiles

13.1 Overview

An acquisition profile is a saved collection of acquisition settings which can be recalled from within the acquisition settings page as well as when starting a new or returning study.

For a given profile, each headbox type has its own set of properties that are remembered from one recording session to the next, or headbox affinity. This allows a user to quickly switch between several headboxes on a single workstation without having to adjust values, such as the sampling frequency, which may differ by headbox type. The values that have headbox affinity are:

- Reference Electrode
- Comments
- Sampling Frequency
- Channel Status (All Channels on or Set Manually)
- Electrode Detection
- Profile name
- Headbox Geometry (Quantum)

There are also settings that are not tied to a particular headbox type. These settings do not change with the selection of the headbox, and are found under the Automatic Actions section on the **Edit > Settings > Acquisition** (tab).

- Start data recording when study starts
- Record Video when data recording starts
- Start ambulatory study when HB disconnected
- Restart study at: – SET TIME
- Restart study every: – SET HOURS
- Run protocol when data recording starts (Drop-down box)

When a profile is created it is automatically saved to a file in either the **NeuroWorks\Settings** (EEG) directory or **NeuroWorks\SettingsSleep** (Sleep) directory depending on the current mode of the software. Because it is saved to the common settings files, an acquisition profile will be synchronized with the **Common Settings Cache** and will therefore be available to other workstations.

NOTE: All acquisition settings are stored independently for each study mode (e.g. EEG or Sleep). The user must establish these settings for each study mode.

For example, if an acquisition profile is required for EEG, the NeuroWorks software must be opened in that mode, or if a Sleep acquisition profile is required, then the NeuroWorks (SleepWorks) software must be opened.

13.2 Acquisition Profiles

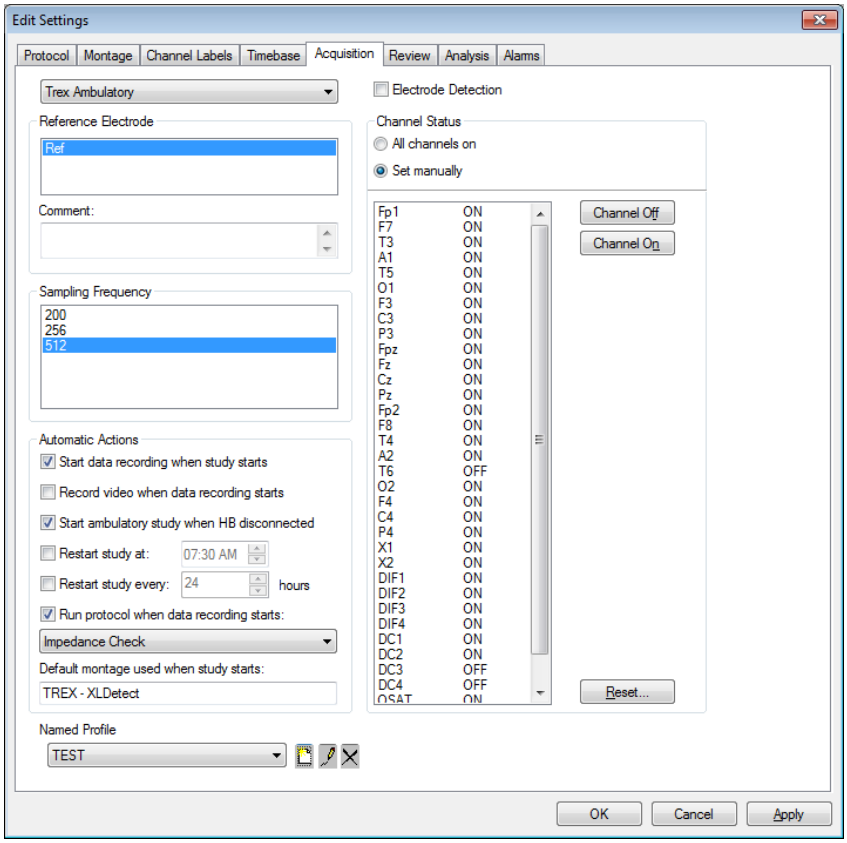
Available acquisition profiles will be shown in the drop-down list under the **Acquisition** tab accessed through the **Edit > Settings** menu, and will update to include all saved profiles for the selected headbox. The selected profile in the drop-down menu is the most recently used, or active, profile. With the icons shown to the right of the profile drop-down, you can create, rename, or delete an existing profile. The table below illustrates the options:

Icon	Description
	Creates a new acquisition profile.
	Renames the existing acquisition profile.
	Deletes the selected acquisition profile.

Creating an Acquisition Profile

To create an acquisition profile

1. In NeuroWorks EEG, choose **Edit > Settings > Acquisition** (tab).
2. Choose the **headbox** from the drop-down menu.



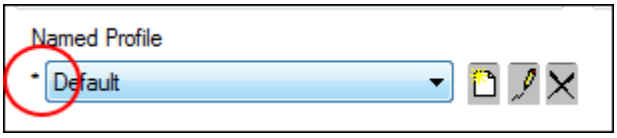
Acquisition tab - Named Profile

3. Set the various settings required for acquisition.
4. Click on the **New Profile** button . This automatically generates a new profile name based on the current selected profile, appending a numeric sequence to ensure that the named profile is unique. If the drop-down list is empty, the profile name **Default** will appear.

NOTE: As a best practice, ensure to rename profiles so that they have meaningful names. These should not include the numeric sequence that is generated automatically each time the profile list is loaded.

- Use only alpha-numeric characters, underscores, and dashes.
- Do not use other characters including but not limited to:~!@#$%^&*()+{}[]"'<>/,.

NOTE: If an attribute or setting on the current, named profile is changed, an asterisk is placed to the left of the profile name next to the drop-down list.



Named Profile – Change to profile made

To undo these changes to the profile, select the current profile name again or select another saved profile from the drop-down list. The changes will be reverted to the saved copy. Alternately, clicking **Cancel** on the Edit Settings dialog will prevent these changes from being saved.

5. Once the profile has been configured, click the **Apply** button or **OK** to save the changes.

Renaming an Acquisition Profile

Renaming an acquisition profile is simple: Click on the **Rename Profile** button . This will turn the dropdown box to an editable box where the new name can be typed. To make your changes permanent, click **OK** or **Apply** in the dialog.

NOTE: As a best practice, rename profiles to have meaningful names. These should not include the numeric sequence that is generated automatically each time the profile list is loaded.

- Use only alpha-numeric characters, underscores, and dashes.
- Do not use other characters including but not limited to:~!@#$%^&*()+{}[]"'<>/,.

Copying an Acquisition Profile

Copying a profile can useful if you are looking to change only one or two aspects of the original profile. All the original attributes are loaded with the original profile, but can be adjusted and then saved under a new name. Giving you two profiles with separate attributes.

To copy an acquisition profile:

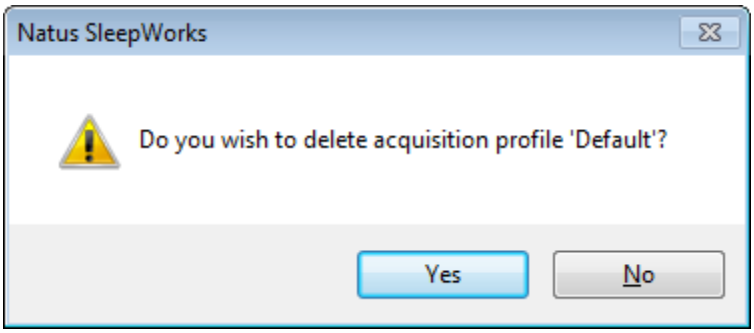
1. Select the desired profile from the dropdown list.
2. Click the **New Profile** button .
3. Click the Rename Profile button and give the copy a unique, meaningful name.
4. To adjust the properties of the copied profile, make the desired changes, and click **Apply** or **OK** to save them.

Deleting an Acquisition Profile

If an acquisition profile is no longer required, it can be deleted.

To delete an acquisition profile:

1. Select the desired profile from the dropdown list.
2. click on the **Delete Profile** button .
3. A confirmation dialog will display. Selecting **Yes** clears the selection dialog box and deletes the selected acquisition profile. In the example below, the **Default** profile has been selected for deletion and results in the following prompt:



Delete Acquisition ProfileConfirmation Dialog

WARNING:
Because acquisition profiles can be shared between workstations, deleting the profile from one machine will also remove it from other machines that are synchronized to the same *Common Settings Cache*. Take precautions when deleting acquisition profiles.

Discarding Acquisition Profile Changes

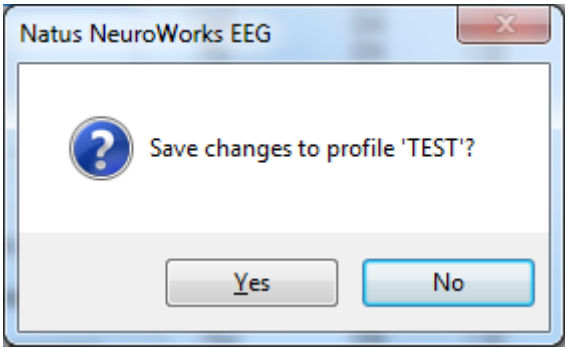
If you have made changes to an acquisition profile, the asterisk should be visible to the left of the profile name. Selecting another saved profile, a different headbox, or clicking **Cancel** will discard any pending changes to the currently selected profile.

13.3 Altering Acquisition Profile Settings During a Live Session

As in previous releases of NeuroWorks, only certain acquisition settings can be altered during a live recording. Most settings cannot be changed. Channel Shorting and Loose Electrode Detection are examples of settings that can be changed and applied to affect the live session.

When the acquisition settings page (**Edit > Settings**) is viewed during a live study, the settings on the page reflect those of the current study and not necessarily those of the selected profile. You can select other profiles from within the acquisition settings page, and the asterisk will appear to indicate that some portion of the displayed settings does not reflect the original saved profile.

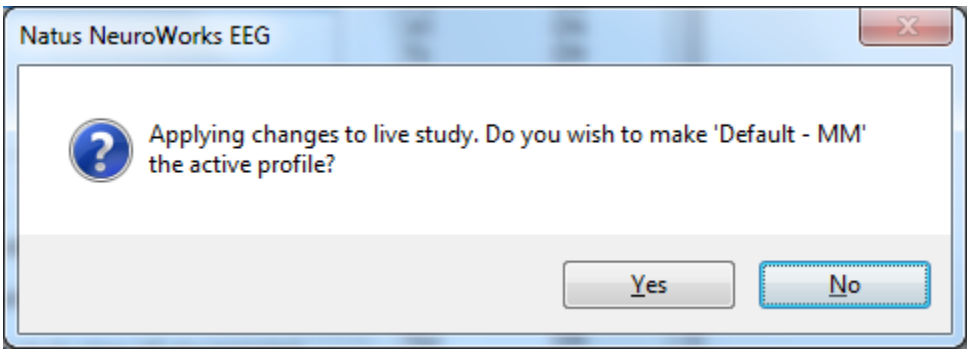
For the properties that can be changed during a live session, clicking **Apply** or **OK** to commit these changes will produce the following confirmation dialog:



Save Changes to Profile Dialog

In this example, the channel status mode was changed from **All channels on** to **Set manually** while the profile **TEST** was selected. Answering **Yes** to this question saves these changes to the selected profile. Answering **No** will leave the saved profile unchanged and apply visible changes to the ongoing study only.

If you select a different acquisition profile during a live study, clicking **Apply** or **OK** will additionally ask you if you wish to make this the new active (default) profile for the current headbox. For additional information on default profile selection refer to *Section 13.7 Establishing the Default Montage*.



Applying Changes to Live Study

13.4 Profile Affinity to Headbox Type

The most recently selected acquisition profile is saved (by name) for each headbox type and study mode. The next time a new or returning study is started, the profile associated with the saved name for the headbox in use, will be loaded and applied to the acquisition registry values. If the profile is missing, existing registry settings will be used.

The active (default) profile is established in one of two ways:

1. Selecting the profile in the Acquisition Settings page and clicking **Apply** or **OK**.
2. Selecting the profile in the **Headbox Connection / Acquisition profile** dialog (during initialization of a new or returning study as discussed in the next section)

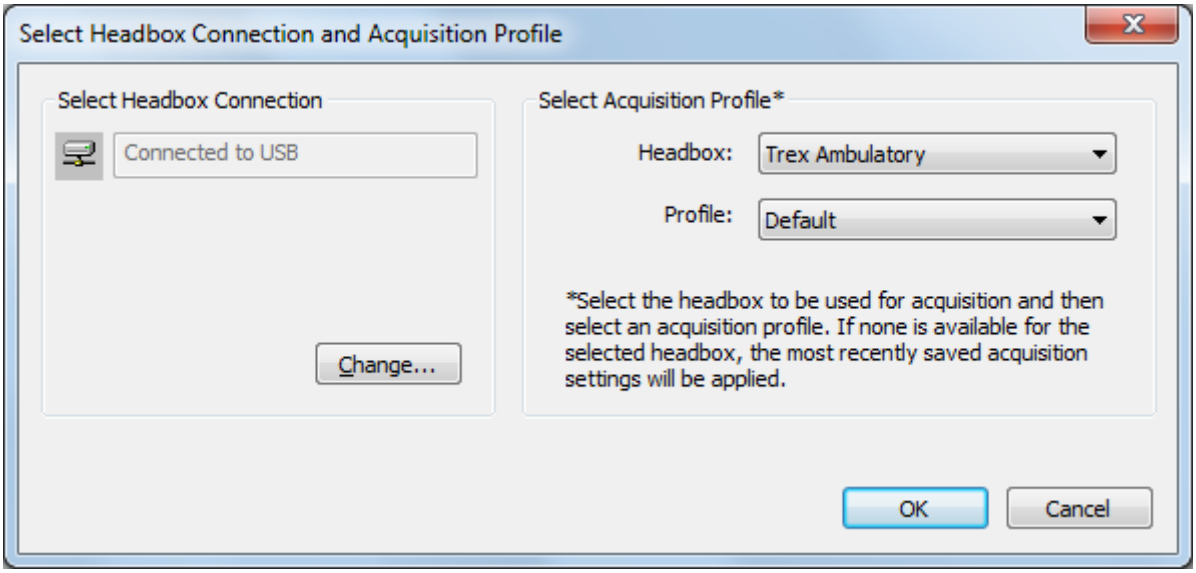
Remember that the active profile is 'remembered' by name. If you make the active profile one that uses indexed names (those with a numeric sequence in square brackets) the profile applied may differ from that expected because indexed names are dynamically assigned). Always rename profiles from their automatically generated name to ensure the expected settings are loaded.

13.5 Selecting a Profile for New or Returning Studies

An acquisition profile can be selected prior to initializing a new study.

To do this:

1. In the **Study Information** dialog, click on the **Change** Change button located to the right of the **Headbox Name** field. The **Headbox Connection and Acquisition Profile** dialog appears.



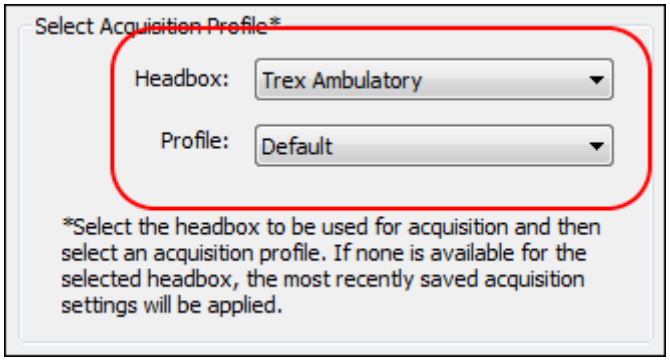
Select Headbox Connection and Acquisition Profile Dialog

The dialog attempts to determine the type of headbox connected via the connection mode. If a successful connection to the headbox was made, the associated type will

be shown in the headbox drop-down list located in the right-hand portion of the dialog under which the current, active profile for the headbox will be displayed. If no profiles have been defined for the selected headbox, the profile drop-down list will be replaced with a tag reading **<none defined>**.

NOTE: This check only works for USB and IP-connected headboxes. For IP headboxes, this can take up to 10 seconds.

2. If the headbox to be used for acquisition is not displayed in the top-right portion of this dialog, select it from the drop down list.
3. Use the Profile drop-list to select the previously saved acquisition profile you wish to apply for the new or returning study.

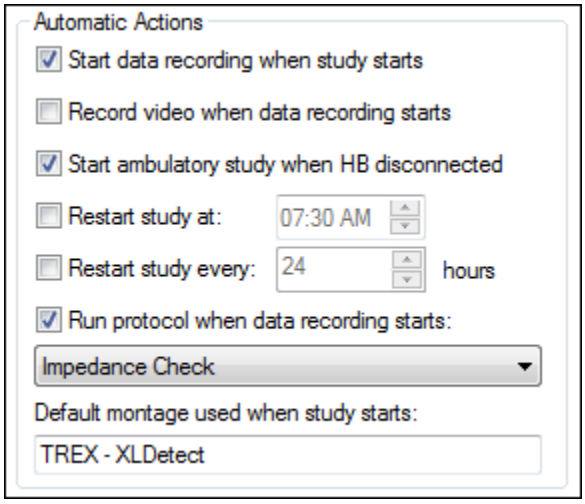


4. Click **OK** to save the new active profile name for the selected headbox. As the new or returning study initializes, it will load the profile associated with this name and setup all the associate registry settings before initializing headbox sampling.

13.6 Automatic Actions Saved into Acquisition Profile

The acquisition page includes settings not specific to a particular headbox type. These are called Automatic Actions and are saved into the Acquisition Profile. These settings, including the default montage are also saved with the acquisition profile.

Note: The **Default montage used when study starts** is headbox-specific but cannot be changed on this page. The default montage for each headbox type is set on the Montage page as described in section *13.7 Establishing the Default Montage*.



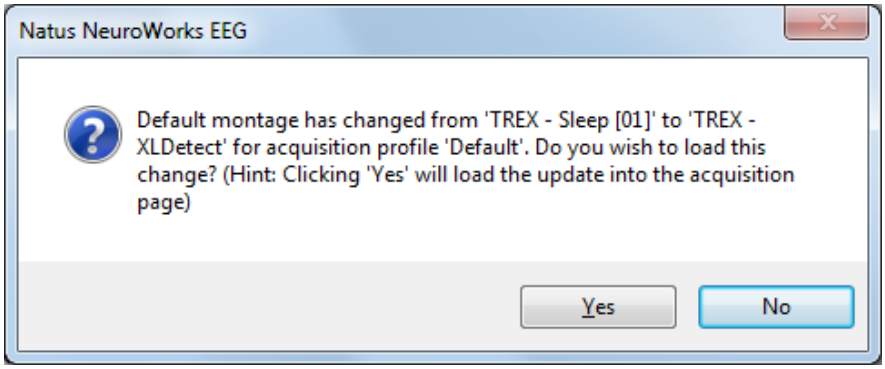
13.7 Establishing the Default Montage

1. Choose **Edit > Settings > Montage**.
2. Select the desired montage from the list.
3. Click Set **Default**. This action will set the selected montage as the default.

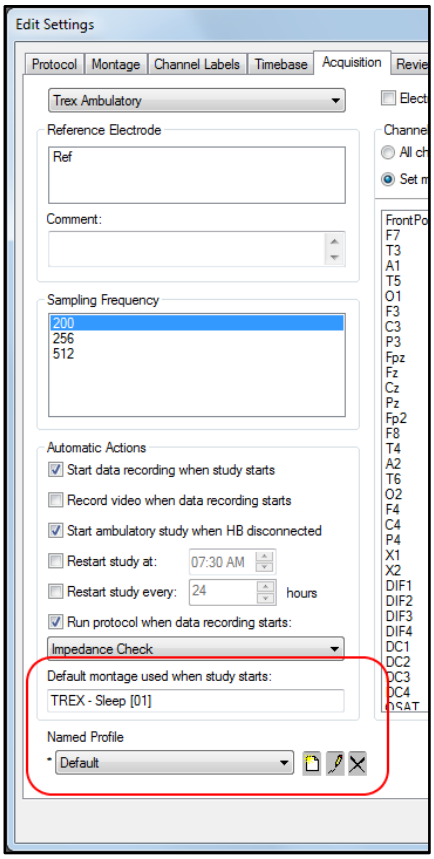
Associating a Montage with an Acquisition Profile

To associate a particular montage with an acquisition profile:

1. Open the **Edit > Settings > Acquisition** tab and select the headbox from the drop down list.
2. Once the headbox has been selected, open the **Edit > Settings > Montage** tab and choose a montage corresponding to the head-box.
3. Click on the **Set as Default** button.
4. Return to the **Edit > Settings > Acquisition** tab and the following dialog confirms the change in Montage.



5. Clicking **Yes** loads the newly selected montage into the **Default montage when study starts** field. An '*' is beside the named active acquisition profile. Clicking **No** leaves the Acquisition tab unchanged.
6. Clicking **Apply** or **OK** saves the changes made as part of the named, active profile.



The next time a study is started with this named profile, the default montage name is extracted from the profile. The name is then used to find the corresponding montage file on the local machine. If the montage file exists, it is loaded and applied to the study.

Tip: The default montage is saved by name into the profile. The montage must be saved into the **Common** location which will allow it to be synchronized by the **Common Settings Cache,** ensuring that the profile can be loaded on any other machine and that the referenced default montage will be present.

14. Settings

14.1 Editing NeuroWorks Settings

To make changes to the settings in NeuroWorks, choose **Edit > Settings**. The **Edit Settings** box appears with tabs that allow you access options for recording and reviewing.

Edit Settings Box Tabs

14.2 Setting up a Protocol

A protocol is a customizable set of actions that are setup to be executed sequentially. For example, NeuroWorks has default protocols set up for photic stimulation, hyperventilation, impedance check, and channel test. Once established, a protocol can be named and saved.

Then you can activate the protocol from the Protocol menu, or by clicking the **Run** button on the **Protocol** tab. The Protocol menu is available only in **Acquisition** (live recording) mode.

To open the **Protocol** tab, choose **Edit > Settings > Protocol**.

Protocol Tab Features

The buttons on the Protocol tab are arranged into a **Protocol** section and a **Step** section.

The **Save** button in the Protocol section enables you to save the protocol to either the **Common** or **Local** location. When editing a montage-change step in a protocol, only two categories of montages are shown.

Common	Lists montages that are typically saved to a non-local drive and are accessible to everyone on the Natus network.
Local	Lists montages that are saved in the local directory.

Although additional montage categories (Study, Patient, Remote) are available in the Montage tab menus, only **Common** and **User** categories are available in the Protocol tab. This prevents you from attempting to apply a montage to the study that may not be available. Additional montages that are associated with particular studies or patients may be available in the Montage menu that appears in the Montage tab.

Selecting a Protocol

To select a protocol, click the arrow in the **Name** combo box to select it from the list of protocols that are available. When a protocol is selected from this list, the steps of the protocol appear in the table below the Name combo box. Any of these steps can be modified or deleted using a button in the **Step** section of the Protocol tab: Append, Insert, Modify, or Delete.

Appending or Inserting a Step in a Protocol

Click the **Append** or **Insert** button. Select an action from the dropdown menu. The selected action is added to the end of the list of steps or inserted before the selected step. If desired, click the cell in the **Time** column, or right-click the cell in the **Description** column, to change these settings for the selected step.

Modifying a Step in a Protocol

- To modify the time, click the **Time** column cell in the row for the step that you wish to modify and type in the desired time
- To modify the action, right-click the **Action** column cell for the step that you wish to modify and menu of action options will appear. Select the desired action from the menu.
- To modify a description, right-click the **Description** column cell for the step that you wish to modify and menu of description settings that apply to the selected action will appear. Select the desired description from the menu.

Deleting a Step from a Protocol

To delete a step from a protocol, click a cell in the step you want to delete, then click the **Delete** button.

Saving a Protocol

The Protocol menu has a **Save (Location)** button that allows you to select a location in which to save a protocol. The face of the save button lists the default location that is set for saving the current protocol; for example, Save (Common). If you click the arrow beside the Save (Location) button, you will see the drop-down menu locations that are available for saving the montage: Save (Local) and Save (Common).

1. Click the **Save (Location)** button. A submenu of locations will appears.
2. Select the location where you want to save the protocol, either **Save (Local)** to save the protocol to a local directory, or **Save (Common)** to save to a directory on the Natus network.
3. If necessary, type a file name for the protocol into the **File Name** text box.
4. Click **Save**.

The saved protocol now appears in the list of protocols shown in the **Name** combo box of the Protocol tab (and in the Protocol menu).

Renaming a Protocol

To rename a protocol:

1. Click the **Rename** button that is located to the right of the Name combo box. The Name combo box now becomes an editable text field.
2. Type a new name for the protocol into the Name combo box and press the Enter key on your keyboard. The new protocol name appears in the Name combo box menu.

Make any desired changes to the steps of the new protocol using the Append, Insert, Modify or Delete buttons in the Step section. After the new protocol is saved, it will appear in the list of protocols in the Protocol menu.

Deleting a Protocol

To delete a protocol:

1. To open the protocol, click the arrow in the **Name** combo box and select the protocol that you wish to delete from the list.
2. Click the **Delete** button. A message box will appear that asks, **Are you sure you want to delete the protocol?** Click **Yes**.
3. To implement the change and close the Edit Settings window, click **OK**.

The deleted protocol no longer appears on the Protocol menu.

14.3 Creating and Editing a Montage

Montages are designed for specific headbox types. For example, a montage created for the 32 channel EEG headbox will not work with the EMU40 headbox. Only montages that are compatible with the current headbox are shown in the Montage menus, but ALL Montages are shown in the Montage tab in the **Edit Settings** window.

NOTE: Montages created in older versions of software are automatically updated to the new format when they are loaded. If you save the montage immediately before applying it to a study, the montage is permanently converted to the new format. This reduces the time it takes to load the montage.

WARNING:

- The **XLDetect** montage does NOT work with the numeric labeling system found on some older EMU36 or Ambulatory 28 headboxes. If your headbox has numeric labeling, you MUST use a custom montage.
- Do NOT use the **XLDetect** montage with custom channel labels.

Hierarchical Montage Menus

The Montage menu now divides montages into subcategories according to their source location on the system. The Montage tab in the Edit Settings window has a new Hierarchical Montage Menus check box that enables you to choose the appearance of the Montage menu.

- If Hierarchical Montage Menus is **selected (checked),** then montages are listed in submenus according to source location.
- If Hierarchical Montage Menus is **unselected (not checked**), montages are shown in one long list with separators to indicate the source location of each montage.

Montage Tab Features

To open the Montage tab:

1. Choose **Edit > Settings > Montage** in NeuroWorks EEG.
2. Right-click a cell to bring up a list of values/labels you can use to populate the cell. When you right-click on either of the input cells (Input 1 or Input 2), the list of channel labels that appears corresponds to the custom headbox channel labels.

Montage menus are arranged into categories. Depending on whether you are recording or reviewing data, and depending on which montages are associated with the current study, the following montage categories may also be available in the Montage tab menus:

Montage Categories

Category	Description
Local	Lists montages saved in a local directory by the current user.
Common	Lists montages saved in a common directory on the network.
Study	Lists montages saved with the current study. Montages used to acquire a live study are embedded in the study file to make these montages available on remote machines. Then, if you review the study on a remote machine, the montages used during acquisition are available.
Patient	Lists montages created and saved for a specific patient whose study is currently being viewed. Montages listed in this section are part of the **Patient Information** saved in the database. If you use the **Returning** button when initiating a study from the ***Natus Database*** for a returning patient, then these patient-specific montages are available in the Montage menu.

Category	Description
Remote	Lists montages that originate on another computer. This enables you to view montages created on the acquisition machine while monitoring from a remote location.
Temporary	Lists new montages created on the fly using the **Montage** tab to edit the settings of an existing montage. They are moved to one of the categories above when saved.

If two or more montages have the same name, then a number is added to the montage name to indicate that it is a copy. For example: Ref All, Ref All [2], Ref All [3].

TIP: You can use the montage tab as a scratch pad to create a new montage based on an old montage: Select a montage, click **Duplicate**, name the new montage, then edit the channel settings as desired.

NOTE: You can use Windows Explorer to make a montage **Read-Only** by changing the read-only attribute on the .mtg file.

Creating a New Montage

To create a new montage:

1. Choose **Edit > Settings > Montage**.
2. Click **New**. This creates a montage that has as many input channels as the headbox used to acquire the current study (if the study is open), or as the default headbox set in the acquisition page (if there is no current study). The montage initially has no output channels (the table is empty). The name Untitled in the Name text box is highlighted. Type in a name for the new montage you are about to create.
3. Add and modify channels as desired, setting Input 1, Input 2, LFF, HFF, Notch, Gain, Set, Color, Type, Detection, and Polarity:
4. Select **Append** to add channels to the end of the montage.
5. Select a channel and click **Edit** (or right-click to select a value from a pop-up list).
6. Select **Insert** to add a channel at the location of the mouse pointer.
7. Select **Delete** to delete selected (highlighted) channels.
8. To save the new montage, click **Save**. To activate the new montage, click **OK**. Now, when you open the Montage menu, the new montage appears in the list of montages.

Duplicating a Montage

1. Click the **Duplicate** button that is located in the Montage set of buttons on the right side of the Montage tab. This creates a new montage that initially has the same input and output channels as the montage currently selected in the list. This montage may not be compatible with the current headbox. To create a montage that is compatible with the current headbox, use the New button.
2. Type a new name for the montage in the **Name** text box.
3. Change the channel settings as desired.
4. Save the new montage.
5. Click **OK** to activate the montage.

Renaming a Montage

1. Click the **Rename** button that is located to the right of the **Name** combo box. The Name combo box now becomes an editable text field.
2. Type a new name for the montage in the Name combo box and press ENTER on your keyboard. The new montage name now appears in the Name combo box menu.
3. Make any desired changes to the settings of channels of the new montage using the Edit, Append, Insert, Modify or Delete buttons. After the new montage is saved, it will appear in the list of montages in the Montage menu.

Saving a Montage

The montage menu now has a new Save (Location) button that allows you to select a location in which to save a montage. The face of the Save button lists the default location that is set for saving the current montage; for example, Save (Common). If you click the arrow beside the Save (Location) button, you will see a menu of the locations that are available for saving the montage; for example, Save (Common), Save (Local) and Save (Patient).

- Select **Save (Local)** to save the montage to a local directory.
- Select **Save (Common)** to save to a directory on the network. This directory is set in the options tab of **File > Customize** in NeuroWorks.
- Select **Save (Patient)** to save the montage along with the Patient Information in the Natus Database so that the montage will be available when the study is opened on a different computer than was used for acquisition.

Reverting to a Previously Saved Montage

Use the **Revert** button to discard any changes you've made to a montage and return all montage settings to their previous settings. This option is limited to montages stored in files (Local or Common categories).

Editing Montage Settings

To edit any of the settings in the montage table, you must first select one or more cells in a column. Then you can right-click (or click the Edit button) to bring up a menu of available setting options for the selected cell(s).

Appending or Inserting a New Channel in the Montage

To add a new channel to the bottom of the montage table, click Append. To insert a new channel after the selected channel, click Insert. Before you can edit the settings in the adjacent cells, you MUST select a label for the Input 1 column cell of the channel. To do so, right-click the cell in the Input 1 column and select a label from the list. Right-click to edit the settings for the other cells in the new channel. For a referential montage, leave Input 2 empty. Set both Input 1 and Input 2 for a bipolar montage.

Grouping Channels

To place selected channels in a group:

1. **SHIFT + Click** to select a consecutive group of channels in the montage. Then, click the first cell in a channel, hold down the **SHIFT** key, and click the first cell of the last channel you want to include in the group. (**CTRL + Click** to select multiple individual channels).
2. Click the **Group** button.

Now when you are recording or reviewing data with this montage, the grouped channels appear as a group in the waveform window with all traces overlapping.

Setting a New Default Montage

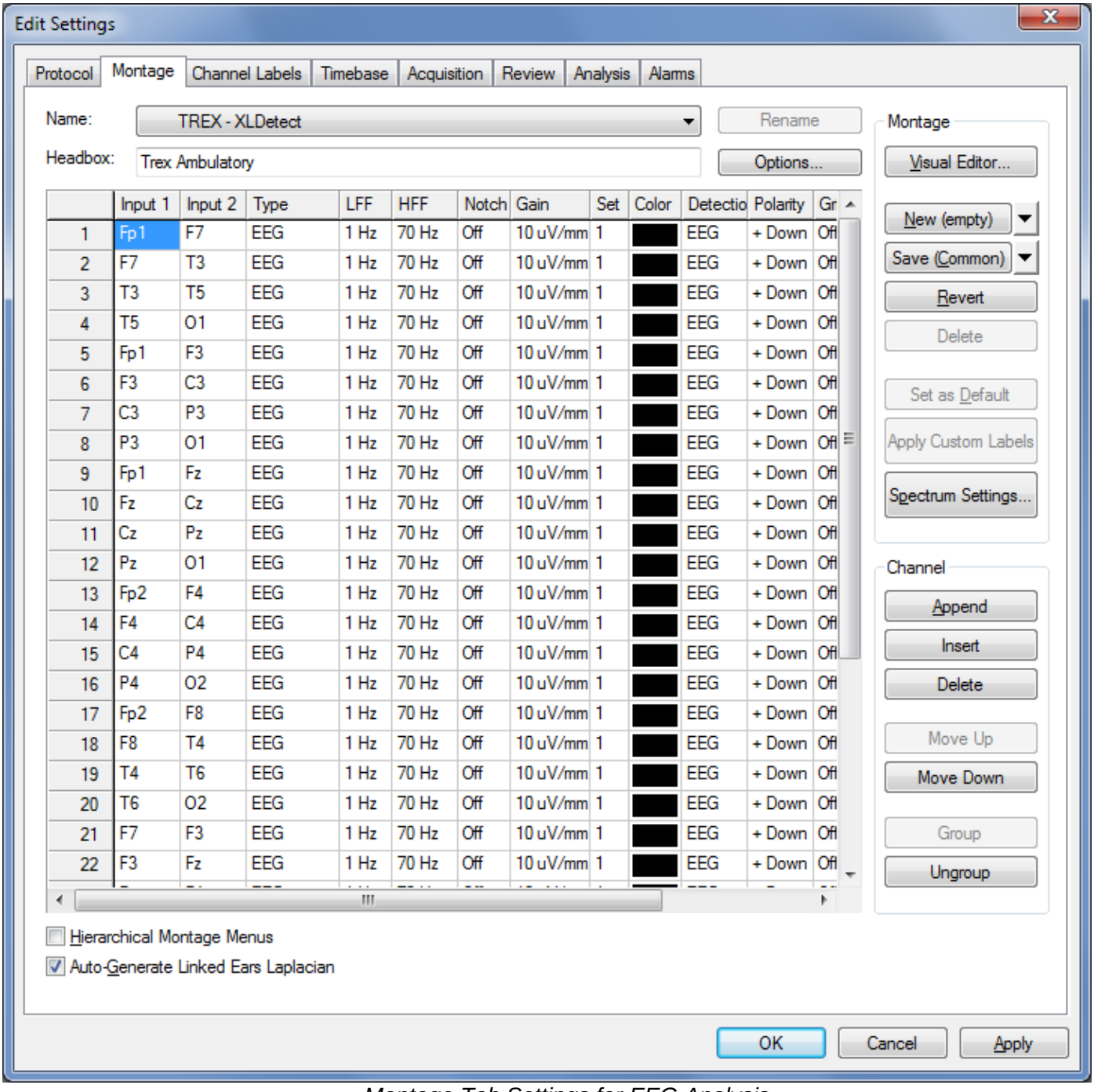
1. Choose **Edit > Settings > Montage**.
2. Select the desired montage from the list.
3. Click Set **Default**. This action will set the selected montage as the default.

14.4 Editing Montage Channel Settings

To edit montage channel settings, choose **Edit > Settings > Montage**.

NOTES:

- Montages created in earlier versions of software are automatically updated to the new NeuroWorks format. If you save the montage immediately before applying it to a study, the montage is permanently converted to the new NeuroWorks format. This reduces the time it takes to load the montage.
- When a montage is changed in the montage editor but not saved, it produces a warning when the dialog is closed (unless the montage file is set to be read-only).



	Input 1	Input 2	Type	LFF	HFF	Notch	Gain	Set	Color	Detectio	Polarity	Gr
1	Fp1	F7	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
2	F7	T3	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
3	T3	T5	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
4	T5	O1	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
5	Fp1	F3	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
6	F3	C3	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
7	C3	P3	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
8	P3	O1	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
9	Fp1	Fz	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
10	Fz	Cz	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
11	Cz	Pz	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
12	Pz	O1	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
13	Fp2	F4	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
14	F4	C4	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
15	C4	P4	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
16	P4	O2	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
17	Fp2	F8	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
18	F8	T4	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
19	T4	T6	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
20	T6	O2	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
21	F7	F3	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off
22	F3	Fz	EEG	1 Hz	70 Hz	Off	10 uV/mm	1		EEG	+ Down	Off

Montage Tab Settings for EEG Analysis

Changing Channel Settings

Before you change the channel settings, you need to select some or all of the channels in the montage.

- To change the channel settings for all the channels in the montage at one time, right-click the label at the top of the column. When you do, a menu appears that allows you to select a setting that will apply to all of the channels.
- To change the channel setting for a particular channel, right-click the particular cell of the channel in the column that you want to work with, then choose the desired setting from the pop-up menu.

For information on montages, see Laplacian Montage and Linked Ears Montage.

Set Inputs

A channel can be set to display the signal from one electrode channel, or the difference between two signals.

- Right-click the Input 1 and Input 2 cells to select electrode locations for each channel.
- You can create a bipolar montage or a referential montage, depending on whether you select Input 2 locations.

Bipolar Channel

The channel has a setting for Input 1 and Input 2. The display shows the signal from the channel marked in Input 1 minus the signal from the channel marked in Input 2.

Referential Channel

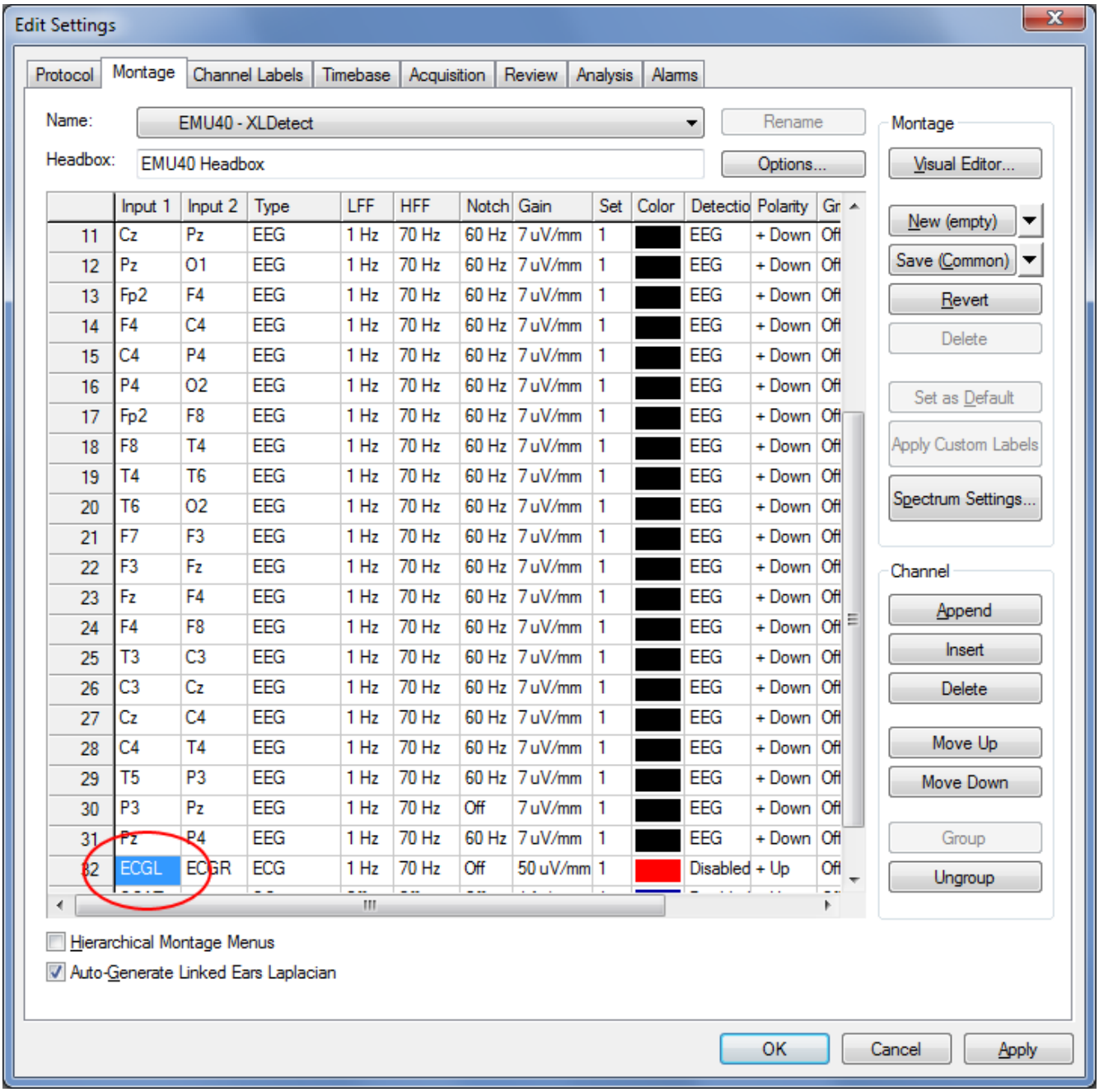
The channel only has a setting in the Input 1 column and the Input 2 column is empty. The display shows the signal coming from that electrode minus the signal from the reference channel.

NOTE: Bipolar montages are more robust because referential montages can be misleading if there is contamination on the reference channel.

Change the Waveform Type

NeuroWorks can accept input from a variety of devices in addition to normal EEG inputs; for example, ECG (or EKG) measuring devices. These input signals have different characteristics which are particular to them. To designate the type of input:

1. Choose **Edit > Settings > Montage**.
2. Right-click the **Type** column, or an individual channel in the Type column, and select a display format from the pop-up menu.



	Input 1	Input 2	Type	LFF	HFF	Notch	Gain	Set	Color	Detectio	Polarity	Gr
11	Cz	Pz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
12	Pz	O1	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
13	Fp2	F4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
14	F4	C4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
15	C4	P4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
16	P4	O2	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
17	Fp2	F8	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
18	F8	T4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
19	T4	T6	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
20	T6	O2	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
21	F7	F3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
22	F3	Fz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
23	Fz	F4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
24	F4	F8	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
25	T3	C3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
26	C3	Cz	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
27	Cz	C4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
28	C4	T4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
29	T5	P3	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
30	P3	Pz	EEG	1 Hz	70 Hz	Off	7 uV/mm	1		EEG	+ Down	Off
31	Pz	P4	EEG	1 Hz	70 Hz	60 Hz	7 uV/mm	1		EEG	+ Down	Off
32	ECGL	ECGR	ECG	1 Hz	70 Hz	Off	50 uV/mm	1		Disabled	+ Up	Off

ECG Channel

Set Filters

Choose **Edit > Settings > Montage**. To change the three filter settings (LFF, HFF and Notch filter), right-click on a cell and choose a value from the pop-up menu.

Available Filters

LFF (Low Frequency Filter)	Filters out low frequency interference below the set value.
HFF (High Frequency Filter)	Filters out high frequency interference above the set value.
Notch filter	Minimizes interference from nearby electrical equipment.

Set the Gain

Choose **Edit > Settings > Montage**. Right-click a cell and choose a value from the pop-up menu to change the gain, or sensitivity, of a channel. Increasing the gain makes traces appear larger on the screen.

Organize Channels into Sets

If you are using a large number of channels, it is recommended that you put your montage channels into sets. Channels can be organized into 8 sets that can be viewed separately on screen. For example, channels 1 – 5 can be placed in Set 1, and channels 6 – 32 can be placed in Set 2. When Set 1 channels are viewed, only channels 1 – 5 are displayed. When Set 2 channels are viewed, only channels 6 – 32 are displayed. To switch between channel sets, open the Trace menu and select Switch Set. Only one set appears on the screen at a time, but you can easily switch between sets while viewing the data by using a keyboard shortcut.

Place a Channel in a Set

Right-click the **Set** cell for a desired channel and select a set number from 1 to 8. Repeat this action until every channel is assigned to a set.

Switch between Sets

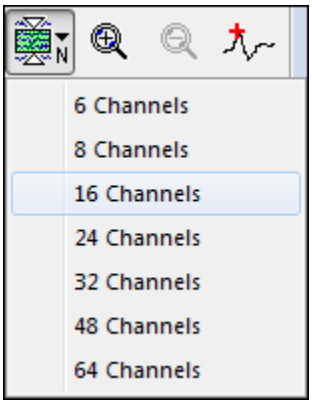
Press:

- CTRL + 1 to display channels assigned to Set 1.
- CTRL + 2 to display channels assigned to Set 2.
- CTRL + 3 to display channels assigned to Set 3.
- CTRL + 4 to display channels assigned to Set 4.
- CTRL + 5 to display channels assigned to Set 5.

- CTRL + 6 to display channels assigned to Set 6.
- CTRL + 7 to display channels assigned to Set 7.
- CTRL + 8 to display channels assigned to Set 8.
- CTRL + ` (key next to 1 key) to move through sets sequentially.

Vertical Paging of Traces On-Screen

An alternative to viewing studies with a large number of montage channels is the **Limit N Channels Per Page** feature which is accessible on both the Acquisition workflow and Review toolbars. Scrolling through sets or groups of channels can be done by clicking on the **Limit N Channels Per Page** button from which you may select to view their desired number of channels from the list of options.



Limit N Channels per Page Options

Once you select the desired number of channels to display on-screen, pressing the **[Page Up]** or **[Page Down]** buttons will automatically scroll up or down the next group of channels based on the increment you selected. The following shortcut keys are also available for use with this feature:

[Ctrl + Page Up]	Scrolls traces one channel up
[Ctrl + Page Down]	Scrolls traces one channel down
[Shift + Page Down]	Switch the vertical limit on and off

Change the Waveform Color

To change the color in which the waveform is displayed:

1. Choose **Edit > Settings > Montage**.
2. To change the color of a waveform, right-click the Color column or individual channel, then select a color from the Color palette selection window. Click the **OK** button.
3. To create a custom color, click on the **Define Custom Colors** option.

Set the Detection Field

The Detection field is used to determine:

- Which montage channels are analyzed by the detector(s) you have enabled.
- Which type of study the montage channel is enabled in.

Detection choices are:

- EEG (used when analysis on the channel has to be enabled only in EEG studies)
- Artifact (used for an EEG Channel with eye blink artifact [EOG])
- Disabled (used for a non-EEG channel)

Normally, in a standard NeuroWorks study, most EEG channels are set to EEG, non-EEG channels are set to Disabled, and EEG Channels with eye blink artifacts are set to Artifact.

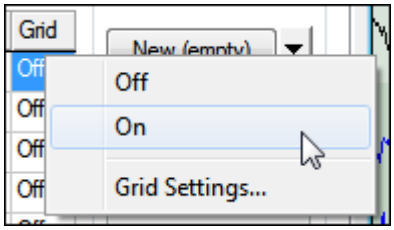
Type Column Setting (Channel Type)	Detection Column Setting
EEG Channel	EEG
EEG Channel with Eye Blink Artifact (EOG)	Artifact
Non-EEG Channel	Disabled

Set the Polarity

Polarity determines whether a waveform is drawn with positive values going up or down. To designate the polarity, right-click the channel cell in the **Polarity** column and choose either **Up** or **Down**.

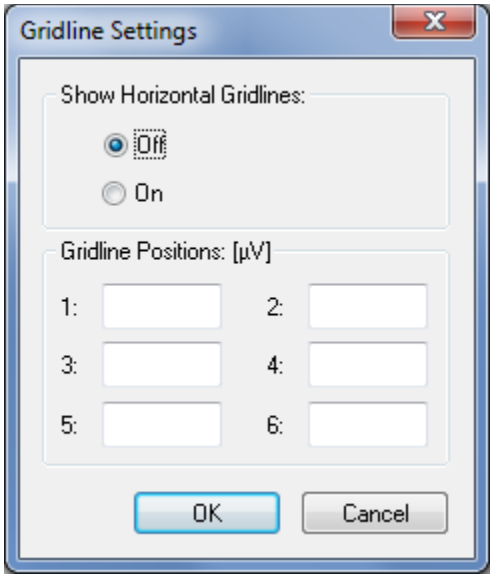
Setting Gridlines

To turn gridlines on or off, right-click the channel in the **Grid** column and choose **On** or **Off**.



Gridlines Options in Montage Tab

To set the gridline positions, right-click and choose **Grid Settings**. Enter the appropriate values in the Gridline Settings dialog box. Values are presented in units specific to each channel. Note that default montages do not have any gridlines set up.

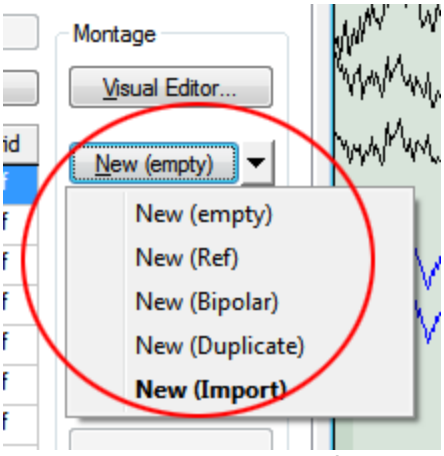


Grid Settings Dialog in Montage Tab

14.5 Montage Editor

New Montage Options

New montages based on 1 of the 5 configurations (shown below) can be created to simply the creation of new montages.



New Montage Tools

Montage Conversion Tool

The Montage Conversion Tool is used to convert a montage originally created for one headbox to work with a different one (Import / Export).

New (Import)

Click **New (Import)** when you have a study open. You will be prompted with a montage name. Select the source headbox and source montage and press **OK**.

This will create a new montage with the same channels as the source montage.

NOTE: The channels that do not have an exact match in the target (current) headbox will not be carried over to the new montage. Use New (Import) when you have a study open that was taken with one headbox (e.g. Trex) and you want to convert and apply a montage that you created for a different headbox (e.g. Connex).

New (Export)

Click **New (Export)** when you have no study open. You will be prompted for a target headbox. Use this option when you have just created a new montage for one headbox (e.g. Trex) and you are going to make the same montage available for other headboxes in your facility (e.g. Brain Monitor, EEG32).

Montage Creation Tool

The **Montage Creation Tool** allows you to create new referential or bipolar montages with one click. This is done using the **New** drop-down button and selecting **New (Ref)** or **New (Bipolar).** You can also choose **(New) Duplicate** to copy a montage you wish to alter slightly.

Move Up and Move Down Buttons in Montage Tab

Use the **Move Up** and **Move Down** buttons to move a single channel.

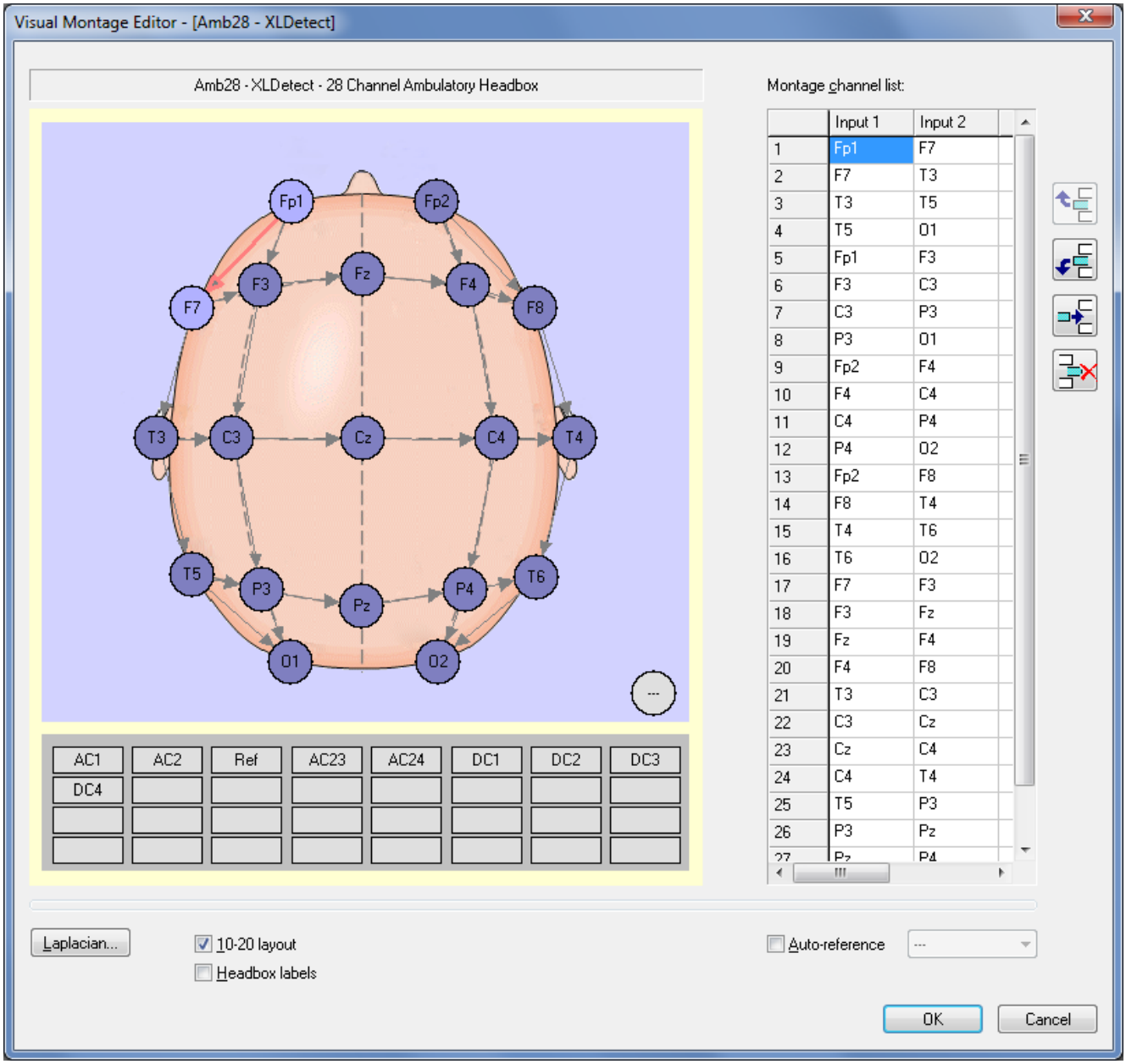
Visual Montage Editor

The **Visual Montage Editor** is a tool for creating and editing montages. It provides an easy WYSIWYG graphical interface where only tabular tools existed before.

NOTE: Linked Ears is included in the list of predefined channels accessible when you click the Auto-reference check box. It is labeled (A1+A2)/2.

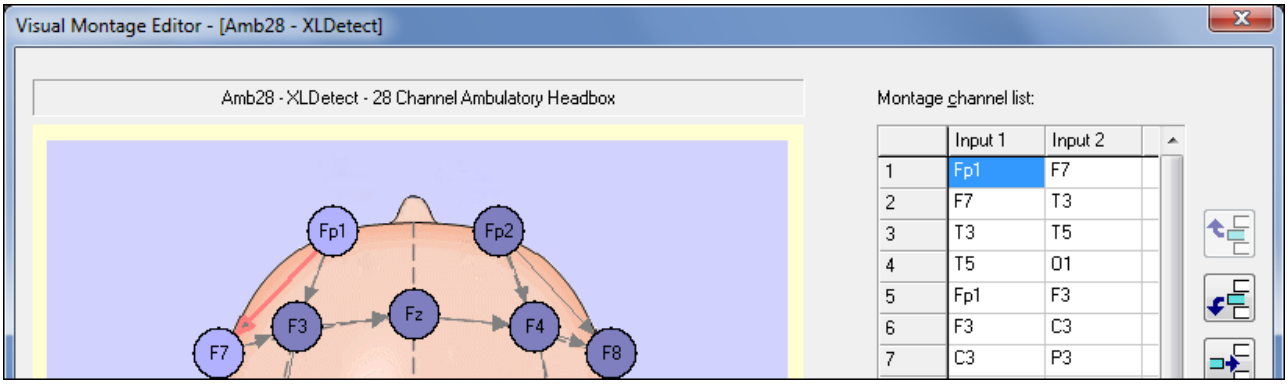
To access the visual montage editor:

1. Choose **Edit > Settings > Montage** (tab).
2. Click the **Visual Editor** button.



Visual Montage Editor

On the left side of the window, you have the standard 10-20 layout (or a grid arrangement for 128 channels). You can graphically connect inputs (by clicking and dragging) to create an input pair that is automatically added to the montage.

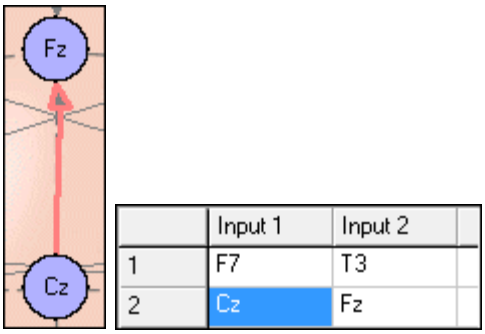


Creating an Input Pair

The visual montage editor is useful mostly for creating an initial montage, but it can be used as well for modifying existing montages after channel types, filter, sensitivity and analysis settings have been adjusted. Those settings are preserved when using the new visual editor (although it does not display them on screen).

Visual Montage Editor Controls

Controls	Function/Description
Graphical Pane	Displays 10-20 or grid arrangement and allows graphical connections.
10-20 Layout Checkbox	Switches between 10-20 and grid arrangement of inputs.
Headbox Labels Checkbox	Switches between hardware labels and display of customized user labels.
Laplacian Button	Invokes Laplacian editor dialog box. This allows creation of any polynomial combination of channels to be used as one of the inputs in montage pair.
Montage Channel List	Lists the channel pairs in the montage and lets you add, delete and re-order them.

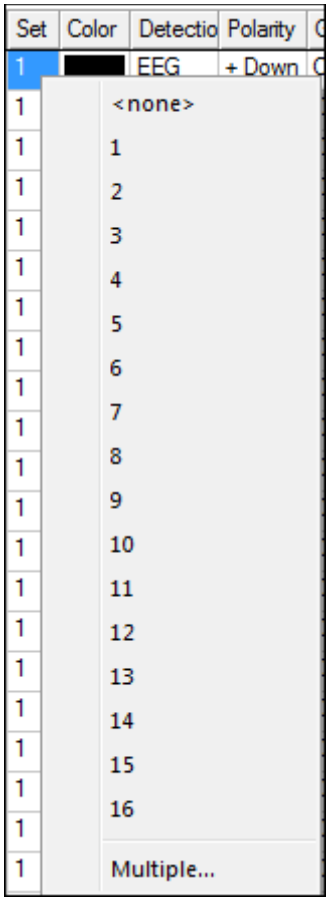
Controls	Function/Description
Auto-reference Checkbox and Selection	Switches to a simple, one-click operation mode in which every click on channel X creates and adds to the montage a <X-Ref> pair where Ref is the selection in the Auto-reference combo box. For example, if **Fz** is selected as the Auto-reference...  ... clicking **Cz** will add the pair **Cz–Fz** to the montage. 
“Null” channel (---).	The “Null” channel is indicated as “---“.  Selecting the “Null” channel as Input 1 or Input 2 will add a referential channel to the montage. This channel will be referenced to the hardware reference of the headbox.
	Move Channel Up button. Re-order montage channels by moving the selected channel up.
	Move Channel Down button. Re-order montage channels by moving the selected channel down.
	Insert Channel button. Inserts a new blank input pair below the selected channel.
	Delete Channel button. Deletes the selected channel.

Controls	Function/Description
	Next / Previous Page buttons. These buttons only appear when there are more channels than can be displayed on a single page.

14.6 Organizing Channels into Sets

Putting channels into sets is helpful when viewing a large number of channels, as in the case of the EMU128 or Quantum channel headbox. You can organize channels into sets that can be viewed separately on the screen.

For example, channels 1 - 5 could be placed in Set 1, and channels 6 - 32 placed in Set 2. When Set 1 channels were displayed, only channels 1 - 5 would be visible. When Set 2 channels were displayed, only channels 6 - 32 would be visible.



To place channels into sets:

1. Choose **Edit > Settings > Montage** (tab).

2. To place a channel in a particular set, right-click the **Set** cell for the channel. Then, choose a value from the menu. Repeat this action until every channel is assigned to a set.

TIP: To switch between channel sets while viewing a study, open the **Trace** menu and choose **Switch Set**.

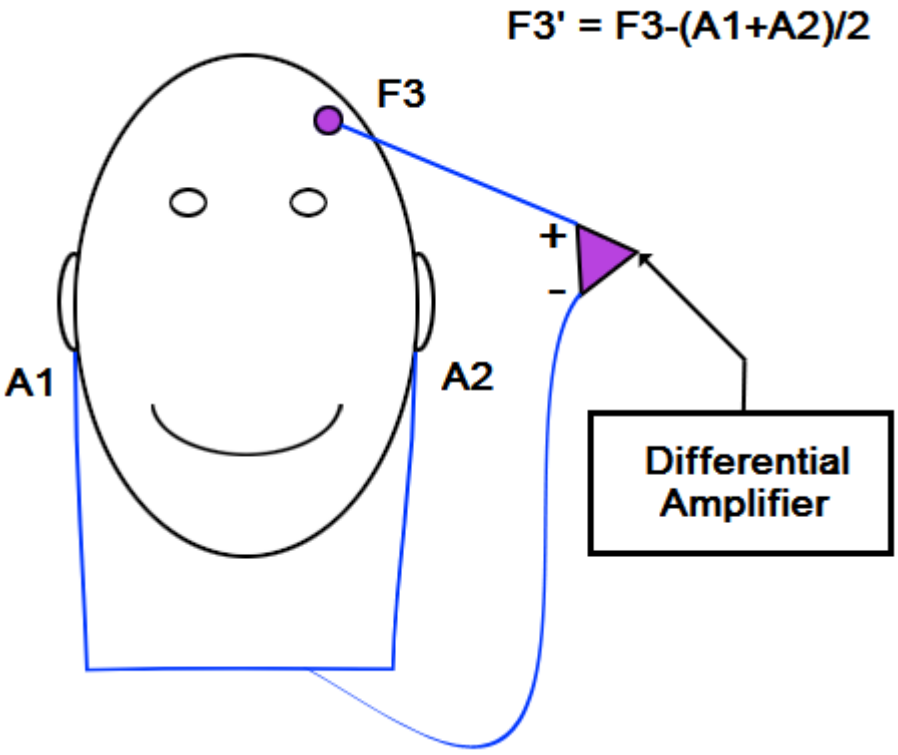
14.7 Linked Ears Montage

Electrical activity is recorded from the scalp as a differential voltage between one lead, designated the active site, and another, designated the reference.

Monopolar montages, also called referential or common reference montages, record from an active site that is referenced to one that is relatively electrically neutral.

Bipolar montages reference an active site to another active site.

One of the most common monopolar montages is the **Linked Ears** montage. In this type of montage, A1 and A2 are averaged to cancel common noise.



Linked Ears Montage

In this objective representation (which would have been done in the past with splitters, adaptors, resistors, etc.) the ears are physically linked, which is why this type of montage, now done with computer software, is still referred to as a Linked Ears montage.

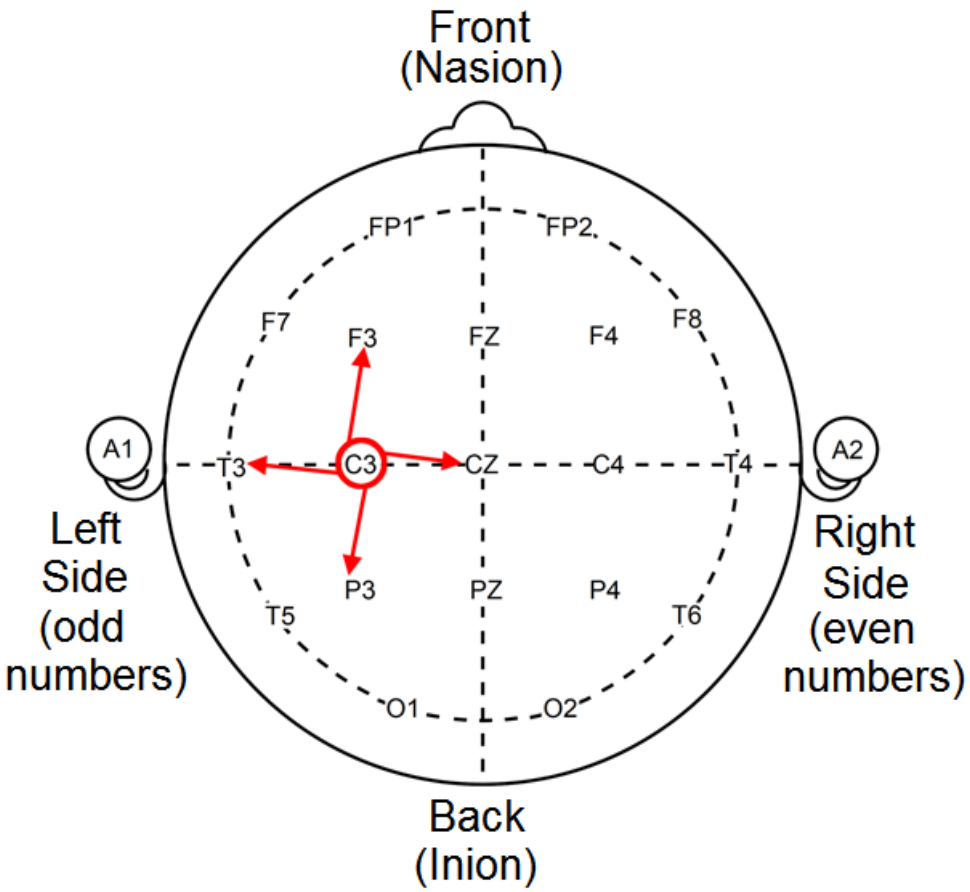
A **Linked Ears** montage is created in NeuroWorks using the **Laplacian Channels** feature.

14.8 Laplacian Montage

Another method similar to the **Linked Ears** (common reference) montage is the **Laplacian** (local reference) montage. The term local reference refers to the creation of a unique reference for each electrode. A small number of electrodes in the vicinity of the target electrode are used to compute the synthetic reference.

In the following illustrated example, the reference for electrode C3, the target electrode, is constructed by averaging the electrodes surrounding it:

- F3
- CZ
- P3
- T3



C3 and Local Reference Electrodes

Typically, the weights in the average are some measure of the distance between the target electrode and its surrounding electrodes. This distance is often the physical distance across the scalp.

NOTE: For practical purposes, the weights can be entered as proportions using the Laplacian Channels feature of NeuroWorks.

For our C3 electrode, we would enter C3 as Input 1 **(Edit > Settings > Montage)** and—using the Laplacian Channels feature— the following formula would be applied as a reference for Input 2:

$$\frac{F3 + CZ + P3 + T3}{4}$$

NOTE: The averaged reference on Input 2 is known as C3 Prime.

Setting Laplacian (Average Reference) Channels

The Laplacian editor facilitates:

- Single-click (no prompt for weights) mode.
- Shortcuts to clear to 0 / set to 1 all weights.

A Laplacian channel is one that is referenced to a mean of two or more other channels.

- One of the most common uses of a Laplacian channel is in a Linked Ears (or common reference) montage.
- Another common use is in the Laplacian (or local reference) montage.

NeuroWorks supports Laplacian channels for all headbox types.

To access the Laplacian feature:

1. Choose **Edit > Settings > Montage**.
2. Right-click an **Input** channel and select **Laplacian**. The **Laplacian Selection** box appears.
3. To add a new Laplacian (average reference) montage, click **New**.
4. Type a name in the **Label** text box.
5. Click a button corresponding to one of the headbox channels you want to use in your average reference montage.
6. The **Set Coefficient Value** box opens. Enter a percentage value, or enter 1 if you want the channel to be averaged equally with other channels.

