

NeuroWorks 9

Reference Manual

Instructions to access the eIFU (Website)

A copy of the Instructions for Use in PDF format is on the website in the associated product area:

- Neurology: <https://natus.com/natus-support>

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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.
- aEEG, Burst Suppression, Envelope, Alpha variability, Spectral Edge and Spectral Entropy trending functionalities included in NeuroWorks are intended to assist the user while monitoring the state of the brain. The automated event marking function of NeuroWorks is not applicable to these analysis features.
- NeuroWorks also includes the display of a quantitative EEG plot, Density Spectral Array (DSA), which is intended to help the user to monitor and analyze the EEG waveform. The automated event marking function of NeuroWorks is not applicable to DSA.
- 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 IPX0 – ordinary degree of protection against ingress of water according to IEC 60529.

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 60601-1 approved system, or it must be approved to IEC 60950-1/ IEC 62368-1 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.

Only devices that are approved by Natus and supplied as part of an IEC 60601-1 approved system or devices that meet the IEC 60601-1 standard may be connected to the input or output ports of the computer system.

If you combine a medical device with another, strictly follow device installation procedures to ensure IEC 60601-1 Clause 16 ME Systems is met after all devices are connected.



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.

Do NOT use the XLDetect montage with custom channel labels.

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

If multiple medical devices are connected to a patient, the sum of the patient leakage currents may exceed the limits given in IEC 60601-1. Consult with service personnel to ensure compliance with IEC 60601-1 limits.



PATIENT ENVIRONMENT WARNINGS AND CAUTIONS

Outside the USA: Any part of the desktop computer that is not IEC 60601-1 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 60601-1 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 60601-1 Standard and in Europe **MUST** be CE marked.

Outside the USA: Any part of the laptop computer that is not IEC 60601-1 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.

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

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.

Symbol	Description
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.

1.5. Disclaimer



Any serious incident that has occurred in relation to the device should be reported to Natus Medical Incorporated DBA Excel-Tech Ltd. (Xltex) and the competent authority of the Member State in which the user and/or patient is established.

2. Introduction

2.1. Basic Overview

Natus NeuroWorks is electroencephalography (EEG) software that displays physiological signals. The software platform is designed to work with Xtek and other select Natus 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: Natus 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:

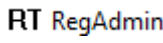
1. Activate installation by inserting the installation CD. To install via the software link, click on the link and press **Run**. Press **Run** again after download completes. In the WinRAR self-extracting archive window that appears, select Destination folder by clicking **Browse**, then press **Install**.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

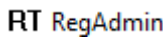
If you wish to add additional features, please contact your Natus representative to place your order. A new Option pack serial number will be provided to you.

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 
2. In the Product Registration Maintenance box, click the View Current Registration Options button.

3. OR
4. In Natus Database, 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 Natus systems, visit the **Technical Support** section of the **Natus** website (http://www.natus.com/index.cfm?page=support_1&cid=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:** Natus 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

Natus headboxes are fully assembled, tested, and calibrated before being shipped to you. There is no need to calibrate either Natus 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	Description
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 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:

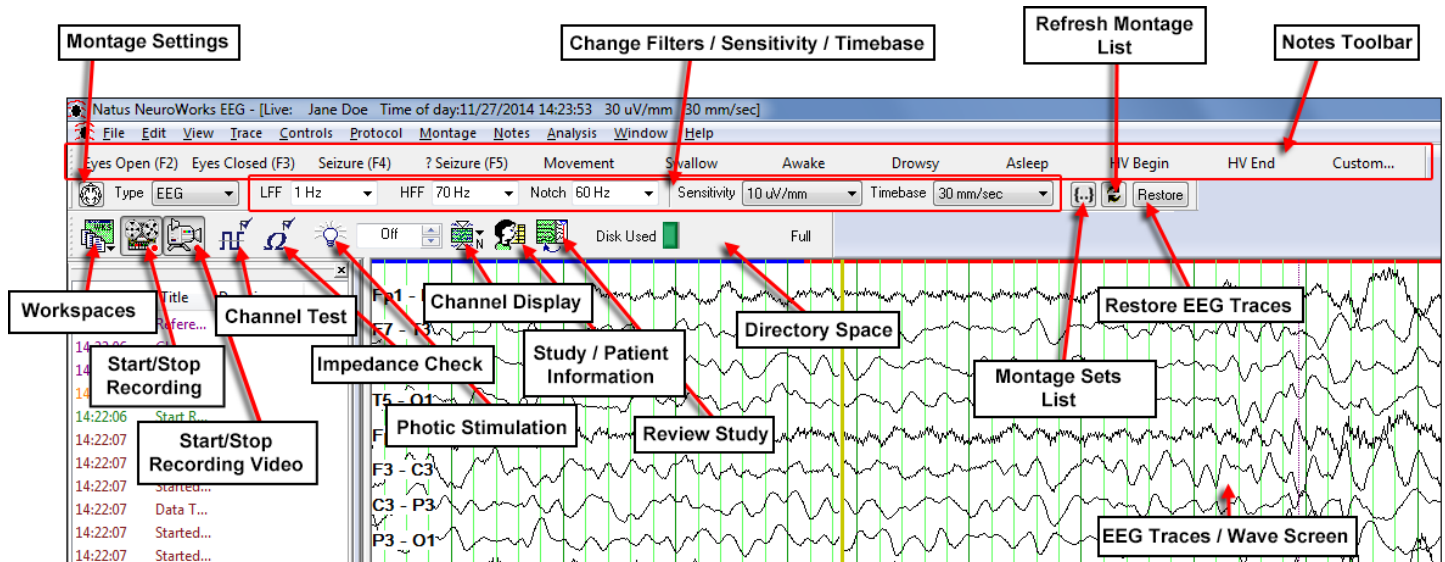
1. Click Start > Settings > Control Panel > Administrative Tools > Event Viewer.
2. The **Event Viewer** window opens.
3. Save this information to your hard drive or a floppy disk by choosing **Action > Save Log File As** on the Event Viewer menu bar and saving the file to the appropriate drive.
4. Send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

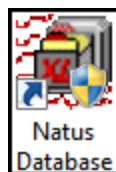
Quick Guides

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.

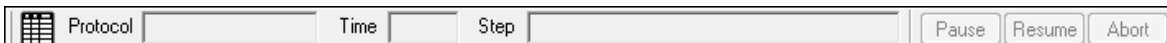


Note Toolbar

- **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...”.

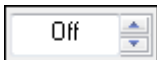
Photic/HV

- **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

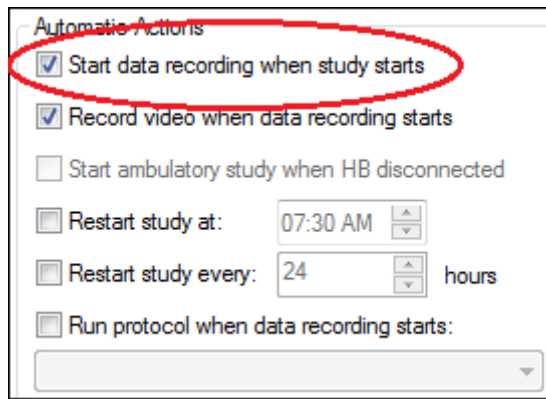


- To review the current study, press the **Review Current Study** button. The currently collecting study will open in the adjacent window. The review window can be maximized or closed independently of the live recording window.

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**.



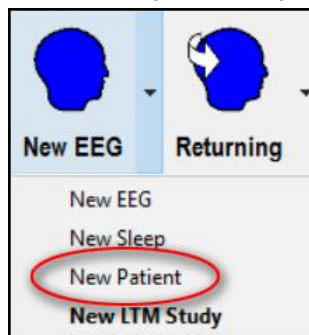
Acquisition tab in Edit Settings dialogue

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).

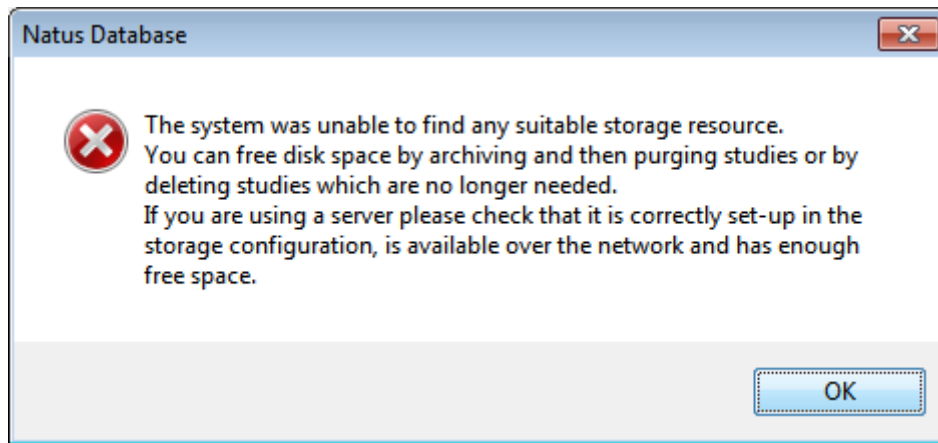


Patient Record in Database List

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.

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

Patient Medications

Patient Info

Last Name Test

First Name Patient

Middle Name

Birth Date

Age

Gender ☐ Male ☐ Female ☒ Not set

Weight kg

Height cm

Body Mass (BMI) N/A

ID

Study Info

Study Name Master

EEG #

Designated Rev.

Visit Name

Order Name

SubtypeGUID__

StartTimeRecord

EndTimeRecord

StudySetGUID

TimeSpanRecord

Patient Address

City

State

Country

ZIP

Telephone

More Patient Info

Chart #

Billing ID

Ref. Phys.

Category ☐ In Patient ☐ Out Patient

Ward

Profile: 256ch

Headbox Name Connected to USB ... ▼

Analyzer Profile Default

Trend Profile Default

Video Assembly @ASSY-SNC550DEMOFR Change

File Name Test~ Patient_4a1e0503-cbc7-49cb-9216-0111427de89c On Xtekdt

Study Directory \\Xtekdt\D\NeuroWorks\DbData\ ...

Start Cancel

Study Information Box at Startup

Study Information

Patient Custom Medications Technologist's Report Physician's Report

Patient Info Study Info

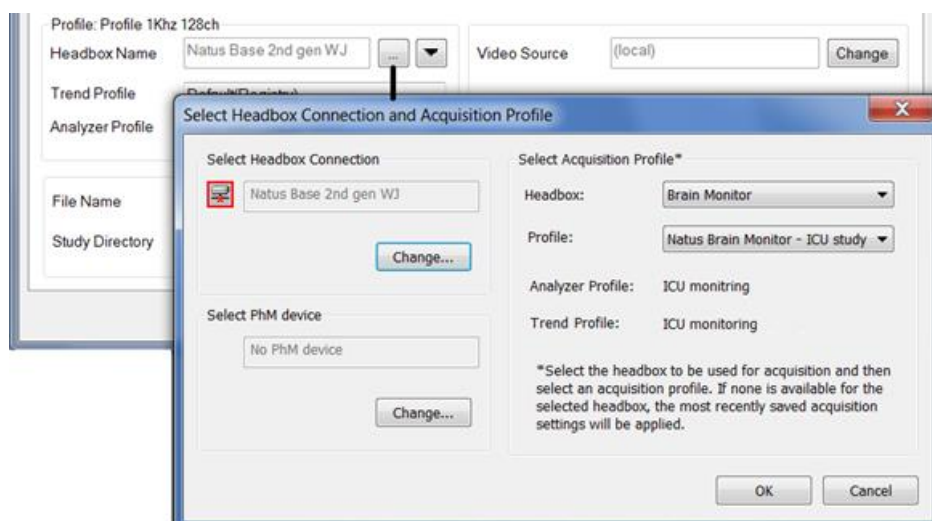
Additional Tabs in Study Information Box after Startup

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:

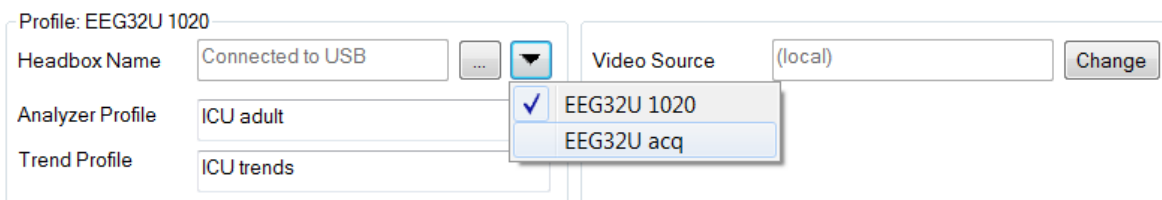
- It is advisable to enter information in all data fields but at a minimum, the patient's first and last name are required.
- **Study Directory box:** Shows the directory on your hard drive or server where the patient's information and data are stored.
- **Change Headbox option**  :
 - The EEG32U, Xltek Brain Monitor, Natus Brain Monitor, Trex/TrexHD, EMUU40EX, and Quantum 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 Select Headbox Connection and Acquisition Profile dialog. This window also allows for the selection of the acquisition profile.



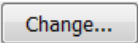
Headbox Option Functionality ()*

(*) The “Select PhM device” option is displayed if the license for Physiological Monitoring is available.

- Select the  button to change the acquisition profile for the currently selected Headbox.



Select Acquisition Profile functionality

- To record data from a Physiological Monitor connected to the Acquisition Unit, press the  button under “Select PhM device”.

The change headbox option is only available at startup on the Study Information Box.

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.

Study Information

Patient Medications **Technologist's Report** Physician's Report

Patient Name: Joe Brown

Patient Status

☒ Normal ☐ Uncooperative ☐ Semi Coma
☐ M.Challenged ☐ Tense ☐ Coma
☐ Awake ☐ Confused ☐ Status Epilepticus
☐ Drowsy ☐ Behavior Difficulty
☐ Asleep ☐ Aphasic

Other

Electrodes

☒ Disc ☐ Needle ☐ Other

Placement

☒ 10-20 ☐ Manual Special Leads

Impedance

Skull Defects

Technologist **Instrument** **EEG #** **Last Attack** **Last Meal**

Administrator

Date **Time** **Age** **Handedness**

Nov 25, 2014 08:46:23 ☐ RT ☐ LT

Hyperventilation **Photic Stimulation** **Technologist's Impression** **Abnormal Features**

History **Clinical Notes** **Normal Background Features** **Sleep Features**

Click the Pencil tool and mark the defect area

Use the Eraser tool to undo a mark.

Click check boxes and buttons to select or clear them.

Click the tabs and enter notes about the various features

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.

Study Information

Patient Medications Technologist's Report **Physician's Report**

Patient Name: Joe Brown

Date: Nov 25, 2014 Time: 11:22:26 Age: 27y EEG #: C

Reviewer: Dr. Frank

Mark As Reviewed **Unmark**

EEG Classification **Clinical Interpretation** Report

Click the tabs and enter information. These tabs can be customized.

Once a study is marked as reviewed, a checkmark appears in one of the fields (columns) in the database window.

Click the Set buttons to choose up to 3 diagnosis codes.

Main Diagnosis: [Text Field] **Set** **Clear**

Suspected Diagnosis: [Text Field] **Set** **Clear**

Secondary Diagnosis: [Text Field] **Set** **Clear**

OK **Cancel**

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.



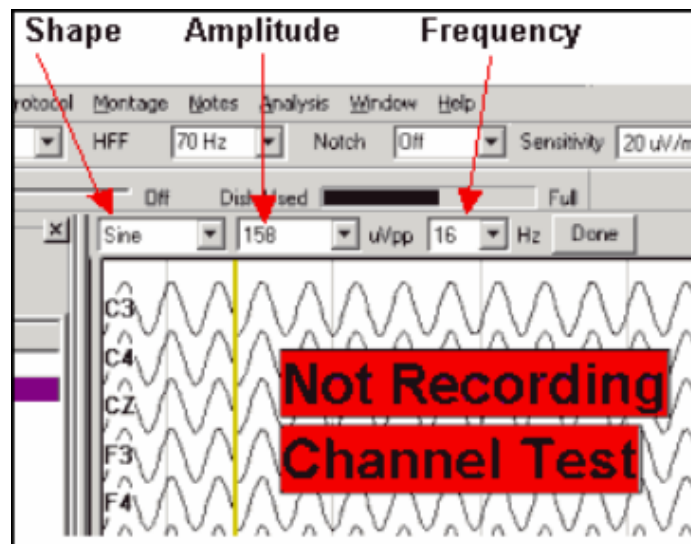
NOTE: The montage changes to ref-all; however, it changes back later.

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 (μ V peak-to peak)	Frequency (Hz)
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
EMU128FS	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/Trex HD	Square	125	0.25, 0.5, 1
Connex & Brain Monitor	Square	50	0.25, 0.5, 1
EMU40EX	Sine	10, 20, 50, 100, 200, 500	5, 10, 20
	Square	10, 20, 50, 100, 200, 500	0.25, 0.5, 1
NeuroLink IP	Square	10, 20, 50, 100, 200, 500, 1000, 2000	0.25, 0.5, 1
Comet-PLUS	Square	500	1, 2, ... , 9, 10
	Square	$\pm$ 50	0.1
V32 & V44	Square	10, 20, 50, 100, 200, 500	0.05, 0.1, 0.2, 1
Natus Quantum	Sine	50, 100, 200	5, 10, 20
	Square	10, 20, 50, 100, 200, 500, 1000, 2000	0.25, 0.5, 1

Headbox	Shape	Amplitude (μ V peak-to peak)	Frequency (Hz)
Natus Brain Monitor Family (Brain Monitor, Brain Monitor iX, Embla NDX, Embla SDx)	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.

To...	Do This...
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 .



NOTE: If the Natus Brain Monitor family amplifier fails to show a test result, please contact tech support.

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:

- **Toolbars** 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:

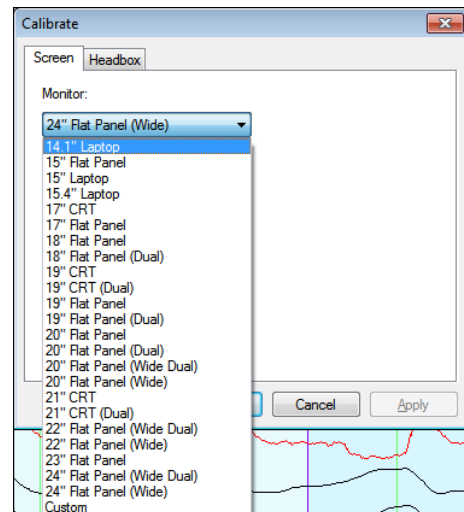
1. Customize any or all of the attributes described above.
2. When you like the current view, press the **Workspaces** button  or **View > Workspace** or **Ctrl + W** or **Ctrl + Shift + Arrow Down** (similar to how **Ctrl + Arrow Down** opens **Navigation** mode drop-down menu).
3. In the drop-down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



Calibrate Screen Dialog

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 monputer) 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:

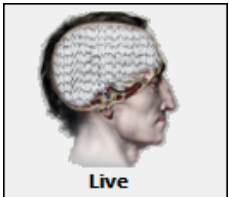
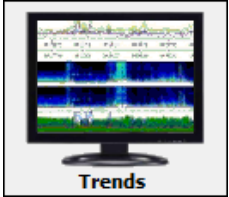
1. In the Database window, select **Tools > Options**.
2. In the Display Options section, put a checkmark next to the **Use ICU Touchscreen mode** option.
3. Select whether you will use the **Natus Trends Summary** or the **Persyst ICU Continuous Monitoring** option to view the study.

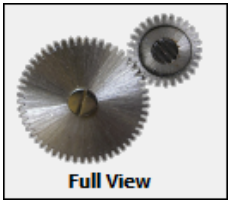
- Once the study is started it will switch to Trends view (or to other mode of user choice) after a period of inactivity. This can be configured in **Natus Database > Tools > Options**.



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

Button	Description
 Show Video	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.
 Camera Control	Camera Control - when equipped with a PTZ camera, this allows the user to control the camera's Pan, Tilt, and Zoom options
 Full View	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.



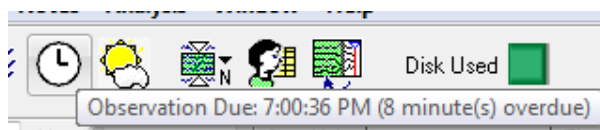
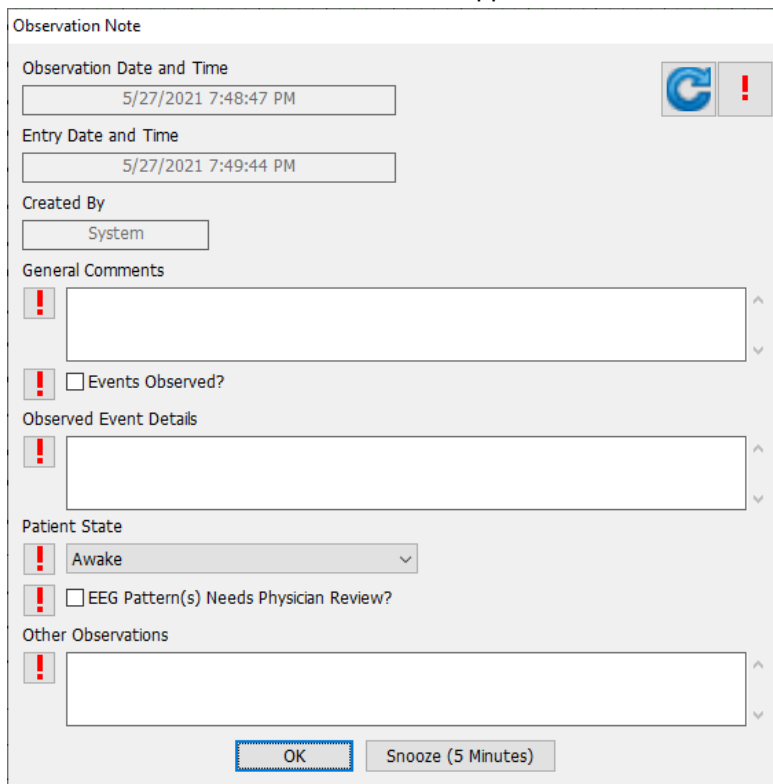
NOTE: Amp saturated indicates the actual signal is too large for the range of the input channel. Adjusting electrode contact to eliminate unwanted signal or noise may correct the problem.

See also: [Recording Video and Audio](#).

3.11. Observation Notes

Observation Notes can be enabled and scheduled to appear at regular intervals during acquisition. The information collected in the Observation Notes and the intervals at which the notes appear are customizable and must be configured prior to starting a study.

The Observation Note dialog box contains auto populated fields such as channel and time information, as well as text fields, check boxes, and drop down fields which can be completed by the acquisition technician. The **Observation Time** displayed is the time the Observation Note dialog box opened and will not update until the note is entered. All other auto populated fields will continue to update or can be refreshed by clicking the blue refresh button in the upper right hand corner.



Sections or entire notes can be marked as important for easy identification in acquisition or review.

To mark a section as important:

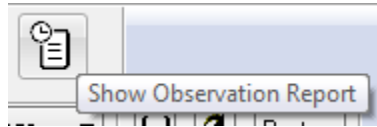
1. Click the **!** in front of a field to mark the entry as important.
2. Click **OK**, hit **Enter** or **ESC** to close the note and save the note information.



Note: Clicking the **!** in the upper right hand corner of the dialog box marks the entire note as important.

An Observation note Icon will appear in the signal window and every note entered will be listed in the Annotation Viewer.

- Click on the Snooze button to delay the Observation entry by a pre-selected amount of time. Snooze closes the dialog box but maintains the Observation Time until it is entered by the user or is automatically saved at the time of the next scheduled observation.
- Show the Observation Note Report by clicking on the Icon to see a list of the Observation Notes entered.



4. Ambulatory Studies

4.1. Overview

During an ambulatory study, EEG or PSG 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
- Trex HD Monitoring
- EMU40EX
- Quantum
- Embletta MPR (PSG only)

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

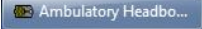
The **Ambulatory Headbox Manager** is a separate program for running studies with ambulatory headboxes (Trex HD, Trex HD Monitoring EMU40EX, Quantum, Embletta MPR).

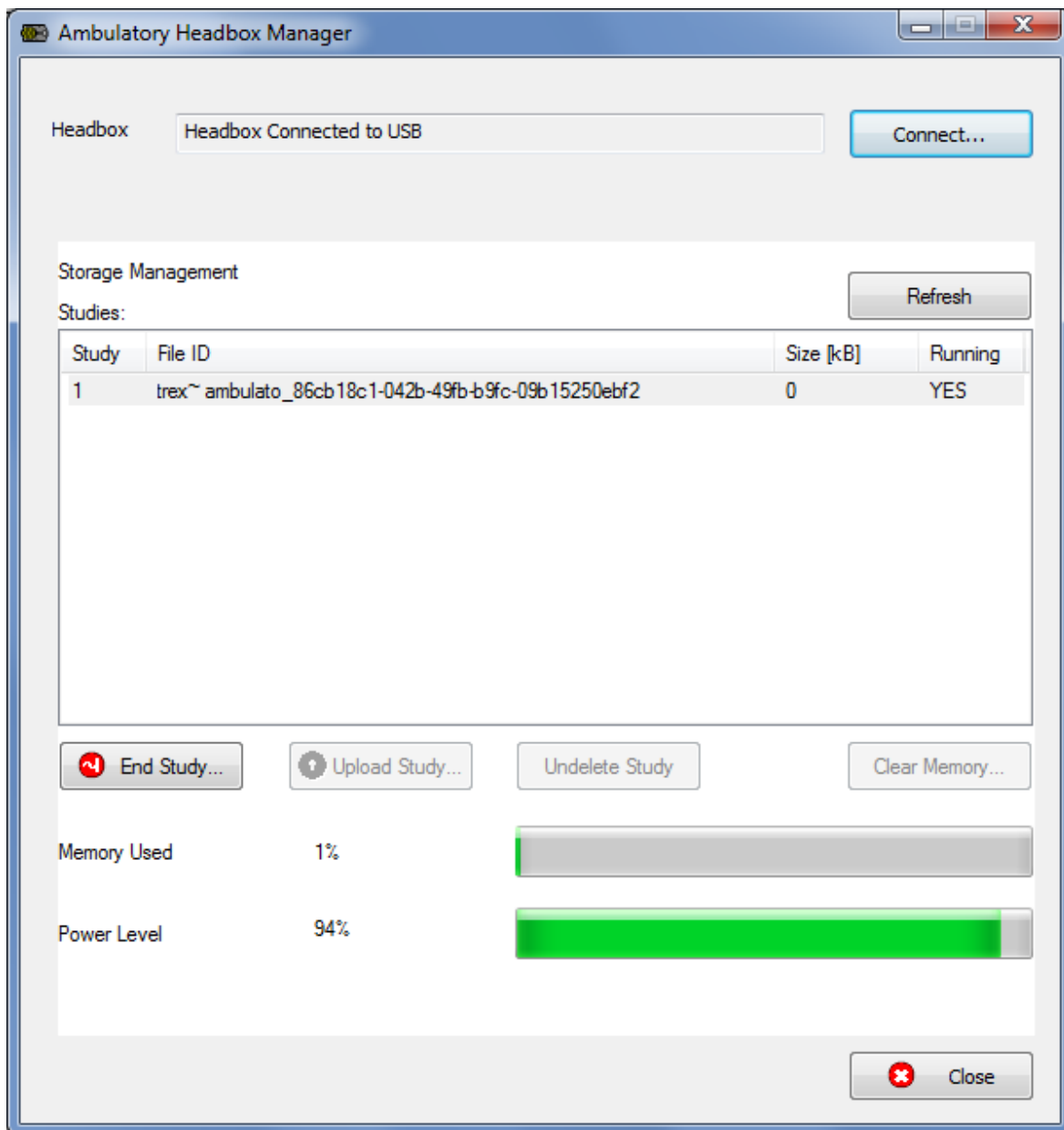
The Ambulatory Headbox Manager window shows information about studies currently stored in the flash memory of the headbox. It also enables you to:

- 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 HD, multiple studies may be visible. The Trex HD 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.

Edit Settings

Protocol Montage Channel Labels Timebase Acquisition Review Analysis Alarms

Trex Ambulatory

- EEG 32 Channel Headbox
- EEG 128-256 Channel Headbox
- 28 Channel Ambulatory Headbox
- Hyppo (Sleep) Headbox
- 36 Channel EMU Headbox
- MOBEE 24 Headbox
- MOBEE 32 Headbox
- Connex/Brain Monitor
- Trex Ambulatory
- EMU40 Headbox
- Quantum Headbox
- Netlink Headbox
- Traveler Headbox

200

256

512

Automatic Actions

- ☒ Start data recording when study starts
- ☒ Record video when data recording starts
- ☒ Start ambulatory study when HB disconnected

Electrode Detection

Channel Status

☒ All channels on

☐ Set manually

Fp1	ON
F7	ON
T3	ON
A1	ON
T5	ON
O1	ON
F3	ON
C3	ON
P3	ON
Fpz	ON
Fz	ON
Cz	ON
Pz	ON
Fp2	ON
F8	ON
T4	ON
A2	ON
T6	ON
O2	ON
F4	ON
C4	ON
P4	ON

Channel Off

Channel On

Menu of Headbox Types in Acquisition Tab

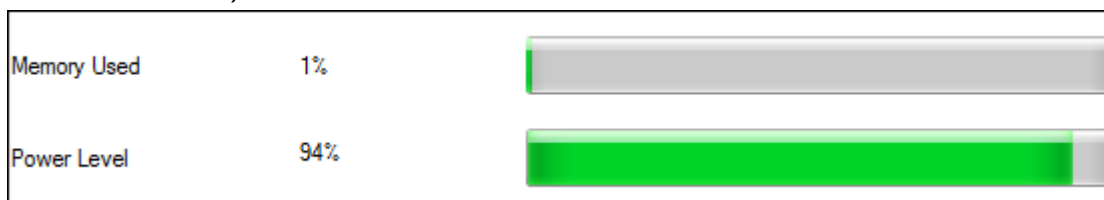
For acquisition settings related to the Trex HD Monitoring headbox and the ambulatory monitoring workflow, refer to the Trex HD Monitoring User & Service Manual (p/n 019694).

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 HD/Trex HD Monitoring):

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 HD, we strongly recommend that you use **major brand name AA alkaline batteries**, such as Duracell® Coppertop®, Duracell Procell® or equivalent. 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 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/Trex HD 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/Trex HD headbox can be verified by a flashing yellow light on side of headbox.



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

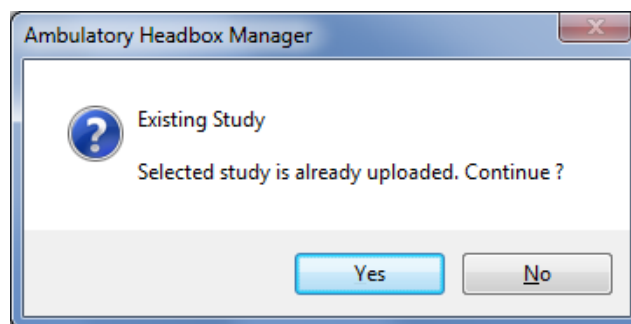
Ending and Uploading an Ambulatory Study

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.

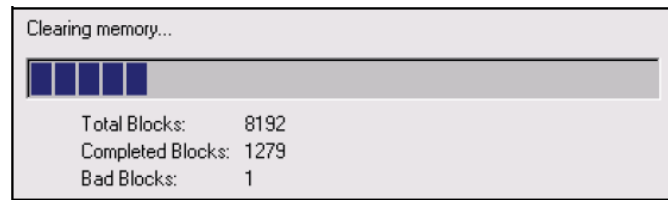
- If the study was started as an ambulatory study and has already been uploaded once, a second version of the study is added to the database.



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   **Close**



NOTE: No status messages will appear when the flash memory of the Trex/Trex HD 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.

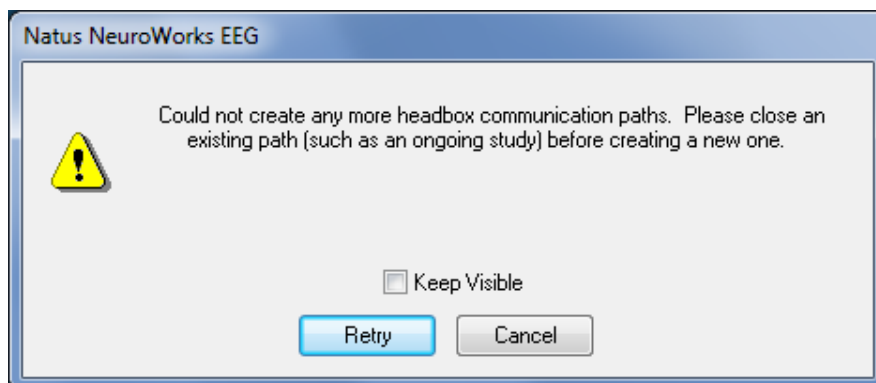
Finding the Study after Uploading

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

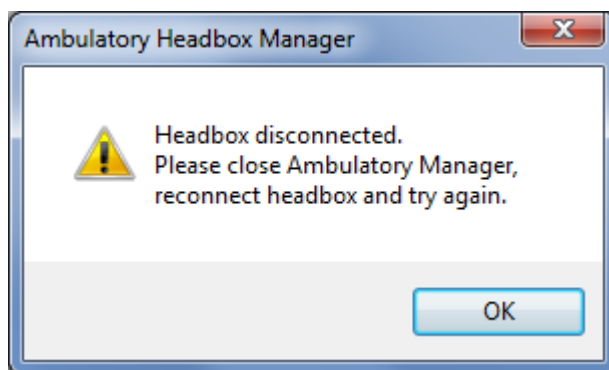


The warning above appears if you have a headbox attached and are running a study, but the data is currently recording to the computer's hard drive.

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 1920x1080 (Full High-Definition) resolution.

USB Webcams

USB webcams are compatible with NeuroWorks 9.3 and later, on portable tablet computers (for use with Trex HD Monitoring). For supported webcam models, refer to the Release Notes in your NeuroWorks installation or contact Natus Technical Support.

Internal Cameras

Internal, or built-in, cameras may be used with NeuroWorks 9.3 and later, on portable tablet computers (for use with Trex HD Monitoring).

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.

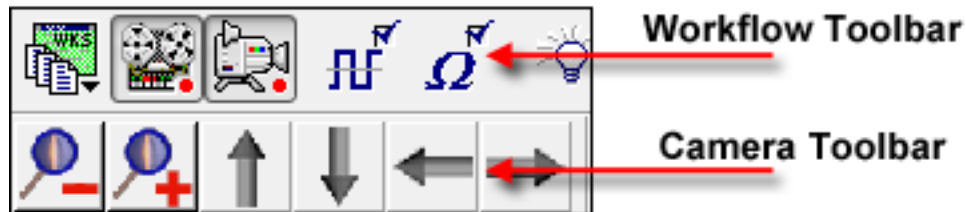
When the microphone and speakers are in the same room, feedback can occur. To avoid feedback, place the microphone up to 80 feet from the acquisition unit (or turn off the speakers).



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.

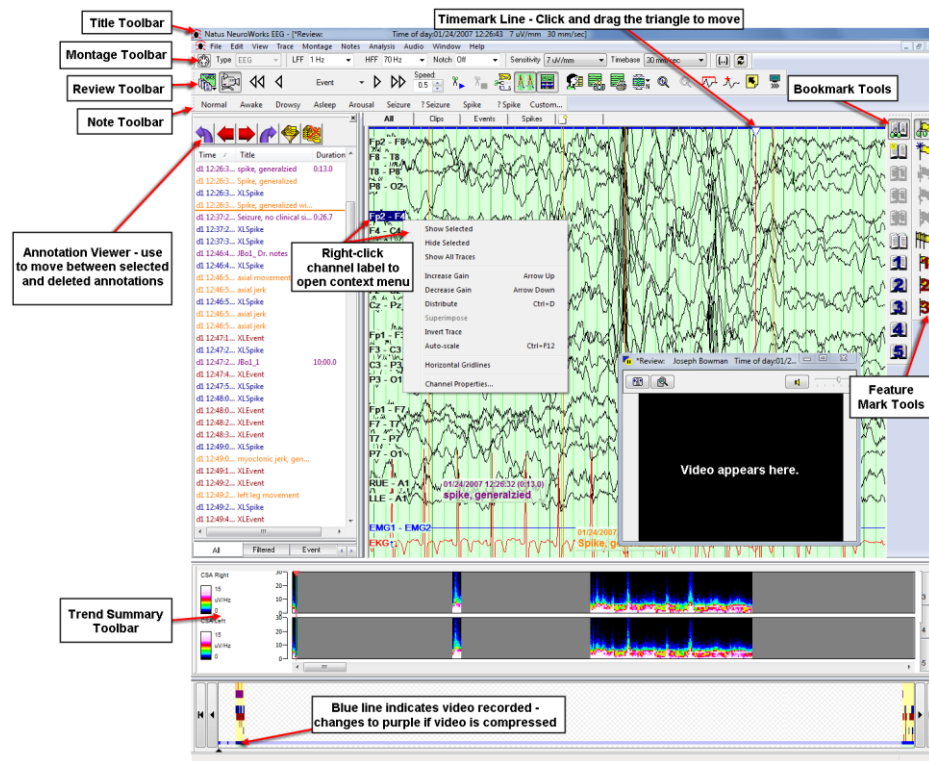
Several tools are available to help you with the review process:

- Screen Capture tool
- Waveform Cursors tool
- Integration with Persyst 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:

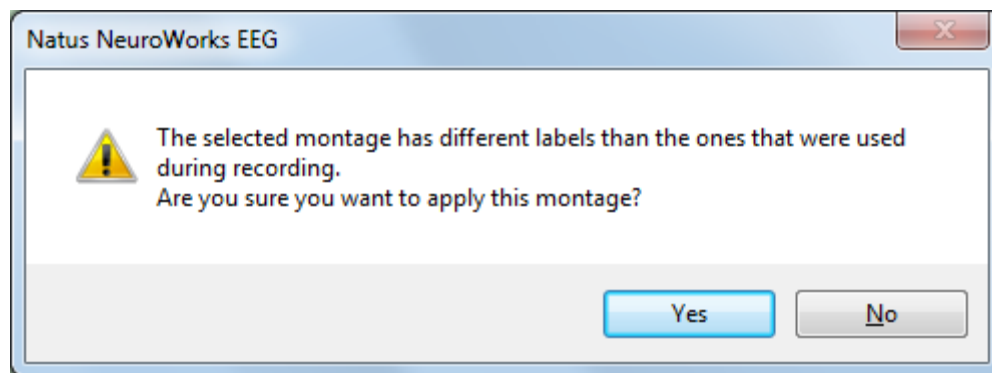
1. Open Natus Database.
2. Select (highlight) the study you want to review.

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

6.3. Mismatched Labels Warning

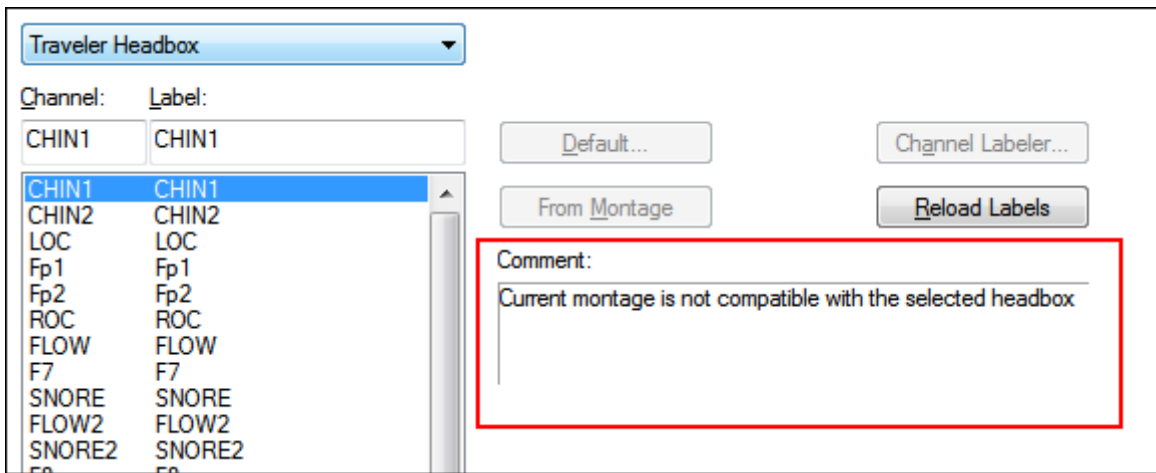
When a recording is made with a multi-channel headbox such as a Quantum or EMU128FS, labels are typically created for each patient or type of study. It is therefore possible that during **Review** a wrong set of labels may be applied to a study, thus making correct review problematic.

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.



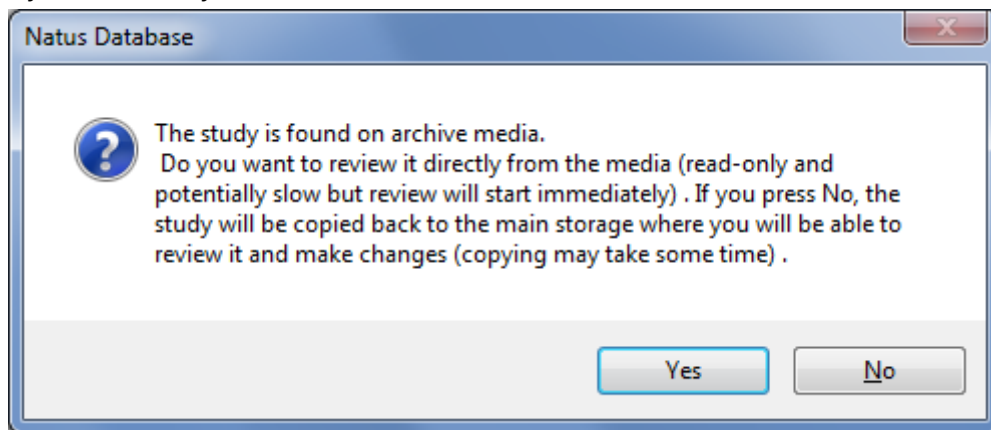
Mismatched Labels Warning – Edit > Settings Menu

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.