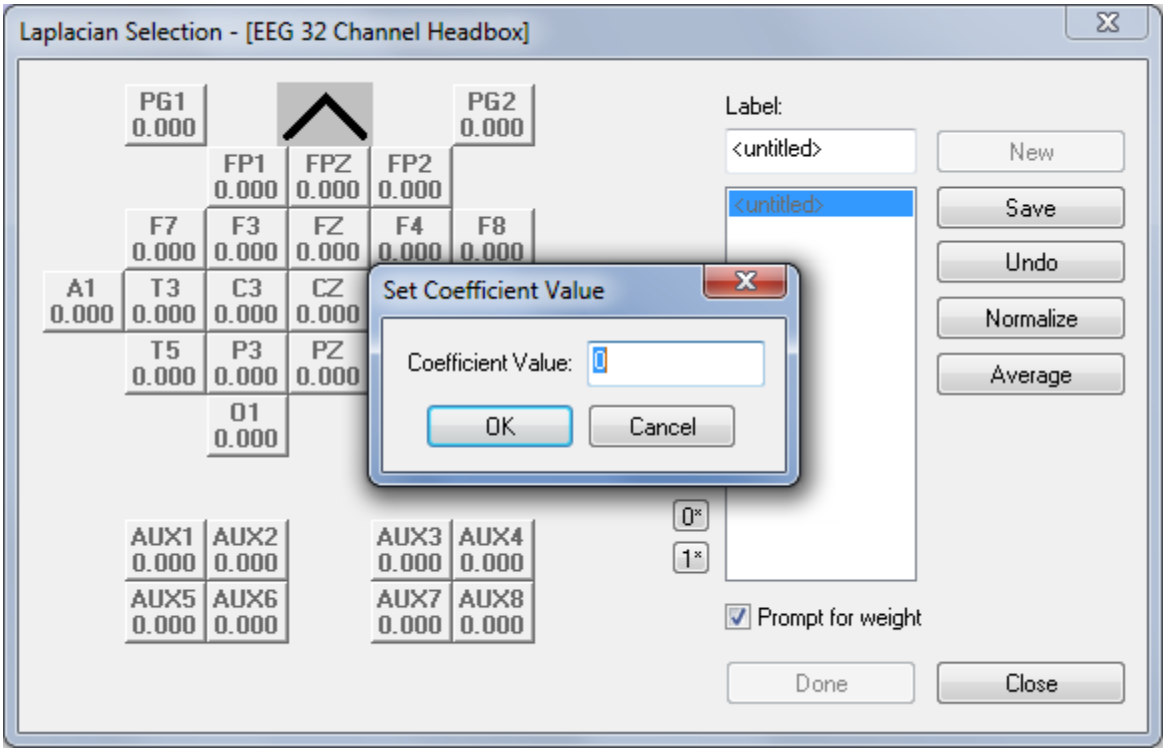
   TIP: For a Linked Ears montage, enter a value of 1 for each of the channels.

7. Click **OK.**
8. Repeat Steps 5–6 for all additional channels you want to include in the calculation.
9. Click Normalize. IMPORTANT!

NOTE: Clicking **Normalize** "normalizes" coefficient values to a value of 1. For example, if you had entered 1 for the first value of two values, and 9 for the second, clicking Normalize would adjust the values to .1 and .9 (or 10% and 90%, respectively). If you fail to click Normalize, the combined values of your reference channels will overpower the value from your active site(s). You will end up with inaccurate values, and possibly the same inaccurate values, on every channel affected.

10. Click **Save.**
11. To close the **Laplacian Selection** box and apply your average reference channel, click **Select**.
12. To close the Laplacian Selection box and store your average reference channel for use later, click **Close**.

NOTE: The next time you open the montage, when you right-click an input channel and select Laplacian, the label you just added will be available in the Laplacian Selection Box - Label list.



Laplacian Selection Box

Sample Laplacian Montage

A typical Laplacian montage definition is shown in the table below. There are others, but the combinations displayed are illustrative of the process of constructing a Laplacian montage.

Typical Laplacian Montage

Target Electrode	Local Reference Electrodes (Prime Combination)
C3	T7 + CZ + P3 + F3
C4	F4 + CZ + T8 + P4
CZ	C4 + PZ + FZ + C3
F1	F7 - FP1 + F3 + 2FPZ
F2	F4 + 2FPZ + F8 - FP2
F3	F7 + FP1 + FZ + C3
F4	C4 + FZ + F8 + FP2
F7	T7 + FP1 + F3
F8	F4 + T8 + FP2
FPZ	2FP1 + FZ + 2FP2 - 2FPZ
FZ	F4 + CZ + FPZ + F3
O1	P7 + P3 + 2OZ - O1
O2	2OZ + P8 + P4 - O2
OZ	2O1 + PZ - 2OZ + 2O2
P3	O1 + P7 + PZ + C3
P4	C4 + PZ + O2 + P8
P7	O1 + T7 + P3
P8	O2 + T8 + P4
PZ	CZ + P3 + P4 + OZ
T7	P7 + F7 + C3
T8	C4 + P8 + F8

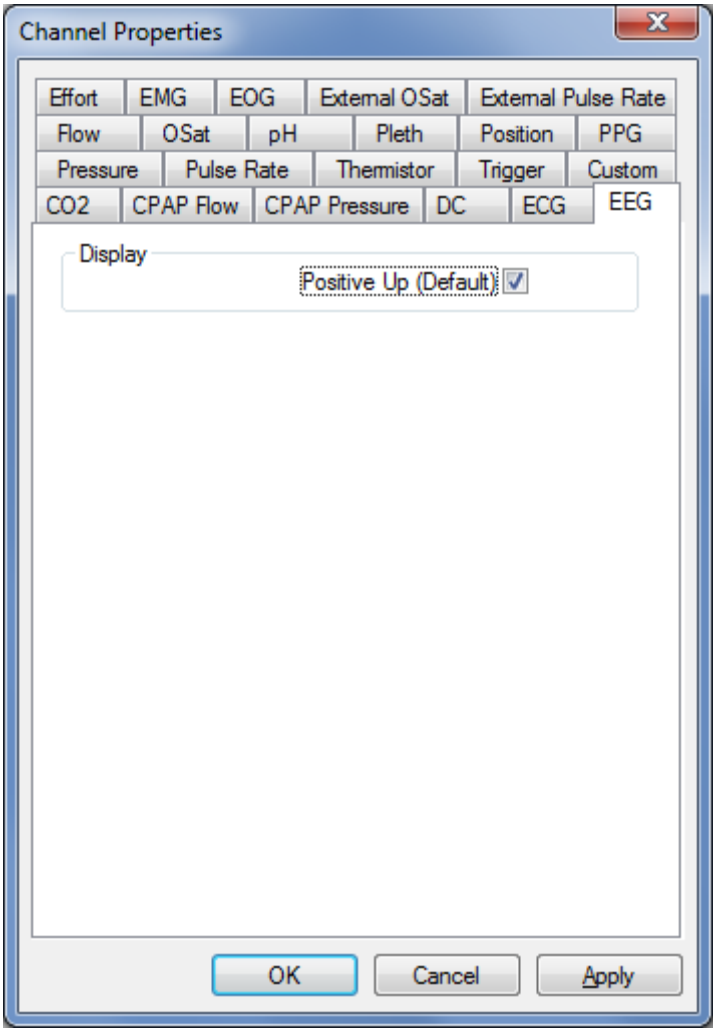
After entering these values individually, you can create a new montage where the Target electrodes are sourced in Input 1 and the reference definitions (Prime combination) are sourced in Input 2 of the various channels.

IMPORTANT! Make sure you **Normalize** each definition so that a valid comparison can be made.

14.9 Viewing and Adjusting Channel Properties

To view or adjust the montage channel properties settings, follow these steps:

1. Choose **Edit > Settings > Montage** (or CTRL + T > Montage or Trace menu > Channel Properties).
2. Click **Properties**.
3. The **Channel Properties** box opens.



EEG Tab / Channel Properties Box

4. Click the tab corresponding to the settings you want to view or adjust.
5. When you are finished making changes or viewing, click **OK**.

14.10 Changing Montage Settings during Recording

You can change the Montage settings while you are recording by using the keyboard or the mouse.

- From the keyboard, press the UP or DOWN arrow keys to regulate the **Sensitivity (gain)** of the study to smaller changes in voltage.
- To change the display of waveforms, use the **LFF, HFF**, or **Notch filter** and **Sensitivity** drop-down lists on the Montage toolbar.

See also: Montage Toolbar and Creating and Editing a Montage.

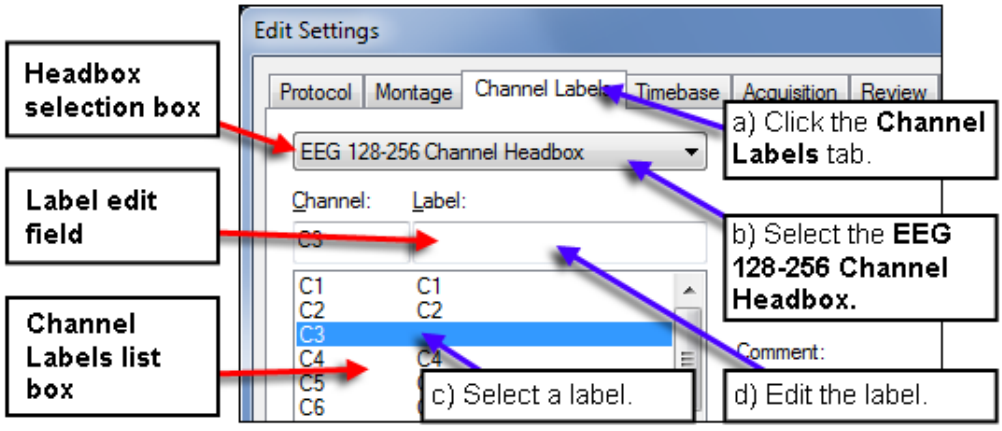
14.11 Editing Channel Labels

This section demonstrates how to modify channel labels and create new montages for a headbox. All headbox channels have a default set of labels. For example, the EEG32 headbox labels correspond to 10-20 montage placements. Other headboxes may have numbered channels.

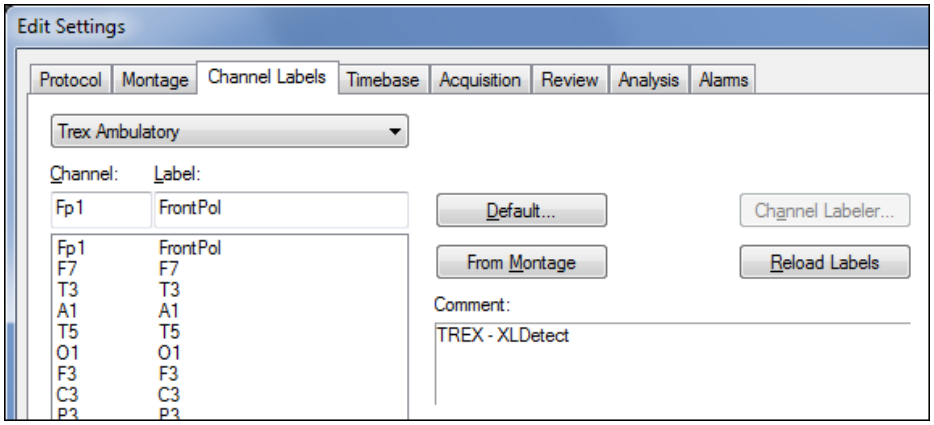
To customize Channel Labels for a particular headbox:

1. Choose **Edit > Settings > Channel Labels**.
2. Select the headbox type from the list.
3. Select the desired channel, then enter a custom name of up to 6 characters. Repeat for all channels to be labeled.
4. Click **OK**.
5. To make your changes live, choose **Edit > Settings > Montage**.
6. Click the Apply Custom Label button.
7. Click **OK**.

Custom labels are applied globally. They appear on the left side of the live EEG display. The illustration below shows how channel labels are edited for the **EEG 128 Channel Headbox**.



Editing Channel Labels for EEG 128 Channel Headbox



Channel Labels Tab

Channel Labels Tab Buttons

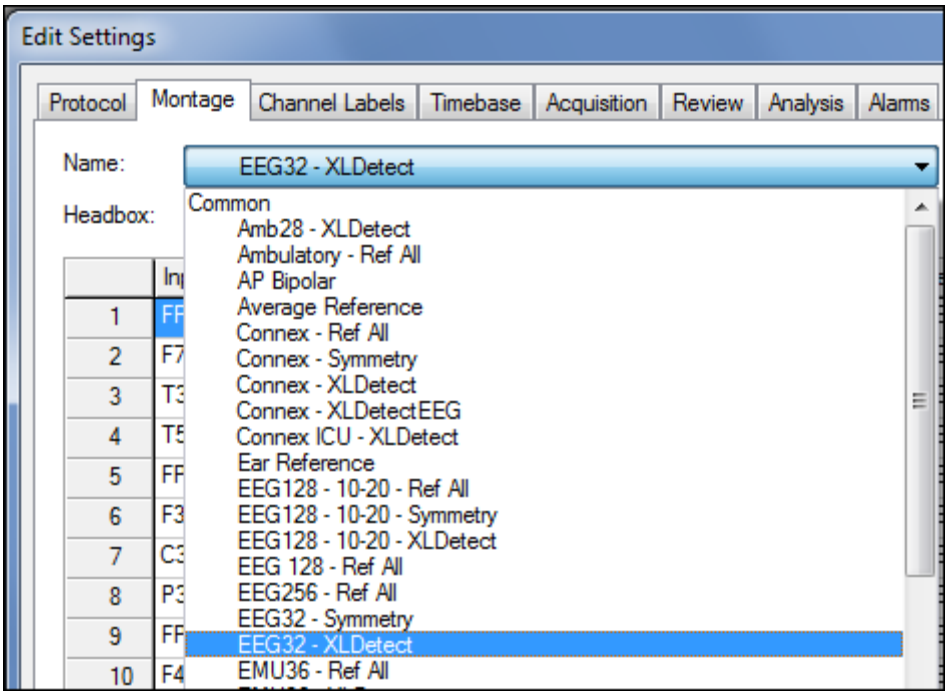
Button	Function/Description
Default...	**Default** returns montage labels to factory defaults.
From Montage	**From Montage** adds the labels from the current montage to the Channel Labels list. However, the labels saved on your machine must be different from those of the current montage.
Channel Labeler...	**Channel Labeler** is a graphical label set editor. To enable it you need to install channel labeler (or DSM function in installation) and have a Quantum, EMU128, or NeuroLink IP study open or have the Quantum, EMU128, or NeuroLink IP set on acquisition page as your current headbox (if you open NeuroWorks with no study). See Channel Labeler section.
Reload Labels	**Reload Labels** re-reads the labels from the computer registry. This is rarely required because the **Channel Labeler** communicates with NeuroWorks when the labels are changed. If this communication is broken, a manual refresh is required.

14.12 Extracting Channel Labels from a Montage

To further improve workflow for multi-electrode studies, it is now possible to extract labels from a given montage. This makes it possible for you to modify an existing set of labels rather than create a full channel set from scratch.

To extract labels from a montage:

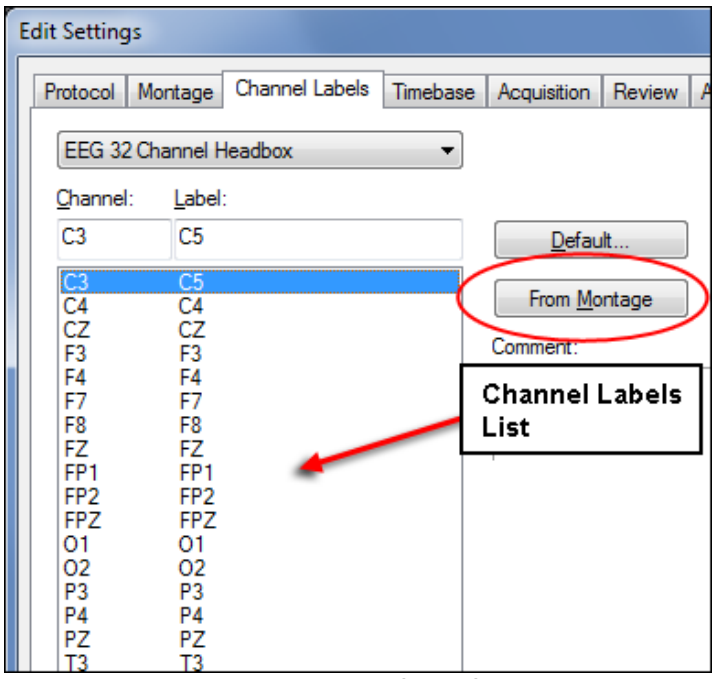
1. Choose **Edit > Settings > Montage** (tab).
2. Select the montage from which you want to extract labels.



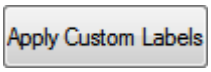
Montage Selected

3. Press the **Apply** Apply button.
4. Click the **Channel Labels** tab to switch to the **Channel Labels** page.
5. Press the **From Montage** From Montage button to add the labels from the current montage to your Channel Labels list.

NOTE: For the **From Montage** From Montage button to be enabled, the labels saved on your machine must be different from those of the current montage.



Montage Selected

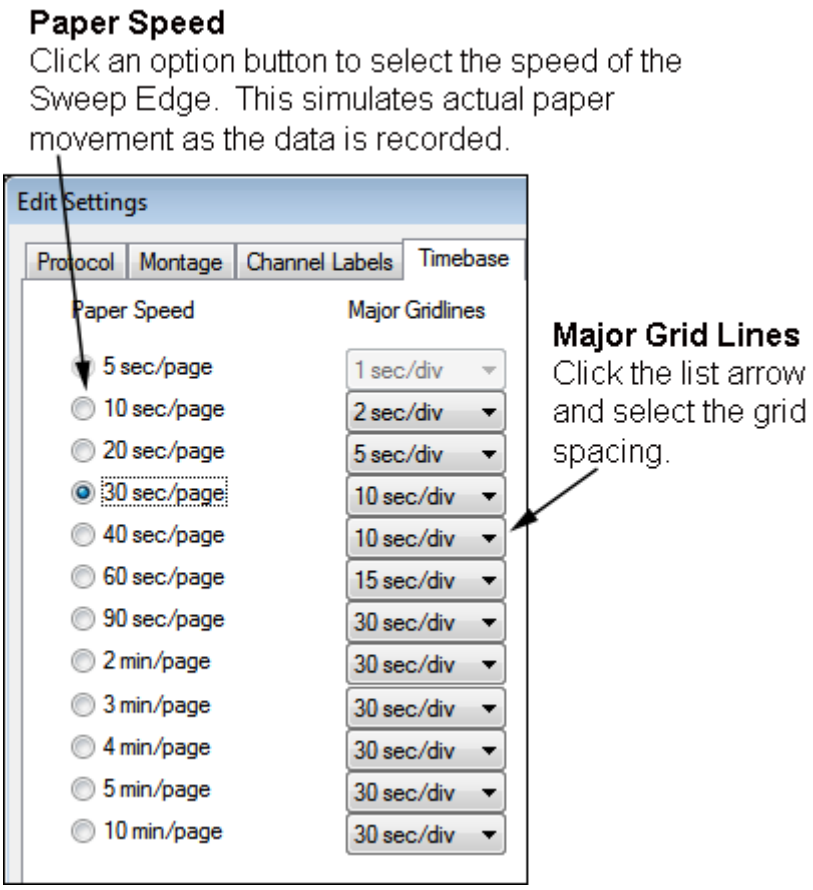
6. Press the **Apply** button to save the labels.
7. Click the Montage tab to switch to the Montage page.
8. Select the montage to which you want to apply the labels.
9. Press the **Apply Custom Labels** 

button to transfer the labels to the montage.

14.13 Editing Timebase Settings

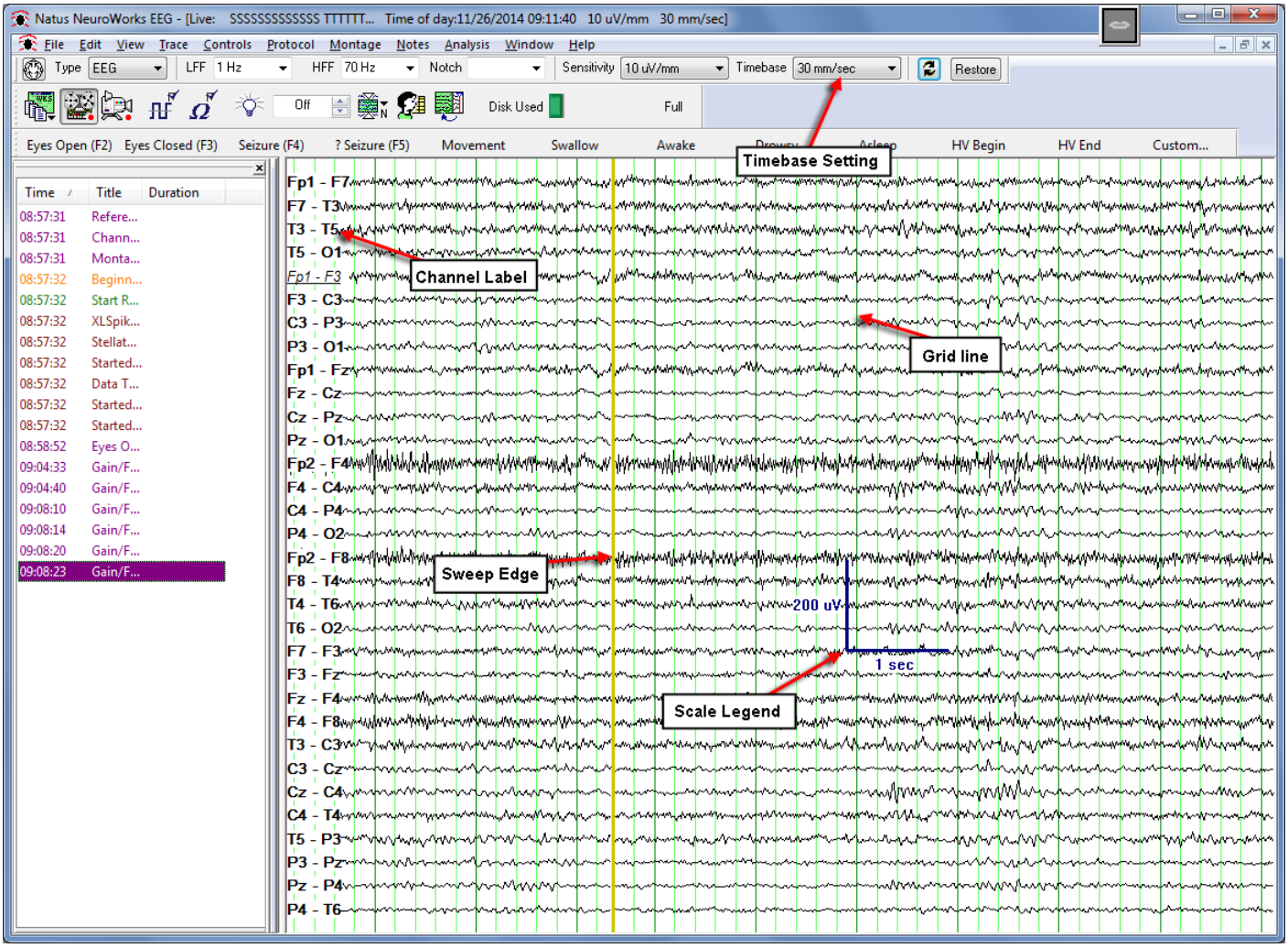
Use the **Timebase** dialog box to select the paper speed and grid line display for the recording.

To open the Timebase dialog box, choose **Edit > Settings > Timebase**.



Timebase Tab in Edit Settings Dialog

When you have selected the **Paper Speed** and **Major Grid Lines**, click the **Apply** button to see the results. If you are satisfied with the selected Timebase, click **OK**.



NeuroWorks EEG Live or Acquisition Window

14.14 Editing Acquisition Settings

Use the **Acquisition dialog box** to define the reference channel, establish the sampling frequency, and turn off channels not being used. To open the Acquisition dialog box, choose **Edit > Settings > Acquisition**.

To...	Do this...
Change the selected Headbox and edit the available Acquisition settings	Select the desired **Headbox** from the dropdown menu.
Activate the Channel On/Off buttons	Select the **Set Manually** option button.

To...	Do this...
Display a large sine wave signal when an electrode becomes disconnected	Select the **Electrode Detection** check box.
Set the reference electrode	Select the **Reference Electrode** from the pre-populated list. This list is based on the selected headbox.
Set the Sampling Frequency	Select the **Sampling Frequency** from the pre-populated list. This list is based on the selected headbox.
Set the automatic actions for the study.	Select the desired **Option for Starting a Study** from this section. This includes options such as starting EEG and Video automatically; restarting a study; or running a protocol at the beginning of the study.

Set or configure an Acquisition Profile

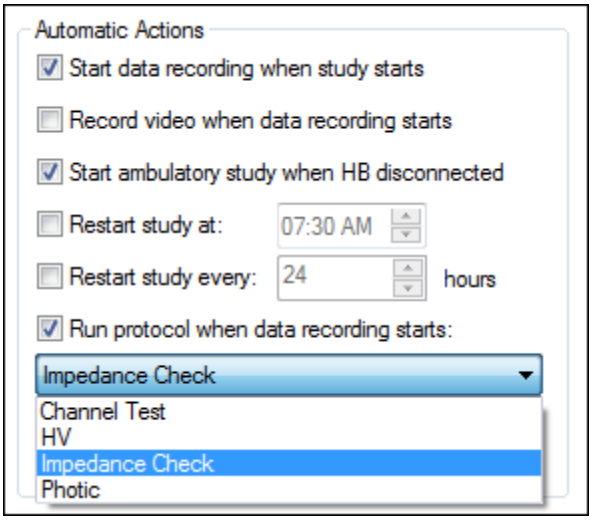
Note: When using the Quantum Amplifier and breakout boxes, you can set the Pinboard Usage which automatically turns on channels in 64-Channel increments. You can also choose the Decimation (Hz) in this screen for downsampling of study data for studies collected at 1000Hz or higher. For additional information, contact Technical Support.

Options for Starting a Study

You can select these options to:

- Automatically start EEG recording at the start of a study.
- Automatically start video recording at the start of a study.
- Tell the Trex headbox to begin an ambulatory study (start storing data to its internal flash memory) once it is disconnected from the main computer.
- Restart a study at a specified time.
- Restart a study every X number of hours.
- Run a protocol at the beginning of a study.

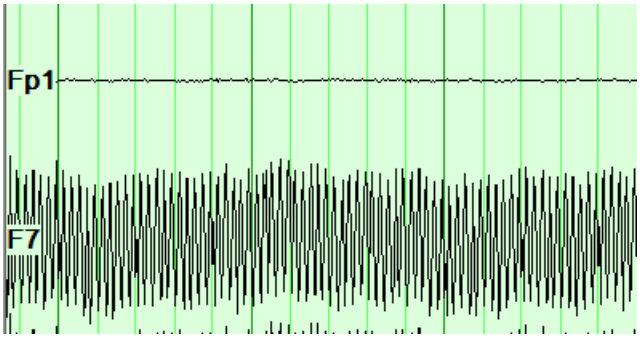
NOTE: Select a preset protocol from the drop-down list. The list becomes active once **Run protocol** ... is selected.



Study Start Options

Loose Electrode Detection

Some Xltek headboxes can help detect when an electrode is “bad”, or “loose/off”. The headbox generates a synthetic waveform that enables you to easily identify an electrode connection problem at a glance.



Example Showing Fp1 is Connected (shorted to ref) and F7 is Disconnected/Loose

To enable Electrode Detection:

1. Choose **Edit > Settings > Acquisition**.
2. Select the **Electrode Detection** check box.
3. Select **Common** from the **Reference Electrode** list.
4. In the **Montage** tab of the **Edit Settings** window, select a montage.
5. Unplug an electrode from the headbox. A sine wave of approximately 500 mVpp/32Hz for EEG32 and 500 mVpp/25Hz for Ambulatory/EMU should appear.

The following headboxes support electrode detection:

- Natus Quantum
- EMU40 and EMU40EX with firmware version 2.61 or higher (NeuroWorks 7.1.1591 or higher)
- All Mobee headboxes

- EEG32 with firmware version 3.4 or higher
- Ambulatory 24 and 48 with firmware version 2.1 or higher
- EMU36 with firmware version 2.1 or higher

During a live study, the **Electrode Detection** check box is grayed out when an EEG32, AMB28, or EMU36 headbox with an older firmware version is used. When you are not running a live study, the detect electrode check box is unavailable only when a headbox other than a Quantum, EMU40, Mobee, EEG32 or EMU36 is selected on the Acquisition tab. If the connected Quantum, EMU40, EEG32 or EMU36 headbox has an older firmware revision, then the check box is not available. The Electrode Detection check box is unavailable whenever a live study is subsequently created because it is not possible to determine the firmware version of the headbox unless a live study is underway.

Technical Specifications of Electrode Detection

The **Electrode Detection** feature applies a small sine wave (500 mVpp/32Hz for EEG32 and 500 mVpp/25Hz for Ambulatory/EMU) to the headbox channel inputs through the impedance measurement circuitry that already exists in the headbox. With an electrode connected to the patient, the resulting amplitude is not detectable. For example, with an electrode impedance of 2K, the amplitude is 0.02 mVpp. This results in orders of magnitude less than the EEG signals.

With the patient lead disconnected, the resulting amplitude is 500 mVpp, which is quite large when viewed in NeuroWorks at the typical sensitivity of 10 mV/mm. Older analog EEG equipment had poor noise rejection and displayed high amplitude noise on channels with disconnected electrodes allowing EEG technicians to use this behavior to detect them. NeuroWorks' new electrode detection feature provides similar behavior. This makes NeuroWorks easier to use for technicians who are accustomed to the older analog equipment.

During an actual EEG acquisition (when the electrodes are connected to a person’s skull), the same sine wave also appears when using a reference other than common. If the non-common reference channel is also disconnected, then the channels that have electrodes connected will have the 500 mVpp sine wave superimposed on the EEG signal, and the disconnected ones will appear flat because the sine wave superimposed on the channel will be cancelled by the sine wave due to the disconnected reference.

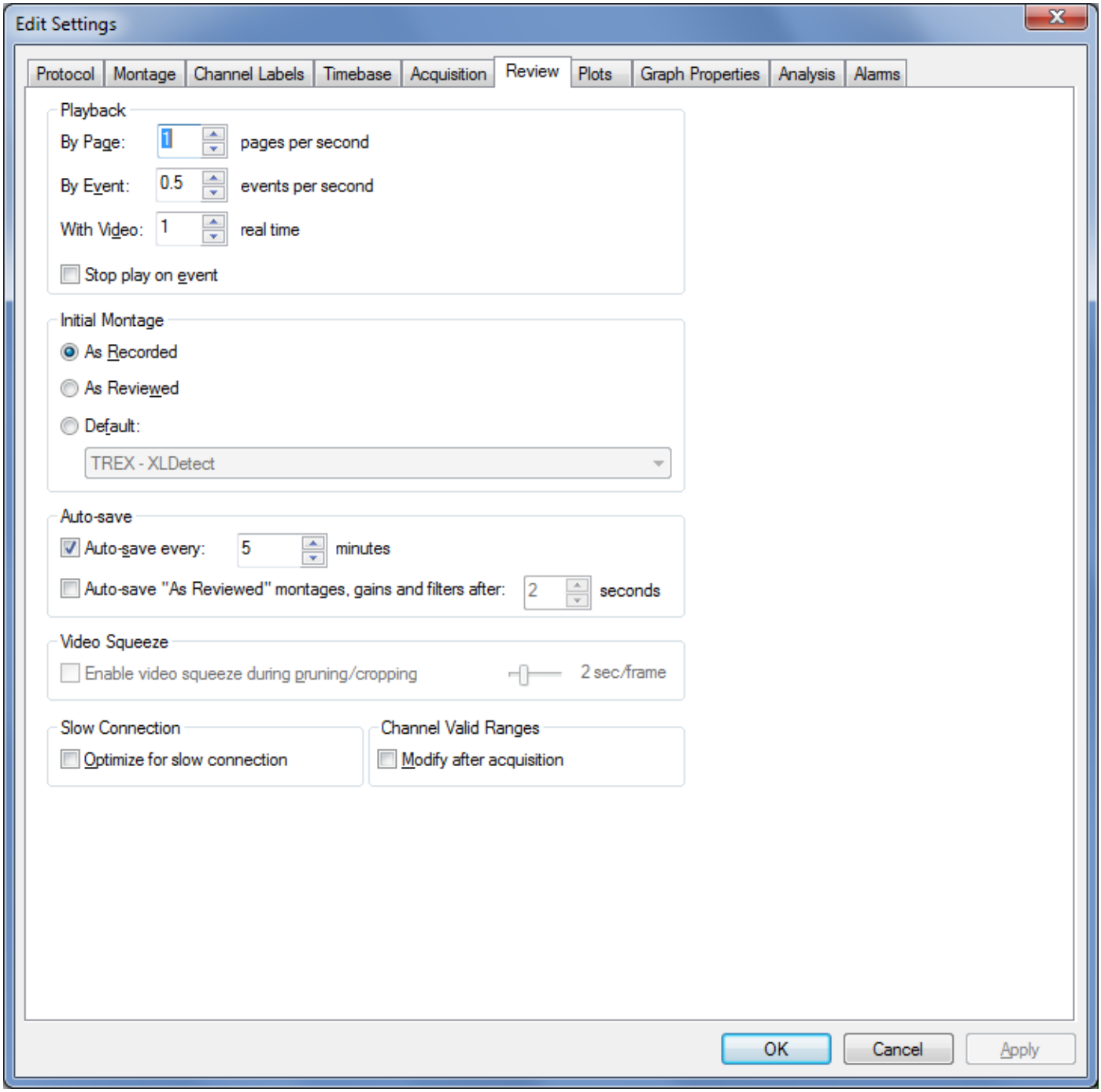
14.15 Editing Review Settings

To determine default system settings for reviewing studies, choose **Edit > Settings > Review**.

Use the **Review** tab to:

- Set the Page Rate.
- Stop Play On Event. If selected, the playback will automatically stop when an event is found in the study.
- Select to review studies with the montage As Recorded, As Reviewed or with the default montage.
- Activate Auto-Save. Used to automatically save your work at a user-defined interval.

- Enable Video Squeeze. If selected, allows you to enable video squeeze in the **Clips dialog** during pruning/cropping and to configure squeeze settings. This option is disabled when a study is open in NeuroWorks EEG. For more information on the Clips dialog, see Clipping and Pruning a Study.
- Optimize for a slow connection.

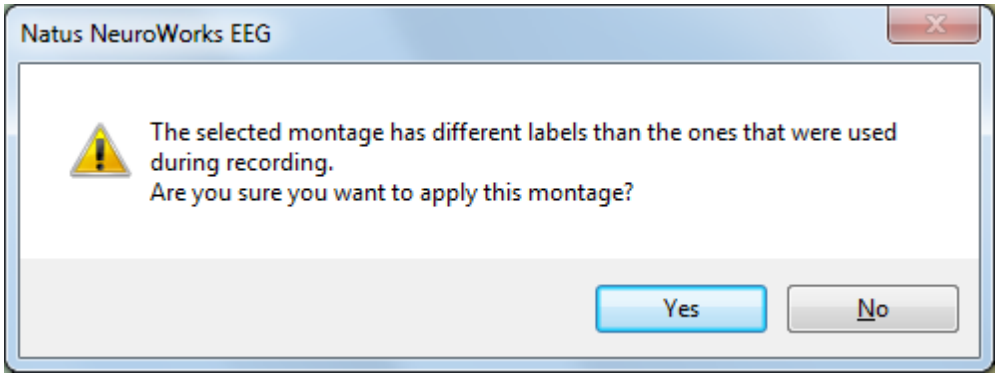


Options in the Review Tab of the Edit Settings Window

Mismatched Labels Warning

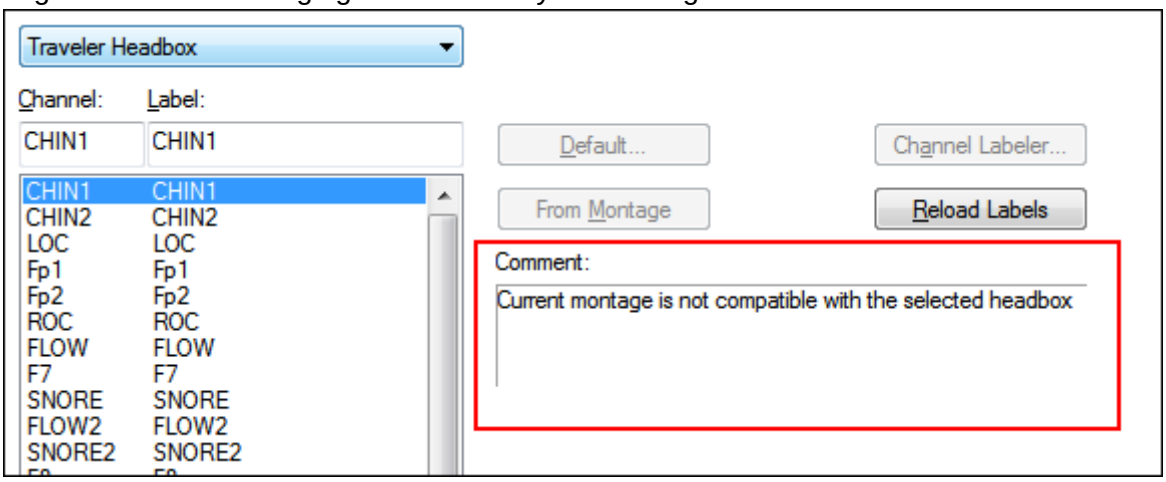
When a recording is made with a multi-channel headbox such as a Quantum or EMU128, labels are typically created for each patient or type of study. It is therefore possible that during review a wrong set of labels may be applied to a study, thus making viewing the correct montage labels problematic.

If you try to apply a montage with labels that do not match the montage that was used during the original recording, the following warning may appear either in remote monitoring or reviewing mode.



Mismatched Labels Warning

This warning may also appear in the comment section of the Channel Labels tab in the Edit | Settings menu when changing the labels for your montage.



Mismatched Labels Warning – Edit> Settings Menu

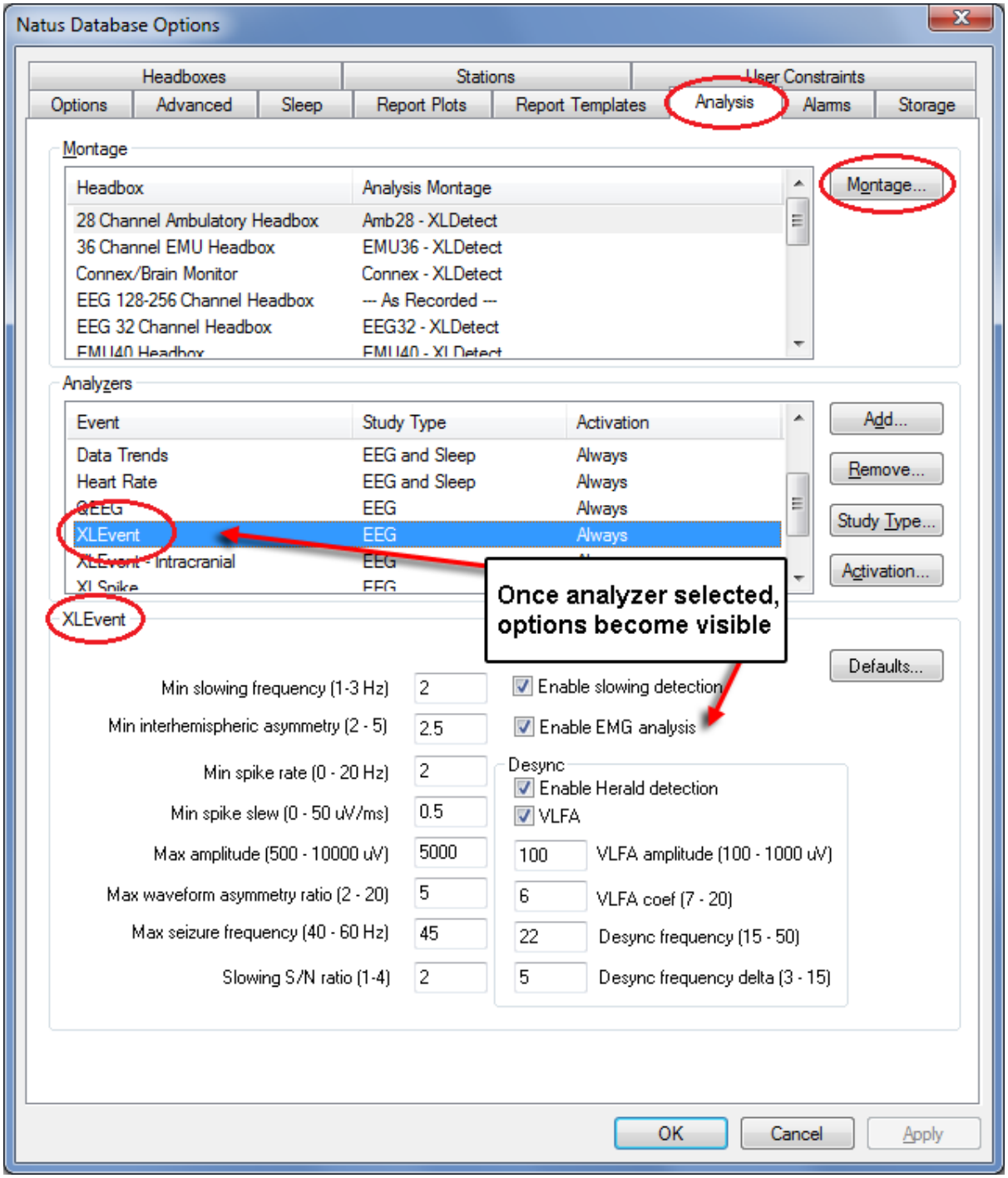
14.16 Editing Analysis Settings

If your NeuroWorks system is equipped with the optional Natus Spike and Event analyzer, you can add a number of analyzers to your study to automatically detect EEG events.

These analyzers are set to factory defaults that work well for the majority of studies. However, settings can be customized using the Analysis tab.

To edit Analysis settings:

1. Choose **Edit > Settings > Analysis**.
2. In the **Analyzers pane**, select the analyzer whose options you want to edit.
3. Once the analyzer is selected, its options appear in the pane below.



Analysis Tab in Edit Settings Dialog

Analysis Tab Options

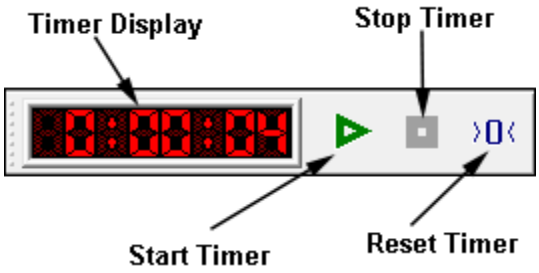
Option	Description/Function
Montage...	Select a headbox in the **Montage** pane. Click the **Montage** button to see a pop-up list of available analysis montages. Click a montage to select it.
Add	Click the **Add** button to see a pop-up list of available analyzers. Click an analyzer to select it.
Remove...	Select an analyzer in the **Analyzers** pane. Click the **Remove** button to remove it
Study Type...	Click the **Study Type** button to see a pop-up list of available study types. Choose **EEG**.
Activation...	Click the **Activation** button to see a pop-up list of study activation options. Choose between: **Never**, **Always**, **Lights Off**, or **Schedule** (enter schedule time in resultant dialog box).
Defaults...	Select an analyzer in the **Analyzers** pane. Click the **Defaults** button to return altered settings to factory defaults.
Analyzer Options Section	Once an analyzer has been added and selected, its options become visible in the bottom section of the Analysis tab. Modify options and click the **Apply** button to set them.

15. Tools and Toolbars

This chapter describes Tools and Toolbars in the NeuroWorks EEG (Wave) window. For Tools in Natus Database, see the Tools and Toolbars topic in the Natus Database chapter.

15.1 Stopwatch Toolbar

The **Stopwatch** measures and displays elapsed time or event duration. To open the Stopwatch, choose **View > Toolbars > Stopwatch**. The Stopwatch toolbar is available in only in **Acquisition** mode.



The Stopwatch

15.2 Montage Toolbar

You can use the Montage toolbar to modify the channel settings. The ranges of settings for the montage are indicated by the values available on the toolbar.

Montage Toolbar

To open the Montage Editor, click the **Montage Settings** button that is located on the far left side of the **Montage Settings** toolbar.

Use the **Type** menu to view the common settings for a particular channel type. To change the channel Type, click the **Montage Settings** button to open the **Montage Editor** and **right-click** the **Type** column to select a new channel signal Type for one or more channels.

LFF (Low Frequency Filter)	Filters out low frequency interference below the set value.
HFF (High Frequency Filter)	Filters out high frequency interference above the set value.
Notch Filter	Minimizes interference from nearby electrical equipment.

Sensitivity	Adjusts the sensitivity, or gain, of the channels. For example, increasing the sensitivity of a channel will make the wave traces appear larger on the screen.
Timebase	Adjusts the speed of the recording on the screen .
	When you click the **Refresh Montages** button, a list of all the montages in the common settings and local directory will be updated. If the Common Settings Cache is enabled, then this cache will be synchronized (updated) first before the montage list update.
	The **Restore** button restores all traces to baseline during live acquisition. This feature is useful, for example, when starting or resuming an ambulatory study. Instead of waiting several seconds for the traces to settle to baseline, click the **Restore** button to perform this function instantly. Clicking this button will also manually zero the amplifiers allowing them to return to the baseline more quickly than previously possible.

TIP: You can check filter values on screen by dragging the left column bar to the right to reveal a window showing individual channel settings.

15.3 Note Toolbar

Different buttons appear on the Note toolbar depending on whether you are recording a live study (acquisition mode) or reviewing a previously recorded study (review mode). To open the Note toolbar, choose **View > Toolbars > Note**.

Note Toolbar in Acquisition Mode

Note Toolbar in Review Mode

Click a Note button to instantly insert a note at the current location of the **Sweep Edge**.

15.4 Bookmarks Toolbar

The **Bookmarks** toolbar manages the creation of and navigation through created bookmarks. A Bookmark saves a view of exactly what a whole page of data looks like, including both the

montage setting and the filter settings. In other words, a bookmark saves a page of a study including the context at the time that the bookmark was selected.

This is useful when, for example, a doctor adjusts the montage and filter settings in order to bring out a particular clinical feature of the EEG and wants to save that exact page of EEG data, using the exact montage and filter settings currently being displayed. Then, another doctor or technologist can navigate to the saved Bookmark and see the EEG in the exact same way that the initial doctor saw it.

To open the Bookmarks toolbar, choose **View > Toolbars > Bookmarks**.

Bookmarks Toolbar

TIP: To see the function of each button, point to a button and a **ToolTip** for that button will pop up.

15.5 Feature Marks Toolbar

The **Feature Marks** toolbar manages the creation of and navigation through created feature marks. This is useful when, for example, a doctor adjusts the montage and filter settings in order to bring out a particular clinical feature of the EEG and wants to save a view of a region of EEG data, using the exact montage and filter settings currently being displayed.

NOTE: The region of interest of a Feature Mark has a rectangle drawn around it with the background of the EEG within the Feature Mark change to a light blue.

Then, another doctor or technologist can navigate to the saved feature mark and see the EEG in the exact same way that the initial doctor saw it. Feature Marks can also be fully annotated and have many comment fields that can be filled out from either pre-configured menus or with

custom information. To open the Feature Marks toolbar, choose **View > Toolbars > Feature Marks**.

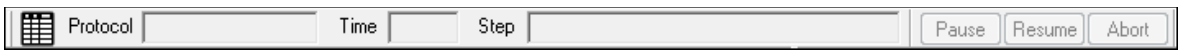
Feature Marks Toolbar

TIP: To see the function of each button, point to a button and a ToolTip for that button will pop up.

15.6 Protocol Toolbar

A protocol is a customizable set of actions that are set up to be executed sequentially. This toolbar displays the name and step of a protocol that is currently being run. Use the buttons on the far-right side of the Protocol toolbar to Pause, Resume or Abort a protocol.

To open the Protocol toolbar, choose **View > Toolbars > Protocol**.



Protocol Toolbar

15.7 Camera Toolbar

The Camera toolbar provides pan, tilt, zoom, and camera switching buttons for remote camera control during live acquisition (depending on camera[s] used). When you are controlling a non-Pan/Tilt camera, the Pan and Tilt buttons are unavailable (grayed out).

To open the Camera toolbar:

- Choose **View > Toolbars > Camera**.
- Or, right-click in the gray area around the visible toolbars, then select **Camera** from the pop-up list.

To hide the Camera toolbar, reverse either of the above steps

Views of the Camera Toolbar

Depending on which camera you are controlling, or how your system is configured, the Camera toolbar can appear in one of three ways.

1. Toolbar with Fixed Zoom Camera (such as Videology)

   Note the unavailable (grayed out) buttons in illustration above.

2. Toolbar with PTZ Camera (such as Pelco, Sunell or Sony IPELA)

3. Toolbar with Two Cameras Used

Note the following:

- When the system is configured to use two cameras, the Camera toolbar will have additional buttons that allow the user to select which camera is currently being controlled.
- The button that appears pressed (numbered 1 above) indicates the camera that is being controlled.
- When the mouse hovers over the button, the ToolTip indicates the full name of the camera.
- The text on a button corresponds to the first character of the camera name specified in the configuration.
- Previous users of NeuroWorks will notice that the Zoom In and Zoom Out buttons have now been moved to the beginning of the toolbar (since they are always enabled).

Buttons on the Camera Toolbar

Use the **Zoom** buttons to change the amount of information displayed in the view.

- To zoom out of the picture (show a wider area), click the magnifying glass with the minus sign.
- To zoom in (show an area in more detail), click the magnifying glass with the plus sign.

Use the **Tilt arrow** buttons to move the camera view up and down.

- To tilt the camera up, click the Up Arrow button.
- To tilt the camera down, click the Down Arrow button.

Use the **Pan arrow** buttons to move the camera view left or right.

- To pan the camera to the left, click the Left Arrow button.

- To pan the camera to the right, click the Right Arrow button.

Use the Numbered buttons to switch between Camera 1 and Camera 2.

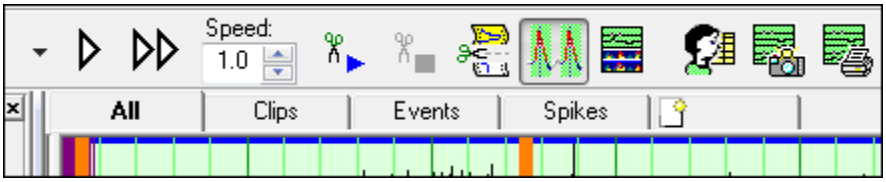
NOTE: Switching the cameras on the toolbar will also switch the video input that is captured – i.e. it replaces the swap cameras functionality previously handled by the swap camera buttons on the Video and Workflow toolbars.

15.8 Instant Pruned View Toolbar

Use the Instant Pruned View toolbar to instantly display the trace window as if you had already clipped and pruned it.

To display the Instant Pruned View toolbar:

1. Select a study in the Natus Database and click **Review**. NeuroWorks opens with the study in Review mode.
2. Click the **Instant Pruned View** button on the Review toolbar (OR **choose View > Instant Pruning** OR press **Alt + L).** The Instant Pruned View toolbar opens:



Instant Pruned View Toolbar

To hide the Instant Pruned View toolbar, reverse the above steps.

Instant Pruned View Toolbar Buttons

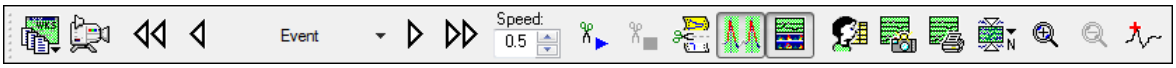
All	Exits Instant Pruned View and redisplays the normal view.
Clips	Displays only any clips that have already been made.
Events	Displays only events that occurred during the study.
Spikes	Displays only spikes that occurred during the study.
	Opens a dialog box where you can set rules for instant pruning.

15.9 Review Toolbar

Use the Review toolbar to navigate through a study. The Review toolbar is available only in **Review** mode.

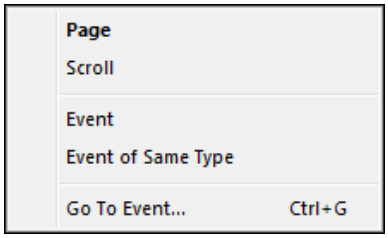
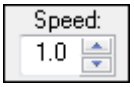
To open the Review toolbar:

- Choose **View > Toolbars > Review**.



Review Toolbar

Review Toolbar Button Functions

Button	Function/Description
	Toggles **video on/off.**
	Plays study in **reverse**.
	Goes to the **previous** item.
 OR  (depending on which option is selected)	Displays drop-down list of **navigation modes** to choose from. 
	Goes to the **next** item.
	Plays study **forward**.
	Changes the **playback speed**. Click arrows  to increase or decrease speed. OR

Button	Function/Description
	Click the number to highlight it and type a new speed.
	Click to **start marking a clip**.
	Click to **end marking a clip**.
	Click to **edit clips**.
	**Instant Pruned View** button. Click to have the system display an automatically pruned record.
	Show or Hide the **Trends Summary** toolbar
	**Capture current page** button.
	Click to **print** the **current page**.
	Vertical paging of traces on screen
	**Magnify** button. Click button, then click and drag rectangle in traces window.
	**Unmagnify** button. Click to return traces window to normal size.
	**Waveform cursors** button. Inserts a cursor with accompanying info box wherever you click on a waveform. To turn off, click button a second time.

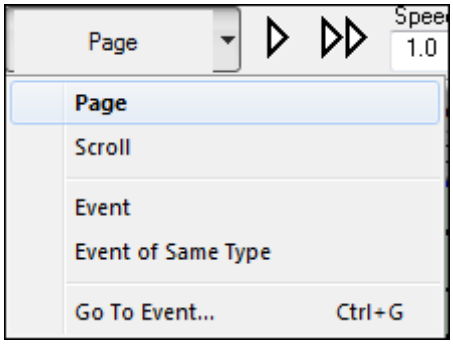
Button	Function/Description
	**Starts** analog printing. This icon only appears if you have the analog printing service installed.
	**Stops** analog printing. This icon only appears if you have the analog printing service installed.
	Shows the analog printing **Properties** window so you can modify the settings for the analog printing service. This icon only appears if you have the analog printing service installed.

TIP: The **Waveform Cursor** can be used to measure waveform amplitude.

NOTE: If you are using a mouse wheel, the middle button selects the navigation mode, and the wheel steps forward or backward using the selected navigation mode.

TIP: You can play through the study forward in any of the navigation modes by hitting the spacebar. Press the spacebar again to stop play. Clicking the right and left arrow keys on your keyboard lets you move forward or backward by navigation mode item. Adjust the slider to control playback rate.

Navigation Modes in Review

Page	Moves through the study page by page.
Scroll	**Scroll** navigation mode is supported for single steps and automatic playback.  In this mode, the time mark remains fixed while signal traces are scrolled and video is playing at high rate. Scrolling speed is controllable with the same slider as the paging rate. Use the spacebar (as with other navigation modes) to start/stop playback.

Event	Moves to the next note starting at the time marker position and selects the note.
Event of Same Type	Moves to the next event of the same type (i.e. Leg Movement, Mixed Apnea).
Go to Event (Ctrl + G)	Chooses an event from a list of scored events.

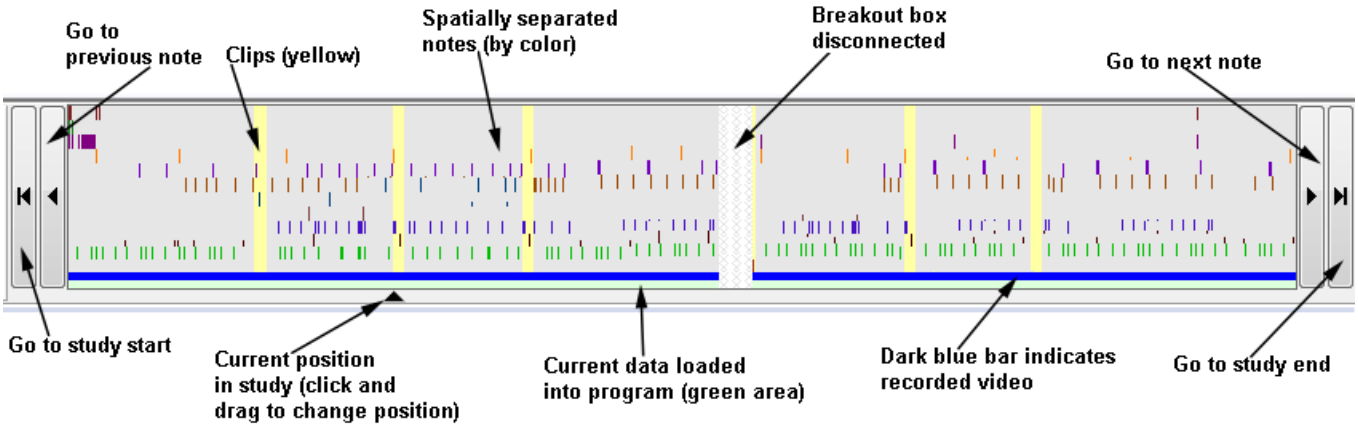
15.10 Study Toolbar

A dark blue bar at the bottom of Study toolbar (indicating that video exists for this study) changes to purple if the video was squeezed.

The **Study** toolbar shows breaks in recording sections where video was recorded as a cross-hatched area, and different events are shown using different colors.

To open the Study toolbar:

- Choose **View > Toolbars > Study**.



Study Toolbar

Note the following regarding the Study toolbar:

- Displays different note types, recorded sections, clips and video segments.
- Displays current buffering status (light green over dark green).
- Study toolbar is resizable. It can be docked at the bottom of the view to stretch across the window width and still be resized vertically.
- Left-clicking on the bitmap middle region will cause Review to jump to that position (similar to grabbing and moving the positioning triangle).
- Right-clicking on the bitmap middle region will cause Review to jump to the nearest displayed note.

- As vertical size is reduced, the toolbar scales accordingly. Information changes to accommodate the available screen real estate (for example, spatial separation of colors is dropped).

15.11 Workflow Toolbar

The **Workflow** toolbar can be used to start and stop recording of EEG and Video data both locally and from a remote computer.

To open the Workflow toolbar:

- Choose **View > Toolbars > Workflow**.

  OR

- Right-click in the gray area around the visible toolbars, then select **Workflow** from the pop-up list.

Workflow Toolbar

Workflow Toolbar Buttons and Indicators

Button	Function
	Start/Stop recording.
	Toggle video on/off.
	Test channels.
	Check impedance.
	Activate photic stimulator. Set flash rate.
	Review current study.

Button	Function
	Disk usage indicator.
	Start analog printing.
	Stop analog printing.
	Analog printing options.

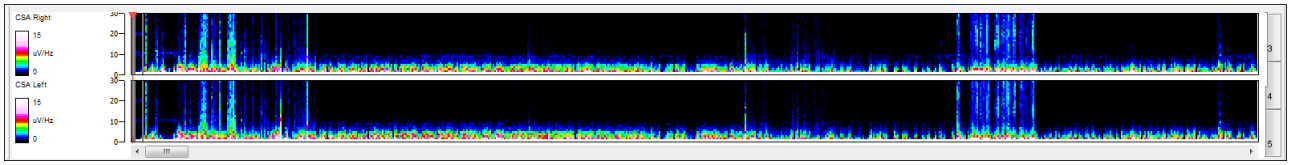
15.12 Trend Summary Toolbar

Use the **Trend Summary** toolbar to display the Compressed Spectral Array (CSA) of the EEG recording and quickly identify and navigate to events within the study. By default, the toolbar displays a graphical representation for the left and right hemispheres of the brain.

You can display the whole study in the toolbar or choose the number of seconds to display at one time. The Trend Summary toolbar is available in both Acquisition and Review modes.

To open the Trend Summary toolbar:

- Choose **View > Toolbars > Trend Summary**.



Trend Summary Toolbar

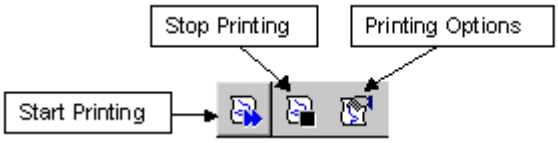
It is possible to configure multiple trends bars by clicking on any of the numbered tabs located on the right side of the trend toolbar. Each tab “remembers” one or more trend plots. Switching between the tabs is usually faster than reconfiguring the whole Trend Summary tool. To show which graphs are configured to be shown in each tab, move the pointer over the tab and check the **tool tip** (on the right). Up to 5 tabs are configured. The tabs are always shown even if they are empty to allow adding plots to them when needed.

15.13 Analog Printing Toolbar

The analog printing buttons are part of the **Review** toolbar in **Review** mode and part of the **Workflow** toolbar in **Acquisition** mode.

To view the Analog Printing buttons:

- In Acquisition mode, choose **View > Toolbars > Controls**.
- In Review mode, choose **View > Toolbars > Page**.



Analog Printing Toolbar Buttons

Analog Toolbar Buttons and Functions

Toolbar Button	Function
Start Printing	Begins digital-to-analog conversion and starts live speed paging (if no video) or scrolling (if video is open).
Stop Printing	Stops digital-to-analog conversion and paging/scrolling. When scrolling is stopped, printing stops too.
Printing Options	Shows the **Analog Printing Properties** window so you can modify the settings for the **Analog Printing Service**. You can modify these settings on the fly while **Analog Printing** is active.

15.14 Docking Toolbars

If you move a toolbar off-screen and want to bring it back on the screen, choose:

- **View > Dock Toolbars**.

This moves all visible toolbars back to their default locations.

NOTE: Dock Toolbars only works for toolbars that are turned on in the View menu. If a menu item has a check mark beside it, then it is turned on. If there is no check mark beside an item, then it is turned off (hidden).

16. Customizing NeuroWorks EEG

Once you are familiar with the basics of Natus software, the startup procedure, and the Natus Database setup, you can modify the NeuroWorks acquisition software settings to suit your particular needs.

The **Customize** window in NeuroWorks allows you to customize many features to suit your own environment and procedures.

To access the Customize window:

- Choose **File > Customize**.

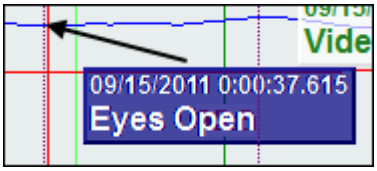
16.1 Customizing Acquisition Options

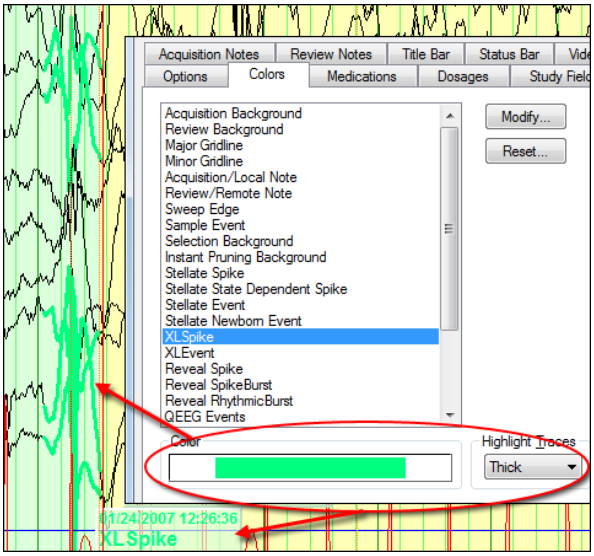
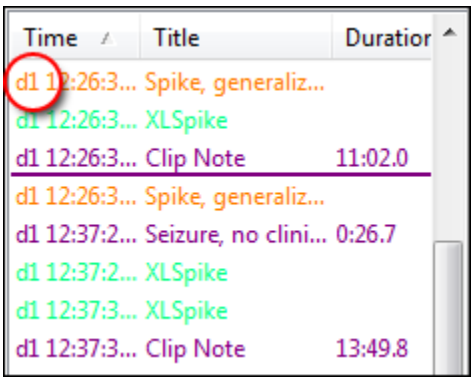
To customize NeuroWorks Acquisition options:

1. Choose **File > Customize**.
2. Click the **Options** tab.
3. Turn options on or off or set as desired.

Suggested Settings for the Options Tab

Option	Comment	Setting
General Options		
Always customize notes	Brings up a **Comments** box every time an event is marked.	[OFF]
Remote view tracks local montage	Enables a remote monitor to see traces in the same montage as the local viewer of the acquisition machine.	[ON]
Keep global settings across montage changes	Changing the montage will change which channels are shown on the screen. However, the filter and sensitivity settings of the new montage won't be applied to channels that were already displayed as part of the old montage.	[ON]
Automatically prompt report forms	Automatically presents **Technologist** and **Physician** reports at close of an Acquisition or Review.	[ON]

Option	Comment	Setting
Common Settings Directory	The location on your network server where common montages can be accessed. These montages appear in the **Common** group in the **Montage** menu.	Set to a directory on the network server.
Formatting Options		
Date Format	Select format of the date.	Sample default: 05-May-03
Time Format	Select format of time segment displayed in the title bar, notes, bookmarks and feature marks.	Recording Time
Notes Styles		
Background	Slider sets value between **Transparent** and **Opaque**.	40% opacity
Text	Slider sets value between **Transparent** and **Opaque**.	Opaque
Show Notes as Dotted Lines	Shows notes as dotted lines in the NeuroWorks Software. 	[OFF]

Option	Comment	Setting
Highlight Traces in Detected Events	Highlights traces in detected events with a specific color which is set in the **Color** tab. 	[OFF]
Show Day of Study in Annotation Viewer	Shows the day of the study in the Annotation Viewer next to the time. 	[OFF]
Notes Fonts Size		
Text Font	Click arrow at right to choose from a drop-down list of choices.	12 point
Time Font	Click arrow at right to choose from a drop-down list of choices.	9 point

16.2 Customizing Display Colors

To change the colors of components of the NeuroWorks display:

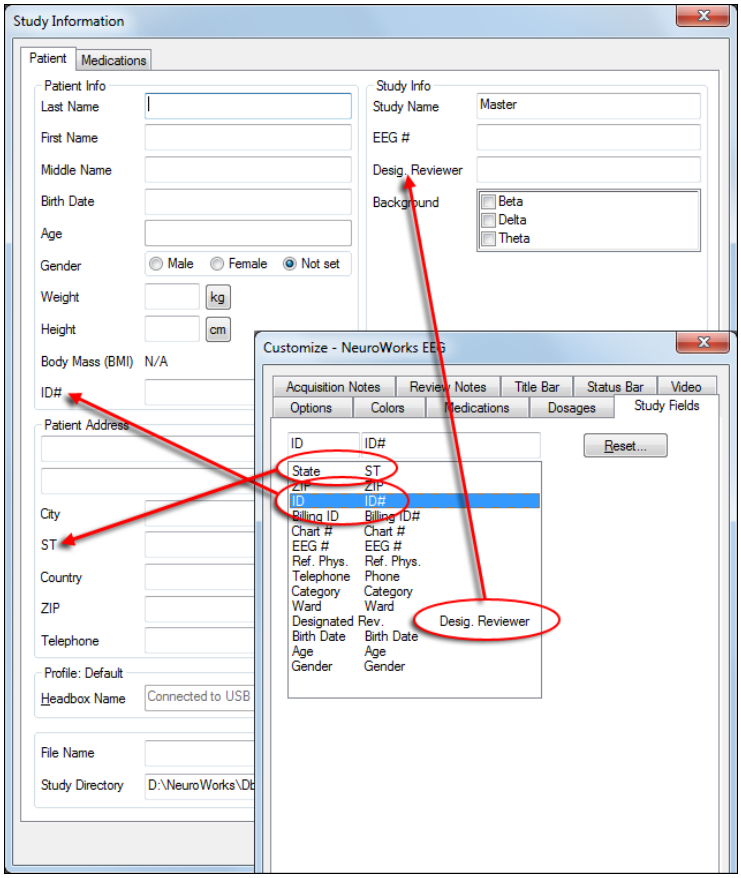
1. Choose **File > Customize**.
2. Click the **Colors** tab.
3. Select an item to modify from the list box (Acquisition Background, for example).
4. To open the color palette, click **Modify**.
5. Select a color.
6. Click **OK**.

The color of the selected screen element will now be the color you selected.

16.3 Customizing Study Field Label Options

To edit the study field labels that appear in the Study Information box:

1. Choose **File > Customize**.
2. Click the **Study Fields** tab.
3. Edit the Study Field labels as desired and click **OK**. Changes take effect on the next new patient entered.



Study Field Label Changes

Click **Reset** to delete any additions and restore the factory default list.

NOTE: Data entered in the Information tab is not automatically included in the **Study Information** file when the patient returns. Only demographic information is retained.

16.4 Customizing Notes, Acquisition Notes, and Review Notes

If you want to customize the information that appears in the Study Information window when you initiate or review a study, the Notes, Acquisition Notes, and Review Notes dialog boxes work the same way as the Medication Information dialog box.

To open any of these dialog boxes:

1. Choose **File > Customize**.
2. Click a tab.
3. To add or delete items from the list, click **Add** or **Delete**.
4. To add a sub-class to an existing item, click **Add Sub**.

Click **Reset** to delete any additions and restore the default list.

The Acquisition Notes and Review Notes tabs contain a **Bind Key** option. This option allows you to create a shortcut key that assigns an automatic note to mark where an event has occurred in a study. You can also use these tabs to place custom buttons on the Note toolbar.

To assign a Blink note to appear when F8 is pressed:

1. Choose **File > Customize**.
2. Click either the **Acquisition Notes** tab or the **Review Notes** tab.
3. In the events box, click **Blink**.
4. Click **Bind Key.** The **Key Binding** box appears. The Bind Key option initially can be used to assign a function key (**F key**) to each event listed in the dialog box.

NOTE: You can also use **Shift, Control, and Alt** together with any **F** key.

5. To open the function key list, click the arrow.
6. To select **F8** as the shortcut key, click **F8**.
7. Click **OK.** You are returned to the Notes tab and F8 is visible in the Key box.
8. To place a **Blink** button on the Note toolbar, select **On Toolbar** below the Key box.
9. Click **Apply.**
10. Go on to assign other shortcut keys to events, or click OK to close the Customize box.

16.5 Customizing Notes

Adding or Removing Notes

To add or remove a note:

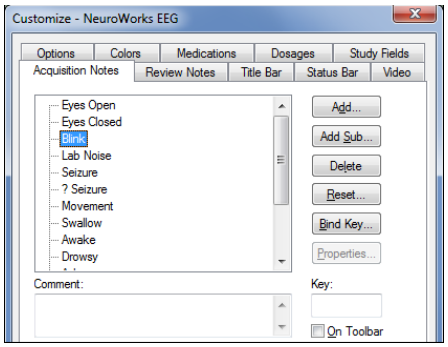
1. Choose **File > Customize**.
2. There are two Note tabs in the Customize box: **Acquisition Notes** and **Review Notes**. Select the appropriate tab.
   - To add a Note button to the Note menu and/or toolbar, click the **Add** key and type the name of the note in the text box that appears in the list of notes on the left. If you want this note to appear as a button on the Note toolbar, select the check box beside On Toolbar. If you do not select On Toolbar, the note will be added to the Notes menu, but it will not appear as a toolbar button.
   - To delete a button from the Note toolbar, select a note from the list and click the **Delete** button.

Assigning a Function Key to a Note

The **Acquisition Notes** and **Review Notes** boxes have a **Bind Key** button. This button allows you assign a function key to place a note in a study where an event has occurred. The following is an example of how to assign an automatic Blink note to appear in the study when F8 is pressed while acquiring data.

To assign a function key to a note:

1. Choose **File > Customize**.
2. Click the **Acquisition Notes** tab.
3. Click **Blink** in the event list box to select it.
4. Click the **Bind Key** button. The **Key Binding** dialog box will open. The Bind Key button assigns a function key to each event listed in the dialog box by attaching an event to a specific key. It also creates a note button for that event on the toolbar.
5. Select **F8** from the function key list.
6. Click **OK**.
7. To place a Blink note button on the Note toolbar, select **On Toolbar**.
8. Click **OK** or **Apply**.



Customize Box—Acquisition Notes Tab (detail)

16.6 Customizing Display for Events Visualization

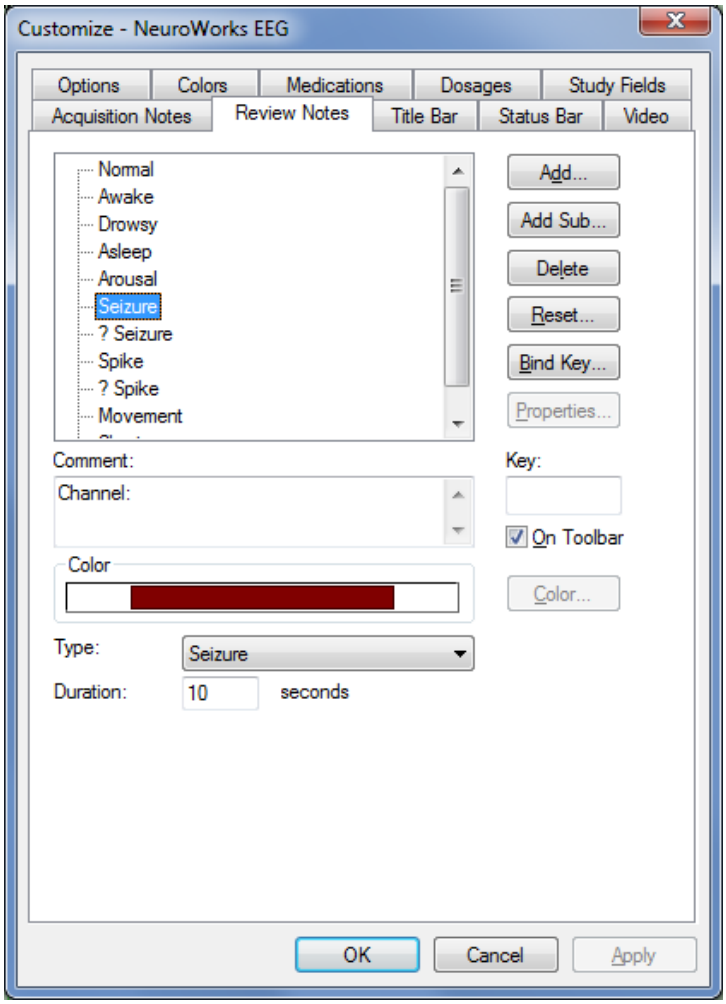
You can customize the display of annotations that have non-zero duration.

To configure an annotation type that provides the ability to enter duration, follow these steps:

1. Select **File > Customize**.
2. Click **Acquisition Notes** or **Review Notes** tab.
3. Select an existing event or add a new event that may have duration
4. Select its type, color and default duration.

NOTE: This dialog only allows notes of “Custom” type to have custom color. Notes of predefined types such as “Seizure” or “Spike” or “Photic” must be configured in Color page.

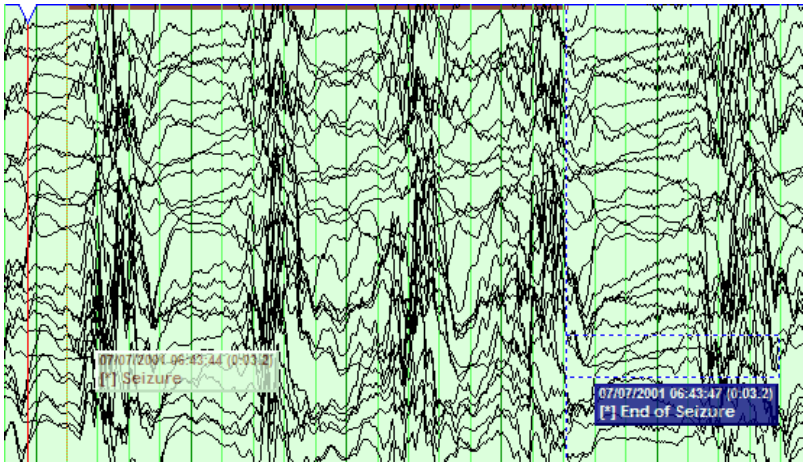
5. Optionally add the note type to the **Quick Access** toolbar.
6. Optionally map the note type to a **Function Key**.



Customizing Annotation Display in Review Notes tab

A note of a type that has duration specified can now be placed in the study. There are several ways to do this:

- In Acquisition or Review mode:
- Select a note type from **Notes** menu
- OR
- Click with a mouse a toolbar button on the **Note** toolbar (if a note type was added to Note toolbar in **Wave > File > Customize** (Acquisition Notes or Review Notes pages)
- OR
- Press a function key that was bound to the note type in **Wave > File > Customize** (Acquisition Notes or Review Notes pages).
- In Acquisition mode:
- Left-click in EEG trace view and selecting appropriate note type from the pop-up menu.



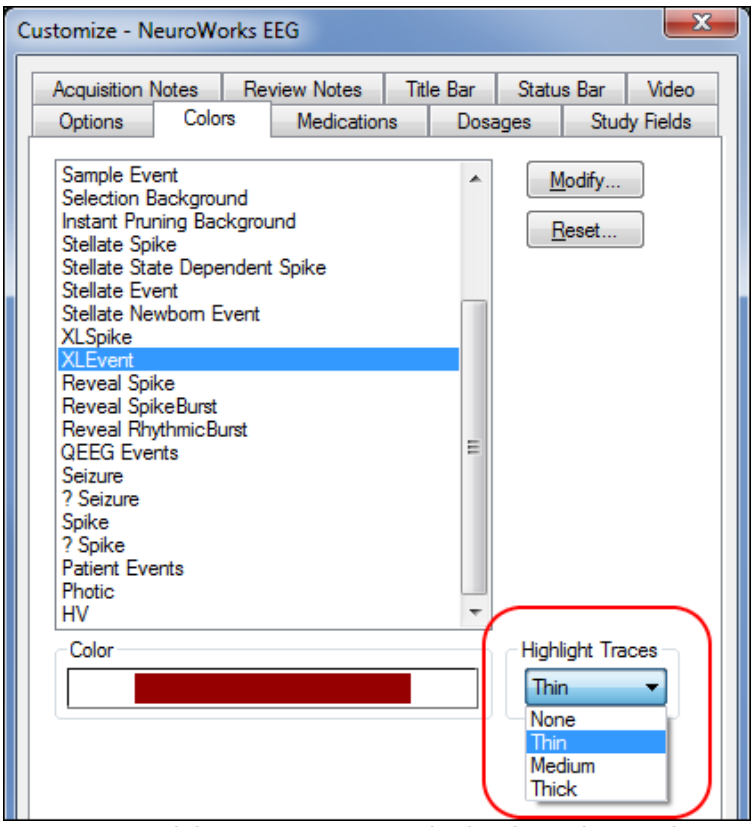
Example of Event Duration Displayed with Customizable Color in Wave Window

Note that initially the duration of the note is set to the default value specified in the Acquisition Notes or Review Notes tab. This duration can later be adjusted in Review by dragging start or end note markers with a mouse.

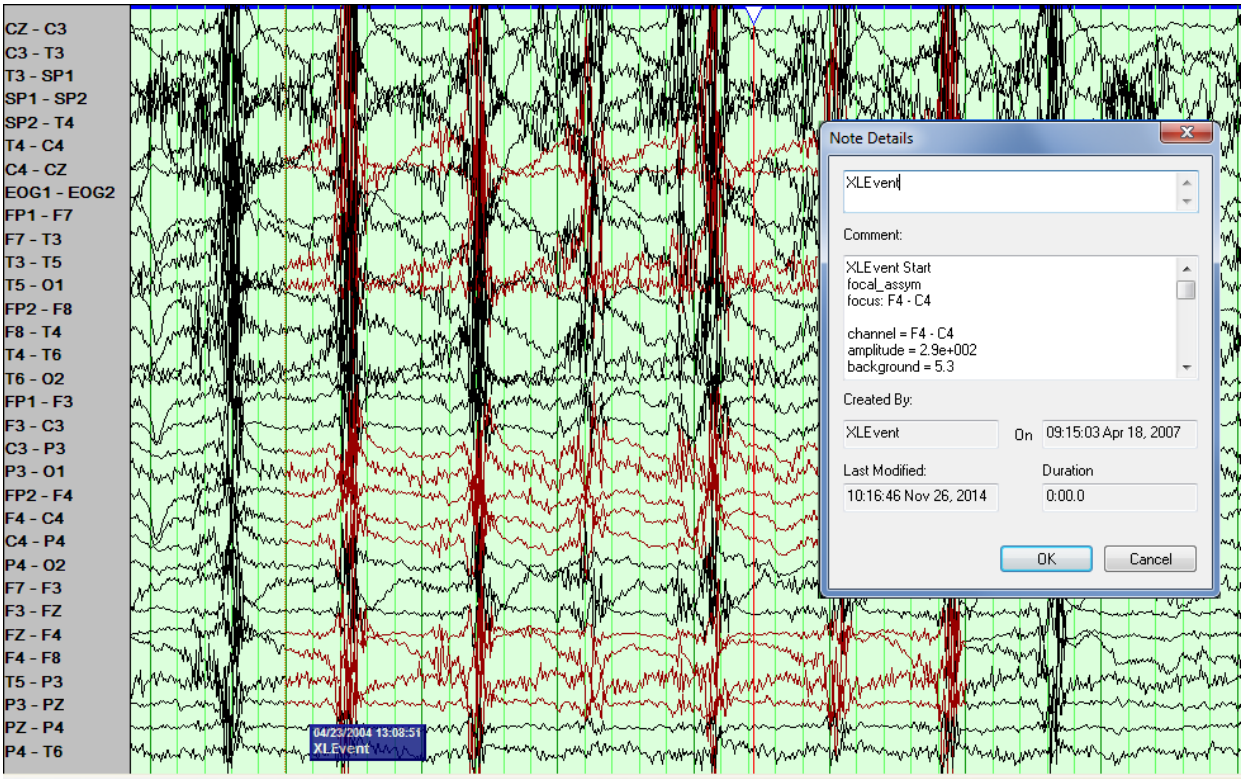
For certain automated events (e.g. automatic event detections), the ability to visualize duration also includes extracting information about specific focal channels and displaying traces from those channels with a different color and/or thickness from background traces.

To enable highlighting traces:

1. Click **Tools > Customize > Options** tab.
2. Enable **Highlight Traces in Detected Events** checkbox under **Notes Styles**.
3. Click **Tools > Customize > Colors** tab and select the event you want to modify.
4. Select color and thickness of trace under **Highlight Traces**.



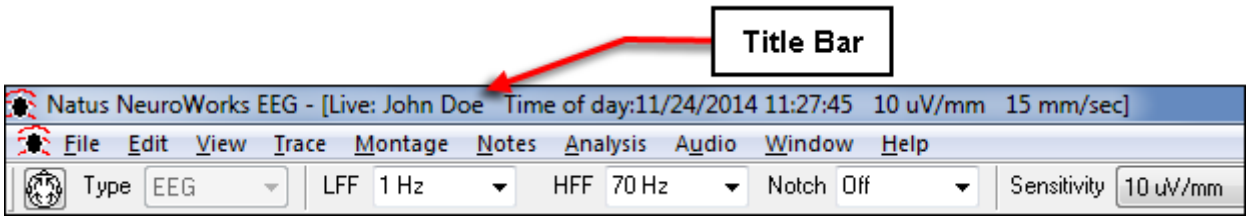
Customizing Event Trace Display in Colors Tab



Example of an Automatic Event Trace Displayed in Select Color in Wave Window

16.7 Customizing the Title Bar

The **Title Bar** shows the information that is set on the **Customize > Title Bar** tab.



In the Title Bar dialog box, the Selected Options list box shows the headings that currently appear in the Title Bar. The Remaining Options list box shows headings that do not presently appear on the Title Bar and are still available to be added to the Title Bar.

To add the name of the Montage Set to the Title Bar headings:

1. Choose **File > Customize**.
2. Click the **Title Bar** tab.
3. Select Montage Set from the Remaining Options.
4. Click **Insert Before**, then click **Apply**. This adds the Montage Set name to the front of the Title Bar.

To remove a heading from the Title Bar:

1. Select an item from the **Selected Options** list box.
2. Click **Remove**.
3. Click **Apply**. The heading you selected is now removed from the NeuroWorks Title Bar.

Displaying Sensitivity in the Title Bar

If you place the Sensitivity value in the Title Bar, it tracks the sensitivity value that is stored in the montage bar and displays that value in the Title Bar. NeuroWorks tracks and displays the sensitivity of all channels matching the Type selected on the montage bar, unless channels are specifically selected.

16.8 Customizing the Study Information Box

You can add, edit, and delete options and tabs available on the tabbed dialog boxes of the Study Information box. The Study Information box appears when you first begin a study. You can also summon it during a study by choosing **Edit > Study Information** or pressing **CTRL + I**.

The process for customizing the options and tabs is virtually identical for the **Patient**, **Technologist's Report**, and **Physician's Report** tabs. For detailed instructions, see Using Custom Fields in the Natus Database.

17. Customizing Video

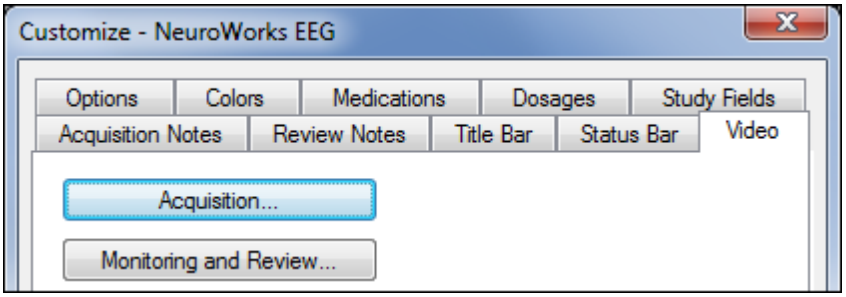
17.1 Accessing Video Options

Video options for locally connected analog video may be customized using the **Video Configuration** Video Configuration utility. This utility is used for **Analog Video** (using a video grabber and software MPEG-4 compression). You can do this either of two ways:

- Click the **Start > All Programs > Excel Tech > Video > Video Configuration**.

  OR

- In NeuroWorks, choose **File > Customize > Video**, then click either the **Acquisition** or **Monitoring and Review** button to set or adjust video options for the two modes.



Video Tab

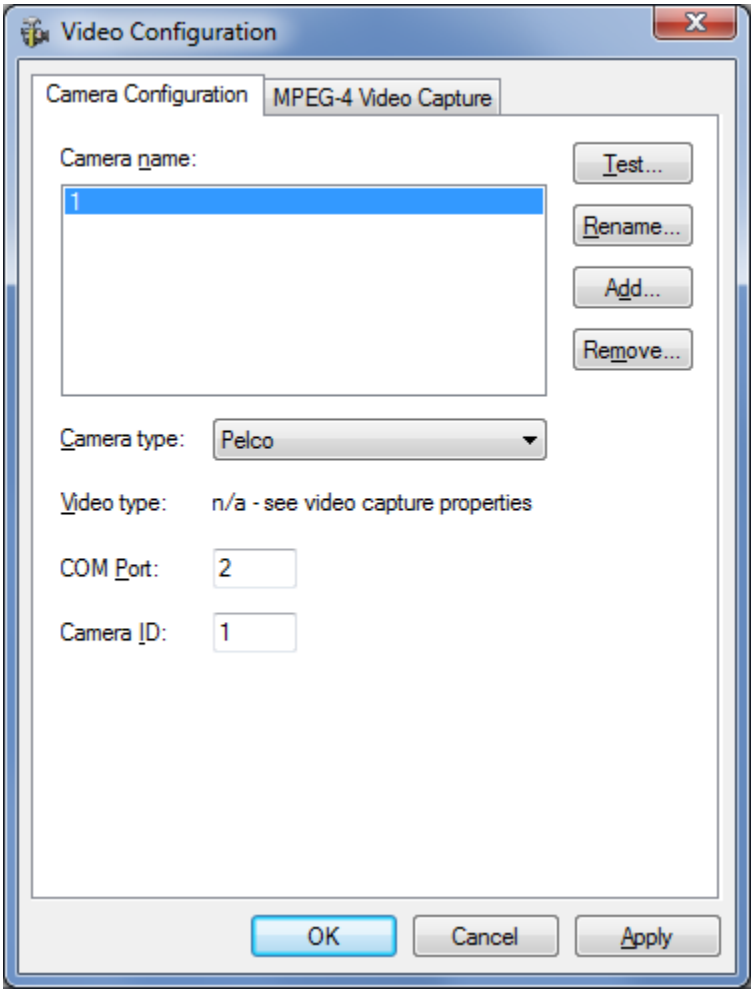
For supported TCP/IP cameras, including High-Definition (HD) video, configuration is performed through the **Natus Machine Manager** utility.

For Trex HD video ambulatory system, video settings are applied through the supported camcorder (see **Trex HD Technical Quick Guide** p/n 009318).

17.2 Analog Camera Configuration

Video options for locally connected analog video may be customized using the **Video Configuration** Video Configuration utility. To open Video Configuration, click **Start > All Programs > Excel Tech > Video > Video Configuration**.

The following section describes locally connected, standard definition, analog cameras, which are configured through the **MPEG-4 Video Capture** option.



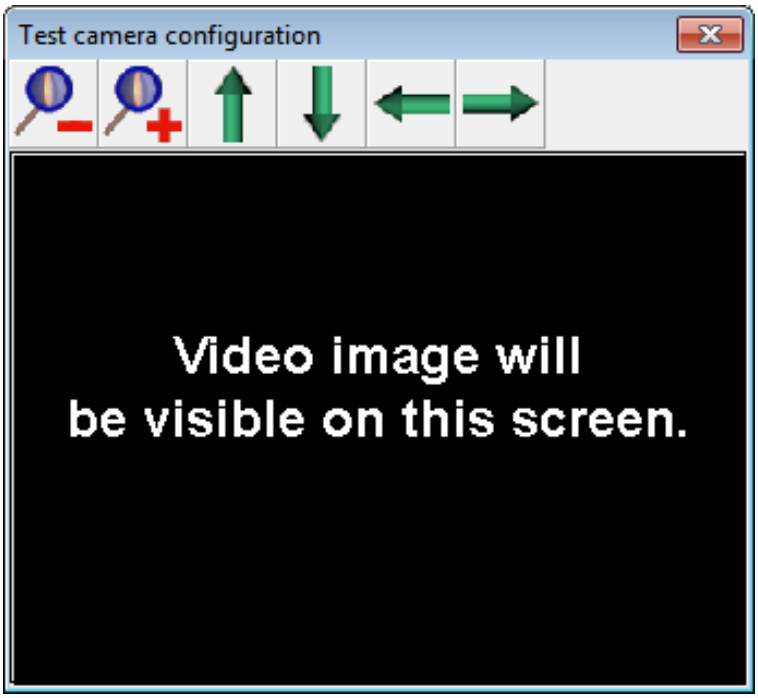
Camera Configuration Tab

The following table lists and describes the options available on the Camera Configuration tab of the Video Configuration application.

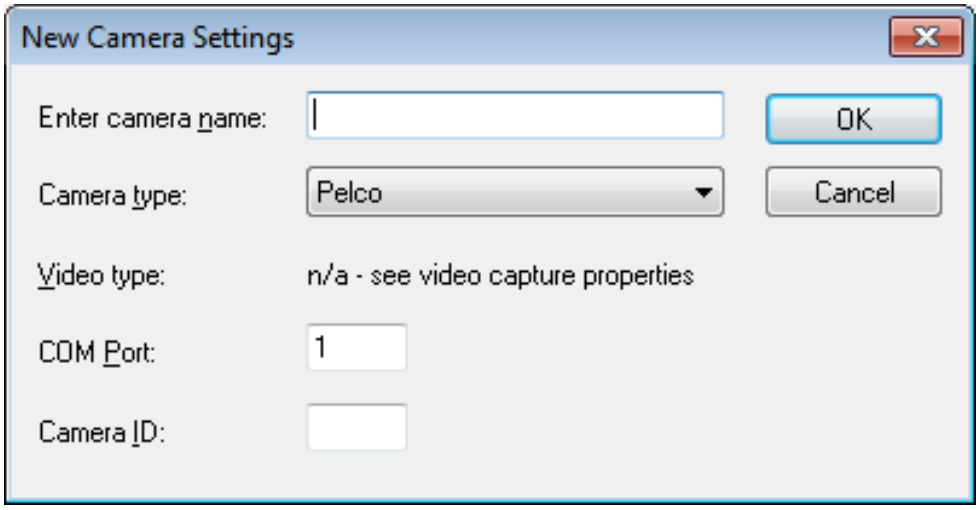
Video Options Available for Analog Video in Camera Configuration Tab

Option	Description
Camera Name	All cameras configured will be listed. Use to choose among available cameras. The settings underneath the cameras' list will reflect the setting of the currently selected camera. Cameras can also be renamed.
	NOTE: *The **first letter** of the camera name will be used in the PTZ control or toolbar to identify a camera.*

Option	Description
Camera Type	Choose from: • Pelco – allows pan, tilt, and zoom control • Videology (old 20VB632) – allows zoom control only • Videology (new 20Z704) – allows zoom control only • Panasonic – allows pan, tilt, and zoom control • Sunell – allows pan, tilt, and zoom control • Sanyo – no control • Network IP – allows pan, tilt, and zoom control and controls IP cameras such as the Sony IPELA, Axis 213, and Axis 242S/243 Video Servers • Other
Video Type	Choose Composite or S-VHS.
COM Port	COM port to which the camera is, or is to be, connected. It is possible to connect more than one camera to a single COM port.
Camera ID	ID of the camera (in case of multiple cameras connected to the same COM port). Sunell, Sony, and Videology cameras allow the user to set an ID for every camera.
Test	Press **Test** to bring up the **Test Camera Configuration** window. The **Test** window displays the video from the selected camera and will allow you to control the selected camera. Use the **Test** window to verify that the specified camera configuration is working.
	 **NOTE:** *This option does not function when the station is off the network.*
Rename	Press **Rename** to change the camera name.
Add	Press **Add** to add a new camera. You will be prompted by the **New Camera Settings** dialog for the camera name and parameters.
Remove	Press **Remove** to delete a camera.



Test Camera Configuration Window

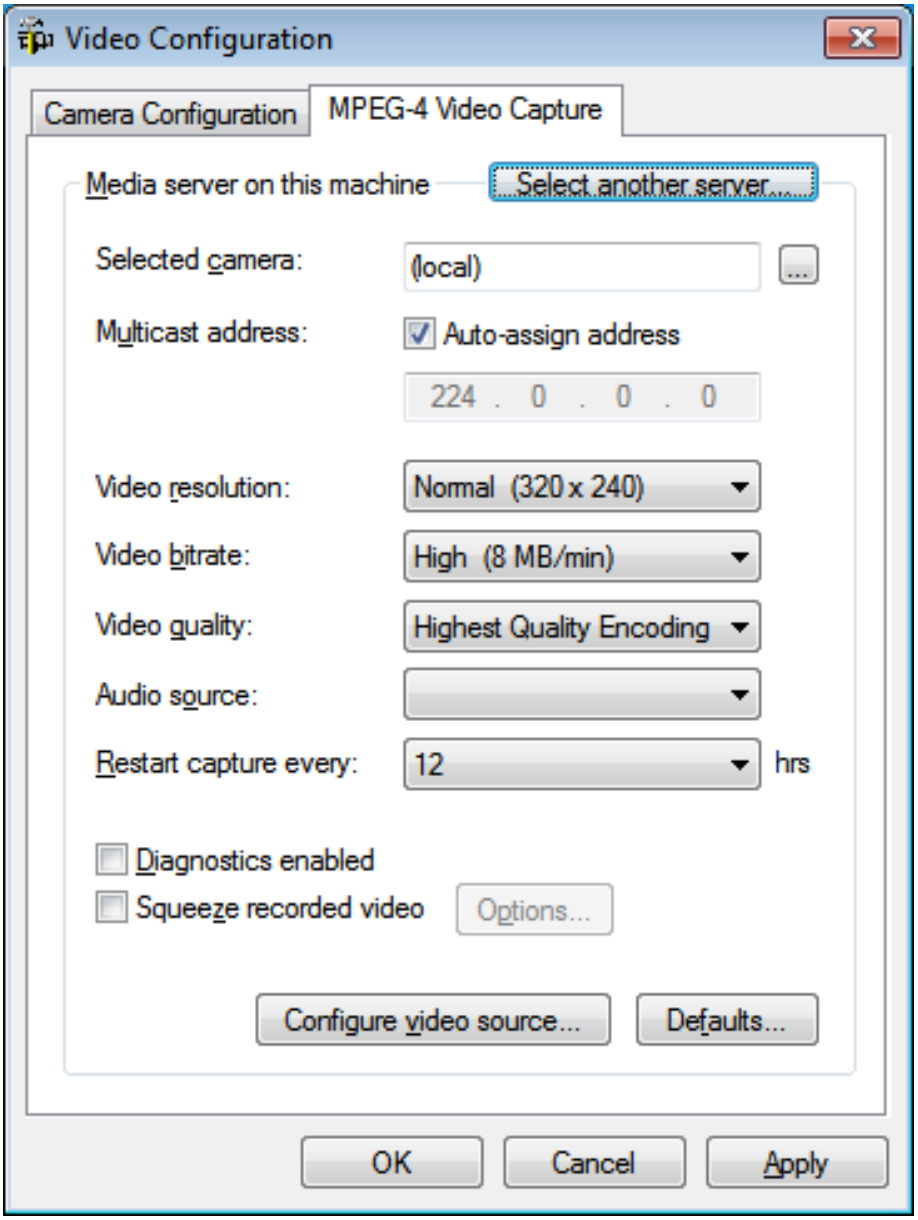


New Camera Settings Dialog

MPEG-4 Video Capture

Note the following:

- MPEG-4 files are 2 minutes in length. This 2 minute size is fixed and cannot be changed.
- There is no legacy mode – **seamless transitions** is the only mode.
- Pruning of MPEG-4 files is simply the copying of wanted files rather than the re-encoding of portions of original files. Because of this, MPEG-4 pruning can be much faster than MPEG-1 pruning (with the cost that the minimum video segment is 2 minutes in length).



MPEG-4 Video Capture Tab

Video Options Available in MPEG-4 Video Capture Tab

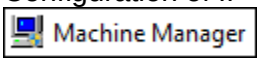
Option	Description
Media server on this machine	If you are using an **IP camera** (such as the Sony IPELA): • Click the Select another Server Select another server... button. • Click the Remote Remote... button. • Choose the remote server and click OK.

Option	Description
Selected camera	If you are using an **IP camera** (such as the Sony IPELA) that is connected to a remote server: • Click the ... button. • Click the **IP Camera** IP Camera... button. • Choose the name of the IP camera and click **OK**.
	NOTE: *Always choose **Local** unless you are using an IP camera.*
Multicast Address	The multicast address **MUST BE UNIQUE** on a given network. It is an IP address with a valid range of 224.0.0.0 to 239.255.255.255. Select the **Auto-assign address** option. OR Type a specific IP address.
	NOTE: *If the* **Auto-assign address** *option is selected, the system will automatically generate an IP address by taking the server's IP address and replacing the first part with "224". On most LANs this will result in a unique multicast (IP) address suitable for successful operation.* *If this does not work on your LAN, you can specify an IP address. It is not necessary to reboot after you change the address.*
Video Resolution	For analog video (using a USB frame grabber and MPEG-4 compression software) options, choose resolution from: • High (640 x 480) • Normal (320 x 240) • Low (160 x 120)
	NOTE: Normal *resolution is the default. To use* **High** *resolution, you require a considerably **more powerful machine** (minimum of a Pentium 4 3.2 GHz processor with Hyper-Threading Technology and a minimum of 1 GB of RAM).* For IP cameras, resolution is configured through Natus Machine Manager.

Option	Description
Video Bitrate	Choose from: • Very High (30 MB/min) • High (15 MB/min) • Normal (8 MB/min) • Low (4MB/min)
	NOTE: *Lower bitrates result in less disk usage at the expense of image quality.* ***Normal*** *offers a balance of quality and disk usage.*
Video Quality	Choose from: • Highest Quality Encoding • High Quality Encoding • Medium Quality Encoding • Low Quality Encoding • Fastest Encoding
	NOTE: ***Highest*** *is best for the majority of installations. By contrast,* **Fastest** *yields much lower CPU loading at the expense of image quality.*
Audio Source	Depending on your audio recording hardware, choose from: • Mono Mix • Stereo Mix • CD Player • Line In • Microphone • Phone Line

Option	Description
Restart capture every __ hours	Choose from: • 1 • 2 • 4 • 8 • 12 • 16
	 **NOTE:** ***12*** *hours is best for the majority of installations.*
Diagnostics Enabled	If a problem occurs with the video subsystem, enable this feature to provide additional diagnostic information. With this feature enabled, an additional dialog box will appear upon detection of a video error. This feature is disabled by default.
Squeeze Recorded Video	For information, see Configuring Squeeze Recorded Video.
Configure Video Source	For information, see Configuring the Video Source.
Defaults	The **Defaults** button resets video options to factory defaults. Factory defaults are shown in the illustration above right. (**NOTE:** The multicast address is not changed when you do this.)

TCP/IP Camera Configuration

Configuration of IP Cameras is performed through the **Natus Machine Manager** 

utility.

To open the video resource editor in Machine Manager:

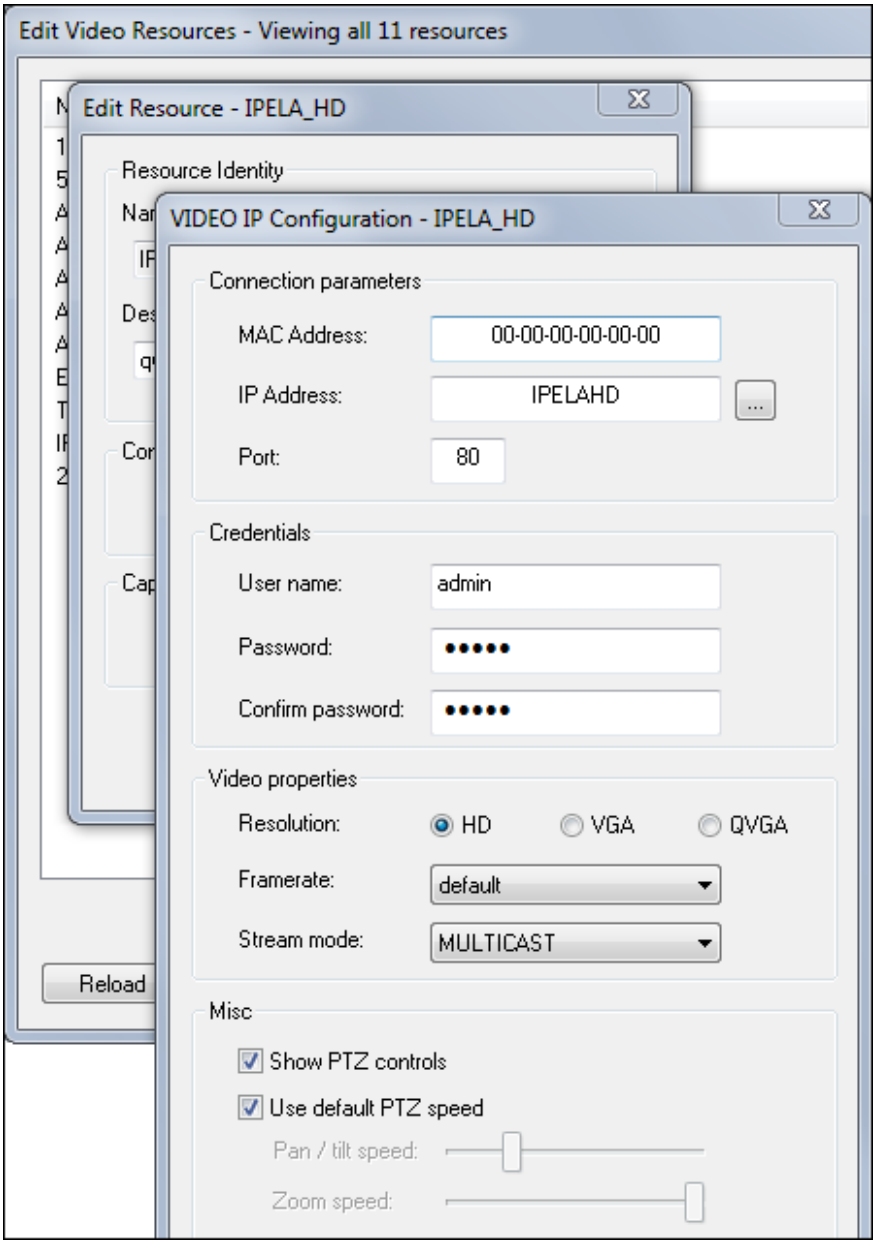
1. Choose **Start > All Programs > Excel Tech > Utilities > Machine Manager**.
2. Under Distributed Resources, select Video Resources and click Edit.
3. In the **Edit Video Resources** dialog that opens, select to highlight the resource and click **Edit**.

4. In the **Edit Resource** dialog that opens, you can navigate to select the resolution settings.

In the video resource editor, the following IP camera resolution options are available:

- HD - 1280 x 720
- VGA - 640 x 480
- QVGA - 320 x 240

NOTE: High Definition video (1280 x 720) is available when a supported HD camera is used.



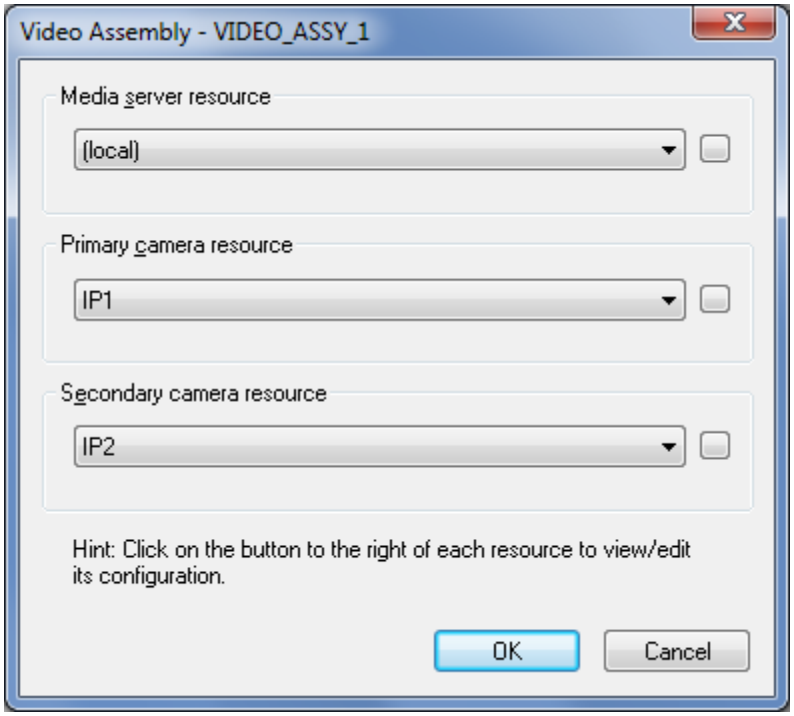
Machine Manager – Video Resource Utility

17.3 Two Simultaneously Recorded Streams of Video

With the `dual-stream' video option activated, a study can record from two camera resources simultaneously. A pair of IP cameras may be used for this purpose, for instance, to provide a general view of the patient bed and a view focused on the patient's face.

NOTE: If a USB-grabber based camera is used, it must be configured as the primary camera resource. In this case, the secondary camera must be an IP camera.

A camera pair is specified within a **Video Assembly** resource in Machine Manager:

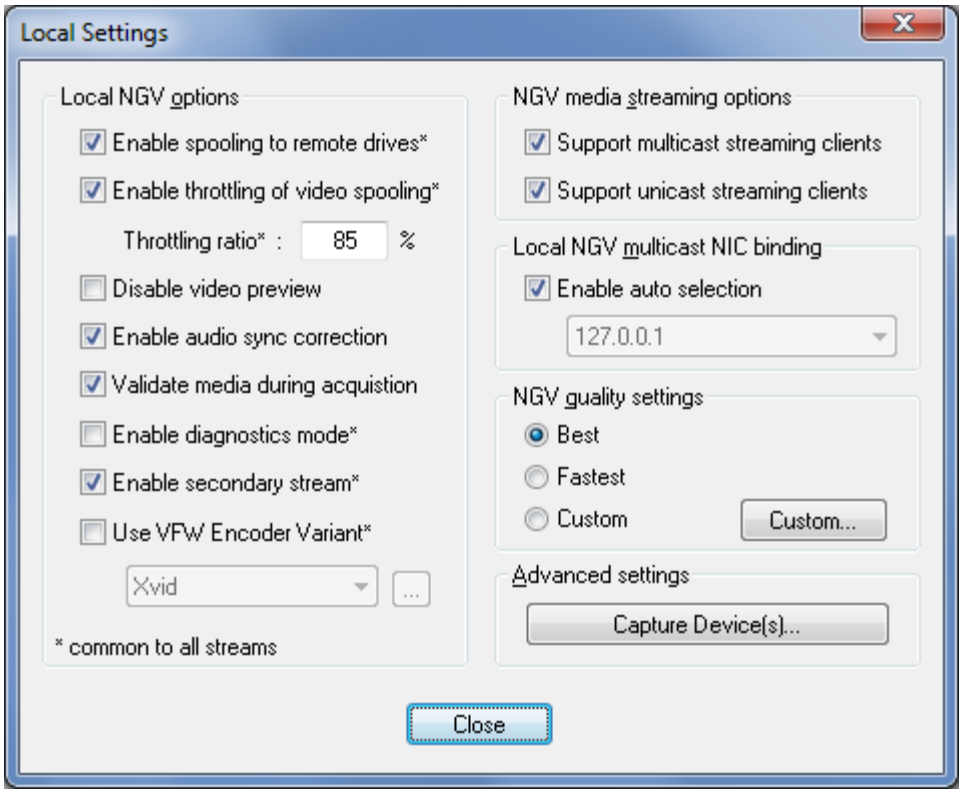


Video Assembly Dialog displaying Dual Camera Resources

Enabling Dual Stream Feature in Media Server

In a system enabled with an optional dual stream video add-on, the Media Server must be configured to enable a secondary stream. To enable dual stream:

1. Open Media Server Diagnostic application.
2. Launch the diagnostic and click on the **Settings** button.
3. In the Local Settings dialog, check the '**Enable secondary stream**' option.
4. Close the settings dialog and allow the system to restart the **Media Server**.



Secondary Video Stream option in Media Server Diagnostic Application

Dual Video in Acquisition

When a dual camera video assembly is specified for acquisition, two video windows are displayed.

- The primary video stream is marked with a **<1>** in the title bar.
- The secondary stream is marked with a **<2>**.

NOTE: The Camera Control toolbar in Wave is used to control the pan/tilt/zoom of the **primary camera only**. The secondary camera's pan/tilt/zoom is controlled using the '*Direct-to-Camera*' mode.

Dual Video in Monitoring

When monitoring a dual stream video study, NeuroWorks automatically detects the two streams and opens a pair of video monitoring windows tagged with **<1>** and **<2>**. By default, the two video monitoring windows open in a '*magnetic-mode*' (with the secondary video window snapping to the right of the primary video window).

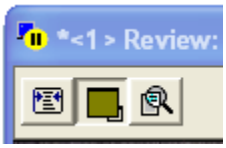
To manipulate video windows:

- Select **View > Video** and hold **TAB** key: disable magnetic mode
- Select **View > Video** and hold **SHIFT** key: enable magnetic mode

- Select **View > Video** and press **SHIFT + Ctrl**: change magnetic mode to a vertical orientation (with the secondary video window snapping to the bottom of the primary video window).

Dual Video in Review

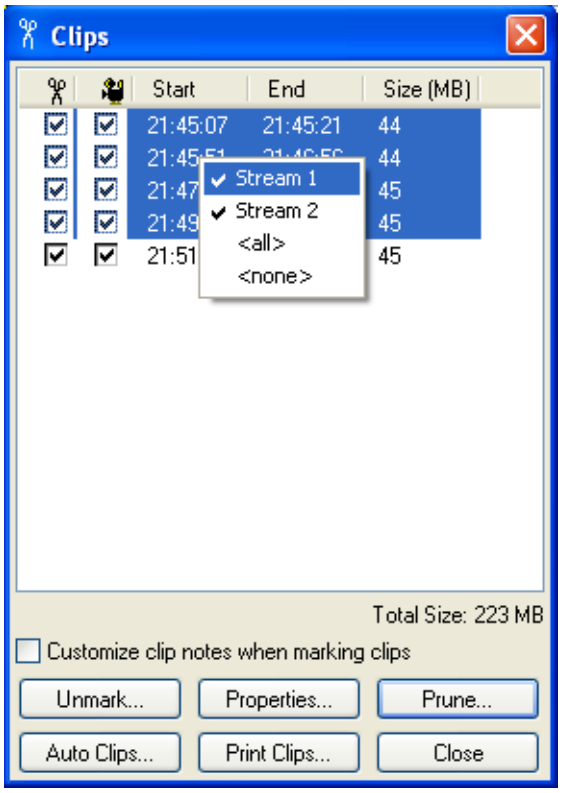
Opening video during review of a study recorded with dual-stream video will display two video windows tagged with **<1>** and **<2>.**



Unlike monitoring, review of dual stream video has an option to choose which stream to use as the 'master' for the purposes of video playback. To select which stream to show as the 'master', open the stream to begin playback, then stop playback and click on the new button between the 'Reset' and 'Digital Zoom' buttons.

Pruning Files with Dual Video Streams

When you prune a dual stream video study, clips designated to include video will include both streams (likewise for move, export and archive operations, etc.). However, when clipping you can specify which stream to keep by right-clicking a clip (or group of clips) in the **Clips viewer** and selecting the preferred option.



Option for Saving Video Stream in Clips window during Pruning

17.4 Configuring Squeeze Recorded Video Options

You can use NeuroWorks' video configuration functionality to squeeze recorded video during recording. This enables you to reduce the size of your video files. For example, you can reduce 8 hours of video to less than 400 MB, which fits on a single CD-R. The system reduces the size of the video by not saving as much video detail during recording.

Six pre-configured video reduction options are available for you to choose from. These video reduction options are tradeoffs between the degree of temporal accuracy vs. spatial accuracy used in the recording.

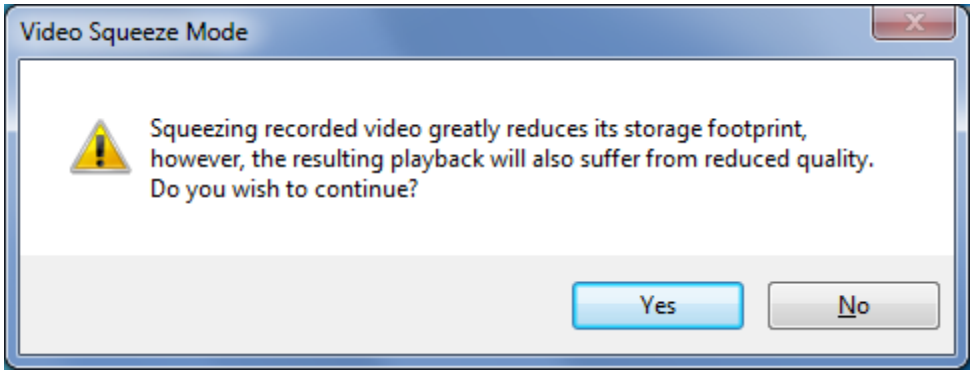
Temporal accuracy: Higher temporal accuracy enables you to see large scale movements (such as limb movements or facial changes) but the image will be fuzzy or blocky.

Spatial accuracy: Higher spatial accuracy enables you to see subtle image detail (facial expression and overall body position) but the number of video frames displayed per second is reduced.

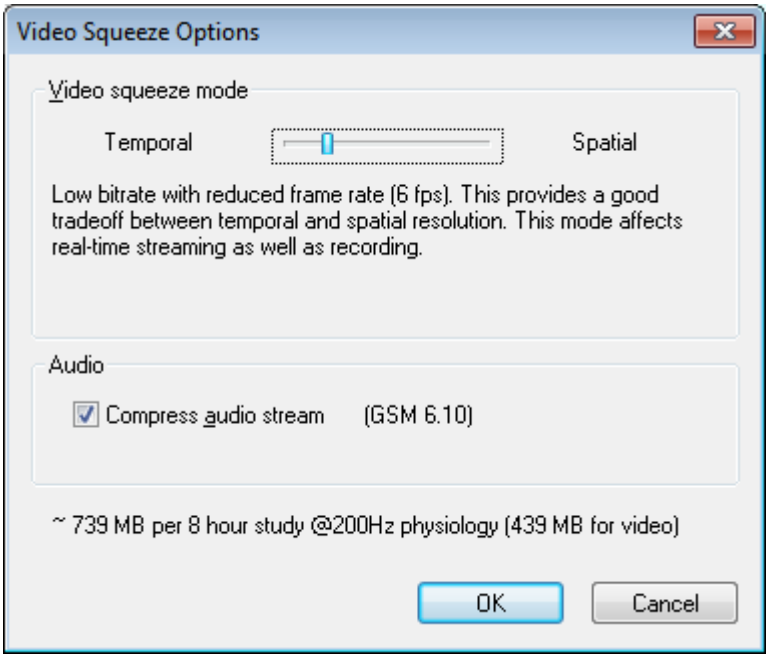
TIP: You can also squeeze video when you are reviewing a study. For information, see Editing Review Settings and Processing Clips in the Clips Box.

To access available options:

1. Select the **Squeeze** recorded video option on the **MPEG-4 Video Capture** tab of the **Video Configuration** dialog box. The window below appears to warn you that the quality of the video will be reduced:



2. If you are sure you want to continue, click **Yes**. (If you click No, the system will automatically deselect the Squeeze recorded video option.)
3. If you chose **Yes** in the previous step, click the Options... button beside the Squeeze recorded video option. The following dialog box appears:



4. Use the slider below **Video** squeeze mode to select one of six pre-configured settings. Text will appear below the slider to explain how each setting balances temporal and spatial resolution.
5. We recommend that you keep the Compress audio stream option selected when you are using the video squeeze option.
6. Click **OK**.

17.5 Configuring the Video Source

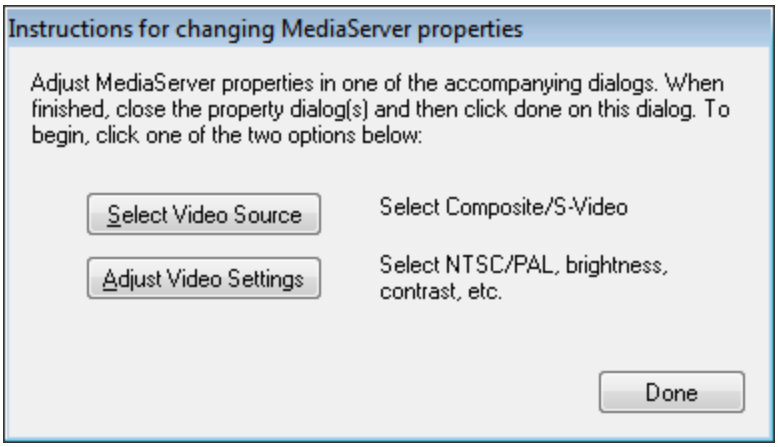
With MPEG-4 video capture, you can use NeuroWorks' video configuration functionality to select the video source or adjust the video settings. This only applies to **analog video** when a video grabber is used. It does not apply to IP cameras.

For more information, see the topic Customizing Video Options.

To access available options:

1. Click the **Configure Video Source** 

button on the MPEG-4 Video Capture tab of the **Video Configuration** dialog box.
2. The following dialog box appears:



Instructions for Changing Media Server Properties Box

3. Click either Select Video Source  or Adjust Video Settings  .
4. You can then use the options on either of the following two tabs to set your preferences.

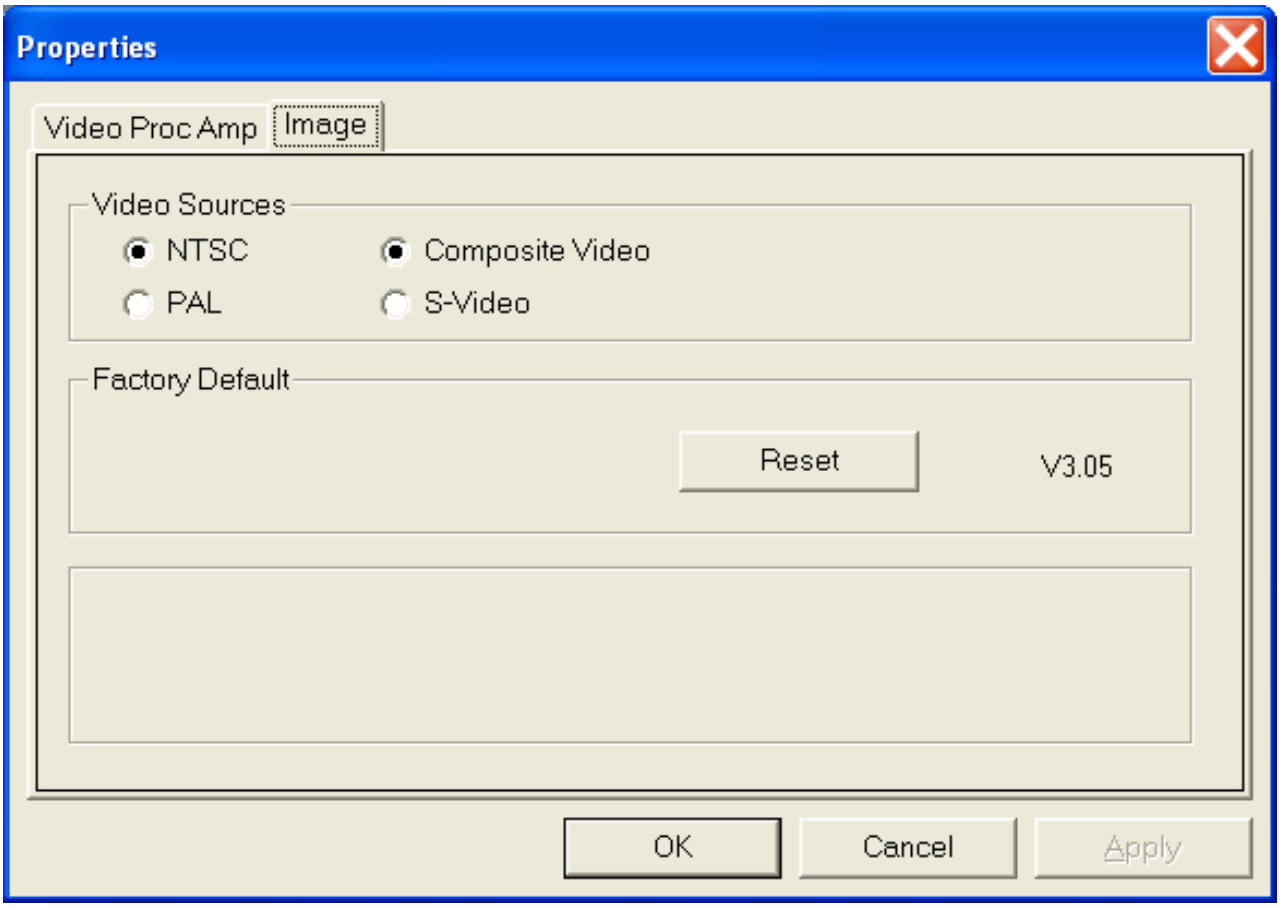
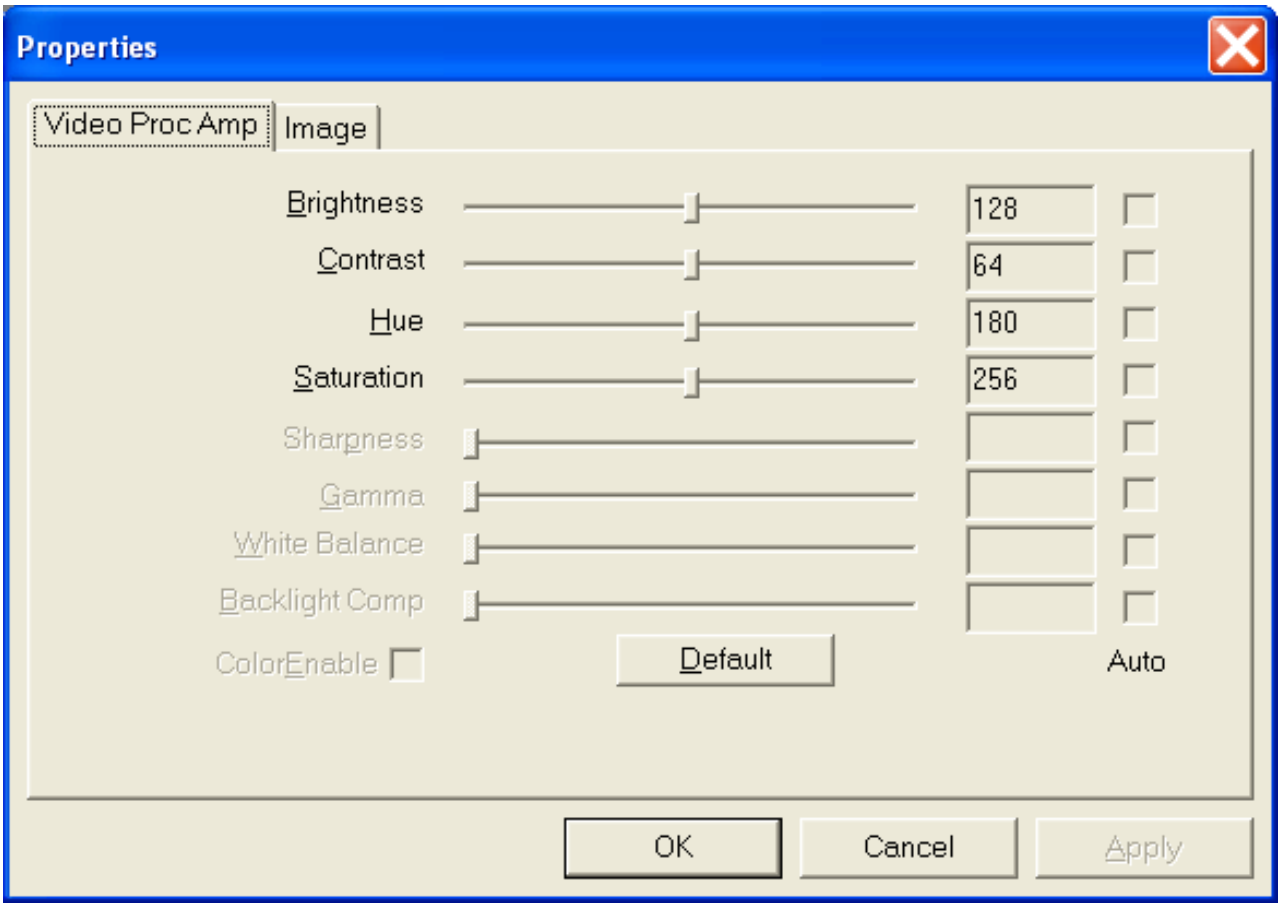


Image Tab



Video Proc. Amp Tab

Available Video Options

Option	Function/Description
Image Tab	
Video Sources	Choose: NTSC / PAL Composite Video / S-Video
Reset	Returns options to factory defaults.
Video Proc. Amp Tab	
Brightness	Drag slider to set level you want.

Option	Function/Description
Contrast	Drag slider to set level you want.
Hue	Drag slider to set level you want.
Saturation	Drag slider to set level you want.
Defaults	Returns settings to factory defaults.

17.6 Two Network Adaptors Problem

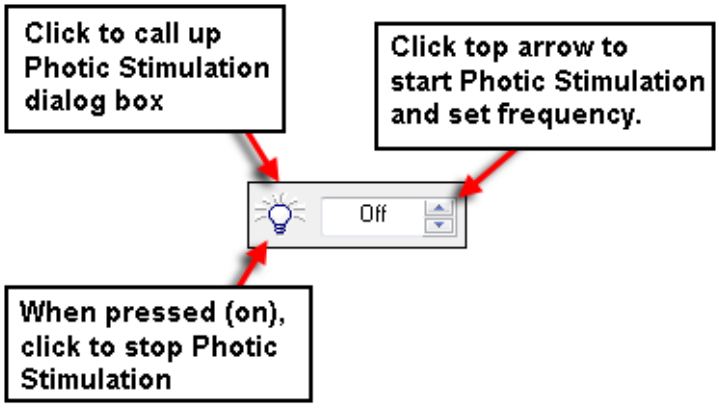
This topic applies only to legacy video. If you receive the following message…

…the computer in question has two network adaptors ENABLED. The wireless adaptor is causing the problem. To correct this, the wireless adaptor must be DISABLED. This ensures that only the wired NIC (Network Interface Card) is used for multicast.

18. Photostimulation using NeuroWorks

18.1 Photic Stimulator Controls

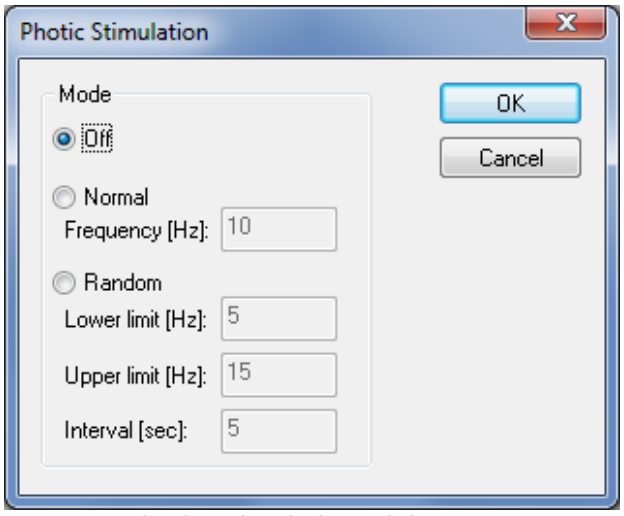
Photic stimulation controls are available in the **Workflow** toolbar.



Photic Stimulation Controls on Workflow Toolbar

To modify photic options in the Photic Stimulation dialog:

1. Click the **Photic Simulation** button in the **Workflow** toolbar or choose **Controls > Photic Stimulation** in NeuroWorks EEG (Acquisition).
2. To disable photic stimulation, select **Off** (off is the default setting).
3. To provide continuous flashing at the frequency that is recorded in the box, click **Normal**. Once the option is selected, you can enter a new frequency if you want.
4. To provide stimulation at random frequencies between high and low set points, click **Random**. Once the option is selected, you can enter lower limit, upper limit and interval values if you want.
5. Click the **OK** button to set the frequency and activate the strobe.



Photic Stimulation Dialog Box

18.2 Photic Protocol

NeuroWorks software provides a **Photic Protocol** with a standard pattern of stimulation using an established range of frequencies that you set to meet specific acquisition requirements.

To run NeuroWorks Standard Photic protocol, choose **Protocol > Photic**.

- The default protocol is set to run for **1 minute, 35 seconds**.
- The **strobe** is activated for five seconds followed by five seconds of inactivity.
- The **frequency of the strobe** increases in 3 Hz increments each time the strobe is activated.
- A **frequency range** of between 1 and 30 Hz is provided.

To view the Photic Protocol in progress, choose **Edit > Settings** and click the **Protocol** tab. The Protocol dialog box appears. By clicking the appropriate button in the Protocol dialog box you can:

- Abort or stop a protocol.
- Skip a particular setting.

To end the protocol, press the **ESC** key.

18.3 Photic Sensor Montage Adjustment

To allow the spike/flash marks generated by the Photic Sensor to be visible on a channel of the EEG, you must make adjustments to the montage.

To adjust the montage, open the montage editor by choosing **Edit > Settings > Montage**.

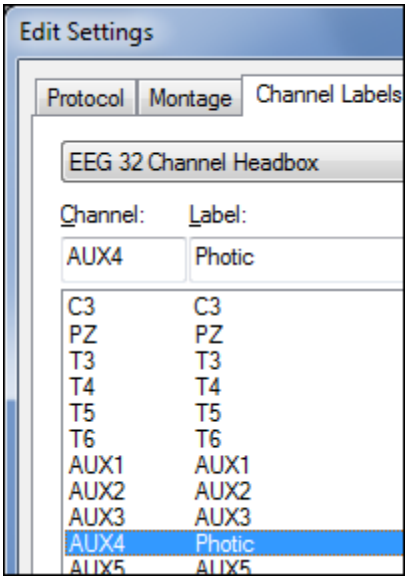
To add a new channel, do one of the following:

1. To add a new channel to the bottom of the montage table, click **Append.**
2. To insert a new channel after a selected channel, select a cell and click **Insert**.
3. To designate an input for the channel, right-click the cell in the Input 1 column and select one of the **AUX** inputs (for example, AUX4).
4. Leave **Input2** empty. (The designated photic sensor input automatically references to ground.)
5. Right-click the cell in the **Gain** column and select 100µV/mm.

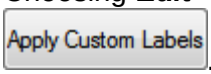
NOTE: 100µV/mm is a suggested value. You can adjust Gain as desired.

To apply a Custom Label to your new channel:

1. Click the Channel Labels tab (**Edit > Settings > Channel Labels**).
2. Select your **AUX** channel in the list and rename it in the **Label** box (six letters maximum).



AUX 4 Renamed to Photic

3. Click **OK**.
4. Choosing **Edit > Settings > Montage** again and click **Apply Custom Labels** 

.
5. Click **OK**.

19. Natus Database

19.1 Basic Overview

About Natus Database

Natus Database launches automatically once you log onto your computer. Natus Database is your gateway to reviewing patient data, acquiring new information, or starting and stopping a study.

To help you navigate through the software, Natus Database contains a main menu bar and toolbar buttons that link to frequently accessed functions and commands. As you acquire data from the studies you perform, a record of patient studies and data is assembled. You can select an existing study from this list or create a new study. Natus Database supports *distributed studies* (studies stored on various stations on a network can be worked on from any other station on the network), and covers the entire range of NeuroWorks and SleepWorks functionality.

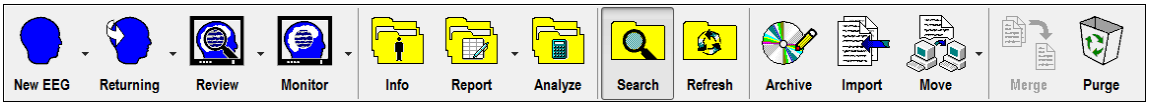
The following list describes some of the main features of Natus Database:

- A combined list of all the studies is maintained and kept in sync so that all stations share the same view of the database. There is no need to switch databases, or aliases, to see studies stored in multiple locations. The system maintains a home storage resource link for each study and accesses it when any operation is requested.

NOTE: Studies can be reviewed and modified only if the home machine is reachable over the network.

- When all machines are on the network, a study acquired and stored on any machine can be reviewed, archived, and modified from any other machine.
- When any station is unavailable, studies stored on that station are also unavailable. However, they still show up in the combined list.
- If changes are made to a study or patient record while a machine is offline, the changes are synchronized when the machine is brought back online.

Operation of the distributed database is basically transparent to the user. Once storage resources have been configured, database synchronizations occur unobtrusively in the background and do not affect normal operation of the system.



Natus Database Toolbar Buttons

Status Bar

The **Status bar** at the bottom of the Natus Database window provides specific information about one or more studies that are highlighted (selected) in the database. Status bar information is useful when reviewing and archiving records.

After you search the database, the status bar information turns red and the only studies passing the search criteria are listed message is displayed. To show all studies in the database, select **Display all studies** in the **Search Companion**.

Red Status Bar Information after Search

The Natus Database **Status bar** shows:

- Amount of storage available in the storage resource being used.
- Whether all studies are listed or only studies matching search criteria.
- Studies listed. Either the number of studies in the database, or the number of studies that meet the search criteria compared to the number of studies in the database
- Number of studies selected to be viewed and the total size of the files (e.g. if the status bar message is 3 studies selected (2 MB), then the three selected studies take up 2 MB of disk space)
    - ***TIP:*** This is useful when you are archiving studies to a disk.
- How the studies are sorted (e.g. by First Name)
- When synchronization was completed with other machines participating in the distributed database.
- A button to manually initiate synchronization.