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.

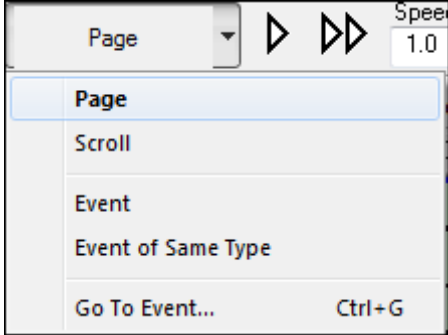
Using the Review Toolbar to Navigate through a Study



Review Toolbar

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

Navigation Options

Option	Description
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:

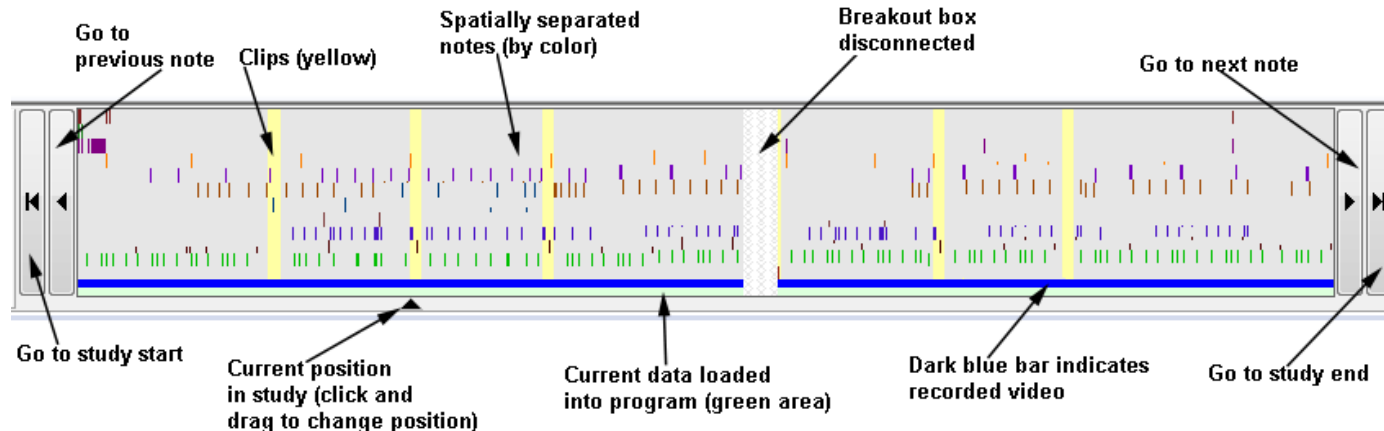


Speed Control in Review Toolbar

- 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.

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.

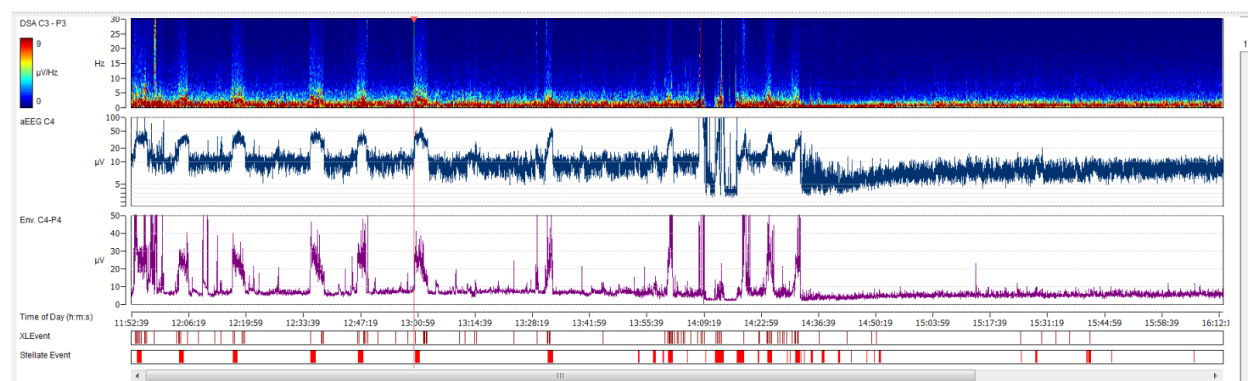


NOTE: The dark blue bar at the bottom of the Study toolbar changes to purple where there is squeezed video.

Using the Trend Summary Toolbar

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:

- Density Spectral Array (DSA)
- Amplitude-Integrated EEG (aEEG)

- Quantified EEG trend (qEEG)
- Burst Suppression trend
- Envelope trend
- Alpha Variability trend
- Spectral Entropy trend
- Spectral Edge trend
- Data and Amplitude trend
- Event trend



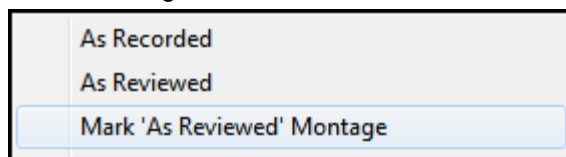
NOTE: Refer to “Using Analyzers to review a study” for more information on how to use trending tools.

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 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.

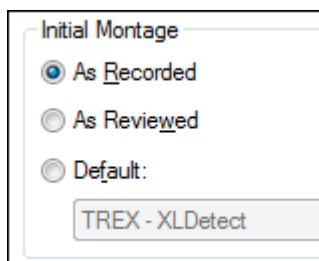
Time	Title	Epoch
04:59:03	Snoring	681
04:59:08	Snoring	682
04:59:15	Montage:cpap [01]	682

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



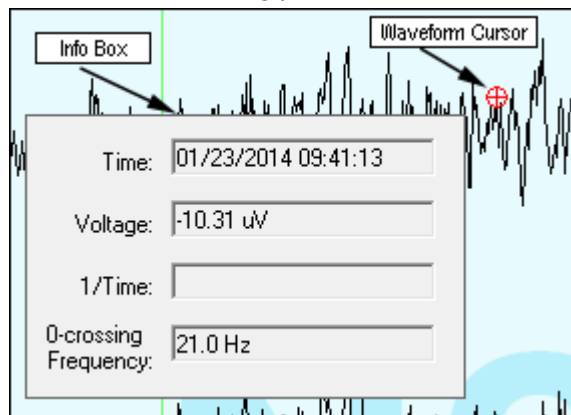
NOTE: Only one **As Reviewed** set of montages is kept and shared by everybody reviewing a given study. Montage changes are kept in the **.ENT file** (notes file).

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.

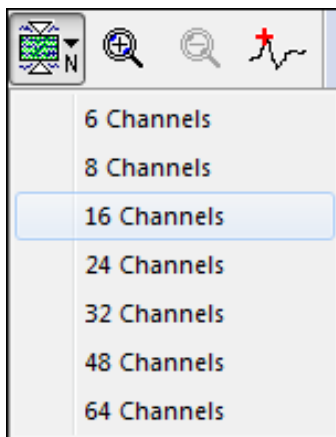


Waveform Cursor and Info Box

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

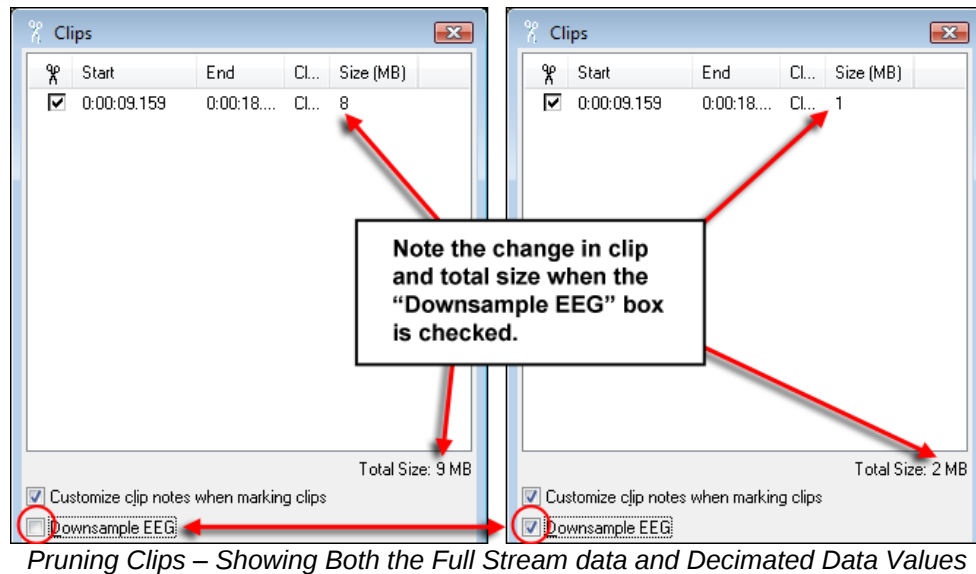
6.9. Clipping and Pruning a Study

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 Quantum, EMU128FS, or Natus Brain Monitor family studies collected at 2000Hz or higher, you can choose to keep only the down-sampled EEG data collected.



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](#)

6.9.1.1. 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**.

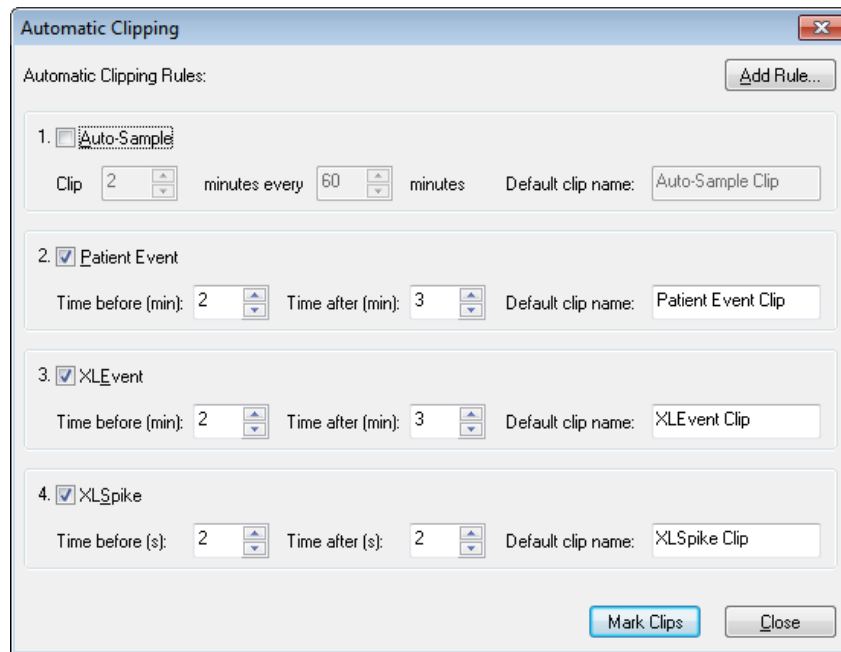
Clipping and Pruning a Study using Automated Clip Marking

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 dialog 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 subtype	The list of available subtypes is dependent on the note type. Some note 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.

Option	Function/Description
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.

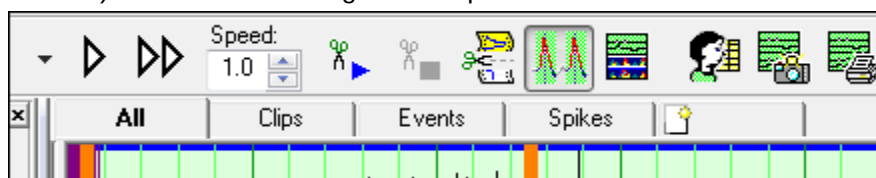
Using the Instant Pruned View

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.

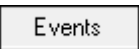
To display the Instant Pruned view:

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:

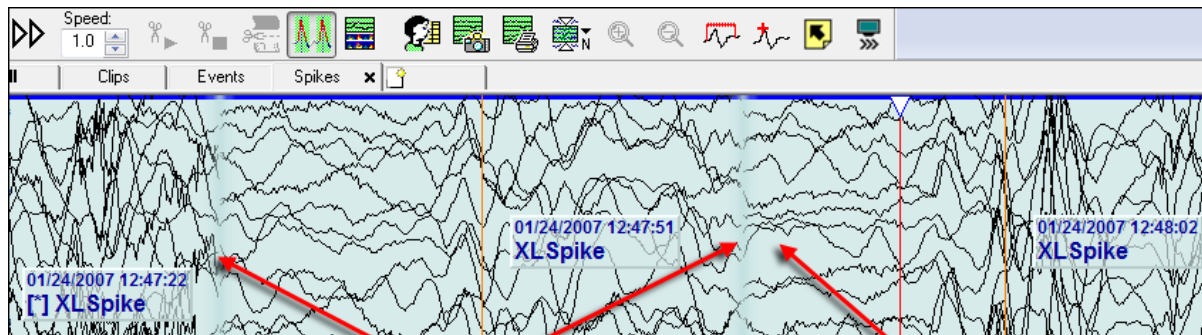


Instant Pruning Toolbar

Instant Pruning Toolbar Buttons

	All: Exits Instant Pruning view and redisplay the normal view.
	Clips: Displays only clips that have already been made.
	Events: Displays only events that occurred during the study.
	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**  or **Events**  or **Spikes** . Here is an example of the instant pruned view of spikes in a study:



Blurred blue areas indicate breaks between the clips

Background appears in blue as a reminder that this is the Instant Pruned View

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**.

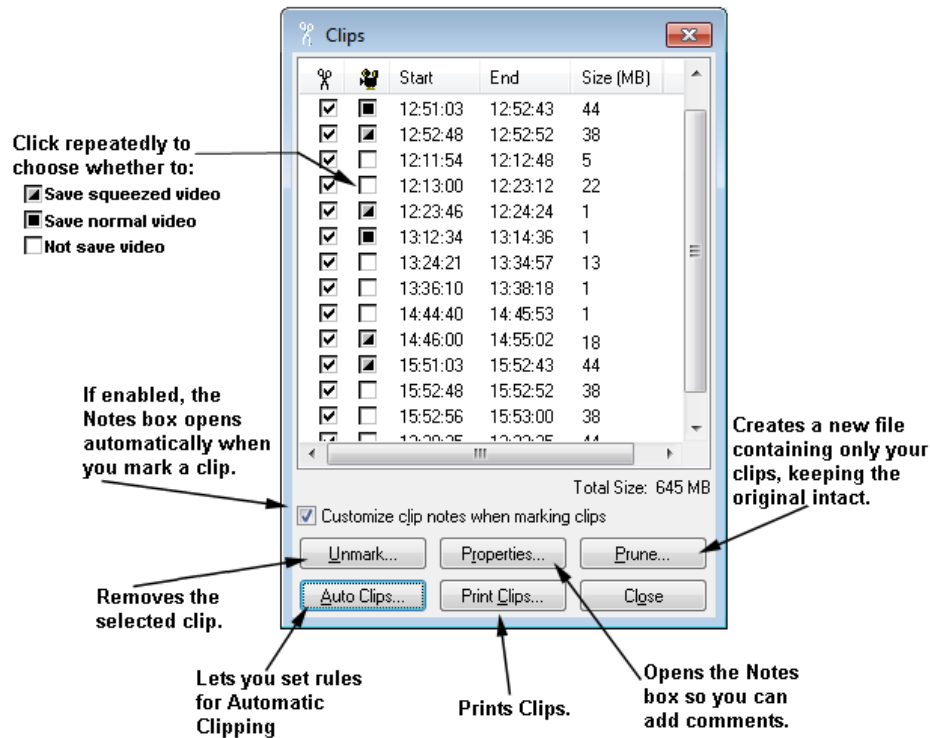
Processing Clips in the Clips Box

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:

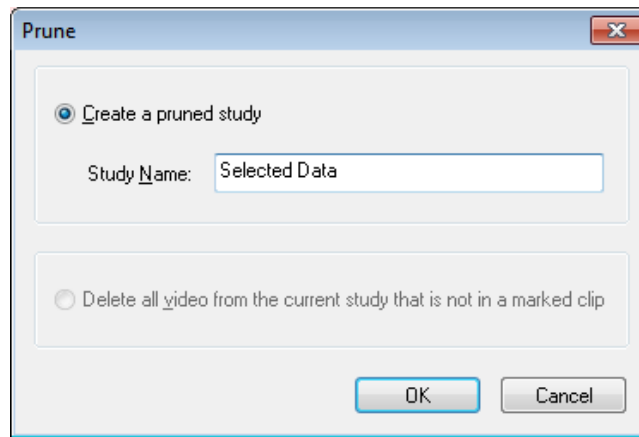
1. Click the **Edit Clips**  button on the toolbar (or choose **Edit > Clips** or press **Ctrl + L**). The **Clips** dialog box appears.

- Choose which clips you want to include with the study by clicking the checkbox under the **Clip**  column.
- Select whether or not include video for each clip. To include video, click the checkbox in the **Video**  column.
- 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](#).
- 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

- When you have finished selecting clips, click the **Prune**  button in the Clips dialog or right-click and choose **Create Pruned Study**.
- 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

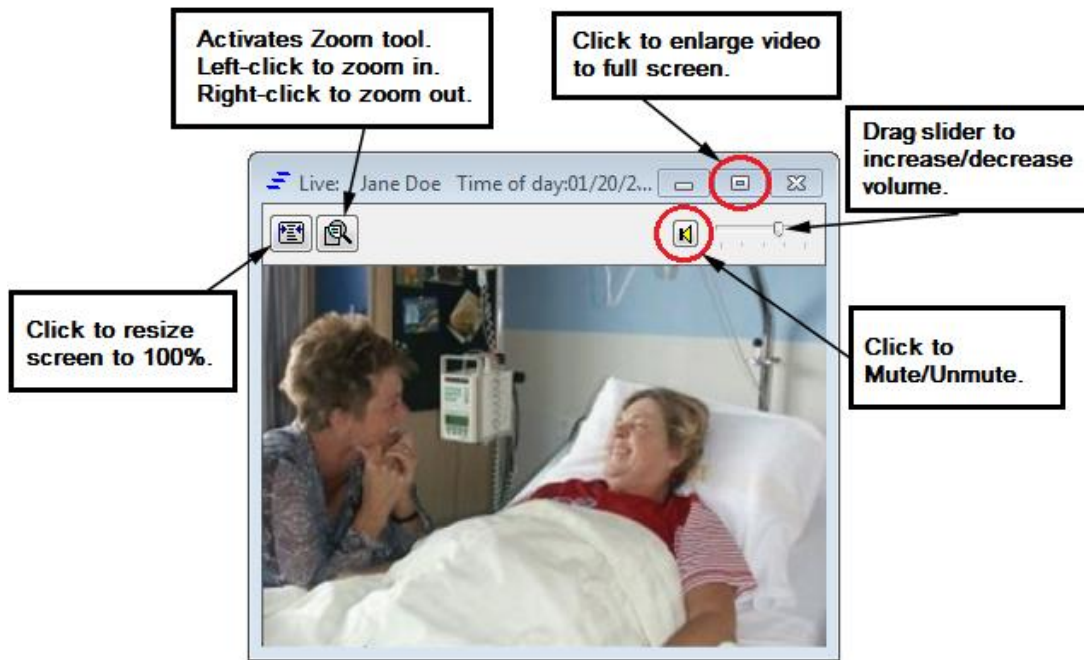
you would like the pruned study to have a different number, click the **Info**  button on the toolbar to open the **Patient Information** dialog box and type a new name into the EEG# text box. The new number for the pruned segment appears in the EEG# column of the Natus Database.

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.

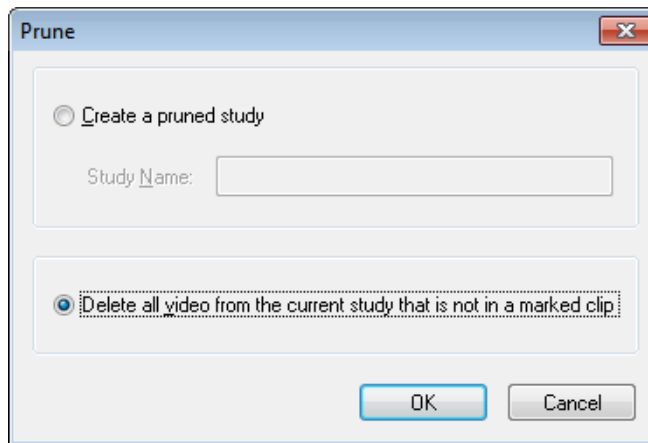
The Review screen will be displayed without video. At the top of the waveform window, there is a **blue line** along the portions of the study with recorded video. To view the recorded video, choose **View > Video (Ctrl + U)**.

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.

1 study selected (70 MB)

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. Screen Capture Using Snapshot

Within NeuroWorks/SleepWorks, you can enable and use the Snapshot feature to automatically save the

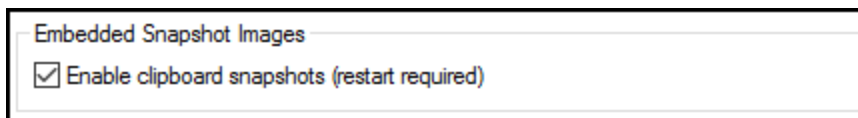
screen captures directly to an image file. This uses the Screen Capture button ; however, the capture is now directly saved to the file as a report image. Once the study has been closed XLDB will be updated with a report icon  beside the study. This indicates either a report is attached to the study, or there are snapshots that can be added to a report. See section 8.6 *Adding Snapshots to Reports* for how to add a snapshot to reports.



NOTE: Snapshots are moved and stored with the reports attached to a study. If excluding reports from when moving files, the snapshot images will be lost.

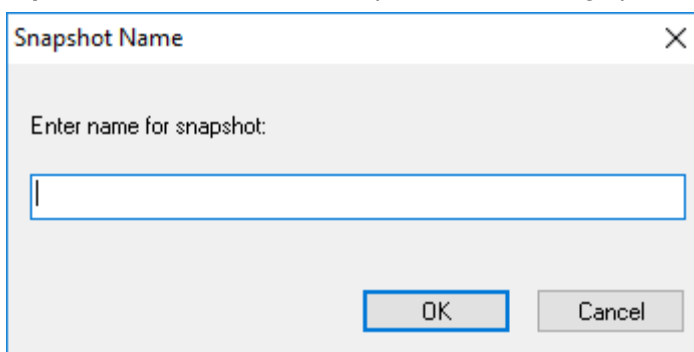
To perform a screen capture using Snapshot:

1. Ensure the Snapshot feature is enabled, by selecting **Edit > Settings> Review (tab)**, and placing a check mark next to **Enable clipboard snapshots (restart required)**. Restarting Wave will enable the snapshot feature.



2. Once snapshots are enabled, navigate to the screen/page you want to capture.

3. Press the **Screen Capture**  button. The Snapshot Name dialog opens.



4. Enter the desired name for the snapshot screen capture, and click **OK**. The snapshot is saved directly to the study.



NOTE: Each snapshot name should be unique. Re-using a name will cause the snapshot to be overwritten with the updated screen capture. The snapshot feature will remember the previously used name in the study, and will auto-populate using this name for future snapshots.

Viewing Snapshots Within a Study

Snapshots can be navigated to from within a study by selecting **File > Go To Snapshot**. The list of available snapshot images will be shown in the Go To Snapshot dialog. Select the desired snapshot and click the **GoTo** button to navigate to the snapshot location.

Deleting Snapshots Within a Study

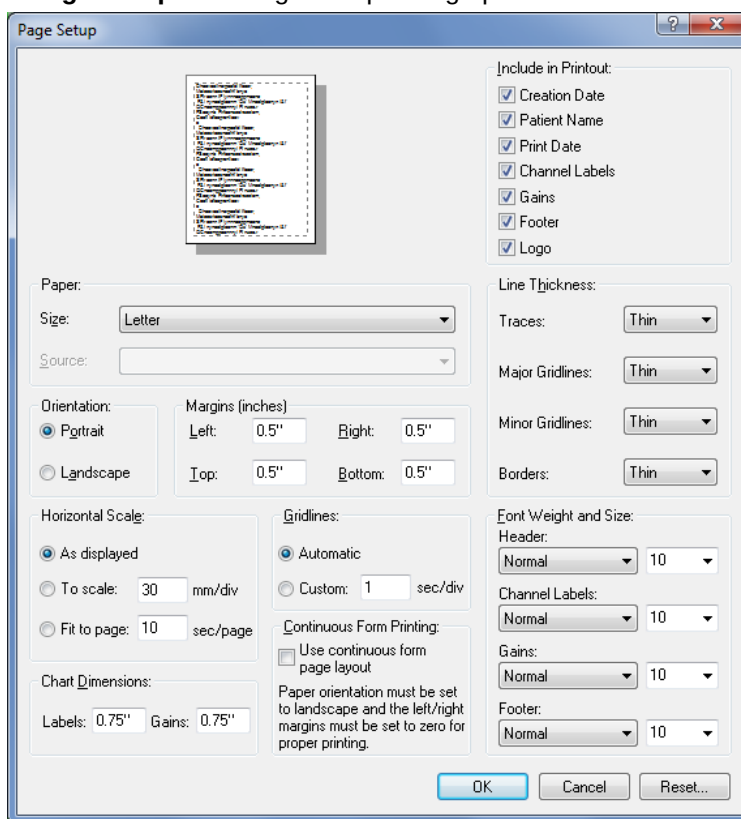
Snapshots can be removed from within a study by selecting **File > Delete Snapshot**. The list of available snapshot images will be shown in the Delete Snapshot dialog. Select the desired snapshot and click the **Delete** button to remove a snapshot from the study. This action cannot be undone.

6.13.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**.

6.14. 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**.

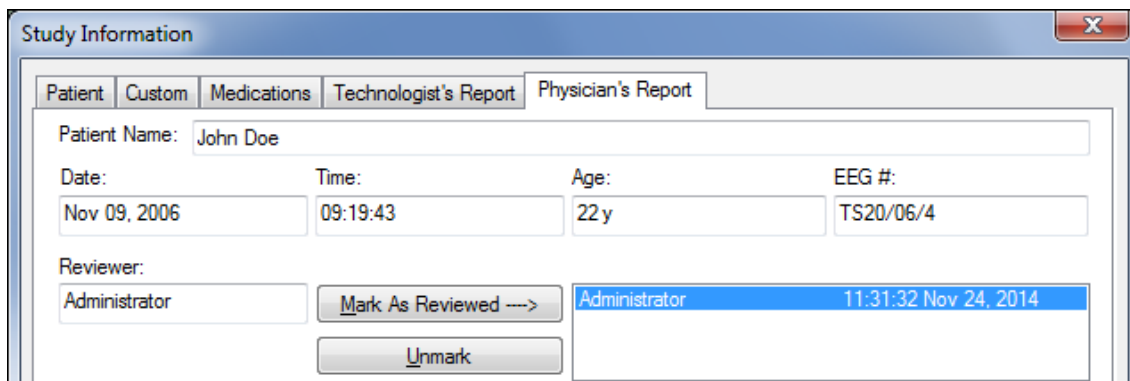
6.15. Marking and Unmarking a Study as Reviewed

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



Patient	Custom	Medications	Technologist's Report	Physician's Report
Patient Name: John Doe				
Date:	Time:	Age:	EEG #:	
Nov 09, 2006	09:19:43	22y	TS20/06/4	
Reviewer:				
Administrator		Mark As Reviewed ---->		Administrator 11:31:32 Nov 24, 2014
		Unmark		

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.

6.16. Adding Comments to Report Tabs

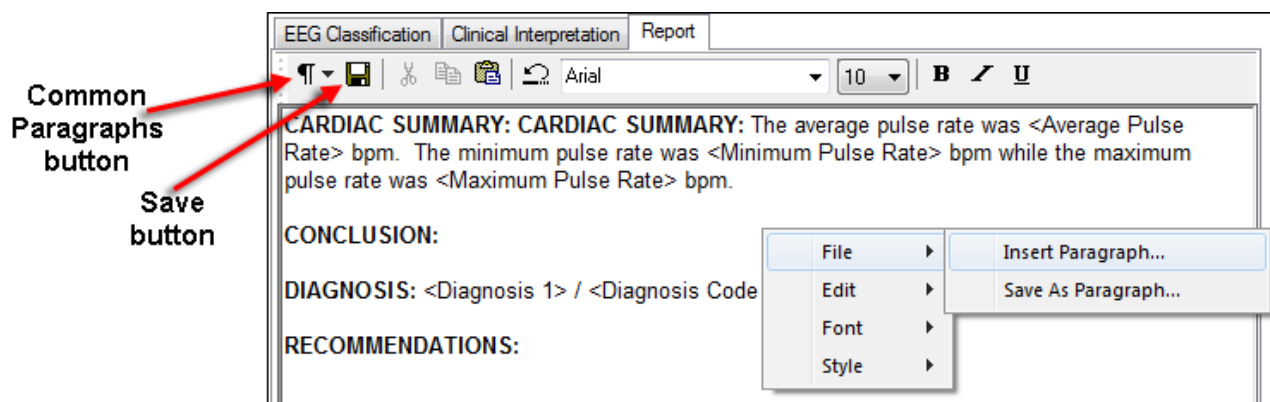
Comments may be typed into the **Study Information** form by selecting any **Report tab** and clicking in the text space area to situate your cursor. Each tab includes a formatting toolbar which can be used to format your text style such as font type and size. **Right-clicking** anywhere in the text 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

6.17. 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.

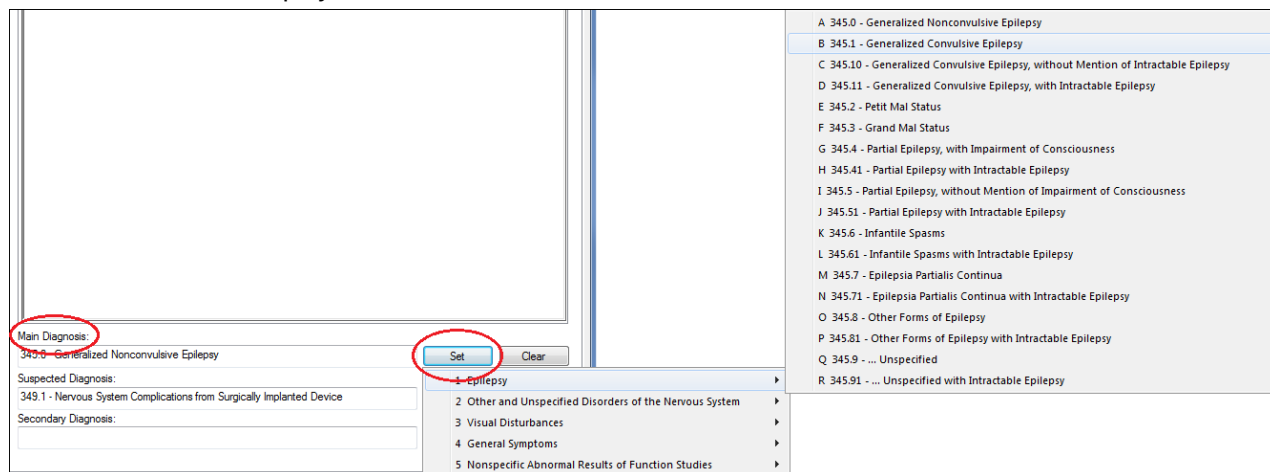
To specify diagnosis codes:

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.

The screenshot shows a software interface for selecting diagnosis codes. On the left, there are fields for 'Main Diagnosis:', 'Suspected Diagnosis:', and 'Secondary Diagnosis:'. The 'Main Diagnosis:' field contains '345.0 - Generalized Nonconvulsive Epilepsy'. Below these fields are 'Set' and 'Clear' buttons. The 'Set' button is circled in red. To the right of the 'Set' button is a dropdown menu with a list of categories: 1 - Epilepsy, 2 Other and Unspecified Disorders of the Nervous System, 3 Visual Disturbances, 4 General Symptoms, and 5 Nonspecific Abnormal Results of Function Studies. The '1 - Epilepsy' category is selected. On the far right, a list of specific diagnosis codes is displayed, ranging from A 345.0 - Generalized Nonconvulsive Epilepsy to R 345.91 - ... Unspecified with Intractable Epilepsy.

Diagnosis Codes

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

6.18. 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.



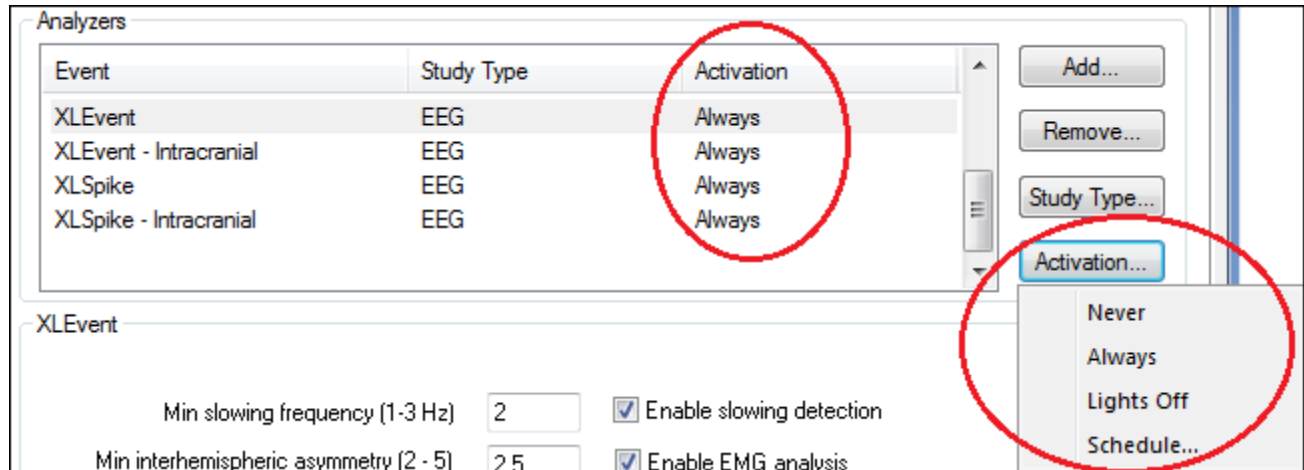
NOTE: In addition to the default analyzer profile, multiple analyzer profiles can be stored as “named” profiles and added to the acquisition profiles.

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.

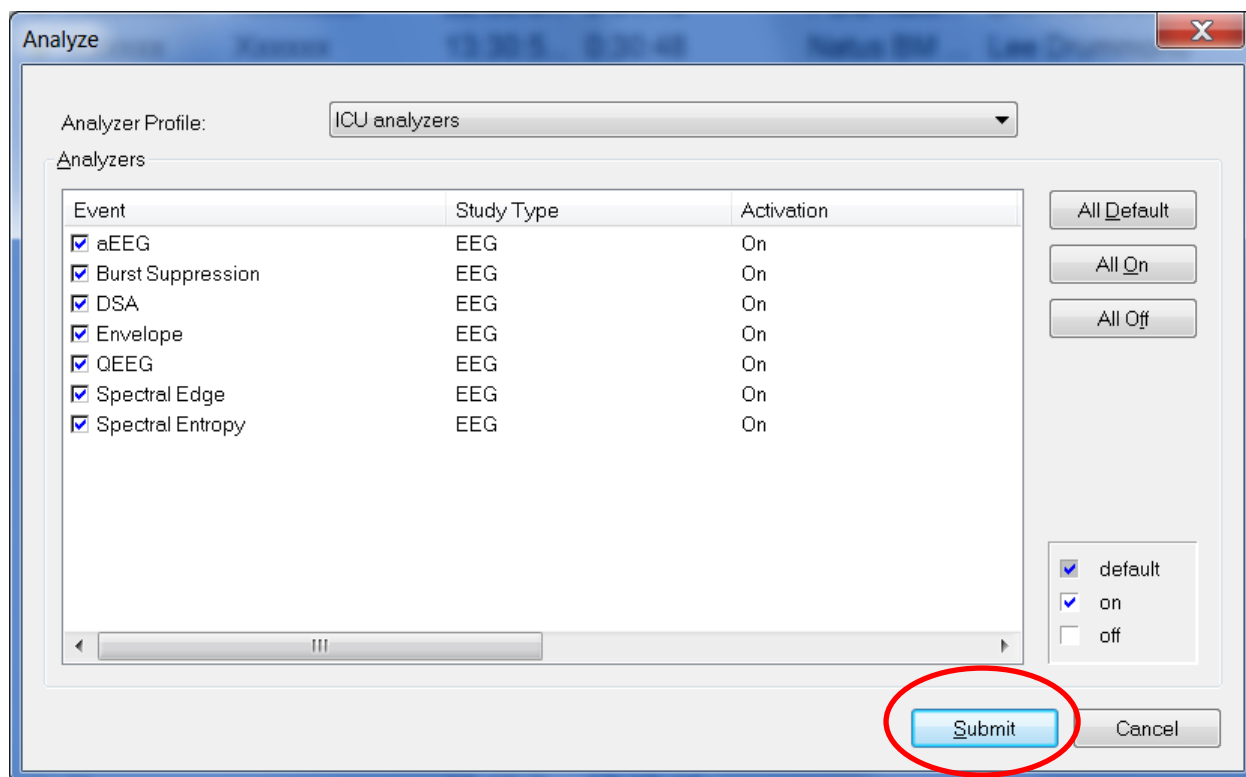


Activation Options Displayed on Analysis Tab

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:

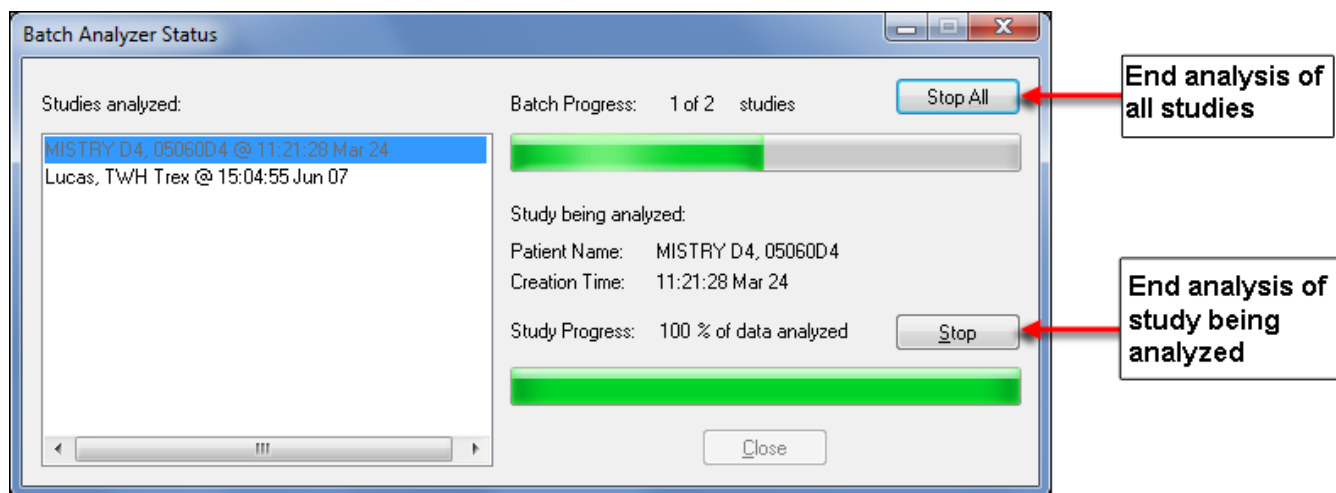
- Do not submit any study for batch analysis that is currently open in a Natus program. Batch analysis will fail to start and an error message will appear.
- Once a study is submitted for batch analysis, do not attempt to open it in a Natus program for review before the analysis is complete. Batch analysis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



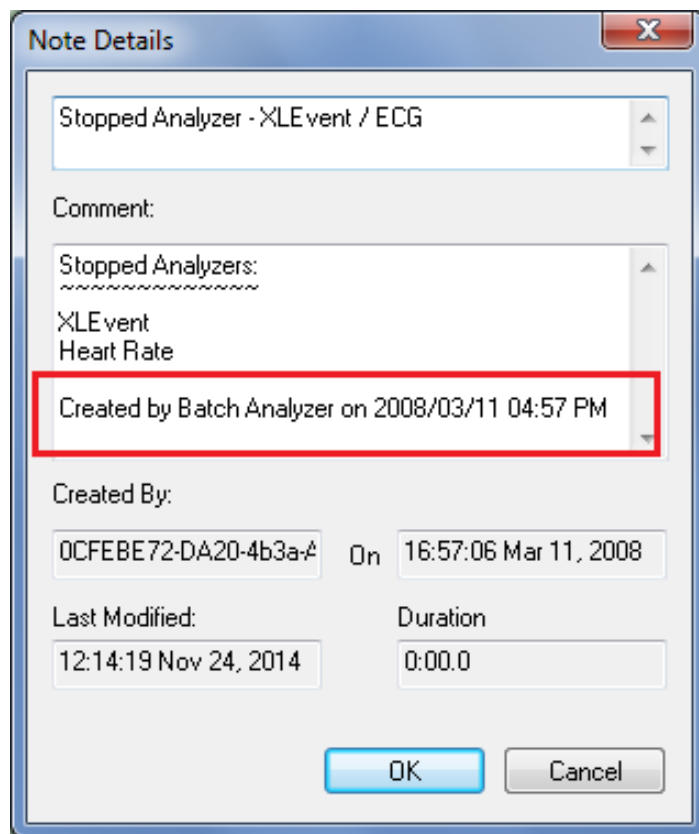
NOTE: If more studies are selected for a batch run, each study (if recorded with a different headbox) needs to have the correctly assigned montage.



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.

				Last name	First name
				XXXXXXXXXX	XXXXXX

Batch Analyzed Study Marker in Natus Database Study Record

Detector Settings for Analyzers

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**).



NOTE: Refer to “Using the analyzers” section to learn more about how to configure the analyzers.

Montages Used by the Analyzers

- 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.

6.19.Integration with Persyst

NeuroWorks is fully integrated with the **Persyst ICU Continuous Monitoring** 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 Persyst analysis tools.

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



NOTE: For more information about Persyst please visit www.persyst.com. NeuroWorks 8.4 is compatible with Persyst 13.

MagicMarker trends and spike and seizure detectors can be viewed in the NeuroWorks EEG application during Acquisition and Review modes.

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

Adding Persyst Trends to Review a Study

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

1.1 Reviewing Observation Notes

The **Observation Notes** collected during study acquisition can be reviewed by one of the following means:

- Clicking on the Observation Note icon in the tool bar to open the closest Observation Note dialog box and navigate to that area of the study
- Single click on the Observation note entry in the Annotation Viewer to navigate to the area of the study that the note was entered. Click on the Observation Note icon in the signal window to open the Observation Note.
- Double click on the Observation note entry in the Annotation Viewer to navigate to and open the selected Observation Note.
- Clicking on the blue arrows in the Observation Note box allows you to jump to the previous or next note in the study.
- Clicking on the Observation Note Report icon will open the report which will display a list of all the Observation notes entered and allow you to navigate to the note of your choice.

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.

Analyzers used for trending purposes:

- Density Spectral Array (DSA)
- Quantitative EEG (qEEG) *
- Amplitude-Integrated EEG (aEEG) *
- Burst Suppression trend *
- Envelope trend *
- Alpha Variability trend *
- Spectral Entropy trend *
- Spectral Edge trend *
- Data and Amplitude trend
- Event trend



NOTE: Trending features marked with * are options included in the Natus advanced trending package.

Analyzers used for detecting and automatic editing of events:

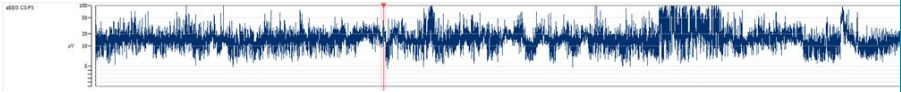
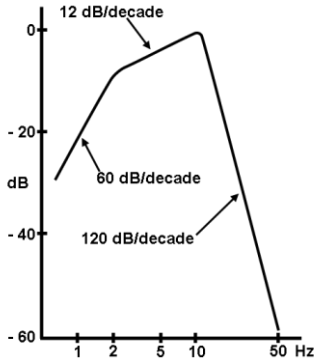
- Spike Detectors (XLSpike, Stellate ICTA-S, Persyst)
- Event Detectors (XLEvent, Stellate ICTA-S, Persyst)
- Event Detectors for Depth/Grid (Stellate ICTA-D)

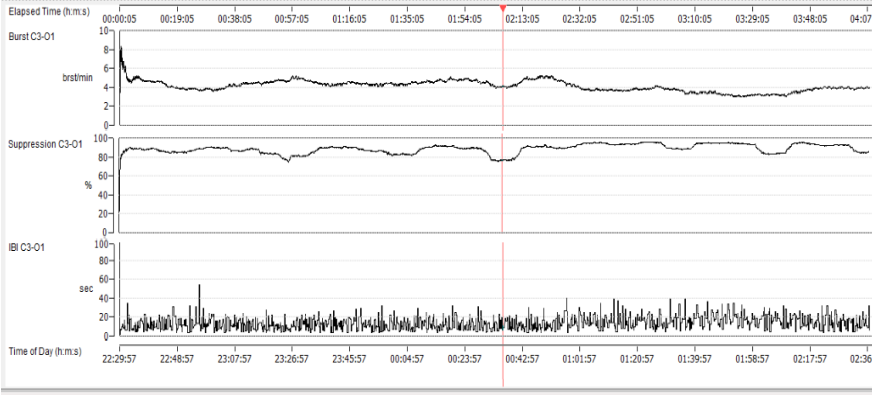
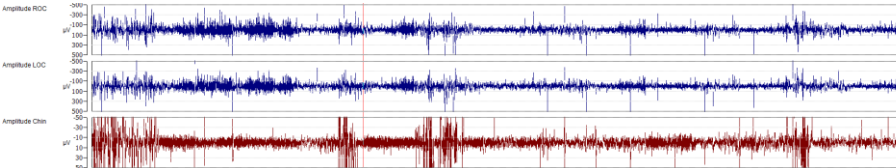
Spike and Event detectors highlight particular events in the EEG. These automatic detectors help users to efficiently process large amounts of EEG data using different detection algorithms. A detector takes as input EEG signal and outputs detected events, by marking them on the traces. You can use a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

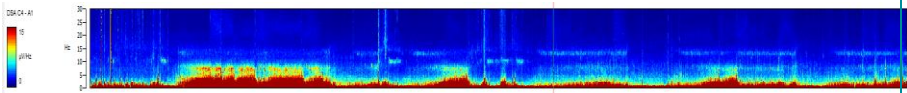
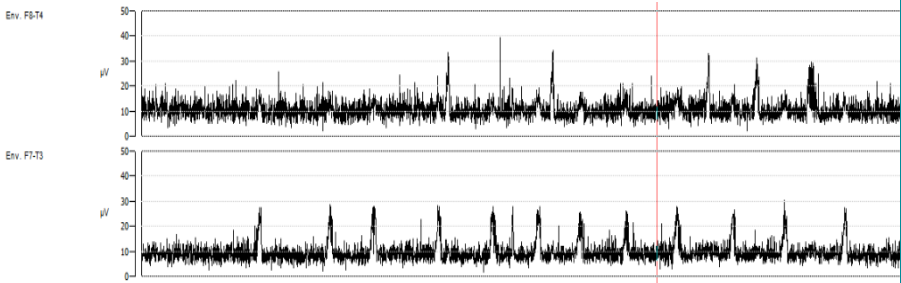
If used online, specified detectors are activated automatically once the data is being recorded. They can also be enabled and disabled manually during data acquisition

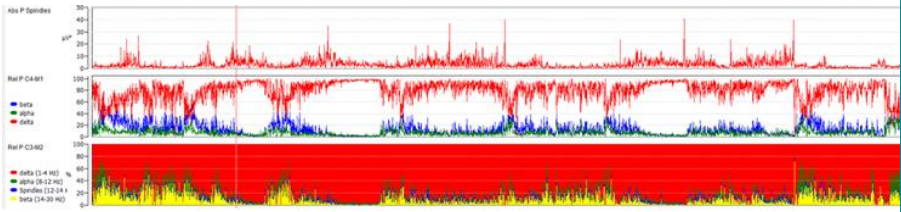
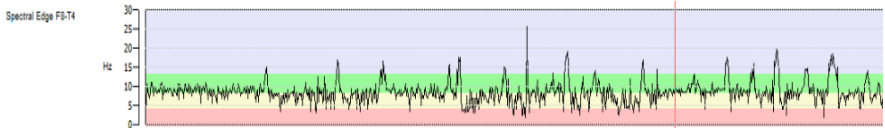
If used offline, you may submit one or more studies for analysis directly from the Natus Database by specifying which detectors are to be used. Each detector can be configured with its own configuration UI interface.

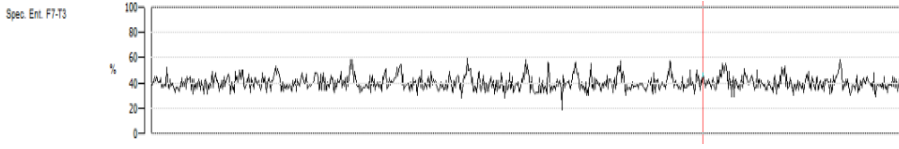
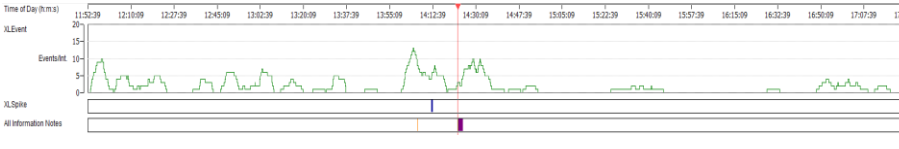
The following table shows details for each analyzer:

Analyzer name	Definition	Use case
aEEG (Amplitude integrated EEG)	The aEEG analyzer processes and stores amplitude of EEG according to the aEEG algorithm, in order to display a aEEG trends. aEEG trends show a compressed view of the variation in amplitude of the EEG.  The aEEG method is based on a time-compressed semi-logarithmic (linear 0 to 10 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. aEEG trends are typically displayed using the 6cm/hour time scale. The specification of the aEEG filter implemented in NeuroWorks is shown below:  aEEG Filter Specifications as Used in NeuroWorks	ICU

Analyzer name	Definition	Use case
Burst Suppression	The burst suppression analyzer detects and stores data related to high amplitude EEG segments alternating with very low amplitude EEG segments and displayed on the Burst Suppression trends. • Burst rate: average n° of segments with higher-amplitude and mixed-frequency activity over the analysis window length • Suppression & % Suppression (=Burst Suppression ratio, BSR): Suppression is defined as segments with low-amplitude background EEG activity (<10 µV), interrupted by bursts. % Suppression = (sum of duration of suppression during analysis window / analysis window length). The default analysis window is 10 min • Inter-burst interval: Duration of the last complete suppression period (will be detected 1 – 2 seconds after arrival of burst ending the suppression...)The numerical values for these parameters can be displayed in the Heads-Up display panel. 	ICU
Alpha Variability	The Alpha Variability analyzer detects and stores power in the 6Hz to 14Hz band (including alpha) compared to the wide band power between 1Hz and 20Hz. The Alpha Variability analyzer is required to display Alpha Variability trends. 	ICU
Amplitude	The Amplitude analyzer detects and stores Minimum and Maximum values of the selected AC type input channel, such as EMG, EOG, etc...The Amplitude analyzer is required to display amplitude trends. 	ICU, LTM, PSG, OR, Research

Analyzer name	Definition	Use case
Data trends	The Data Trend analyzer detects and stores Minimum and Maximum values for data recorded from external devices or channels through DC inputs. The Data Trend analyzer is required to display Min/Max trends.	ICU, PSG
DSA	The DSA analyzer is required to display DSA trend graphs, which are 3-dimensional color graphs representing frequency on the vertical axis, time on the horizontal axis, and power on the color scale. The DSA analyzer processes and stores FFT data representing the spectral power distribution in the signal from a number of selected referential channels DSA from differential channels or from a group of channels (such as left or right hemisphere) can be selected in the trend plot settings. Specifications for DSA: • Bandwidth = 0.5Hz to 64Hz • Time resolution = 2 seconds • Frequency resolution = 1Hz or 0.5Hz • Unit = $\mu\text{V}/\text{Hz}$ or $\mu\text{V}^2/\text{Hz}$ Max. number of channels: 20 	ICU, LTM, PSG, OR, Research
Envelope	The Envelope analyzer algorithm provides advanced analysis of the amplitude of the EEG, reducing the impact of artefacts, for the purpose of assisting the user in localizing seizures. The envelope analyzer is required for displaying envelope trends. 	ICU, LTM

Analyzer name	Definition	Use case
qEEG	Power spectrum is analyzed with the optional Quantitative EEG (qEEG). The spectrum bands may be analyzed during a live study or during review. Spectrum analysis plots may be added when reviewing study without a need to re-analyze. 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. QEEG data can be processed up to 30Hz. 	ICU, LTM, PSG, OR, Research
Spectral Edge	The Spectral Edge analyzer processes and stores FFT data, representing the frequency below which the majority of the power (typically 95%) is located. The Spectral Edge analyzer is required to display Spectral Edge trends. 	OR

Analyzer name	Definition	Use case
Spectral Entropy	The Spectral Entropy analyzer stores data indicating the complexity or the regularity of the EEG signal, required to display Spectral Entropy trend graphs. The Spectral Entropy analyzer is required to display Spectral Entropy trends. 	ICU, LTM, Research
Event	Event trends represent the presence of annotation of a selected type throughout the whole study. Event trends can show a single tag for each event, or a vertical bar representing the number of events of the selected type in a time interval. 	
Persyst	Analyzer required to display trend graphs using Persyst software (optional).	ICU, LTM, PSG, OR
Stellate 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. Refer to “Stellate Analyzers” in this manual for more details.	ICU, LTM
Stellate 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. Refer to “Stellate Analyzers” in this manual for more details.	ICU, LTM
XLEvent XLEvent-Intracranial	The 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.” Refer to “Stellate Analyzers” in this manual for more details.	ICU, LTM
XLSpike XLSpike-Intracranial	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. Refer to “Using Analyzers to Review a study” in this manual for more details.	ICU, LTM
Oxygen desaturation	Detects minimum and maximum amplitude of Oximetry. In addition to detection of Oxygen desaturation events, the Oxygen Desaturation analyzer is required for displaying O2Sat trends.	ICU, LTM, PSG
Heart Rate / R-R	Detects minimum and maximum amplitude of Heart Rate. The Heart Rate / R-R analyzer is required for displaying Heart rate and RR Interval trends.	ICU, LTM, PSG

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

Analyzer profiles

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



NOTE: Analyzer settings can be defined in a single Default profile, or in multiple customized profiles meeting the requirements for several specific use cases.

Configuring Analyzers to Run During Acquisition

On acquisition units it is recommended to add the analyzer profile to the acquisition profile for online analysis of the recorded data.

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

The screenshot shows the 'Natus Database Options' dialog box with the 'Analysis' tab selected. The 'Profile' dropdown is set to 'ICU analyzers'. The 'Headbox - Montage pair' section shows 'Headbox: Brain Monitor' and 'Montage: --- As Recorded ---'. The 'Analyzers' table lists several analyzers, with 'Burst Suppression' selected. The 'Burst Suppression' section is expanded, showing 'Use Montage: Custom montage: AP Bipolar - BM', 'Labels: Track "As Recorded" labels' (checked), 'Channels: C3-O1, C4-O2, Fp1-C3 (Display in HUD), Fp1-T3, Fp2-C4, Fp2-T4', and 'Parameters' including 'Minimum suppression length (seconds): 2', 'Burst threshold (µV): 300', 'Suppression threshold (µV): 40', and 'Sliding analysis window (seconds): 600'.

Event	Study Type	Activation
aEEG	EEG	Always
Burst Suppression	EEG	Always
DSA	EEG	Always
Envelope	EEG	Always
QEEG	EEG	Always
Spectral Edge	EEG	Always

Burst Suppression

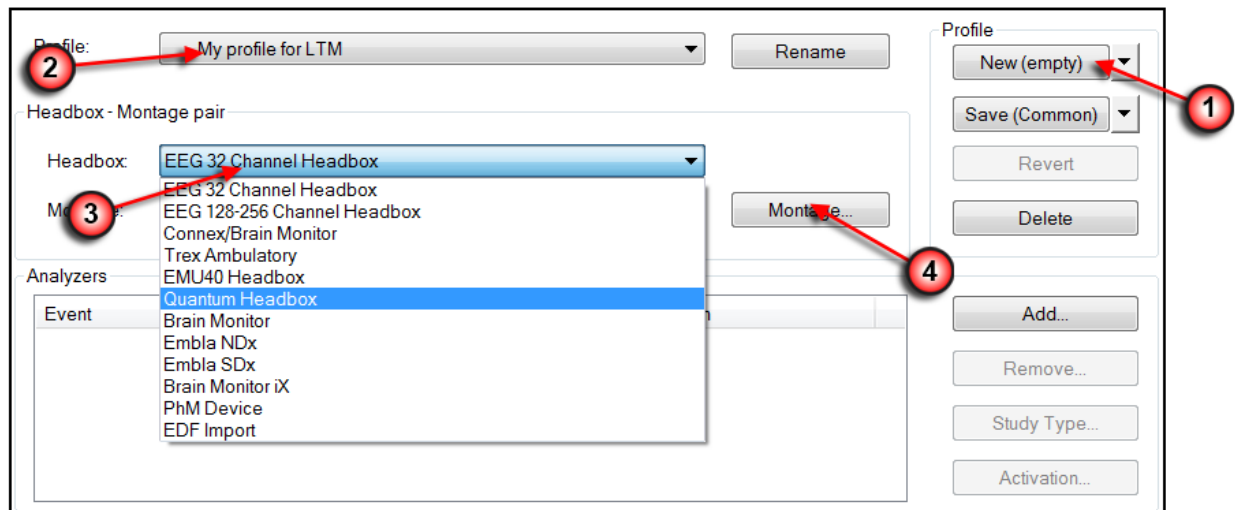
Use Montage:
☐ Custom montage: AP Bipolar - BM

Labels:
☒ Track "As Recorded" labels

Channels:
C3-O1
C4-O2
Fp1-C3 (Display in HUD)
Fp1-T3
Fp2-C4
Fp2-T4

Parameters
Minimum suppression length (seconds) 2
Burst threshold (µV) 300
Suppression threshold (µV) 40
Sliding analysis window (seconds) 600

To create an analyzer profile :

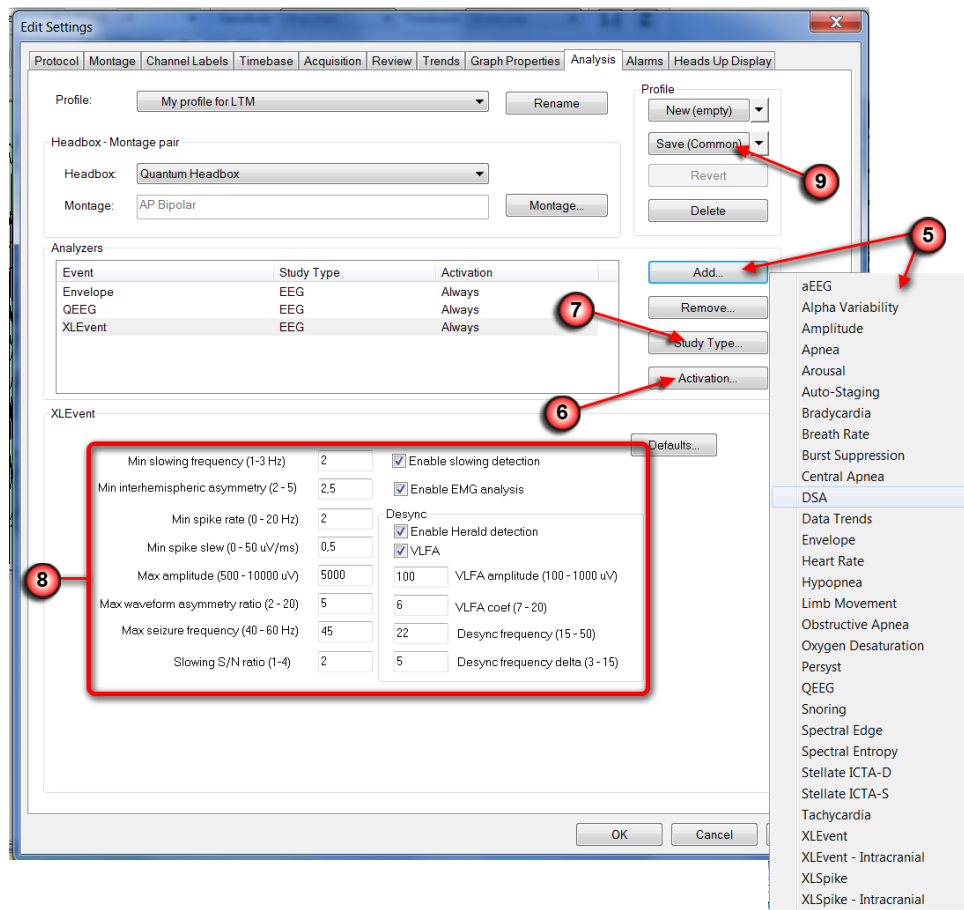


Creating an Analyzer profile

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.

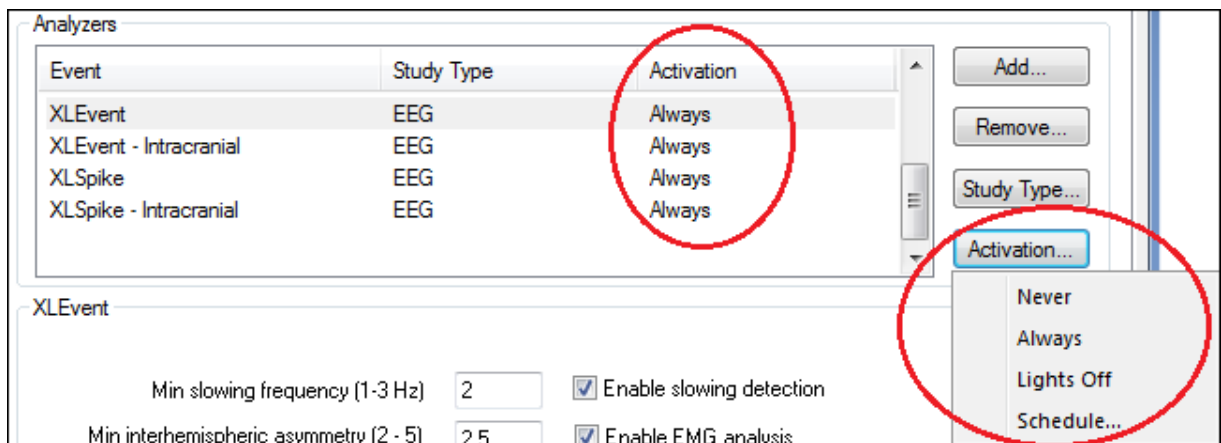


NOTE: The analyzer montage specified as a default for the whole profile, or the custom montage specified in individual analyzers must be available on the system running the analyzer. Only channels available in the selected montage will be analyzed. Consequently, montages used by analyzers should never be deleted.



Configuring analyzers in the Analyzer profile

4. Click **Add** to add an analyzer that is available but not visible on the Analysis tab.
5. 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

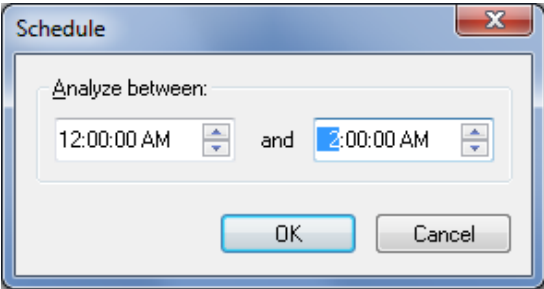
- Click the **Study Type** button to define if the analyzer shall be used in EEG type studies, in Sleep studies, or both in EEG and Sleep studies. In the context of analyzer profiles, each analyzer in the profile should be set to the same study type.
- Define the settings of the analyzer.
- Once all analyzers are configured in the profile, click the **Save (Common)** button to store the Analyzer profile to the local settings, or to the common settings folder.

Save (Common)



NOTE: Customized “named” analysis profiles are typically used to meet the requirements for specific use cases, such as ICU monitoring, LTM, or even Sleep. Therefore, the study type in the list of analyzers part of a single profile is typically set to the same type for all analyzers in a “named” profile.

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).	A. Select Schedule. The Schedule box appears. B. Set times by clicking and entering values or using the up and down arrows. C. When finished, click OK. 

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

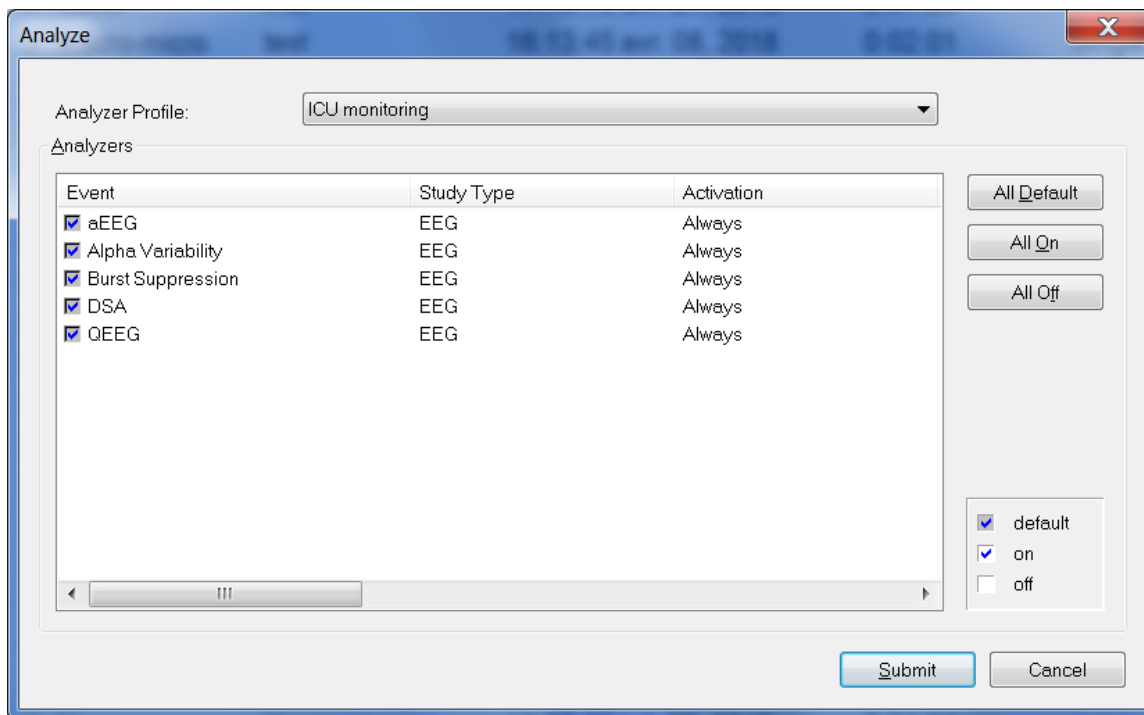
Running analyzers Manually after Acquisition

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.

- In Natus Database, left-click to select and highlight the study (or multiple studies).



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



Batch Analyzer Dialog

- Select the Analyzer profile to run for the study or studies
- 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.
- If appropriate, some of the analyzers included in an analyzer profile can be deactivated if it is not required to (re-)run these analyzers.
- Press **Submit** to send the selected study for **Batch analysis**.
- After analysis is completed the study can be open for Review to see the newly created trend data.

See also: [Batch Analyzer](#)

7.4. Working with trend plots in NeuroWorks

General workflow for configuring and using trends

Workflow for configuring analyzers and trends on an acquisition unit :

- Create an analyzer profile. Make sure to specify the amplifier hardware to be used for recording with this profile, as well as a default montage containing the channels to be analyzed.
- Add the analyzer profile into the acquisition profile for the specific amplifier hardware.
- Start a new study using this acquisition profile. Leave the default trend configuration for the first recording as trends can only be configured within a live or review study.
- In the trend summary settings window, create a new trend profile. Store the profile in the local or common settings.

5. Store the new trend profile in the acquisition profile for use with future studies.

Workflow for configuring analyzers and trends on a review unit:

1. Create an analyzer profile. The amplifier type in the analyzer profile does not matter for batch analysis, but the channels configured in the analyzers must be available in the selected montage.
2. Select the analyzer profile from the **Analyze** menu item and perform batch analysis.
3. Open the study for review.
4. Create a new trend profile in the trend summary settings window. Store the profile in the local or common settings.



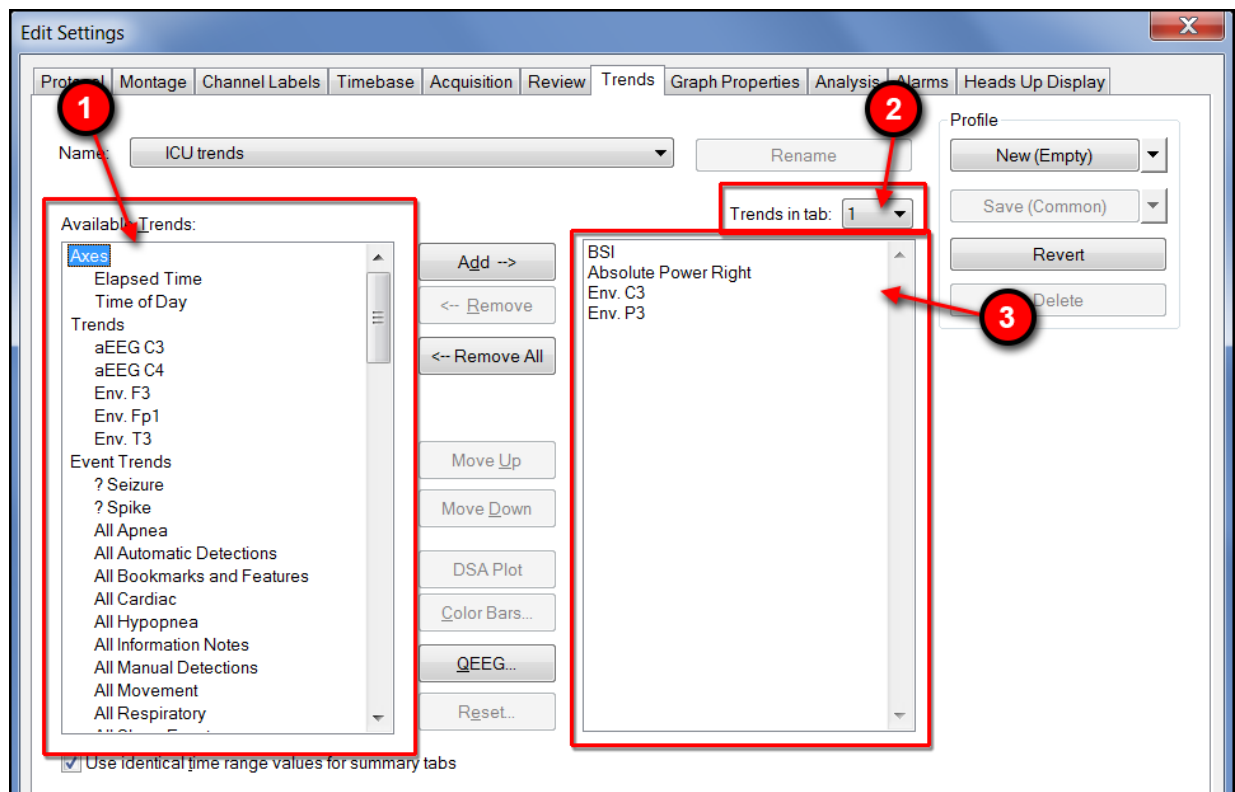
NOTE: Channels not available in the specified montage will not be analyzed. As a result, the trend plot cannot be selected for display.



NOTE: Make sure the specified montage is available.

Pre-defining Trend plot configurations

From NeuroWorks, go to **EDIT | SETTINGS | TRENDS** tab to define the trend plots to display on each trend plot tab.



Trend plot configuration

- 1 List of available Trends, Event trend summary bars, and Time axes
- 2 Trend tabs (max. 10)
- 3 Trend plots configured in the selected trend tab

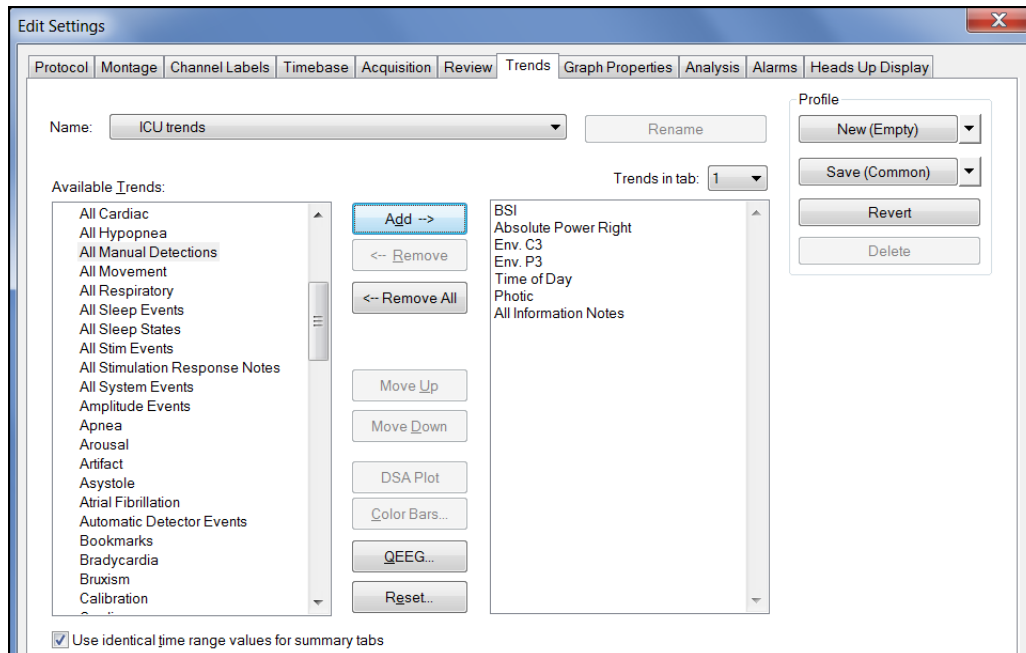
Trend settings can be defined in the “Default” profile, or in additional profiles customized to meet the requirements for multiple use cases.

The trend profile can be stored in the acquisition profile in order to use the trends on the fly during recording and review.



NOTE: Make sure to configure and run the analyzers required for each trend. If no analyzer data is available the trend plot remains empty.

This example utilizes several Trend graphs, a time axis, and 2 Event Trends:



Example of a Trend configuration



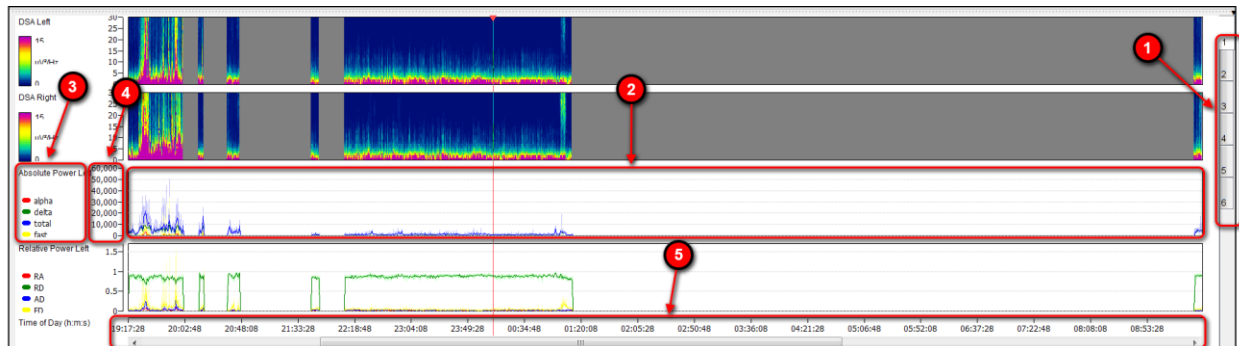
Corresponding Trend plots in NeuroWorks based on the example of a trend configuration

Trend Toolbar user interface

Select the **Show or hide trend summary toolbar** icon  in the study toolbar to display the trend toolbar area. This option can also be selected from the **VIEW > TOOLBARS > TREND SUMMARY** menu.

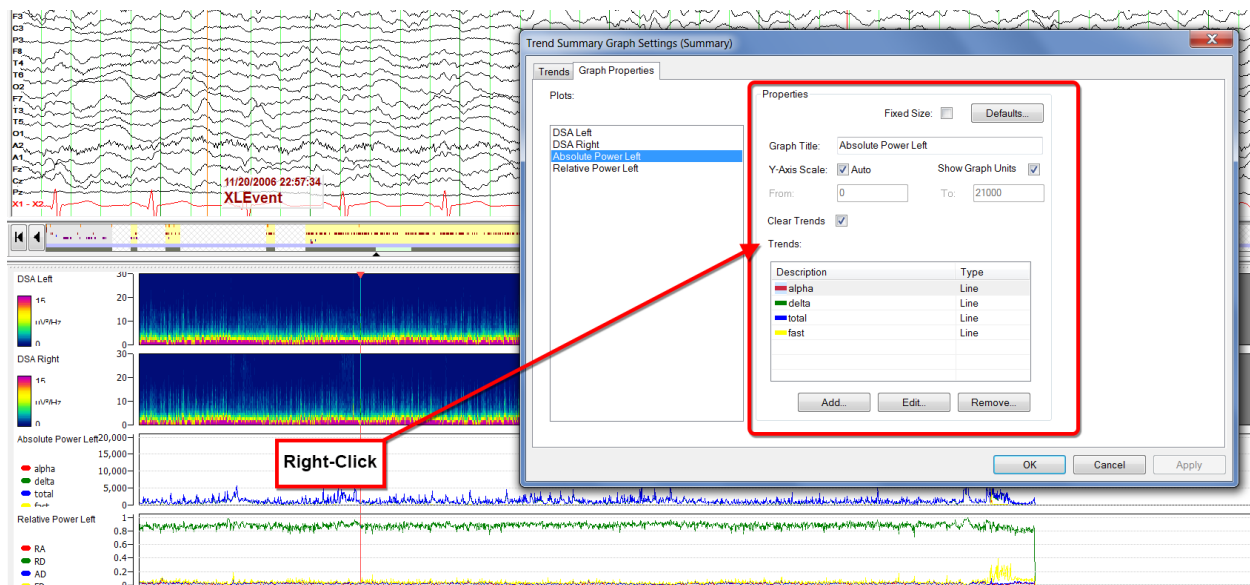


The following areas can be identified on the trend toolbar:



- 1** Trend tabs: Each tab can contain a large number of trend plots. A single click on a trend tab allows fast switching between trend tabs.
- 2** Trend plot
- 3** Trend plot label, including Trend plot name and color scale information
- 4** Trend plot Y-Axis
- 5** Trend toolbar navigation bar, only displayed when the study duration exceeds the chosen Time Interval for display of trend plots.