NOTE: The leftmost indicator in the **Status bar** 

, as well as the one in the **Title bar** 

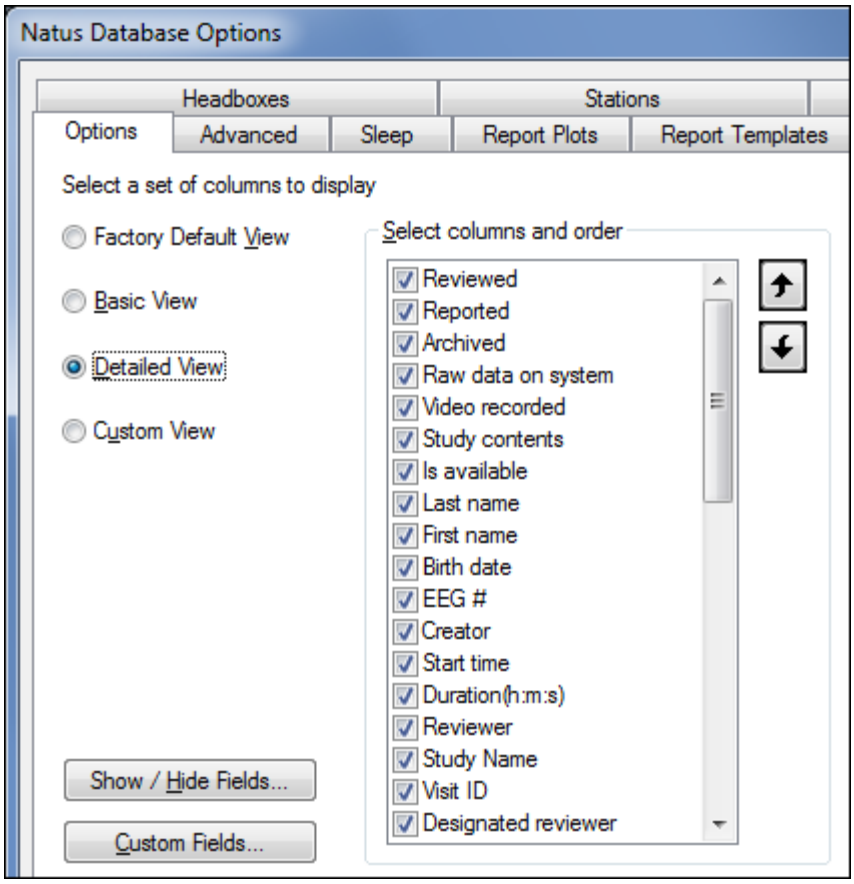
, displays the amount of free space available on local storage.

19.2 Customizing the Natus Database View

To customize the Natus Database view:

1. Click **View** on the menu bar.
2. Choose from Default, Basic, Detailed or Custom.

   OR
3. Choose **Tools > Options > Options** (tab).



Study List View Options

Available Views

There are four list views, three of which can be configured separately:

- Factory Default (cannot be customized)
- Basic (pre-set to show only basic patient and study fields)
- Detailed (pre-set to show the most popular columns)
- Custom (set initially the same as Detailed view; for individual configuration)

You can assign Database Column categories to these four choices (and display their headings) through the **Tools > Options > Options** (tab).

Moving and Resizing Database Elements

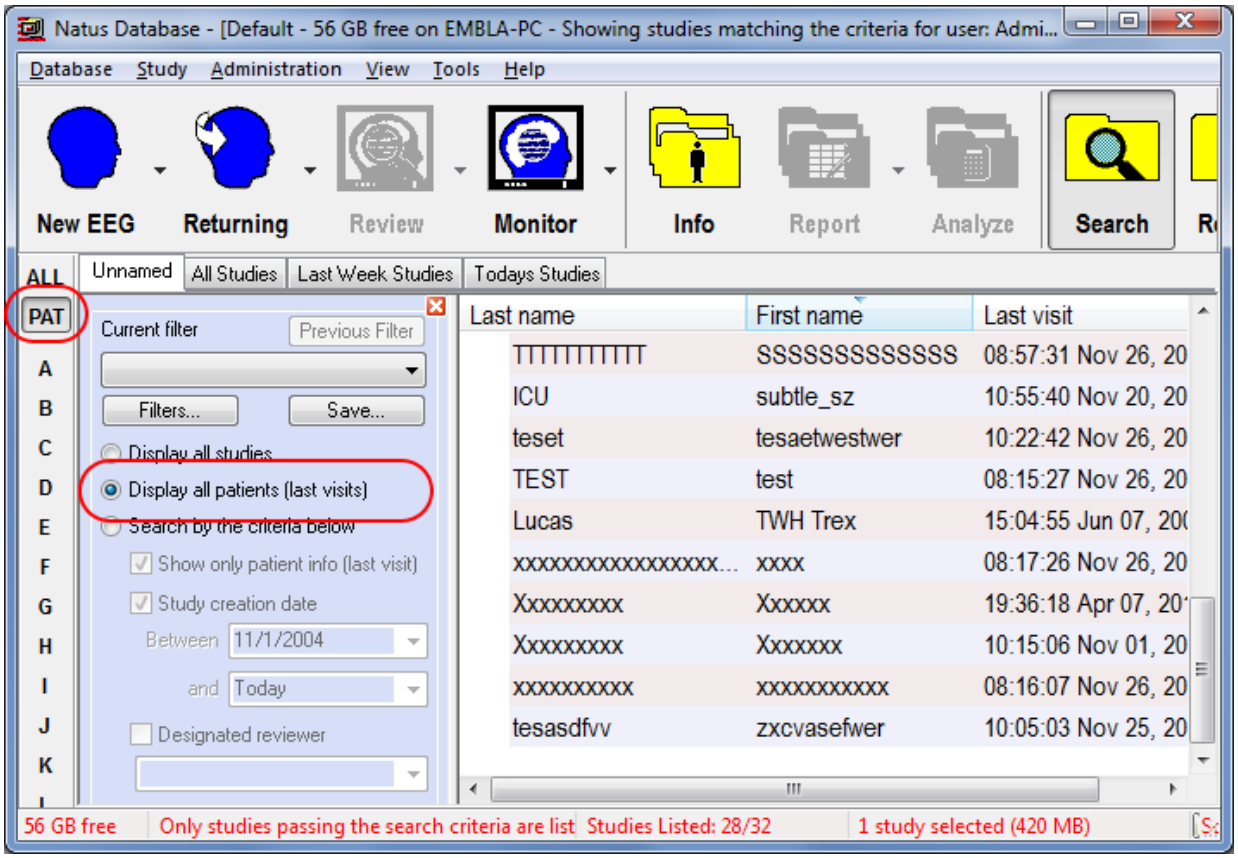
To…	Do This…
Change the width of the column	Click and drag any dividing line to the right or left.

To…	Do This…
Hide columns	Click and drag the dividing line to the left to shorten the space until the column disappears.
Show hidden columns	Click on the dividing line where the column was hidden and drag it to the right until the column has reappeared.

Clicking on the column header displays the studies in ascending or descending order according to the information in that column.

Patient-Centric View

Natus Database features the ability to see a list of patient records (collapsing all studies for the same patient). This filter collapses all studies to show a single line for each patient. To activate Patient view, press **[PAT]** button on the alphabet bar or select "**Display all patients**".



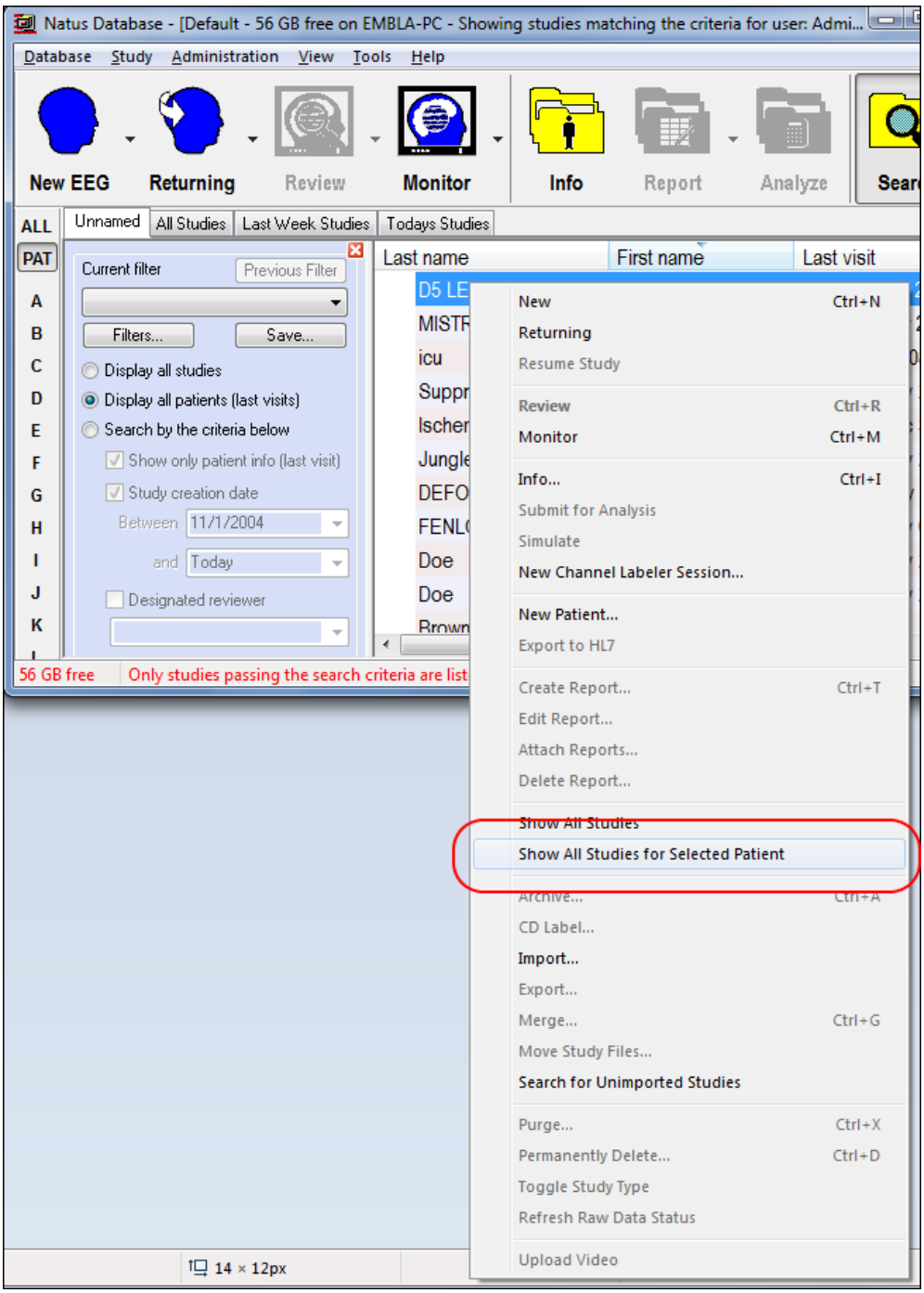
Patient View in Natus Database

The patient view can be combined with other filters allowing for creation of complex search filters. Also, any advanced filter can use the Patient View; select "**Show only Patient Info**" checkbox in the Study tab of the **Advanced Search Options** dialog and save the filter.

Displaying All Studies for a Patient

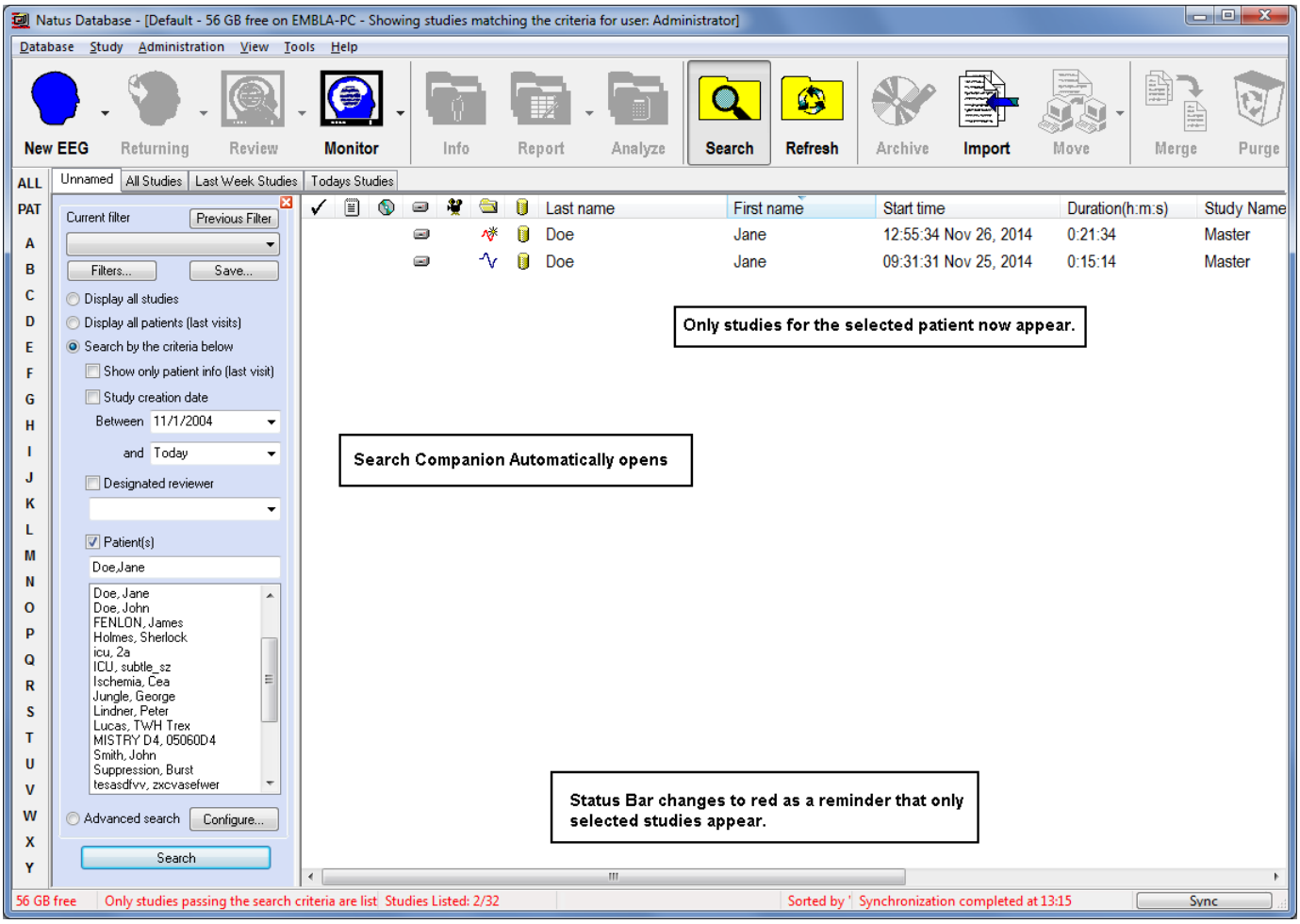
To display all studies for a patient:

1. Select a study and right-click your mouse.
2. Choose Show All Studies for Selected Patient.
3. The **Search Companion** pane automatically opens.
4. To redisplay all studies, right-click the mouse and choose **Show All Studies**.



Show all Studies for a Patient

Only studies for the selected patient appear.



All Studies Displayed for Single Patient

19.3 Column Headings

To sort the information in the columns in ascending or descending order, click the column title. For example, to sort the studies alphabetically by last name, click the Last Name column heading.

TIP: The Database stores the last four sorts so you can sort by multiple criteria (the software remembers the last four columns that were used to sort). For example, if you click on **First Name** and then on **Last Name**, the database will be sorted by last name but within last name by first name (helpful if you have many patients with the same last name but different first names).

Icon	Description
✓	A check mark symbol in this column indicates the study has been reviewed.

Icon	Description
	A report symbol in this column indicates a report has been generated for the study.
	A CD symbol in this column indicates the study has been archived.
	A hard drive symbol in this column indicates the raw data associated with the study still resides on the system's hard drive.
	A camera symbol in this column indicates video has been recorded with the study.
	A green camera symbol with dots in this column indicates video has been partially uploaded (for Trex HD ambulatory studies).
	The following symbols appear in the Study Data column.

Icon	Description
	Patient info has been added to database but no studies have been performed.
	Raw data has been collected
	Pruned study
	Live study
	Study has been analyzed
	Study has been analyzed with the **Batch Analyzer** and pruned
?	Contains data from an older version of ***XLTEK*Works** software.

<table>
<tr><th>Icon</th><th>Description</th></tr>
<tr><td>  </td><td>The following symbols appear in the Is Available column.
<table>
<tr><th>Icon</th><th>Description</th></tr>
<tr><td>  </td><td>Study is stored on the local database (the computer you are using). Your local machine is always available.</td></tr>
<tr><td>  </td><td>Study is stored on a remote computer (or server) and remote location is available.</td></tr>
<tr><td>  </td><td>Study is stored on a remote computer (or server) and remote location is unavailable (network down; problems with database authentication, file permissions, etc.)</td></tr>
</table></td></tr>
<tr><td>Last name</td><td>Lists the acquired studies by the patient’s last name.</td></tr>
<tr><td>First name</td><td>Lists the acquired studies by first name.</td></tr>
<tr><td>Birth date</td><td>Lists the acquired studies by the patient’s birth date in day-month-year format.</td></tr>
<tr><td>EEG #</td><td>Shows the EEG number assigned in the Patient tab of the Study Information window. Characters other than numbers may be entered for this field.</td></tr>
<tr><td>Creator</td><td>Shows the Local Account User Name (from Tools > Customize > Options) at the time the study was started.</td></tr>
<tr><td>Study type</td><td>Appears only when both SleepWorks and NeuroWorks are installed on the system. Shows the study type, either EEG or SLEEP.</td></tr>
<tr><td>Start time</td><td>Shows the date the study was started in day-month-year format: 17-Aug-04.</td></tr>
<tr><td>Duration(h:m:s)</td><td>Shows the duration of the study in hour-minute-second format: 1:09:05.</td></tr>
<tr><td>Reviewer</td><td>For studies acquired with NeuroWorks, shows the reviewer's name. This column is not used with SleepWorks.</td></tr>
<tr><td>Designated reviewer</td><td>Shows the name of the Designated Reviewer that is assigned in Advanced Options of the Patient tab in the Study Information window.</td></tr>
</table>

Icon	Description
Referring physician	Shows the name of the **Referring Physician** that is assigned in **Advanced Options** of the **Patient** tab in the **Study Information** window.
CD ID	Shows the CD ID number automatically generated by **Natus Database** which can be used to locate the CD.
CD label	Shows the name of the CD that was assigned in the **Archive CD Label** dialog box when the study was archived. This name can be up to 255 alphanumeric characters. If no name was assigned, then **No Label** is shown.
Headbox type	Shows the type of headbox used for the study.
Stored on	Shows which machine on network study is stored on.
File path	Shows the **last name, first name_filepath** designation associated with the study.
Diagnosis code	Shows the **ICDS** (International Classification of Sleep Disorders) **Code** associated with the diagnosis (**SleepWorks** only).
Diagnosis	Shows the diagnosis associated with the study (**SleepWorks** only).
Study Name	Displays name given to study initially in **Study Information** box.

19.4 Search Companion and Search Filters

Search Companion

Natus Database **Search Companion** allows you to perform the most common database queries with just few mouse clicks.

To perform a Basic Search using Search Companion:

1. Click the **Search** 

button on the toolbar.
2. Enter your search or filter criteria and click **Search**.

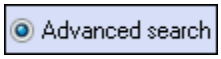
The Advanced Search option can be used to limit the displayed studies to categories such as:

- Studies recorded last week
- Studies recorded with a particular headbox

- Studies done on a particular patient
- Studies designated for review by a specific physician
- Studies stored on a specific station

To perform an Advanced Search:

1. Click the **Search** 

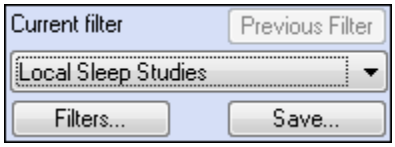
button on the toolbar.
2. Select **Advanced Search** 

and click **Configure** to open the **Advanced Search Options** box. This dialog has four tabs that you can use to define search parameters: **Patient, Study, Diagnosis, and Custom Fields**.
3. Once a study filter is in effect, only some of the studies are visible.

NOTE: When not all studies are shown, the status bar at the bottom of the screen turns red and presents a count of selected and all studies.

Red Status Bar with Studies Listed

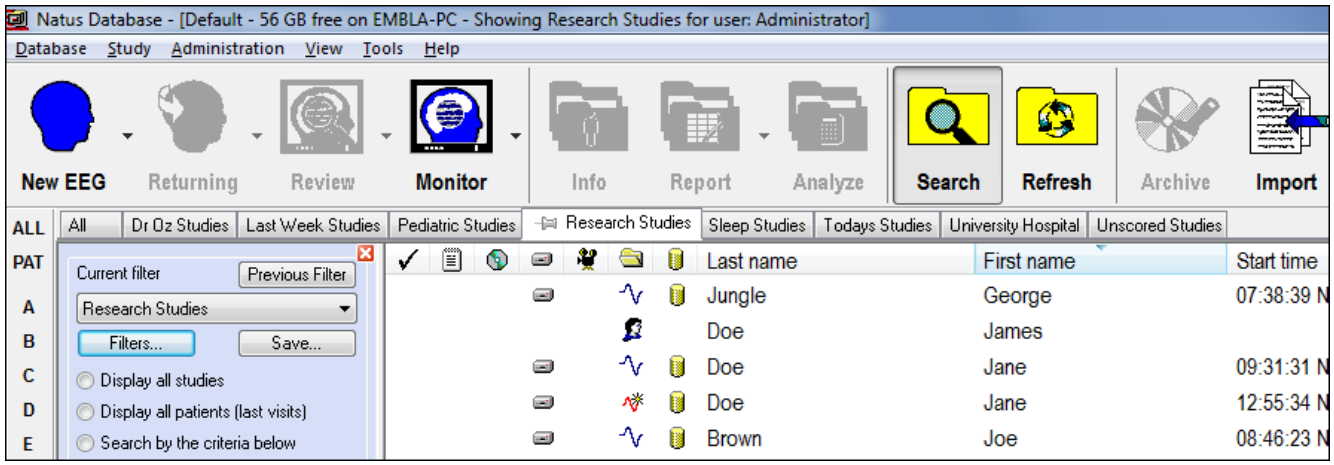
4. Click the Search button again to hide Search Companion and show all the studies.



Search Companion

Displaying Filters in Tabs in the Database Window

Each time a filter is selected in the **Search** bar, a tab is created and displayed in the database window for fast switching of database filter views. You can display up to 8 filter tabs. If you choose to add additional tabs to the database window, any tab which is not *pinned* to the interface will be removed to allow the entrance of your most recent filter selection.



To *pin* a tab to the database window, click the **Pin** icon on the tab. To *un-pin* the tab, click on the pin icon again.

A separate **All** tab is always shown (in addition to the up to 8 custom filters) and always stays at the left edge to allow returning to unfiltered view quickly.

Filtering Studies Based on Custom Fields

To filter studies based on custom fields you have added:

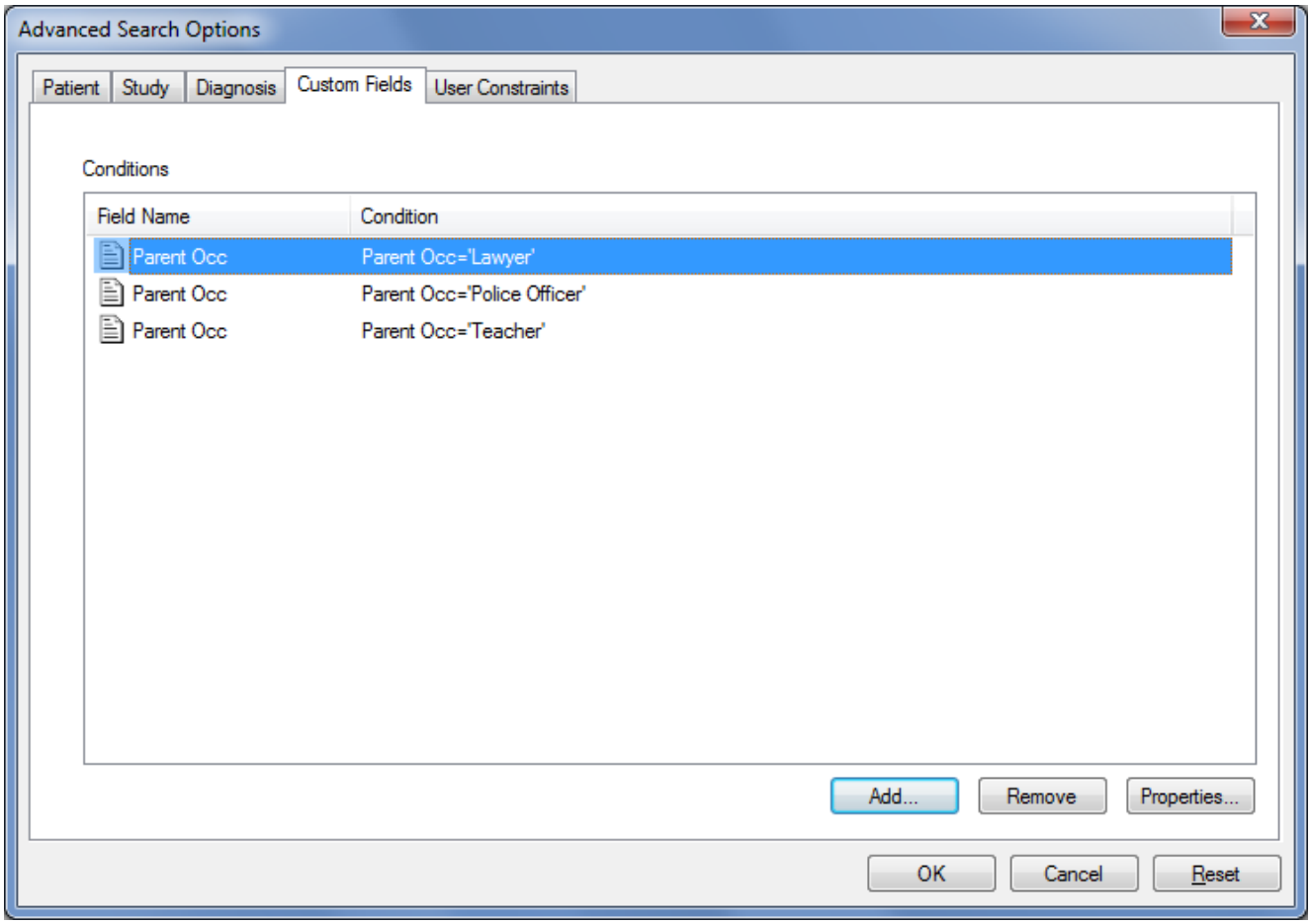
1. Click the **Search** 

button on the toolbar.
2. Select Advanced Search 

and click Configure to open the Advanced Search Options box.
3. Select the **Custom Fields** tab. See the following section for how to use this tab.

The OR Operation

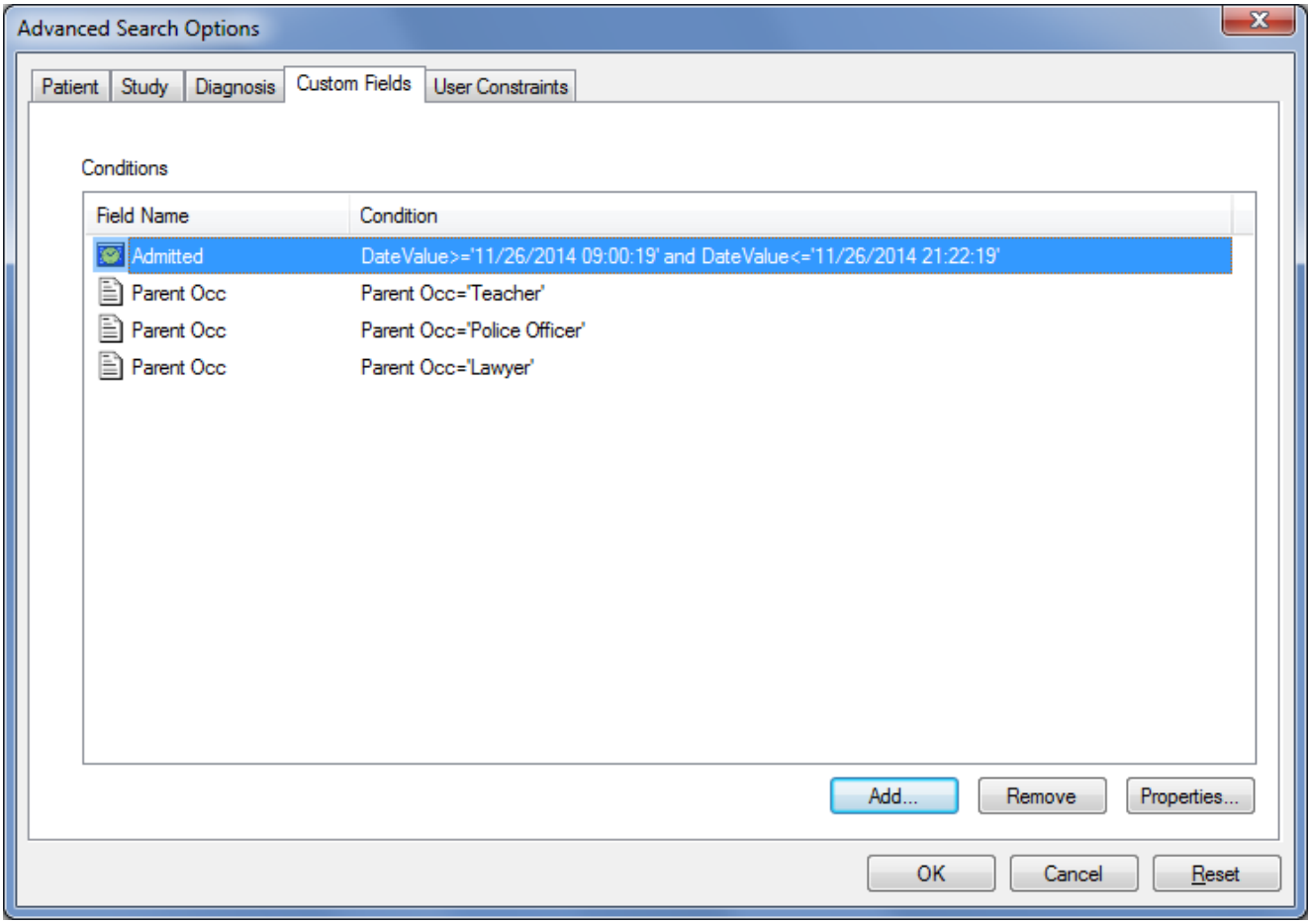
- Adding the same field to the filter multiple times with different values will result in an **OR operation** between the values.



The filter shown in the image above will search for study records where a custom text field called Parent Occ (Occupation) contains one of the three values: Police Officer **OR** Lawyer **OR** Teacher.

The AND Operation

- Adding different fields will perform the logical **AND operation** between the criteria.



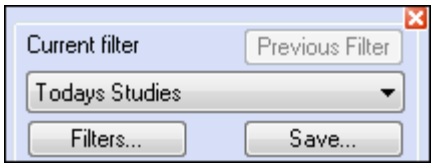
Combination of Same and Different Fields with Values

The filter shown in the image above will search for study records where a custom date field named Admitted contains a date and time between the values shown **AND** a custom text field called Parent Occ (Occupation) contains one of the three values (Teacher **OR** Police Officer **OR** Lawyer).

NOTE: Configuration of the custom fields is synchronized in a distributed database setup so that you only need to configure them once.

Database Search Filters

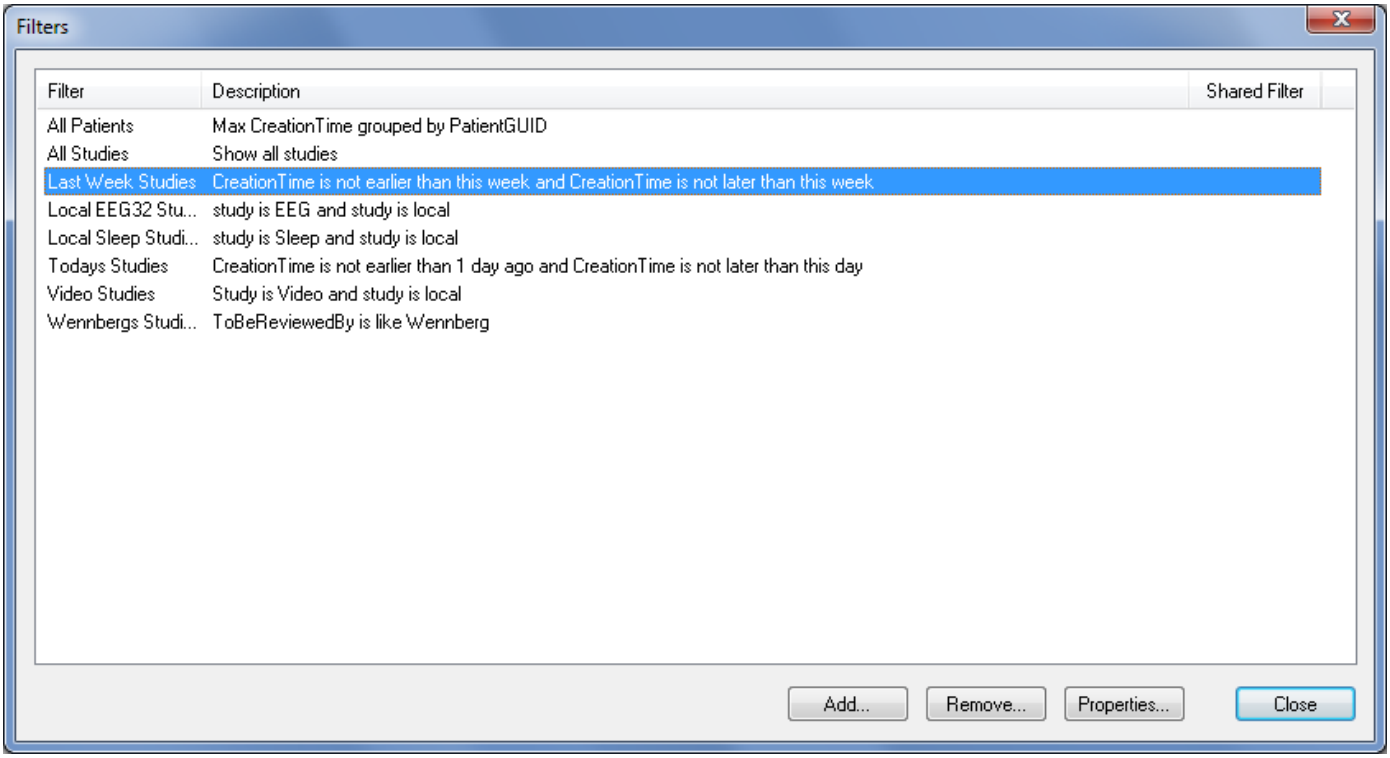
There are often too many studies in the database for you to easily find a given study or perform operations on a group of studies. To allow easier operation, the Search Companion allows custom filters to be created and assigned friendly names and saved for quick access.



Filters Selector in Search Companion

Note the following:

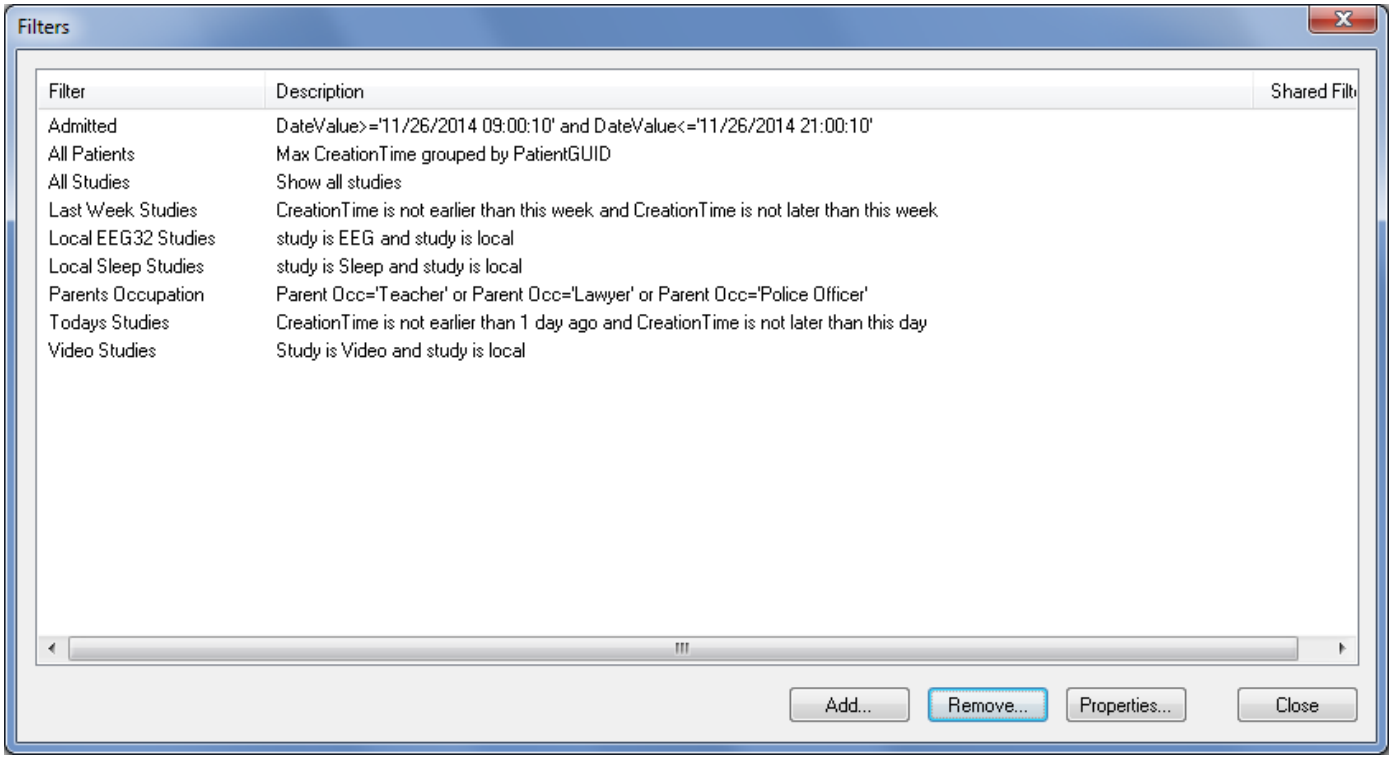
- You create a search filter as usual, and then click the **Save** button. In the dialog box, enter a name and click **OK** to save the filter.
- Use the **Filters** button to see all of the saved filters. You can also Add, Remove, Rename and/or change the search criteria (Properties) for any of the existing filters through the **Filters** dialog.



Filters Dialog showing Saved Filters

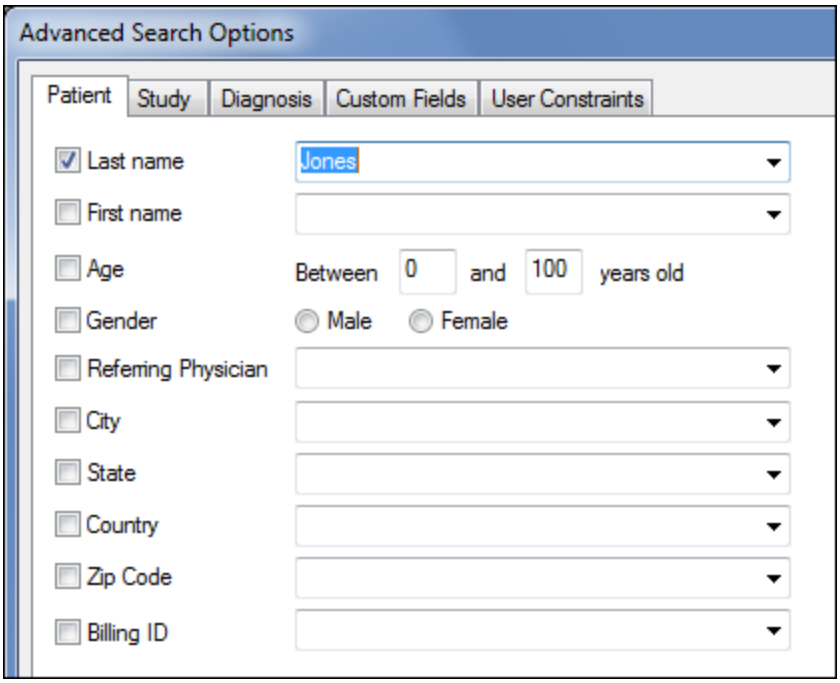
To create a search filter based on last name:

1. Click the **Filters**  button in the **Search Companion**. The **Filters** dialog box opens.



Filters Dialog

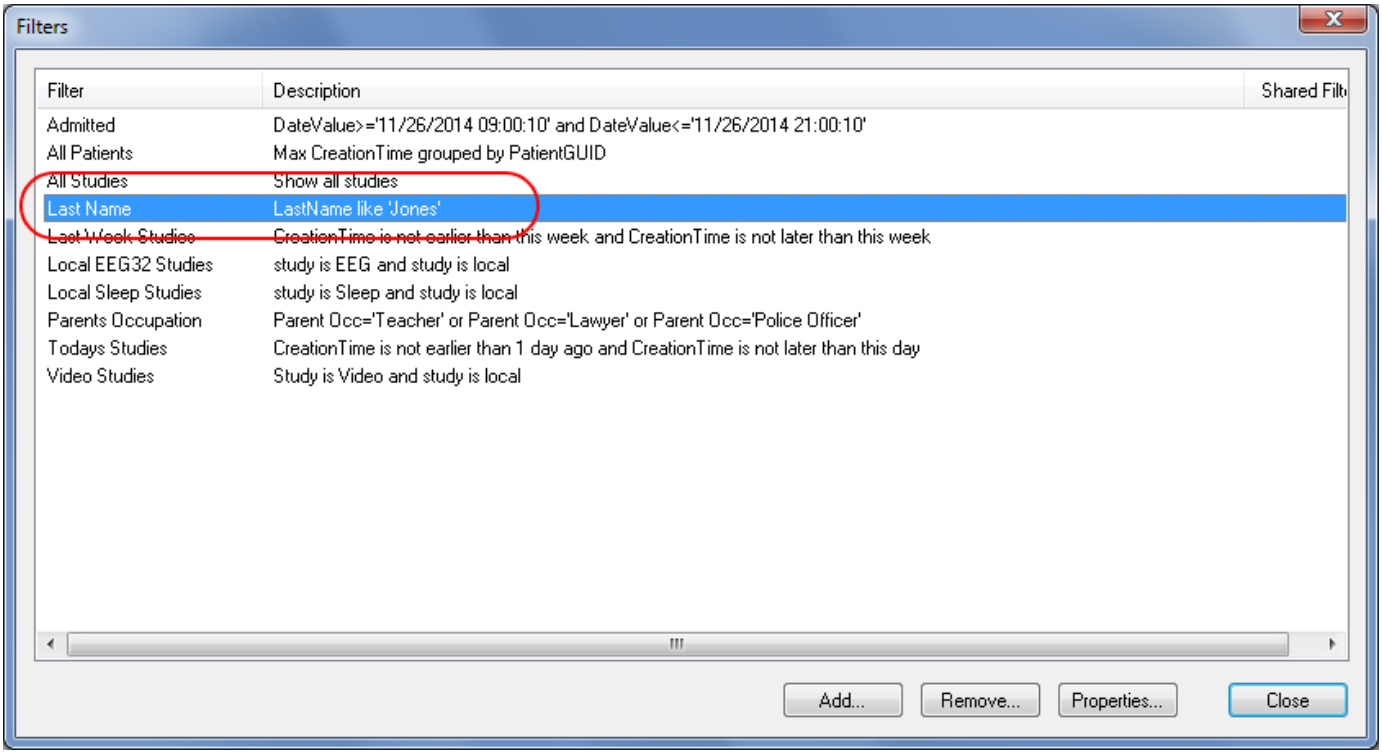
2. Click the **Add**  button.
3. In the **Filter Name** dialog box, type a filter name and click **OK**.
4. In the **Advanced Search Options** dialog box, click the Patient tab, select Last name and type a last name. Click **OK**.



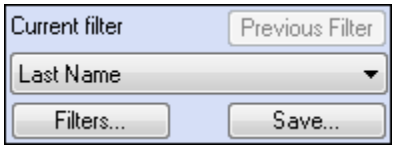
Advanced Search Options Box – Patient Tab (detail)

NOTE: If you were adding a different type of filter, in this step you might have chosen one or more of the other three tabs – Study, Diagnosis, or Custom Fields – to set your filter options.

5. Your new filter is added to the existing Filters list. Note that you could further add to or edit a filter at this point by clicking the **Properties** button. Click **Close**.



6. Your new filter is now selected as the Current filter in the Search Companion. To save it, click the **Save** Save... button.



Last Name as Current Filter

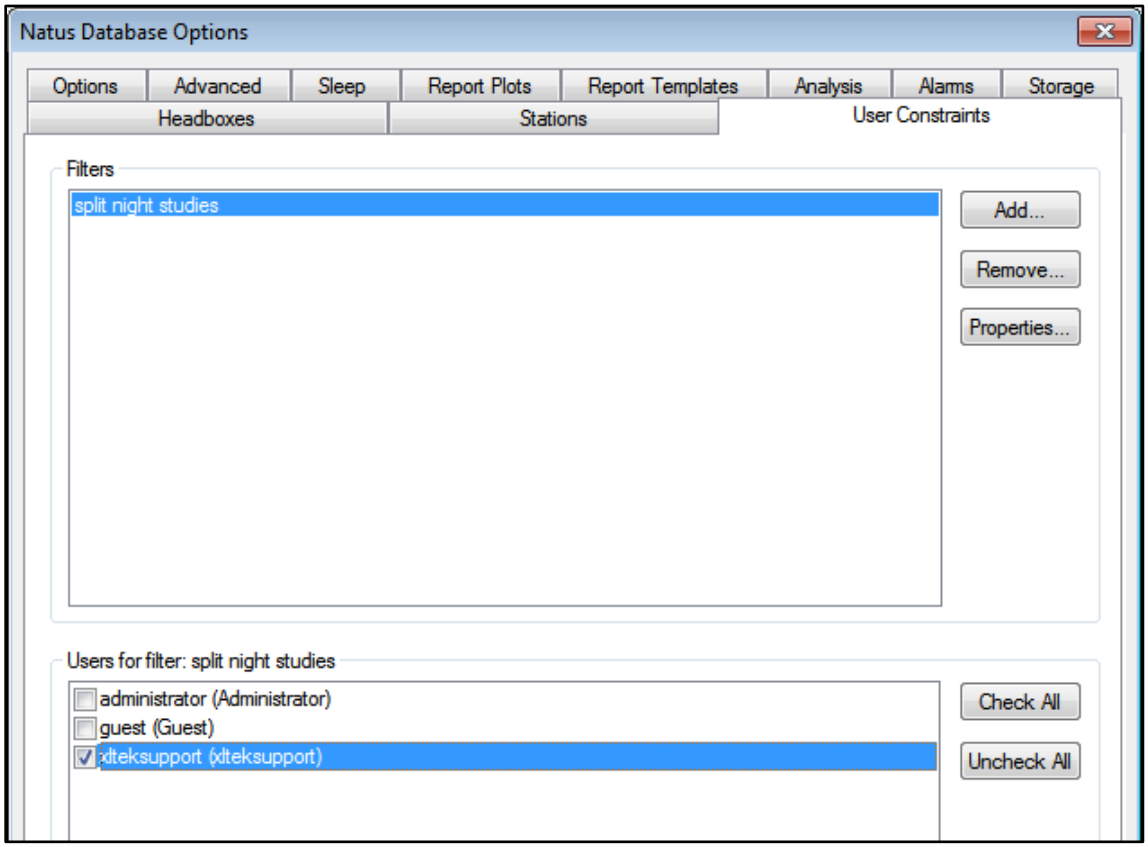
Filtering Studies Based on Logged In User

It is possible for a system administrator to create and maintain special *background filters* to limit which studies are visible to a user in the Natus Database. Those filters are activated without any feedback to a regular user so that the user cannot tell by looking at the screen that a background filter is active. Users are still able to define their own filters that will be applied on top of the background filter.

This function allows creation of secure sub-offices that can only have access to some but not all patient records. It maintains the data security at the central office and allows access to background filter configuration only to the account with **Site Administrator** XLSecurity access.

To add a background filter not visible to logged-in users:

1. Log in as a user with **Administrative** privileges and log in to Natus Database.
2. Click **Tools > Options > User Constraints** (tab) to open the Natus Database Options dialog.
3. Click the **Add** button to add a background filter.
4. Type in a name for your new filter.
5. Define your filter by specifying values in or checking off any of the database fields including custom fields. Click **OK** to save the filter.
6. In the window frame below apply your selected filter to specific users by clicking in the checkbox next to the user name.



User Constraints Tab in Natus Database Options Dialog

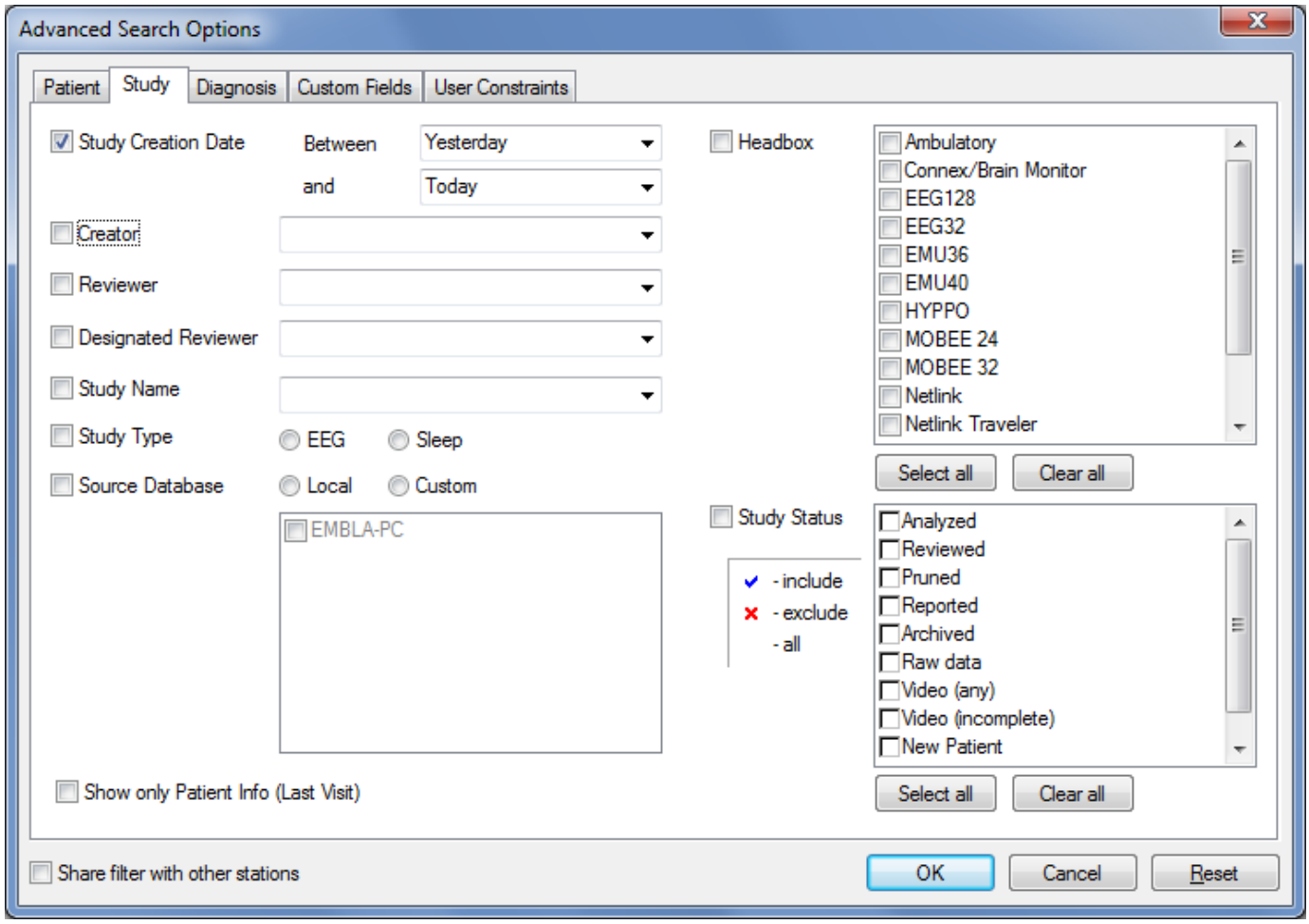
NOTE: More than one user can use the same filter. This is especially useful with the filters that use **<Current User>** tag in place of the actual user name in such fields as Creator, Reviewer or Designated Reviewer. It allows creation of a single filter that acts as *a personal studies* filter for any user logged in.

Customizing Search Filters for the Designated Reviewer

You can customize your search filters so that each user only sees the studies for which he or she is the **designated reviewer**. This is similar to each person having a personal mailbox.

The following example shows how to customize a search filter to use the designated reviewer feature:

1. Click the **Filters** button in the **Search Companion**. The **Filters dialog** box opens
2. **Double-click** a filter (or click a filter and then click the **Properties** Properties... button).
3. When the **Advanced Search Options** box opens, click the **Study** tab.



Study Tab in Advanced Search Options Dialog

4. For **Designated Reviewer** choose **<Current User>.** Then click **OK**. The next time the "designated reviewer" user chooses this filter, the user will only see the studies for which he or she has been assigned as the designated reviewer.
5. Change your other filters to use the designated reviewer feature as required.
6. When finished, click **Close**.

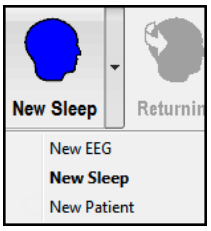
NOTE: You can filter on the Creator, Reviewer and Referring Physician fields in exactly the same way as the Designated Reviewer field.

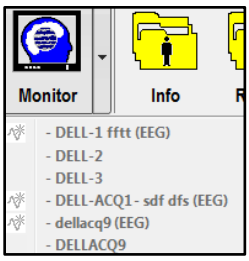
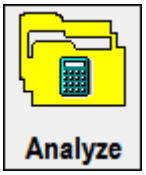
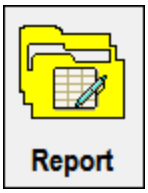
19.5 Toolbars

The toolbar buttons in the Natus Database can be divided into the following four categories. Follow the links for more information about the buttons in each category.

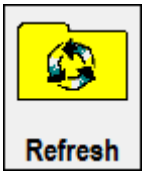
- Patient Related Buttons
- Database Related Buttons
- Administration Related Buttons
- Database Column Heading Buttons

Patient Related Buttons

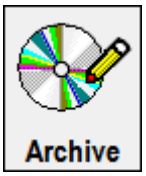
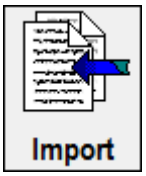
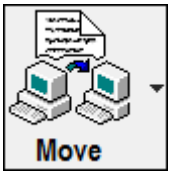
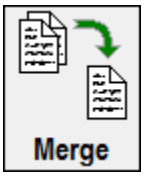
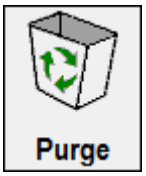
	Click the New button to begin acquisition of a new study for a patient who is NOT already in the database.
	Select a patient from the database main window, then click the Returning button to begin acquisition of a new study for the returning patient.
	Select a study from the database main window, then click the Review button to review the study. Multiple reviewers can open the same study at the same time, with write access for all of the reviewers.
	If both SleepWorks and NeuroWorks EEG are installed on your system, the New button is named according to the mode the system is in: • New Sleep if the system is in Sleep mode • New EEG if the system is in EEG mode Click the arrow beside the button, then do one of the following: • Select New EEG to open a study in NeuroWorks. • Select New Sleep to open a study in SleepWorks. • Select New Patient to add a new patient to the database.

	Click the arrow beside the Monitor button to open the Monitor menu and select a study that is currently being acquired. All of the acquisition stations in the network are shown on the Monitor menu. The stations that are not acquiring a study are unavailable (grayed). The stations that are currently acquiring a live study are shown in black text with the patient's name and a live acquisition symbol. If you select an ongoing study, and click Monitor, the system automatically connects to the acquisition machine and displays the study that is currently being acquired.
	Select a study from the database list and click the Information button to see patient information. You can edit the information in the patient information text boxes if desired.
	Use the Analyze button to submit selected studies for batch analysis.
	Click the Report toolbar button to automatically generate: • A Physician's Report, Technologist's Report, and Study Report for a NeuroWorks EEG study. NOTE: These reports are *Microsoft Word* documents. A taskbar button appears on your Windows taskbar for each report. To view a report, click the taskbar button. • A Polysomnography (Sleep) Report for a SleepWorks study. Also a *Microsoft Word* document, the Sleep Report loads automatically.

Database Related Buttons

	Click the Search toolbar button to search the database for patients.
	Click the Refresh toolbar button to update the list of studies to reflect any custom changes you have made or to ensure that studies are updated when a portable (ambulatory) study has been uploaded.

Administration Related Buttons

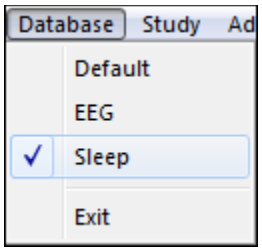
	Click the Archive button to store data on a CD or other electronic media. Once saved to a CD, study information can be purged from the hard drive and reviewed remotely or copied back into the database if needed.
	Use the Import button to import studies from either a database or a local file location.
	Use the Move button to move studies between databases that are inside the distributed virtual database.
	The Merge button merges two or more studies. Select two or more studies that belong to the same patient, then click Merge. The Merge Studies dialog box appears so you can select whether to import the merged study and delete the original studies after the merge.
	Click the Purge button to remove the data files associated with a study but retain the patient name and information in the database. You are prompted to enter a password and confirm your request.  **WARNING:** This step is irreversible unless the files have been archived to CDs.

19.6 Menus

Database Menu

The Database menu lists the virtual databases available for viewing. Note the following:

- A virtual database groups a database file and a patient directory under a user-defined name.
- You can select a different database to work with using the Database menu.
- The virtual database currently displayed has a check mark next to it.
- Selecting a different virtual database from the Database menu changes the database displayed.
- When you switch to another virtual database, a refresh is performed and synchronization is started (if it hasn't been performed in the last 10 minutes).



Available Virtual Databases

NOTE: When a Natus program is open (i.e. NeuroWorks or SleepWorks), it is not possible to open a different database in Natus Database (menu items are dimmed).

Study Menu

The Study menu provides various study options, including starting/monitoring/reviewing a study, submitting for analysis and reporting.

Study Menu Options

Item	Function/Description
New	Starts a **new study** and opens the **Study Information** window. Selecting **New** has the same effect as clicking the **New** toolbar button.
Returning	Starts a study for a **returning patient**. Select a study from the database and then click **Returning**. The **Study Information** window appears and a **new study** is initiated for that patient. Selecting **Returning** has the same effect as clicking the **Returning** toolbar button.
Review	Opens a study for review. Select a patient from the database and then select **Review**. Selecting **Review** has the same effect as clicking the **Review** toolbar button. Multiple reviewers can open the same study at the same time, with write access for all of the reviewers.
Monitor	Displays a study that is running on another computer that is networked to your computer. Selecting **Monitor** has the same effect as clicking the **Monitor** toolbar button. NOTE: A live study should **NEVER** be set to monitor itself on the same acquisition station.
Info	Opens the **Patient Information** dialog box. Add or edit information as desired and click **OK** to save the changes. Selecting **Information** has the same effect as clicking the **Information** toolbar button.
Submit for Analysis	Opens the **Batch Analyzer** to analyze files off line or after an upload. For the Batch Analyzer to work properly, some setup has to be done. **Submit for Analysis** is only enabled if the optional Natus, Stellate Gotman, or Sleep analyzers are installed and one or more studies are selected.

Create Report	• If an **EEG** study is selected, **three** reports are automatically generated in *MS Word*: **Study Report**, **Technologist's Report** and **Physician's Report**. Click the *MS Word* taskbar buttons to open, edit and print the reports. Selecting **Report** has the same effect as clicking the **Report** toolbar button. • If a **Sleep** study is selected, the Sleep **Create Report** box appears and prompts you to select a template to use for the report.
Edit Report	If a **Sleep** report exists, choosing this option opens the report in *MS Word* for editing. This option is not available for EEG studies.
Delete Report	If a **Sleep** report exists, choosing this option allows you to delete the report. However, you are first prompted by a Natus Database **warning box** that asks you to confirm your intention to delete the report. This option is not available for EEG studies.

NOTE: The above menu choices (and more) are also available in the context menu that appears when you select a study and right-click.

Administration Menu

The Administration menu provides options for study file management, including resuming upload of Trex HD ambulatory video.

Administration Menu Options

Item	Function/Description
Archive	Enables you to archive EEG Files by copying files to a CD (or other electronic media), to another location on your hard drive, or to another computer in your network. Selecting **Archive** has the same effect as clicking the **Archive** toolbar button.
CD Label	Enables you to create a CD label. Select an **archived** record from **Natus Database**, then select **CD Label** to specify a new label for that CD. The CD label can be an unlimited number of alphanumeric characters. The CD label will appear in the **CD Label** column of **Natus Database**. This option can also be used to create a CD Label in Microsoft Word that can be cut out and placed in the CD case. Selecting **CD Label** has the same effect as clicking the **CD Label** toolbar button.
Import	Imports studies from either a **database** or a **local** file location.
Export	Exports files (that is, copy to) in three formats: Natus, De-identify, EDF.

Item	Function/Description
Merge	Merges two or more studies. **CTRL + Click** or **SHIFT + Click** to select two or more studies that belong to the same patient. Then choose **Administration > Merge Studies**. This option lets you choose whether to import the merged study and delete the original studies after the merge. Selecting **Merge Studies** has the same effect as clicking the **Merge** toolbar button.
Move Study Files	Moves study files from one machine in the distributed setup to another; for example, from or to the server.
Purge	Removes the data files associated with a study, but retains the patient name and information in the database. You will be prompted to enter a password and confirm your request. Selecting the Purge option has the same effect as clicking the Purge toolbar button.
	 **WARNING:** Purging function is irreversible unless the files have been archived.
Permanently Delete	Deletes a study. Select the study from the database and select **Permanently Delete** from the menu. You are required to enter a password to carry out the delete function.
	 NOTE: This step is irreversible unless you have archived the study to another location; in which case, you can re-import it.
Toggle Study Type	If both SleepWorks and NeuroWorks are installed, this option changes a Sleep study to an EEG study or vice versa. The study can then be opened or reviewed in the alternate program.

View Menu

Use the items in the View menu to control which information appears in Natus Database.

NOTE: If either SleepWorks or NeuroWorks is not installed, then the Study Type column does not appear.

To sort the studies, click a column heading. For example, to sort the studies alphabetically by last name, click the Last Name column heading.

Natus Database stores the last four sorts so you can sort by multiple criteria (the software remembers the last four columns that were used to sort). For example, if you click on First Name and then on Last Name, the database will be sorted by last name but within last name by first name (helpful if you have many patients with the same last name but different first names).

To modify elements shown on the screen, open the **View** menu and select or clear items as desired.

View Menu Options

Item	Function/Description
Default	When **Default** is selected (checked) the following column headings are shown: • Reviewed • Reported • Archived • Raw Data on System • Video Recorded • Study Contents • Is Available • Last Name • First Name • Start Time • Duration (h:m:s) • Study Name • Designated Reviewer • Study Type • Stored On
Basic	Choose **Tools > Options > Options** (tab) to set the number and order of columns that you want for each of these levels.
Detailed	
Custom	
Search	Selecting **Search** opens the **Search Companion**. It enables you to search the database of patient records using a wide variety of criteria such as Study Creation Date, Designated Reviewer, Headbox, Diagnosis, etc.
Refresh	Use **Refresh** to refresh the database list and see pruned files after clipping and pruning data records.

Tools Menu

The following options are available in the Natus Database Tools menu.

Tools Menu Options

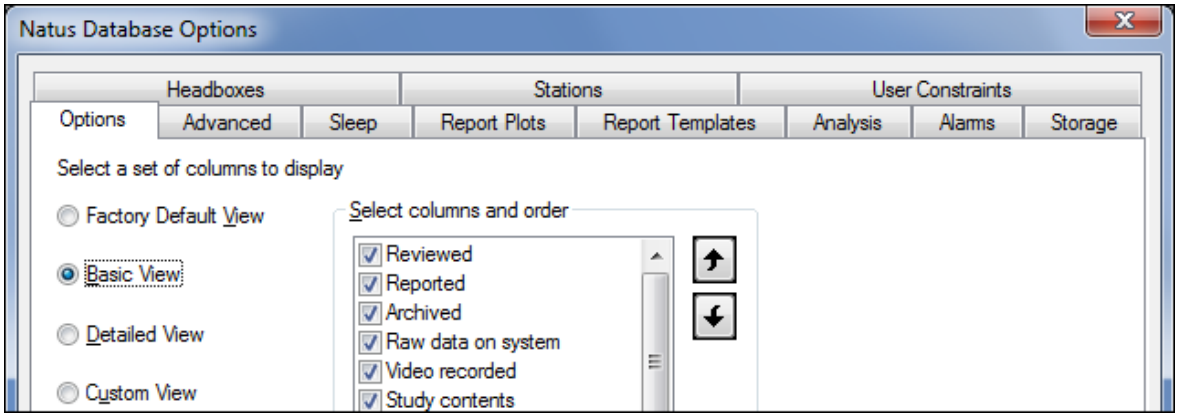
Option	Function/Description
Distribution of Diagnoses	Creates a **Distribution of Diagnoses Report** (based on ICSD [International Classification of Sleep Disorders] Codes for **all** or **selected** studies. The Diagnoses Report is a *MS Word* document. It appears as a **taskbar button** on your Windows taskbar. Click the taskbar button to view the report.

Ambulatory Manager	Opens the **Ambulatory Headbox Manager**. Used to monitor or upload an ambulatory study and clear the memory of the ambulatory headbox.
Options	Opens the **Natus Database Options** box which has the following tabs: • Options • Autorecovery • Sleep • Report Plots • Report Templates • Analysis • Alarms • Storage • Headboxes • User Constraints

19.7 Customizing Natus Database

To customize Natus Database options and directories, choose **Tools > Options.**

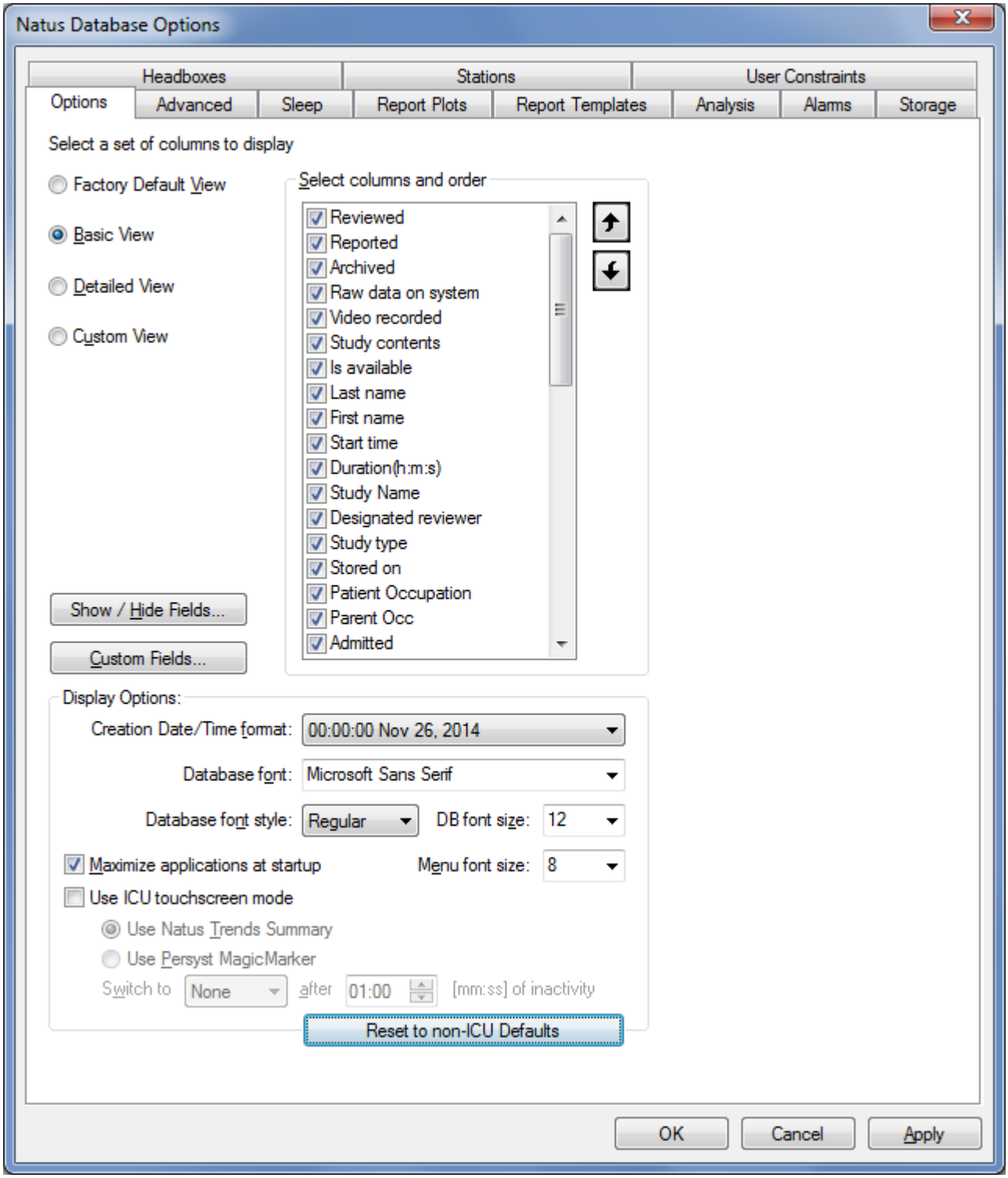
Different tabs are available depending on which Natus programs are installed on your system. If you have both SleepWorks and NeuroWorks installed, then all of the tabs shown below are visible in the **Natus Database Options** box.