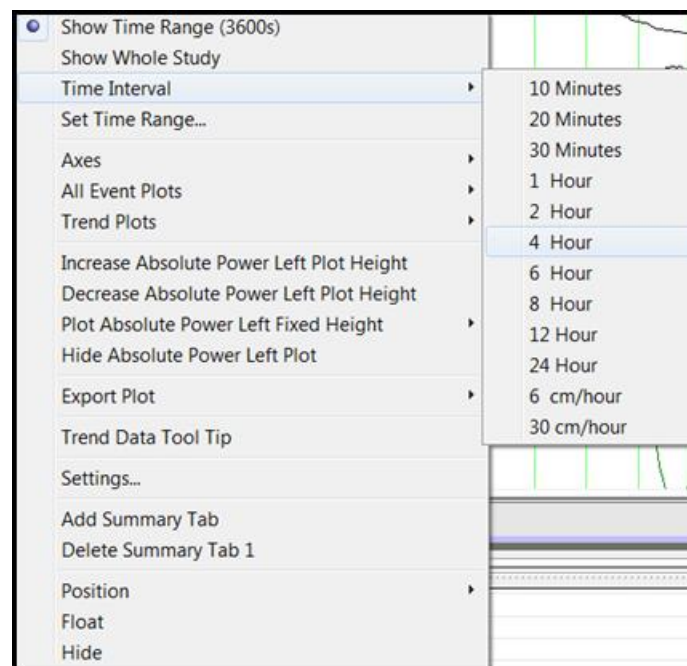
To access and change the trend plot configuration, right-click a trend plot or its label area and select **Settings** to directly display the settings of the selected trend plot:



Changing the time scale for trend plots

To choose a time interval for the trend plots:

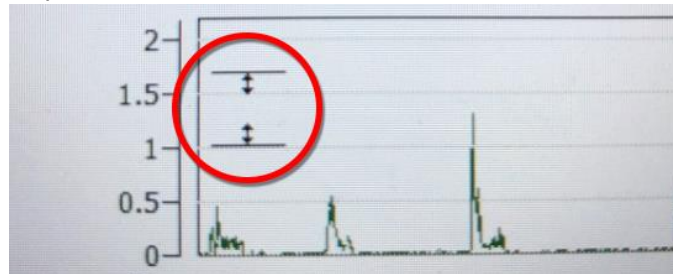
- Right-click on the aEEG trace.
- Select **Time Interval** OR **Show Whole Study**.
- The following options are available for Time Interval:



Setting a Time Interval

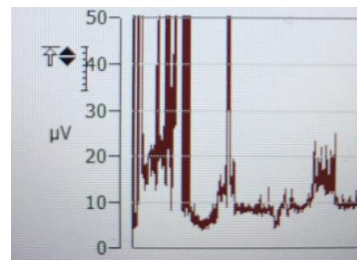
Changing the height of trend plot summary plots

Place the mouse cursor on the left side of a trend plot, and use the mouse wheel to increase or decrease the height of a single trend plot:

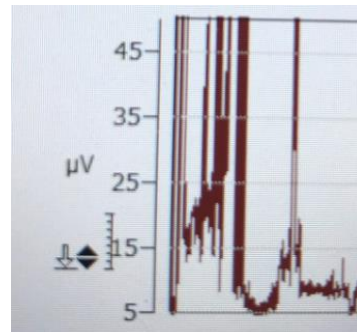


Changing the maximum or the minimum value of the Y-axis

Place the mouse cursor on the upper part of Y-scale, and use the mouse wheel to increase the maximum range of the Y-axis of a single trend plot

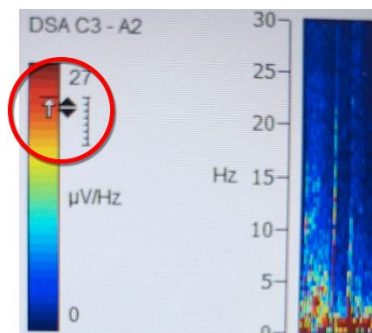


Place the mouse cursor on the lower part of Y-scale, and use the mouse wheel to increase the maximum range of the Y-axis of a single trend plot



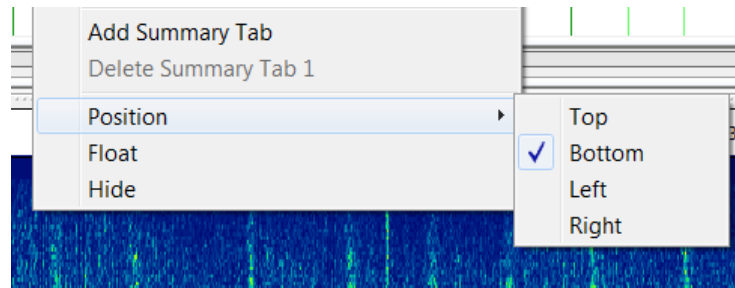
Changing the gain of the DSA power scale

Place the mouse cursor on the color scale of a DSA trend plot, and use the mouse wheel to increase or decrease the height of a single trend plot



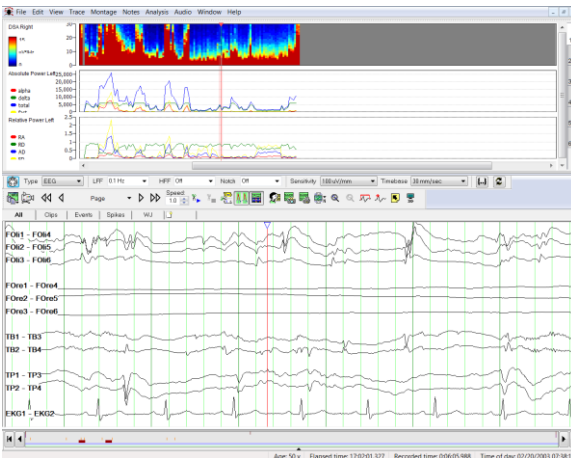
Docked Trend Toolbar versus Floating trend Toolbar

Right-click the Trend Toolbar to access the Position and Float/Docked options:

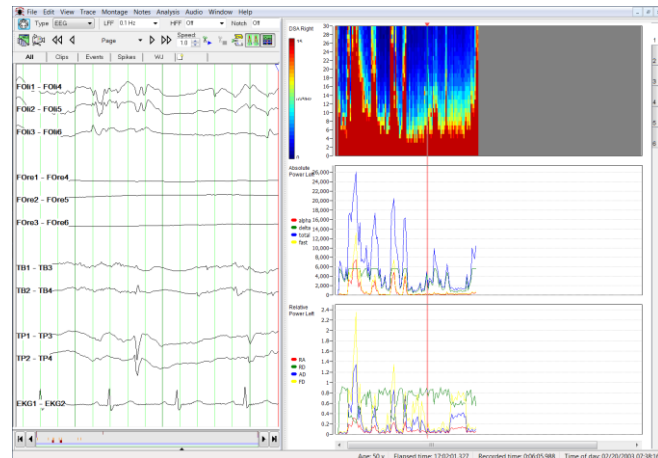


Trend Toolbar Position Options

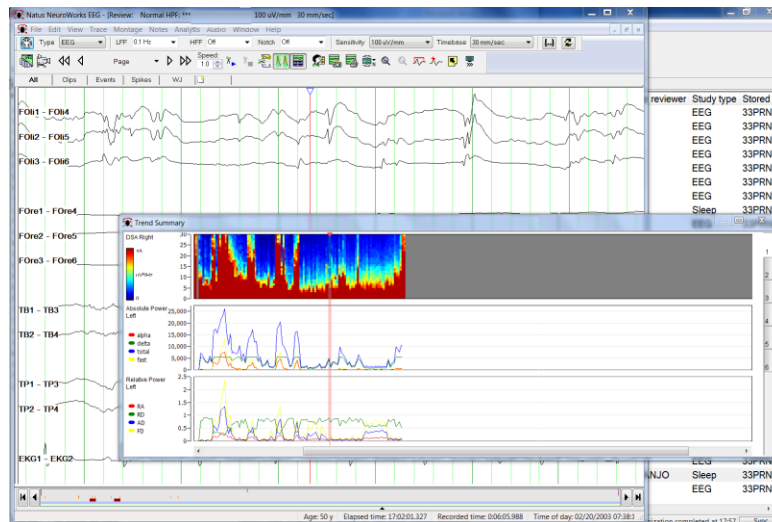
Some examples of Trend Toolbar positions:



Top position



Right position



Floating position



NOTE: In **Floating** position, the Trend Toolbar can be positioned on a second monitor.



NOTE: Trend Toolbar positions are stored in Workspaces.

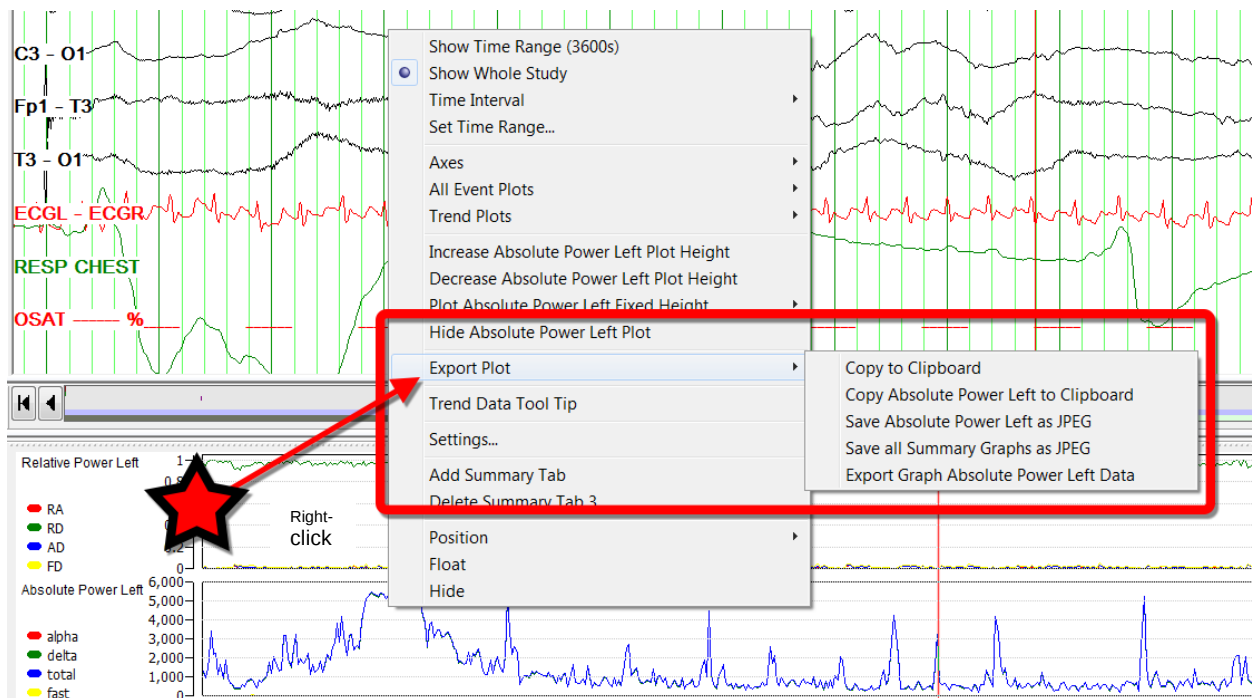
7.5. Displaying trends during live monitoring

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.

7.6. Export options in the Trend Toolbar

Right-click the Trend Toolbar to access the Export options:

- Copy all trend graphs from the current trend tab to the Clipboard in order to Paste the picture in another document
- Copy the selected trend plot to the Clipboard in order to Paste the picture in another document
- Copy and save all trend graphs from the current trend tab as a Jpeg picture
- Copy and save the selected trend plot as a Jpeg picture
- Export values from the Selected Trend Plot to a file (CSV, Comma Separated Value format)



7.7. Natus Spike and Event Detection

The 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 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.



WARNING: Do NOT use the XLDetect montage with custom channel labels.

7.7.1.1. XLDetect Montage

The XLDetect Montage is the recommended montage when running Natusdetectors. 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.

7.7.1.2. 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 EMU128FS 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 EMU128FS, 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 EMU128FS 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

7.7.1.3. 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)

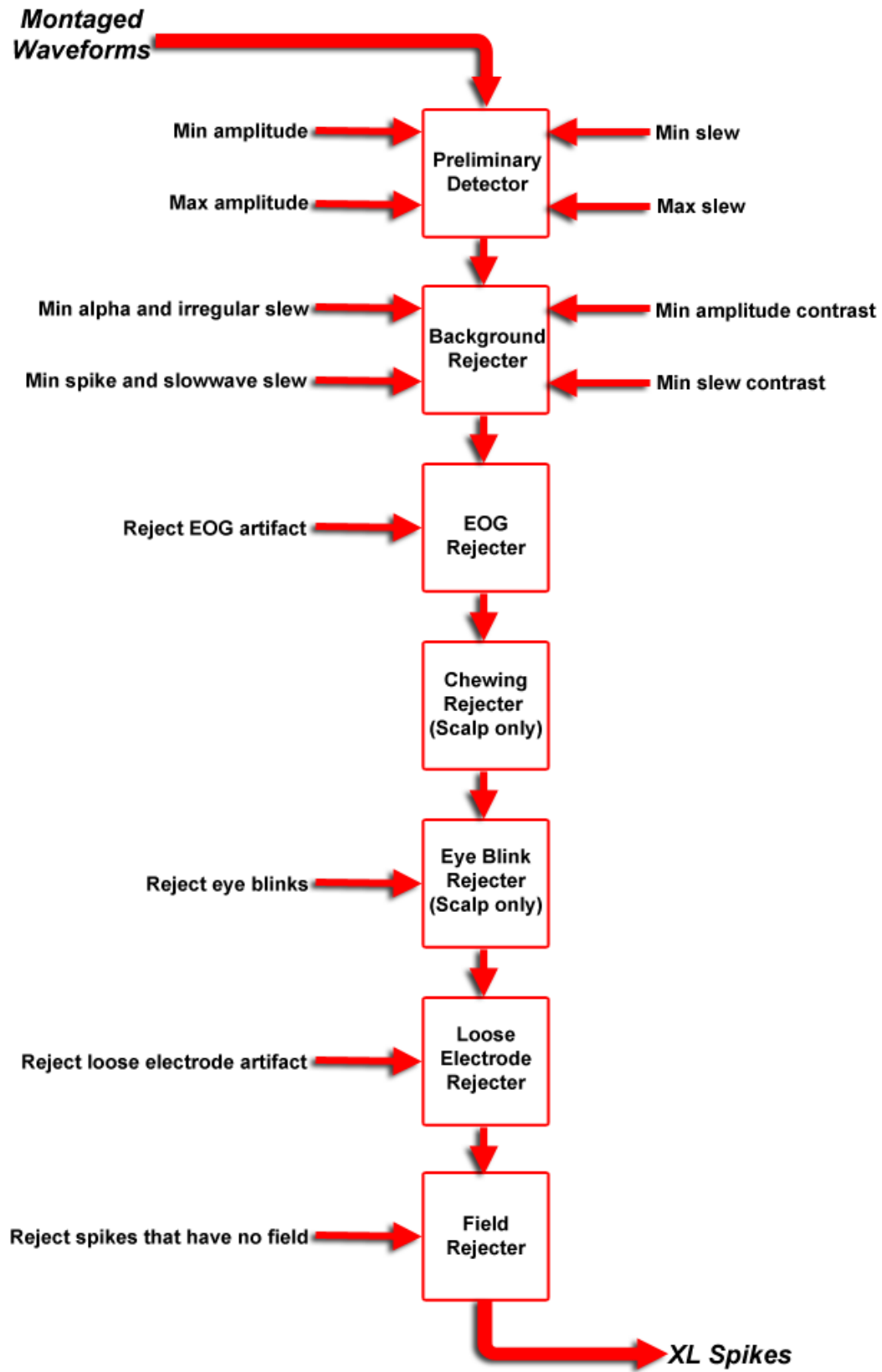
The Natus spike detection algorithm can be described as a multi-stage classification system through feature selection that uses a morphological approach to extract intuitive parameters from the waveform. Parameters such as the relative amplitude, sharpness and duration of different segments are used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

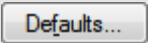
Block Diagram of the XLSpike Detector



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 $\mu\text{V}/\text{ms}$. The default setting for maximum spike slew is 20 $\mu\text{V}/\text{ms}$ for scalp recordings. After the preliminary wavelets are isolated the detection continues on this reduced set.
Min slew	The default setting is 0.3 $\mu\text{V}/\text{ms}$ 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.

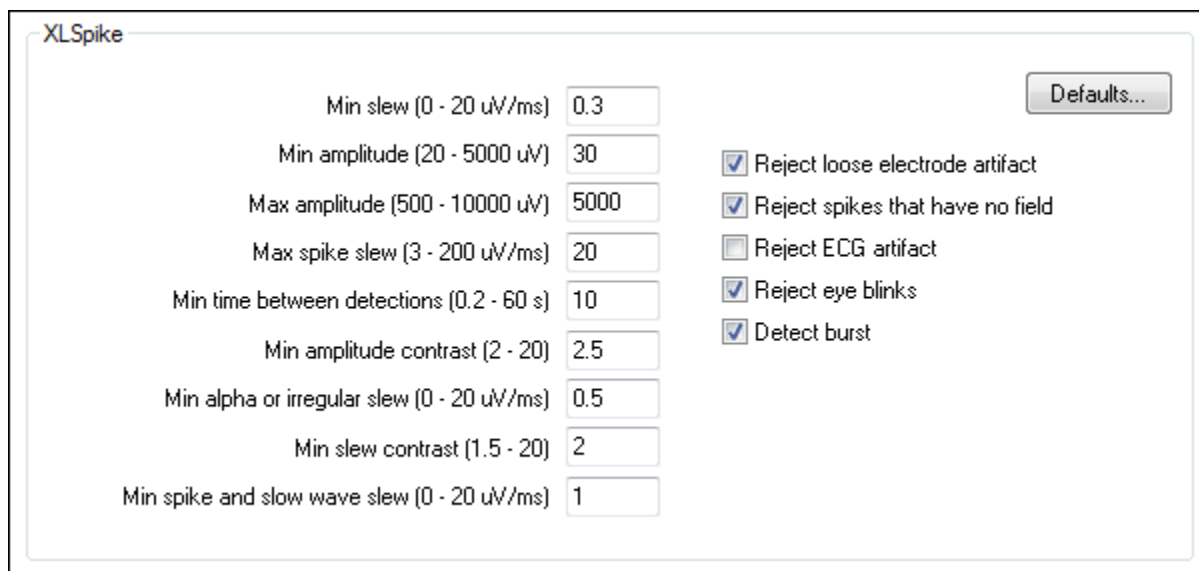
XLSpike Rejection Settings

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 $\mu\text{V}/\text{ms}$ for scalp recordings.
Min Slew Contrast	This is the minimum slew ($\mu\text{V}/\text{ms}$) 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 is 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 $\mu\text{V}/\text{ms}$ 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.
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.

Setting	Description/Function/Adjusting
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:



The screenshot shows the XLSpike settings window with the following default values:

- Min slew (0 - 20 $\mu\text{V}/\text{ms}$): 0.3
- Min amplitude (20 - 5000 μV): 30
- Max amplitude (500 - 10000 μV): 5000
- Max spike slew (3 - 200 $\mu\text{V}/\text{ms}$): 20
- Min time between detections (0.2 - 60 s): 10
- Min amplitude contrast (2 - 20): 2.5
- Min alpha or irregular slew (0 - 20 $\mu\text{V}/\text{ms}$): 0.5
- Min slew contrast (1.5 - 20): 2
- Min spike and slow wave slew (0 - 20 $\mu\text{V}/\text{ms}$): 1
- ☒ Reject loose electrode artifact
- ☒ Reject spikes that have no field
- ☐ Reject ECG artifact
- ☒ Reject eye blinks
- ☒ Detect burst

A "Defaults..." button is located in the top right corner of the window.

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 EMU128FS). 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 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

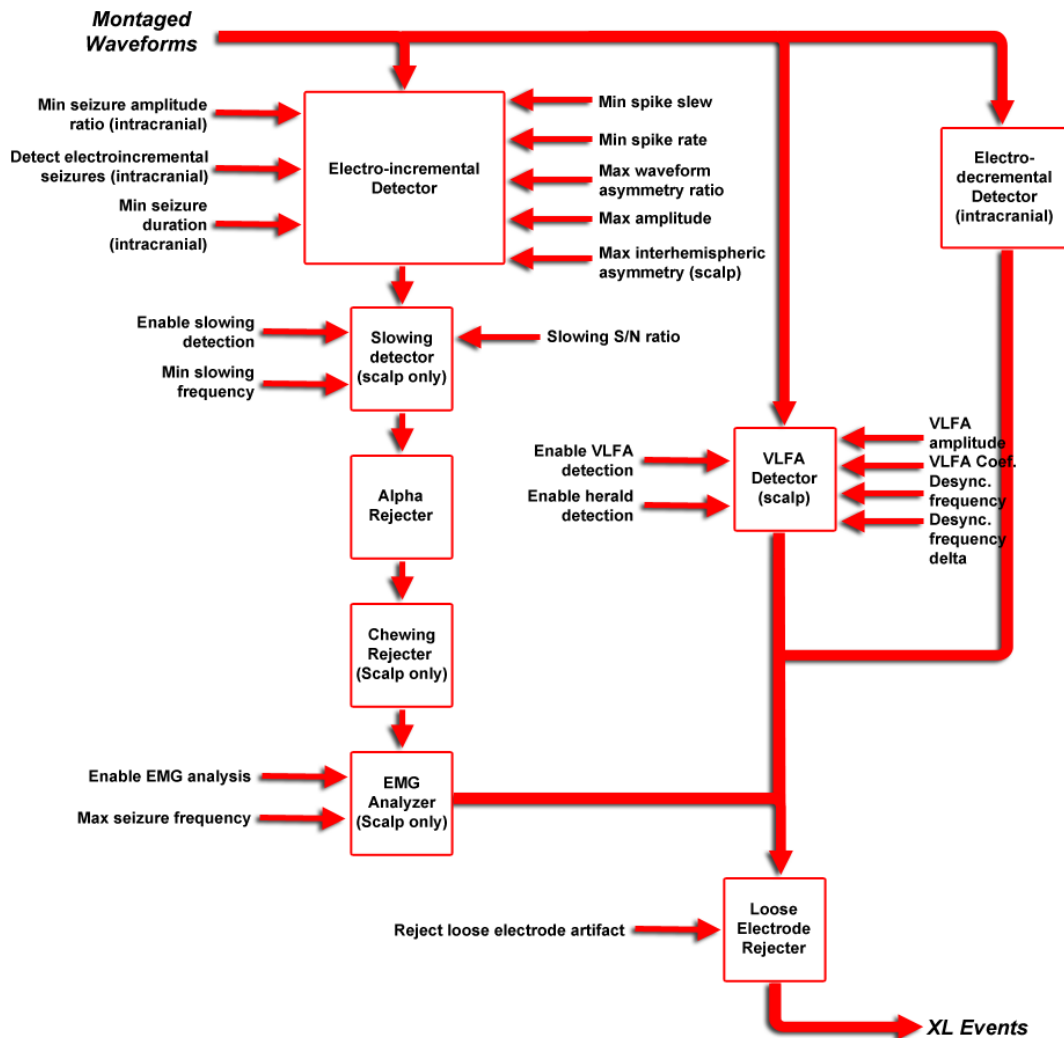
Once a section of EEG has been pre-qualified as "EVENT", the analyzer checks the background for alpha activity, chewing and EMG. If a detection of any kind has been made and no artifacts are detected by the methods indicated above, the detector checks if every channel included in the detected section 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 μ V. 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



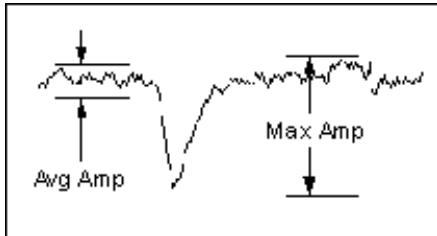
XLEvent Settings

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 $\mu\text{V}/\text{ms}$. 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.

Setting	Description/Function/Adjusting
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. 
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.

Setting	Description/Function/Adjusting
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-slowness. 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.
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.

Setting	Description/Function/Adjusting
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:

The screenshot shows the XLEvent settings window with the following default values:

Parameter	Default Value	Option
Min slowing frequency (1-3 Hz)	2	☒ Enable slowing detection
Min interhemispheric asymmetry (2 - 5)	2.5	☒ Enable EMG analysis
Min spike rate (0 - 20 Hz)	2	☒ Desync
Min spike slew (0 - 50 uV/ms)	0.5	☒ Enable Herald detection
Max amplitude (500 - 10000 uV)	5000	☒ VLFA
Max waveform asymmetry ratio (2 - 20)	5	100 VLFA amplitude (100 - 1000 uV)
Max seizure frequency (40 - 60 Hz)	45	6 VLFA coef (7 - 20)
Slowing S/N ratio (1-4)	2	22 Desync frequency (15 - 50)
		5 Desync frequency delta (3 - 15)

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:

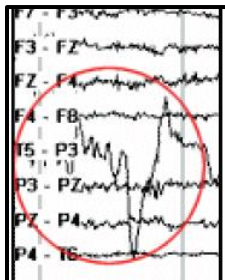
- The quality of the recording (electrical noise, artifacts, loose electrodes) may be too low. The detector is designed to compensate for certain levels of poor signals, such as a single loose electrode, but will fail if multiple channels are affected.
- The detection settings may be adjusted incorrectly.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

7.9.1.1. 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.

7.9.1.2. 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 > Study Reports > 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:

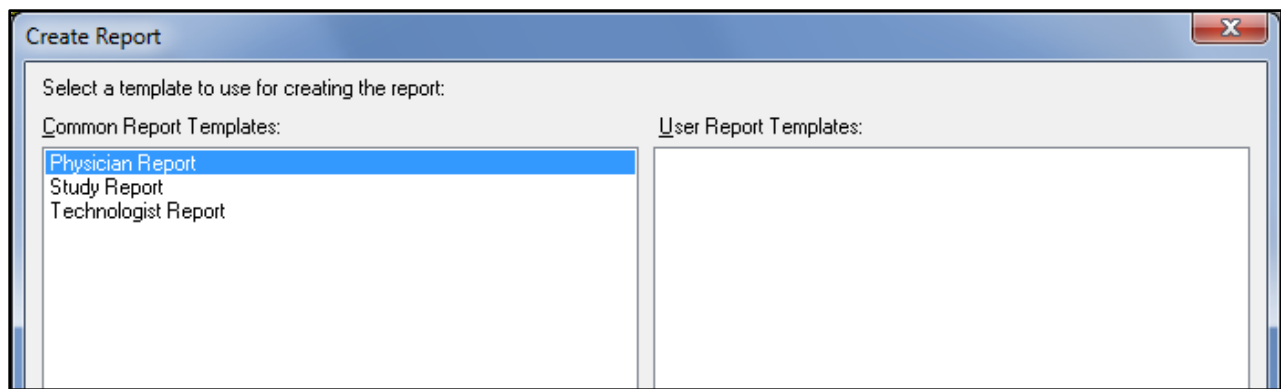
1. Choose **Edit > Study Information**. The Study Information window appears.
2. Click any or all (successively) of these tabs:
 - a. Patient
 - b. Medication Information Technologist's Report
 - c. Physician's Report

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

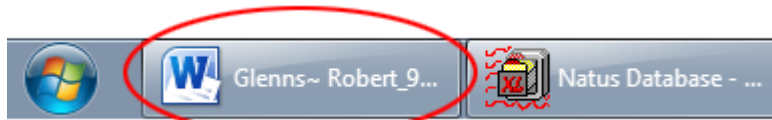
To generate a NeuroWorks report:

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...**).

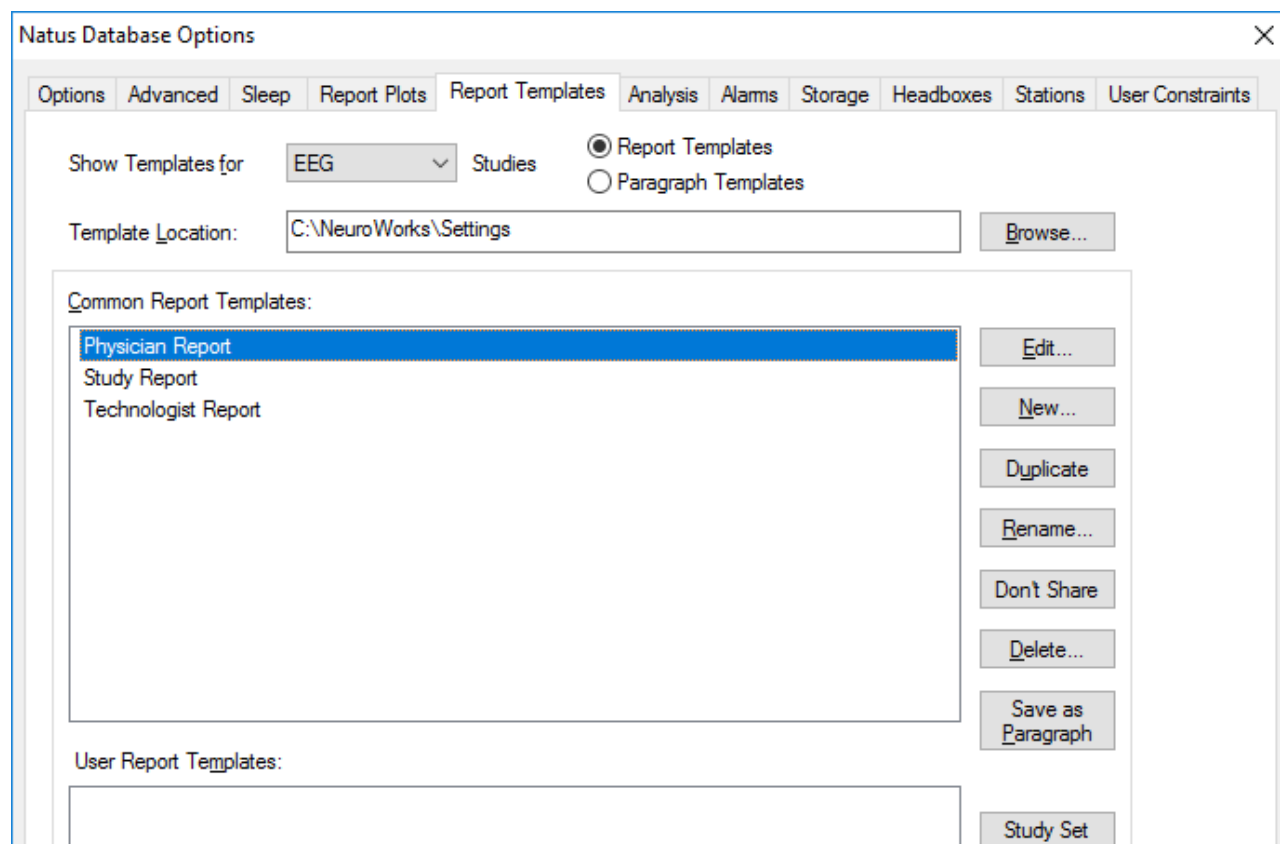
The file names for the report templates are:

- 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.

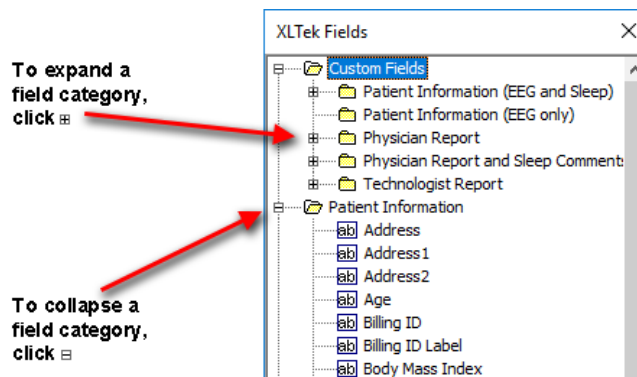
To...	Do This...
Access the Report Templates tab	In the Natus Database, choose Tools > Options > Report Templates.
Edit a template	Select an existing template and click Edit . Microsoft Word launches with the selected template loaded.

To...	Do This...
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 .
Study Set Options	Set the Ingest options for multi-study reporting. See section <i>0 Multi-Study Report Ingest Options</i> for additional details.

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 **XLTEK Fields** box floating above the template.
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).



XLTEK Fields Box



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.



NOTE: To ensure that reports generate completely, avoid the use of the ">" or "<" in the text of the report template. These two symbols should only be used with the scalars as input by the NeuroWorks / SleepWorks software.

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

Billing ID	Referring Physician	Category	Ward	Service Date
<BillingID>	<Referring Physician>			11/28/14 2:18 PM

Study Report

Study Information:

File Name: <FilePath>
 Created: <CreationTime>
 Duration (ms): <StudyDuration>
 On Instrument: <AcquisitionInstrument>
 Reviewed By: <Reviewer>

Clinical Interpretation:

<Clinical Interpretation>

EEG Classification:

<EEG Classification>

History:

<History>

Tech Impression:

<Technologist's Impression>

General Comments:

The patient is a <Age> year old <Gender> who is <Height (in)> and weighs <Weight (lb)> <He/She> has been |

XLTek Fields

- [-] Custom Fields
 - [-] Patient Information (EEG and Sleep)
 - [-] Patient Information (EEG only)
 - [-] Physician Report
 - [-] Physician Report and Sleep Comment
 - [-] Technologist Report
 - [-] Patient Information
 - [-] Address
 - [-] Address1
 - [-] Address2
 - [-] Age
 - [-] Billing ID
 - [-] Billing ID Label
 - [-] Body Mass Index
 - [-] Category
 - [-] Chart#
 - [-] City
 - [-] Country
 - [-] Date of Birth
 - [-] Date of Birth Label
 - [-] First Name
 - [-] Gender
 - [-] Gender pronouns
 - [-] He/She
 - [-] he/she
 - [-] Him/Hier
 - [-] him/her
 - [-] His/Her
 - [-] his/her

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**.

8.5. Multi-Study Reports

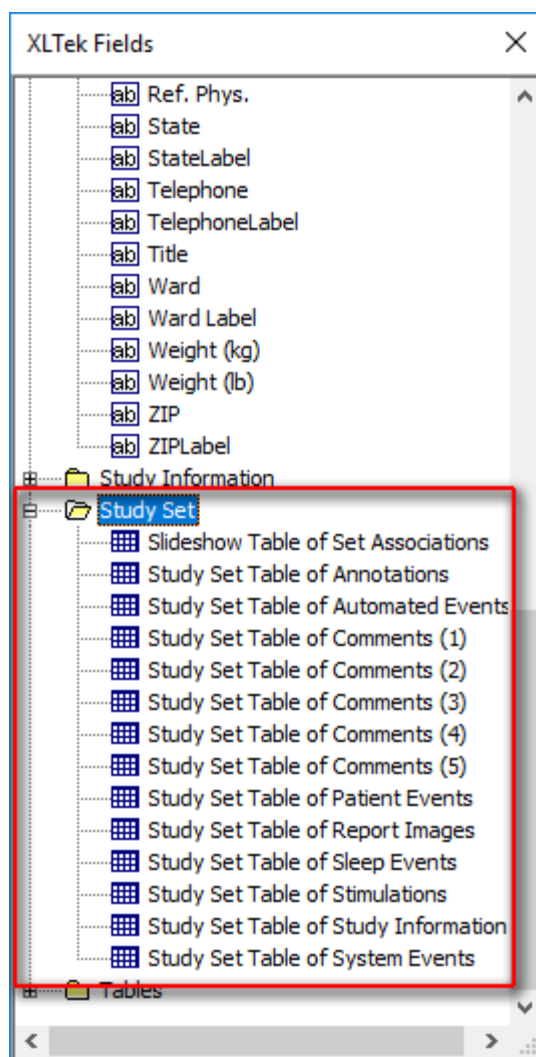
Multi-Study Report Templates

Report templates can be created to report on multiple studies such as those compiled in long term monitoring or slideshow studies.

To create a multi-study 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 **XLTEK Fields** box floating above the template.

NOTE: The multi-study report options can be found under the Study Set Field in the XLTek Fields dialog.



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, Study Set Table of Patient Events).



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

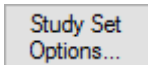
4. To save the template, choose **File > Save**. Do not change the name of the template.

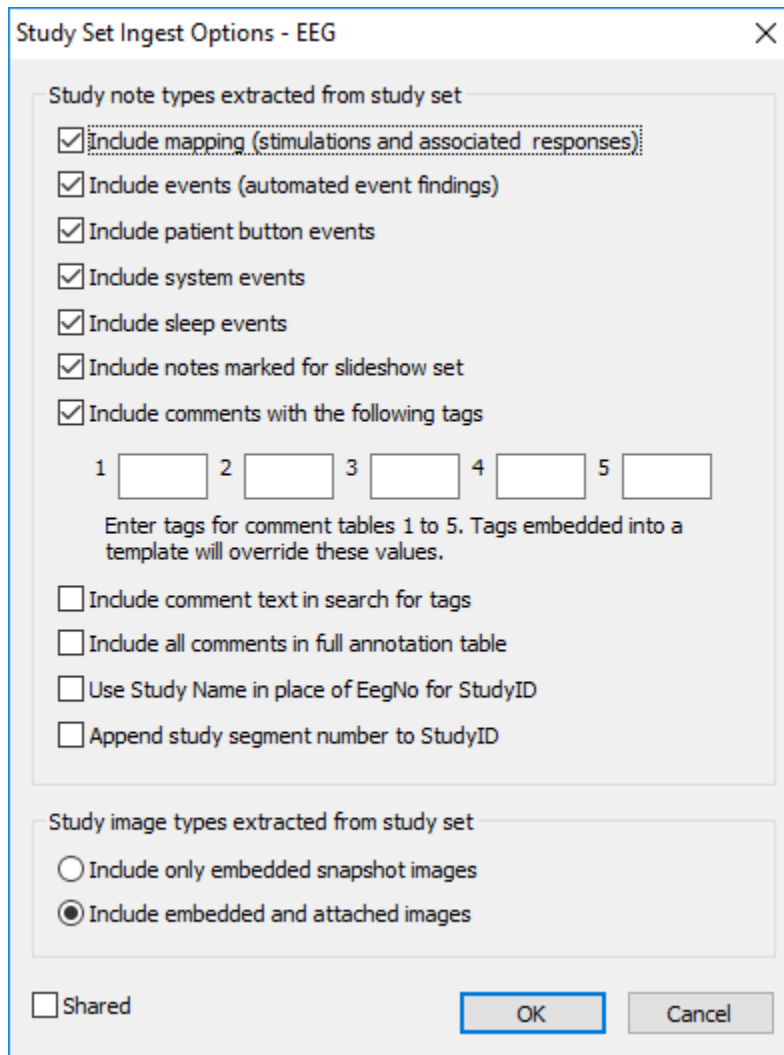
The report template can now be run on an LTM study or a Slideshow to produce a report based on multiple studies.

Multi-Study Report Ingest Options

To establish the ingest options for populating a report from a Slideshow or LTM study, you can setup specific options which will affect the output of the reports.

To setup multi-report ingest options:

1. In the Natus Database, choose **Tools > Options > Report Templates** (tab).
2. Select the **Study Set Options** button  to open the Study Set Ingest Options dialog.



The dialog box is titled "Study Set Ingest Options - EEG" and has a close button (X) in the top right corner. It contains two main sections: "Study note types extracted from study set" and "Study image types extracted from study set".

Study note types extracted from study set

- ☒ Include mapping (stimulations and associated responses)
- ☒ Include events (automated event findings)
- ☒ Include patient button events
- ☒ Include system events
- ☒ Include sleep events
- ☒ Include notes marked for slideshow set
- ☒ Include comments with the following tags
 - 1 2 3 4 5
 - Enter tags for comment tables 1 to 5. Tags embedded into a template will override these values.
- ☐ Include comment text in search for tags
- ☐ Include all comments in full annotation table
- ☐ Use Study Name in place of EegNo for StudyID
- ☐ Append study segment number to StudyID

Study image types extracted from study set

- ☐ Include only embedded snapshot images
- ☒ Include embedded and attached images

At the bottom, there is a checkbox for ☐ Shared, and two buttons: **OK** and **Cancel**.

Ingest Option - Description / Function

Study note types extracted from study set Options

Include mapping (stimulations and associated responses)

Include events (automated event findings)

Include patient button events

Include system events

Include sleep events

Include notes marked for slideshow set

Include comments with the following tags

☒ Include comments with the following tags

1
2
3
4
5

Enter tags for comment tables 1 to 5. Tags embedded into a template will override these values.

This setting uses tags that are set at the time the annotations were written. For example, P#, T#, etc. These tags are pulled directly from the name of the annotation, so the tag should be used at the point the annotation is created. Setting up a naming convention is key to being able to use them for sorting and reporting.

Include comment text in search for tags.

This setting can be used in conjunction with the previous setting to sort and display comments with specific tags in them. These would be set in the body of the annotation and not just the name.

Include all comments in full annotation table

Use Study Name in place of EegNo for StudyID

Append study segment number to StudyID

Study Image types extracted from study set

Include only embedded snapshot images

Include embedded and attached images

3. Select the desired options from the dialog, and click **OK** to save and close the dialog.



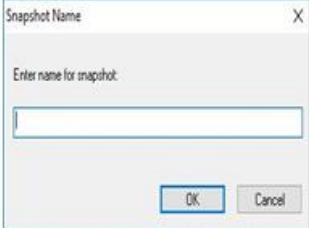
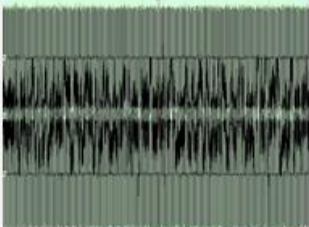
TIP: Clicking on the Shared checkbox will share these settings with other Neuroworks workstations via the Common Settings Cache.

4. Click **Apply** to save and/or share the updated details, and click **OK** to close the dialog.

8.6. Adding Snapshots to Reports

To add snapshot images to a report, the template must be modified to include the **Study Set Table of Report Images** from the XLTek Fields dialog in Microsoft Word. This is done by following the steps and details found in section 0 *Editing a Report Template*. Adding this table will display in your report showing all externally attached report images, and all snapshots within a study.

Study Set Table of Report Images

#	StudyID	Time	Title	Image
001	-	2017-07-07 09:33:54 AM	My first snapshot	
002	-	2017-07-07 09:34:39 AM	My 2nd snapshot	
003	-	-	Image 1	



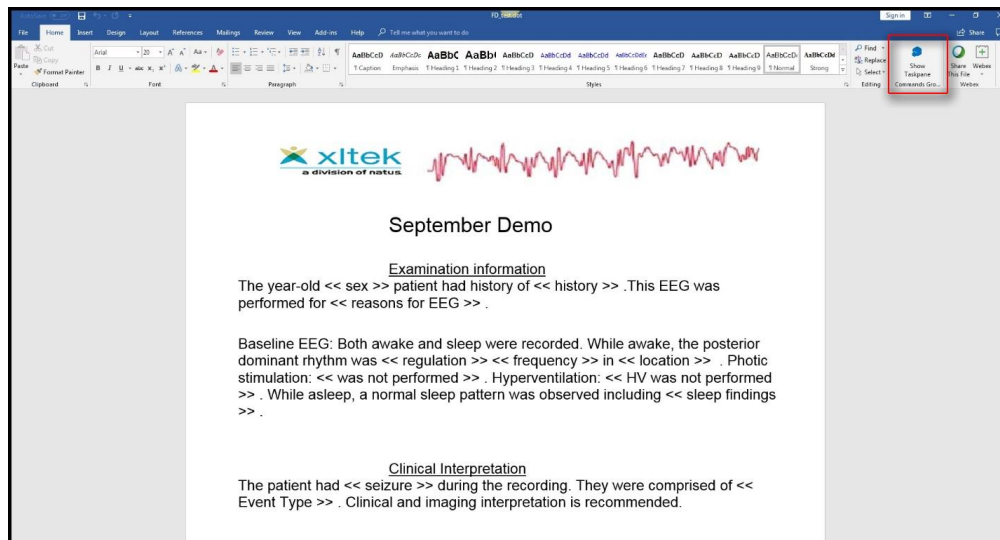
NOTE: In the table, all external report images do not reference a time; however all snapshot images will display the time within the table.

8.7. Dynamic Fields in Reports

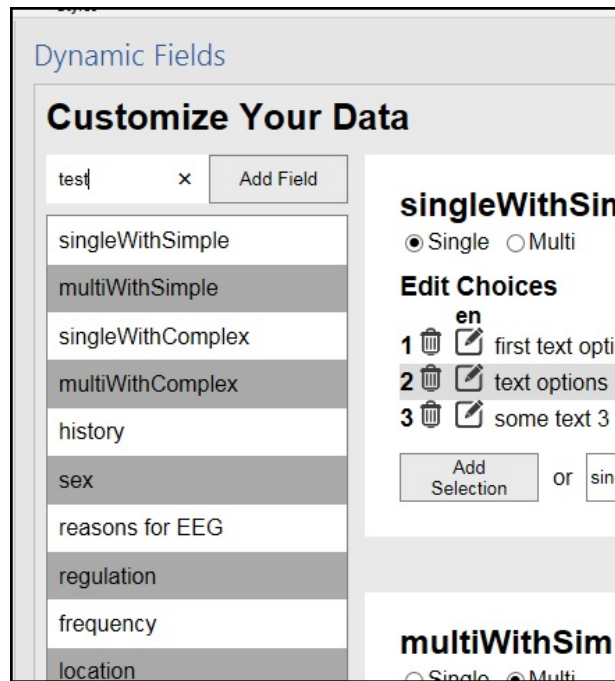
Using dynamic fields in reports allows a user to create configurable choices for text selection during report editing. In order to use Dynamic Fields, they have first to be created as part of Report Template customization. For the type of MS Word versions and setup required to use Dynamic Template functionality read Dynamic Fields in Report Templates (DOC-031439).

To add dynamic fields to reports:

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 **XLTEK Fields** box floating above the template.
3. Enable Dynamic Field pane for viewing by clicking on the **Show Taskpane commands group** icon in Microsoft Word.



4. Create a new Dynamic Field by typing new field name and pressing the **Add Field** button.



5. Set newly created field to be **Single** or **Multi** selectable and populate these choices with the required text.
 - **Single** – Allows for a single possible text selection option.
 - **Multi** – Allows for multiple text selection options to be available.



NOTE: For every field the following two options will always be automatically added:

- Add Free Text
- Delete Sentence

6. It is possible to create nested custom fields in which part of internal text is nested field in itself by

adding a choice using “Add Nested Selection” button and selecting previously created Dynamic Field . Nested dynamic fields can be recognized by surrounding brackets.

7. Add all desired fields to the template, and save the template in Word.

Using Dynamic Fields in Reports

After creating a report template with dynamic fields, the report should be generated in order to apply the designated fields to the patient report.

When a report with dynamic fields is generated, clicking on the “**Highlight Dynamic Fields**” button in the report makes it easy to identify all of the dynamic fields available.

Clicking on a paragraph in a report automatically highlights the first dynamic field in the selected paragraph. Once the dynamic field is selected right pane contains possible preconfigured choices for this field

Baseline EEG: Both awake and sleep **frequency** recorded. While awake, the posterior dominant rhythm was well regulated **frequency** in location . Photoc stimulation was not performed . Hyperventilation was not performed. While asleep, a normal sleep pattern was observed including sleep findings .

Clinical Interpretation
The patient had seizure during the recording. They were comprised of Event Type . Clinical and imaging interpretation is recommended.

alpha (8-12 Hz)
theta (5-8 Hz)
delta (1-4 Hz)
absent
Add Free Text
Delete Sentence

Highlight Dynamic Fields

Preview



NOTE: The option to “Add free text” is always available for adding text in addition to the pre-configured choices. Selecting this option opens the Dynamic Fields - Free Text Editor.

Dynamic Fields-Free text editor

B I U A T %

frequency unknown to man

When a dynamic field is configured to be **single** selectable, selecting any of the available choices automatically populates text in the report and moves to the next dynamic field in the report. For **multi**-selectable fields pressing > arrow button populates report with all options that were selected by the user. Preview pane in the right bottom corner allows user to see all the text that will be inserted into report based on current selections

Examination information
nt had history of history .This EEG was performed for reasons

wake and sleep **frequency** recorded. While awake, the posterior well regulated **frequency** in location . Photoc stimulation was ventilation was not performed. While asleep, a normal sleep ncluding sleep findings .

Clinical Interpretation
e during the recording. They were comprised of Event Type . terpretation is recommended.

Physician and Tech Comments

Dynamic Fields

Field Editor

✓ alpha (8-12 Hz)
✓ theta (5-8 Hz)
delta (1-4 Hz)
absent
✓ frequency unknown to man X
Add Free Text
Delete Sentence

Highlight Dynamic Fields

Preview

alpha (8-12 Hz), theta (5-8 Hz), frequency unknown to man

In some cases, it is useful to have a field in which parts of the internal text are dynamic fields on their own. This is a nested dynamic field. Nested dynamic fields are visually identified with brackets around the field selection. Clicking on the nested field brings the user to internal selection.

Dynamic Fields

Field Editor

<< HV response >> Reset

<< reasons >> Reset

Add Free Text
Delete Sentence

Dynamic Fields

Field Editor

☒ diffuse background slow waves were n
☒ no background slowings were noted
☐ asymmetric focal slowings were noted

Add Free Text
Delete Sentence

Highlight Dynamic Fields

>

Preview

performed and diffuse background slow waves
were noted during HV, no background slowings
were noted

In this case, the inner text for the nested dynamic field is selected and prefixed by the text “performed and.” The selected inner text is seen in red in the preview pane until it is applied to the report.

When the inner text of a nested dynamic field is inserted using the arrow button, the user is returned to the upper level of the nested field while the preview pane shows currently selected and applied text in black.

Dynamic Fields

Field Editor

☒ performed and diffuse backg

Add Free Text
Delete Sentence

Highlight Dynamic Fields

>

Preview

performed and diffuse background slow waves
were noted during HV, no background slowings
were noted

8.8. Using Trend plot images in Reports

Dynamic fields for insertion of Trend Plots are available when editing Report templates:

The image shows two screenshots illustrating the process of inserting a trend plot into a report template.

Left Screenshot: The "XlTek Fields" menu is open, showing a list of fields under the "Plots" category. The field "Plot of Spectral Entropy Trend(s)" is highlighted with a red box. A red arrow points from this field to the report template on the right.

Right Screenshot: The report template is shown, titled "General Hospital Physician Report.d...". It includes a patient information table and a section for "Physician's Report". The "Trend plots:" section contains the text "Plot of Spectral Entropy Trend(s)". A red arrow points from this text to the plot image on the right.

Plot Image: The plot image shows two stacked line graphs. The top graph is labeled "Spectral Entropy Trend(s)" and the bottom graph is labeled "Spectral Entropy Trend(s)". Both graphs show a fluctuating signal over time, with the x-axis labeled "Time of Day" and the y-axis labeled "Spectral Entropy".

9. Working with Notes

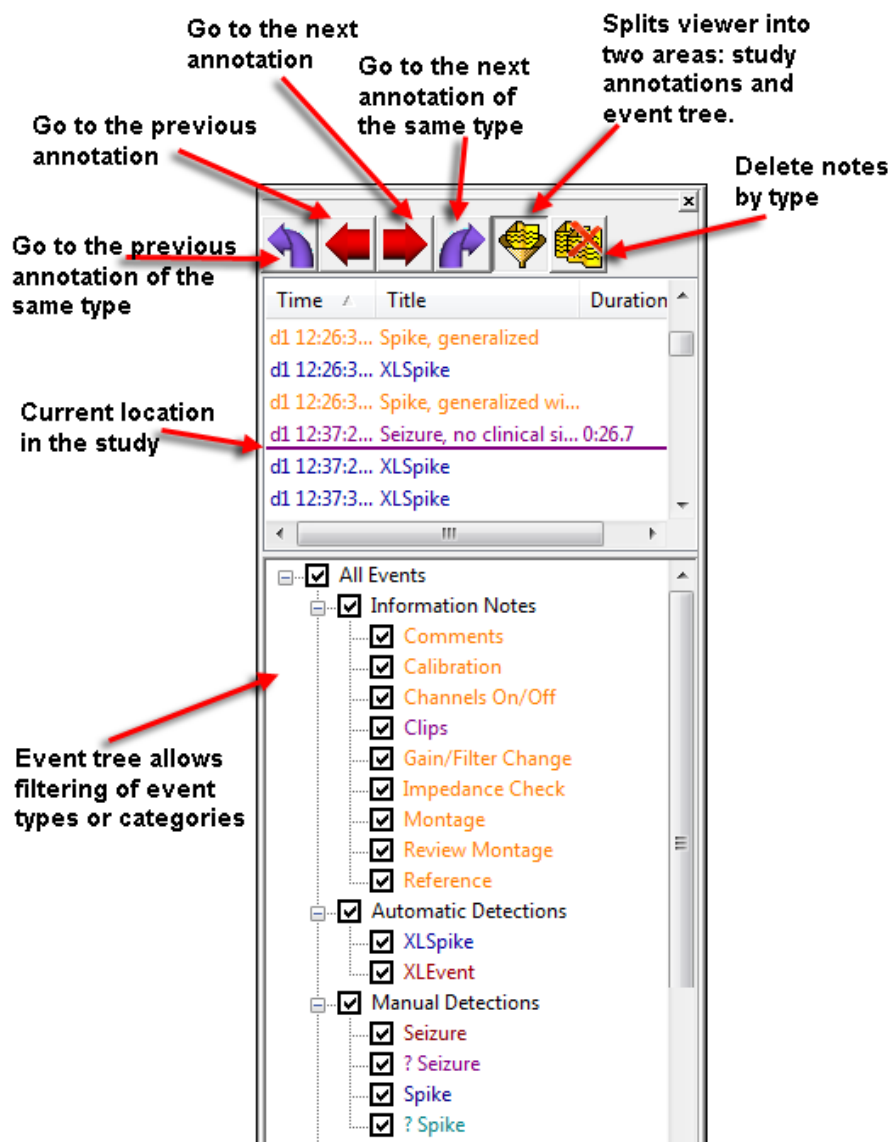
9.1. Annotation Viewer

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

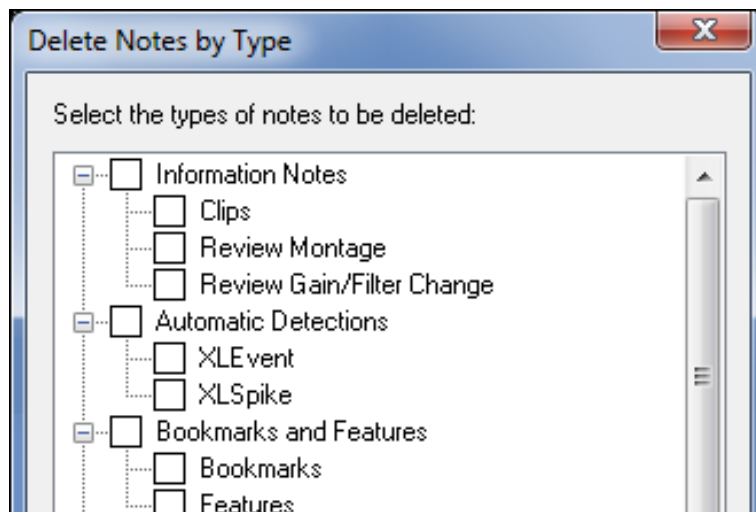
The software allows for the quick deletion of multiple events by type. To activate this functionality, press



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.



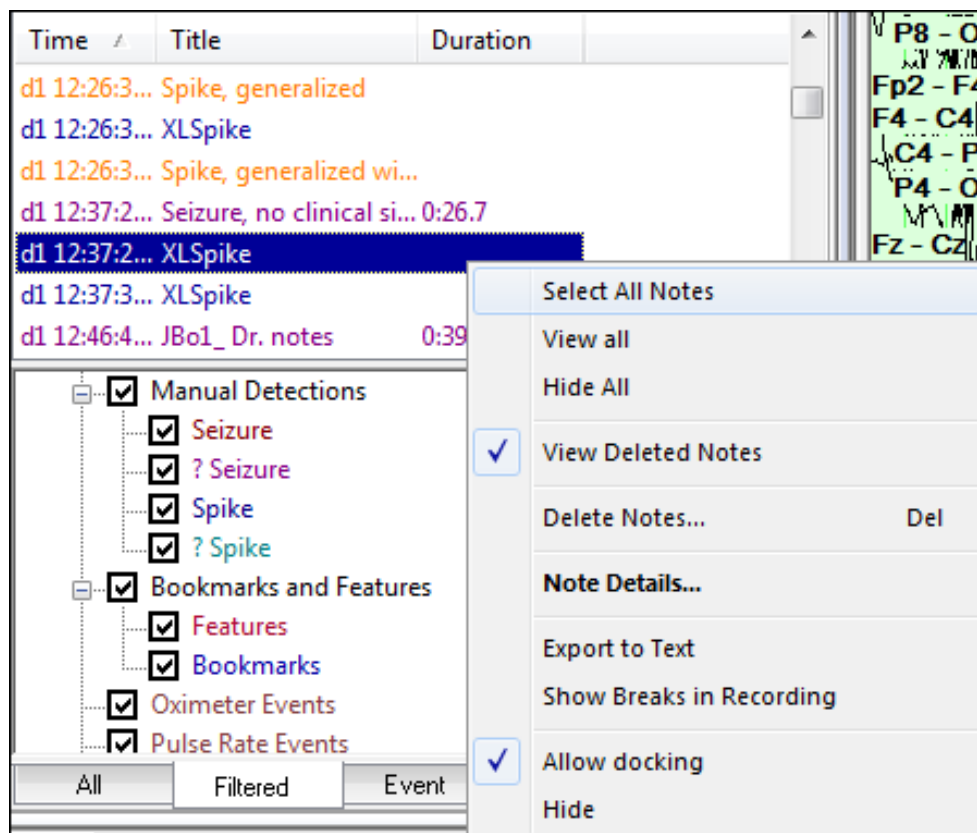
Delete Notes by Type Option in Annotation Viewer

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:

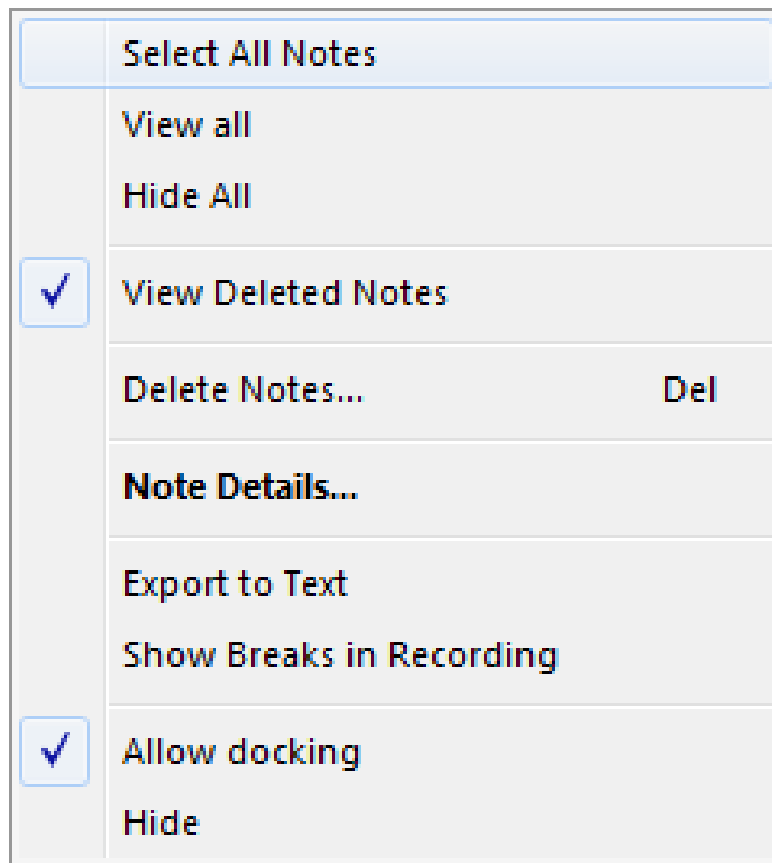
- Change Notes Type
- Accept Events (auto-detections)
- Delete Notes

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 an additional option 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.

The **Note** dialog box opens.

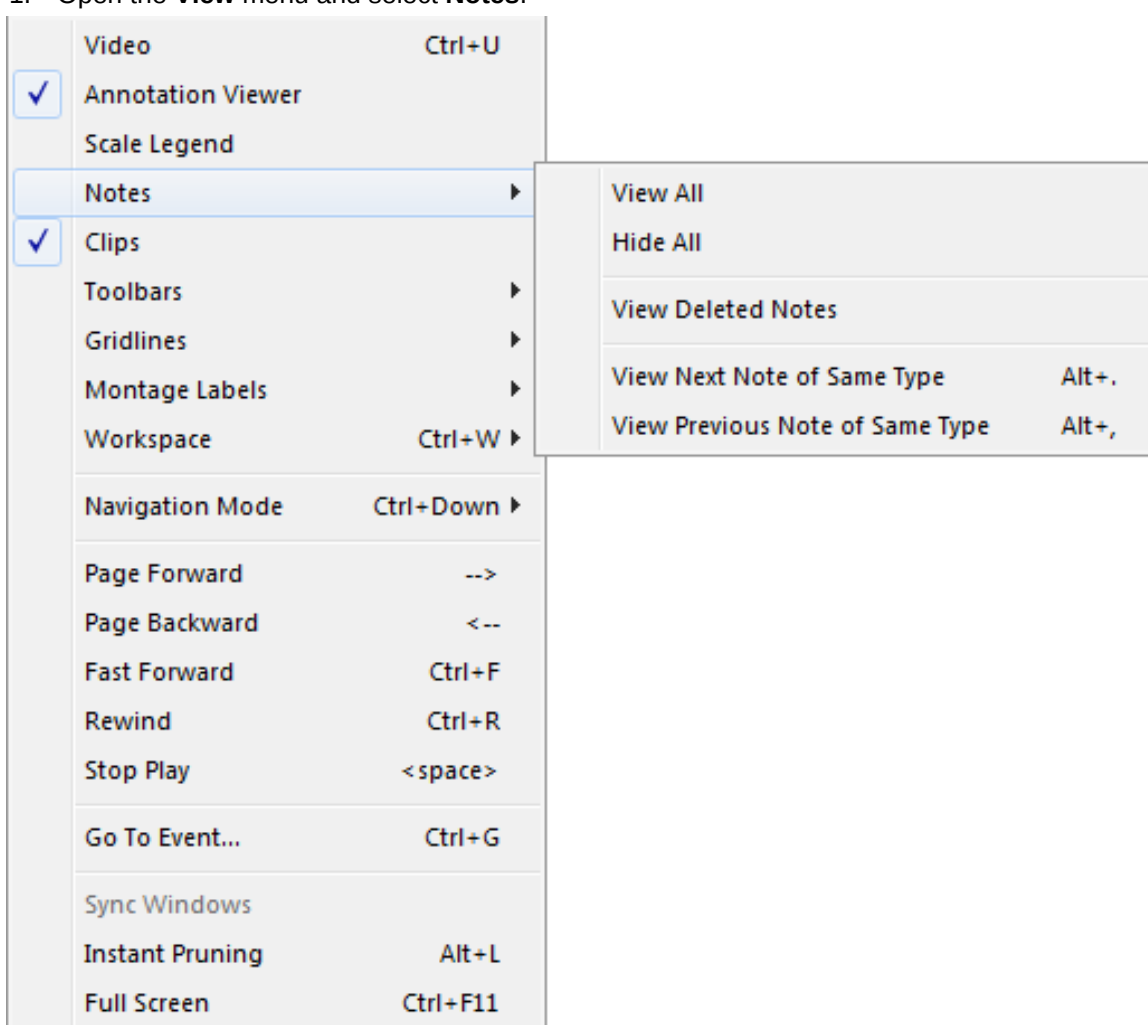
2. Finish typing the note, then click **OK**.

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 Using Mouse Click Annotation Mode



Notes can be added during Review by enabling the Mouse Click Annotation Mode  on the Workspace toolbar. With this button enabled, marking annotations is as easy as clicking anywhere on the screen, selecting the note type, and filling in the details without having to use the Notes Menu. While this button is active, clicking and dragging for a longer period of time is disabled. Disabling the Mouse Click Annotation Mode button is completed by clicking the button a second time.

9.4. 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. **Right-click** anywhere on the study traces (except for other mouse-sensitive areas such as the labels or the scale legend). The acquisition **Notes** menu opens.
2. Choose **Custom** or a pre-defined note.
3. 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.
The **Note box** opens.

Note Box

2. 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.

9.5. Adding a Note to a Slideshow Set

Adding a note as a part of a slideshow set is as easy as selecting the particular Slideshow for it to be a part of from the dropdown menu.

To add a note as a part of the slideshow set:

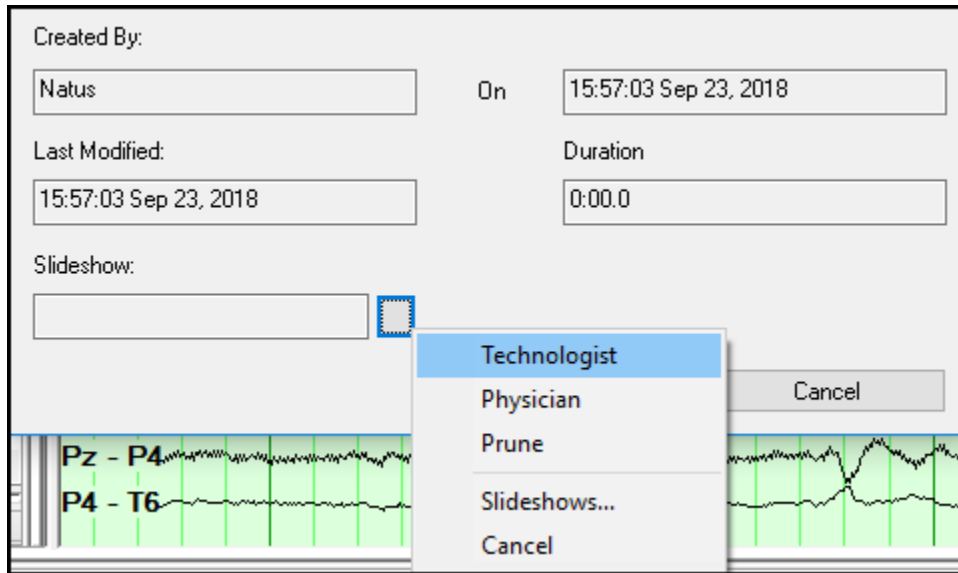
1. **Right-click** anywhere on the study traces (except for other mouse-sensitive areas such as the labels or the scale legend). Alternately, you can enable the mouse click annotation button  and left-click anywhere on the study traces. The acquisition **Notes** menu opens.



NOTE: You can also update slideshow membership by editing the note, or by holding the CTRL key and left-clicking on the note tag which displays the slideshow set membership context menu.

2. Choose a **Custom** or pre-defined note.
3. If you choose **Custom**, fill in your information in the **Note box**.

4. Select the Slideshow set by clicking on the button  next to the Slideshow selection box in the Note dialog.



A dropdown appears showing all the available Slideshow sets that are defined.

5. Select the category to assign the annotation to.
6. Click **OK** to accept the note and close the note box.

9.6. 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.



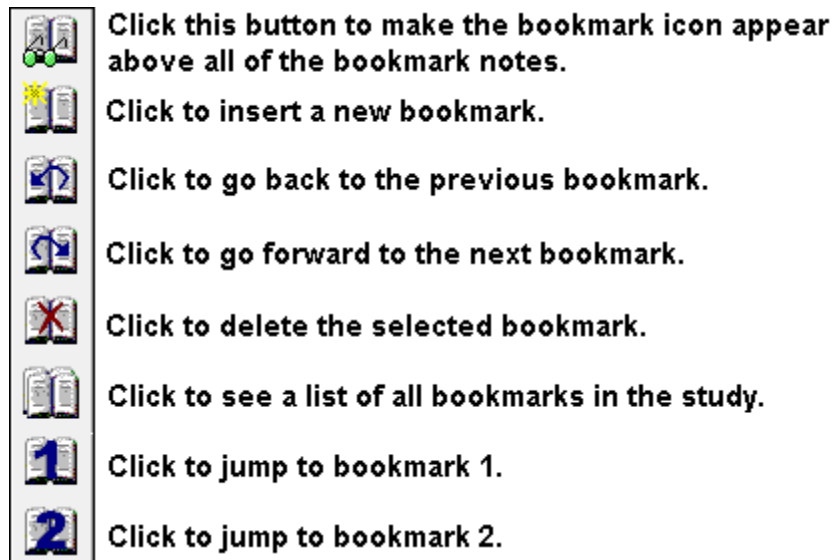
If the bookmark icon is an open book, then the bookmark is currently being viewed in the same context in which it was recorded.



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.

9.7. 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.

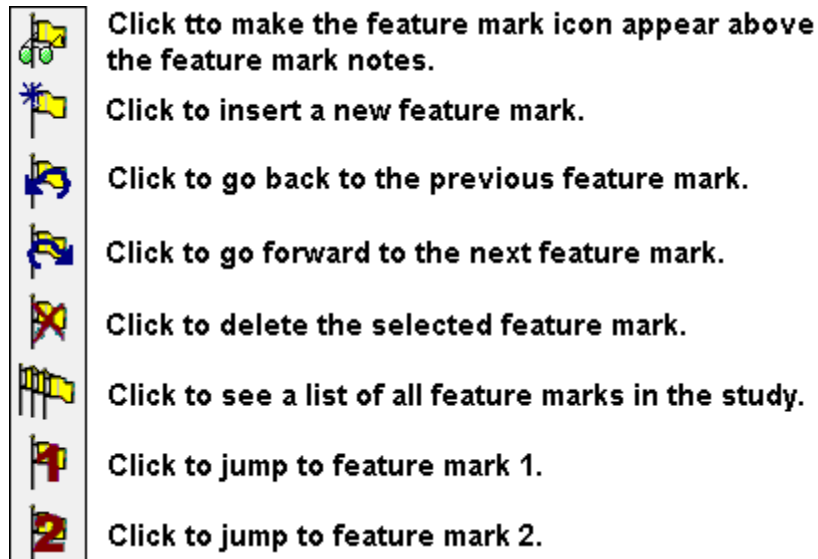


NOTE: A limit of 20 feature marks can be added to a study.

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 EMU128FS, 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:

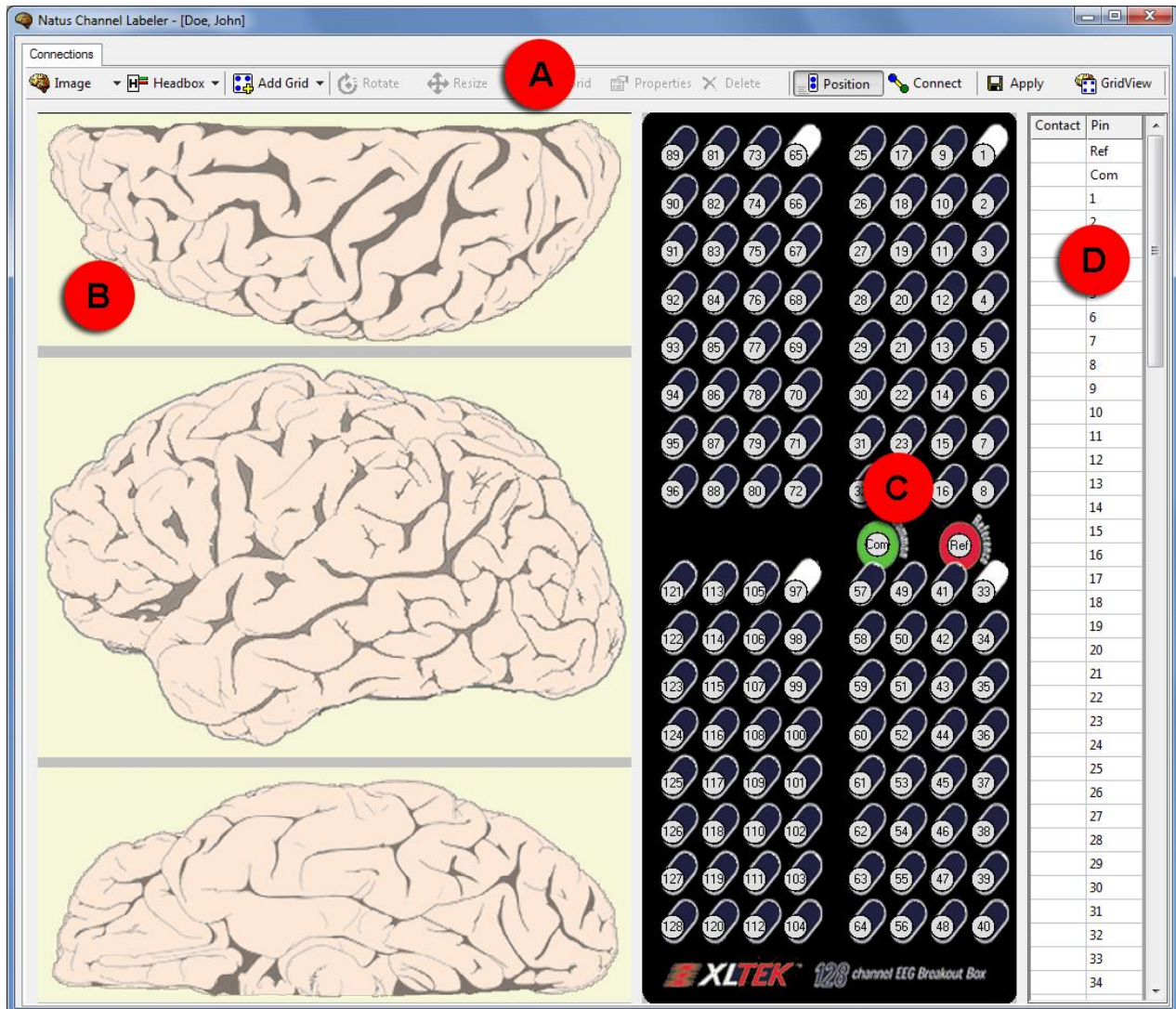
1. Open Windows Explorer.
2. Browse to the CD.
3. Double click on the **SwitchMatrix** folder.
4. Double click on **Setup.exe**.

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](#)

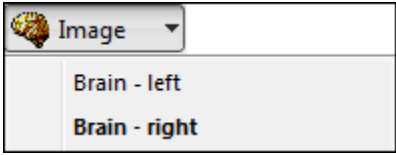
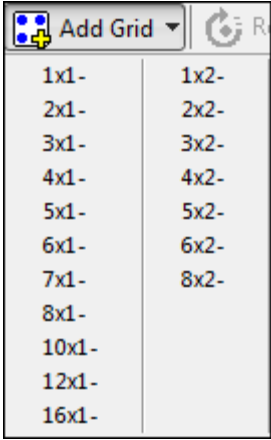
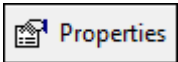
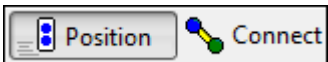


Channel Labeler User Interface

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.
	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.

Button	Description
	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 **Connect** 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

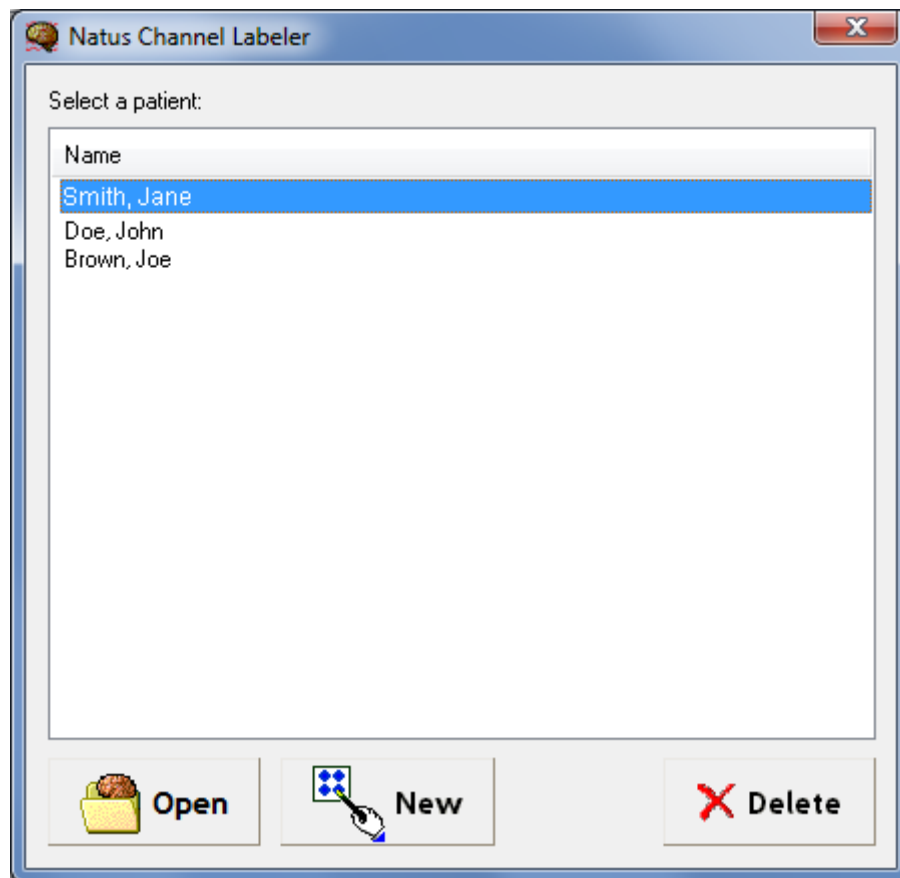
Contact to Headbox Pin table matches contacts to pins. It displays the specific contact name and its corresponding pin number. This pin number indicates the pin on the headbox.

10.2.Using Channel Labeler

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

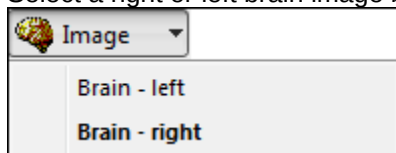
To apply a grid in Channel Labeler:

1. In **Natus Database**, right-click on a the patient or study record and select **New Channel Labeler Session**.
2. OR
3. In NeuroWorks EEG, select Edit > Settings > Channel Labels and press Channel Labeler button.
4. 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.
5. 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.

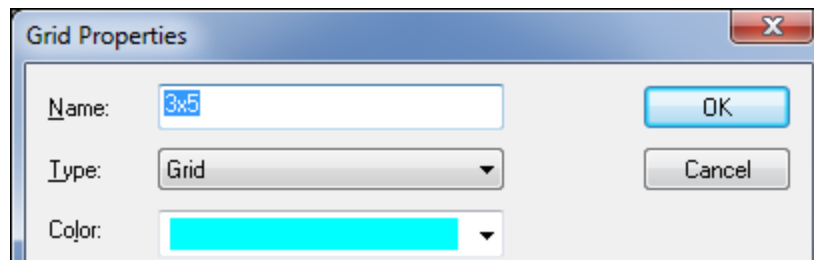


Selecting a Patient in Channel Labeler

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



7. 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

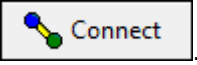
3x3 grid and enter a name of LT, the contacts will be named LT1, LT2 through LT9. If you name the grid LT-, the contacts will be named LT-1, LT-2 through LT-9.

- d. Choose a color for the grid. This is the color that the grid will have on the brain image.
 - e. Click **OK**.
8. 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 will be pressed in .
 - 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 will be pressed in .

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

10.2.1.1. 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.

10.2.1.2. 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.

10.2.1.3. 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.

10.2.1.4. 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.

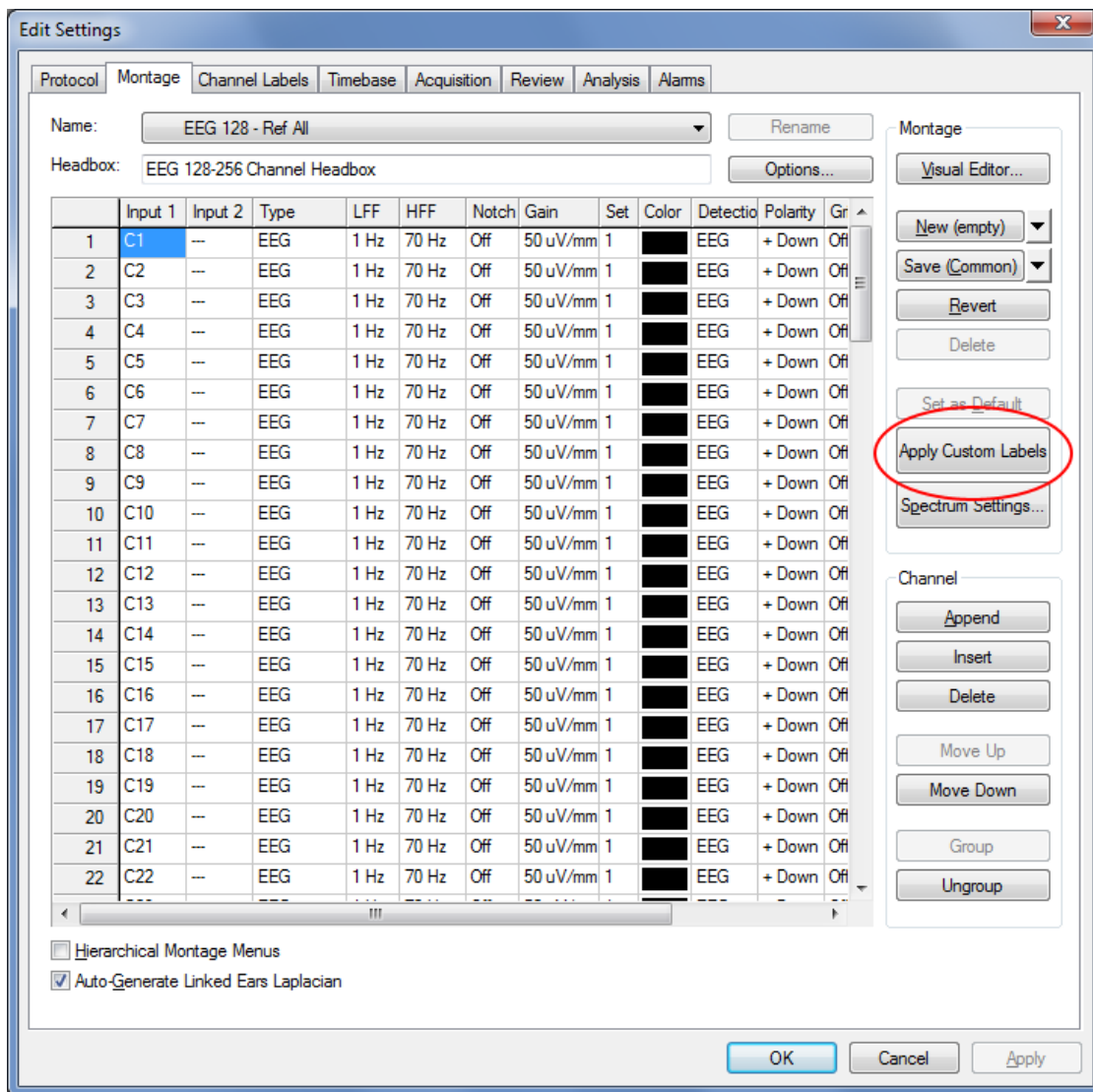
Setting Channel Labels

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



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.

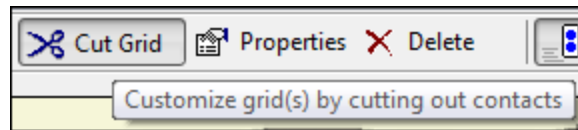
Grids Customization

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:

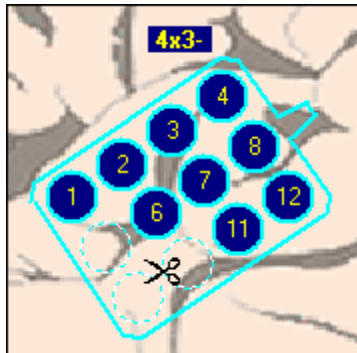
1. Open Channel Labeler and open an existing session or start a new session

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

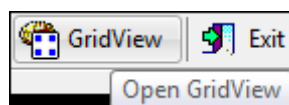
5. To revert the electrode to “active” state, click it again while the scissors cursor is active.
6. Un-press **Cut Grid** button again to cancel this mode.

Stellate GridView

NeuroWorks is 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

10.3.1.1. 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 Directory>\Brains (typically D:\Neuroworks\SwitchMatrix\Brains). The default images are 545x870 pixels at 72 pixels/inch.

10.3.1.2. 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.

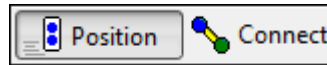
10.3.1.3. How do I add strips or depths?

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

10.3.1.4. 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.

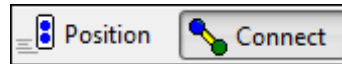
Ensure that you are in **Position** mode.



10.3.1.5. 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 **Connect** mode.



10.3.1.6. 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.

10.3.1.7. 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.