Natus Database Options Dialog

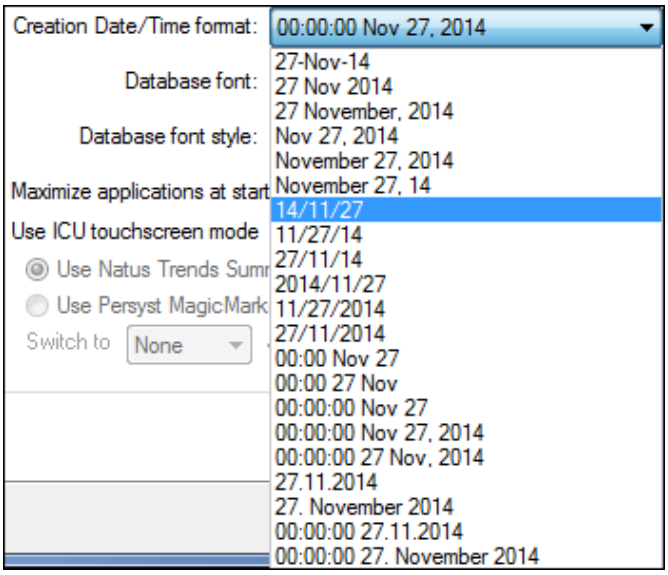
Options Tab

To access the Natus Database Options tab, click **Tools > Options > Options** (tab).



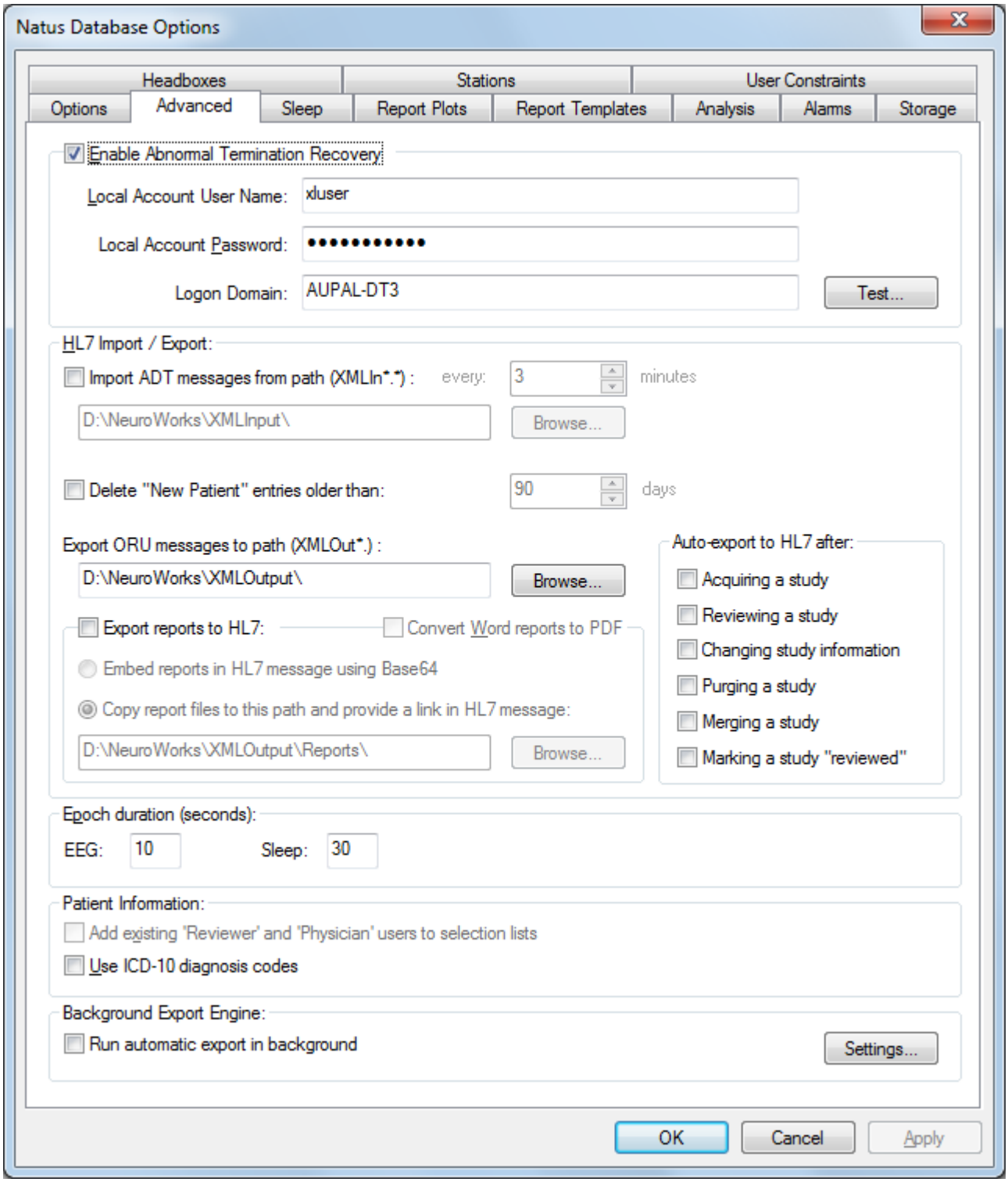
The first four choices on the Options tab determine the columns displayed in each of the four views available on the Natus Database View menu.

Options Tab Options

Option	Comment	Suggested Setting
Select a set of columns to display		
Factory Default View	Fixed set of 15 headings.	Non-customizable.
Basic View	Use to set preferred basic view.	Customizable.
Detailed View	Use to set preferred detailed view.	Customizable.
Custom View	Use to set preferred custom view.	Customizable.
Creation Date/Time Format	This determines the format of the time in the **Start Time** column of the database.	Choose a format from the drop-down list. 
Custom Fields...	Use to add, remove or change the order of custom fields in the database and in reports.	
Show / Hide Fields...	Use to choose the fields and tabs shown in the patient information dialog.	Customizable.

Advanced Tab

To access the Natus Database Advanced tab, choose **Tools > Options > Advanced** (tab).



Advanced Tab Options

Advanced Tab Options

Option	Comment	Suggested Setting
Enable Abnormal Termination Recovery	If enabled, this option lets the system automatically reboot in case of a system failure. Note that the option to set the 'abnormal recovery' user is only available when logged into NeuroWorks under a Windows account belong to the administrators group.	[ON]
Local Account User Name	This user name is used by the system in case of an abnormal termination recovery.	Windows user name. Note that this may be different than the one used to log into the ***Natus*** security system.
Local Account Password	This password is used by the system in case of an abnormal termination recovery.	Password used to log into Windows. Note that this may be different than the one used to log into the ***Natus*** security system.
Logon Domain	Domain name if the computer is logging into domain; computer name if logging in locally.	N/A
HL7 Import / Export		
Enable import from path (XMLIn*.*):	Select to import HL7 data. The path specified has to match the Mirth (or another HL7 gateway) configuration.	N/A
Check import path every ___ minutes	Type a value or use arrow keys to set import checking time.	N/A
	 **NOTE:** The **Check** function works silently in the background looking in the directory, parsing XML messages. Those are HL7 messages translated by an HL7 gateway such as the LinkMed gateway. There should be no workflow disruptions, and the error messages, if any, would be visible only in the application event log or other troubleshooting facilities.	
Export path (XMLOut*.*):	The path specified has to match the LinkMed (or another HL7 gateway) configuration..	N/A

NOTE: If you are monitoring an acquisition station from a remote station, and the acquisition station undergoes auto-recovery, the study will resume and monitoring will continue after the acquisition station has rebooted.

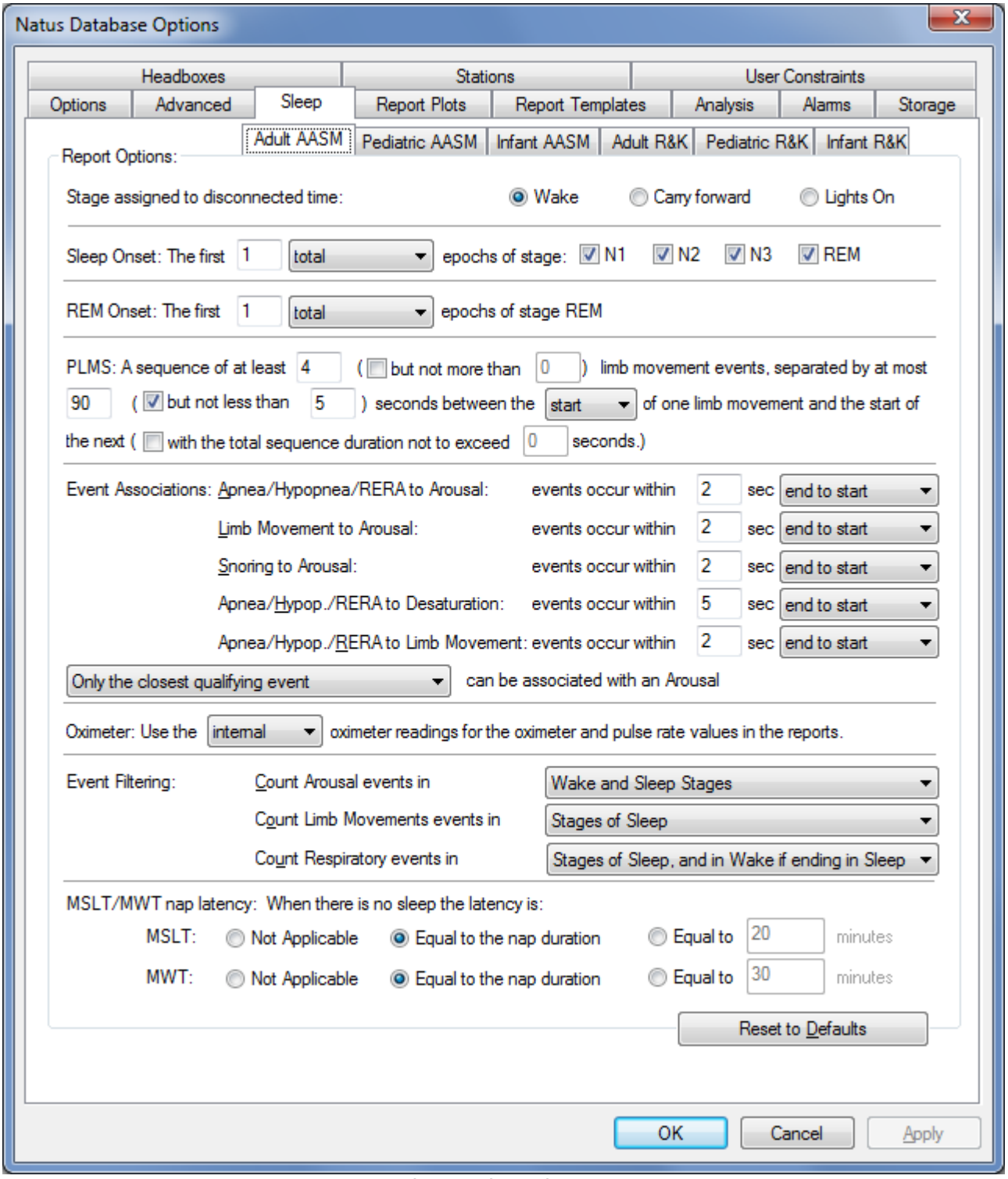
Sleep Tab

To access the Natus Database Sleep tab, choose **Tools > Options > Sleep** (tab).

The Sleep Settings tab lets you control and set options about the following:

1. Length of an epoch
2. Location of report template
3. Report Options related to:
    - Sleep onset epochs included in the report
    - REM onset epochs included in the report
    - PLMS included in the report
    - Events related to an arousal included in the report
4. Type of oximeter used
5. Events to be filtered from the report
6. MSLT nap latency
7. MWT nap latency

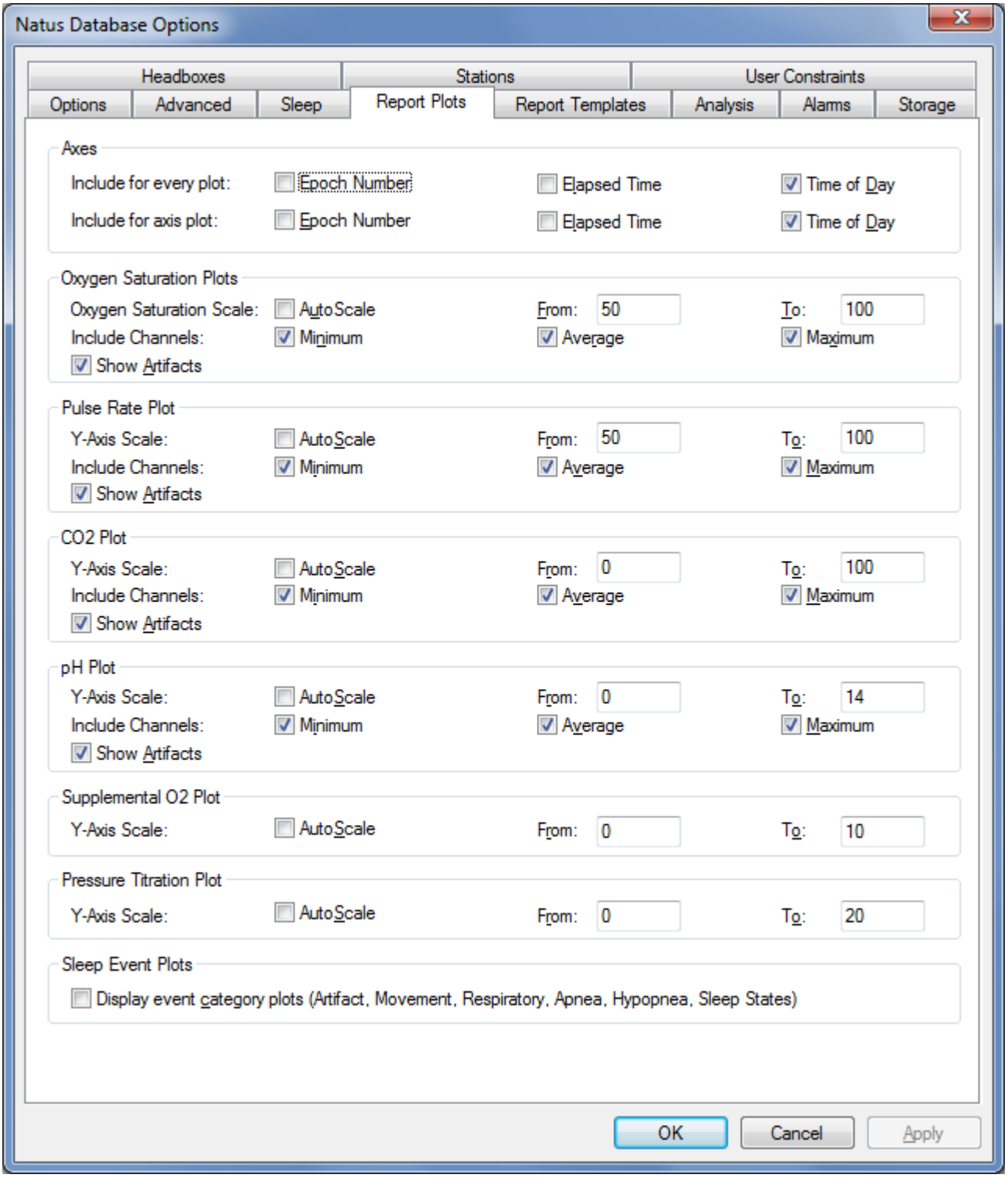
Options are set by selecting and clearing boxes, choosing from drop-down lists, and clicking boxes and entering values with the keyboard.



Sleep Tab Options

Report Plots Tab

To access the Natus Database Report Plots tab, choose **Tools > Options > Report Plots** (tab).



Report Plots Tab Options

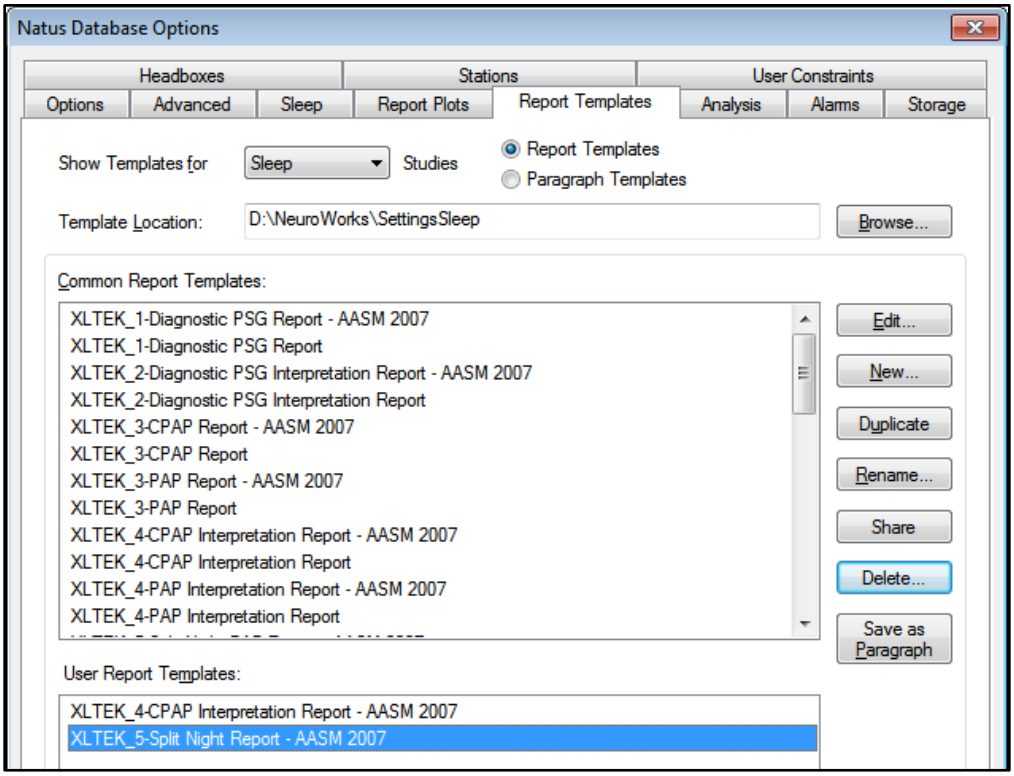
Report Plots Tab Options

Option	Description
Axes	
Include for every plot	Choose to include: • Epoch Number • Elapsed Time • Time of Day
Oxygen Saturation Plot	
Y-Axis Scale	Auto-scale the oximetry plot or enter the Y-axis scale values.
Include Channels	Choose from: • Minimum (**red** in Sleep plots) • Average • Maximum (**green** in Sleep plots)
Pulse Rate Plot	
Y-Axis Scale	Auto-scale the pulse rate plot or enter the Y-axis scale values.
Include Channels	Choose from: • Minimum (**red** in Sleep plots) • Average • Maximum (**green** in Sleep plots)
CO2 Plot	
Y-Axis Scale	Auto-scale the CO2 plot or enter the Y-axis scale values.
Include Channels	Choose from: • Minimum (**red** in Sleep plots) • Average • Maximum (**green** in Sleep plots)

pH Plot	
Y-Axis Scale	Auto-scale the pH plot or enter the Y-axis scale values.
Include Channels	Choose from: • Minimum (**red** in Sleep plots) • Average • Maximum (**green** in Sleep plots)
Supplemental 02 Plot	
Y-Axis Scale	Auto-scale the supplemental O2 plot or enter the Y-axis scale values.
Sleep Event Plots	
Display event category plots	Users have the option of including or not including categories in sleep event plots.

Report Templates Tab

To access the Natus Database Report Templates tab, choose **Tools > Options > Report** Templates (tab).



Options on Report Templates Tab for Sleep Study

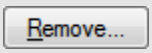
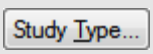
Report Templates Tab Options

Option	Description
Edit	Select an existing template and click **Edit.** Microsoft Word launches with the selected template loaded.
New	Click **New**. The **Template name** box appears. Type a name and click **OK**. Microsoft Word launches with the new (and blank) template loaded. You must now **edit the template** and add your own headings, information fields, and overall formatting.
Duplicate	Select an existing template and click **Duplicate**. A template called **Copy of (template)** is added to the **User** list. Select the **Copy of (template)** and click **Rename**. The **Template name** box appears. Type a new name for the template and click **OK**.
Rename	Select an existing template and click **Rename**. The **Template name** box appears. Type a new name for the template and click **OK.**
Share/Don't Share	Selecting a template in the **User Templates** section and clicking **Share** moves it into **Common Templates** section and makes it available to all users. Conversely, selecting a template in the **Common Templates** section and clicking **Don't Share** moves it into **User Templates** section and makes it only privately available.
Delete	Select an existing template and click **Delete**.

Analysis Tab

To access the Natus Database Analysis tab, choose **Tools > Options > Analysis** (tab).

Analysis Tab Options

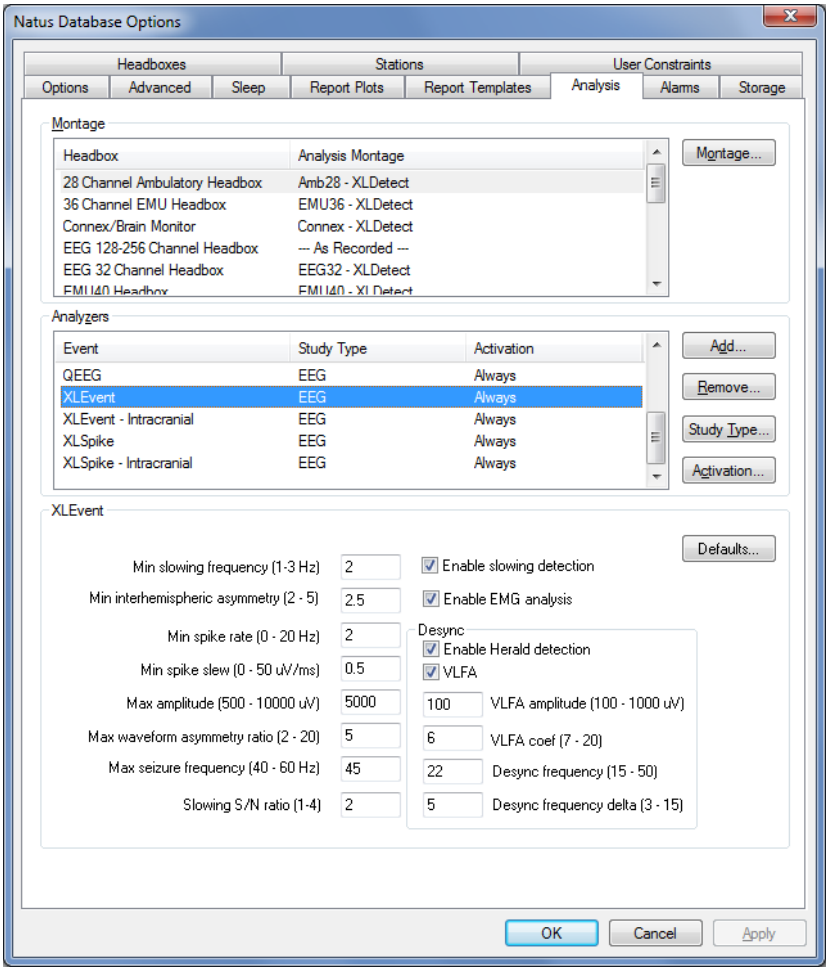
Option	Description/Function
	Select a headbox in the **Montage** pane. Click the **Montage** button to see a pop-up list of available analysis montages. Click a montage to select it.
	Click the **Add** button to see a pop-up list of available analyzers. Click an analyzer to select it.
	Select an analyzer in the **Analyzers** pane. Click the **Remove** button to remove it
	Click the **Study Type** button to see a pop-up list of study types to which you can add an analyzer. Choose from **EEG, Sleep, EEG and Sleep.**

Option	Description/Function
Activation...	Click the **Activation** button to see a pop-up list of study activation options. Choose from **Never, Always, Lights Off, or Schedule** (enter schedule time in resultant dialog box).
Defaults...	Select an analyzer in the **Analyzers** pane. Click the **Defaults** button to return altered settings to factory defaults.
Analyzer Options Section	Once an analyzer has been added and selected, its options become visible in the bottom section of the Analysis tab. You can then modify options. Lastly, click the **Apply** button to set them.

Adding an Analyzer and Setting Its Options

After clicking the **Add** button, select and click an analyzer to add it to a study. Once you have added the analyzer, you can set its options.

You can also access the Analysis tab in NeuroWorks by choosing **Edit > Settings**.

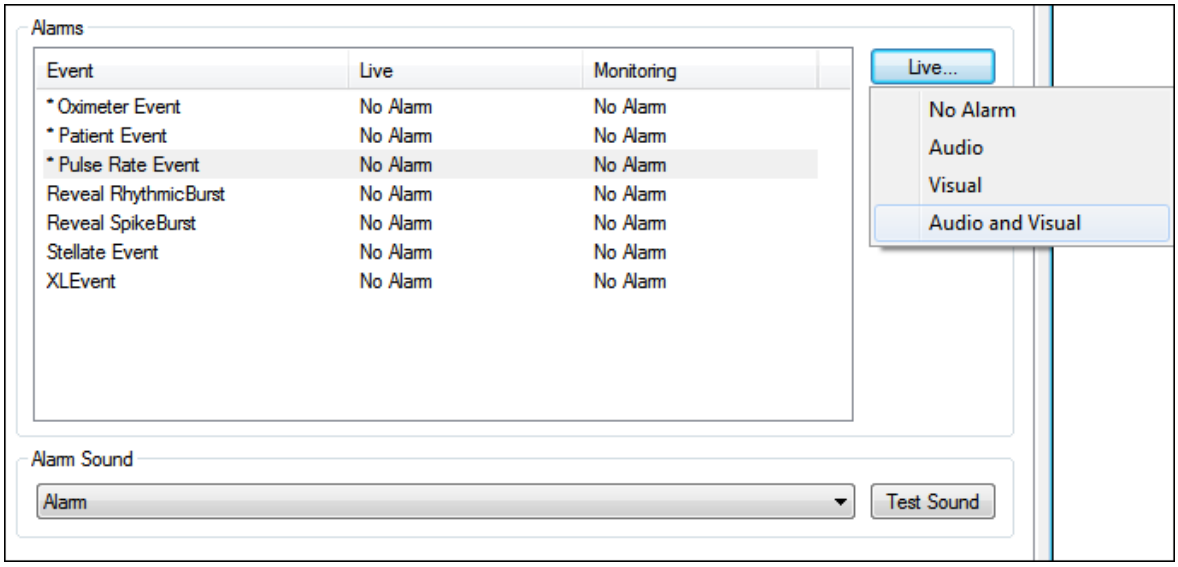


Analysis Tab Options

Alarms Tab

To access the Natus Database Alarms tab, choose **Tools > Options > Alarms** (tab).

You can also access the Alarms tab in your NeuroWorks EEG by choosing **Edit > Settings**.



Event Alarms Activation Box

The options available on the **Alarms** tab allow you to add a visual and/or an audio alarm to any event in either Live or Monitoring mode.

You can add an alarm by right-clicking in either the **Live** or **Monitoring** column, or clicking either the **Live** or **Monitoring** button and choosing from the four pop-up choices.

- No Alarm
- Audio
- Visual
- Audio and Visual

Alarm Attributes

- When a visual alarm occurs, the word **ALARM** flashes on top of the waveform window.

Visual Alarm

- When the default audio alarm occurs, there is a beeping sound.
- To turn off the alarm, press **F12**.

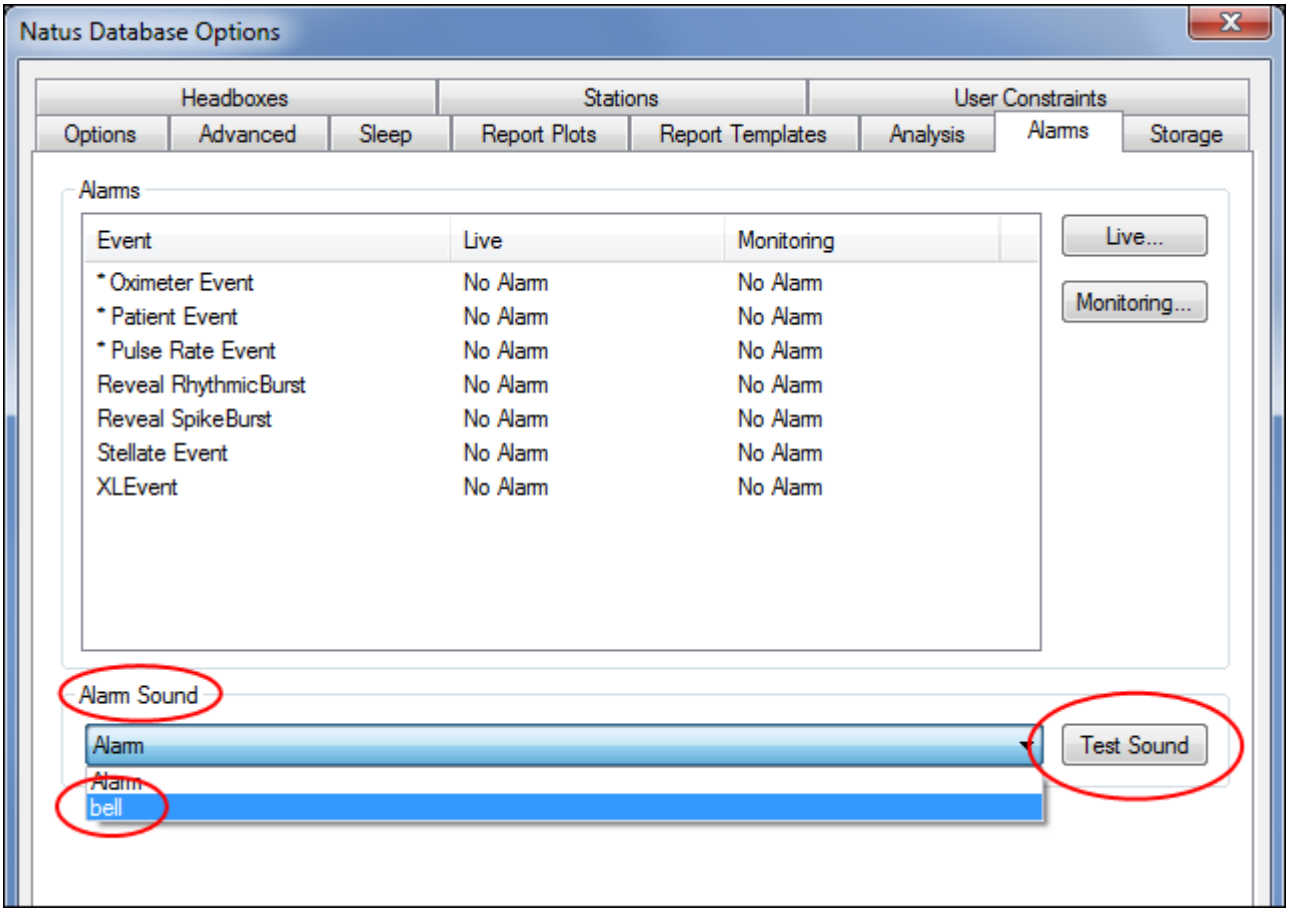
WARNING: The alarm system is **NOT** intended to replace stand-alone hospital alarms.

Adding a Custom Alarm Sound

It is possible to add additional sounds to the list of sounds available in the Alarm Sound list on the **Alarms** tab.

To add an alarm sound:

1. Open Windows Explorer.
2. To view available alarm sounds, go to **D:\NeuroWorks\Alarm Sounds**. This is the default directory for the **Alarm Sounds .wav** files.
3. To add a sound to the **Alarm Sounds** list, copy and paste, or move, a standard **.wav** file to the **Alarm Sounds** directory.
4. Restart the NeuroWorks program.
5. The new file that you added now appears in the **Alarm Sound** list.

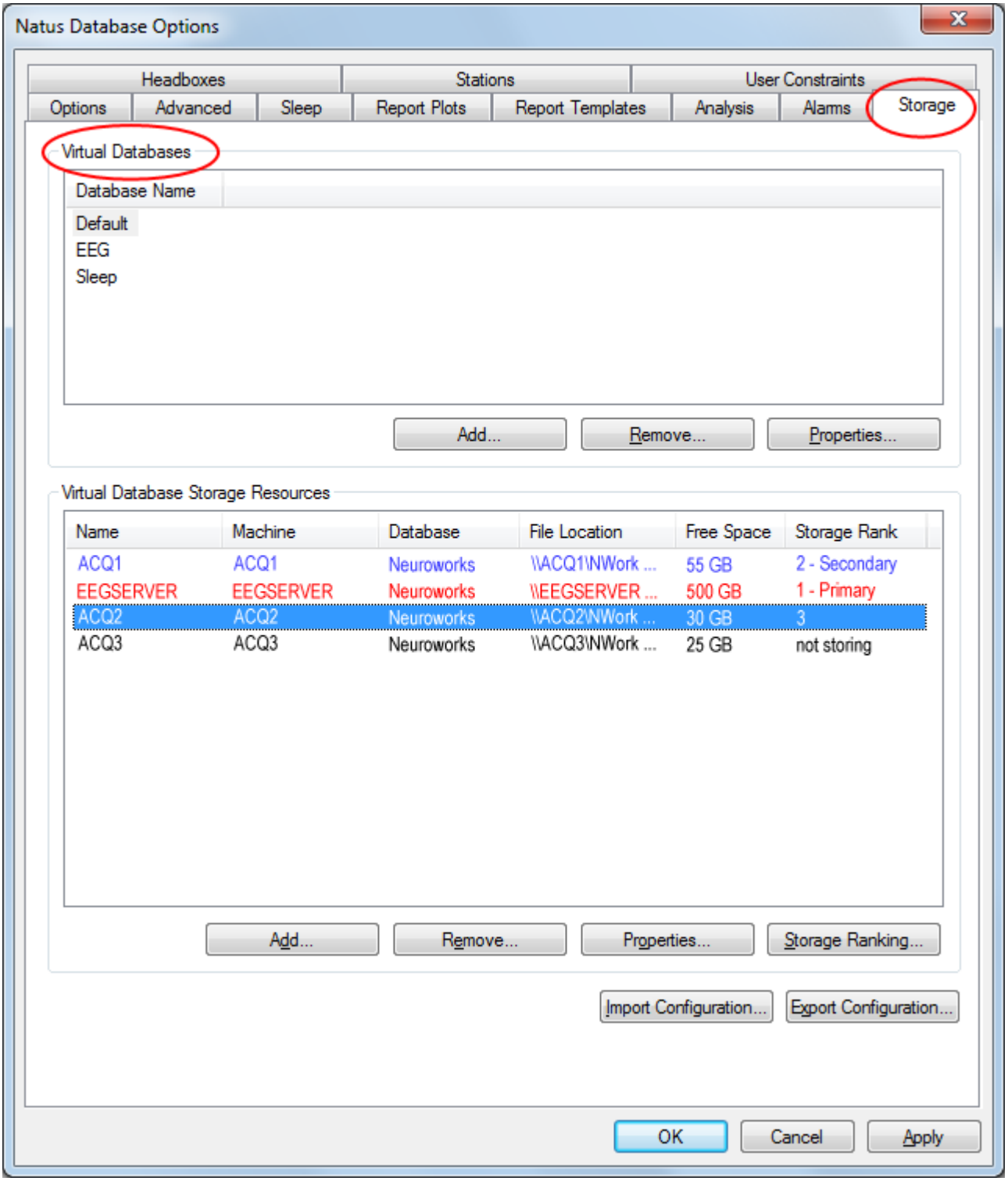


Custom "bell" Alarm Added to Alarm Sound List

6. To confirm that your custom alarm is working, select it and click the **Test Sound** button.

Storage Tab

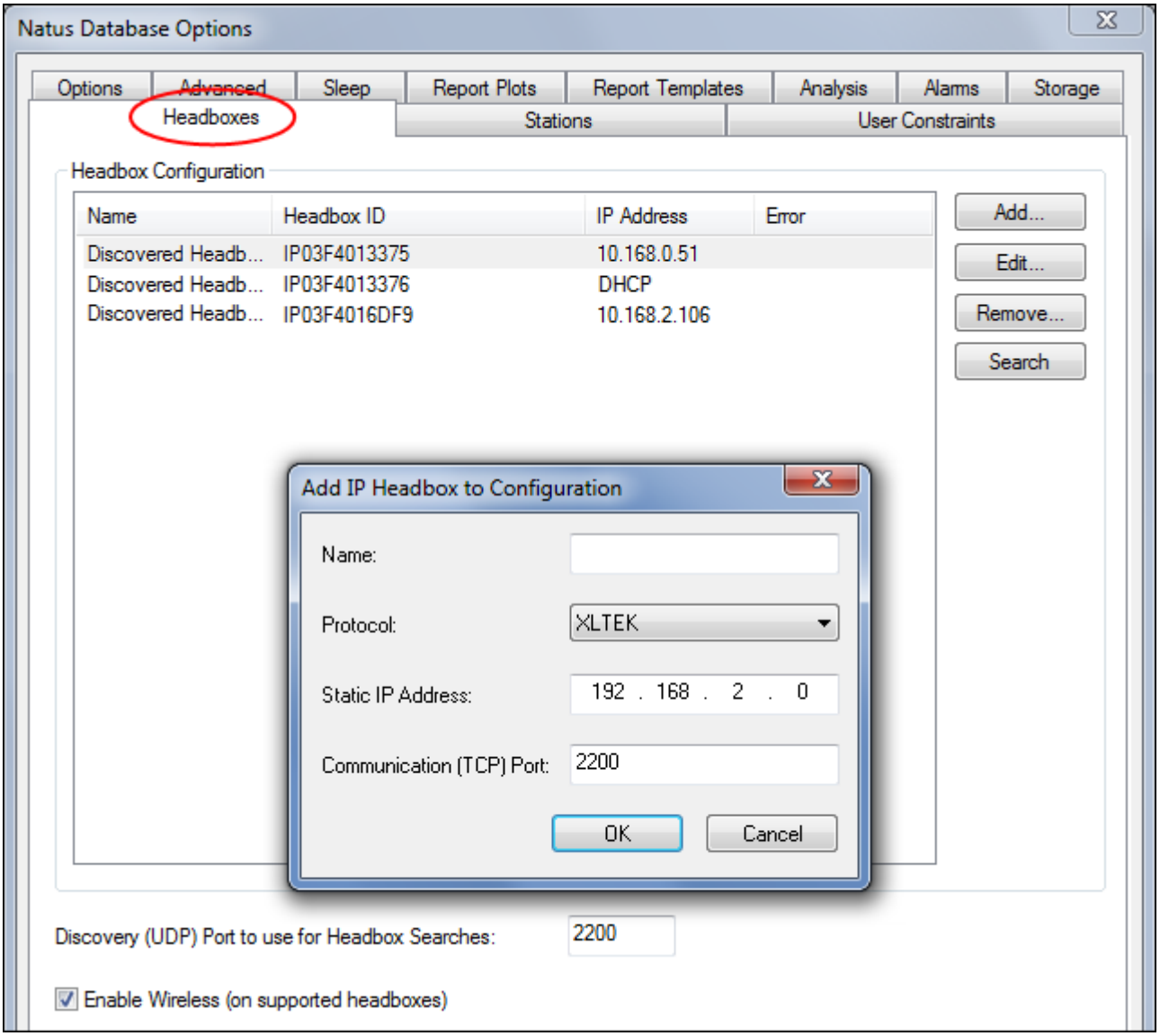
To access the Natus Database Storage tab, choose **Tools > Options > Storage** (tab).



Storage Tab

Headboxes Tab

To access the Natus Database Headboxes tab, choose **Tools > Options > Headboxes** (tab).

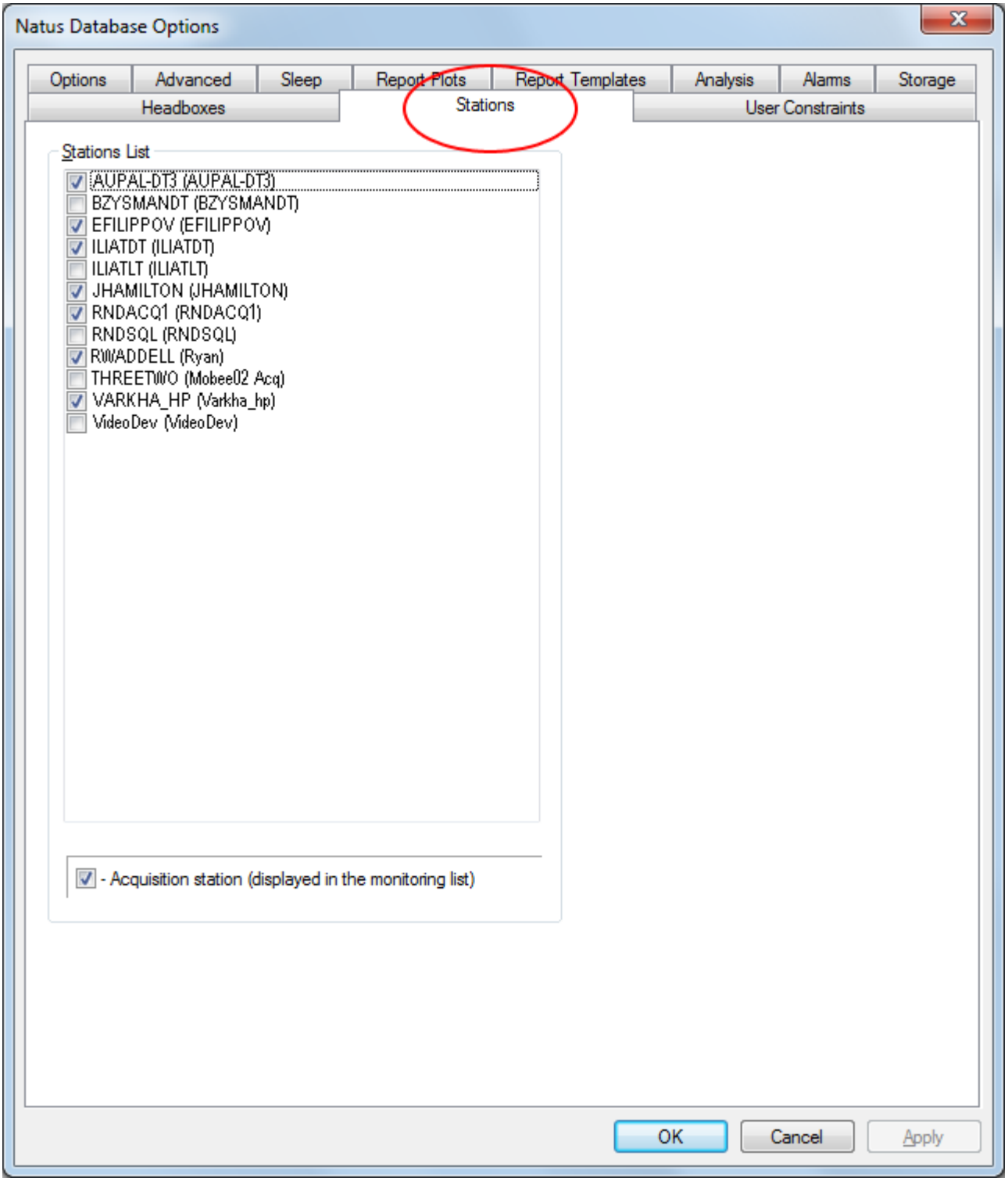


Headboxes Tab with Add IP Headbox Dialog (detail)

The Headboxes tab is can be used to configure IP-connected headboxes.

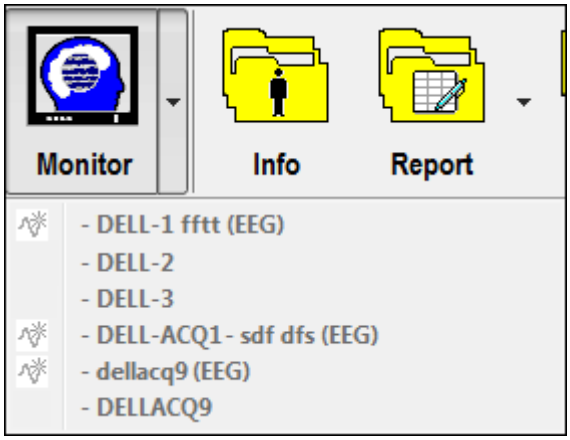
Stations Tab

To access the Natus Database Stations tab, choose **Tools > Options > Stations** (tab).



Stations Tab

The list of stations shown in the **Monitor** dropdown list can be configured through the Stations tab in the Natus Database Options dialog box.



Stations in Monitor List

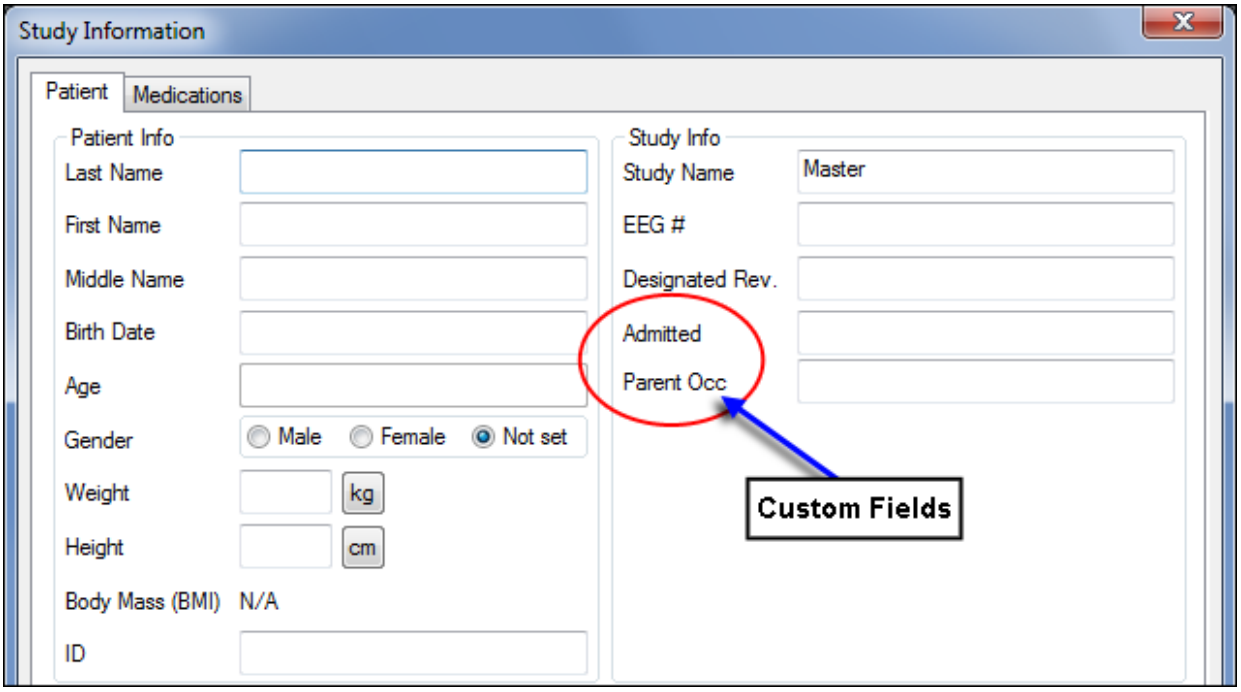
Note the following:

- Stations that are checked appear in the monitor drop-down list. This list is maintained in the alarms database; therefore, for the settings to apply to all machines, a central alarms server needs to be configured.
- To add a station to the monitor list, select its check box and click **OK** or **Apply**.
- To remove a station from the monitor list, clear its check box and click **OK** or **Apply**.

19.8 Custom Fields in Natus Database

Displaying and Editing Custom Fields

All custom fields are displayed/edited in the **Patient Info** dialog box. To access the **Patient Info** box in Natus Database, choose **Study > Info**.

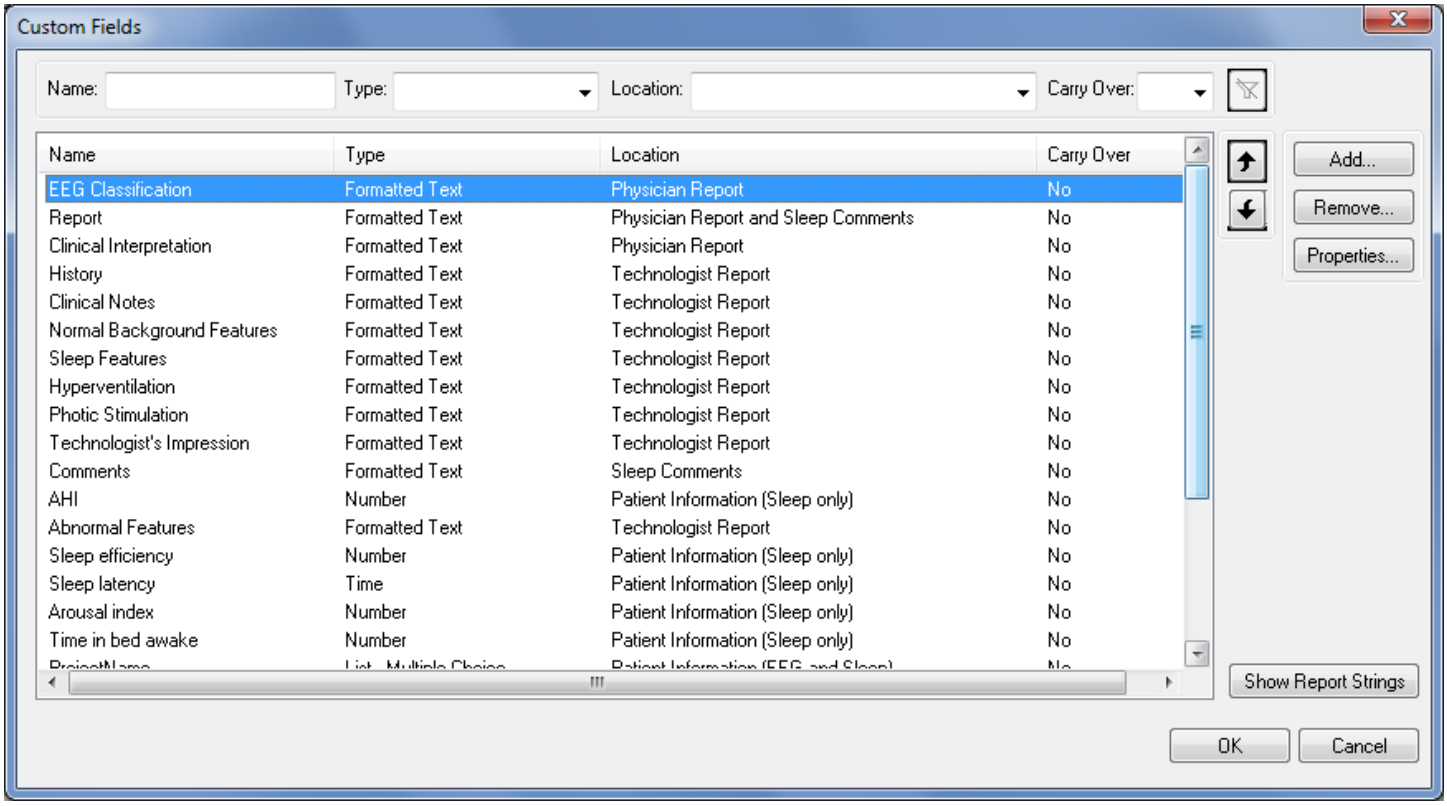


Patient Info Dialog

Adding Custom Fields in the Database and Reports

To access the custom fields function:

1. Choose **Tools > Options > Options** (tab).
2. Click the **Custom Fields**  button.
3. The **Custom Fields** dialog box opens.



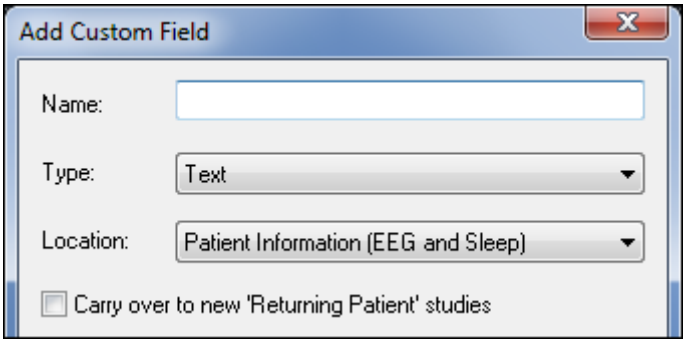
Custom Fields Dialog

To change the order of a custom field, select the field and click the up arrow  or down arrow  .

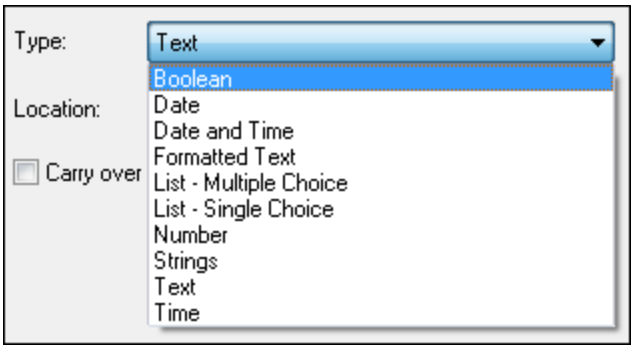
To remove a custom field, select the field and click the **Remove** button.

To add a custom field:

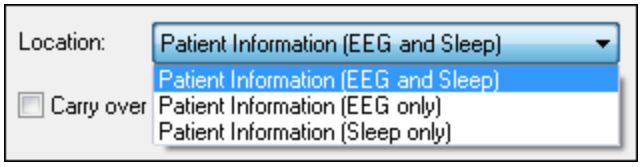
1. Click the **Add** button.
2. The Add Custom Field box opens.
3. Type a name for your custom field in the **Name** box.



4. Click the dropdown arrows beside the **Type** and **Location** boxes, and choose the options you want. Location options may vary depending on **Type** chosen.

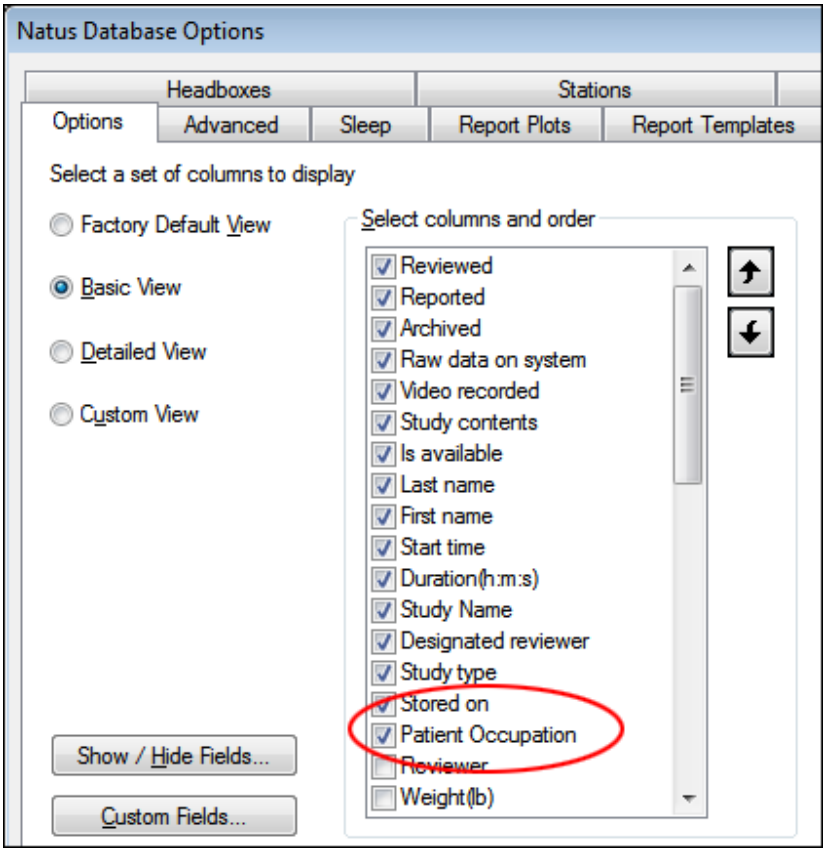


Type Options



Locations Options for Text Type

5. If you want the value entered in the custom field to be "carried over" to subsequent studies for a patient whose profile already exists in the database by checking the **Carry over to new Returning Patient Studies** option. Using the **Returning Patient** function would cause the value in this field to be copied into the same field for a new study. Click **OK**.
6. Once added, a custom field can be put into a View set.



Custom Field Added to View Set

7. The custom field will then be displayed in Natus Database.

Stored on	Patient Occupation
DANIEL...	

Field in Natus Database

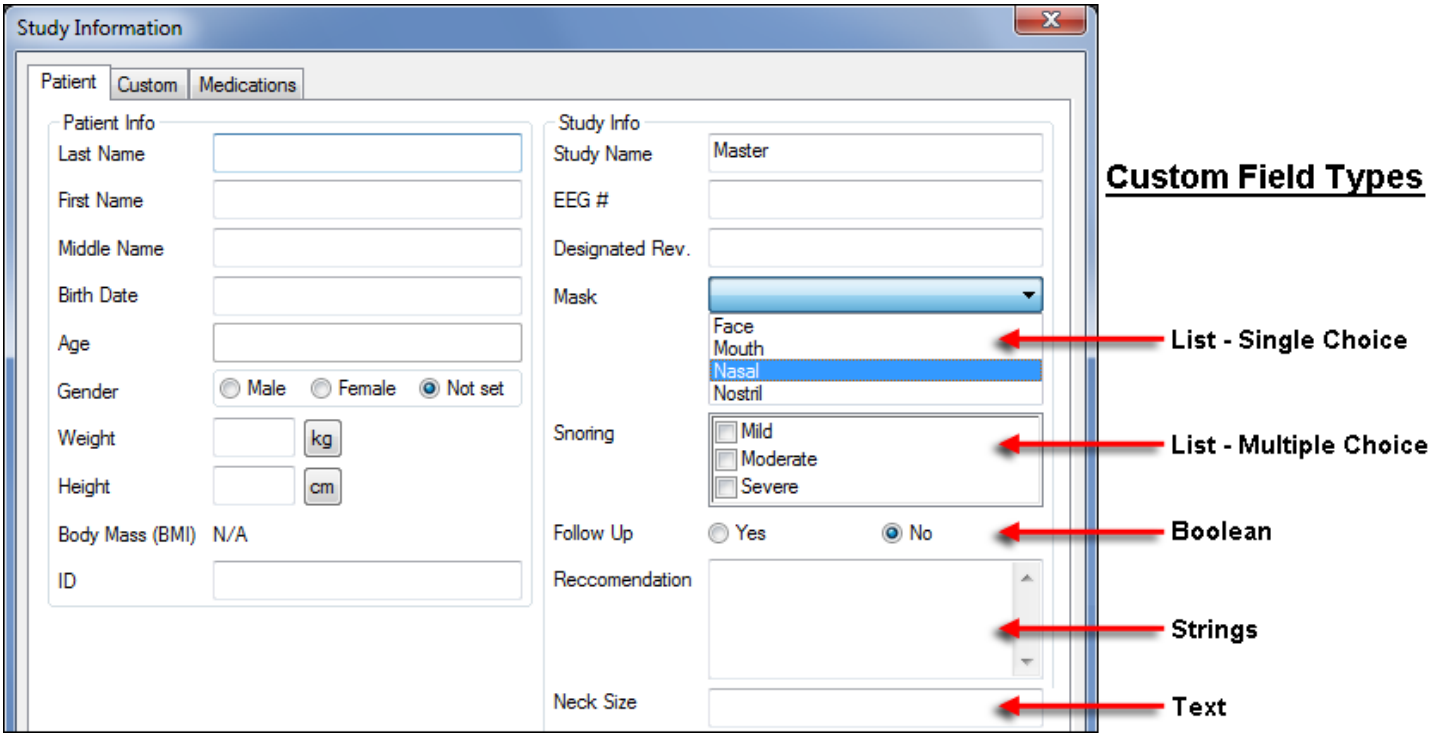
NOTE: When you add a number of new fields, the first few fields will show up on the first page in the **Patient Info** dialog box. The rest will overflow to the **Custom** page.

To change the properties of a custom field:

1. Click the **Properties** Properties... button.
2. The Custom Fields Properties box opens.
3. Click the dropdown arrows beside the **Type** and **Location** boxes and choose the options you want.
4. Click **OK**.

NOTE: Your customized or new option will not be active until the next acquired study.

Types of Custom Fields



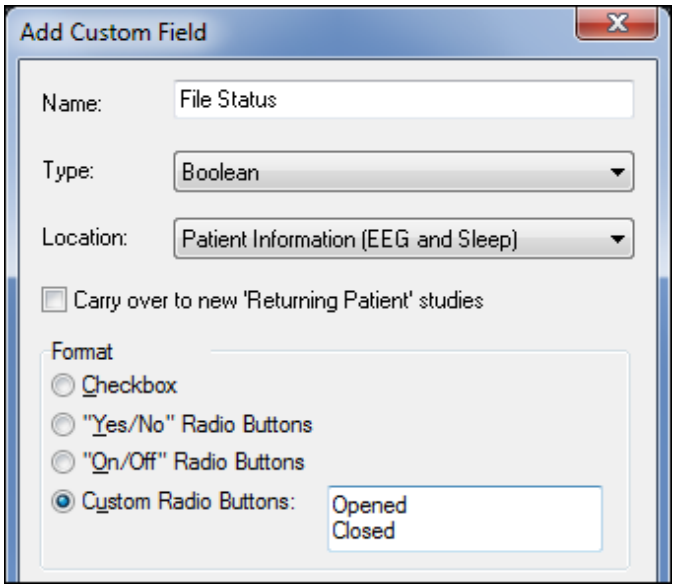
Custom Field Types in Patient tab on Study Information Dialog

Custom Field Types

Type	Description
Formatted Text	Denotes RTF (Rich Text Format) fields in **Physician / Technician** pages of the Patient Info dialog box in **NeuroWorks**.
Sleep Comment	Denotes RTF (Rich Text Format) fields on the **Comments** page of the Patient Info dialog box in **Sleep**.
Boolean	A field containing 2 choices/options - For example, a **Yes/No** field, an **On/Off** field. A *Custom* option is available where you can define 2 options.
List - Multiple Choice	User interface displays multiple choices presented with a checkbox next to each option. User can then check any options that are applicable. Additionally, users are presented with an option to define longer text strings attached to each label option which can substitute for the labels in generated reports only.
List - Single Choice	Use this field type to add a drop down box to your **Study/Patient Info** form.
Strings	Use this field type to add a field where you want to type in comments or sentences spanning multiple lines which you can define.
All Other Types	The field will be on the first page of the **Patient Info** dialog box or, if there are too many non -RTF fields, a new page will be added to the Patient Info dialog box.

Boolean

The Boolean field is an option where you can present 2 choices to an end user, where only 1 choice may be selected. This field may be presented as a "Yes/No" field, an "On/Off" field or a Custom option is available where you can define 2 choices. When you select the Boolean option, you must choose a format.

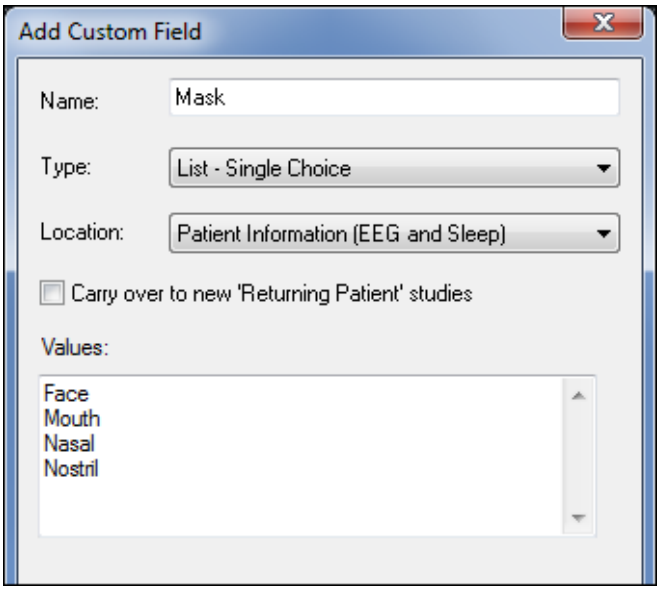


Boolean Custom Field Option

If you select the **Custom** option, type your first choice text on the first line, then press the **RETURN** button on your keyboard. In the next line, type in your second choice text.

List - Single Choice

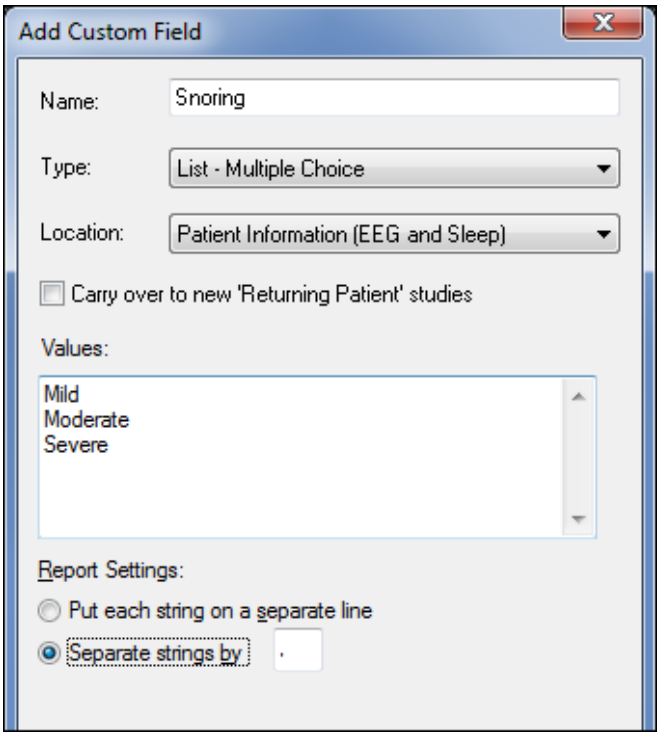
Use this field type to add a dropdown box to your **Study/Patient Info** form.