10.3.1.8. 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

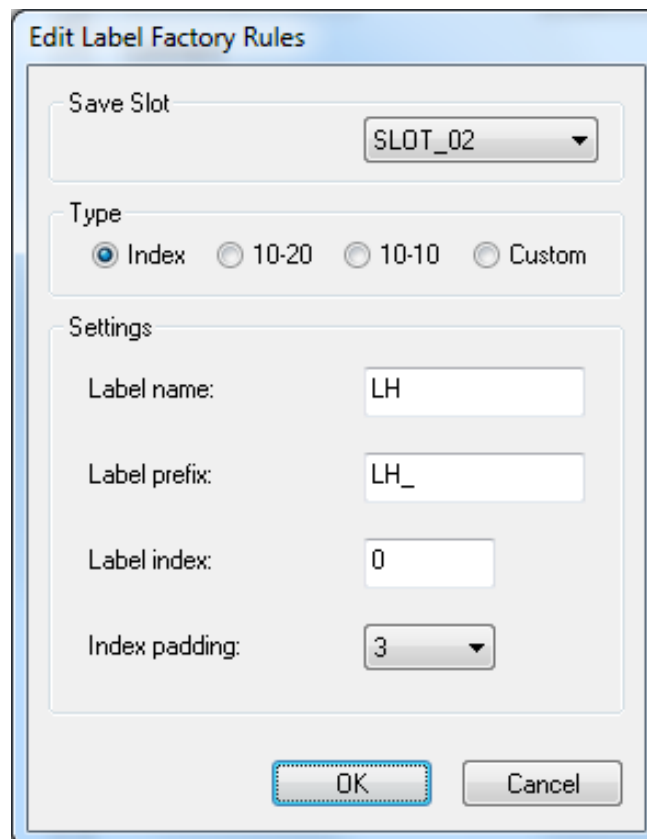
NeuroWorks currently has two methods for labelling channels. For grid studies with 128 or more channels, a dedicated Channel Labeler utility addresses the complexities of grid placement and mapping of grids to physical headbox channels. For other headboxes, with considerably fewer channels, a manual 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.

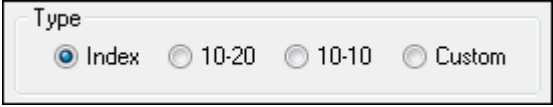
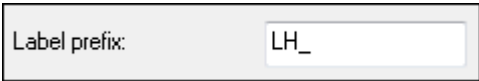
The image shows a dialog box titled "Edit Label Factory Rules". It has a light blue border and a white background. At the top, there is a "Save Slot" label and a dropdown menu showing "SLOT_02". Below this is a "Type" section with four radio buttons: "Index" (selected), "10-20", "10-10", and "Custom". Underneath is a "Settings" section with four labels and input fields: "Label name:" with "LH", "Label prefix:" with "LH_", "Label index:" with "0", and "Index padding:" with a dropdown showing "3". At the bottom right are "OK" and "Cancel" buttons.

Edit Label Factory Rules Dialog

3. Select a save-slot to use for the desired label factory settings from the drop-down list.

- 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

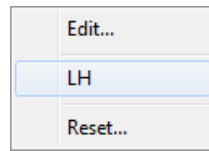
Element	Description
Save Slot	Up to 10 different label factories can be created and saved, each to a Save Slot. 
Type	There are several types of label factories including Index, 10-20, 10-10, and Custom. 
Label name	This is the tag displayed in the context menu (e.g., LH in the example below). 
Label 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.

- 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.

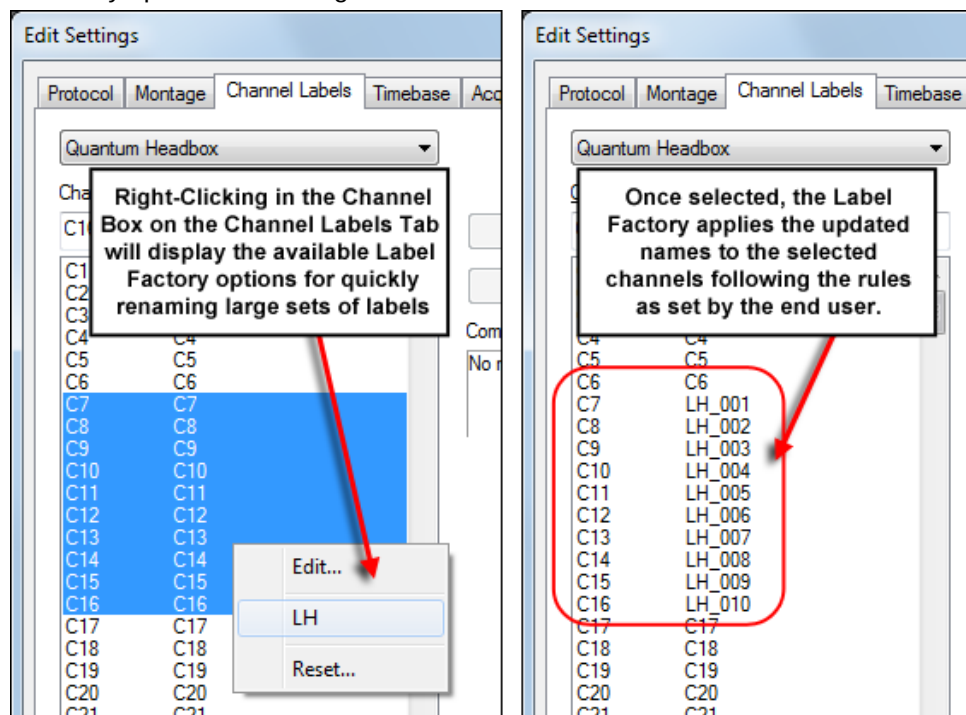


Label Factory – Context Menu

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

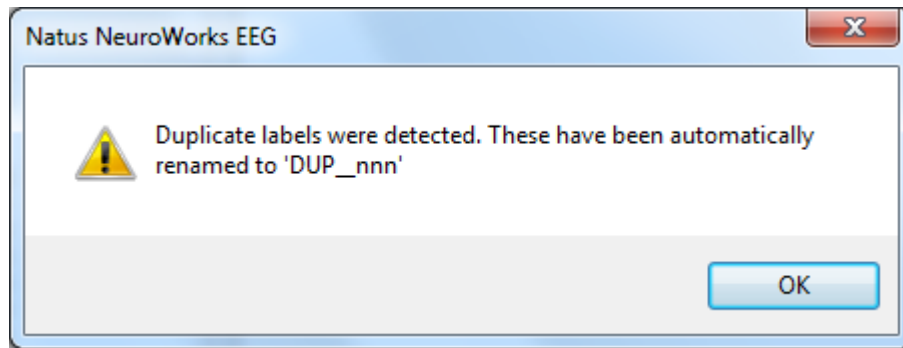
You can apply a label factory multiple times to a channel list by selecting additional channels and following the above steps as many times as required to rename the channels. The index numbering of the subsequent selections continues from the last index of the previous application of the Label Factory.



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 11.3 Applying a Label Factory to a Channel Selection.

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.
Print (Ctrl + P)	Prints a study.

Option	Function/Description
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)
Calibrate	Enables you to select a monitor that matches the system monitor.

Option	Function/Description	
		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.
Annotation Viewer	Hides or displays the Annotation Viewer which shows a list of all Notes , Bookmarks and Feature Marks in a study.
Slideshow Magnetic Mode	Enabling this mode allows the Slideshow dialog to overlay the Annotation Viewer when the slideshow is active.
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.
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.
Clips	Use to turn clip background color coding on or off.
Toolbars	Enables you to determine which toolbars appear on the screen. Clicking a specific toolbar toggles its visibility on or off.
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.
Gridlines	Hides or displays major and minor gridlines. Select an option to enhance the recording or avoid cluttering the waveform window.
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.

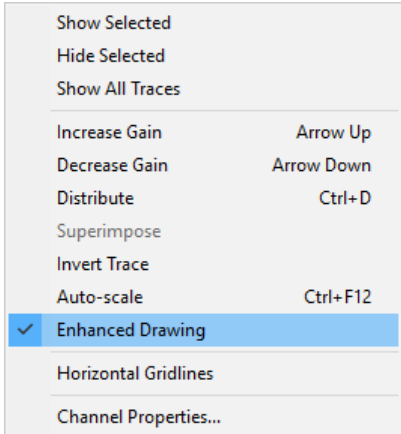
Option	Function/Description
Workspace (Ctrl + W)	Workspaces can be loaded, saved, deleted, or duplicated (Save Workspace As) from here.
Navigation Mode (Ctrl + Down)	Choose to navigate by: Page, Scroll, Event or Event of Same Type.
Page Forward (Arrow Right)	Moves one page forward in the record. Available only in Review mode.
Page Backward (Arrow Left)	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.
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.
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 two or more waveforms on top of each other. To select the waveforms, press the <Ctrl> or <Shift> key, click on the channel labels, and then select the Superimpose option.
Invert Trace	Flips the polarity of a displayed EEG or other signal trace.

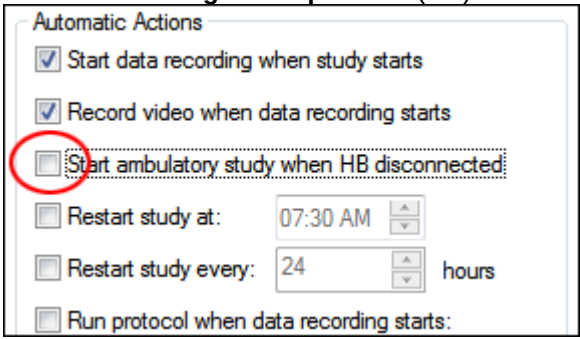
Option	Function/Description
Enhanced Drawing	The High Resolution drawing method allows the user to draw the Snore and EMG channel types using the Enhanced Drawing method found by right-clicking on the channel name, and selecting Enhanced Drawing from the context menu.  The Enhanced Drawing Method uses the min and max values at each data point to plot the signal. In comparison, on the Standard Drawing mode uses only a single data point. By default, the Standard Drawing method is selected.
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.

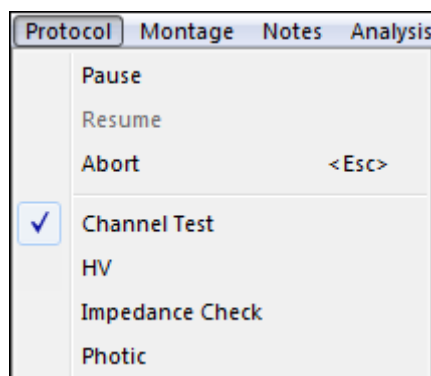
Controls Menu Options

Option	Function/Description
Record (Ctrl+<space>)	Begins recording.
Stop Recording (Ctrl+<space>)	Stops recording.
Record Video	Use to initiate or end video recording. When checked, video recording is enabled.
Restart Acquisition	Restarts recording.
Stop Acquisition	Stops the acquisition completely.
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.

Option	Function/Description
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 EMU128FS and Quantum headboxes attached.
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/Trex HD headbox. When enabled, the Trex/Trex HD 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/Trex HD 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 Stimulation 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.

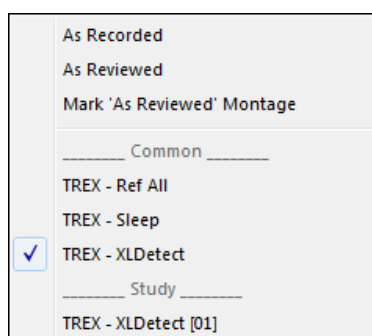
To set the montage, open the **Montage** menu and select an appropriate montage. This does not set the selected montage as the default. For further information, see [Creating and Editing a Montage](#).

Montage Menu Groups

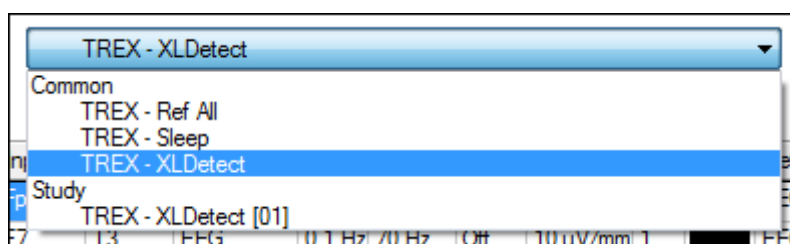
Group	Description
Common	Lists montages that are typically saved to a non-local drive. These montages can be accessible to everyone on the network.
Local	Lists montages that are saved in the local directory.
Patient	Lists montages that have been created and saved for a specific patient whose study is 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)



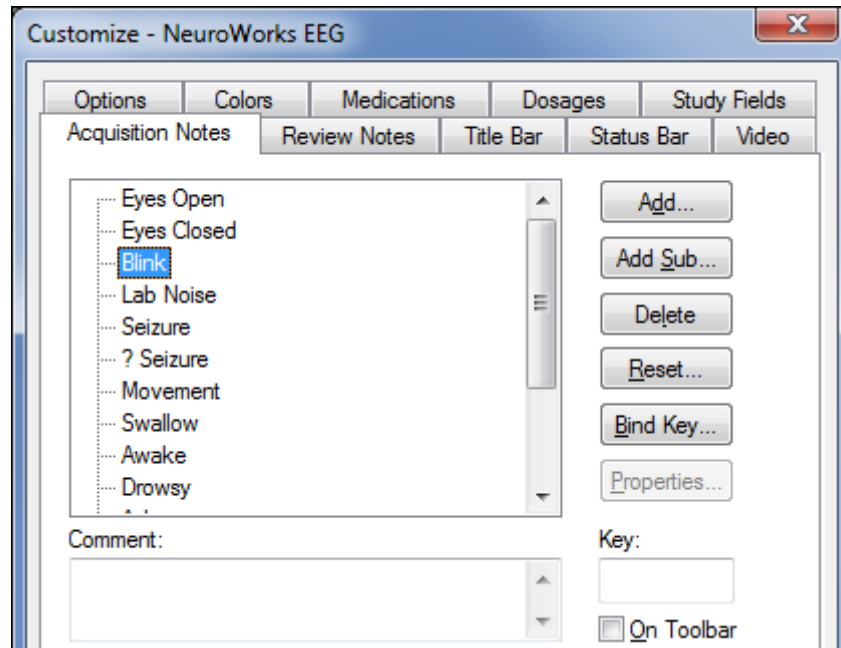
Montage Tab List

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:

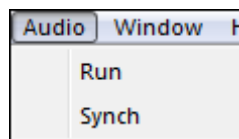
- Choose **File > Customize > Acquisition Notes**.



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.

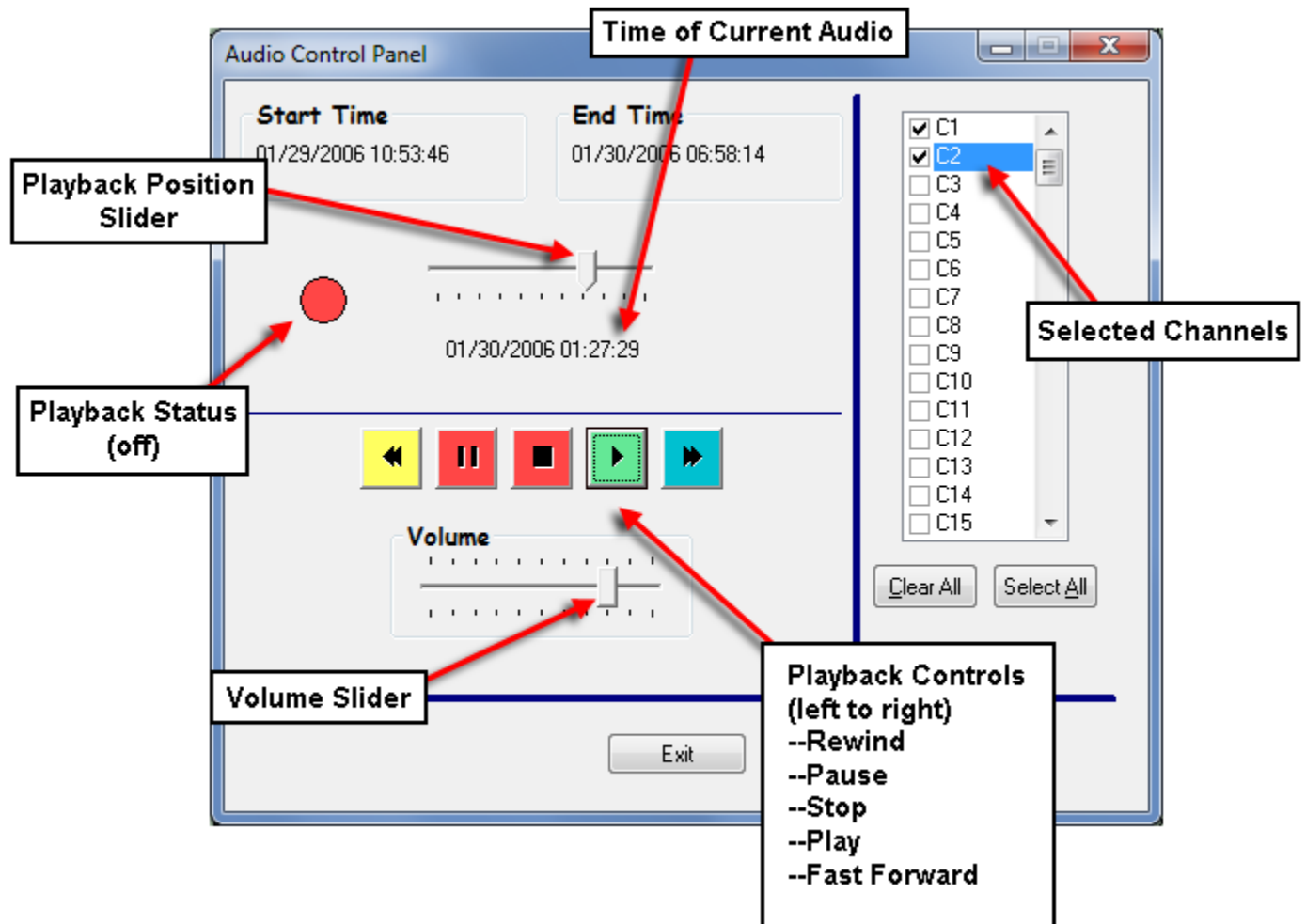
To open the Audio Control Panel:

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

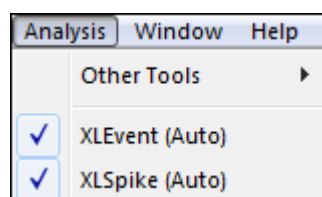
The **Synch** command on the Audio menu allows you to synchronize data played by the **Audio Control Panel** with the data displayed in the waveform window. For example, use the Review toolbar to move to a different location in the study. Then click Synch to synchronize audio playback with the data currently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



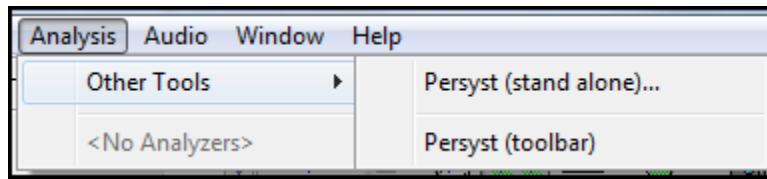
Audio Control Panel

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.

- **Persyst.** **Persyst** is available under the **View > Toolbars** dropdown menu if you have the latest version installed and if your system has been configured to allow integration. The **Persyst** toolbar can also be added by clicking **View > Toolbars > Persyst**.
- 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 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.
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 .

Option	Function/Description
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.

Edit Settings

Protocol Montage Channel Labels Timebase **Acquisition** Review Analysis Alarms Heads Up Display

Brain Monitor

Reference Electrode
External(Ref)

Comment:

Sampling Frequency
256
512
1024
2048
4096

Automatic Actions
☐ Start data recording when study starts
☐ Record video when data recording starts
☐ Start ambulatory study when HB disconnected
☐ Restart study at: 07:30 AM
☐ Restart study every: 24 hours
☐ Run protocol when data recording starts:
Impedance Check
Default montage used when study starts:
AP Bipolar - iX

Profiles
Acquisition Profile
Brain Monitor all ch 512hz
Analyzer Profile
ICU analyzers
Trend Profile
Trends profile 1

Channel Status
☒ All channels on
☐ Set manually

C3	ON
C4	ON
Cz	ON
F4	ON
F7	ON
F8	ON
Fz	ON
Fp1	ON
Fp2	ON
Fpz	ON
M1	ON
M2	ON
O1	ON
O2	ON
Oz	ON
P3	ON
P4	ON
P7	ON
P8	ON
Pz	ON
T7	ON
T8	ON
X25	ON
X26	ON
X28	ON
X29	ON
X30	ON
X31	ON
X32	ON
ECG-LA	ON
ECG-RA	ON
ECG-LL	ON

Channel Off
Channel On
16Hz
64Hz
☒ Derive Channels
SpO2 Data Type
4-beat Averaged
Light Sensor
☐ Use Light Sensor
Trigger Threshold:
50 %
Diff Inputs:
1 2 3
Ref. Diff
Decimation (Hz)
Off
Reset...
Advanced...

OK Cancel Apply

Acquisition tab - Named Profile

- Set the various settings required for acquisition.
- 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.



NOTE: Make sure to define the Analyzer and Trend display profiles in order to automatically use the appropriate Analyzers and Trend settings when starting a study with the acquisition profile.

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 be 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:

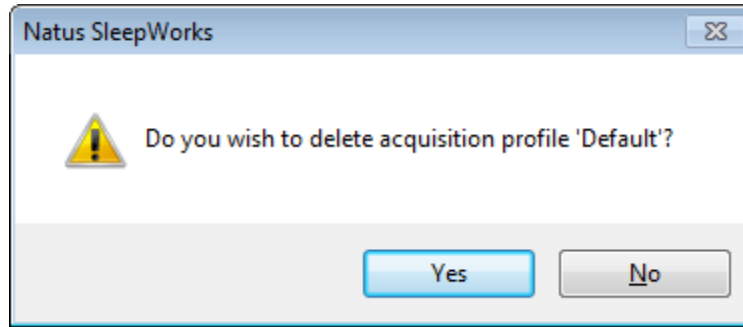
1. Select the desired profile from the dropdown list.
2. Click the **New Profile** button .
3. Click the **Rename Profile** button  and give the copy a unique, meaningful name.
4. To adjust the properties of the copied profile, make the desired changes, and click **Apply** or **OK** to save them.

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 Profile Confirmation 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

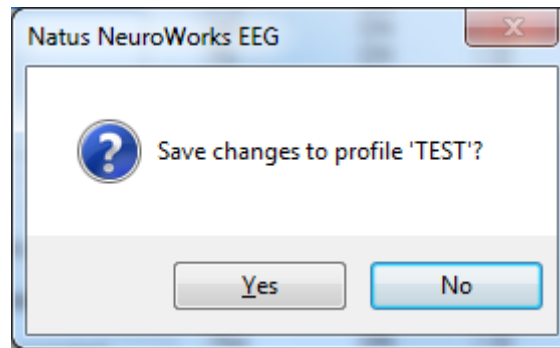
If you have made changes to an acquisition profile, the asterisk should be visible to the left of the profile name. Selecting another saved profile, a different headbox, or clicking **Cancel** will discard any pending changes to the currently selected profile.

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.

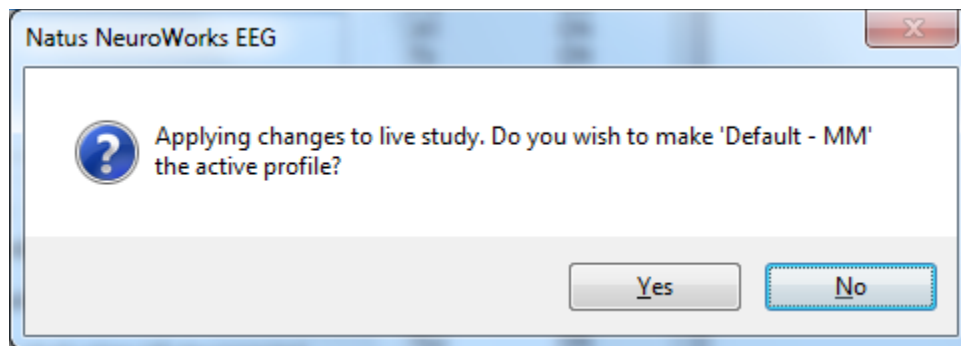
For the properties that can be changed during a live session, clicking **Apply** or **OK** to commit these changes will produce the following confirmation dialog:



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)

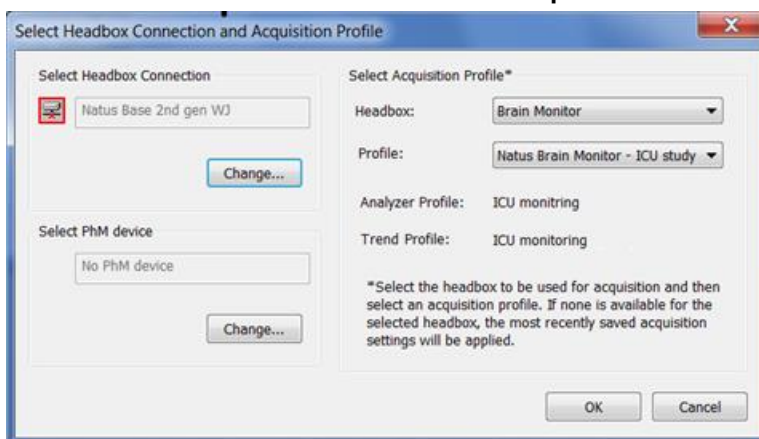
Remember that the active profile is 'remembered' by name. If you make the active profile one that uses indexed names (those with a numeric sequence in square brackets) the profile applied may differ from that expected because indexed names are dynamically assigned). Always rename profiles from their 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**  button located to the right of the **Headbox Name** field. The **Headbox Connection and Acquisition Profile** dialog appears.



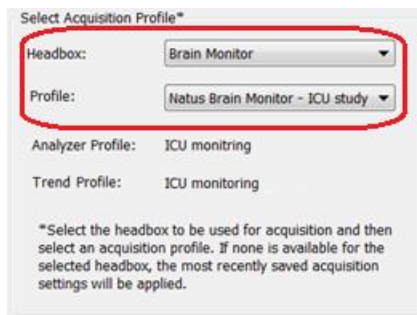
Select Headbox Connection and Acquisition Profile Dialog

2. 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.

3. 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.
4. Use the Profile drop-list to select the previously saved acquisition profile you wish to apply for the new or returning study.



5. 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*.

The screenshot shows a dialog box titled "Automatic Actions". It contains several checkboxes and input fields. The checkboxes are: "Start data recording when study starts" (checked), "Record video when data recording starts" (unchecked), "Start ambulatory study when HB disconnected" (checked), "Restart study at:" (unchecked), "Restart study every:" (unchecked), and "Run protocol when data recording starts:" (checked). The "Restart study at:" field has a time picker set to "07:30 AM". The "Restart study every:" field has a numeric spinner set to "24" and the unit "hours". The "Run protocol when data recording starts:" dropdown menu is set to "Impedance Check". Below the dropdown, there is a text field labeled "Default montage used when study starts:" with the value "TREX - XLDetect".

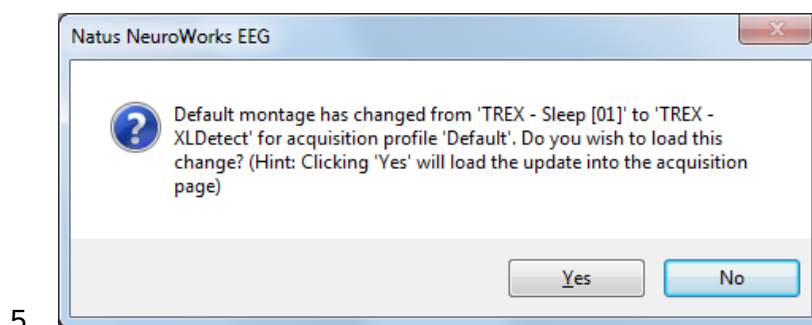
13.7. Establishing the Default Montage

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.

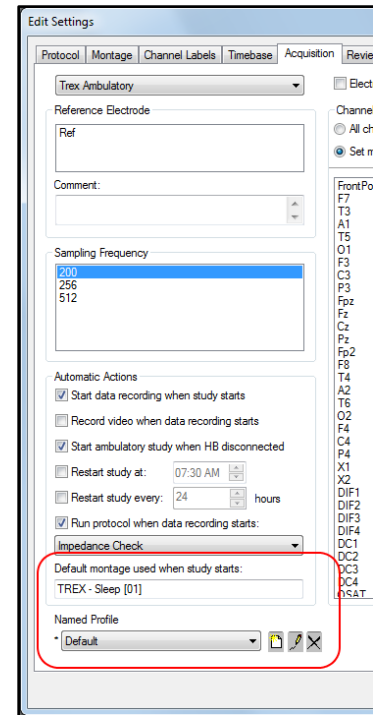


5.

6. 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.
7. 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.

8. **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. Slideshows

14.1. Overview

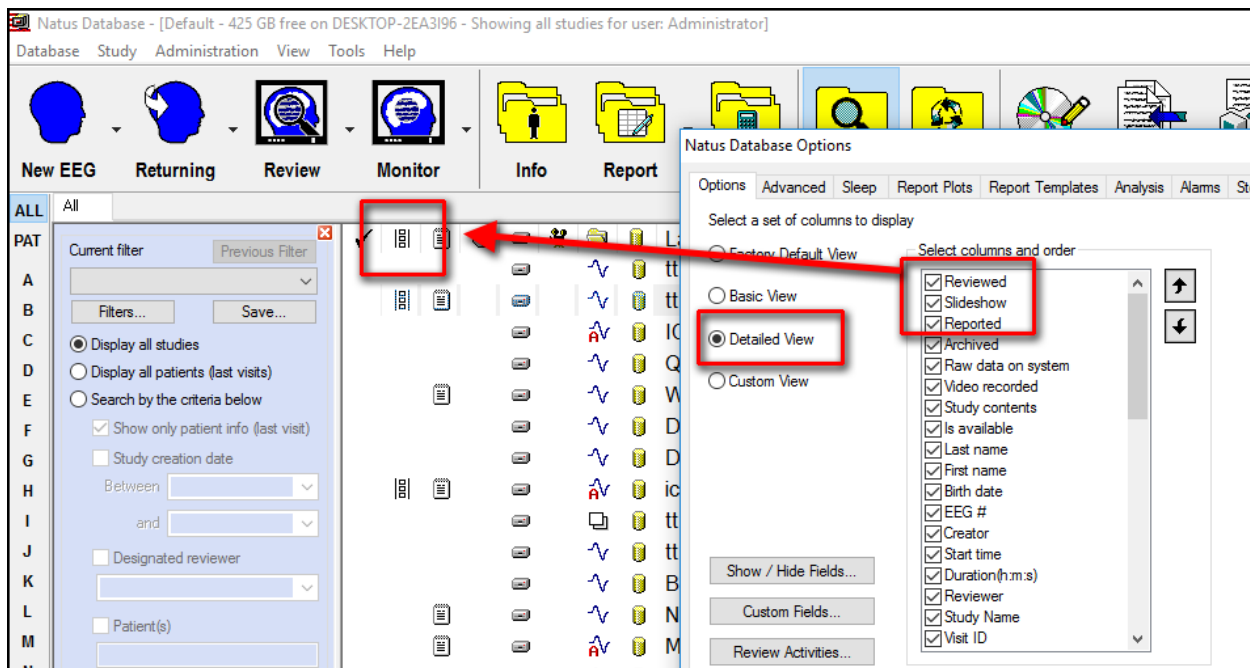
A Slideshow is a collection of studies, a “set,” for the same patient, and modality (EEG/Sleep) which combines and builds a list of annotations from the collection. This can be used to view a set of annotations across the entire collection, can then be used to navigate between the different studies and annotations. When reviewing a study, the user can add an annotation to any marker in the pre-defined set. The slideshow feature also allows for the configuration of ingest rules, pruning and display options, annotation filtering, and a scalable user interface which can be used during review and annotation of the defined collection of studies.

14.2. Enabling the Slideshow Icon in the Natus Database

In the Natus Database, a Slideshow icon, , can be enabled so that it is visible for studies that contain saved Slideshows.

To Enable the Slideshow icon:

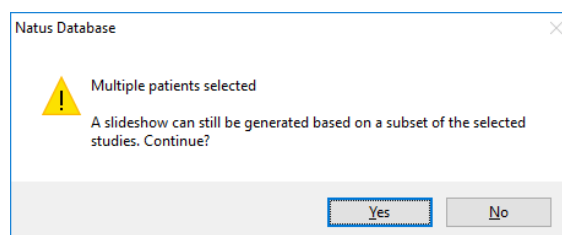
1. Open the Natus Database
2. Click **Tools > Options > Options** (tab).
3. Click on the **Detailed View** radio button and locate the **Slideshow** column field in the **Select columns and order** box.
4. Place a checkmark in the Slideshow checkbox, and move it to the desired display location.
5. Click **Apply** and then **OK** to save the change and display the Slideshow icon column in the Natus Database.



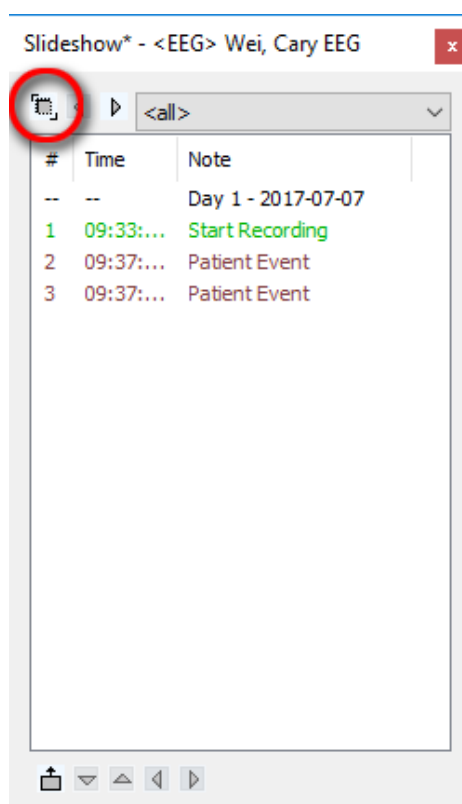
14.3. Creating a New Slideshow

To create a new Slideshow:

1. In the Natus Database, locate a set of studies for the same patient and in the same modality, and select them all.
2. Right-click on a selected study, and select **Slideshow > Create Slideshow** from the context menu.
3. The Natus Database checks the studies for compatibility and creates a Slideshow from them. If one or more of the selected studies do not meet the ingest rules, for example, multiple patients are selected, then a notice is displayed indicating that only a portion of the selection can be used for the slideshow. Selecting **Yes** will continue with the Slideshow creation, and selecting **No** cancels the generation.

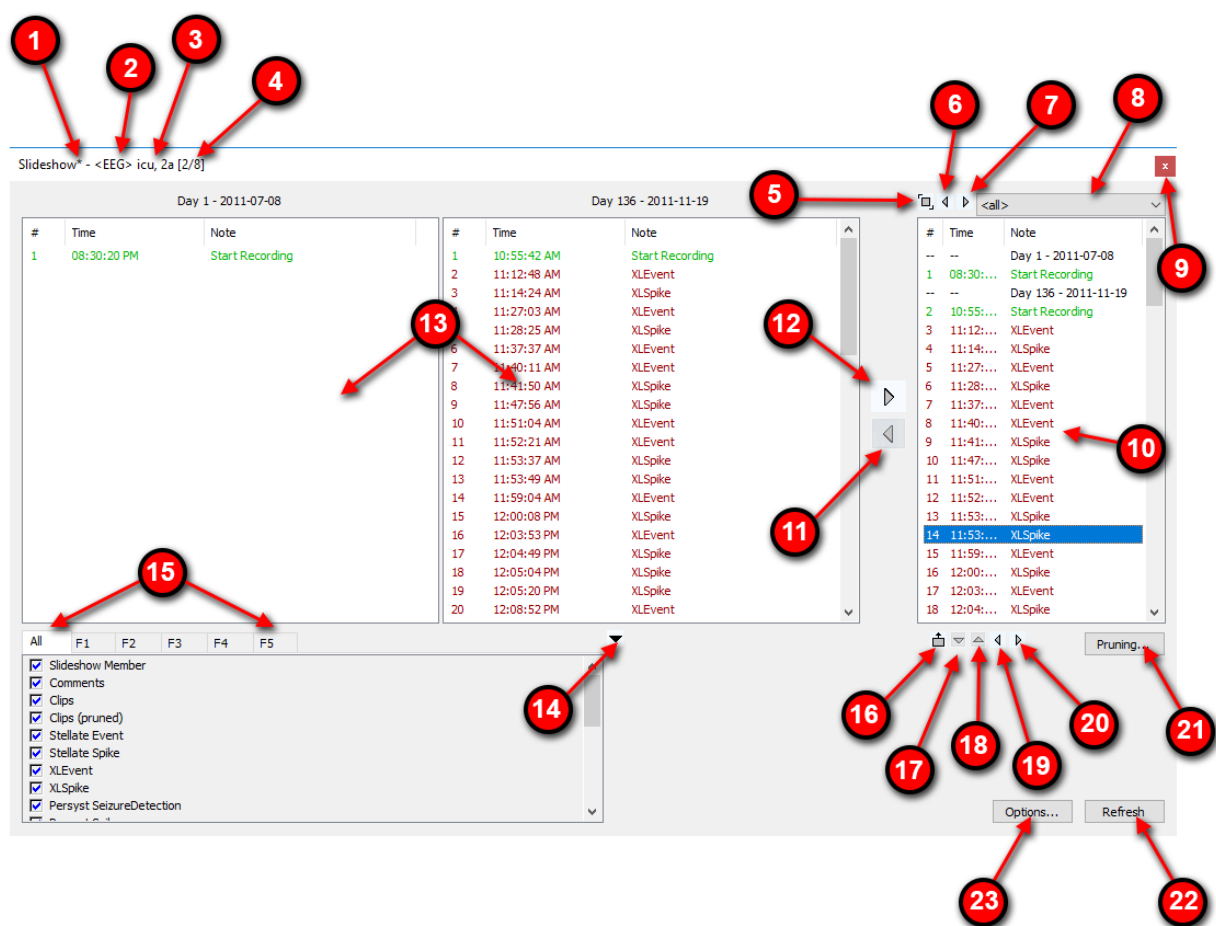


The slideshow window opens showing the Modality and the patient name in the dialog. An asterisk (*) in the dialog name indicates that a Slideshow has not been saved. The Slideshow has two different visual options. By default, the smaller of the two opens when the first Slideshow is created. Clicking on the  icon expands the window to the full view. Each subsequent opening of the Slideshow remembers the previous view, and opens in it.



Slideshow Minimal Dialog

14.4.Slideshow Dialog



Number	Description/Function
1	An asterisk (*) next to the Slideshow means that the slideshow has not been saved.
2	The modality of the Slideshow is shown in the brackets < >. If mixed mode is selected, this is shown here as well.
3	Patient name is shown next to the modality.
4	Shows the number of studies in the set and the current record. The first number is the current record. The second is the total number of studies in the set.
5	Maximizes or Minimizes the dialog view for the Slideshow.
6	Opens the previous Segment in NeuroWorks.
7	Opens the next Segment in NeuroWorks.
8	Select the active Slideshow set. This can be configured for up to twenty (20) different sets.

Number	Description/Function
9	Closes the slideshow.
10	Shows the annotations from the selected slideshow set in the dropdown.
11	Navigate to the Previous day in the study set.
12	Navigate to the Next day in the study set.
13	Annotations included in the study set by day. This is configurable based on the desired number of panels to be shown.
14	Minimizes / Maximizes the filter panel. Click the button again, to reverse the action.
15	Filter Panels. Customize up to five (5) different annotation filters for viewing. These can be renamed by right-clicking on the F1 to F5 tabs.
16	Saves the slideshow.
17	Move annotations down in the list, when the Show Days option is turned off.
18	Move annotations up in the list, when the Show Days option is turned off.
19	Navigates to the Previous note in the displayed annotations.
20	Navigates to the Next note in the displayed annotations.
21	Prunes the study set by taking visible annotations and generates a pruned study based on each annotation according to the options set under the Options dialog.
22	Updates slideshow annotations from the linked studies. This pulls in
23	Sets the slideshow options.

14.5. Configuring Slideshow Options

The slideshow feature includes the ability to configure ingest rules, annotation filtering, and pruning and display options.

To configure Slideshow options:

1. Open a Slideshow from the Natus Database.
2. Ensure the Slideshow window is fully expanded to show the Options button by clicking on the Max/Min  button.
3. Select the **Options** button. The Slideshow Options dialog opens.

Slideshow Options

General Options

- ☐ Auto context menu
- ☒ Gang slideshow to view
- ☒ Navigate by note ID
- ☐ Allow mixed shows

Layout

Number of panels to display (1-8):

Start of day offset (hours):

Colors

- Comments
- Clips
- Clips (pruned)
- Stellate Event
- Stellate Spike
- XLEvent
- XLSpoke
- Persyst SeizureDetection
- Persyst Spike
- Persyst SpikeBurst**
- QEEG Events
- Seizure
- Spike

Advanced

Ingest...

Config...

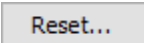
Pruning...

Site...

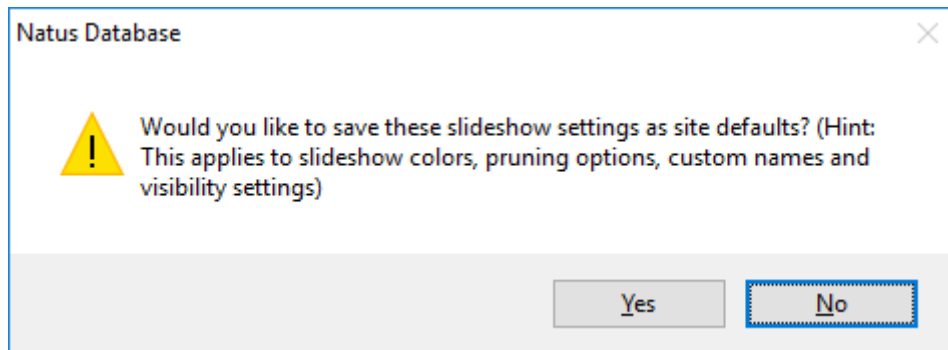
Reset... OK Cancel

4. Select or modify the desired options:
 - **General** – Modify the general characteristics of the Slideshow.
 - **Layout** – Modify the layout of the Slideshow.
 - **Colors** – Modify the colors of the annotations.
 - **Advanced** – Change the Ingest, Config, and Pruning Options.



NOTE: Clicking the **Reset**  button restores the settings back to the most recently saved site settings.

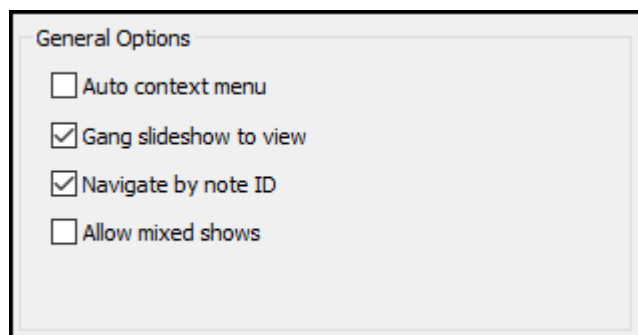
5. Click **OK** to close the dialog. A confirmation dialog may display based on the settings selected under section 0 *Defining Pruning Options*.



- Click **Yes** to save the updated slideshow options as the site default. This overwrites the current saved defaults for the site. Click **No** to save the options for the current slideshow only.

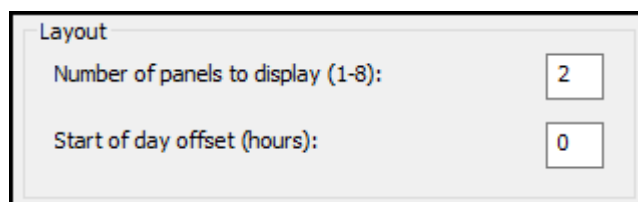
General Options

Set the General options in this panel of the Slideshow Options dialog.



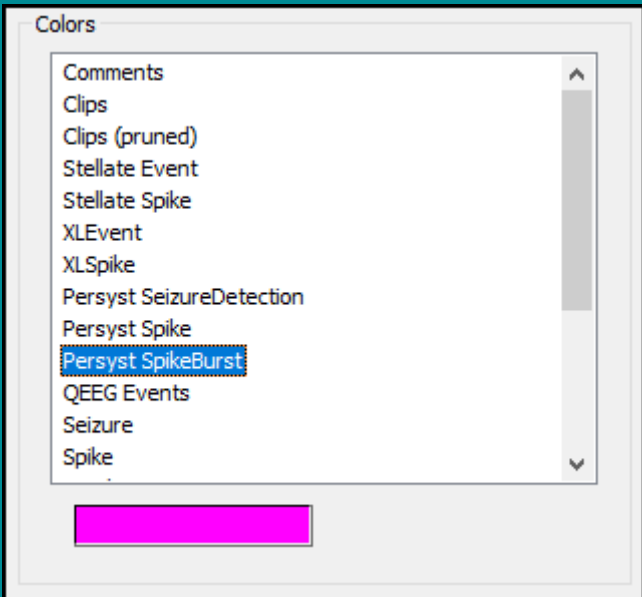
Option	Description/Function
Auto context menu	Brings up the slideshow membership context menu when you add an annotation to the study. When enabled, the slideshow context menu shows automatically when the annotation dialog is closed to ensure an annotation is added to the correct slideshow set.
Gang slideshow to view	When enabled, selecting an annotation in NeuroWorks will also select it in the slideshow dialog. It works for the reverse as well.
Navigate by note ID	This is an extension of the normal navigation mode which is by the timestamp. Enabling this allows the user to jump to the location of the annotation in NeuroWorks and selects it.
Allow mixed shows	Enabling this option will allow for the selection of a mixed sample of either patients or modalities, or both patients and modalities for a slideshow. Pruning is unavailable in mixed slideshows.

Layout Options

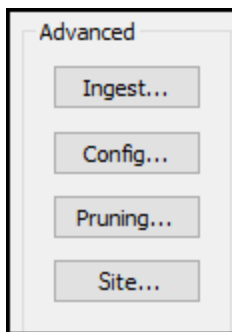


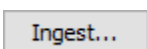
Option	Description/Function
Number of panels to display (1-8):	Select the number of panels to display in the slideshow expanded view. This correlates to the number of visible panels in the slideshow dialog. Choose a number from 1-8.
Start of day offset (hours):	By default, the standard day begins at 12 a.m. If desired, the start of day can be offset in hours by the number defined here. For example, if the desired time is 6 a.m. for the start of each day, then enter the number 6 in this option.

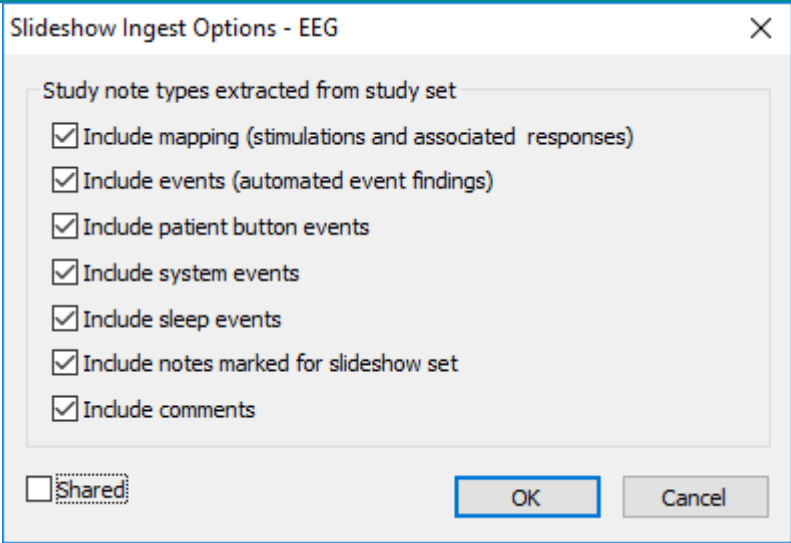
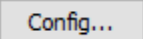
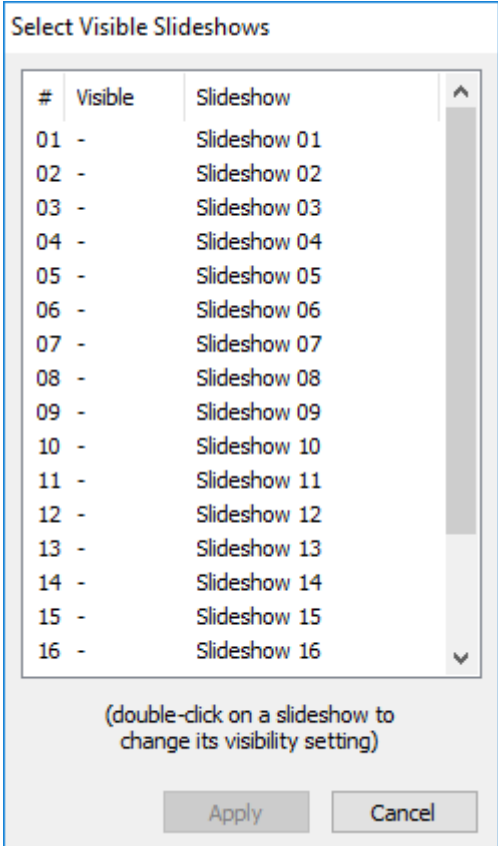
Color Options

Option	Description/Function
	Color Allows for the selection of different colors to apply for specific annotation types. Double click on either the name of the annotation or the color swatch to define a custom color.

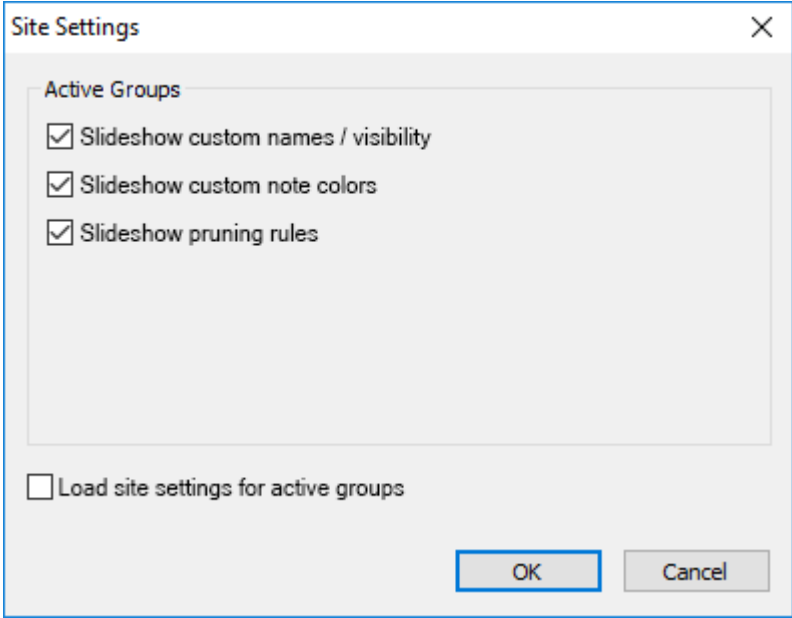
Advanced Options



Option	Description/Function
	Defines which types of annotations are to be extracted from within the studies and stored in the slideshow. Provides additional control over what annotations are included in the slideshow. Click the checkbox the checkbox next to an option to enable or disable the inclusion of a specific study note type in the slideshow. Clicking next to the Shared option allows the settings to be synchronized across the site or deselecting maintains the settings for just the current user account.

Option	Description/Function
	
	Controls the visibility in the slideshow dialog and defines the naming conventions of the slideshow sets. See section <i>14.6 Defining Slideshow</i> for additional details. 

Option	Description/Function
Pruning...	Defines the pruning options for the slideshow. Sets the clip policies and general options for each annotation type. See section <i>0 Defining Pruning Options</i> for additional details. Slideshow Pruning Options General Options ☒ Include video ☐ Compress video ☒ Include reports ☐ Inclusive mode ☒ Prompt for name ☒ Auto-close on success ☐ Apply video clip policy Clip Policies Slideshow Member Comments Clips Clips (pruned) Stellate Event Stellate Spike XLEvent XLSpike Persyst SeizureDetection Persyst Spike Persyst SpikeBurst QEEG Events Seizure Spike (pre/post roll in seconds) OK Cancel

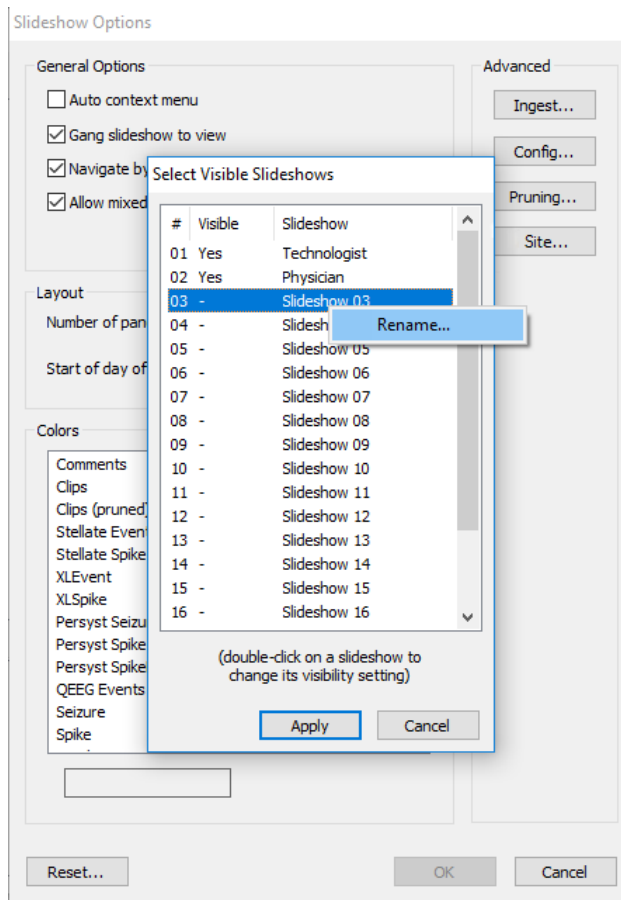
Option	Description/Function
Site...	Defines which options are saved or used in the overall site settings. Select the desired settings and click OK to save. Enabling the Load site settings for active groups setting triggers the check for saved site settings when you save changes. This checks the site settings and asks for an update, and will overwrite any local user user settings with the overall site settings. 

14.6.Defining Slideshow Categories

Using Slideshow categories, annotations can be assigned to a specific set during review. These sets can be selected from the dropdown in the Slideshow dialog to show only the defined annotations for a specific category. A total of twenty (20) unique sets can be pre-defined for use. By default, categories are labeled as Slideshow 01 to Slideshow 20 and can be modified and set as active from within the Slideshow Options dialog.

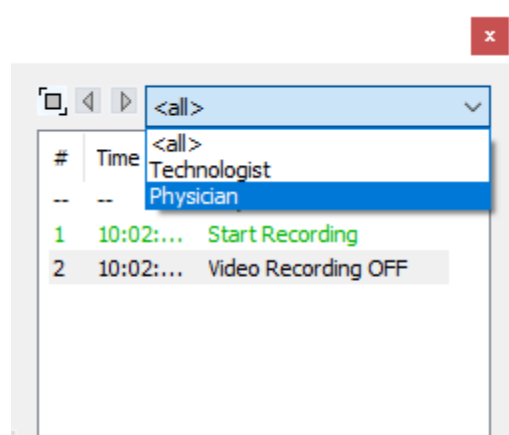
To Define a Slideshow Set:

1. Open a Slideshow from the Natus Database.
2. Ensure the Slideshow window is fully expanded to show the Options button by clicking on the Max/Min  button.
3. Select the **Options** button. The Slideshow Options dialog opens.
4. In the Slideshow Options dialog, select the **Config** button to open the Select Visible Slideshows dialog.
5. Right-click on a Slideshow category, and select **Rename**. The Rename Slideshow dialog displays.



6. Give the Slideshow category a unique name, and click **OK**.
7. Double-click on a Slideshow category to make it visible or to remove visibility. When all categories have been labeled and activated, select apply to close the dialog and apply the changes.
8. Click OK to apply the settings and close the Slideshow Options dialog.
9. A confirmation dialog may show asking to save the slideshow settings as the site defaults. Selecting **Yes** overwrites the default settings for the site with the new settings. Selecting **No** saves the setting to the current Slideshow only.

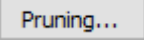
The category dropdown in the Slideshow is now populated with the updated naming and visibility details. Selecting one of these categories will filter the list below to reflect only the annotations which have been marked as part of the set. See section 9.5 *Adding a Note to a Slideshow Set* for additional details on marking annotations as a part of a set.



14.7. Pruning Studies from a Slideshow

Pruning works by taking every annotation that is visible in the slideshow and generates pruned studies on each one based on the pre-defined pruning options. Pruned studies are not added to the original Slideshow, but are added as free-floating studies in the database. These pruned studies can then be added or sorted into another Slideshow. Alternately you can re-generate new pruned pieces based on a different filter selection or based on different time options.

To prune a study:

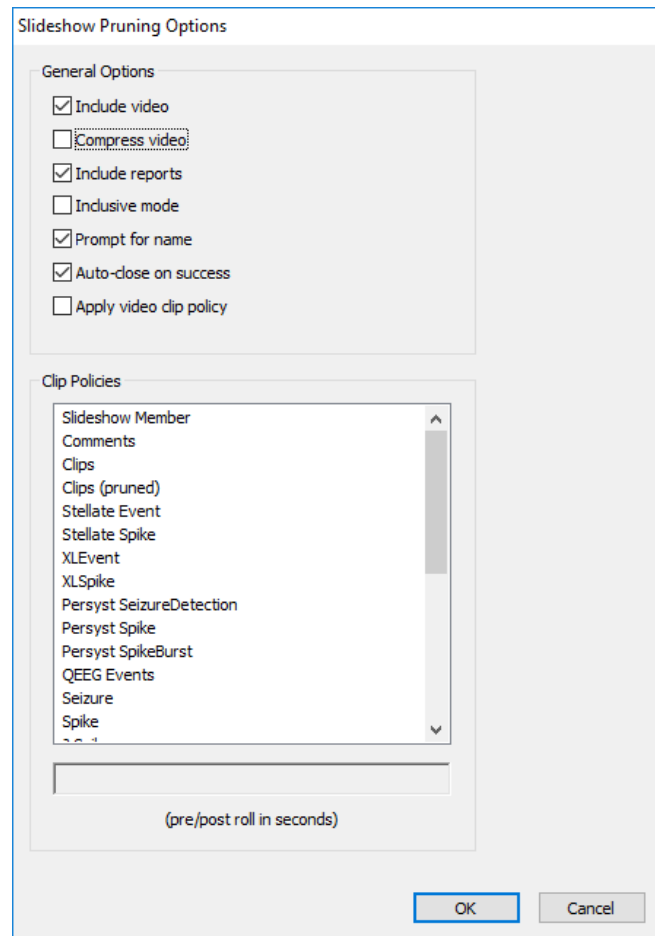
1. Open a Slideshow from the Natus Database.
2. Ensure the Slideshow window is fully expanded to show the Options button by clicking on the Max/Min  button.
3. Select the **Pruning**  button. This begins the process of pruning the annotations based on the pre-defined options.

Defining Pruning Options

By defining the pruning options, you can prune annotations across the entire study set from the selected slideshow. The resulting pruned studies are given their own base name; however, they are not associated with the parent study set.

To set the pruning options:

1. Open a Slideshow from the Natus Database.
2. Ensure the Slideshow window is fully expanded to show the Options button by clicking on the Max/Min  button.
3. Select the **Options** button. The Slideshow Options dialog opens.
4. In the Slideshow Options dialog, select the **Pruning** button to open the Slideshow Pruning Options dialog.



5. Select or modify the desired options:
 - **General** – Modify the general characteristics of the Slideshow pruning option.
 - **Clip Policies** – Modify the pre and post roll options for each of the annotation types.
6. Once all settings have been modified, select the OK button to close the dialog and save the pruning options.
7. Click **OK** to close the dialog.

14.7.1.1. Pruning Options – General

Set the General options in this panel of the Slideshow Pruning Options dialog.

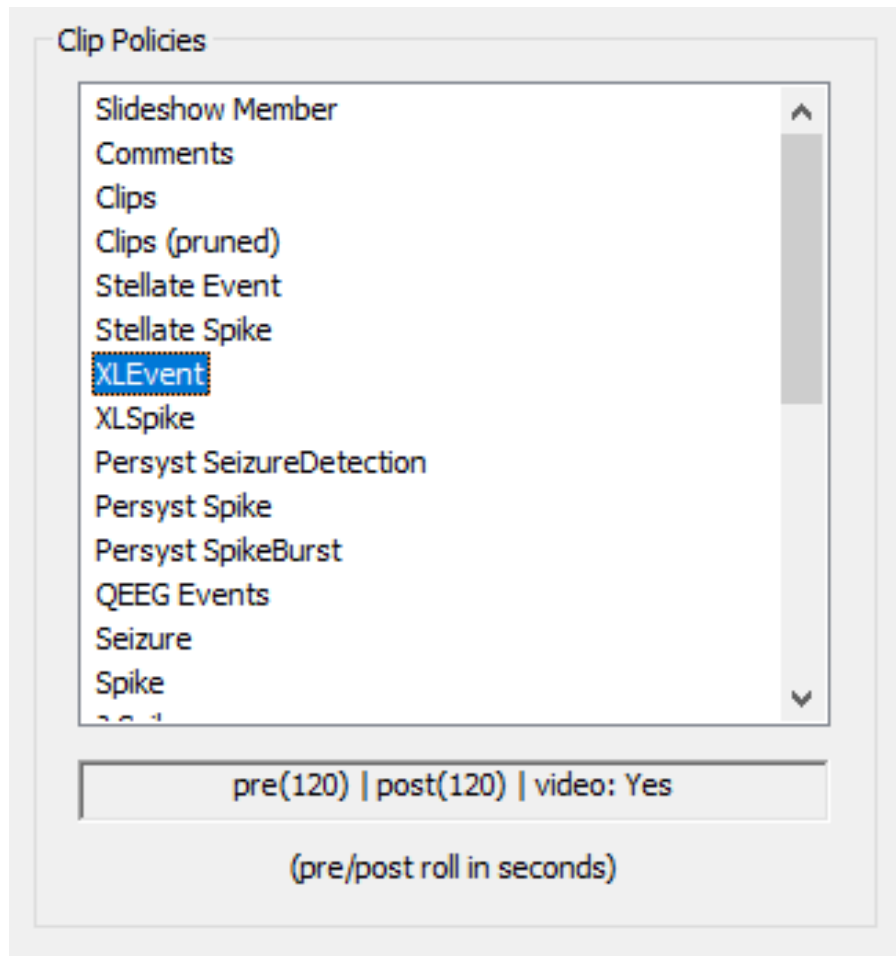
General Options

☒ Include video
☐ Compress video
☒ Include reports
☐ Inclusive mode
☒ Prompt for name
☒ Auto-close on success
☐ Apply video clip policy

Option	Description/Function
Include Video	Includes the video in the pruned annotation.
Compress video	Compresses video in the pruned annotation.
Include reports	Includes reports in the annotations for pruning.
Inclusive mode	Creates a single pruning clip spanning from the earliest to the latest visible annotation for each study, rather than separate clips around each visible annotation.
Prompt for name	Prompts for a study name for the pruned annotations. It then applies an indexed number to the pruned annotations.
Auto-close on success	With this option disabled, the pruning process will pause after each pruned study. When enabled (default), pruning continues until all pruned studies are created.
Apply video clip policy	Applies the video clips in the pruned studies. This is applicable to Clip policies where the Include Video checkbox is enabled. See section <i>14.7.1.2 Pruning Options – Clip Properties</i> .

14.7.1.2. Pruning Options – Clip Properties

Set the pre and post-roll options for annotations in this panel of the Slideshow Pruning Options dialog.



To modify the clip policies:

1. Select the desired annotation from the list, and double-click. The Edit Clip Policy dialog opens.
2. Define the **Pre-roll** in seconds. The pre-roll is the amount of the study that comes before the annotation which is to be added in the pruned study.
3. Define the **Post-roll** in seconds. The post-roll is the amount of the study that comes after the annotation which is to be added in the pruned study.
4. Select the **Include video** checkbox if you'd like to include video clips with the pruned study.



NOTE: You must also have the global **Include video** and **Apply video clip policy** options selected for the video clips to be visible to the pruned study.

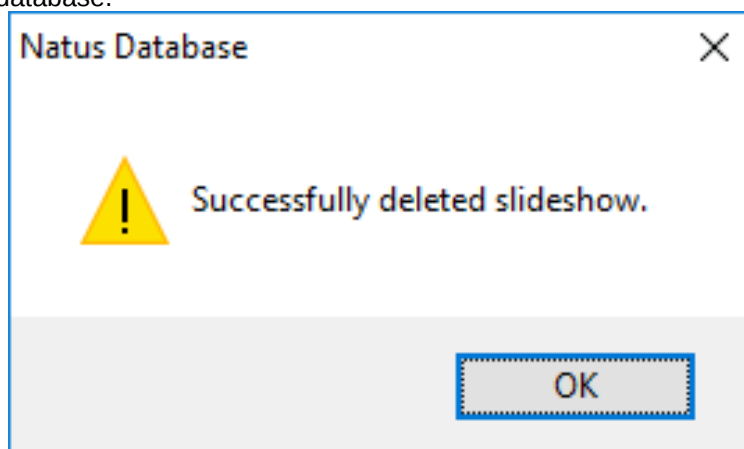
5. Click **OK** to save the changes.
6. Once all changes are complete, click **OK** to close the dialog, and **OK** again to close the Slideshow Options dialog.

14.8. Deleting a Slideshow

Deleting a slideshow removes any custom ordering of annotations in each slideshow set. However, all the annotations in each study will still have their slideshow associations intact. This means that creating a slideshow again, enables you to still see all the associations.

To delete a slideshow:

1. In the Natus Database, locate a study set that includes a slideshow .
2. Right-click on the desired study, and select **Slideshow > Delete Slideshow** from the context menu.
3. Click **Yes** in the confirmation dialog to delete the slideshow. Click **No** to return to the Natus database and leave the slideshow intact.
4. Confirmation of the deletion is then displayed in a dialog. Click **OK** to close this dialog and return to the Natus database.



14.9. Reporting on a Slideshow

Once a slideshow has been created, a report can be generated based on the multiple studies in the slideshow set. In order to report on a slideshow, the appropriate template must be created using the Study Set fields.

For additional details on setting up report templates, see section 8.2 *Report Templates*.

To generate a report from a slideshow:

1. In the Natus Database, locate a study set that includes a slideshow .
2. Right-click on the desired study, and select **Slideshow > Create Slideshow Report** from the context menu. The report generates.



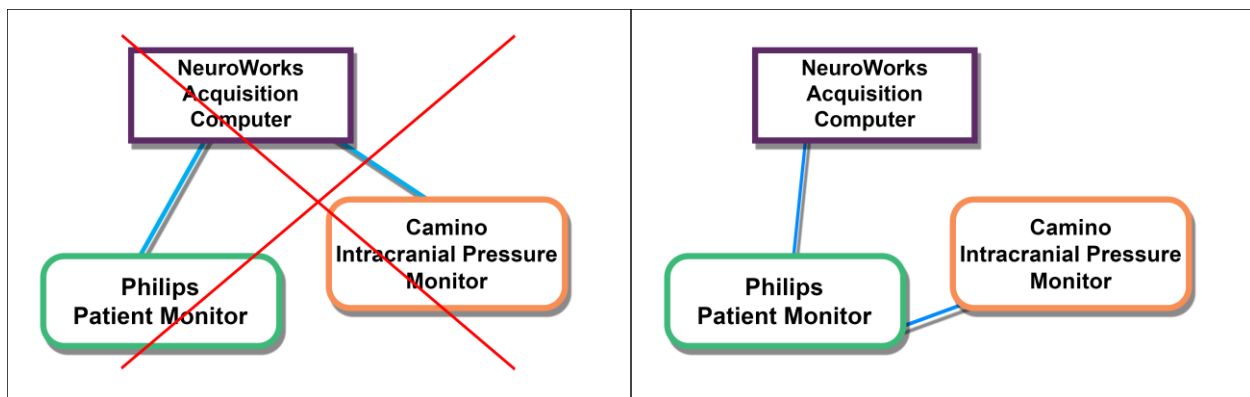
NOTE: The software builds the report based on multiple studies. All demographics are based on the study that has the main slideshow associated with it.

For additional details on reporting on multiple studies see section 8.5 *Multi-Study Reports*

15. Physiological Monitoring Integration

15.1.Introduction

Physiologic monitoring integration (PMI) allows various physiological parameters from select 3rd party monitors to be recorded synchronously with a NeuroWorks EEG study. Patient monitors measuring vital signs (e.g. Philips MX800 Patient Monitor) or other specialized physiological parameters such as intracranial pressure (e.g. Camino) may be directly connected to a NeuroWorks acquisition station using a connection (e.g. serial or USB connection) from the PhM device to the acquisition station, or through a network connection utilizing an IP address. NeuroWorks supports one physical connection between an acquisition station and a PhM device. In some instances, a PhM device may be connected to another PhM device and it will be possible to receive data from both devices as long as the second device is connected to the vital signs PhM device and both devices are supported by the NeuroWorks software. Refer to the NeuroWorks release notes for a list of supported devices.

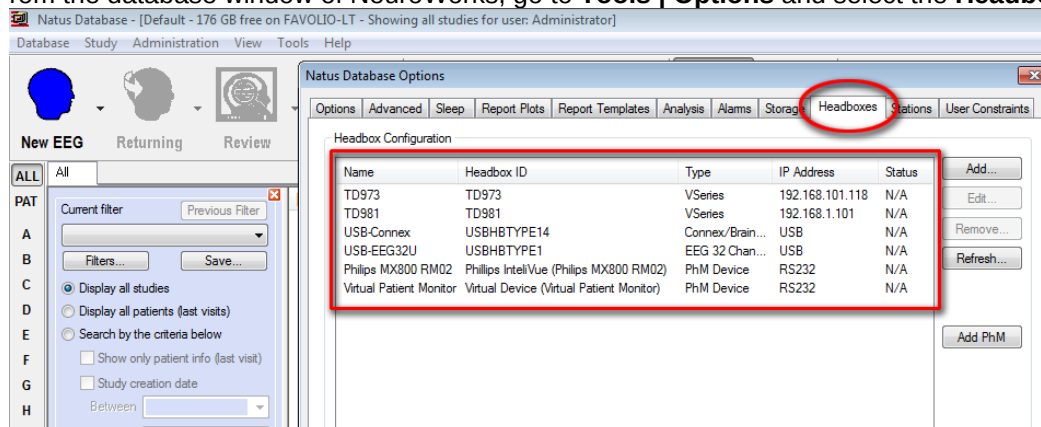


CAUTION: While NeuroWorks supports a physical connection to only one PhM device, it may be possible to receive data from more than one device if the other device(s) are connected to a vital signs monitor that supports connections from other devices.

Before proceeding with any connections from a PhM device, check NeuroWorks Release Notes to ensure that the PhM device is supported. You can also check the Headboxes section in Neuroworks software to see if your PhM device is listed.

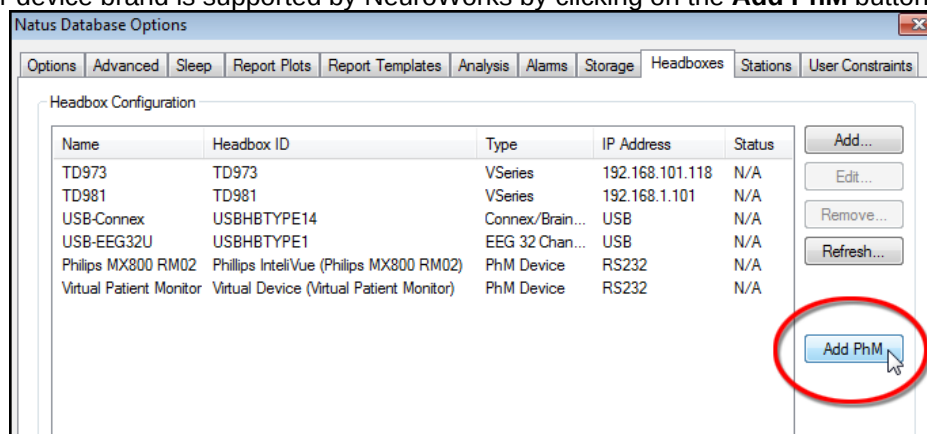
15.2.Supported PhM Devices

1. From the database window of NeuroWorks, go to **Tools | Options** and select the **Headboxes** tab.



The Headboxes dialog lists the last known list of EEG amplifier units along with physiological monitoring devices that a particular acquisition station was or is able to communicate with.

- **Name/Headbox ID:** Should be labeled in such a way as to provide a clear idea as to the nature of the connected device.
 - **Type:** If the **Type** column displays **PhM Device**, this denotes that the device is a physiological monitoring device which could include multiple manufacturer's brands or types. If the hardware device is an EEG amplifier, the **Type** column will display the name or model of the amplifier.
 - **IP Address:** The **IP Address** displays how the EEG amplifier or the PhM device communicates with the current acquisition station. Physiological monitoring devices will show one of the following: IP address, RS232 (serial), or USB.
 - **Status:** The **Status** column displays whether or not the device is accessible by displaying either online or N/A.
2. If the PhM device you wish to connect is not listed in the Headboxes dialog, you can check to see if your device brand is supported by NeuroWorks by clicking on the **Add PhM** button.



The Add PhM dialog displays

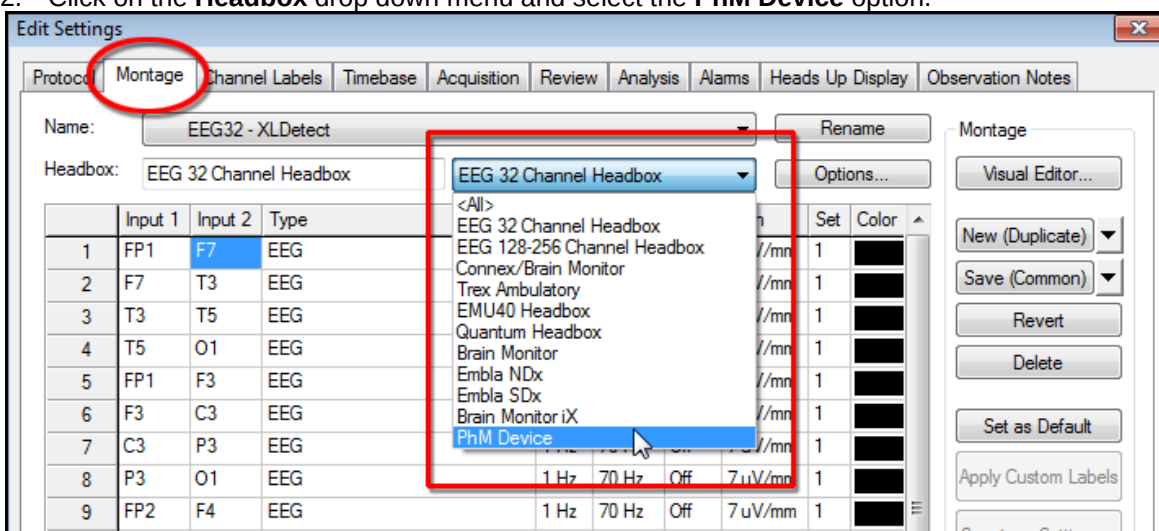
3. From the Add PhM dialog, click the PhM Type drop down list to display all supported physiological monitoring devices. If your device is not listed, contact Natus Technical Support at 1-800-303-0306 or via e-mail OTS@natus.com.

15.3.Supported PhM Parameters

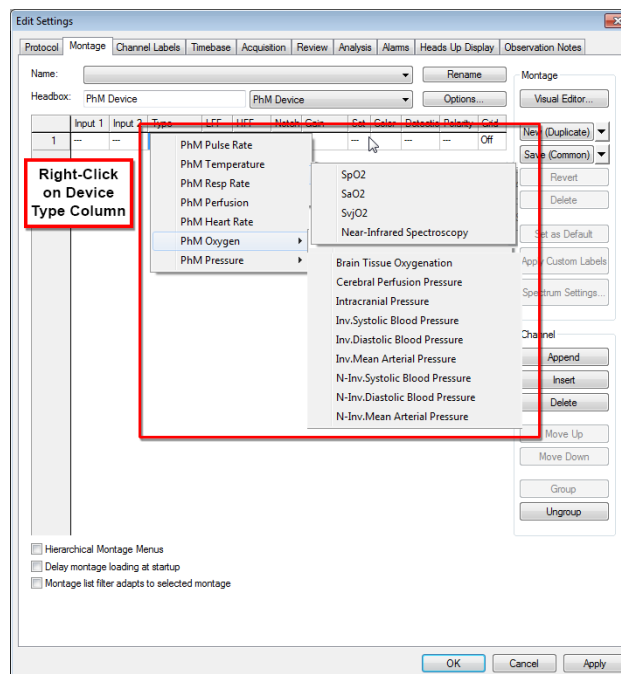
Not all parameters generated or measured by a physiological monitoring device may be available for recording in the NeuroWorks software. Select parameters from all device types are available and identified in the NeuroWorks montage window.

To see a list of available parameters:

1. Access the NeuroWorks montage window from WAVE by going to **Edit | Settings** and selecting the **Montage** tab.
2. Click on the **Headbox** drop down menu and select the **PhM Device** option.



3. Right click in the **Type** column to display a list of all possible PhM parameters. Only the channel types shown are supported by the NeuroWorks software, as long as the corresponding PhM Device is also a supported device.

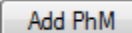


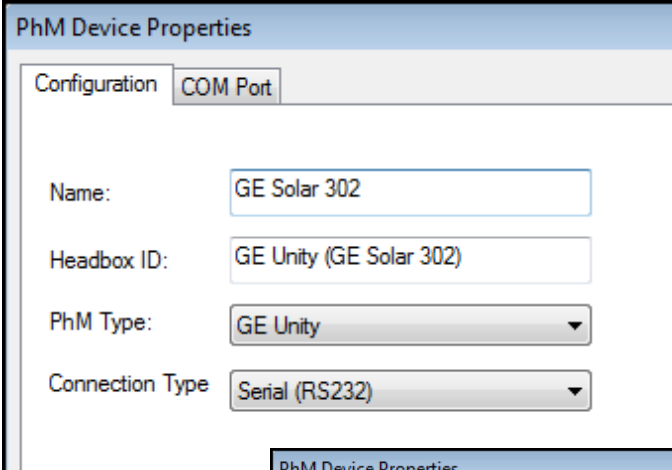
15.4. Establishing a Connection to a PhM Device

A connection can only be established between a physiological monitoring device and a NeuroWorks acquisition station that has been properly licensed for physiological monitoring. If you are not sure if your acquisition station is licensed to record data from a PhM device, contact Natus Technical Support at 1-800-303-0306 or via e-mail OTS@natus.com.

Before recording any PhM parameter, a PhM device must be added and configured.

To establish a connection to a PhM device:

1. From the Natus database, select **Tools | Options | Headboxes** (tab).
2. In the Headboxes dialog, check to see if your PhM device is already listed and the proper connection type (e.g. RS232 or IP address) is shown. If it is not listed, click on the **Add PhM** button . The PhM Device Properties Dialog displays.
3. In the **Name** field type in a user friendly name for the device. The name should be labeled in such a way as to provide a clear idea as to the nature of the connected device. The **Headbox ID** field automatically populates based on your **Name** entry and the selection of the **PhM Type** in this dialog.
4. Click on the **PhM Type** drop down list, and select the corresponding PhM device type to use.
5. Select which **Connection Type** to use between the PhM device and the NeuroWorks acquisition station from the drop down list.



PhM Device Properties

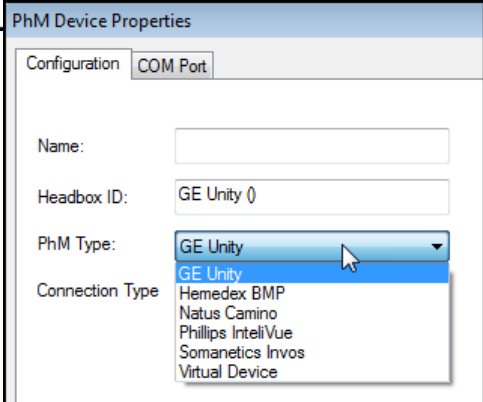
Configuration COM Port

Name: GE Solar 302

Headbox ID: GE Unity (GE Solar 302)

PhM Type: GE Unity

Connection Type: Serial (RS232)



PhM Device Properties

Configuration COM Port

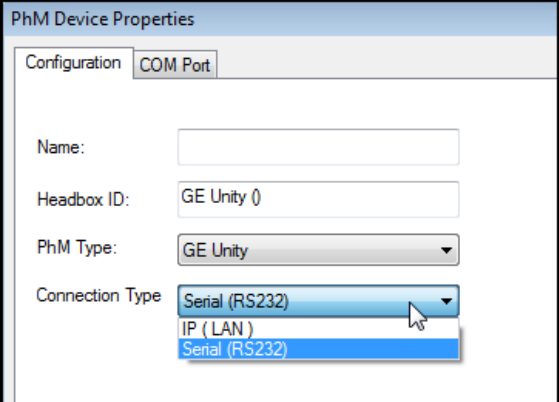
Name:

Headbox ID: GE Unity ()

PhM Type: GE Unity

Connection Type: Serial (RS232)

GE Unity
Hemedex BMP
Natus Camino
Phillips IntelliVue
Somanetics Invos
Virtual Device



PhM Device Properties

Configuration COM Port

Name:

Headbox ID: GE Unity ()

PhM Type: GE Unity

Connection Type: Serial (RS232)

Serial (RS232)
IP (LAN)
Serial (RS232)

- If you select the **Serial** option, click on the **COM Port** tab and confirm the default selection of parameters, or make any necessary changes such that it aligns with your PhM device.

PhM Device Properties

Configuration COM Port

Port: COM1

Bits per second (Baud Rate): 9600

Parity: N

Data bits: 8

Stop bits: 1

Rts/Cts: N

- If you select the **IP (LAN)** option, click on the **Address** tab and enter the **IP address** of the PhM device.

PhM Device Properties

Configuration Address

IP Address:

☐ Obtain an IP address automatically

☒ Use the following IP address:

IP address: 127 . 0 . 0 . 1

Subnet mask: 0 . 0 . 0 . 0

Default gateway: 0 . 0 . 0 . 0

Communication (TCP) Port: 7000

6. Click **OK** to save the configuration, and close the PhM Device Properties Dialog. The configuration should display in the **Headboxes** dialog and should be ready to connect.