List – Single Choice Option

List - Multiple Choice

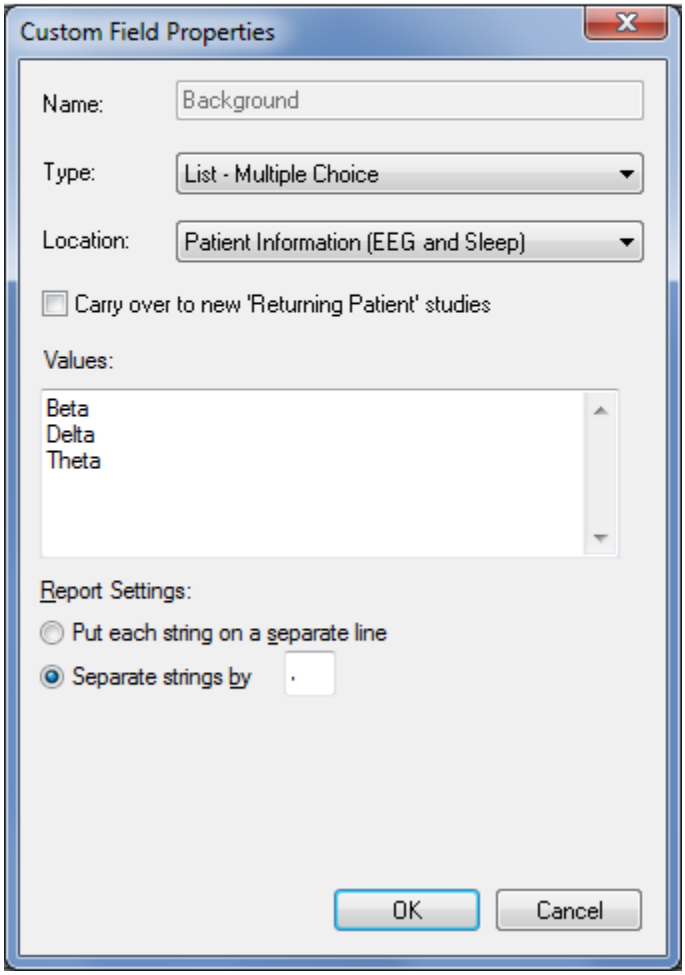
Use this field type to add check boxes to your **Study/Patient Info** form where you can select more than one option.



List – Multiple Choice Option

List - Multiple Choice with Strings

With this field type you have the option to attach or create longer text strings or sentences to each label or option you define as part of your multiple choice list. The longer text strings or sentences would only appear in a generated report. Using **Multiple Choices** with **Report Strings** allows you to display short and simple labels in your **Study/Patient Info** form but longer and more descriptive phrases in your generated reports.



List – Multiple Choice Option

Strings

Use this field type to add a field where you want to type in comments or sentences spanning multiple lines which you can define. Unlike the **Formatted Text** option, the **String** field type can be queried using search filters in the database.

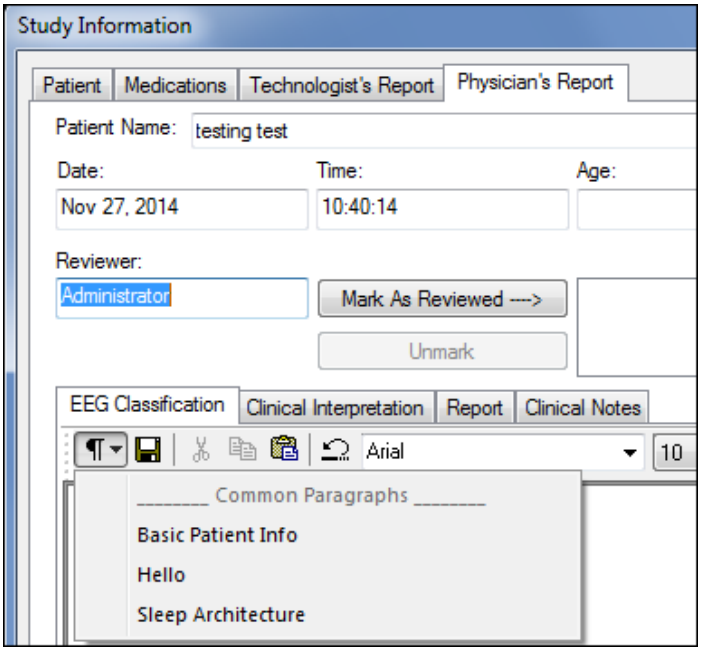
Type relates to the location at which the field is displayed.

Paragraphs Available in Custom Fields

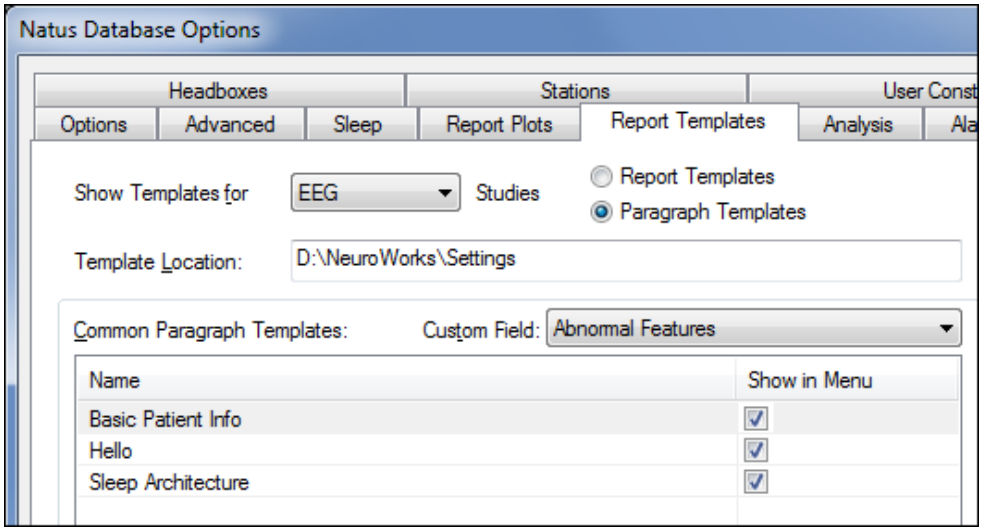
Complete paragraphs of texts may be preconfigured, including programmable report tags, and included in the formatted fields that are part of **Study Information** dialog. This may be done after custom fields are established.

To configure a paragraph to be available in the **Paragraph** ¶ dropdown menu in the **Study Information** dialog:

1. In Natus Database, select **Tools > Options > Report Templates** (tab).
2. Under Common Paragraph Templates, select **Show in Menu**.
3. Specify the **Custom Field** that may show the specified paragraph in the dropdown menu using the dropdown options in **Custom Field** (only **Formatted Text** fields are listed).



Paragraph Dropdown Menu in Study Information Dialog



Report Templates Tab in Options Dialog

19.9 Customizing Patient/Study Information Dialogs Using the HTML Forms Generator

The HTML forms generator allows site administrators to customize the patient and study information dialogs. Fields can be added removed and put in a specific order as deemed necessary by the site.

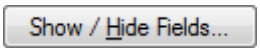
Custom fields can be utilized for the implementation of pre and post questionnaires – one tab for each – or for standard questionnaires such as the Stanford Sleepiness scale.

HTML forms can be used to pre-fill content during study review. This content can then be drawn into the reports during report generation.

Accessing the HTML Forms Generator

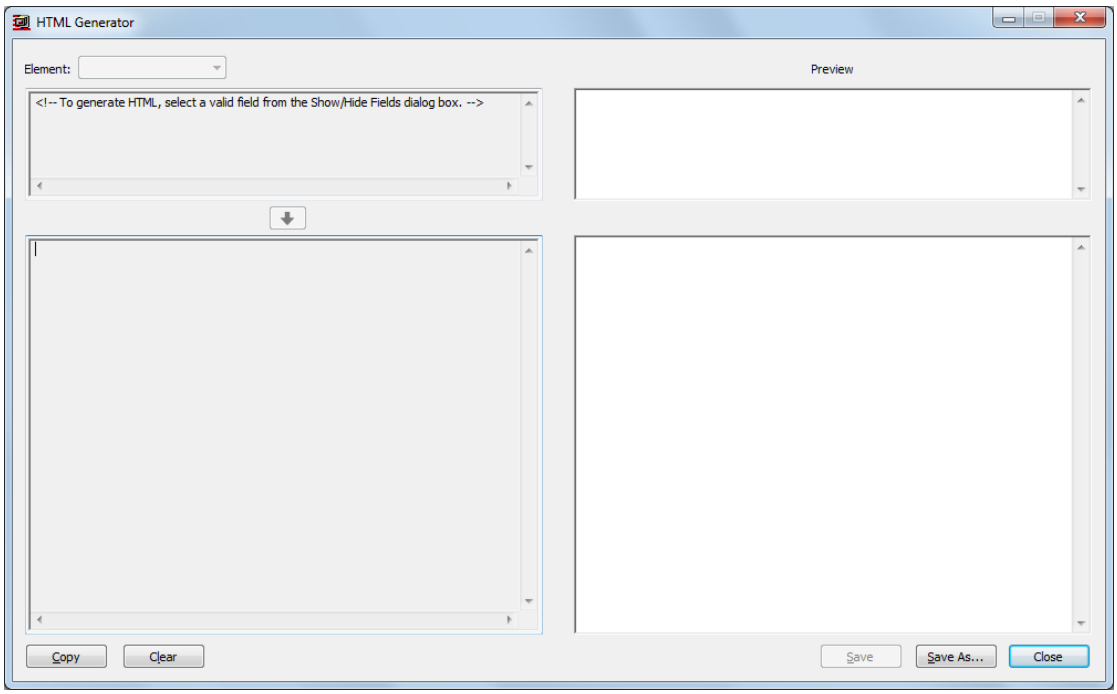
The HTML forms generator can be accessed through the **Show/Hide Fields Dialog** box.

To access the HTML forms Generator

1. In the Natus Database, choose **Tools > Options > Options** (tab).
2. Click the **Show/Hide Fields…** 

button.
3. The **Show/Hide Fields** dialog box opens.
4. Select **Generate HTML…** 

button.
5. The **HTML Generator** dialog box opens.



HTML Generator Dialog

Adding a Field

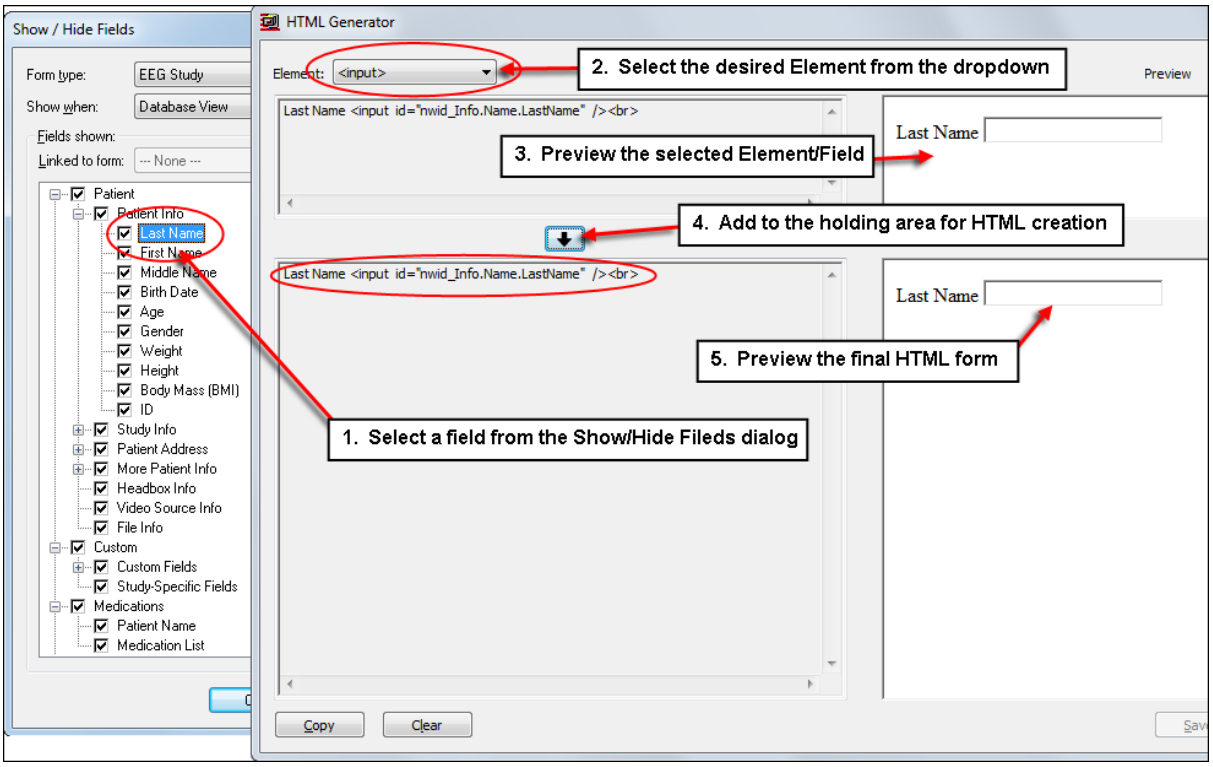
Clicking on any field in the **Show/Hide Fields** dialog will generate HTML code for that field in the top left edit box of the HTML Generator. It can then be added to the new HTML dialog that is being created.

To add a field into the HTML Generator

1. Select an element from the **Show/Hide Fields** dialog.
2. Choose an **HTML Element** from the dropdown box.
3. Click on the  button to add the element to the holding area.
4. Repeat Steps 1-3 until all elements have been added to the new form.

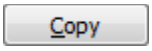
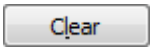
NOTE: Each field can only be added once unless the edit box is cleared.

The two edit boxes on the right side of the dialog show previews for the currently selected field and all added fields, respectively.

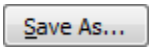


HTML Generator Dialog Showing Field Added

Copy and Clear the HTML Code

- The Copy  button will copy all the HTML code in the holding area to the clipboard for pasting into another document.
- The Clear  button removes all the current fields from the holding area.

Saving to HTML

1. All currently added fields can be saved to HTML by clicking the **Save As...** 

button.
2. A prompt asking for the save location and file name will appear.
3. If changes are made to the HTML code after the HTML file has already been saved, the **Save** 

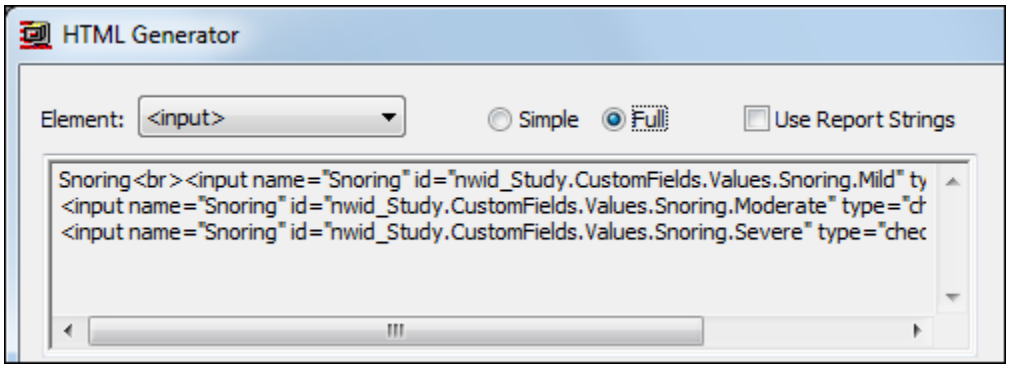
button is enabled. Clicking this button will automatically save to HTML, without any additional prompts.

Additional Options for Single/Multiple Choice List Fields

Full Format vs Simple Format

When the selected field contains a multiple or single selection list, the option to use HTML in either **Full** or **Simple** format. Select the appropriate radio button to switch between these two formats.

With the **Full** format, all options in a given multiple or single selection list field are included in the HTML code. Conversely, the **Simple** format does not require a field to include all options in the HTML code. Options for the **Simple** format HTML fields are populated automatically by the Natus Database once a custom form is loaded.



HTML Generator – Showing Full format in a multi-selection list

Show Report Strings

For single or multiple selection lists, there is also the option to show their report strings rather than the names of the options. Select or deselect the **Use Report Strings** checkbox to enable or disable this option as desired.

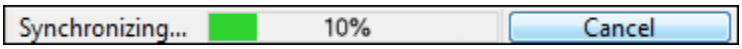
19.10 Synchronizing with Storage Resources

Automatic Synchronization

In order to display the most up-to-date information about the state of studies on remote systems, the database view will periodically synchronize with other machines that are participating in the distributed database.

Note the following about the synchronization function:

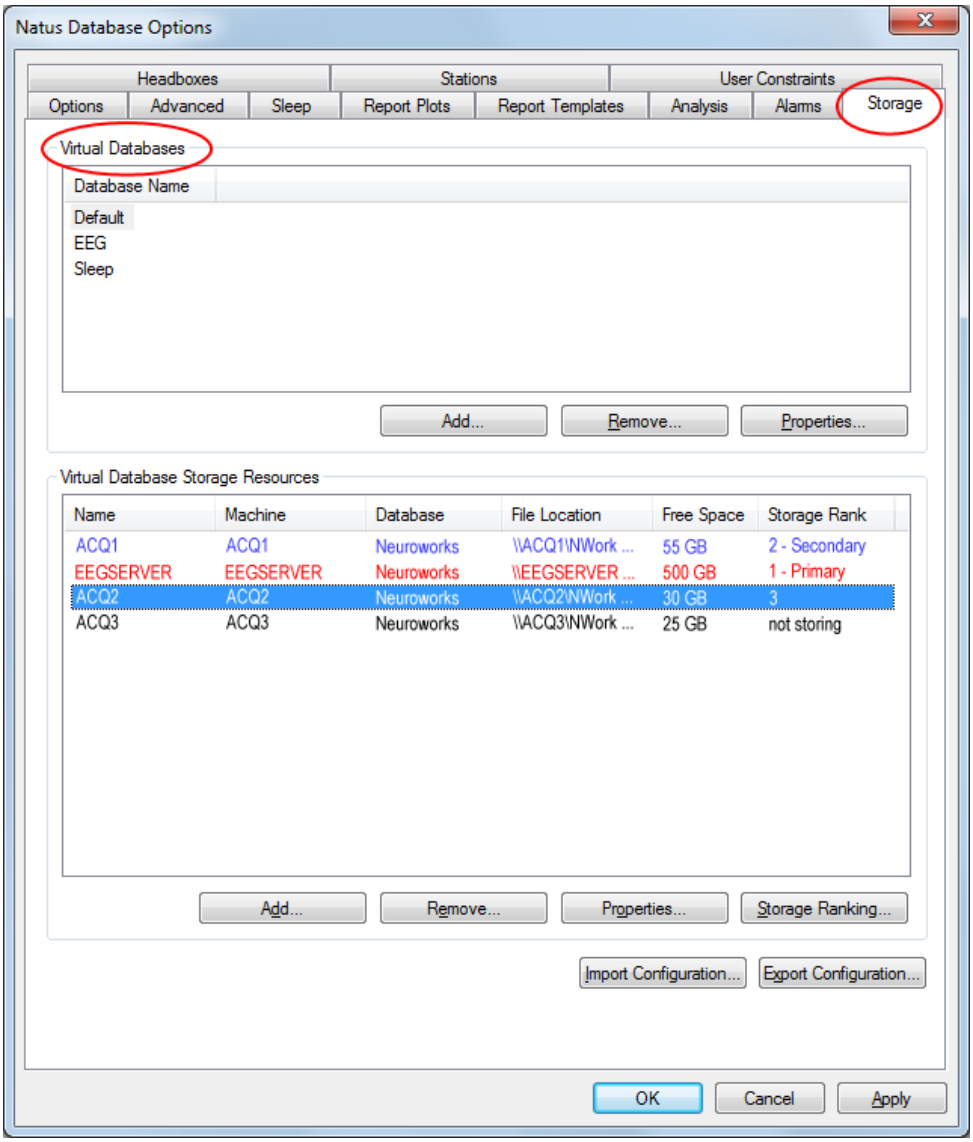
- Synchronization takes place automatically every 10 minutes.
- During synchronization progress percentage is displayed in the status bar.



- To manually initiate synchronization, click the **Sync** button on the **Status bar** or the **Refresh** button on the toolbar.
- To cancel the ongoing synchronization, click the **Cancel** button on the **Status bar**.

Synchronizing Features Overview

Storage resources are managed through the Storage tab. In Natus Database, click **Tools > Options > Storage** (tab).



Storage

Note the following synchronizing features:

- The **Resources** list view (at the bottom of the **Storage** tab) displays the resources that are part of the currently selected database (in the top list).
- The primary storage location is marked in red. The secondary storage location is marked in blue.
- Storage rank is displayed for all resources. The storage rank shows the settings for the machine you are using.
- When you create a new virtual database, the system automatically creates a local storage resource corresponding to it. This local resource cannot be deleted from the list of resources. It is only removed when the database itself is removed.
- The virtual databases list is sorted alphabetically by database name.
- The user can export the storage resource and virtual database configuration to a file and import it from a file.

NOTE: A local path will be transformed into a **UNC** path [Uniform Naming Convention path] and back again during this process.

- The free space displayed in the Storage dialog box and in other dialog boxes includes a safety margin (10% up to maximum of 300 MB).

Synchronizing with a Non-Removable Resource

In order to synchronize the database of a given machine with that of another machine (or machines), you must add the other machine as a resource. A storage resource can be configured as:

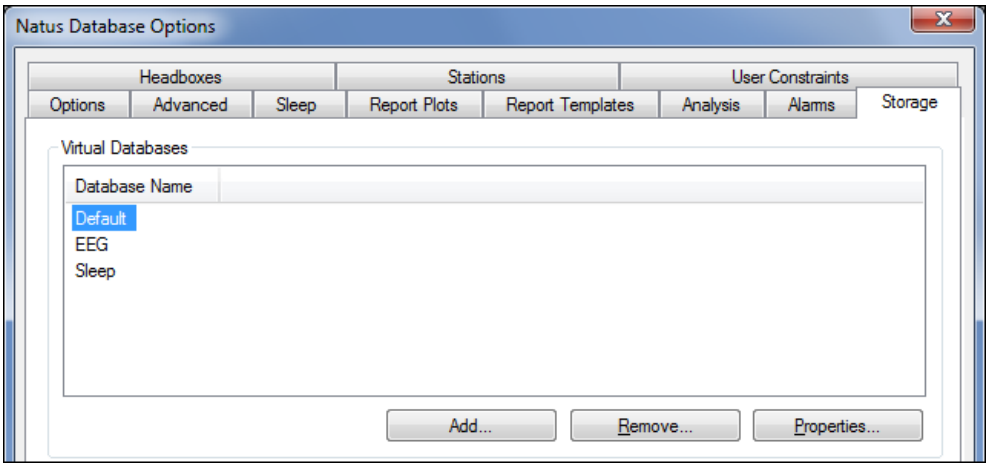
- Not Recording (for example, a review station)
- Recording
- Removable

For the first two options, adding a resource is as simple as pointing the **Import DSN File** function to a directory containing a database on a different station or on the server.

Adding a Not Recording or Recording Resource

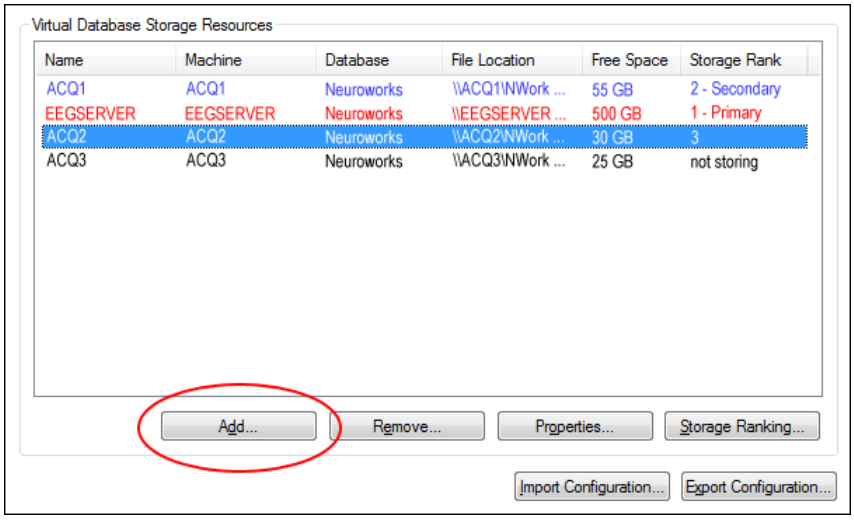
To add the resource:

1. In Natus Database, choose **Tools > Options > Storage** (tab).
2. In the **Virtual Databases** pane, select the database you want to add the resource to.



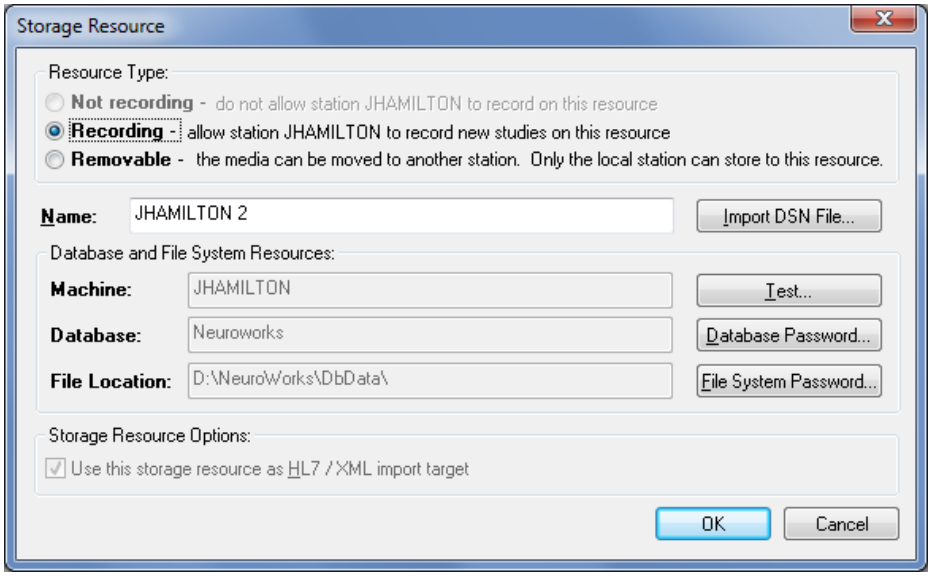
Virtual Databases Pane

3. Click the **Add** button below the lower, Storage Resources, pane.



Storage Resources Pane

4. The **Storage Resource** dialog box opens.



5. Click the **Import DSN File…**  button, and browse to the DSN file (typically Neuroworks.dsn) on the resource you want to add, then click **OK**.
6. Click **OK** again to apply your choice and close the **Natus Database Options** dialog.

NOTE: For synchronization to be two way between two machines, you need to add respective resources to each of the machine's configurations. For example, for machines A and B you need to add \\B\\Neuroworks\Neuroworks.dsn to A's configuration and \\A\\Neuroworks\Neuroworks.dsn to B's configuration.

NOTE: After adding several resources, initial synchronization may take a considerable time because a large amount of data needs to be imported into the local database.

Support for Removable Drives

Scenario # 1

1. The user begins with the acquisition and review stations having their regular **d:\Neuroworks** local databases and default storage resources.
2. The user attaches a removable drive to the acquisition station and goes to **Resource Configuration** (**Tools > Options > Storage** (tab)).
3. The user creates a new storage resource of the type removable. The local database is created that corresponds to the drive.
4. If the user brings this drive to another station and repeats number 3 above, the system detects that it already has a DSN file and deduces the name for the local database from there.
5. If the user brings another drive to this station and repeats number 3 above, then another local database is created.

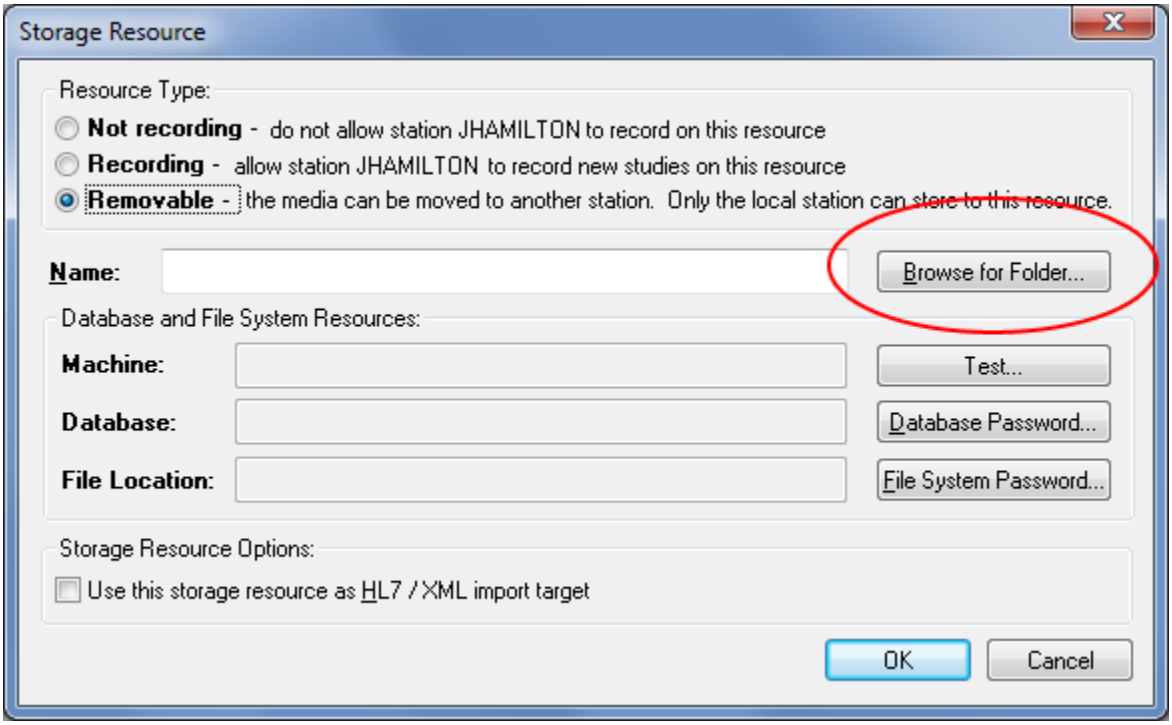
In order to allow for drive letter changes, the system scans the removable drives attached to it and modifies **Storage Resource** configuration to correspond to the current drive letter assignment. The scan begins whenever Natus Database starts, or every time the user clicks the **Refresh** button. If a removable drive resource is discovered during a refresh, the system performs an import to synchronize local database with files on the drive.

Scenario # 2

1. The user configures the storage ranking for the new resource as either **Primary** (if the user wants to acquire there) or **Secondary** (if the user normally acquires locally).
2. The user acquires straight to the removable drive or, alternatively, acquires locally. The user then uses the Move functionality (**Administration > Move Study Files)** to move the studies to the removable drive.
3. The user brings the disk to the review station and executes an **Import > From Files** by pointing to the **e:\ drive**. The files are copied to the appropriate storage.
4. The user brings the disk back to the acquisition station and uses the Purge functionality to clear it.

Synchronizing with a Removable Resource

Choose this option to synchronize with a removable drive. When you select this option, the **Import DSN** button changes to a **Browse for Folder** button.



Storage Resource Dialog Box – Removable Option Selected

After clicking the **Browse for Folder** button:

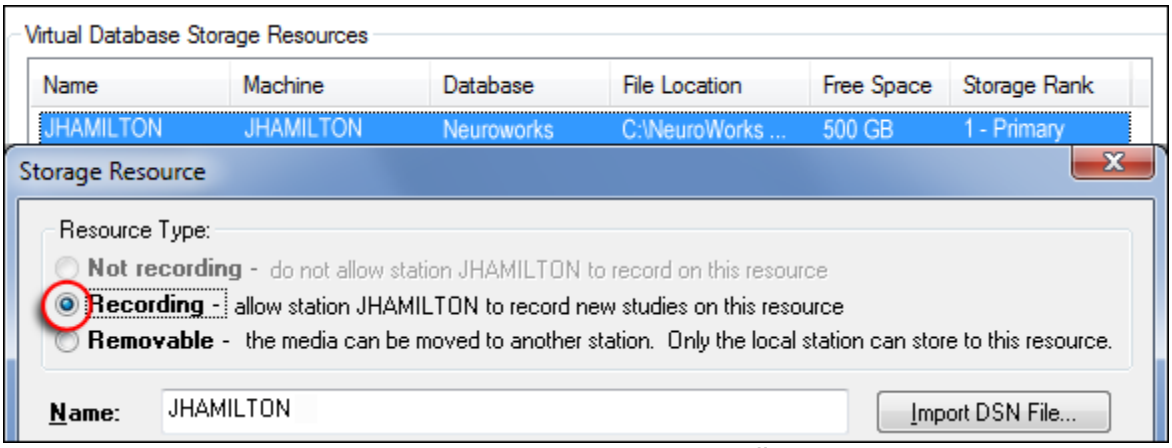
1. Select a removable drive root (for example, e:\).
2. If the folder does not contain a DSN file, a system prompt asks:
4. Are you sure you want to prepare e:\ for removable workflow?
5. If the folder does contain a DSN file, the system prompt says:
6. ‘e:\ is already prepared for removable workflow. The system will create database &rdquo"NWRemovableDDMMYYYYHHMMSS” on this machine. OK?
3. If the answer is **Yes**, the system creates a new database called NWRemovableDDMMYYYYHHMMSS. (NOTE: DDMMYYYYHHMMSS = day/month/year/hour/minute/second.)
4. A corresponding DSN file (named **Removable.dsn**) is placed in e:\. This DSN file contains (local) in the server name.
5. DBData and Deleter folders are created on e:\.
6. The Deleter configuration is updated to include **e:\Deleter**.
7. If you have not yet typed a name in the **Name** box, the name **Removable** drive is added.
8. If you click **Cancel**, the database and the DSN are removed.
9. If you click **OK**, a new resource is added to the configuration.

Recording Storage Resources on Review Stations

Natus Database allows you to set the storage resource type to **Recording** on Review and Monitoring stations.

To set the storage resource type to recording:

1. Choose **Tools > Options > Storage** (tab).
2. In the lower pane (Virtual Database Storage Resources), select the storage resource and click the button.
3. In the Resource Type section, click Recording.



Resource Type Set to Recording

Setting the storage resource type to Recording on review / monitoring stations has advantages:

- Facilitates the importing of studies (for example, ambulatory studies) directly to the server from the review / monitoring station. If the server resource is set as Recording, and it is your primary resource from ranking point of view, then the ambulatory study will be uploaded directly, bypassing the review station's local storage altogether.
- Allows the monitoring of free space left on the storage media from a remote monitoring station.

19.11 Working with Databases

About Virtual Databases

In addition to a Primary and a Secondary database, NeuroWorks allows you to create as many virtual databases as you like.

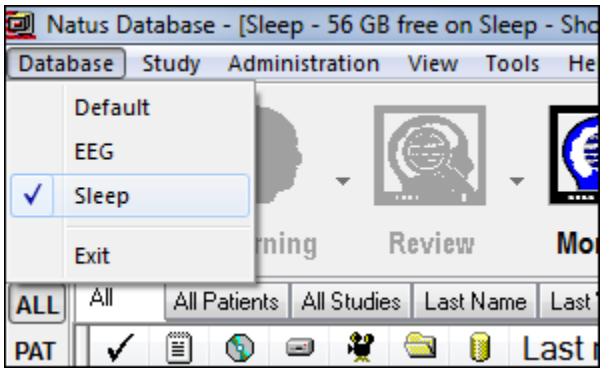
Primarily, virtual databases are used to distinguish between different sets of studies. For example, you could create Adult / Pediatric databases or 2010 / 2012 / 2013 databases.

You can manually change the database by selecting another virtual database from the **Databases** menu. A check mark indicates the current selection. When you switch to another virtual database, a refresh is performed and synchronization is started (if it has not been

performed in the last 10 minutes). Switching of databases is not allowed when acquiring, monitoring or reviewing a session.

The name of the selected database appears on the Natus Database **Title bar** along with the amount of available storage. Studies stored in the database appear in the studies pane below.

In the following image, the Sleep database has been selected from the Database menu. Therefore, the title bar says Natus Database - [Sleep : 56 GB free on Sleep].



Sleep Database Shown as Active Database

Virtual databases can be added or removed using the functionality on the **Storage** tab of the **Natus Database Options** dialog box. To access the Storage tab, choose **Tools > Options > Storage** (tab).

Large Site Workflow

Natus Database has various features designed to accommodate large EEG and Sleep sites that use servers and which may also have a need for multiple databases (for example, Adult and Pediatric). Migration of such sites to the distributed database mode is supported. Detailed below are a number of possible site setups.

No Server

The acquisition machines store data locally. There is one virtual database which includes all the acquisitions.

Simple Server

There is one server to which acquisition machines store data when the server is available. When the server is not available, the machines store the data locally. There is one virtual database which includes the server and all the acquisition stations.

Multi Server

There are multiple servers, or multiple drives or partitions on a single server, in order to satisfy the site capacity. This is the most common situation when upgrading a relatively small site and adding a number of beds. Acquisitions are configured to store to the first or the second server. There is one virtual database which includes both servers, or partitions or drives, and all the acquisitions.

Multi-Site

A single server is used to support two distinct (from the user's point of view) databases (for example, Adult and Pediatric). Some acquisitions store into Adult and some into Pediatric. Portable machines store locally but still distinguish between whether they store for Adult or Pediatric (so that when they come back to the network, their data is visible in the proper database).

There are two databases and file locations on the server and on the acquisition stations – one for Adult data and one for Pediatric data. The virtual database for Adult includes the server Adult database and the acquisition Adult database. The virtual database for Pediatric includes the server Pediatric database and the acquisition Pediatric database.

NOTE: A Multi-Site setup can be combined with a Multi-Server setup (that is, 4 servers: 2 used for Pediatric and 2 for Adult).

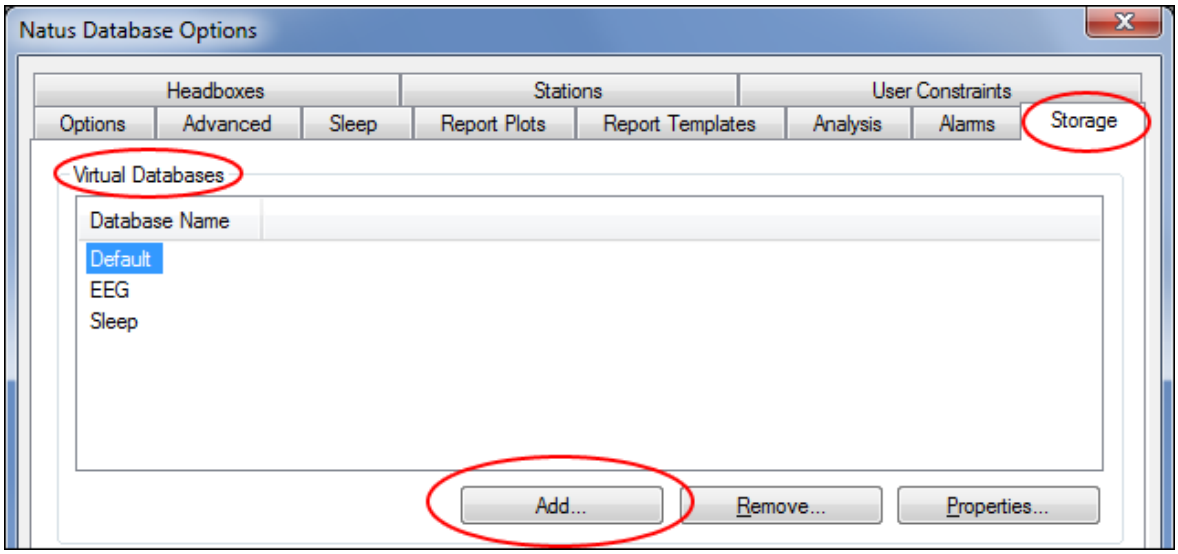
Removable Storage

A removable drive can reside in more than one system. It is used to carry the data acquired on one system to another system. The user stores data directly on the removable drive, or moves the data to it from the local drive. The data is then transferred from the removable drive for permanent storage, and the drive itself is cleared. A single drive may be used in many acquisition systems, and a system may use many drives.

Adding or Removing a Virtual Database

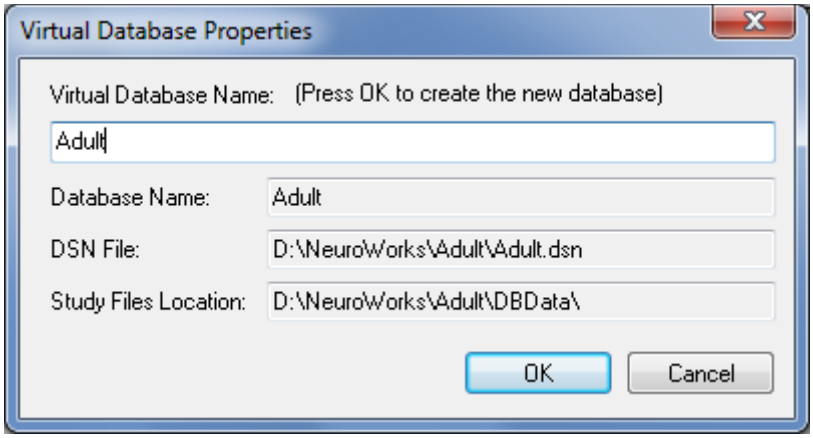
To add a virtual database:

1. In Natus Database, choose **Tools > Options > Storage** tab.
2. Click the **Add** button below the **Virtual Databases** (top) pane to open the **Virtual Database Properties** box.



Virtual Databases Pane

3. Type a name for the database in the **Virtual Database Name** text box. This is the name that will appear in the Database menu. It also becomes the name of the virtual database DSN file and the name of the folder inside the NeuroWorks folder that contains the DBData folder (with all study files).



Virtual Database Properties Box

4. Click **OK** to create the new database.
5. An **Operation Progress** box appears that indicates the progress synchronizing local and remote databases.
6. Once the Operation Progress box closes, the name of the new virtual database is added to the Database menu.

Removing a Virtual Database

1. In Natus Database, choose **Tools > Options > Storage** (tab).
2. Select the virtual database that you want to delete in the **Virtual Databases** pane.
3. Click the **Remove** button.
4. A warning appears prompting you to confirm deletion. Click **Yes** to permanently delete the virtual database.

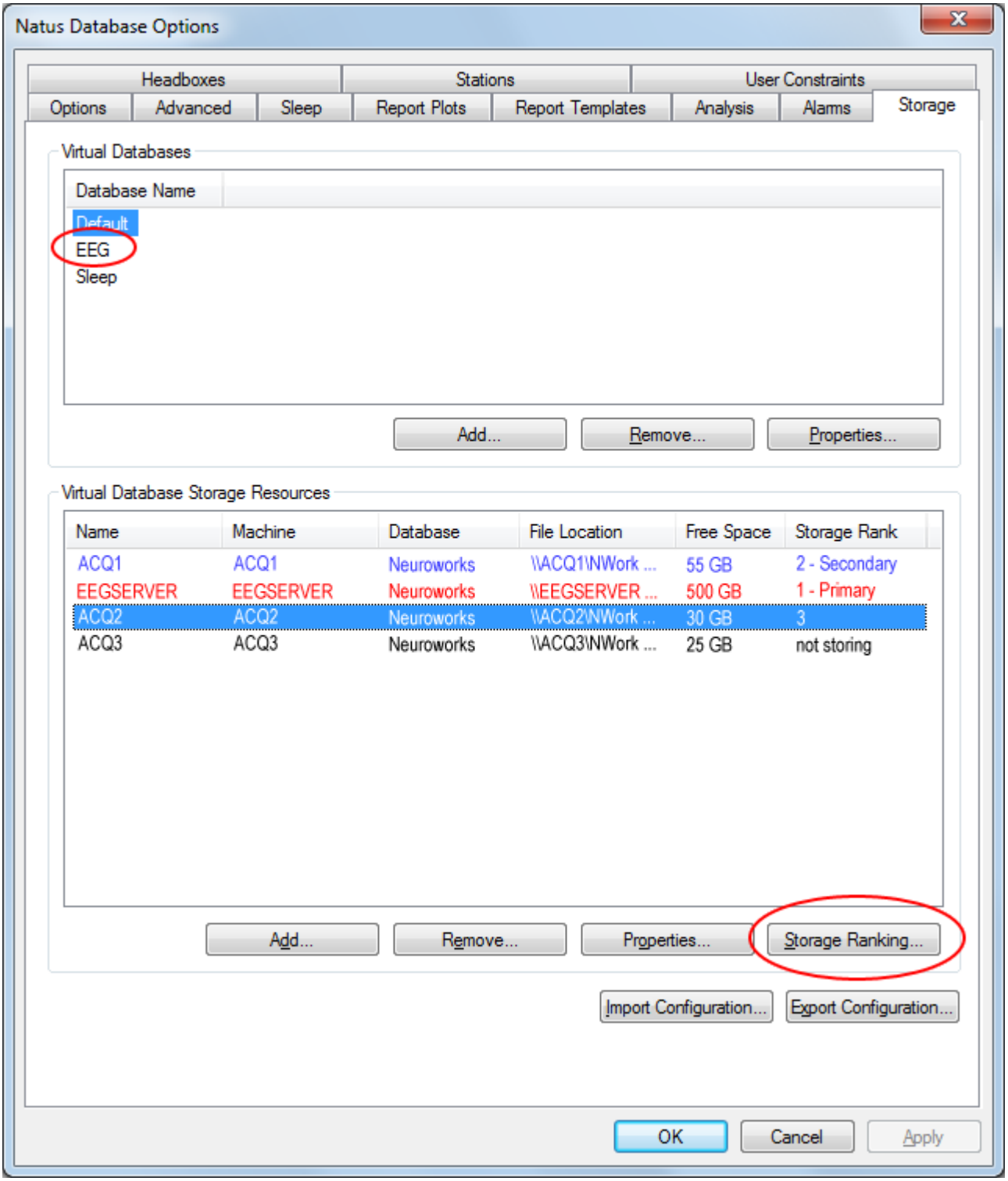
Database Storage Ranking

Virtual databases are ordered by ranking and may be customized by the user.

When a higher-ranking resource runs out of space, the program switches to the next-lower-ranking resource. When space becomes available again, the setting of an option in the **Storage Ranking** dialog box determines whether the program automatically switches back to the higher-ranking resource or not.

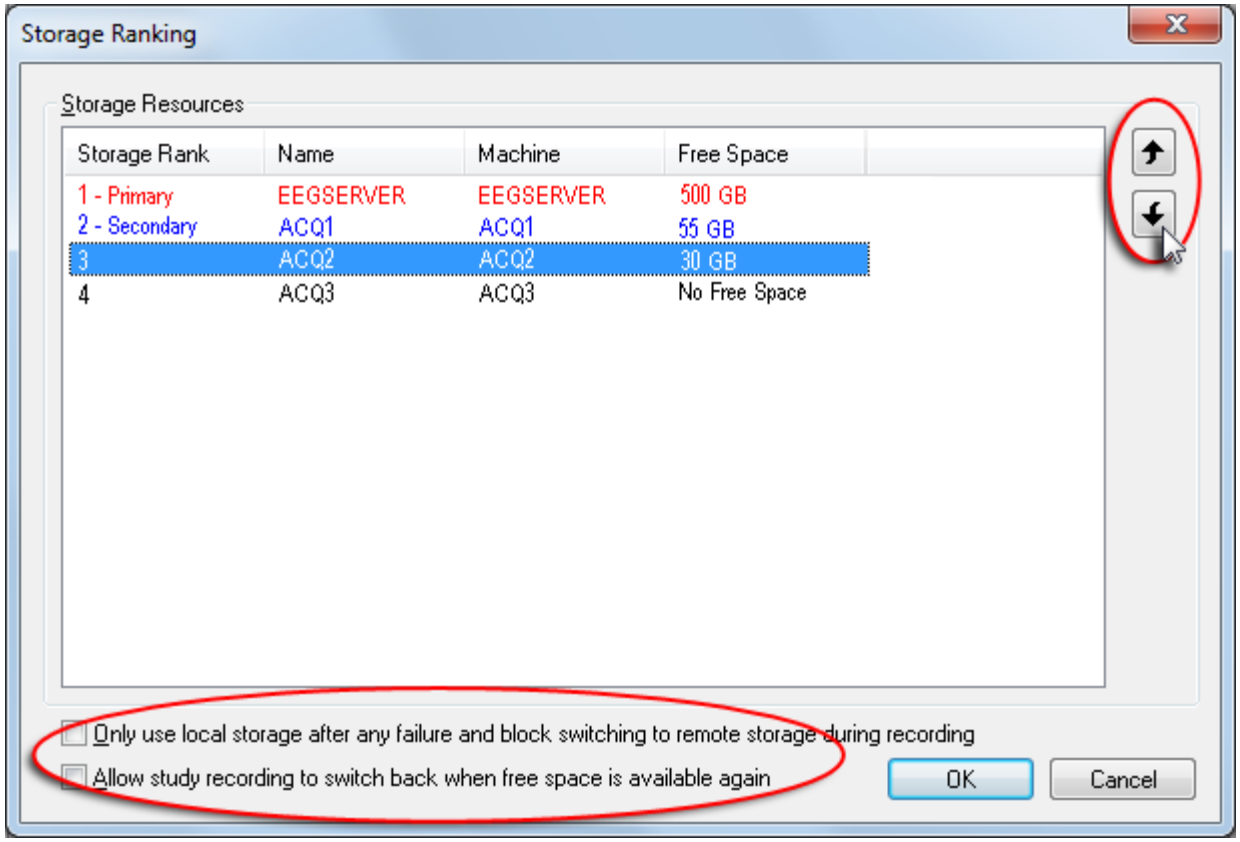
To set database ranking:

1. Choose **Tools > Options > Storage** (tab).
2. In the Natus Database Options box, select a virtual database in the (upper) **Virtual Databases** pane.
3. Available storage resources and their rankings appear in the (lower) **Virtual Database Storage Resources** pane.



Natus Database Options Dialog Box

4. Click the **Storage Ranking** button at the bottom right of the dialog box to open the **Storage Ranking** box.



Storage Ranking Dialog Box

5. Select a storage resource and then click either the up or down arrow to alter its order of ranking.
6. Select or clear the automatically switch back option at the bottom of the dialog box depending on whether you want recording to return to the primary resource if it defaults to secondary resource because of a lack of free space or a connection problem.
7. Select or clear the local storage option at the bottom of the dialog box, depending on whether you want to use the local storage after a failure of remote storage while recording.
8. Click **OK**.

Switching of Storage Resources

Automatically on Startup

On startup, Natus Database opens with the most recently used database and its primary storage resource. If its primary storage resource is unreachable, its secondary storage resource is used. The name of the secondary storage resource and the amount of space available on it appear in the Natus Database title bar. Studies stored on the unavailable resource are crossed out in the **Is Available** database column.

The primary storage resource remains primary, but it is defined as unreachable. This means that although the secondary storage resource is currently displayed, upon restarting, Natus Database will default to the primary storage resource (presuming it has become available).

NOTE: If the primary database is still unreachable, the secondary database is used; however, the database defined as primary remains unchanged.

Automatically During Autorecovery

When a current storage resource becomes full or unavailable, the system restarts. The study restart is accomplished without restarting the machine (provided Storage/VServer and other services do not crash as a result of a sudden storage unavailability).

Multiple storage resources are considered as targets for the study acquisition. The order in which they are considered is determined by their storage ranking (which can be customized by the user. The first available resource with enough free space (10% up to 300 MB safety margin) is chosen.

Manually

You can manually change the database by selecting another virtual database from the Databases menu. Then, the storage rankings set for that particular database apply. A check mark indicates the current selection. When you switch to another virtual database, a refresh is performed and synchronization is started (if it hasn't been performed in the last 10 minutes).

Switching of databases is not allowed when acquiring, monitoring or reviewing a session.

You can manually reconfigure the storage resource rankings for a virtual database by using the options on the Storage tab (**Tools > Options > Storage** (tab)).

Switching to Local Storage Recording after any Failure

In a location in a hospital or clinic where the local network is unreliable, it is recommended to restrict recording to only local storage resources. For convenience, the system may be configured to only consider storage on local drives of the acquisition station after a failure.

To do this:

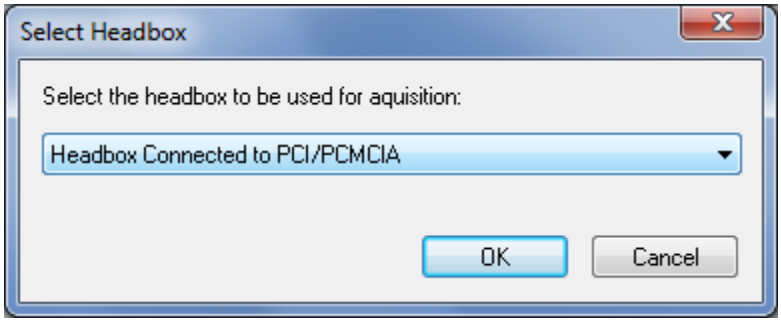
1. In Natus Database, select **Tools > Options > Storage** (tab).
2. Press **Storage Ranking**…button to open the Storage Ranking dialog.
3. Check the option "Only use local storage after any failure and block switching to remote storage during recording".

This option may still coexist with recording directly to a remote server. However, should any recording failure occur, the system will restart recording to local storage and will not revert to recording to the server until the study is manually stopped and restarted.

19.12 IP Headbox Configuration

Headbox Selection

When starting a new study, you can select a headbox in the **Study Information** dialog box under **Change Headbox**. The **Change Headbox** button is enabled only when starting a new study.

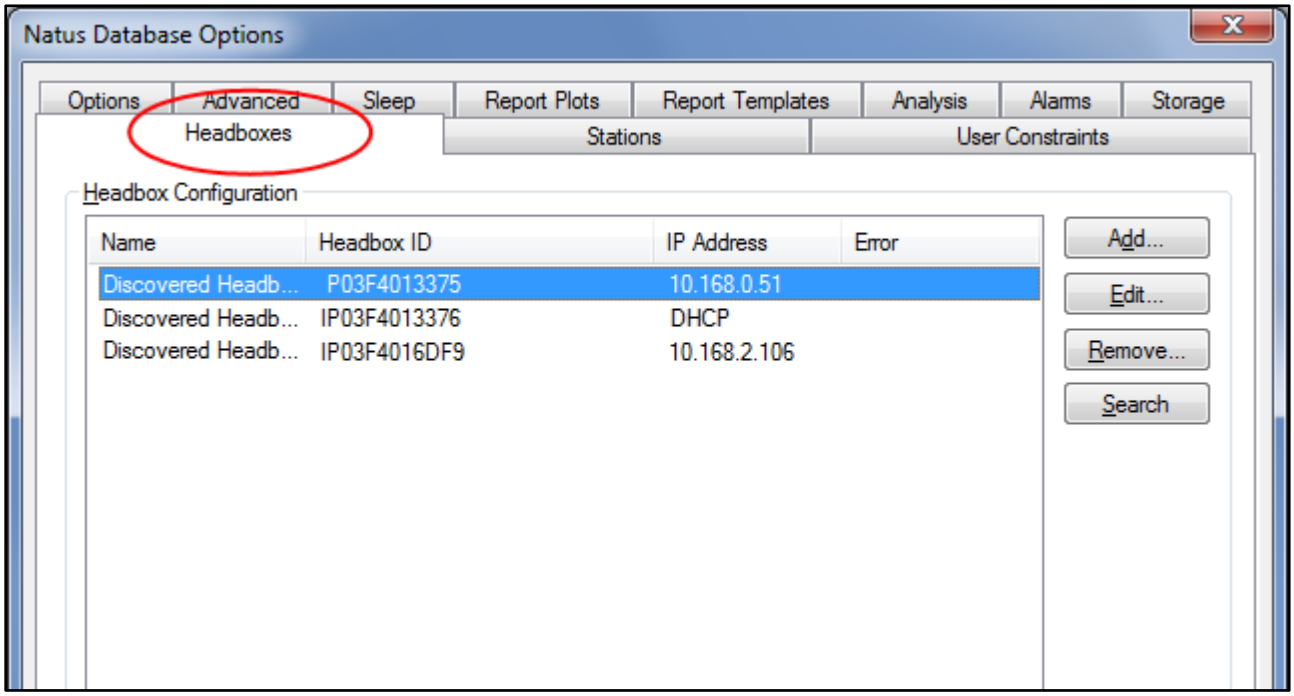


Select Headbox Box on Study Information Dialog

The dropdown list allows you to select the headbox connected to PCI, the headbox connected to USB, or a headbox that has previously been configured. The *friendly names* of all configured headboxes in the database are displayed.

IP Headbox Configuration

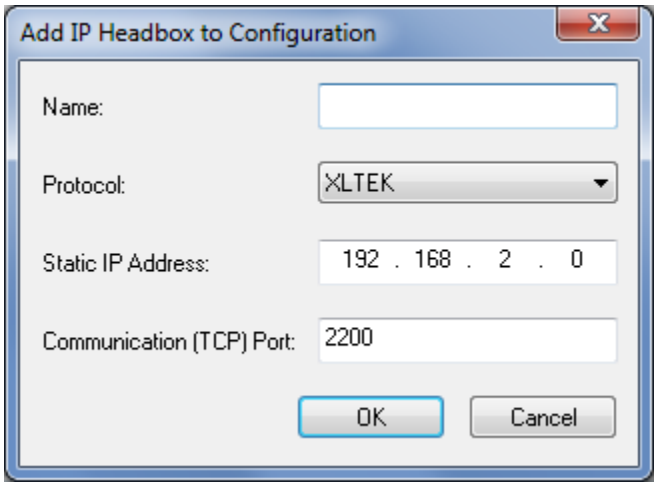
IP Headboxes can be configured by selecting **Tools > Options > Headboxes** (tab) in Natus Database.



IP Headboxes Configuration Box

Note the following:

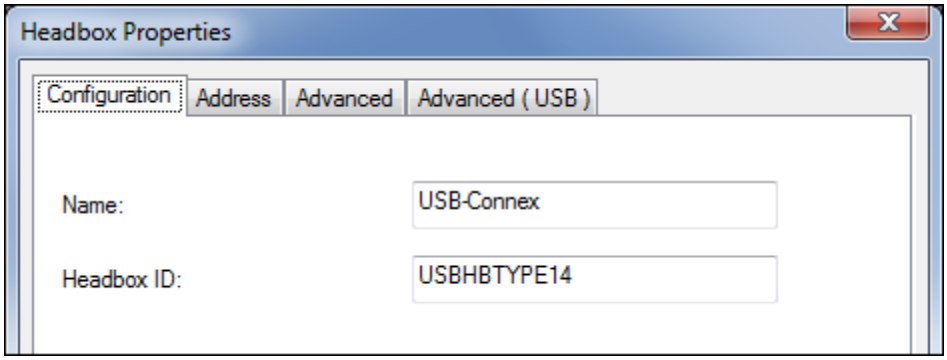
- Before the dialog box appears, the database is synchronized. Database synchronization is then disabled until you close the dialog box. When the dialog box first appears it is filled with the data in the database. When you select the Search button any discovered headboxes that are not already configured are added to the list.
- Discovered headboxes are named **Discovered Headbox nnn** where **nnn** is a unique number. The discovered headboxes are saved to the database.
- When there is a collision during database synchronization, or there is a conflict between a discovered headbox and a configured headbox, items are marked with an error code. These items are available for editing and configuration; however, they do not appear in the list of headboxes that can be used for acquisition. The **Error** column is only visible when there are errors to be reported.
- Selecting the **Add** button displays the **Add IP Headbox** dialog box.
- Selecting the **Edit** button displays the **Edit Headbox Configuration** dialog box.
- Selecting the **Remove** button asks you to confirm removal of a headbox from the configuration. After confirmation, the record for the headbox is removed from the database.



Add IP Headbox Dialog

Selecting the **Add** button from the **IP Headboxes Configuration** dialog box displays the **Add IP Headbox to Configuration** dialog box:

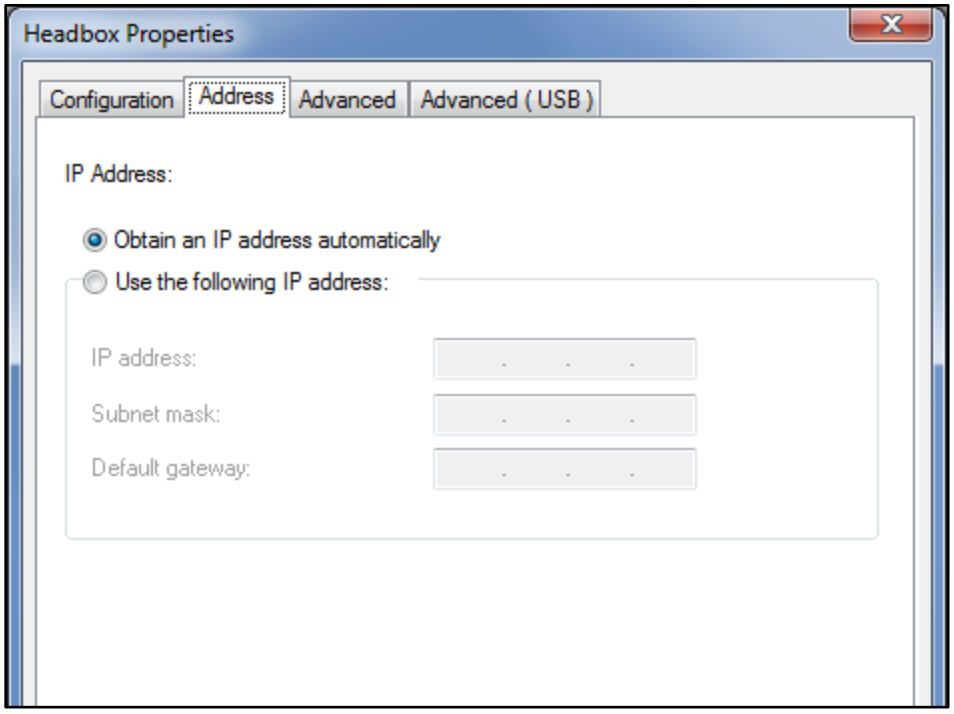
- When this box is shown, the **Static IP Address** is always filled with the factory-defined headbox IP address.
- Both the name and the IP address must be unique in the database.
- When you select **OK**, a new record is added to the database for the headbox.



Edit Headbox Properties Dialog

Selecting the **Edit** button from the IP Headboxes Configuration dialog box displays the **Edit Headbox Configuration** dialog box:

- The name must be unique in the database.
- When you select **OK**, the information for the headbox is updated in the database.
- When you select **Properties**, the **Headbox Properties** dialog box is displayed.

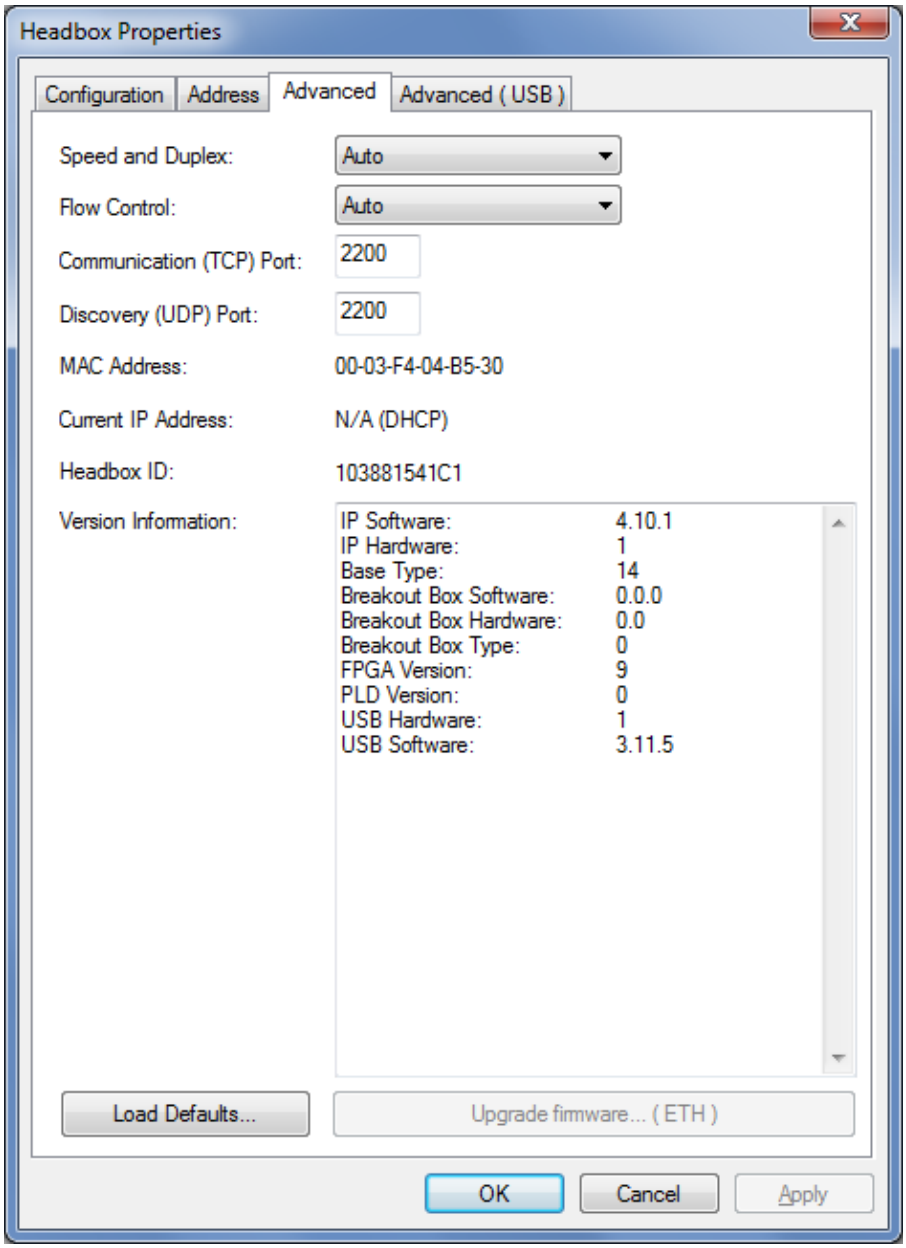


Headbox Properties Dialog – Address Tab Options

Selecting the **Properties** button from the **Edit Headbox Configuration** dialog box displays the **Headbox Properties** dialog box:

- When the box is first opened, an attempt is made to connect to the headbox. If the attempt fails, an appropriate error message is displayed (for example: *The headbox is in use*).

- When a connection with the headbox is established, the headbox is queried for the current values, and the edit boxes are filled with values from the headbox. The headbox is then disconnected until you select **OK** or **Apply**.
- If you change the information in this dialog box and select **OK** or **Apply**, the data in the database is updated. A connection is made with the headbox, and the properties are changed in the headbox. If there is a collision with an IP address in the database, you are notified and prompted for confirmation of the change. The record of the entry with the duplicate name is flagged in the database.
- When you select the **Advanced** tab, the **Advanced Properties** dialog box is displayed.



Headbox Properties Dialog – Advanced Tab Options

Selecting the **Advanced** tab from the **Headbox Properties** dialog box displays the **Advanced Headbox Properties** page.

- The headbox is queried for the current values, and the edit boxes are filled with the values from the headbox. The program remains disconnected from the headbox until the **OK** or **Apply** button is selected.
- Selecting **Defaults** will, after you enter confirmation, fill the edit boxes with the factory-defined defaults. The values will not be sent to the headbox until you select **OK** or **Apply**.
- The **Upgrade Firmware** button displays **Select Upgrade File** dialog to upgrade the firmware. This prompts you to for the location of the firmware file to be uploaded.

19.13 Study File Operations

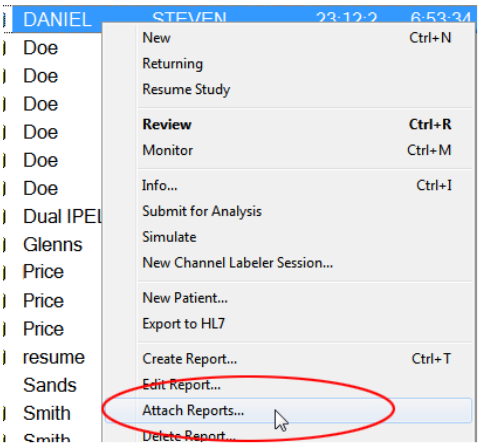
Attaching External Documents to a Study

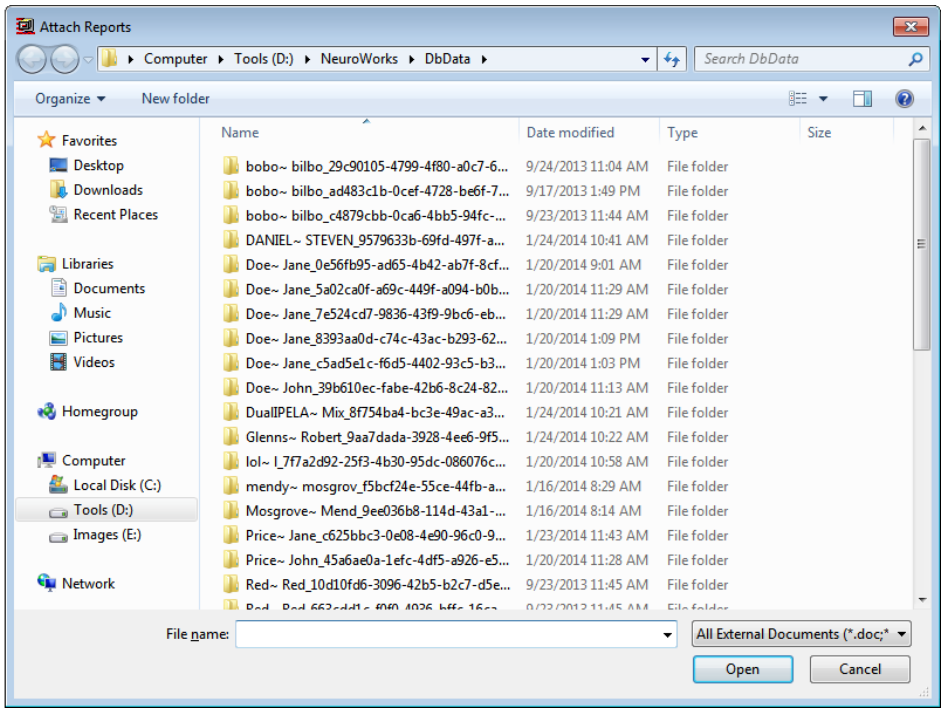
It is often useful to be able to attach external documents to patient records, such as reports from other sources. External documents that you can import into the NeuroWorks system and attach to studies include Word documents and scanned documents in TIFF or PDF format.

You can display these attached documents just as you would other NeuroWorks reports, using **Study > Edit Report**.

To attach a document to a record:

1. Right-click on the study record in the database window and select **Attach Reports.**
2. Browse to the location where your file is stored and select the file. Click **Open**.





3. Type in a ‘user friendly’ name for the file you are about to import and click **OK.**

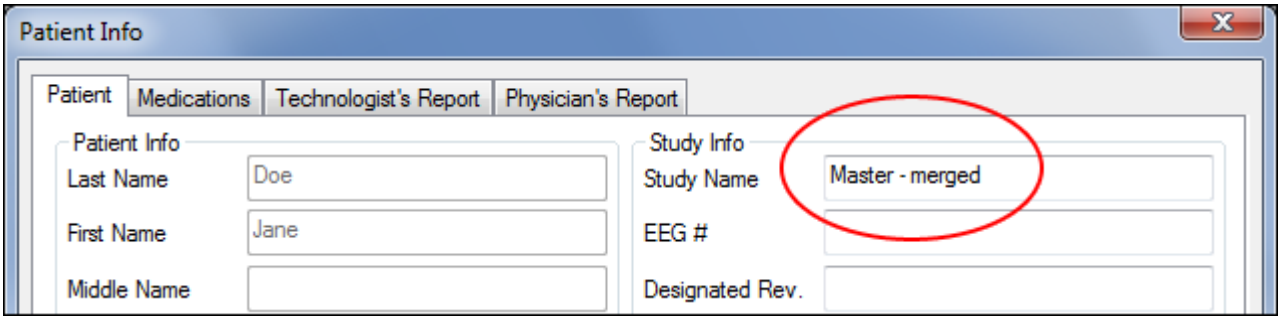
4. Wait for a confirmation message indicating that the file was successfully imported and click **OK**.

Merging Studies

In Natus Database, two or more studies can be merged as long as they satisfy the following criteria:

- Have actual recorded information (that is, they have a raw data icon in the database and duration greater than 0).
- Were recorded the same day on the same headbox and on the same patient (first and last name).
- Were recorded with the same sampling frequency.
- Are NOT read-only.
- Are either both EEG or both Sleep.
- Are not overlapping in time (in other words, are not already part of merged study).
- Were recorded with the same file schema. (For practical purposes, this means you cannot run a study, upgrade to a software version that introduced a file format change, then run a new study and expect those two studies to be mergeable.)
- Are stored on the same storage resource.

Study files which were constructed from two or more "fragmented" studies and later merged together are indicated or denoted in the **Study Info** or **Patient Info** dialog **Study Name** field with the text string "**Merged**".



Patient Info Dialog for Merged Study

The name of the merged file (in the **Study Name** column) is the name of the **first study** followed by "**merged**".

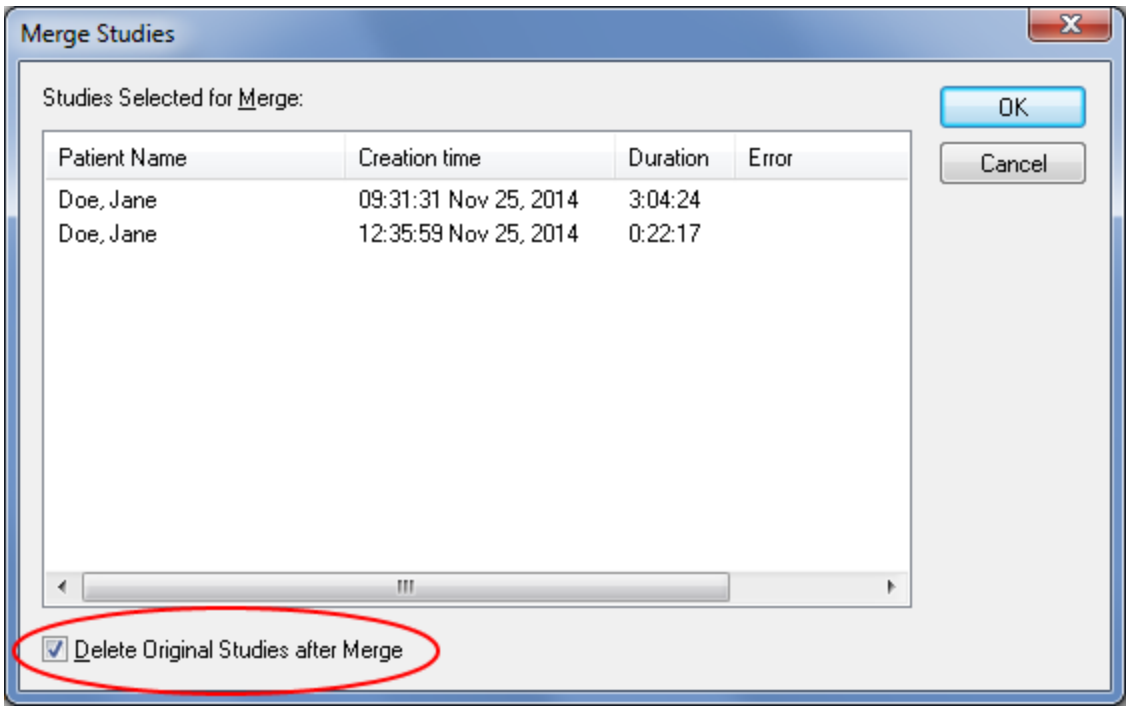
To merge the studies:

1. Press **CTRL + Click** or **SHIFT + Click** to select two or more studies.
2. Then choose **Administration > Merge Studies**.

   OR

   Click the **Merge** toolbar button.

3. The **Merge Studies** box appears. You may choose to delete the original studies after the merge.



Merge Studies Box

4. Select or clear the Delete option and click OK.

Remotely Starting Studies

NeuroWorks allows you to start and restart studies from review and monitoring stations.

To start and re-start studies from review and monitoring stations, use **New** and **Returning** toolbar buttons in Natus Database. You must enter the name of the acquisition station that will run the study and then proceed with the regular patient and study information form.

Remote control is available only from review and monitoring stations (not from another acquisition station).

19.14 Archiving Studies

Archiving Background

After a study and report are complete, a file needs to be archived (stored) as part of the patient's record. Studies may be stored on CD, DVD, server or external USB drive.

Archiving (and then purging) creates free space on your system's hard drive to allow new acquisitions.

WARNINGS:

- Archived studies are not automatically deleted from the hard drive. You must implement a regular program of purging archived studies.
- Do not delete files that have NOT been archived first.

Each patient record consists of a group of component files with the following extensions:

- ENT and EEG (contain notes and data from the recording)
- ERD, SNC, and ETC (contain the raw data [waveforms] and time references)
- VTC and MPG (video files)

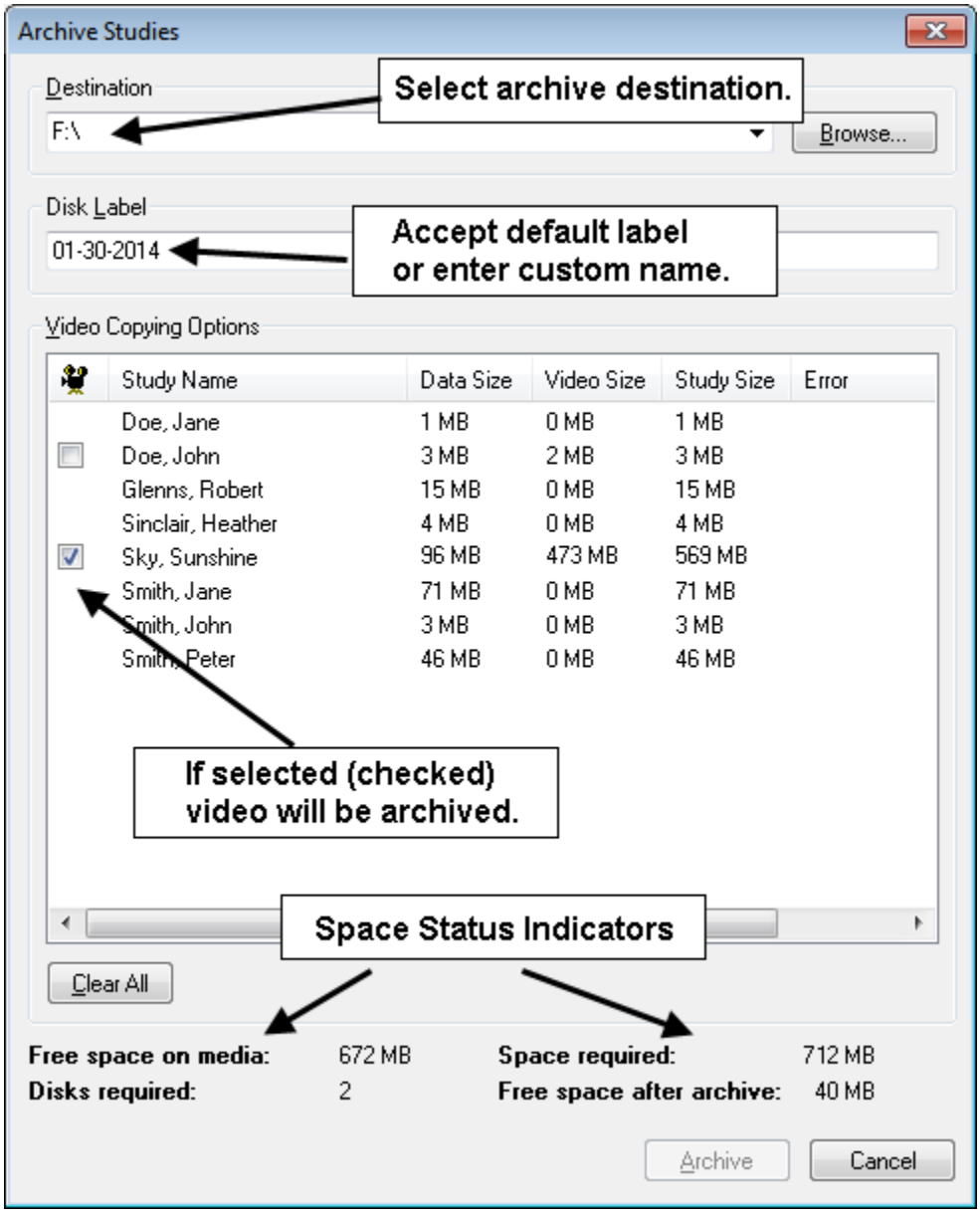
Since many studies are too large to fit on a CD, you should clip and prune studies before archiving. The procedure for pruning a study is different depending on whether the studies were recorded in SleepWorks or NeuroWorks EEG.

Please contact Natus Technical Support or visit the **NERVE Center** on the Natus Website for quick guides on this topic.

Archiving Process

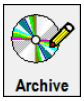
The **Archive** dialog box displays all studies selected in the study view. Studies not eligible for export are displayed in gray. The last column indicates the reason:

- Is ongoing
- Data access error
- No data files
- Unavailable
- In Use
- Unknown



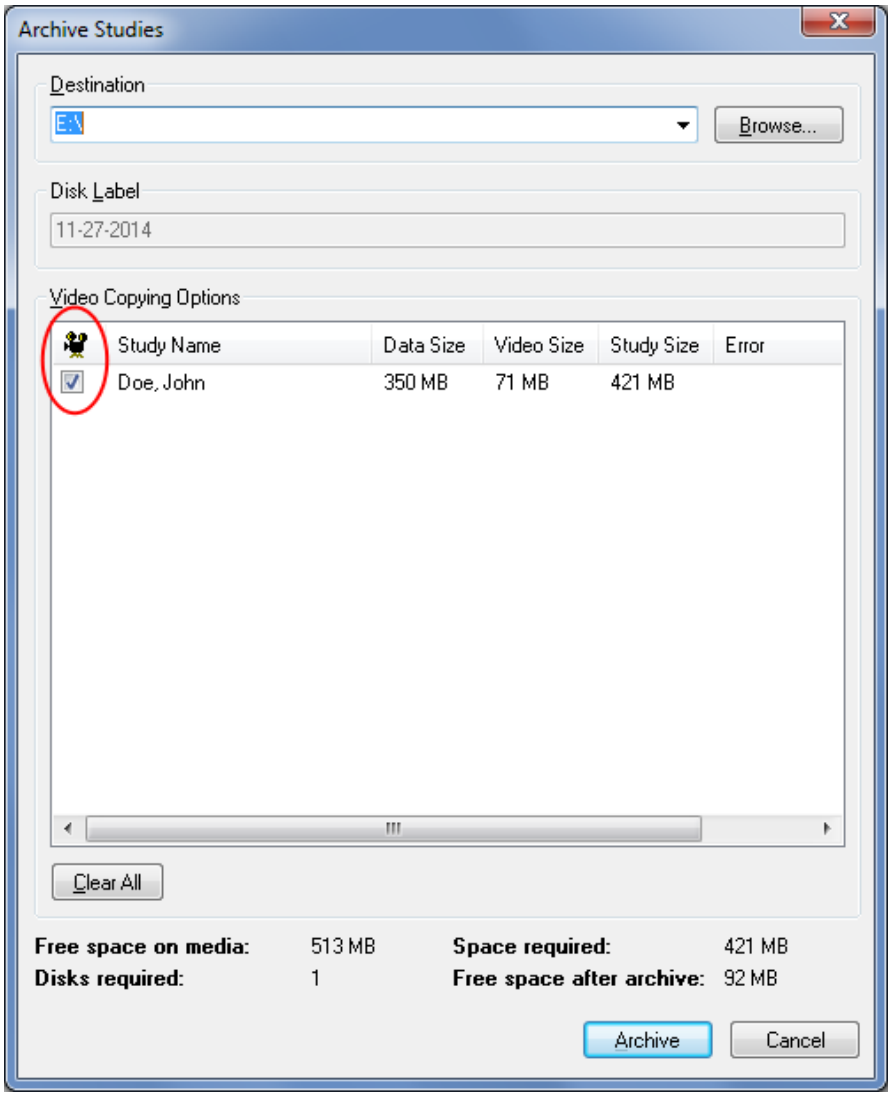
Archive Studies Dialog

To archive studies:

1. Connect the storage resource you will be archiving to (e.g. external USB drive, formatted CD).
2. In Natus Database, select and highlight the study or studies to be archived.
3. Press the **Archive** 

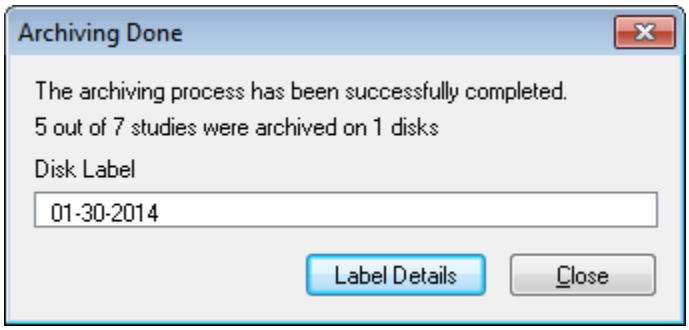
button on the main toolbar (or choose **Administration > Archive). Note:** If this is the first time a CD has been used, the **Archive CD Label** box appears. Type a CD label into the text box. To save the CD label and CD ID# in Natus Database, click **OK**.
4. The Archive Studies box opens.

5. Select the location to archive to and whether to include video in archiving. If a study contains video, a checked box appears beside the **Study Name** in the camera column.
   - To archive the video files for a study, leave the box checked.
   - To archive a study without including the video files, clear the check box. To archive all studies without video, click the **Clear All** button. All check marks will be removed.



Archive Studies Box

6. Check the information at the bottom of the **Archive Studies** box to make sure there is sufficient space on the disk to archive the studies you have chosen. (If there is not, click the **Cancel** button and either choose a storage location with more space or choose fewer studies.
7. You can also specify the label for the archive (current date by default).
8. When archiving is complete, the **Archiving Done** box opens. It lets you display CD labels in printable form using *MS Word*.



Archiving Done Box

9. If it is not already selected, select the label. Then press the **Label Details** button to open the MS Word document that can then be edited and printed.

natus neurology

CD Label: 01-30-2014
CD #: {99619730-D4EF-437B-BDC6-E6559567E755}

Patient Name	Study Date	EEG #
Smith, Peter	1/20/2014 8:04:00 AM	-
Doe, John	1/20/2014 11:07:40 AM	-
Doe, Jane	1/20/2014 11:29:33 AM	-
Glenns, Robert	1/20/2014 1:58:57 PM	-
Sinclair, Heather	1/24/2014 11:26:57 AM	-

Typical CD Label

10. You can archive several patient studies during the same session and keep the CD open to add more patients later. When you press the eject button to eject the disk from the CD drive, a box appears asking if you want to close the CD or keep it open.
    - Select Leave the disc as it is to leave the disc open so you can add more files later or create a disc label.
    - Select **Close** to read on any computer to close the CD so that it can be read automatically in most standard CD-ROM drives.

Archiving tips:

- Some studies are not eligible for archiving or export (for example, unavailable or ongoing studies) and will not be displayed in the Archiving or Export dialog boxes even if they were selected prior to pressing the Archive button or choosing **Administration > Export** from the menu commands.
- The status bar below the database list indicates how many megabytes of memory the selected file (s) takes up. Make sure this number does not exceed the space available on your CD. This is helpful when you are archiving to multiple CDs.
- You cannot eject a CD disc while you are reviewing a file on the disc. Close the record in the NeuroWorks program before pressing the Eject button.
- If files are too large, you can edit, or prune, files before you archive them. This discards the sections you do not need.

- To select multiple individual studies, hold down the CTRL key and click each study. To select a group of studies, click the first study, hold down SHIFT key, then click the last study.

NOTE: Reporting is only available if one study is selected.

Insufficient Disc Space Message

When there is insufficient storage space on a CD, an **Insufficient Disc Space** message is displayed.

If you see the **Insufficient Disc Space** message:

1. Remove the CD disc that is full from the CD drive.
2. Insert an empty, formatted CD disc.
3. Click **OK** to continue.

If a formatted disc is not available then, without clicking anything on the archiving screen, open the CD formatting program. Format a new disc. When formatting is complete, click the **Yes** button on the archiving screen.

Creating a CD Label

NOTE: Before you can create a CD label for a study, the study must be archived to a CD; otherwise, the **CDLabel** option in the **Administration** menu will be dimmed.

When you create a CD label, both your Natus NeuroWorks program and *Microsoft Word* are used to create two types of CD labels:

- An electronic CD Label that is used by the program to identify the CD.
- A paper label for the CD case that includes a catalog of the records on the CD. After you use Microsoft Word to create and print the CD labels, you can cut the labels out for the CD case.

natus neurology

CD Label: 01-30-2014
CD #: {99619730-D4EF-437B-BDC6-E6559567E755}

Patient Name	Study Date	EEG #
Smith, Peter	1/20/2014 8:04:00 AM	-
Doe, John	1/20/2014 11:07:40 AM	-
Doe, Jane	1/20/2014 11:29:33 AM	-
Glenns, Robert	1/20/2014 1:58:57 PM	-
Sinclair, Heather	1/24/2014 11:26:57 AM	-

Sample NeuroWorks EEG Disc Case Label

This topic does not refer to the **CD Volume Label**, an electronic label assigned to the new CD when you first format it with the **Direct CD Wizard** (Windows XP only).

In order to use this feature, the CD must be open. This means that when you previously ejected the CD, after archiving the files, you selected the option Leave the disc as it is. If you selected organize the disc so that it can be read in most standard CD-ROM drives, now when you attempt to create CD labels, you will get this error message: The archive information cannot be located on the disk. The disk may be corrupted or the disk may not be an archive disk.

When you generate a CD label for studies imported from a CD with studies archived from a different database, the label shows only the studies imported into the current database. The same holds true for studies that have been transferred using **Database Export** or **Database Import**.

To create a CD label:

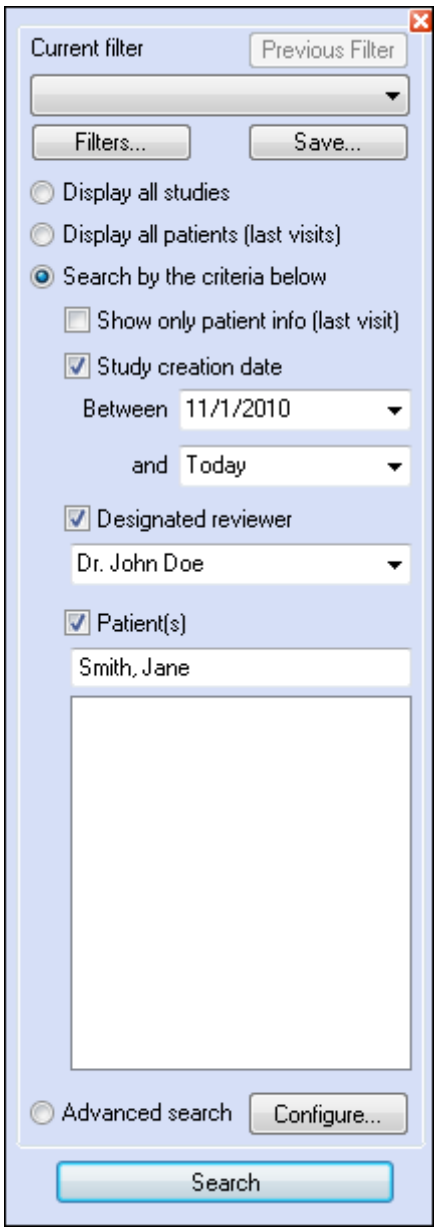
1. In Natus Database, select a study that has been archived to a CD.
2. Choose **Administration > CDLabel**.
3. The **CDLabel box** appears with the current disk label of the CD.
4. Click the **Labels Details** button.
5. The program generates a *Microsoft Word* file that contains:
   - The CD Label
   - The CD #
   - A table containing a list of patients, study dates, and study #'s of the files on the CD
6. To print the label, click the **Print** button in *Microsoft Word*. The label can then be cut to fit your CD case.

Locating and Reviewing an Archived Study

To find an archived study in the database:

1. Connect the appropriate storage resource (insert the CD or connect the USB device).
2. Click the **Search** 

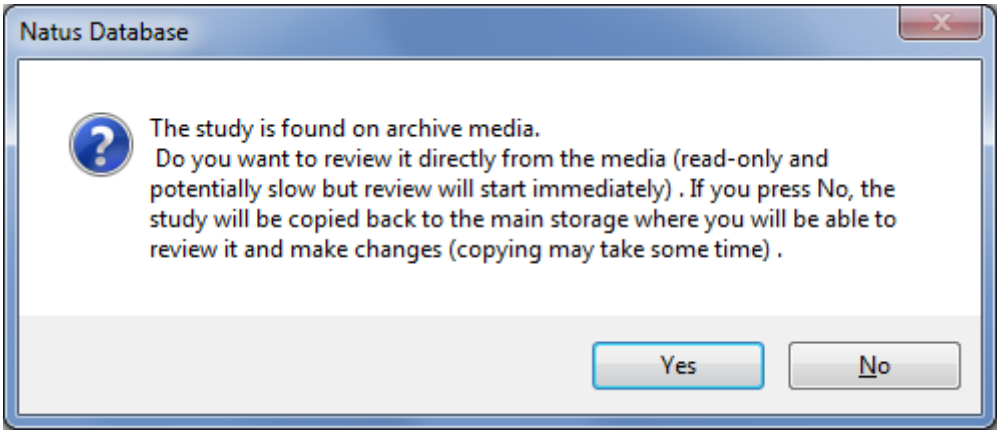
toolbar button in Natus Database.
3. The **Search Companion** appears. Use the **Search Companion** to locate the study using whatever parameter or parameters are most convenient (for example, items relating to the patient, study or diagnosis).



Search Companion

NOTE: When a filtered list based on search criteria is displayed, the **Status** bar font turns red, and the Status bar displays the message **Only studies passing the search criteria are listed**.

4. Select (highlight) the desired patient study file, then click the **Review** toolbar button. The following message box appears. It asks if you want to review the study directly from the CD as read-only, or copy it back to the main storage area where you can make changes. Note that reviewing from the CD may be slow.



Archive Reviewing Message

5. After you make your choice, NeuroWorks opens in **Review** mode with the archived study.
6. When you have finished reviewing the study, click the **Close** button in the top right corner of NeuroWorks to close the study.
7. Disconnect the storage device (to eject a CD, press the Eject button on the CD drive).

If you are working directly from the CD, and if you make changes to the study while you have it open for **Review**, and then save those changes, you will be presented with the **Leave Open/Close** options that you saw before, when you initially archived the study onto CD. You should close the CD.

To reset the database to show all studies, select the **Display all studies** option in the **Search Companion**.

19.15 Purging Studies

After a study has been archived it can be purged to create free space to allow for new acquisitions. Purging removes all study data from your hard drive but the patient name and information are retained in the database. This link later allows you either to review the study remotely, or to copy its data back onto your hard drive (for faster reviewing).

WARNING: Purging is irreversible. If you purge a study without having archived it first, all study data will be lost.

NOTE: A CD symbol associated with a study in Natus Database indicates the study has been archived. A hard drive symbol associated with a study indicates study data still resides on your hard drive.

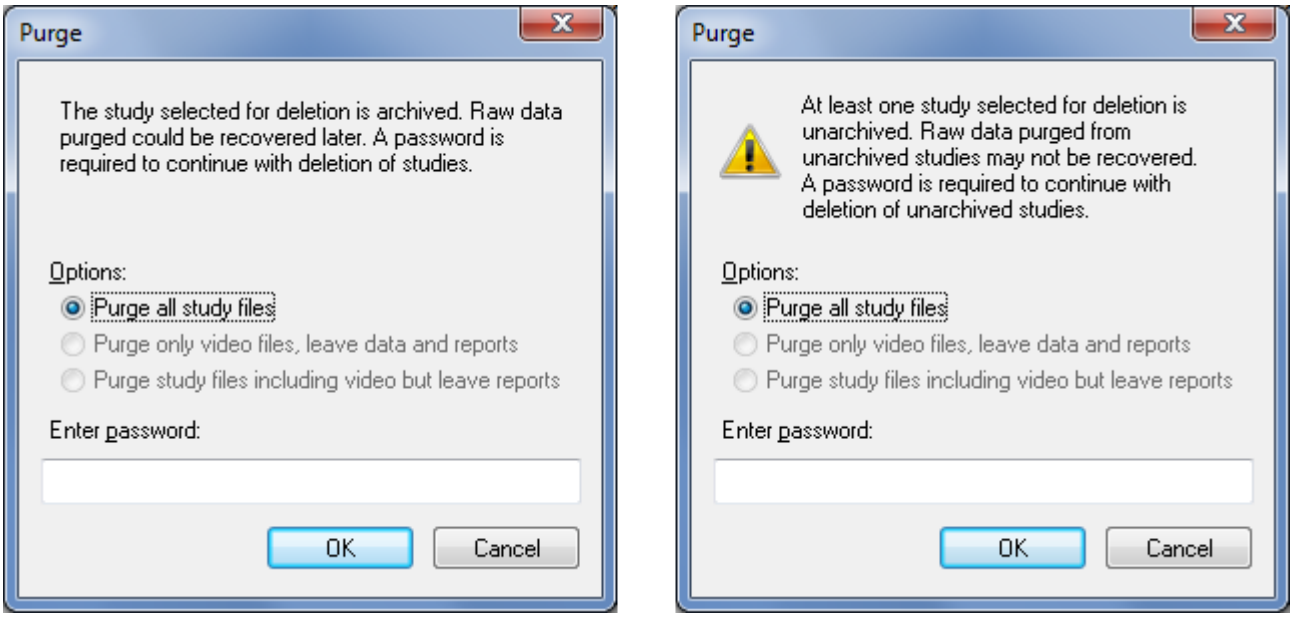
To purge a study:

1. Select the study record in Natus Database.
2. Do any of the following:

- Click the **Purge** 

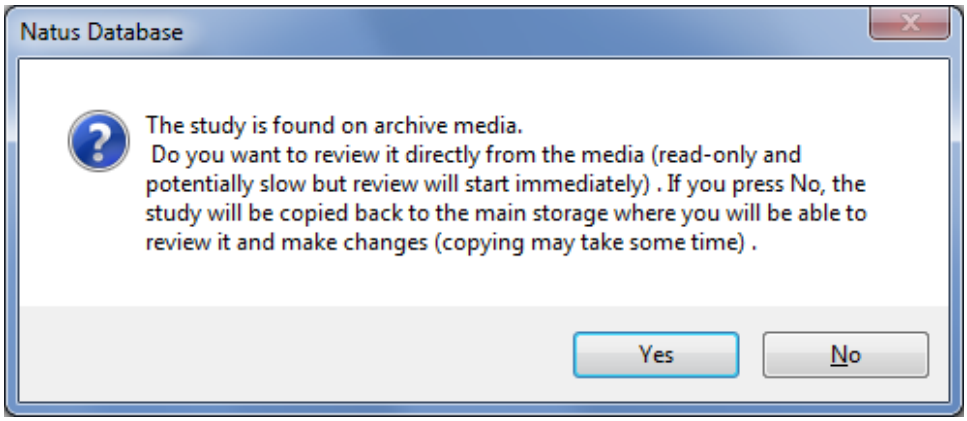
button.
- Choose **Administration > Purge**.
- Right-click and choose **Purge**.
- Press CTRL + X.

3. One of two **Purge Warning** dialog boxes opens indicating the study or studies are archived or not archived. You must enter a password to proceed with the purge (your XLSecurity password or Natus if XLSecurity is disabled). If no studies need to be archived, enter the password and click **OK**.



Purge Warning Dialogs

4. When purging is complete, there is no longer a hard drive symbol associated with the study record.
5. If you choose to review the study at a later date, you will be presented with the choice of reviewing directly from the archive medium or copying the study data back to your hard drive.



Copy Back Prompt Box

6. If you choose to return to the study at a later date, the NEW study data will be stored on your hard drive, as was done originally.

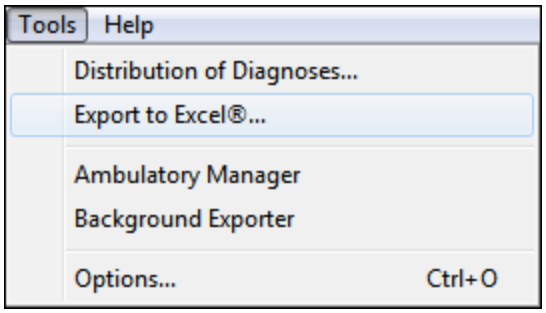
19.16 Importing and Exporting Studies

Exporting List of Studies to Excel

The list of studies is put into CSV (comma-separated version) format, suitable for importing into Excel.

To export a list of studies to Excel:

1. Select to highlight the study or studies.
2. Choose **Tools > Export to Excel®.**



3. In the **Export to Excel** box, choose an option and click **OK**:

Choose this option…	To include this in the text file…
All Studies	All studies whether displayed or not
Filtered Studies	The studies currently displayed on the screen
Selected Studies	The studies currently highlighted on the screen

If Microsoft Excel® is installed on the computer, the list of studies opens in Excel.

NOTE: If Microsoft Excel® is installed on your computer, then by default Excel will open after you select the **Export to Excel®** command and display the results of your export. If Excel is not installed on your machine then it will open up Notepad and display your export results as a text file. This file (in the CSV format) can be imported into other 3rd party applications such as other spreadsheet or database programs.

Exporting Study Data

When you are exporting the actual study data, several export formats are available depending on the type of software you will be using the data with:

You can use study data with...	Description...
Another NeuroWorks system	Several options exist to allow you to export: • **Copy:** All data associated with a study • **De-Identify:** All data associated with a study, except for patient identification information • **Briefcase:** Partial data associated with a study (includes only files that can be updated as a study is reviewed (not the EEG data itself)
Another system *without* NeuroWorks	**Natus Datashare:** This format includes a light version of the NeuroWorks or SleepWorks reviewing software in addition to the study data. This enables you to view studies almost as if you had the NeuroWorks or SleepWorks software installed. You cannot update study data using this method.
HL7	An XML-compatible format to be used with Mirth HL7 connectivity products.
Other 3rd party software	**EDF:** A format that can be used with third-party software tools, such as Persyst.

Please contact Natus Technical Support or visit the **NERVE Center** on the Natus Website for access quick guides on this topic.

There are two cases where you can import updated study data back into the original system:

- If you update a study using another NeuroWorks you can import the updates back into the original system. The most common example of this is when a physician takes a study home to review it on a laptop with NeuroWorks then later imports the updates back into the clinic system.
- You can import updates to the original study using HL7.

Exporting Study Data to another NeuroWorks System

NOTE: When exporting a study collected at 1000Hz or higher, you can choose to keep only the down-sampled data with the export.

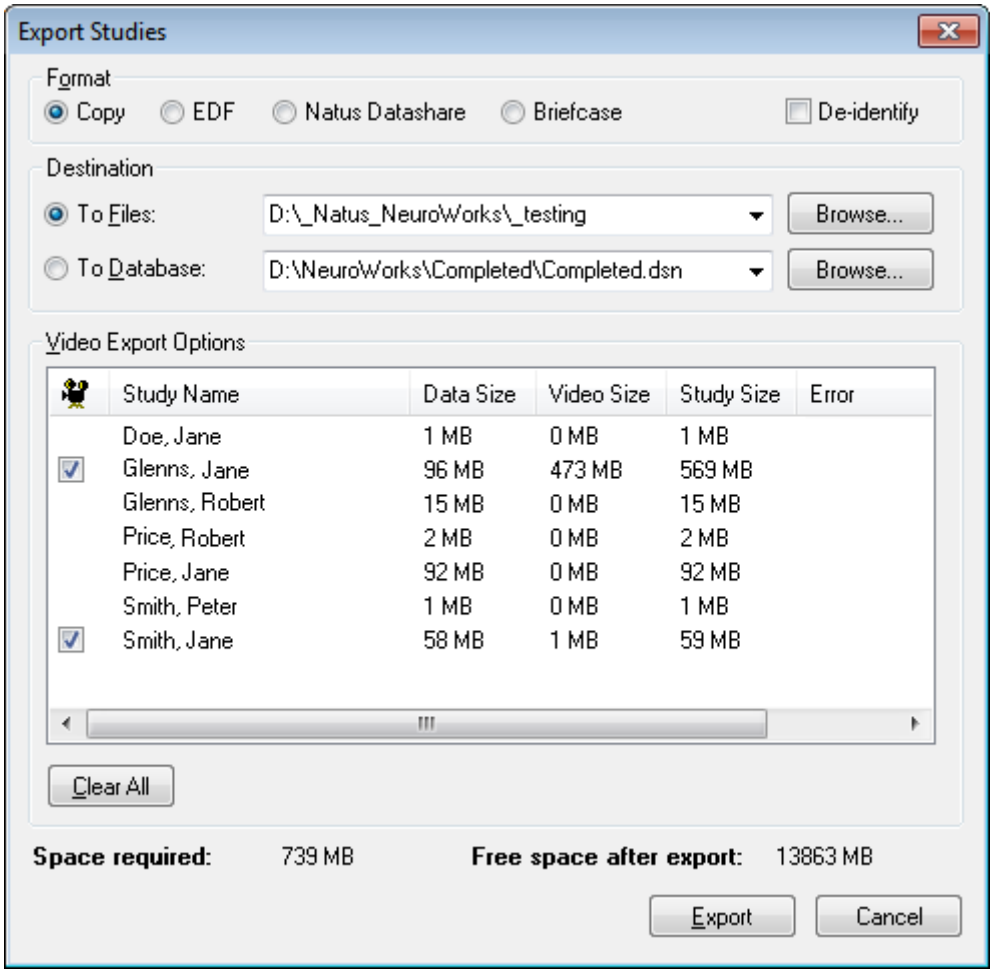
Four export options are available:

- All the study data (**Copy** option)

- Only the study data that gets updated as a study is reviewed (**Briefcase** option)
- All the study data except for patient identification information (**De-Identify** option)
- Format to be used with third-party software such as Persyst (**EDF** option)

To export study data:

1. In Natus Database, select (highlight) the study or studies you want to export.
2. Choose **Administration > Export**. The Export Studies box opens.



Export Studies Dialog

3. Below **Format**, choose a format:

Scenario:	Steps:
You want to take a study home to review and update and then return the updates to the clinic.	• Export the study using the Copy option, which includes EEG and video data. • At home, import the study using the From Files option. • Review and update the study as usual. • Export the study using the Briefcase option, which includes only your updates. • At the clinic, import the study using the Briefcase option.
You want to send a study without patient identification data to another party that does not have NeuroWorks.	• Export the study using the De-identify option, which includes all study data except for patient identification information. • Import the study back into NeuroWorks/SleepWorks under a different name. • Export the study again to whatever format the other party requires - HL7, Natus Datashare, EDF.

4. Below **Destination**, choose a folder or database where the study is to be exported.
5. Below **Video Export Options**, a list of the studies to export appears. A checkbox appears beside studies that contain video data. Click the checkbox(es) to include video data in the export.

NOTE: Some studies are not eligible for export (for example, unavailable or ongoing studies) and will be displayed in gray in the Export Studies box along with the reason.

6. Click the **Export** button to export the studies.

Export Format Options

Natus Datashare - Exporting Studies to Systems without NeuroWorks

Natus Datashare enables you to export studies to a formatted CD along with a light version of the NeuroWorks reviewing software. Later, this Natus Datashare CD can be used to review the studies on another computer that does NOT have NeuroWorks review software installed.

Briefcase - Exporting Studies to Other NeuroWorks Systems

Natus Database supports a **Briefcase** option for exporting and importing study data. The Briefcase option is very fast because only the files that may be updated as a study is reviewed get exported or imported, not the EEG or video data.

Use these steps if you need to export study data from one NeuroWorks system to review on a different NeuroWorks system. After you review the study, you can bring your updates back into the original system.

EDF - Exporting Studies for Use with 3rd Party Software

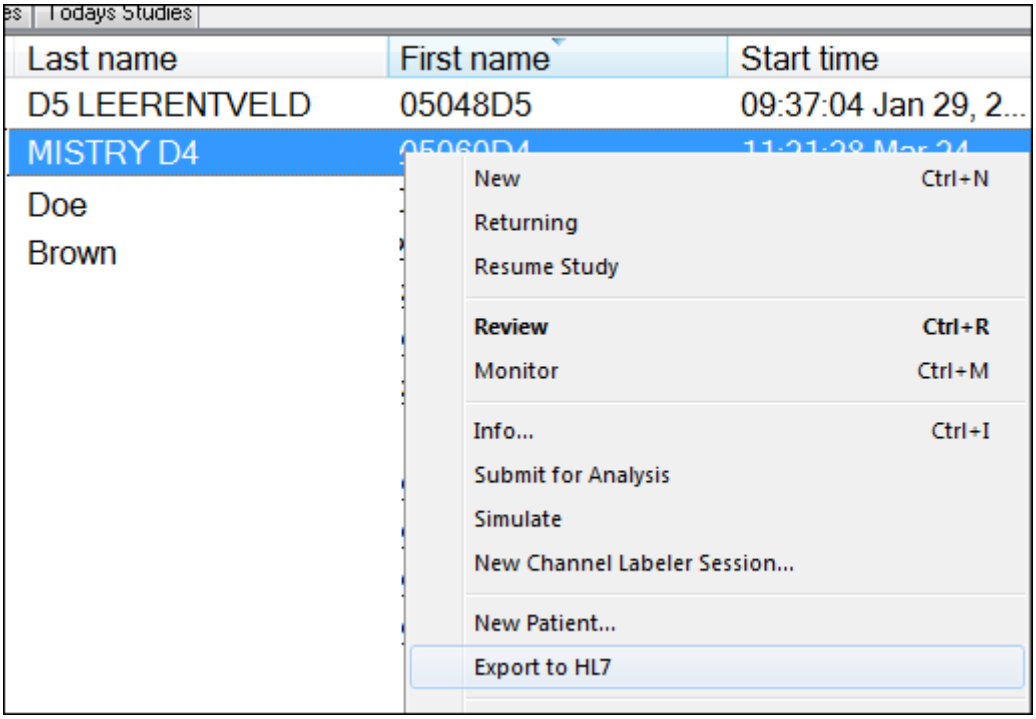
If you want to use study data with 3rd party software, such as Persyst, use the **EDF** option for exporting data.

TIP: If you want to exclude patient identification information from the exported data, take a two-step approach. First use the **De-identify** option to create a NeuroWorks study with no patient identification information. Then export that study using the EDF option.

Exporting Patient and Study Data to HL7

To export patient and study data to HL7:

1. Right-click the study (or studies) and select **Export to HL7**.



Export to HL7 Option in Right-Click Menu

2. The resulting XML files will be put into the export directory, and the HL7 gateway - if configured properly - will transmit them to an HL7 compatible hospital system.

Exporting of Reports to HL7 in PDF Format (NeuroWorks 7.1.1510 build or later)

To export reports to HL7 in PDF format, Microsoft Office 2007 or later must be installed. To enable this option, open Natus Database and select **Tools > Options > Advanced > Convert Word reports to PDF**.

HL7 Options in Advanced Tab in Natus Database Options Box

When this option is enabled, all DOC or DOCX Word documents attached to a study are converted to PDF automatically before export to HL7. This affects how the reports are exported in both modes – embedding as Base64 and copying to a remote system and providing a link over HL7.

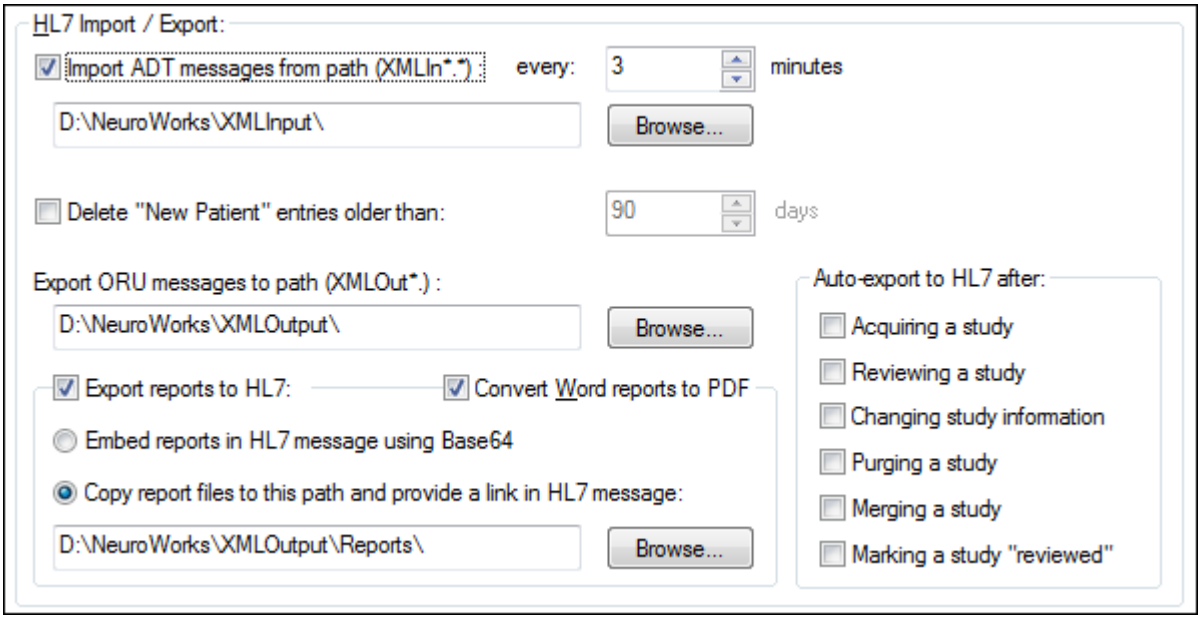
Mirth™ Connect – Exporting Studies for HL7 Connectivity Products

Natus Database supports the import and export of patient and study data into an XML-compatible format with the open source Mirth Connect HL7 connectivity products.

For more information, visit www.mirthcorp.com/products/mirth-connect.

To configure HL7 import or export:

1. In Natus Database, choose **Tools > Options > Advanced** (tab).



Import/Export Options on the Advanced Tab

The paths specified have to match the Mirth (or another HL7 gateway) configuration.

NOTE: XML schema for the communication interface is available from Natus Technical Support.

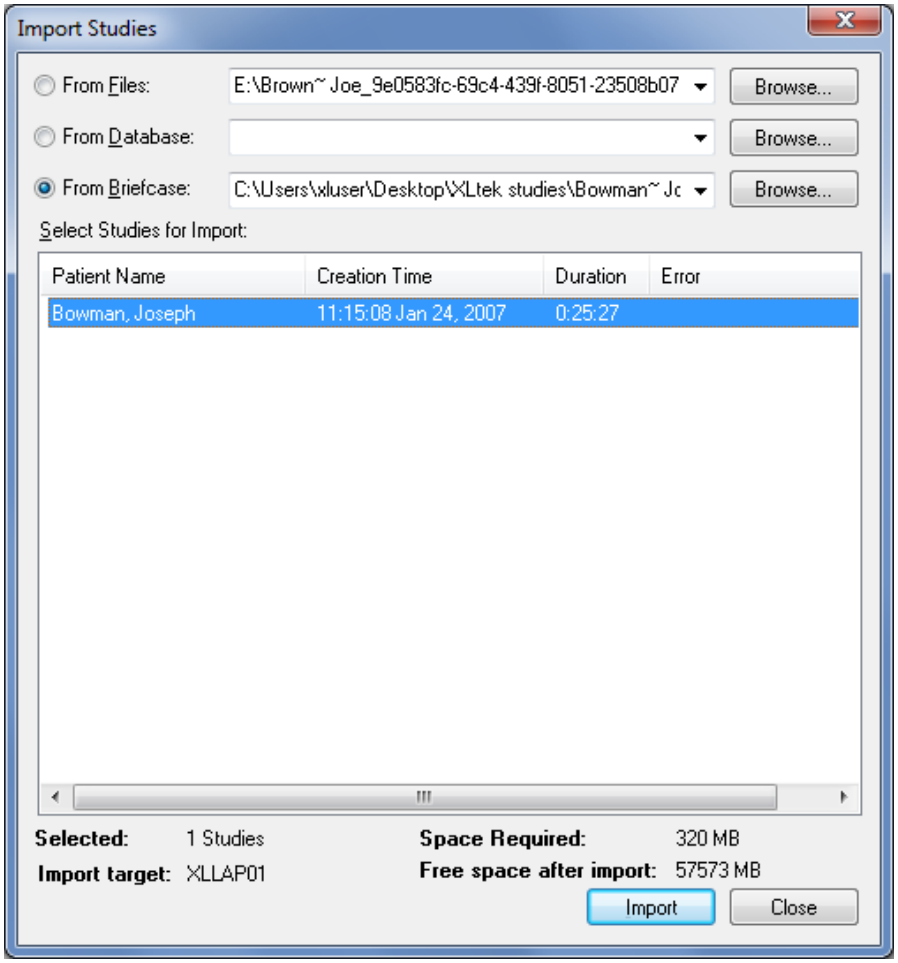
Importing Study Data

Importing Study Data from another NeuroWorks system

To import study data from another NeuroWorks system:

1. In Natus Database, click the **Import** 

button on the main toolbar (or choose **Administration > Import**). The **Import Studies** box opens.



Import Studies Box

2. Select the import source (**File, Database**, or **Briefcase**). A list of studies eligible for import appears.
3. Select one or more studies. Space required for their import is indicated at the bottom of the box.
4. Click the **Import** button to import the selected studies. An **Operation Progress** box shows studies being imported.

NOTE: Some studies will be displayed in gray in the **Import Studies** box along with the reason. You can still select studies that are displayed in gray. If the selected studies will not fit on the selected import target, the **Import** button will be grayed out.

Importing Patient and Study Data from HL7

To import patient and study data from HL7:

1. Copy the data into the **Import** directory, which is checked for updates (new patient data records) at a configurable frequency.

TIP: If you want to exclude patient identification information from the exported data, take a two-step approach. First use the **De-Identify** option to create a NeuroWorks study with no patient identification information. Then export that study using the **HL7** option.

19.17 Database Backup

NeuroWorks utilizes Microsoft SQL Server for database management. The out-of-box configuration includes a database maintenance plan (backup, optimization and integrity check) for various versions of the SQL Server on Windows XP and 7. Database backup is performed with the **Scheduled Tasks** function in the **Windows** operating system.

The default daily backup schedule is:

- SQL Backup: 7:10am
- SQL Optimize: 1:00am
- SQL Check: 12:00am

To modify the maintenance plan settings, or for instructions on configuring data server backup plan, please contact Natus Technical Support.

19.18 Setting up a Network Connection

Setting Up and Validating Your Network Connection

WARNINGS:

- Contact the Information Systems (or appropriate) department before connecting any equipment to an existing hospital network.
- Do NOT attempt to monitor another acquisition at the same time as you are acquiring a study.
- Do NOT attempt to monitor an acquisition station from more than three other computers.

Network connection should be done with the supervision of a network technician. Each machine requires a computer name and **Internet Protocol (IP)** address. Assigning these values randomly may create problems for other hospital equipment. Each section below should be completed in sequence to prevent any conflicts in the network.

When Is a Network Connection Required?

Network Connection Is Required For:	Network Connection Is Not Required For:
• Reviewing EEG on any machine other than the acquisition station (without archiving the data to CD and transferring manually). • Maintaining a single database containing studies recorded on different acquisition stations. • Remote monitoring of patients.	• A single system used to record and review EEG, even with the database.

Hardware Setup for a Network Connection

To network two computers:

- Connect a null cable from the **RJ45** connector of one unit to the other.
- If the network will connect more than two computers, then each system may be connected to a hub using a standard cable.
- When both ends of the cable are connected, and the systems are powered on, the yellow and green lights next to the RJ45 connector will turn on.
- If the lights are not on, then the cable may be faulty, or the port that the cable is connected to may not be active.

Network Validation

Step 1: Test Network Using the Command Prompt

1. Choose **Start > Programs > Accessories > Command Prompt**. The Command Prompt window appears.
2. Type **ping EEG1** (where EEG1 is the name of another machine on the network) and press **ENTER**.

   If the network is correctly set up, you should see the following:

   C:\>ping EEG1

   Pinging eeg1 [192.168.0.1] with 32 bytes of data:

   Reply from 192.168.0.1: bytes=32 time<10ms TTL=128

   Reply from 192.168.0.1: bytes=32 time<10ms TTL=128

   Reply from 192.168.0.1: bytes=32 time<10ms TTL=128

   Reply from 192.168.0.1: bytes=32 time<10ms TTL=128

3. Close the Command Prompt window.

Step 2: Test Network Using another Station

To test the network, start a new study and monitor the study from another Acquisition or Review station.

- If waveforms are displayed, then the network is connected properly.
- If you see a message similar to the following, the network connection has not been set up correctly:

```
C:\>ping EEG1

Bad IP address EEG1.

- or -

C:\>ping 134.123.123.123

Pinging 134.123.123.123 with 32 bytes of data:

Request timed out.

Request timed out.

Request timed out.

Request timed out.
```

In this case, carefully check both connections and the required entries. If you are still not successful, call your Information Systems department. If the Information Systems department is unsuccessful in resolving the problem, call Natus Technical Support for assistance.

Support for Citrix XenApp

Citrix XenApp is a thin client computing platform allowing fast and reliable way to access computers over a LAN or WAN connections.

NeuroWorks can be deployed on a Citrix XenApp server (client licenses sold separately). Users can access NeuroWorks review functionality using a variety of Citrix client software.

This enables remote review of studies over a VPN or even over public internet connections.

For additional information, see the Healthcare section on the Citrix website (http://www.citrix.com).

Cached Settings on Portable Stations

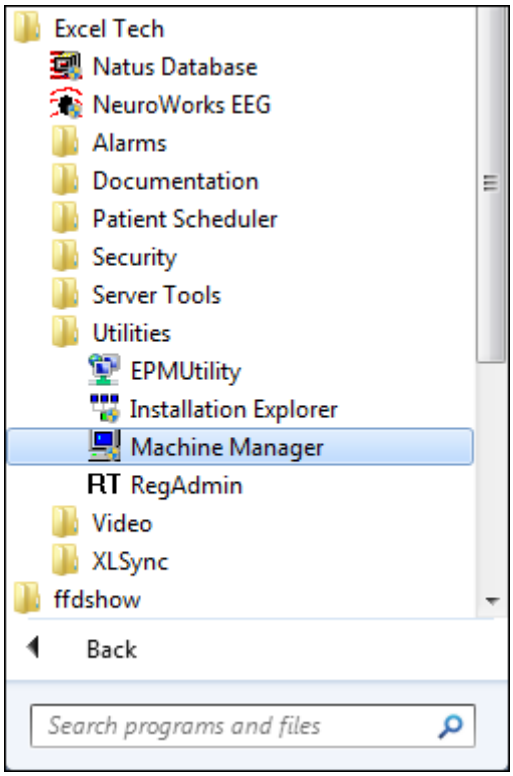
Portable stations present specific challenges to the workflow. They may be connected to the network and recording to a network server, or they may be standalone and record studies

locally (to be uploaded later). This makes maintaining a common pool of settings files (montages, templates, protocols, etc.) a laborious and error-prone task.

NeuroWorks allows portable stations to benefit from *central storage of common settings files* while, at the same time, maintaining an independent cache in cases when stations are run off-line (disconnected). Cache operation is automatic and allows for both two-way and one-way synchronization.

When two-way synchronization is enabled, changes done to the common montages and other files are propagated to the server when connectivity is re-established. Synchronization can be limited to being one-way only when you want to ensure a push model of operation. In this scenario, only a system administrator can add or change common settings files, and changes done locally on portable stations are ignored for safety reasons. By default, the common settings cache is set up using same computer as set for the **Central Settings Server**.

Use the **Machine Manager** application to configure this feature. To open Machine Manager, choose **Start > All Programs > Excel Tech > Utilities > Machine Manager**.



Machine Manager Application in Windows 7 Start Menu

19.19 Laptop Operating Modes

Stand-Alone Mode (Acquisition LT)

Use **Stand-Alone** mode for acquiring, reviewing, archiving, and managing patient information. Note that in this operating mode, the laptop is isolated from all other systems. No networking is required.

To run your Acquisition LT in Stand-Alone mode:

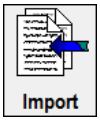
1. Set up the system
2. Turn on the system and log on.
3. Start the NeuroWorks application.
4. In Natus Database, click the **New** button to enter patient information and start a new study.
5. Perform the study.
6. When finished, choose **File > Close**. The study is stored in the database on the laptop's hard drive.

To review a previously recorded study, double-click the patient's name in the list in Natus Database.

Networked Mode (Acquisition LT)

Use **Networked** mode when you want to use the Acquisition LT as a portable device. In Networked mode, the laptop is temporarily disconnected from the network and can be transported from patient to patient. Once all studies have been performed, the laptop is returned to its base location and re-connected to the network. The studies are then uploaded to the database, and they can be reviewed from any review station connected to the database.

To run your Acquisition LT in Networked mode:

1. Power down the laptop.
2. Disconnect the network cable and transport the laptop to the patient.
3. Set up the system.
4. Turn on the system, log on, and start the NeuroWorks application.
5. In Natus Database, click the **New** button to enter patient information and start the study.
6. Perform the study. When the study is finished, select **File > Close**. The study is temporarily stored on the laptop's hard drive.
7. Power down the system and transport the laptop to its base location.
8. Connect the network cable, turn on the laptop, and then log on.
9. Run Natus Database from the desktop screen.
10. Use the Natus Database importing studies functionality to **import** all studies acquired while the laptop was roaming (select **Administration > Import** or click the **Import** 

button).

In Networked mode, the database of patient studies resides on a machine other than the laptop. There are two ways to network the laptop to the machine that holds the database:

- Peer-to-Peer Networking
- Server Based Networking

20. XLSecurity

20.1 Overview

What is XLSecurity?

XLSecurity is an installation package consisting of several software components. It is a set of services is used by the NeuroWorks/SleepWorks family of Natus products to manage login, verify permissions, lock down, and change the security-related configuration of the system. It provides a means by which user interaction with a workstation is tracked and execution of key functions recorded to an audit log.

XLSecurity functionality can be divided into the following four categories:

1. **Managing login:** Allowing users to log in and out of the system, managing account and passwords, keeping track of who the currently logged-in user is, etc.
2. **Managing inactivity:** Detecting periods of inactivity, locking down the system, bringing up the screen saver, etc.
3. **Authentication services:** Allowing or denying users access to parts of system functionality based on their permissions.
4. **Audit services:** Tracking user interaction with a machine and recording key functions in an audit log.

Why Is XLSecurity Needed?

HIPAA (Health Insurance Portability and Accountability Act of 1996) legislation stresses the privacy of patient medical information. The health care provider is responsible for ensuring that this privacy is maintained and is thus accountable for who is granted access to patient medical information.

With the introduction of medical instruments capable of storing and displaying networked study data to multiple caregivers, a need has arisen to take additional steps to ensure that only authorized personnel gain access to this information.

An additional challenge to health care providers is to ensure accessibility to authorized personnel in locations frequented by non-authorized persons (e.g. the patient's room).

How Does XLSecurity Facilitate HIPAA Compliance?

XLSecurity facilitates HIPAA compliance by offering the following features:

Feature	Description
Restricted Access	Requiring a username and password to gain access to equipment

Feature	Description
Role Based Restrictions	Users are assigned roles which limit the operations they can perform
Automatic Lockdown	Machines automatically lockdown after a period of inactivity
Manual Lockdown	Machines can be manually locked down
Machine-Specific Policies	Lockdown policies can be customized for individual machines
Central Administration	Users, roles and lockdown policies are centrally administered
Disconnected	Machines disconnected from the network 'remember' the most recent list of users, roles and lockdown policies, thus ensuring both security and availability
Desktop Security	Desktop security restricts access to Operating System facilities such as Windows explorer and the Control Panel as an added security measure
Audit Trail	Activities performed by the current user are written to the audit log

XLSecurity and Windows Security

Relying on Windows security alone may not provide sufficient flexibility to healthcare providers to meet both HIPAA compliance and core workflow requirements. There are two primary reasons:

- Switching logged-in users cannot be accomplished in Windows without stopping and restarting on-going tasks such as LTM epilepsy and sleep studies. A healthcare environment requires that several caregivers have intermittent access to each medical device throughout any given study. Each is required to identify themselves to the device, gaining limited access according to their security profile. Switching users ‘on-the-fly’ is one of the many strengths of XLSecurity.
- Granularity of restricted use is insufficient in Windows to be of use in a HIPAA-compliant setting. Windows granularity works at the file system level. Natus customers require a level of granularity commensurate with the richness of the medical device’s feature-set. XLSecurity implements role-based restrictions according to the particular operations available within the medical device.
- Windows security-related functionality serves often only in conjunction with a domain controller and either fail or introduce significant periods of interrupted service when a station is taken off the network. XLSecurity maintains its functionality, including restricting access to authenticated users even when disconnected from the network.

XLSecurity controls access to and creates an audit trail for specific device features within the Neuroworks/Sleepworks family of Natus products while embracing the strengths of Windows security for its ability to control access to network resources such as file shares and central

databases. This is particularly import in large installations where Natus medical devices share network resources with other users of the institution's network infrastructure.

For sites where Active Directory (AD) groups are established, XLSecurity can be configured to link AD groups to its internal roles, thus bridging group membership on the domain to medical device restrictions. With Active Directory integration, users authenticate to XLSecurity using their domain credentials. Group membership, users and user credentials are maintained as part of the domain and need not be duplicated within the XLSecurity framework.

A typical installation of XLSecurity creates a special local account with a username 'XLUSER'. By design, this account has only local access. To gain access to a Windows Workgroup or Domain, additional steps must be taken.

Current XLSecurity User vs. Current Windows User

System Set Up for Personal Use

When a NeuroWorks system is set up only for personal use, the personal-use mode security functions transparently, and lockdown and credential checking are disabled. However, the system still requires a designated XLSecurity user, as well as a Windows user.

Password Confirmation

- Password confirmation within the NeuroWorks family of products is now the *XLSecurity administrator password* (the factory default is *Natus*).

NOTE: This password can be changed using the Security Configurator.

User Name(s)

- The name of the user associated with the patient's medical record and all study data (e.g. annotations) is the name of the current Windows user, but the name of the user in the *XLSecurity audit log* is *administrator* - in other words, the current XLSecurity user - regardless of the Windows user. The audit log indicates what was done, but it does not differentiate between users, as does any Natus program in relation to study data.

System Set Up in Secure Access Mode

Password Confirmation

- In secure access mode, password confirmation is the password of the current XLSecurity user.

User Name(s)

- When the system operates in secure access mode, the name associated with the patient's medical record and all study data is the full name (not just the username) of the current XLSecurity user.

Windows or Citrix Authentication with XLSecurity

NeuroWorks can use the built-in *XLUSER Windows account* to benefit from XLSecurity HIPAA services. Another option allows Windows user accounts to be used to provide user-based security and functional granularity. This mode is automatically activated when one of the stations that NeuroWorks is installed on is using a **Citrix Presentation Server**.

If you need to use Windows authentication but you are not installing under a Citrix server, you will need to select a new Enable secure access under Windows account selection when installing XLSecurity for the first time.

If you are installing NeuroWorks over an earlier release you will need to open the Local Security Setup utility and make the change there.

When this mode is enabled and a user is logged in using her regular Windows account, XLSecurity will attempt to find a matching user in the XLSecurity database (same account name). If this match is found the XLSecurity user profile will be used and user access rights and policies will be enforced.

20.2 XLSecurity Brief Tutorial

Logging In

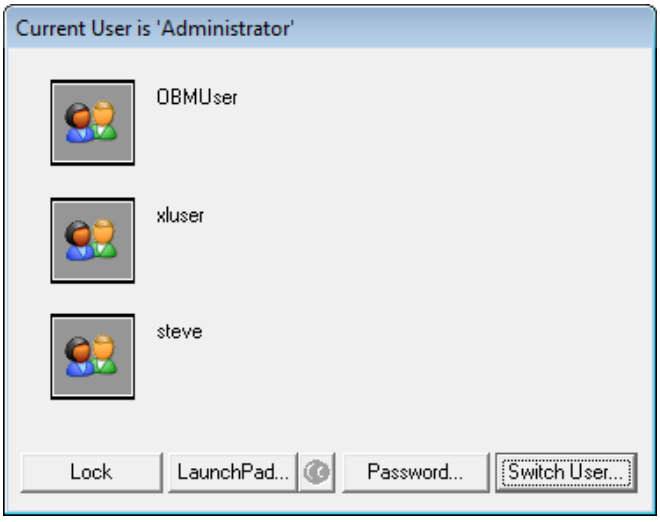
To facilitate ease of login, XLSecurity provides a **quick click** list that displays the last three users.

To access the Quick Click list:

- Press the Windows key  + A.

  OR

- Press CRTL + ALT + F12.



Quick Click List in Current User Box

NOTE: Built-in accounts such as **administrator**, **Guest** and **xlteksupport** are not added to quick-click list. Use **Switch User** button to logon if the desired user is not in the quick click list. Note that the default password for these built-in accounts is lowercase 'xltek'. This can be changed through the **Security Configurator** at any time after installation.

To login as an arbitrary user:

- Click the **Switch User**… button.

When a user attempts to logon one of several things may happen:

1. The user gets authenticated and logged-on and the screen, keyboard and mouse are unlocked.
2. The user is denied access because the system is currently performing a critical task that this user is not authorized for.
3. The user is allowed access to the system but the system performs predefined post-logon actions. This happens for instance when a user lacks permission to view patient information and patient information is displayed on screen. In this case the system will hide the patient information from the screen before accepting the user log in.
4. The user is denied access (either the username is unknown or the password does not match).

Once you gain access to the system, all running applications gain access to the new user context and can modify their behavior accordingly. Certain options may become unavailable, certain data may be recorded with the user name as part of it and an audit log of user actions continuously records user actions.

20.3 Launch Pad

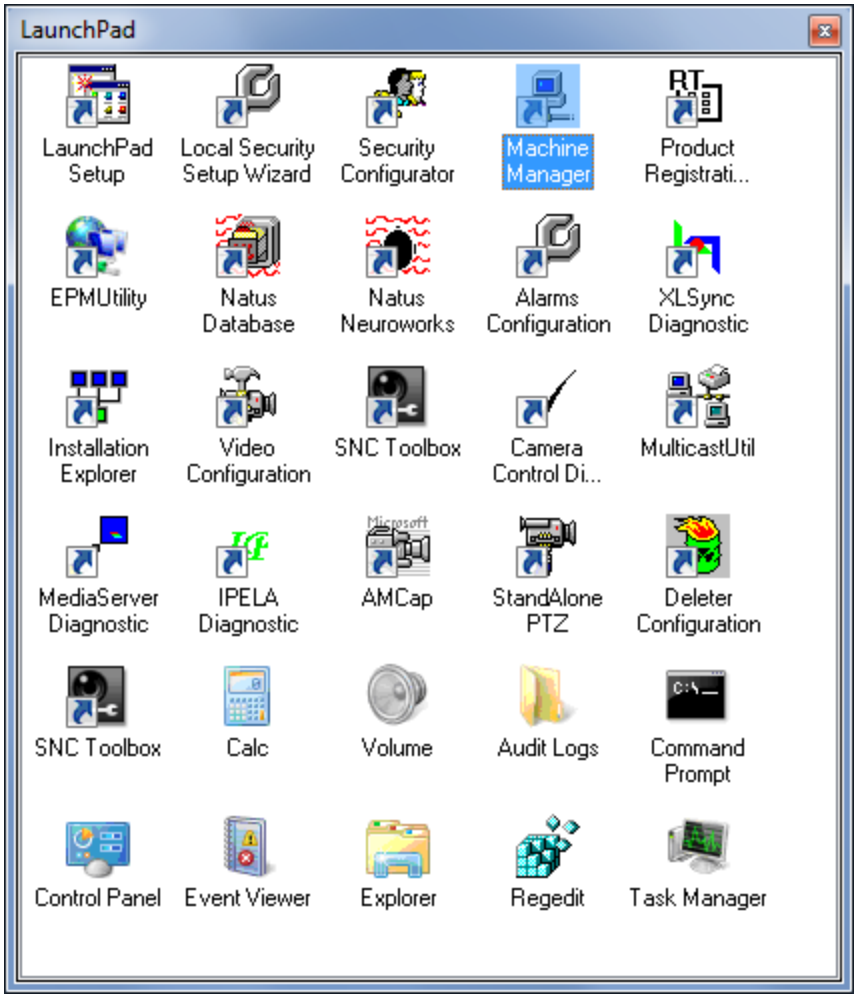
The Launchpad is a pop-up dialog from which the user can launch NeuroWorks software as well as configuration and diagnostic utilities. The Launchpad is aware of the current logged-on user and can be configured to allow or deny access to individual programs. If desktop restrictions are applied during local security setup, the Launchpad is the only means to launch the various applications:

To access the Launchpad:

- Press the Windows key  + Z.

  OR

- Press CRTL + ALT + F11.



Launch Pad (unpinned)

NOTE: The items (available programs) that you see in the Launchpad are based on your role credentials. For example, you will not see the Central Security Configuration icon unless you have an administrator's role.

Launchpad Views

The Launchpad is attached to the XLSecurity logon dialog by default. Its title bar can be clicked and dragged away in order to detach it. A 'pinned' icon on the logon dialog can be clicked to reconnect the two dialogs.

When the two are pinned, the Launchpad follows the logon dialog. You can close the Launchpad separately and hide it. You can then click **Windows key + A** to show the logon dialog and then click the 'LaunchPad…' button to display the Launchpad once again.

Note the following:

- Launchpad remembers its pinned height and reverts to it when going from unpinned to pinned.
- When you reopen Launch Pad, size, position, and pinned/unpinned state are remembered (on a per-user basis).
- When you double-click to launch from the Launch Pad, both the **Launch Pad** and the **Login Dialog** autohide. You can suppress this feature by holding down the **<CTRL>** key while launching.

20.4 Windows (Active Directory) Users

When operating with Active Directory integration enabled, a user may logon to a Neuroworks system with their usual user name and password (maintained through the Active Directory domain). When Active Directory integration is used, it is no longer necessary to create shadow user accounts in XLSecurity's configuration utility. With Active Directory integration, there is virtually no difference from the point of view of regular user's experience whether the user account is configured in XLSecurity or comes from the sites Active Directory.

20.5 Changing Password

For users defined within the XLSecurity framework (not Active Directory users, or 'native' user accounts), an account policy can be established to force a password change every xxx days. The system will warn a user at the time of logon within 14 days of expiry. Passwords for built-in accounts such as **administrator, Guest and xlteksupport** cannot be changed in this manner. They can only be changed through XLSecurity's configuration utility.

Passwords for user accounts that are not configured in XLSecurity but instead come from the Active Directory are maintained in the Active Directory (by the institution's IT department). Their expiration policy, requirements for complexity and locking are all maintained outside of XLSecurity with the help of Active Directory maintenance tools.

20.6 Switching the Logged-on User

XLSecurity allows the user to be switched without shutting down any running applications, stopping any activities or logging out of Windows. This can be accomplished by pressing **Ctrl + Alt + F11** (or **Windows + S**) and using one of the 3 buttons representing recent users or a **Switch User** button.

Switching on-the-fly without a need to shut down applications or log off from Windows is possible in equal measure for both "native" XLSecurity user accounts and Active Directory user accounts.

20.7 Locking the System

The system can be configured to lock the screen and request authorization after a period of inactivity. A user can lock the system manually at any time. This can be done by pressing **Ctrl + Alt + F9** or by using the login dialog (**Windows + A**) and selecting **Lock**. A screen saver will be activated and a user will be requested to authenticate in order to unlock the system.

NOTES:

- Locking the system is not available when XLSecurity is configured with the option: "This computer is for my personal use" (established by the Local Security Setup Wizard).
- Features accessed by the logon dialog (including 'locking the system', switching users and accessing the Launchpad) are not available when XLSecurity is installed to run on a Citrix XenApp environment (i.e., also known as Windows authentication mode or 'inproc' mode).

20.8 XLSecurity Shortcut Key Commands

XLSecurity Shortcut Key Commands

Key Combination	Function
Windows key + A **OR** **CTRL + Alt + F12**	Calls up/closes the **Current User** box with **Quick Click** user list.
Windows key + S **OR** **CTRL + Alt + F10.**	Calls up/closes the **Current User** box with **Login** box attached.
Windows key + X **OR** **CTRL + Alt + F9**	**Locks** system.
Windows key + Z **OR** **CTRL + Alt + F11**	Calls up/closes **Launch Pad**.

20.9 XLSecurity FAQs

Login

Q. Every time I login, a Synchronization dialog box appears before the system unlocks. What is this?

A. Whenever a login sequence switches the current user, the security framework connects to the security server and downloads the latest set of credentials for all users, as well as the current set of lockdown and account policies. This takes a certain amount of time, the time in which a progress dialog box appears. If the server is unreachable, synchronization is skipped and a cached copy (from the most recent synchronization) of the security database is accessed locally.

Locked Account

Q. I forgot my password and entered it incorrectly. Now the system says my account is locked out. What happened, and how do I unlock my account?

A. One of the account policies stipulates whether or not to lock a user's account in the event of several consecutive failed login attempts (due to an incorrect password). The default number of failed attempts is set by the site administrator. Once a user exceeds this number of consecutive attempts, the system automatically locks the user's account. The site administrator must use the **Security Configurator** application to unlock the account.

Q. I've been away on vacation for several weeks. When I returned to work and tried to access the system, it reported that my account had been locked. Why?

A. The most likely reason is that your site administrator has set a relatively short account policy geared to lock dormant accounts (i.e. accounts that aren't used for extended periods of time). The default period for this setting is 90 days. If this was changed to an unusually short period, your account may appear dormant to the system. Contact your site administrator to unlock your account.

Invalid Passwords

Q. I keep typing in my password, but the system tells me that it's incorrect. Why?

A. This may happen for one of two reasons. The most common is that the Caps Lock is enabled on your keyboard. Remember, passwords are case sensitive. Make sure the Caps Lock is disabled before you enter your password. A second reason for a rejected password is that it has been changed by your site administrator.

No Password Prompt

Q. I clicked on my username in the login dialog, and it logged me in without even asking for my password. Why?

A. If your password is blank, the system detects this as a special case and bypasses the prompt for a password. This applies only to the quick-click login icons, not to the **Switch User** dialog.

Changing Passwords

Q. When I tried to change my password, the system reported that my new password is invalid. Why?

A. Passwords must adhere to two rules. First, they may be made up only of the letters a-z and A-Z, plus the numeric characters 0-9. Secondly, the account password policy may require a minimum number of characters for a valid password. The default is 6 characters.

NOTE: The message box that reports your invalid password states the current policy to help you choose a valid password.

Built-in Accounts

Q. I tried to change the administrator password, and then a message reported I was not allowed to change the password for a built-in account. Why?

A. Passwords for built-in accounts such as **administrator** and **Natussupport** cannot be changed through the login dialog's Password button. You must use the **Security Configurator** to make these changes.

Launch Pad

Q. There are some icons that are not in my Launch Pad. Why?

A. You may not have access to the category-level activity associated with the **Launch Pad** item.

Q. How do I rearrange the order of icons in the Launch Pad?

A. Contact your site administrator.

Lockdown

Q. Why is there no screen saver?

A. There are two possible answers:

1. The lockdown policy stipulates that no screen saver be used during an activity that happens to be on going.
2. A local override is preventing the screen saver from running.

Q. How do I lock the system when I want to?

A. You can lock down the system using the quick keys **CTRL + ALT + F9** or the **Windows key + X**.

NOTE: You will not be able to lock the system on demand if lockdown has been overridden in the local settings (such as in the personal usage or security disabled installation modes).

Desktop Restrictions

Q. Why can't I use or access:

- Auto-run
- Certain programs in the Start menu
- Command prompt, Windows Explorer, Registry Editor, Control Panel, etc.
- Certain desktop icons
- Quick Launch in the Taskbar
- System Tray icons (WinXP only)
- Windows user password
- Task Manager
- Windows log off (only Shutdown / Restart are available)
- The Run option

A. For security reasons, Desktop Restrictions have been applied to the computer you are using. All the functions that are available to you are in the Launch Pad.

To access the Launch Pad:

- Press the **Windows key +** Z.
- OR
- Press CRTL + ALT + F11.

NOTE: A shortcut to the Launch Pad can, or may have been, added to the Start menu.

Q. How can I access **Windows Explorer**?

A. You need to be granted administrative access to use Windows Explorer. Then, it will be available in the Launch Pad. See your site administrator.

21. Troubleshooting

If you are not sure how to deal with a problem please contact Natus Technical Support at 1-800-303-0306 or OTS@natus.com.

21.1 General Troubleshooting

Troubleshooting Checklist

- ☑ Ask the patient to relax.
- ☑ Inspect your cables.
- ☑ Make sure there is a tight connection between the headbox and the computer.
- ☑ Make sure the patient electrodes are connected to the correct channel in the headbox.
- ☑ Make sure the patient electrodes fit properly into the headbox (not loosely).
- ☑ Make sure there are no apparent breaks in the patient electrode cables.
- ☑ Are any of the electrodes touching? If so, they are causing a short circuit and will develop an artifact.
- ☑ If you are using a Mobee 32 or Mobee O2 headbox and the LCD freezes, try pressing the restart button to reset the Mobee. The reset button is a small, square, black button located inside the battery compartment.
- ☑ Check the impedance.
- ☑ Unplug any other devices on the same circuit such as printers, mechanical beds, vacuum cleaners, or other potential sources of interference.
- ☑ Install a medical grade ground to make sure that your clinic has a properly grounded electrical system.
- ☑ Change the acquisition cable. You should always have a backup acquisition cable.
- ☑ Check the gain and timebase settings to ensure they are appropriate for the current test. You may also want to check the LFF, HFF, and Notch filter settings.

21.2 Software and Hardware Troubleshooting

A. Cannot install or uninstall any new software.

If the Error connecting to service manager message appears when you attempt to load new software, then you do not have adequate administrative privileges on your computer. See your network administrator for instructions on how to proceed.

B. During a study, at the end of a study, or while closing a reviewed study, you obtain the error message, "An application error has occurred … storage.exe."

If you try to end or review a study after seeing this error, the message, "Could not connect to storage server on…," also appears. To proceed, you need to restart the storage server:

1. On the Windows desktop taskbar, choose **Start > Settings > Control Panel**. The Control Panel window appears.
2. Double-click the Services icon. The Services dialog box appears.
3. From the Services dialog box, select NWStorage. The Status of NWStorage should be started. If the Status is blank, select NWStorage and click Start.

C. The Full Disk warning screen appears when I attempt to start a Study.

This message tells you that your hard disk is full. Before you can start a study, you need to remove some files from your hard drive. The following actions will help you make room.

- From the Natus Database, delete patient studies not required on the hard drive.
- Archive the files you want to keep on CD and purge raw data.
- Empty the Windows Recycle Bin.

D. A new study is running but no waveforms are displayed on the acquisition screen.

If no waveforms are displayed, make sure that you have set a default montage. To set a default montage:

1. Choose **Edit > Settings** and click the **Montage** tab.
2. Select the desired montage from the list.
3. To set the selected montage as the default, click **Set Default**.

E. Database does not display a patient file.

If the Natus Database does not display a patient file, check to see if the Status bar at the bottom of the screen is red. If it is, a Search Filter is activated and the database is displaying the files

requested from a particular search. To reset the database to display all of the files, select Display all studies in the Search Companion.

F. Reports and/or waveforms are printed in incorrect orientation.

If your report or waveform is printed in landscape orientation (wider than tall) instead of portrait orientation (taller than wide), you need to modify the print setup. In the Microsoft Word menus, select **File > Page Setup.** Then click the desired orientation (Landscape or Portrait).

G. Report takes a long time to be processed.

You may experience a delay in report processing time if other applications are open. Check that **Microsoft Word** is NOT currently open for another purpose.

H. A toolbar was accidentally moved off screen and/or cannot be found.

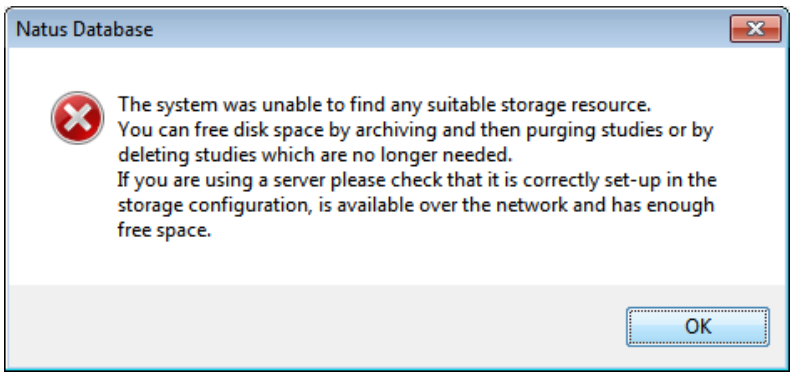
If you move a toolbar off the screen, choose **View > Toolbars > Dock Toolbars** to restore the lost toolbar. You should also check that the toolbar has not been turned off. A toolbar is turned off if a check mark does not appear to the left of its name in the View menu.

I. Too many .erd files are being collected.

If too many .erd files are being collected, you need to check the signal quality. To do so:

1. To look at the referential montage, choose **Edit > Settings > Montage**.
2. To check impedance, choose **Controls > Impedance Check**.
3. To turn off unused channels in the montage:
    a. Choose **Edit > Edit Settings** and click the **Acquisition** tab.
    b. Select **Set Manually**.
    c. Select all of the channels that are not active and click **Channel Off**.
    d. Click **Apply**.
    e. Click **OK**.

If the following message box still appears after you have switched to a database that has space available, simply click OK and proceed with the study.



J. ActiveX Control error message solution

Error Message	An ActiveX Control on this page is not safe. Your current security settings prohibit running unsafe controls on this page.

To adjust your Security Settings and enable ActiveX Controls:

1. Start Internet Explorer.
2. Choose **Tools > Internet Options.** (In IE 4 select **View > Internet Options**.)
3. Click the **Security** tab.
4. Click the **Custom Level** button. (In IE 4 select the Custom button and click the Settings button.)
5. Modify the following security settings so that they are set to Prompt or Enabled:
    a. Download signed ActiveX controls
    b. Run ActiveX controls and plug-ins
    c. Script ActiveX controls marked safe for scripting
6. Click **OK**.

K. Unit and screen are very hot.

Switch the unit off IMMEDIATELY. If the unit and screen are very hot, it is probably because the fan has failed. When the unit and screen have cooled down sufficiently, restart the unit and check for fan noise. If the fan has failed, call Natus Technical Support.

21.3 Ambulatory Troubleshooting

Error Message	Solution
"Could not connect to Signal/Storage server".	From the Windows **Start** menu, select **Settings > Control Panel**. Double-click the **Services** icon, then make sure the **NWSignal** and/or **NWStorage** services are running.
"Could not connect to the headbox"	Make sure the cables are properly connected. If the problem persists, reset the headbox by removing and reinserting the batteries. If the problem still persists, restart the computer.
"No headbox of type…connected"	From NeuroWorks, select **Edit > Settings > Acquisition**. Make sure the headbox type selected is the correct ambulatory headbox.
"Could not create anymore headbox communication paths. Please close an existing path (such as an ongoing study) before creating a new one."	This error message occurs if you attempt to connect to the headbox via **Ambulatory Manager**. If you want to use Ambulatory Manager you have to stop the study that is running in NeuroWorks.

21.4 Video Troubleshooting

A. Your Nursing Station PC no longer responds to mouse commands.

If your NeuroWorks computer no longer responds to mouse commands, you need to restart it.

1. Press **CTRL + ALT + DELETE** and follow the commands to restart your computer.
2. Log on to the system network using your User Name and Password.
3. When the desktop appears, double-click the red alarms icon. The video pictures of each patient reappear.

B. Patient is often out of camera range.

The patient or family quickly forgets that the camera is in the room and moves off camera or blocks the camera view. Frequent reminders help to ensure that the best data is captured.

Remind the patient or family to notify the nurse if they are moving from bed to chair. Reinforce this message during regular vital signs assessment.

C. Patient or family forgets to press event button.

Admission to hospital is a stressful occurrence for patients and their family members. It is common for individuals to forget verbal instructions. Reinforce the importance of pressing the event button every time an event occurs.

D. Patient does not agree to video or is not an EMU patient.

Occasionally, a non-EMU patient is admitted to a monitored bed. If these patients do not wish to be monitored by video, move the camera to the corner of the room and zoom in on the ceiling or floor.

E. Patient requests that the data acquisition unit and video unit be left on to view the information.

Patients want to be involved in their care, and they often request that the data acquisition unit and video unit be left on in the room. Staff need to determine a policy in this situation. An open workstation may allow unauthorized users to adjust settings that could result in of loss patient data.

F. Video picture is not changing or is black.

If you notice that the video picture is not changing, or that the screen has gone black, wait for 30 seconds. If there is no change, call Natus Technical Support.

G. Video window displays “Trying to Connect” message.

If the video window displays the message “Trying to Connect,” the video connection has ended. Ask your Video technician if the acquisition machine in the patient's room is turned off. If so, ask the technician to turn the video on and wait up to 5 minutes for the video to appear. If the video is still not showing, call Natus Technical Support.

H. Camera control buttons do not become active when the mouse pointer is over them.

When you point at an active area of the screen, each camera control button should become active. If you point at a button and the button does not work as expected, wait for the system to restore itself and try again. If the controls don't respond after 30 seconds, call Natus Technical Support.

I. Camera control buttons are clicked but the camera doesn't move.

It can take up to 10 seconds for the camera to respond to the control buttons. If the camera does not respond after a reasonable period of time (3 to 4 minutes), close the application using the small red exit icon on the screen. Restart the application by clicking on the red alarm bell icon. Restart the computer if the problem continues. If the camera does not respond after restarting, call Natus Technical Support.

J. Video picture appears slightly blurred.

If the camera position is zoomed out to the maximum setting you may notice a decrease in picture quality. This can be fixed by zooming in the camera lens slightly. To do so, click the **Zoom In**  button on the Camera toolbar.

K. Camera rotation occurs spontaneously and camera returns to a fixed place.

On rare occasions (such as during emergency power test), the camera may make a 360 degree rotation and end up in a zoomed in position on either a ceiling tile or room corner. The video picture appears gray and fuzzy, and no warning message appears on the area of the video picture (for example, “Video Trying to Reconnect”). To correct this, use the Camera toolbar to zoom the camera out until you can see definite objects in the room. Then, center the camera on the patient.

Camera Toolbar

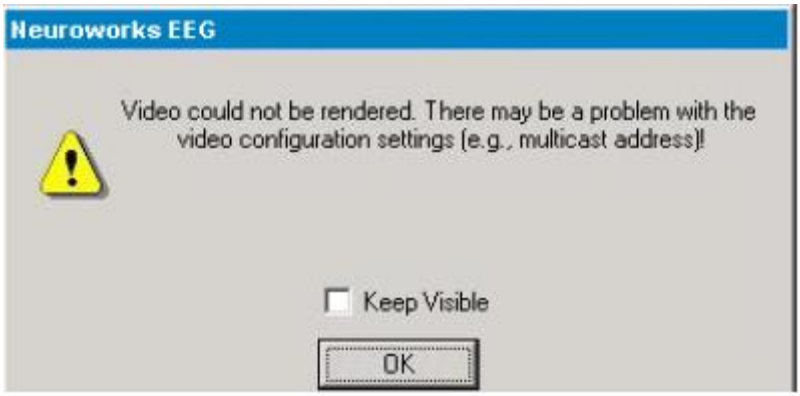
L. Need to adjust video to solve flickering with 50 Hz ballast for fluorescent lighting.

To initialize flicker-free recording:

1. Click the Windows  button and then choose **All Programs > Excel Tech > Video > Diagnostics > Camera Control Diagnostics**.
2. Click the Flickerless On button in the Camera Diagnostic & Control box.

M. Receiving “Video could not be rendered...” message.

If you receive the following message...



... the computer in question has two network adaptors ENABLED. The wireless adaptor is causing the problem. To correct this, the wireless adaptor must be DISABLED. This ensures that only the wired NIC (Network Interface Card) is used for multicast.

21.5 Recording FAQs

A. How do I create a new recording for a patient?

After the patient has been connected, log onto the NeuroWorks system. The Natus Database window launches automatically. Once the Natus Database main window is displayed:

1. To open the **Study Information** dialog box, click New .
2. Enter the patient's information.
3. Click **OK.** The NeuroWorks live recording screen appears.

NOTE: The system requires a minimum entry of the patient's first and last name in order to create an identifiable file. You can enter additional data later by choosing the **Natus Database >Edit > Study Information**.

B. What are some measures I can take to help get the impedance levels down (below 10 kOhms)?

- Make sure each electrode plug is completely inserted into the correct channel.
- Make sure electrode plugs are dry and clean. Remove any debris, collodion, paste etc. from previous recordings.
- Apply more 10/20 conductive gel into electrode discs.
- Adjust electrode placement on the scalp.
- Apply more skin prep to remove any oil from the patient's scalp.

C. What are some measures I can take to help eliminate muscle artifact from the recording screen?

- Ensure that patient is relaxed with mouth slightly open to eliminate jaw clenching and loosen tense muscles.
- Have the patient close his or her eyes and focus on relaxing their entire body.
- Use the filters in the Montage settings toolbar (HFF and Notch) to reduce higher noise frequencies.

D. How do I reset the position of the electrode channels to the normal arrangement in the waveform window?

- Choose **Trace > Distribute.** The channels are reset to their original position.

E. How do I view only selected channels on the screen at a given time?

1. To select multiple individual channels, press the CTRL key and click each individual channel that you want to select. To select a group of channels, press the SHIFT key and click the first channel and last channel in a group of channels that you want to select.

2. Choose **Trace > Show Selected**. Now only the selected channels are displayed.

F. How do I hide channels that aren't working and/or creating too much artifact during a recording?

1. Select the desired channels (as described above).
2. Choose **Trace > Hide Selected**.

NOTE: Although hidden channels do not appear on your screen, they are still recording data.

G. How do I turn off certain channels before an acquisition so that no data is recorded?

1. Choose **Edit > Settings > Acquisition**.
2. Select **Set Manually**.
3. Scroll through the list of channels and select **On** or **Off**.

H. How do I scan back to view recorded activity without losing sight of current activity?

1. Choose **Window > Review Current Study**.
2. The screen automatically splits into two windows allowing you to view missed recordings while watching new recordings. To return to the original view, click the Close button to close the review window.

I. How do I add extra channels to current montage?

1. Choose **Edit > Settings > Montage** tab.
2. Do one of the following:
    a. To place a new channel above the cursor position, click Insert.
    b. To place a new channel at the bottom of the list of channels, click **Append.**
3. When finished, click **Apply**.

NOTE: Generally, it is not good practice to change the montage during live recording. Switch to another montage and make changes, prior to the start of recording.

J. How do I move notes previously entered into the recording?

1. Choose **Window > Review Current Study**.
2. Scroll through the study and find a note you wish to move.
3. Click and drag the note and to a new location in the study.

NOTE: You can only move custom notes that have been placed on the study manually (blink or eyes closed, for example). You cannot move notes that are automatically generated by the system (Gain filter notes or Spike and Event notes, for example).

K. How do I change the color of the acquisition background or recording screen?

1. Choose **File > Customize > Colors**.
2. Select **Acquisition Background** from the list box.
3. Click **Modify**. Select a new color from the pallet and **click OK.**
4. Click **Apply** to activate the change.

L. How do I view the montage settings pane in the waveform window?

1. To expand montage settings pane, point to the divider between the montage settings pane and the waveform window pane.
2. When the pointer changes to a double-headed arrow , hold down the left mouse button as you drag the divider right so that montage settings are visible for each channel.

M. How do I adjust the sensitivity and filters for selected channels (LFF, HFF, Notch)

LFF (Low Frequency Filter)	Filters out low frequency interference below the set value.
HFF (High Frequency Filter)	Filters out high frequency interference above the set value.
Notch filter	Minimizes interference from nearby electrical equipment.

To adjust these filters, do one of the following:

1. In the waveform window, select one or more channels and use the Montage Settings toolbar to select new values for LFF, HFF and/or Notch filter.
2. Choose **Edit > Settings > Montage**. To change the three filter settings (LFF, HFF and Notch filter), right-click on a cell and choose a value from the pop-up menu.

N. How do I change the color and appearance of channels in a montage?

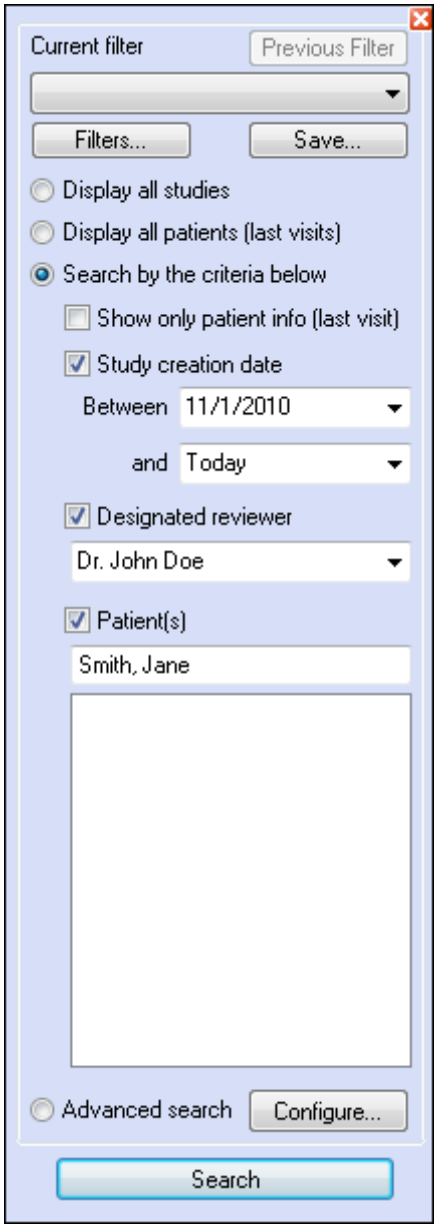
1. Select **Edit > Settings > Montage**.
2. To display the color pallet, right-click the cell in the Color column of the channel you wish to change.
3. Select a color and click **OK**.
4. Click **Apply**.

21.6 Reviewing FAQs

A. How do I locate studies from previous recording sessions?

1. Click the **Search** 

toolbar button in the **Natus Database**.
2. The Search Companion appears.



Search Companion

3. Use the **Search Companion** to locate the study using whatever parameter or parameters are most convenient (for example, items relating to the patient, study or diagnosis).

TIP: To reset the database to show all studies, click the Search toolbar button. Click **Reset**. Click O**K**.

B. How do I flip through recorded EEG pages?

- Use the Review Toolbar. Choose **View > Toolbars > Review**.

Use the Keyboard Shortcuts

To...	Do this...
Play the study forward or backward continuously.	Press **CTRL+F** or **CTRL+R**.
Toggle between play and stop.	Press the **SPACEBAR**.
Move the study forward one page.	Press the **RIGHT ARROW** key.
Move the study backward one page	Press the **LEFT ARROW** key.
Move the study backward or forward in a series of successive pages.	Hold down the **LEFT** or **RIGHT ARROW** key.

C. How do I zoom in or magnify sections of a recording for in-depth examination?

- On the Review toolbar, click the **Zoom In** (plus sign magnifying glass) button. Now when you move the mouse pointer over the record, it appears as a magnifying glass.
- To isolate certain traces, press the left mouse button and then drag to outline the area to be enlarged.
- To return the screen view to normal, click the **Zoom Out** (minus sign magnifying glass) button.

D. How do I adjust the software filters when reviewing a study?

You can edit montage channel settings to further clarify a study element by using the keyboard or dropdown list boxes:

- From the keyboard, press the up or down arrow key to regulate the Gain, or sensitivity, of the study to smaller changes in voltage.
- Use the menus on the **Montage Settings** toolbar (located above the waveform window) to adjust the filter settings

LFF (Low Frequency Filter)	Filters out low frequency interference below the set value.
HFF (High Frequency Filter)	Filters out high frequency interference above the set value.
Notch filter	Minimizes interference from nearby electrical equipment.

21.7 Networking FAQs

A. How do I run a stand-alone (portable) study that is disconnected from the network?

1. Turn on the computer in the patient's room.
2. Login using your user name and password.
3. Prepare the patient while you are wait for the Natus Database screen to appear. You may see the message, **Attempting to connect to the network.** Please be patient…
4. When the Natus Database screen appears, click New 

and record a study.
5. When you are finished with the patient, click the Close  button in the top right corner of the NeuroWorks screen.
6. Click **OK** in the **Technologist Report** dialog box to confirm that you want to close the study.
7. You will receive one more prompt asking, "Are you sure you want to end the current study." Click **Yes**.
8. Click the **Close**  button in the top-right corner of the Natus Database screen.
9. Click the **Windows Start** button and follow the prompts to shut down the system.

22. Shortcut Keys

22.1 Shortcut Keys for Acquisition

Natus has developed a series of keyboard shortcuts, or hot keys, to activate certain features of the program.

To access most functions, hold down the **CTRL** key and then press another key. For example, hold down the **CTRL** key and press the letter I to open the **Study Information** dialog box.

Acquisition Shortcut Key Table

Short Cut Keys	Action
CTRL + A	Select all channels
CTRL + B	Start ambulatory study
CTRL + C	Copy selected material
CTRL + D	Distribute traces to original positioning
CTRL + I	View Patient and Study Information
CTRL + T	Edit Settings
CTRL + U	Show/Hide Video
CTRL + V	Paste
CTRL + X	Cut
CTRL + Z	Undo
CTRL + ` **(key next to 1 key)**	Switch to the next set in the montage

Short Cut Keys	Action
CTRL + 1	Switch to Montage Set 1
CTRL + 2	Switch to Montage Set 2
CTRL + 3	Switch to Montage Set 3
CTRL + 4	Switch to Montage Set 4
CTRL + F11	Toggle the Trace window between full screen mode and regular mode
F12	Clear alarm (sound and flashing “Alarm” message)
SHIFT + DELETE	Cut
CTRL + INSERT	Copy
SHIFT + INSERT	Paste
DOWN Arrow	Decrease sensitivity
UP Arrow -	Increase sensitivity
SHIFT + LEFT Arrow	Decrease Timebase
SHIFT + RIGHT Arrow	Increase Timebase
CTRL + SPACE BAR	Start/Stop Recording
CTRL + <–> (minus on number pad)	Impedance Check
/ (on number pad)	Note Menu

Short Cut Keys	Action
*** (on number pad)**	Montage Menu
ESC	Stop Photic Stimulation (and exit from other dialog boxes)
Alpha/Function Keys	Start entering a note.

22.2 Shortcut Keys for Reviewing

Natus has developed a series of keyboard shortcuts, or hot keys, to activate certain features of the program.

To access most functions, hold down the **CTRL** key and then press another key. For example, hold down the **CTRL** key and press F to activate the play fast forward function

Reviewing Shortcut Key Table

Shortcut Keys	Action
CTRL + A	Select all traces
CTRL + C	Copy to clipboard (in text edit controls)
CTRL + D	Distribute traces evenly on screen
CTRL + E	Go to Epoch by number
CTRL + F	Play Forward
CTRL + G	Go to Event List
CTRL + I	Edit Patient and Study Information
CTRL + K	Start/Stop marking a clip for pruning

Shortcut Keys	Action
CTRL + L	Edit pruning clips
ALT + L	Collated view (pruning preview)
CTRL + M	Open remote study monitoring session
CTRL + N	Use *rapid* event marking mode
CTRL + SHIFT + N	Use event marking mode
CTRL + O	Open a study for review
CTRL + P	Print
ALT + P	Edit playback (paging) speed
CTRL + R	Play in Reverse
CTRL + S	Save Study
CTRL + T	Edit Settings
CTRL + U	Show/Hide Video window
CTRL + V	Paste from clipboard (in text edit controls)
CTRL + W	Open the Workspaces menu
CTRL + X	Cut to clipboard (in text edit controls)
CTRL + Y	Copy trace view to clipboard

Shortcut Keys	Action
CTRL + F11	Toggle the Trace window between full screen mode and regular mode
CTRL + F12	Auto-scale traces (for respiratory channels)
CTRL + ` (key next to 1 key)	Switch to the next set in the montage
CTRL + 1	Switch to Montage Set 1
CTRL + 2	Switch to Montage Set 2
CTRL + 3	Switch to Montage Set 3
CTRL + 4	Switch to Montage Set 4
Space Bar	Stop and start the study playback
, (comma)	Go to the previous note
. (period)	Go to the next note
ALT + , (comma)	Go to the previous note of the same type
ALT + . (period)	Go to the next note of the same type
> (SHIFT + comma key)	Go to the previous unverified analyzer note
< (SHIFT + period key)	Go to the next unverified analyzer note
+ (not on the number pad)	Increase the playback speed

Shortcut Keys	Action
– (not on the number pad)	Decrease the playback speed
CTRL + 0 (not on the number pad)	Reset the playback speed to one page per second
Right arrow key	Page forward by the unit selected on the Review toolbar (page, epoch, event, etc.)
Left arrow key	Page backward by the unit selected on the Review toolbar (page, epoch, event, etc.)
6 (on the number pad with Num Lock ON)	Scroll forward
4 (on the number pad with Num Lock ON)	Scroll backward
/ (on number pad)	Note menu
*** (on number pad)**	Montage menu
Home	Go to the beginning of the study (or the first epoch in Epoch navigation mode
End	Go to the end of the study

23. Configuring NeuroWorks

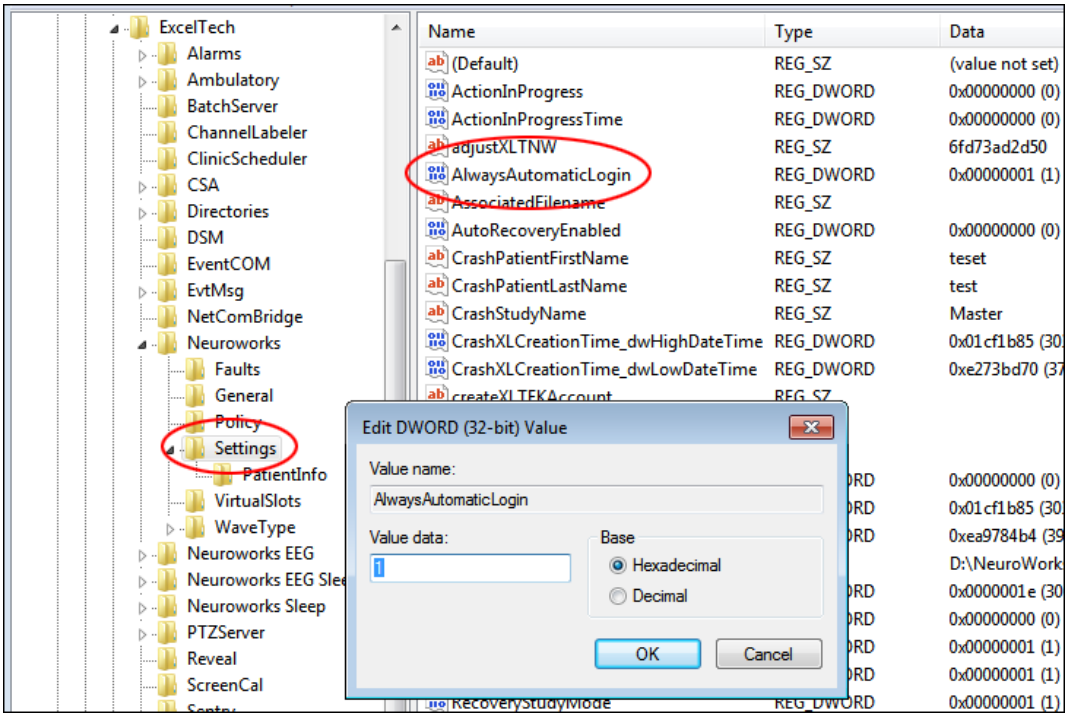
23.1 Restoring Automatic Login

WARNING: This topic describes registry keys that can be set to customize NeuroWorks software. Only experienced computer users with previous knowledge of registry keys should alter these settings. Please contact Natus Technical Support for more information.

When you change a Natus computer to be on a domain, the domain policy usually disables the automatic login. To correct this, you have to go into the registry and fix it. For instructions on how to access the registry, and create and modify registry value settings, see the topic Settings for Fast EEG Review.

Note the following:

- The registry key is located in:
- HKEY_LOCAL_MACHINE\Software\ExcelTech\NeuroWorks\Settings\AlwaysAutomaticLogin
- It is a DWORD value that should be set to 1.
- Without the registry key set, Windows dialogs may prevent a login after an abnormal shutdown.
- With the registry key set, the computer will always log on automatically.
- This registry key is set by the installation to 1 only on acquisition stations.



Editing the DWORD Value

23.2 Settings for Fast EEG Review

WARNING: This topic describes registry keys that can be set to customize NeuroWorks software. Only experienced computer users with previous knowledge of registry keys should alter these settings. Please contact Natus Technical Support for more information.

Registry Parameters for Review Speed and Buffering

NumberBufferPages	Sets the size of the buffer in terms of the number of screen pages of EEG.
BufferPortionFromBottomToRestart	Begins look-ahead reading when the user passes more than **BufferPortionFromBottomToRestart** percents into the buffer.
BufferPortionFromBottomToStop	Stops look-ahead reading when there is less than **BufferPortionFromBottomToStop** percents between the bottom and the current position.

PageRateMax	Sets the maximum review speed that the user can attempt in terms of the number of screens of EEG that are shown each second.

Default Fast EEG Review Values

The following default registry value settings should allow all users to obtain fast EEG review functionality:

- BufferPortionFromBottomToRestart (percents, Default = 40)
- BufferPortionFromBottomToStop (percents, Default = 20)
- NumberBufferPages (integer, Default = 225)
- PageRateMax (integer, Default = 6)

To set the values for review speed and buffering:

1. From the Windows desktop, click **Start > Run**. The Run dialog box appears.
2. To open the Registry Editor window, type **regedit** and click **OK**.
3. Open the following key path:
4. HKEY_CURRENT_USER\Software\ExcelTech\NeuroWorks EEG\Settings
5. Locate the DWORD values titled the following:
    - BufferPortionFromBottomToRestart
    - BufferPortionFromBottomToStop
    - NumberBufferPages
    - PageRateMax
6. If you cannot locate a value, then add the value to the list. To add a new DWORD value:
    a. Right-click the Settings folder, point to New and click DWORD Value. A new value appears in the left pane of the Registry Editor.
    b. Type in the name of the value exactly as it appears in step 4 above. For example, type **BufferPortionFromBottomToRestart.**
    c. To set the default values, double-click the value, click Decimal and type in a default value, and then click OK to save and close the value.

23.3 Audio EEG Time Offset

Note the following about the audio EEG time offset:

- The playback rate of the audio review of EEG is at 60x normal speed. This means that for every second of real time that goes by, 60 seconds of EEG is heard.
- There is usually at least a half-second delay between the time the technologist hears an EEG artifact and the time the technologist clicks the Stop button to synchronize the

displayed EEG with the audio review. During this half-second, approximately 30 seconds of EEG is played by the audio review software.

- As a result, the EEG displayed when the technologist clicks the Stop button is approximately 30 seconds ahead of the time that the technologist first hears the EEG artifact.

23.4 Disabling Acquisition Profiles

WARNING: This topic describes registry keys that can be set to customize NeuroWorks software. Only experienced computer users with previous knowledge of registry keys should alter these settings. Please contact Natus Technical Support for more information.

If you wish to disable the acquisition profiles feature, a registry DWORD (32-bit) called EnableAcqProfiles should be created under one or both of the following paths:

- HKCU\Software\ExcelTech\Neurworks EEG\Settings (for EEG)
- HKCU\Software\ExcelTech\Neurworks EEG Sleep\Settings (for Sleep)

With a value of zero (0), the acquisition profile drop-list will be disabled on the acquisition page in the NeuroWorks / SleepWorks software and in the headbox connection / profile selection dialog. A value other than zero (0) will enable acquisition profiles. Both EEG and Sleep modalities are dealt with independently; therefore, you can disable acquisition profiles for one while enabling them for the other.

24. System Tools

24.1 Sentry Tool

About the Sentry Tool

The Sentry tool performs the following functions:

- Captures statistics during a live study
- Reports the status of disk capacity and disk space
- Reports remaining study time

The Sentry tool is available on both the acquisition station and on a remote monitoring platform.

When an alert threshold is crossed, the Sentry window is automatically displayed. To manually activate the Sentry window, open the View menu on the main menu bar and select Sentry.

The Sentry tool has two components:

- Disk Usage Monitor
- Data Quality Monitor

The **Disk Usage Monitor** tracks disk usage patterns and issues an alert when disk storage capacity drops below a 10% safety margin. At this point, it terminates a recording session and switches to an alternative path (local or network). The Disk

Usage Monitor tracks the rate of storage depletion over a period of several minutes and estimates the remaining storage capacity (in hours) based on the average consumption rate. Therefore, you always know how much time you have left, based on present conditions.

NOTE: Estimate of remaining storage in hours takes into consideration all activity on the network, not just one station. You do not have to divide hours by the number of stations to determine how much storage capacity is left.

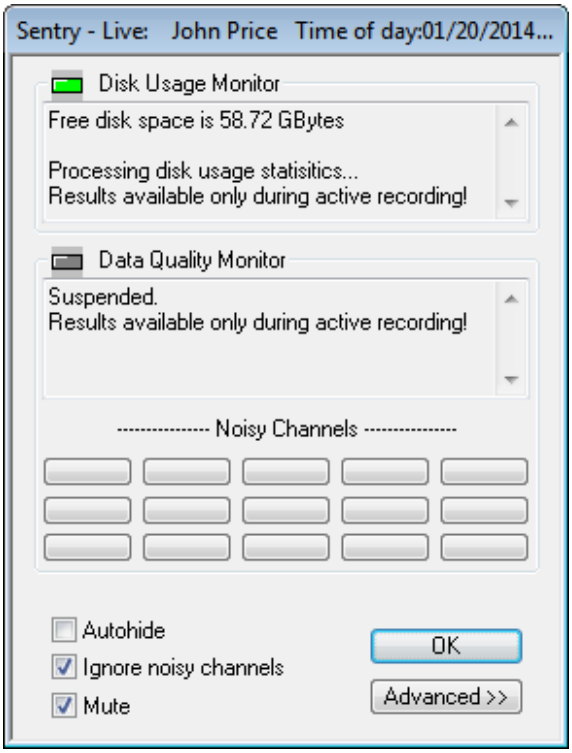
The **Data Quality Monitor** checks for electrical noise per recording channel and the rate of file growth for the study file. To save disk space, data is compressed as it is stored. The compression process stores the main acquisition data and then records the variations, rather than storing the complete data volume every time there is a change.

In practical terms, a noisy signal with a lot of changes does not compress well. Too much data has to be compressed every time. A clean signal compresses well. Study files grow more quickly when compression is poor. Poor compression is an indication of electrical interference and poor conduction of the electrode.

Viewing the Sentry Tool

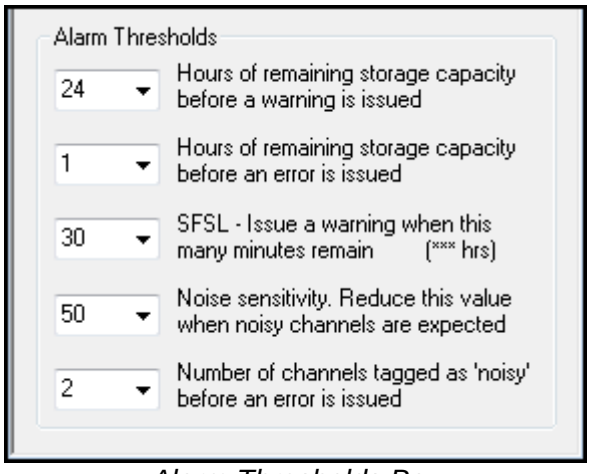
The Sentry tool appears automatically, if conditions require it, but you can open the Sentry tool at any time when you are recording a study.

To open the Sentry tool, on the NeuroWorks screen, choose **View > Sentry**.



The Sentry Tool

You can also configure the Sentry tool by setting the **Alarm Thresholds**.



Alarm Thresholds Box

The table which follows shows default values for the five Alarm Threshold parameters and contains a description of each.

Default Values for Disk Capacity Warnings

Default Value	Alarm Threshold Parameter	Description
24	Hours of remaining storage capacity before a warning is issued	This serves as a reminder to purge existing studies in order to free necessary disk space for future studies.
1	Hours of remaining storage capacity before an error is issued	See note below for difference between warning and error.
30	SFSL – Issue a warning when this many minutes remain	SFSL means Study File Size Limit. Basically an obsolete parameter. Because of program improvements in saving, you no longer need to adjust this value. Parameter remains for in-house calibration.
50	Noise sensitivity. Reduce this value when noisy channels are expected	Value is a percentile. Scale ranges from 0–100. 100 means perfect compression. Lower this value when noisy signals are expected. Raise this value if signals will be clean and slowly varying. Data rate (i.e. file size) increases with noisy signals. This means storage capacity (length of time available for a study) drops.
2	Number of channels tagged as noisy before an error is issued.	If two channels are tagged as noisy, an error window appears.

NOTE: A warning message cannot be bypassed. When you receive an error message, the error must be corrected before you can proceed.

24.2 Alarms

NeuroWorks incorporates an **Alarm** functionality. The alarm types included in NeuroWorks are:

- Technical alarms
- Patient-initiated alarms

Once an alarm is detected, it is immediately activated. An alarm message appears on the display, and a distinctive audible alarm is activated.

The purpose of **Technical alarms** is to aid users in the acquisition of valuable data with the smallest interference from technical disruptions that, if known, could be promptly corrected. Technical alarms indicate a condition that affects the quality of the recording and they include:

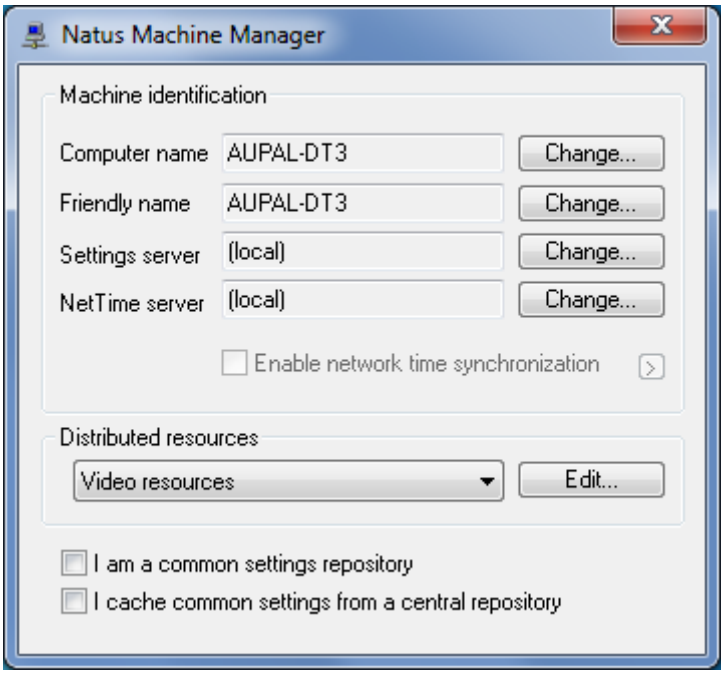
- Sentry alarms
- Video recording alarms

Sentry Alarms inform users of situations related to the availability of sufficient resources for recording (i.e., disk space) and **Video Alarms** include notifications for malfunctioning of the video camera.

24.3 Machine Manager

Many configuration tools are simplified and combined into a **Machine Manager**.

To open Machine Manager, choose **Start > All Programs > Excel Tech > Utilities > Machine Manager**.



Machine Manager

The Machine Manager application allows you to change the computer name, friendly name and the name of the server on which to keep the settings repository (in most cases this will be same computer as the XLAlarms and XLSecurity settings server).

System functions that use **Machine Manager** include:

- Synchronizing settings with a central location or server using Centralized Settings Cache (XLSync)
- Starting / stopping EEG recording remotely from a monitoring station

- Starting / stopping video recording remotely from a monitoring station
- Remote Pan-Tilt-Zoom camera control from monitoring or nurse alarms stations
- Analog Printing
- Nurse Alarms

Cached Settings on Portable Stations

NeuroWorks's Centralized Settings Cache (**XLSync**) allows portable stations to benefit from a central storage of common settings files while at the same time maintain an independent cache in cases when stations are run off-line (disconnected). By default the common settings cache is set up using the same computer as set for the **Central Settings Server**. The **Machine Manager** application is used to configure this feature.

Cache operation is automatic and allows for both two-way and one-way synchronization. When two-way synchronization is enabled changes done to the common montages and other files are propagated to the server when connectivity is re-established. Synchronization can be limited to be one-way only when customer wants to ensure a "push" model of operation where only a system administrator can add or change common settings files and changes done locally on portable stations are ignored for safety reasons.

Automatic Time Synchronization

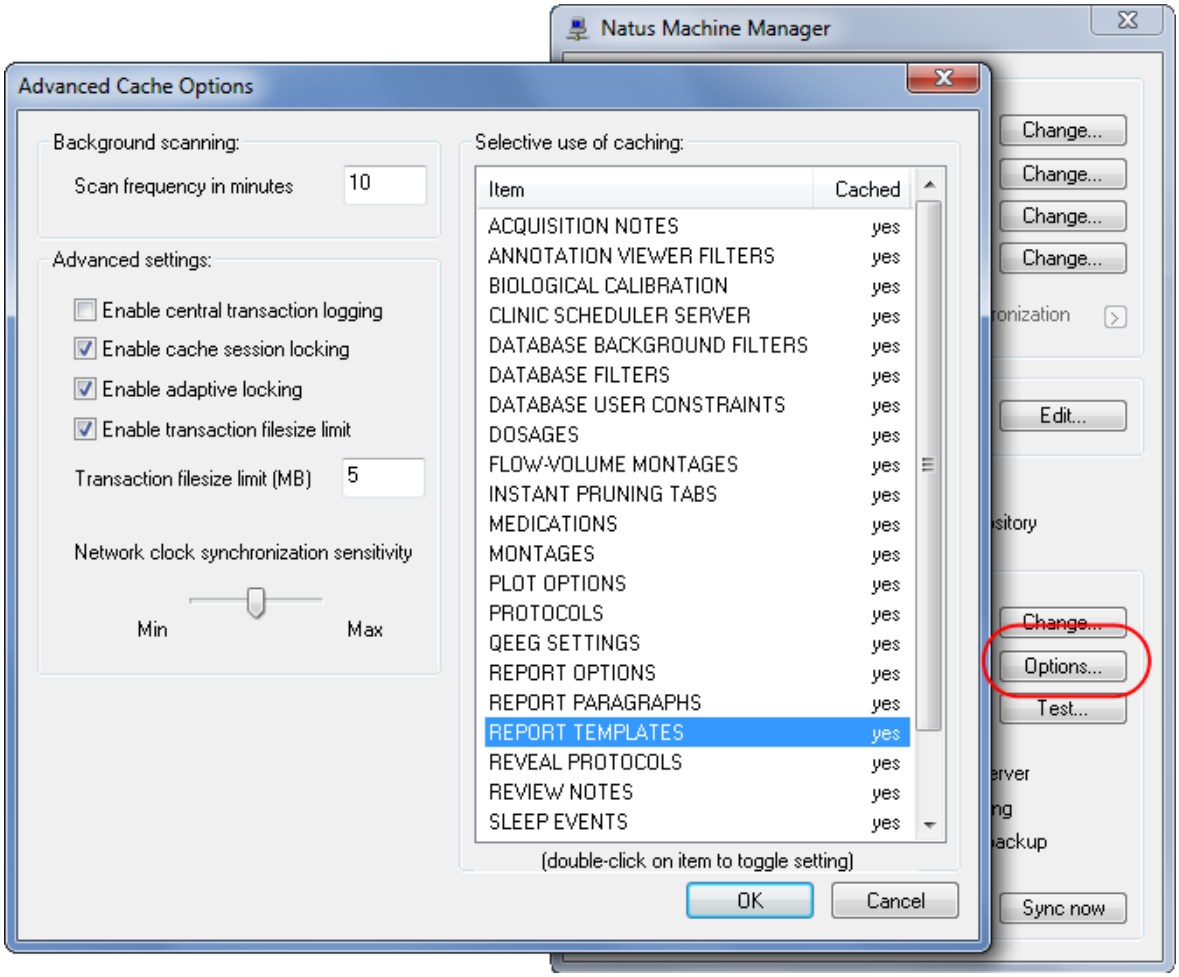
Machine Manager allows you to set up automatic periodic time synchronization between the central location of your choice (usually the **Central Settings Server**) and the local PC. This ensures time consistency between the stations that are sharing database and allows consistent time order for changes to the patient or study information as well as flow of alarms and events in the system.

Fine Tuning which Files are Distributed with XLSync

With its default settings, Centralized Settings Cache (XLSync) synchronizes all the relevant files in common settings directories. Machine Manager is used to customize which types of settings are synchronized and which are not.

To select or de-select settings to be cached:

1. Choose **Start > All Programs > Excel Tech > Utilities > Machine Manager**.
2. In Natus Machine Manager select I cache common settings from a central repository.
3. Press Options…
4. In the **Advanced Cache Options** dialog control which configuration items are cached (synchronized) locally.
5. Double-click on an item to flip its cached **yes/no** configuration.



Advanced Cache Options in Natus Machine Manager

25. Appendix

25.1 Appendix A: Brief Discussion of Clinical and Non-clinical Testing for Natus Spike and Event Detection

Non-Clinical: The NeuroWorks Spike and Event Detection Algorithms rely upon underlying mathematical analyses, including signal regularity, maximum frequency, and amplitude variation. Each mathematical analysis was independently calculated and verified against results generated from published methods.

Clinical: NeuroWorks conducted an extensive clinical test to: 1) Evaluate the positive percent agreement (i.e., detection sensitivity based on independent EEG review panel) and false detection rate (based on independent EEG review panel) of NeuroWorks Spike and Event Detection Algorithms on long-term scalp EEG recordings; and, 2) Demonstrate the seizure detection performance, in terms of positive percent agreement and false detection rates, of NeuroWorks Spike and Event Detection Algorithms is equal to or better than those of the predicate device.

Subject Population and Test Dataset

The seizure detection performance of NeuroWorks Spike and Seizure detection algorithms was evaluated on scalp EEG recordings from patients with medically refractory seizures. All patients 18 years of age or older with a history of seizures admitted to an Epilepsy Monitoring Unit for long term EEG-video recordings for diagnostic or pre-surgical evaluation were asked to participate. The validation data set includes EEG studies with full montage (21 channels).

Dataset Description

Number of Seizures: 615

Number of Spikes: 1598

Total Number of Patients: 102 Total Number of Hours: 334 (mean ± SD =3.18 ± 0.03. Range 2.0 ~5.2)

Under the constraint that no more than 3% of the total seizures were included from one subject; detection performance was tested on 615 seizures in a total of 334 hours of scalp EEG recordings from 102 patients. Otherwise, no additional inclusion/exclusion criteria were applied in the data selection process.

Reference Standard

Each of the EEG recordings was reviewed by three independent, blinded EEG experts (all neurologists/epileptologists) to identify electrographic seizures and spikes. The end point of this independent review was to identify, if any, the seizure onset times and spikes in each of the sampled EEG segments. Due to the anticipated inter-rater variability among EEG experts, a majority rule (at least 2 out of 3) was applied to make the final determination of "true" electrographic seizure and spikes events.

Statistical Analysis for Seizure Detection Algorithm

1. Inter Rater Performance for Seizure detection Algorithm - Inter-rater Positive Percent Agreement (PPA) ranged between 73 and 89%, while False Detection per hour (FD/h) was very close for all three raters (0.3 FD/h, on average) for Seizure Detection.

	Seizures					
	Rater 1		**Rater 2**		**Rater 2**	
	PPA	**FD/h**	**PPA**	**FD/h**	**PPA**	**FD/h**
Rater 1	1.00	-	0.85	0.2	0.80	0.3
Rater 2	0.78	0.3	1.00	-	0.73	0.3
Rater 3	0.89	0.4	0.88	0.4	1.00	

2. Detection Performance for Seizure detection Algorithm -Based on the seizure samples determined by the independent EEG review panel, the positive percentage agreement (i.e., detection sensitivity based on the Reference Standard) and false detection rate (based on the Reference Standard) were estimated for both NeuroWorks Seizure Detection algorithm and the predicate device. Bootstrap method was applied to construct 95% confidence intervals for the estimated performance statistics, as well as to statistically compare positive percentage agreement between NeuroWorks Seizure Detection algorithm and the predicate device.

Results of Seizure Detection Algorithm - Summary

The Table below depicts a summary of the detection performance statistics for NeuroWorks Seizure Detection algorithm and the predicate device.

	NeuroWorks	Predicate
PPA (95% C.I.)	76.2% (70%, 80%)	72% (67%, 76%)
FDR 95% C.I.)	0.6 (0.2, 0.9)	1.0 (0.9, 1.4)
PPA - Positive Percent Agreement FDR - False Detection Rate (FD/h) (95% C.I.) - 95% Bootstrap Confidence Interval		

The Seizure Detection Algorithm had a 76% Positive Percent Agreement and a False Detection Rate of 0.6 FD/h when compared to the reference standard. The positive percent Predicate device PPR was 72% and FDR of 1.0 FD/h.

Statistical Analysis for Spike Detection Algorithm

1. Inter Rater Performance for Spike detection Algorithm - Inter-rater Positive Percent Agreement and FDR for Spike Detection is shown in the table below. Inter-rater PPA ranged between 26% and 55% while FD/h for all three raters in average was 15 FD/h.

	Spikes					
	Rater 1		Rater 2		Rater 2	
	PPA	FD/h	PPA	FD/h	PPA	FD/h
Rater 1	1.00	-	0.35	8.7	0.28	5.6
Rater 2	0.55	26.1	1.00	-	0.37	10.6
Rater 3	0.52	29.3	0.45	15.5	1.00	-

2. Detection Performance for Spike detection Algorithm - Based on the spike samples determined by the independent EEG review panel, the positive percentage agreement were estimated for both NeuroWorks Spike Detection algorithm and the predicate device. Bootstrap method was applied to construct 95% confidence intervals for the estimated performance statistics for NeuroWorks and the predicate device Spike Detection algorithms.

Results of Spike Detection Algorithm - Summary

The Table below depicts a summary of the detection performance statistics for NeuroWorks Seizure Detection algorithm and the predicate device.

	NeuroWorks	**Predicate**
PPA (95% C.I.)	60.1% (54%, 66%)	50.1% (43%, 57%)
FDR 95% C.I.)	5 (4, 15)	15 (12, 27)
PPA - Positive Percent Agreement FDR - False Detection Rate		

The Spike Detection Algorithm had a 60% Positive Percent Agreement (95% Bootstrap Confidence Interval = [54%, 66%]) and a False Detection Rate of 5 FD/h (95% Bootstrap Confidence Interval = [4, 15]) when compared to the reference standard. The positive percent agreements of the predicate was of 50.1% (bootstrap 95% CIs = [43%, 57%]). Predicate device FDR was of 15 FD/h (bootstrap 95% CIs = [12, 27]).

Conclusion

Compared to the predicate device and reference standard, NeuroWorks' Xltek Seizure and Spike Detection algorithms are substantially equivalent (equal to or better than those of the predicate device) in safety and performance, including sensitivity (positive percent agreement) and false detection rate.

25.2 Appendix B: Description of Equipment Symbols

The following table lists and describes the symbols that may appear on various pieces of Natus NeuroWorks systems.

Symbol	Description
	**ATTENTION:** **Consult Accompanying Documents**
	Consult Accompanying Documents
	Protective Earth (Ground)
	Type BF Equipment
	Dangerous Voltage
	Alternating Current
	Direct Current
	Power On
	Power Off
	**EU only**: Do Not Dispose as Unsorted Municipal Waste
CE 0086	CE Mark

Symbol	Description
	Class II Equipment (non-grounded enclosure)
	ESD Sensitive OR Static Sensitive
	RF Equipment for Non-ionizing Radiation

25.3 Appendix C: Glossary

The following are definitions of names, abbreviations, technical and other terms that may be used in this guide. Entries are listed in alphabetical order.

A

ADSL–Asymmetric Digital Subscriber Line. Allows high-speed communication, including video, across an ordinary twisted-pair copper phone line.

Algorithm–A sequence of steps for performing an operation or solving a logical or mathematical problem.

Alias–A database alias groups a database file and a patient directory under a user-defined name. You can select a different database to work with using the Databases menu in ***Natus Database***.

Ambulatory Study–An EEG record obtained with a mobile acquisition unit such as the Mobee24 or Trex headbox. The study measures electrical activity in the brain over 24 hours.

Amp Saturated–Amp stands for amplifier - the input amplifier. Indicates signal is too large for the range of the input channel. Varying sensitivity will not correct this. Try adjusting electrode contact. Unwanted signal or noise may be the problem.

Amplitude–1. Maximum absolute variation of a wave through one cycle. 2. In ***Natus*** **Detection**, refers to how many times bigger a wave is than the local background.

Archive–A collection of patient studies that has been transferred from the computer hard drive to CD discs for long-term storage.

Artifact–Disturbances in the study record caused by transitory events that obscure the data recording. For example, motion artifacts may be caused by electrode movements, loss of contact with electrodes, muscle activity, head movements, scratching the scalp, or sweating.

Asymmetry–Asymmetry is a measurement of how much an event swings in amplitude in the five second interval surrounding an event (). The ***Natus*** Spike and Event Analyzer uses the Asymmetry measurement to detect XLEvents ().

B

Breakout Box–A device for attaching multiple electrode leads to the headbox. This permits greater patient mobility. A Breakout Box is available as an optional attachment.

Broadband–A communications system in which the medium of transmission carries multiple messages at the same time.

C

Calibration–Adjusting equipment to measure as accurately as possible. The software, monitor, and/or headbox are adjusted by ***Natus*** prior to shipping to ensure all measurements are correct. Calibration is done at the ***Natus*** factory. You do not need to calibrate NeuroWorks software or headbox accessories yourself.

Channel–Each electrode attached to a patient's scalp transmits electrical signals from the patient's brain to a channel on the headbox. The electrical information that passes through the channel is interpreted and displayed on screen according to the filters and timebase set in the Montage toolbar.

CPU–Central Processing Unit. The chip that functions as the brain of a computer. The term can refer to both the processor and the computer's memory.

D

Detection Class–A spike is said to pertain to some class if it is embedded in a background that falls in that class's frequency range.

E

EDF–European Data Format. A simple format for exchange of digitized polygraphic recordings.

EEG–Electroencephalogram. EEG refers to a technique for studying electrical current within the brain. Electrodes are attached to the scalp. Wires connect these electrodes to a headbox that records the electrical impulses. The results of the EEG study are displayed on a computer screen.

EKG (ECG)–Electrocardiogram. A recording of the electrical activity of the heart. The electrocardiogram detects and records the electrical potential of the heart during contraction.

Electrode–A conductor attached to the patient's scalp to establish electrical contact with the patient's brain through a channel connected to a headbox.

Electrooculogram (EOG)–A record of the standing voltage between the front and back of the eye. It is correlated with eyeball movement and obtained by electrodes placed on the skin near the eye.

EMG–Electromyogram. A trace of the electrical activity associated with functioning skeletal muscle.

F

False Negative (FN)–A report of a negative outcome (e.g. no event) when the correct outcome was positive (e.g. there really was an event).

False Positive (FP)–1) A detection that is not relevant for the technologist. 2) A report of a positive outcome (e.g. an event is detected) when the correct outcome was negative (e.g. there really was no event).

FFT (Fast Fourier Transform)–The FFT is an algorithm (or formula) that calculates and analyzes a signal's frequency spectrum.

Field–A setting in XLSpike Detection that determines whether a spike on one channel must be confirmed with a simultaneous spike on at least one other channel to result in a detection.

FN–False Negative. Represents an event that is missed by the detector.

FP–False Positive. Represents a detection that is not relevant for the technologist (since it did not really happen).

Function Key–One of the F + number keys at the top of the keyboard.

G

Gain–An increase in the sensitivity of a signal as it is acquired by the headbox and interpreted by NeuroWorks software. An increase in Gain will amplify the sensitivity of the trace.

H

Headbox–The electronic device that interfaces between the electrodes attached to the patient's scalp and the computer. *Natus* offers a variety of headboxes with a number of different channel capacities such as the Quantum, Mobee24plus, EEG32 and EMU128.

High Frequency Filter (HFF)–The High Frequency Filter blocks signals above the value set in the HFF box on the Montage toolbar.

HIPAA–Health Insurance Portability and Accountability Act

L

LAN–Local Area Network. A group of computers and other devices spread over a small area and connected by a link that lets any device interact with any other.

LCD–Liquid Crystal Display. A type of electronic display screen.

Local Background–In *Natus* detection, refers to the median average of the surrounding waves. Also known as Local Median.

Low Frequency Filter (LFF)–The Low Frequency Filter blocks signals below the value set in the LFF box on the Montage toolbar.

M

Montage–A configuration of headbox channels set to record and display data acquired during a study. Choose **Edit > Settings >Montage** to select combinations of inputs.

N

Natus Database–The database in which all stored studies are kept.

Notch Filter–Filters out a selected range of frequencies (usually the A/C frequencies used in ordinary electrical equipment.

NwDb–NeuroWorks Database. The obsolete database formerly used by NeuroWorks and superseded by the Natus Database in version 5.0.

P

pH–A measure of the concentration of hydrogen ions in a solution, and therefore of its acidity or alkalinity.

Photic Stimulator–A strobe-light-like device used for photic activation of the EEG, routine clinical procedures in visual evoked potentials, electroretinography and neuro-opthalmology. The XLPS-1 Photic Stimulator is a portable unit consisting of a power unit, a flash unit, and a connecting cable.

Polarity–The Polarity column in the Montage tab of the Edit Settings window is used to set the orientation of the waveforms to Up or Down (electrical positive or electrical negative).

Protocol–A customizable set of actions and/or functions set up to be executed sequentially by a headbox during data acquisition.

R

Referential Montage–Channels have a setting only in the Input 1 column. The Input 2 column is empty. The signal coming from an electrode minus the signal from the reference channel (Input 2) is displayed.

Rhythmicity–Level of steadiness in a frequency domain, i.e. a regularly repeated signal.

S

Sa02–Saturation of oxygen. Percentage of normal oxygen level in the blood.

Sensitivity–This setting adjusts the gain of the channels. Increasing channel sensitivity will make the wave traces appear larger on the screen.

Sharpness–How sharp the angle is from the leading edge of a spike to the next edge of a spike.

Slew–Measures the steepness of the leading edge (up or down) of a spike.

Study–Refers to the acquisition, review, analysis and interpretation of data as recorded by the headbox and represented on screen by NeuroWorks software.

T

Taskbar–The bar at the bottom of the Windows desktop.

Thermistor–A temperature sensor. A semiconductor that exhibits a large and fairly linear change in resistance as a function of temperature. The name is derived from thermal resistor.

Thin Client–In a client/server relationship, a client computer that performs little or no data processing. The processing is instead performed by the server.

Threshold–The minimum point at which an effect is produced or detected. The minimum value of a signal that can be detected by the system.

Throughput–The measure of the data transfer rate through a communications system.

Timebase–This setting adjusts the display and speed of the recording on screen. The Timebase can be adjusted in the Montage toolbar.

Toolbar–A row of buttons, located below the main menu bar, that contains buttons and commands for commonly used tasks.

Trace–The on-screen display of an electrode channel as a study is recorded. A line that represents electrical activity in the patient's brain. The term is derived from tracing, the way waves were drawn on paper by mechanical polygraphs. The Trace menu on the main menu bar controls the display of the electrode channels.

Transducer–A device that transforms one type of energy to another. For example an external oximeter or heart rate monitor.

Type–In XLSpike detection, waveform type falls into one of four categories based on the pattern of surrounding waves: Irregular, Spike and Slow Wave, Fast, or Slow.

V

Visual Evoked Potentials–A visual evoked potential test measures the brain's response to various kinds of visual stimulation.

VPN–Virtual Private Network. Network that uses public wires to connect nodes; i.e. a network using the Internet to transport data and which employs encryption technology for data security.

W

WAN–Wide Area Network. A communications network that connects geographically separated areas.

Wave–NeuroWorks software is also known as Wave. This is the software used to acquire and represent electro-physiological data on screen.

Waveform–A graphical representation of the shape of a wave for a given instant in time over a specified region in space.

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