Natus Database Options

Options Advanced Sleep Report Plots Report Templates Analysis Alarms Storage Headboxes Stations User Constraints

Headbox Configuration

Name	Headbox ID	Type	IP Address	Status
GE Solar 302	GE Unity (GE Solar 302)	PhM Device	192.168.2.221	N/A
Philips MX600 RM62	Philips IntelliVue (Philips MX600 RM62)	PhM Device	RS232	N/A
TD973	TD973	VSeries	192.168.101.118	N/A
TD981	TD981	VSeries	192.168.1.101	N/A
USB-Connex	USBHBTYP14	Connex/Brain...	USB	N/A
USB-EEG32U	USBHBTYP1	EEG 32 Chan...	USB	N/A
Virtual Patient Monitor	Virtual Device (Virtual Patient Monitor)	PhM Device	RS232	N/A

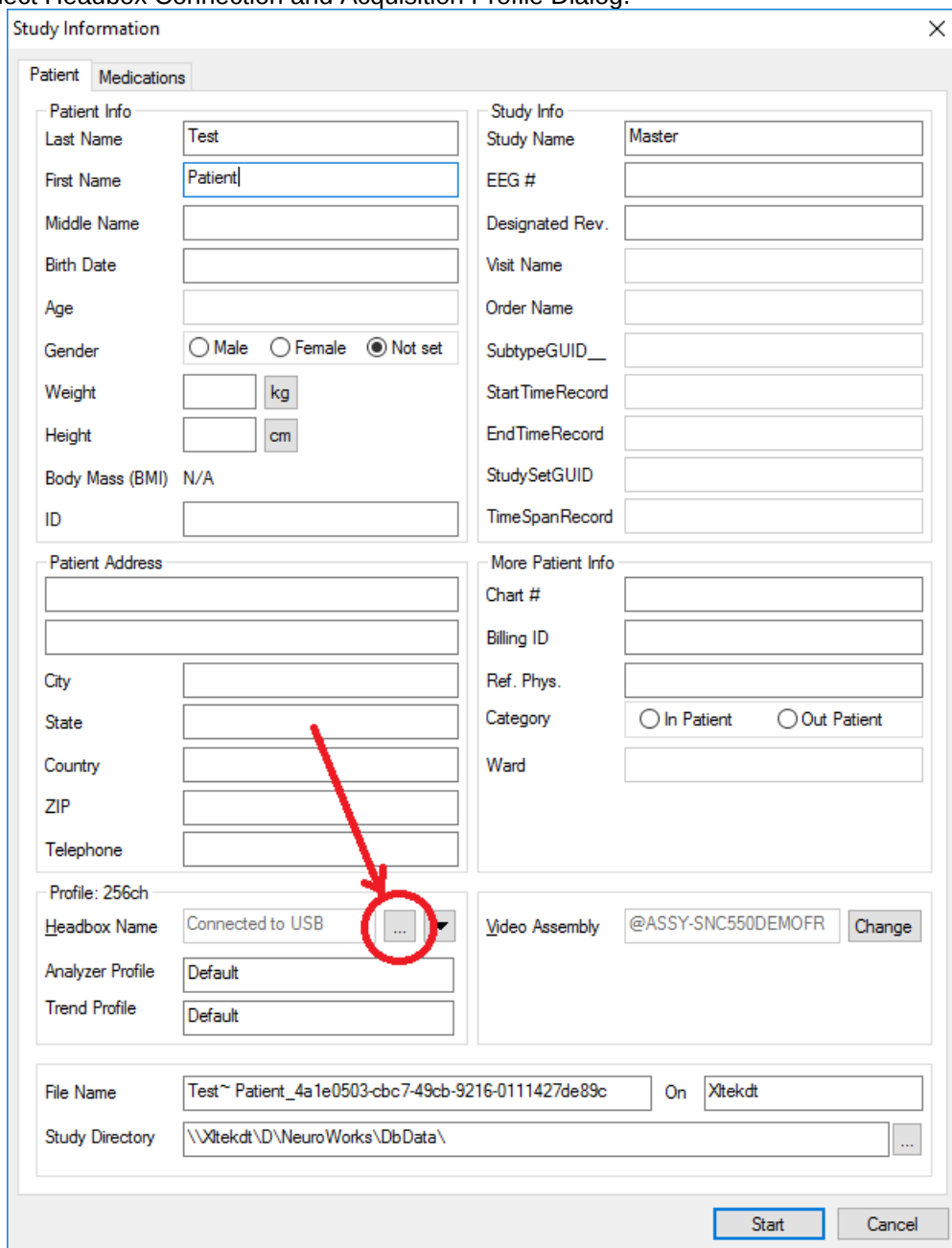
Add... Edit... Remove... Refresh... Add PhM

In order for the connection to succeed, ensure the PhM device is properly connected to the acquisition computer. If using an IP (LAN) connection, ensure that the acquisition computer and the PhM device reside on the same network.

15.5.Start an EEG Recording with PhM Data

Setup your acquisition station and amplifier as you normally would for an EEG recording.

1. In the Headbox section of the Study Information window, select the **ellipse** button  to open the Select Headbox Connection and Acquisition Profile Dialog.



Study Information

Patient Medications

Patient Info

Last Name: Test

First Name: Patient

Middle Name:

Birth Date:

Age:

Gender: ☐ Male ☐ Female ☒ Not set

Weight: kg

Height: cm

Body Mass (BMI): N/A

ID:

Study Info

Study Name: Master

EEG #:

Designated Rev.:

Visit Name:

Order Name:

SubtypeGUID:

StartTimeRecord:

EndTimeRecord:

StudySetGUID:

TimeSpanRecord:

Patient Address

City:

State:

Country:

ZIP:

Telephone:

More Patient Info

Chart #:

Billing ID:

Ref. Phys.:

Category: ☐ In Patient ☐ Out Patient

Ward:

Profile: 256ch

Headbox Name: Connected to USB 

Analyzer Profile: Default

Trend Profile: Default

Video Assembly: @ASSY-SNC550DEMOFR Change

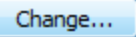
File Name: Test~ Patient_4a1e0503-cbc7-49cb-9216-0111427de89c On Xitekdt

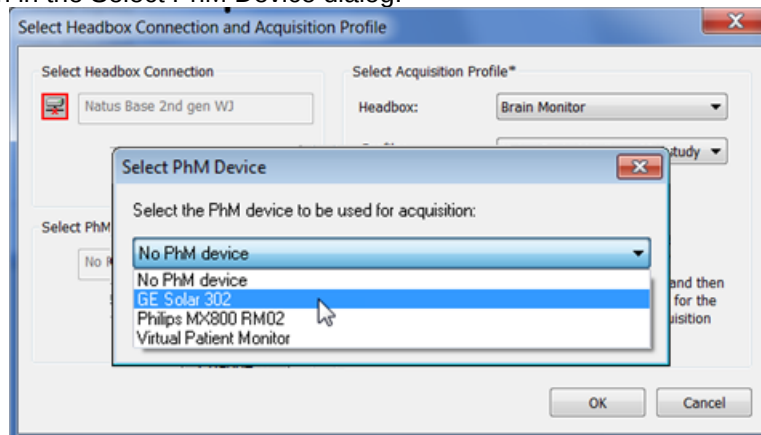
Study Directory: \\Xitekdt\D\NeuroWorks\DbData\

Start Cancel

The Select Headbox Connection and Acquisition Profile Dialog includes a section displaying the PhM device currently configured to provide data for this particular EEG study.



2. If the current selection does not correspond to the PhM device you want to record from, click on the **Change**  button, and select the device to use with the current EEG recording from the dropdown in the Select PhM Device dialog.



NOTES: The headbox selection for an EEG study recording does not affect the selection of a PhM Device.



The Acquisition Profile applies solely to the EEG headbox selection and recording.

3. After selecting the PhM Device, click **OK** to save the changes.
4. Then click **START** to begin acquisition.

In the acquisition window, only the data from the EEG recording montage is visible. It does NOT show data from the PhM device. This data is only available for viewing while in Review mode which is accessed by opening the study recording for review from the Natus Database, or by clicking the **Review Current**

Study  icon in the acquisition workflow toolbar.



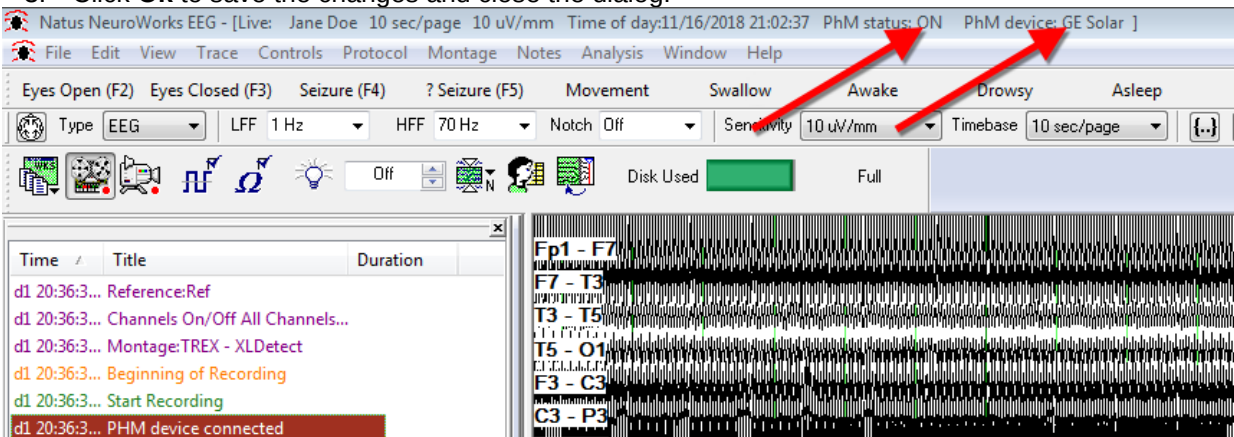
NOTE: Do not expect to begin receiving PhM data from the PhM device as soon as NeuroWorks enters into acquisition mode. It is normal to experience an initial lag or delay for up to approximately 1 minute until NeuroWorks begins to receive physiological monitoring data.

Adding PhM Indicator to an EEG Recording

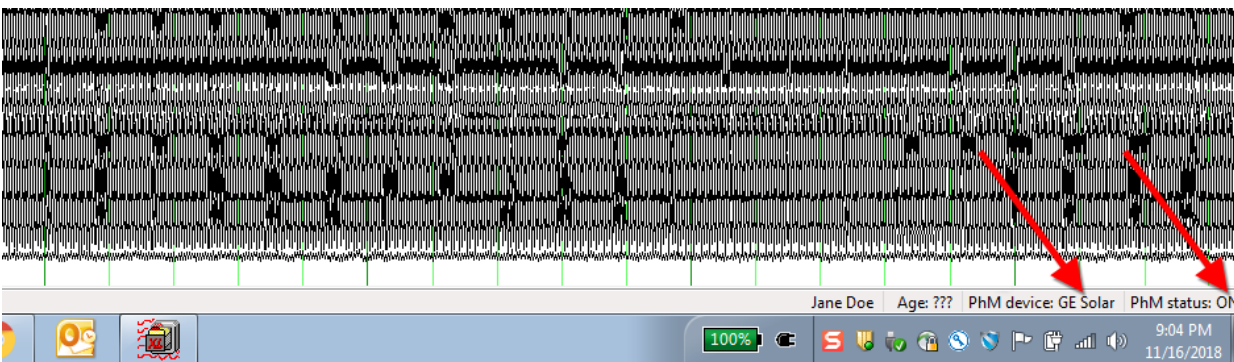
It is possible to include an indicator in the acquisition window that displays whether or not a PhM device is currently connected to the EEG recording. There are 2 different indicators that can be added to the acquisition title or status bar.

To Add an Indicator to an EEG recording:

1. Open Wave, and select **File | Customize**.
2. Select either the **Title Bar** and/or **Status Bar** tabs. In each tab, both **PhM Device** and **PhM Status** can be added.
 - **PhM Device:** If a PhM device is connected to the acquisition station and NeuroWorks recognizes that the device is available, it will display the name of the PhM device.
 - **PhM Status:** If a PhM device is connected to the acquisition station and it is currently sending PhM data to the EEG study, the status indicator will display **On**.
3. Click **Ok** to save the changes and close the dialog.



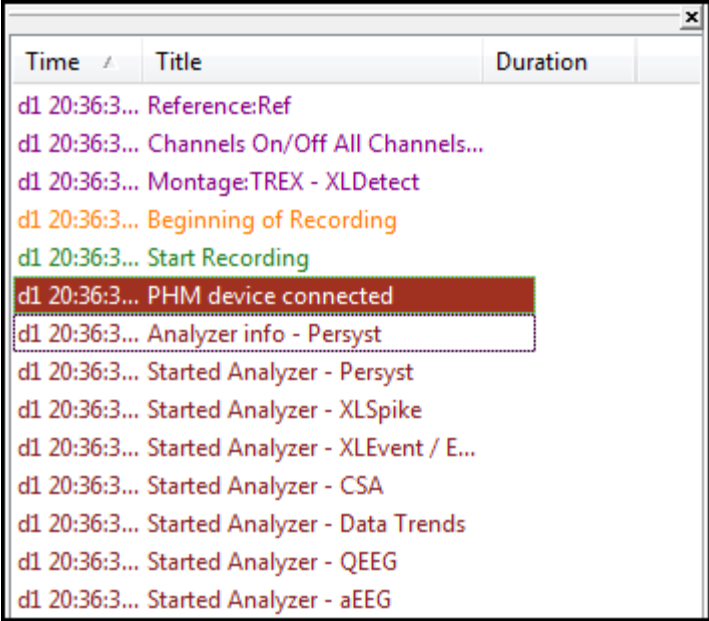
Title Bar



Status Bar

15.6.Connecting a PhM Device During Acquisition

When NeuroWorks detects that a PhM device is connected for the first time during study acquisition, NeuroWorks will include a note in the Annotation Viewer. If enabled, the PhM Device and PhM Status indicators in the Title Bar and/or Status Bar will also reflect the current state of a PhM Device. See section 0 Adding PhM Indicator to an EEG Recording for additional information.



Time	Title	Duration
d1 20:36:3...	Reference:Ref	
d1 20:36:3...	Channels On/Off All Channels...	
d1 20:36:3...	Montage:TREX - XLDetect	
d1 20:36:3...	Beginning of Recording	
d1 20:36:3...	Start Recording	
d1 20:36:3...	PHM device connected	
d1 20:36:3...	Analyzer info - Persyst	
d1 20:36:3...	Started Analyzer - Persyst	
d1 20:36:3...	Started Analyzer - XLSpike	
d1 20:36:3...	Started Analyzer - XLEvent / E...	
d1 20:36:3...	Started Analyzer - CSA	
d1 20:36:3...	Started Analyzer - Data Trends	
d1 20:36:3...	Started Analyzer - QEEG	
d1 20:36:3...	Started Analyzer - aEEG	

During an EEG acquisition with a PhM device connected, NeuroWorks will receive and record the data accordingly as long as the correct or corresponding PhM device was selected at the start of the acquisition study in the Study Information window. See section 15.5 *Start an EEG Recording with PhM Data* for details. If the PhM device is disconnected or loses its connection to the NeuroWorks acquisition station during an EEG acquisition, the NeuroWorks EEG study acquisition shall continue to operate in its current state. If a PhM device, of the same type (not necessarily the exact model used prior to the disconnect) is re-connected to a NeuroWorks acquisition station, NeuroWorks begins to receive the data from the device and record it synchronously with the EEG recording. If a different model other than the previous model is connected, the EEG study will need to be stopped, and re-started with the new PhM device selected from the Headbox section of the Study Information window. For example, if you began the acquisition recording having selected a Philips MX800 patient monitor and then later on disconnected it and connected a GE Solar patient monitor, you will need to stop the EEG study in NeuroWorks and change your PhM device selection from the Patient Information Window from the Philips device to the GE model.



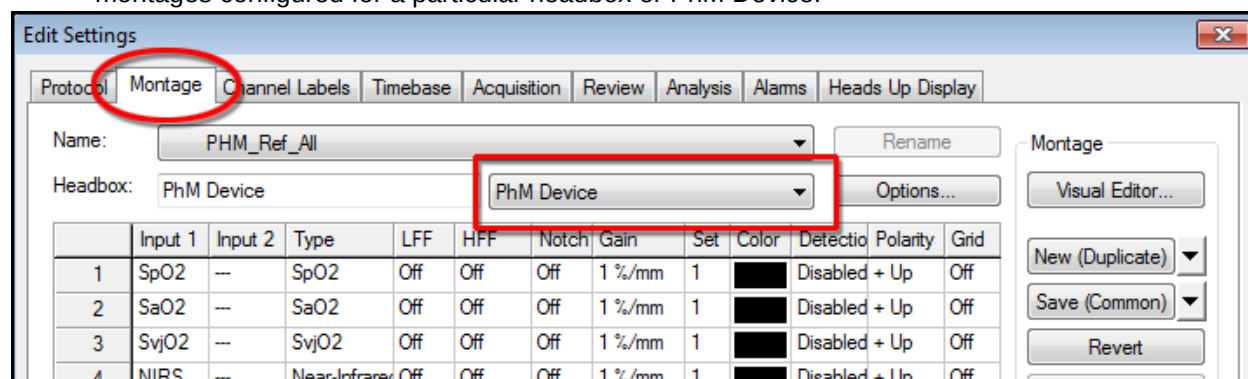
WARNING: Attention must be exercised when re-connecting a PhM device in the middle of an EEG recording after a PhM device was disconnected to ensure that you are streaming PhM data from the same patient to the same EEG study recording. NeuroWorks does **NOT** distinguish where it is receiving patient data from based on the patient's identity – it is based solely on the physical connection established between the acquisition station and the PhM device.

15.7.Montage Setting for Physiological Monitoring

The selection of physiological monitoring parameters to include in an EEG recording is configured and stored in a montage that is separate from a regular EEG montage. These are known as PhM montages. PhM montages are configured and managed using the same interface as EEG montages in NeuroWorks. Unlike EEG montages however, PhM montages are not accessible in Acquisition mode. It can be accessed in Review mode.

To access the PhM montage interface:

1. Open the NeuroWorks Wave application.
2. From the menu toolbar, select **Edit | Settings | Montage** (tab).
3. In the **Montage** tab you will see a **Headbox** section where you can click on the drop down list and select a headbox or a PhM Device. This filters the Montage window to display only those montages configured for a particular headbox or PhM Device.



NOTE: In the **Montage** window, NeuroWorks does not differentiate between different types of PhM devices when it comes to montages (unlike different types of headboxes for EEG).

4. Selecting the PhM Device option for your Headbox in the Montage window will display all of the montages configured for ANY PhM device regardless of model. By default, NeuroWorks includes a default montage called **PHM_Ref_All** which includes all of the possible PhM parameters which can be recorded from the list of all PhM devices supported by NeuroWorks.



NOTE: While the default montage **PHM_Ref_All** intends to include all possible channels from PhM devices, this does not necessarily mean that it is possible to receive all of these parameters at the same time during a single acquisition study. This is due to limitations within NeuroWorks and the PhM device. It may be prudent to include all channels in a PhM recording and simply hide or remove the unwanted or not recorded channels when reviewing the study later.

PhM Montages may be modified, duplicated and created similar to EEG montages. Similarly, a new and different PhM montage may be selected as the **Default** recording montage.

15.8.Reviewing an EEG Study with PhM Data

Data from physiological monitoring devices can be reviewed while NeuroWorks is in Review mode. This can be done by opening study for review from the Natus Database; by selecting the Review current Study

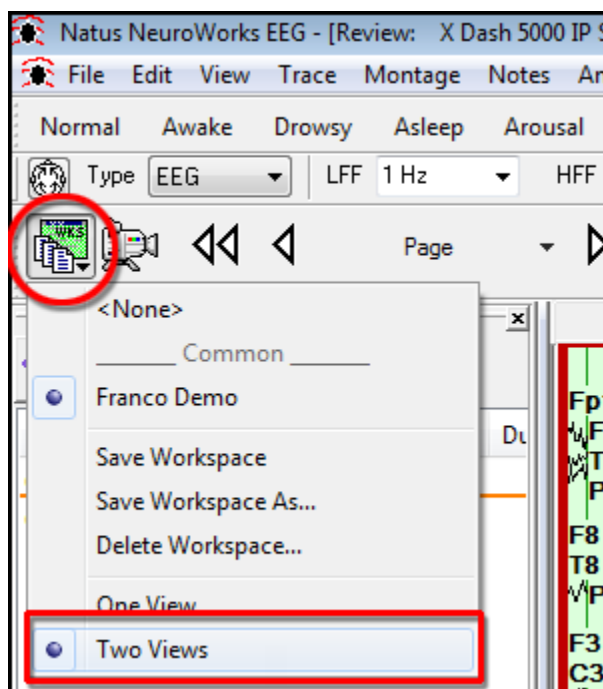


icon during a live acquisition; or by using the Remote Monitoring  feature from the NeuroWorks Database on another NeuroWorks workstation.

In the Review window, data from physiological monitoring devices can be displayed in the EEG/Wave window as well as in the Trend Summary toolbar.

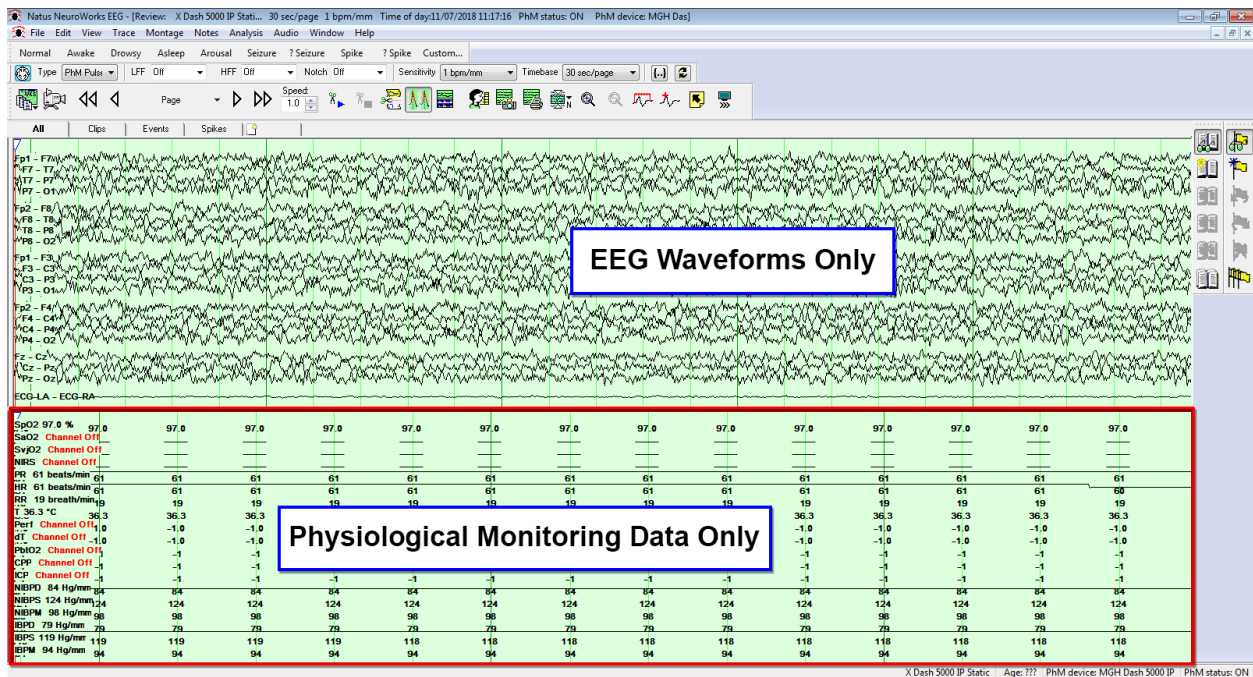
Viewing PhM Data in an EEG Window (Wave)

While in the review window, access the **Workspace** menu and select the **2 View** option.

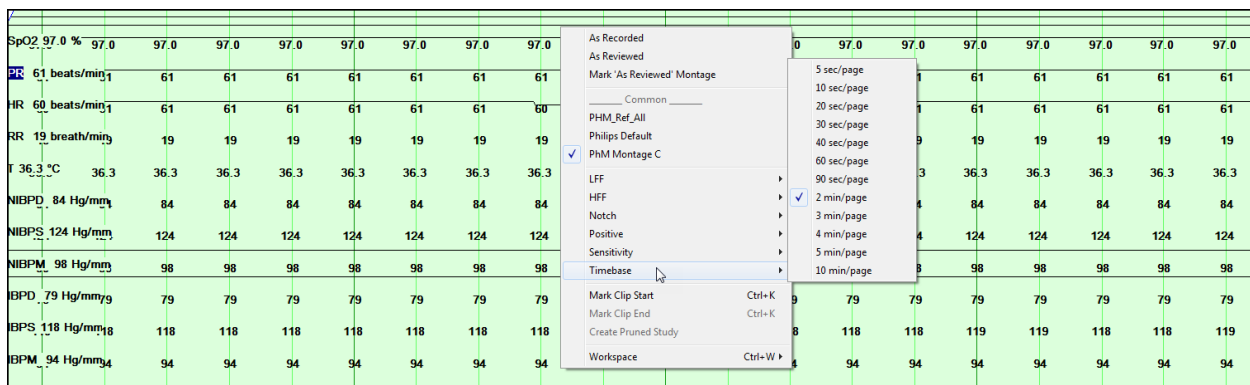


NOTE: Physiological Monitoring data can **ONLY** be displayed using the **2 View** workspace or as a trend in the Trend Summary toolbar.

When using a 2 View workspace, the EEG window is divided into 2 sections. Each window is restricted to displaying EEG or physiological monitoring data only. The section highlighted with a red border is considered the Active section which means any clicking actions on any of the toolbars (e.g. Menu bar, Review toolbar) will apply to the **Active** window only. Left-clicking in the 2nd view window will de-activate the previous window and make the 2nd view window the Active window.



Similar to a regular EEG 1 View workspace, the window containing physiological monitoring data can be manipulated similar to the EEG window. Channel filters, sensitivity, timebase, hiding channels, and montage changes may be applied to the PhM window as you would for a standard EEG window.



In circumstances where no data is being received from a PhM device, a **Channel Off** label shall appear next to the channel label.

SpO2	97.0 %	97.0	97.0	97.0
SaO2	Channel Off			
SvjO2	Channel Off			
NIRS	Channel Off			
PR	61 beats/min			
HR	61 beats/min	61	61	61
RR	19 breath/min	19	19	19
T	36.3 °C	36.3	36.3	36.3
Perf	Channel Off	-1.0	-1.0	-1.0
dT	Channel Off	-1.0	-1.0	-1.0
PbtO2	Channel Off	-1	-1	-1
CPP	Channel Off	-1	-1	-1
ICP	Channel Off	-1	-1	-1
NIBPD	84 Hg/mm	84	84	84
NIBPS	124 Hg/mm	124	124	124
NIBPM	98 Hg/mm	98	98	98
IBPD	79 Hg/mm	79	79	79
IBPS	119 Hg/mm	118	118	118
IBPM	94 Hg/mm	94	94	94



WARNING: It is possible depending on the PhM device that in the event a patient sensor is off or the device is not sending data for various reasons particular to the PhM device, that NeuroWorks may display the **Channel Off** label or erroneous data values from the PhM device may appear and may consequently appear in the NeuroWorks study recording.



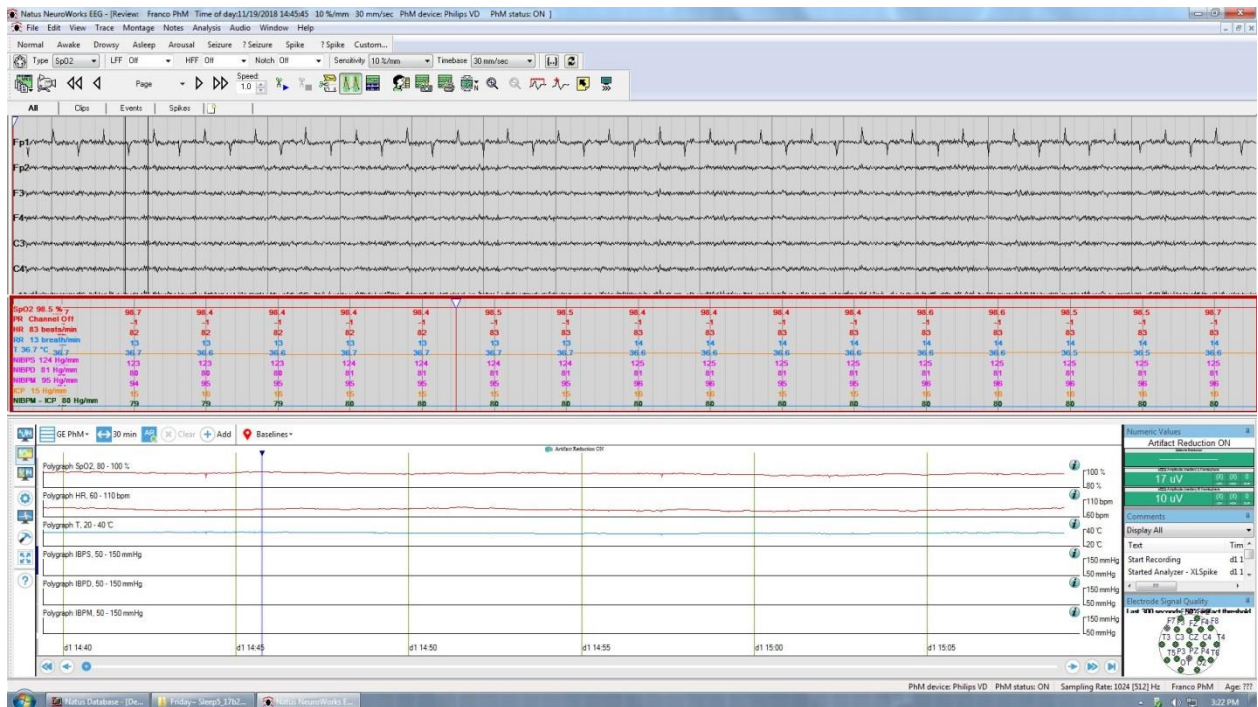
WARNING: No clinical decisions regarding patient care should be made based on the accuracy of the physiological monitoring data values as they appear in the NeuroWorks EEG recording. Any correlation of physiological monitoring data with EEG must be verified against the source physiological monitoring devices outputting the data.

Viewing PhM Data in the Trend Summary Toolbar

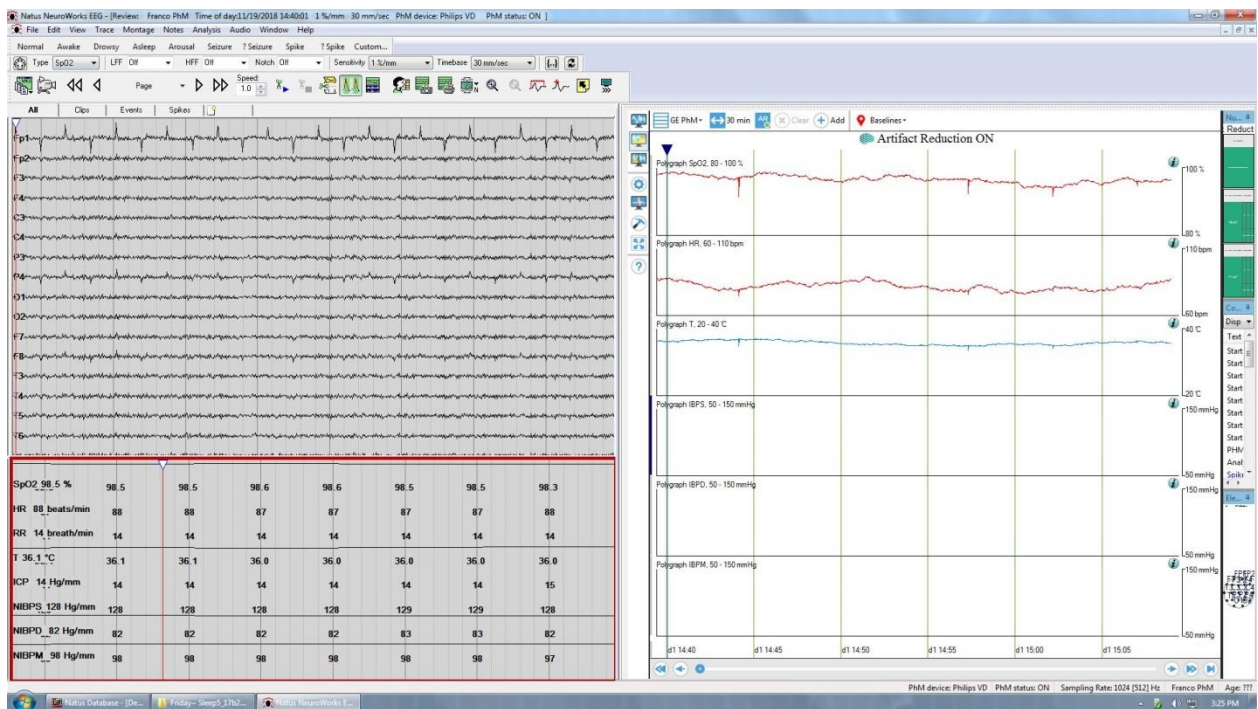
In order to view any of the physiological monitoring data in the trend summary toolbar, the Persyst software must be installed. NeuroWorks uses the Persyst software engine to generate and display trends corresponding to the PhM data recorded with NeuroWorks EEG studies.

To display PhM data in the NeuroWorks review window:

- Enable the Persyst toolbar by selecting **View | Toolbars | Persyst** from within NeuroWorks. Refer to the Persyst User Manual to add physiological channels recorded from a NeuroWorks EEG study to its Trend Summary window.



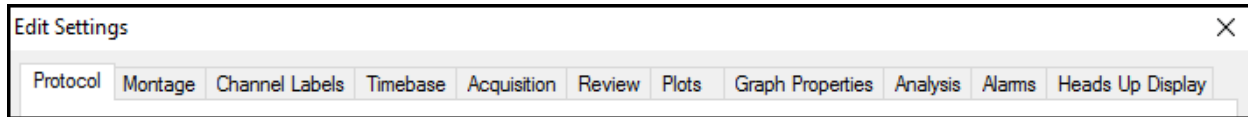
Re-size or re-position the Persyst toolbar to display your EEG and PhM data as desired.



16. Settings

16.1.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

16.2.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 appear.
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.

16.3.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:

- 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.

Category	Description
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.
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.

16.4.Editing Montage Channel Settings

To edit montage channel settings, choose **Edit > Settings > Montage**.



NOTES:

- 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).

Edit Settings

Protocol Montage Channel Labels Timebase Acquisition Review Plots Graph Properties Analysis Alarms Heads Up Display

Name: TREX - XLDetect [01] Rename

Headbox: Trex Ambulatory Options...

	Input 1	Input 2	Type	LFF	HFF	Notch	Gain	Set	Color	Detection	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

☐ Hierarchical Montage Menus
☒ Delay montage loading at startup
☒ Montage list filter adapts to selected montage
☒ Auto-Generate Linked Ears Laplacian

Montage: Visual Editor...
 New (empty) ▼
 Save (Common) ▼
 Revert
 Delete
 Set as Default
 Apply Custom Labels
 Spectrum Settings...

Channel:
 Append
 Insert
 Delete
 Move Up
 Move Down
 Group
 Ungroup

OK Cancel Apply

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.

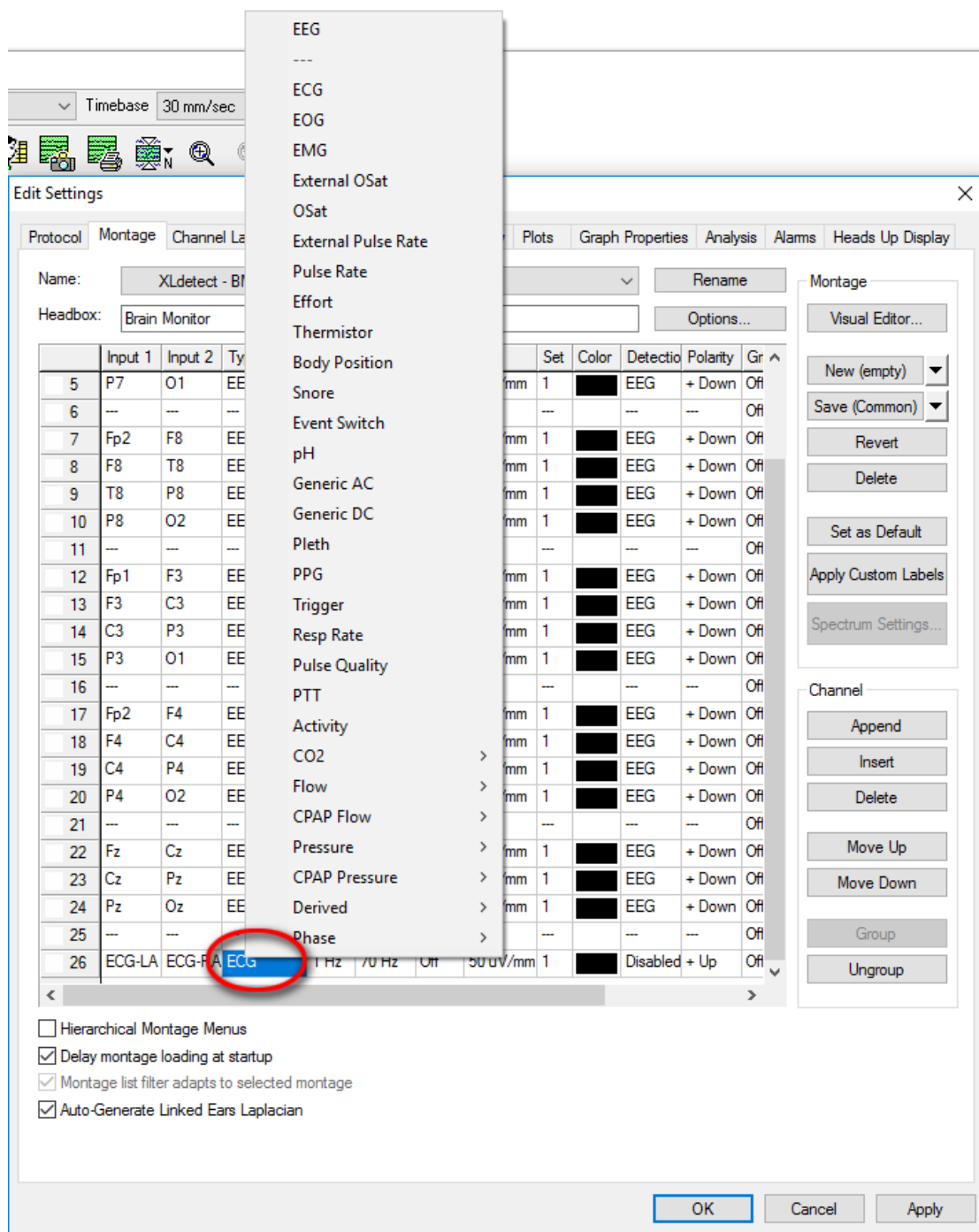


NOTE: Bipolar montages are more robust because referential montages can be misleading if there is contamination on the reference channel.

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.



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, select the  button on the Montage toolbar. Alternately, 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.

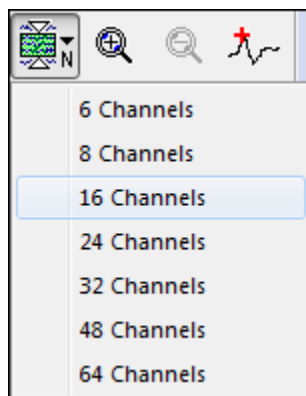
1.1.1.1. Switch between Sets

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

- 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.

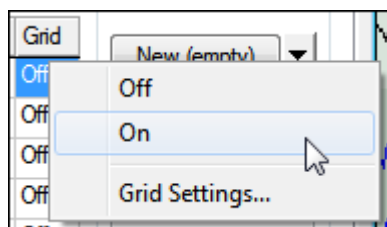
Type Column Setting (Channel Type)	Detection Column Setting
EEG Channel	EEG
EEG Channel with Eye Blink Artifact (EOG)	Artifact
Non-EEG Channel	Disabled

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**.

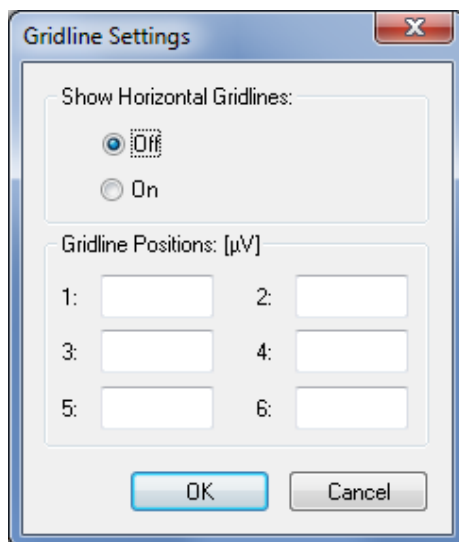
Setting Gridlines

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.

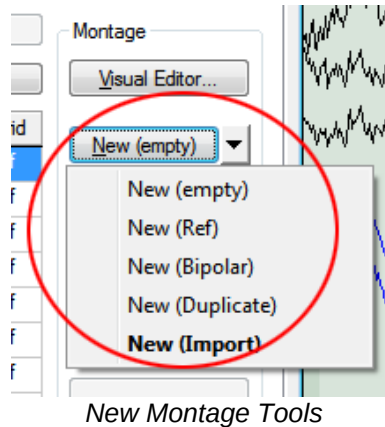


Grid Settings Dialog in Montage Tab

16.5.Montage Editing

New Montage Options

New montages based on 1 of the 5 configurations (shown below) can be created to simplify the creation of new montages.



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).

16.5.1.1. 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/Trex HD) and you want to convert and apply a montage that you created for a different headbox (e.g. Connex).

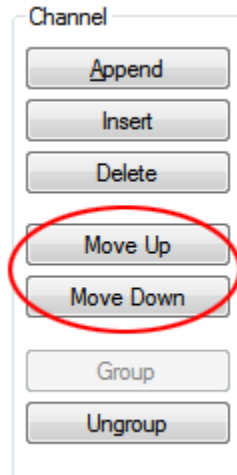
16.5.1.2. New (Export)

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/Trex HD) 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.

Use the **Move Up** and **Move Down** buttons to move a single channel.



Move Up and Move Down Buttons in Montage Tab

Visual Montage Editor

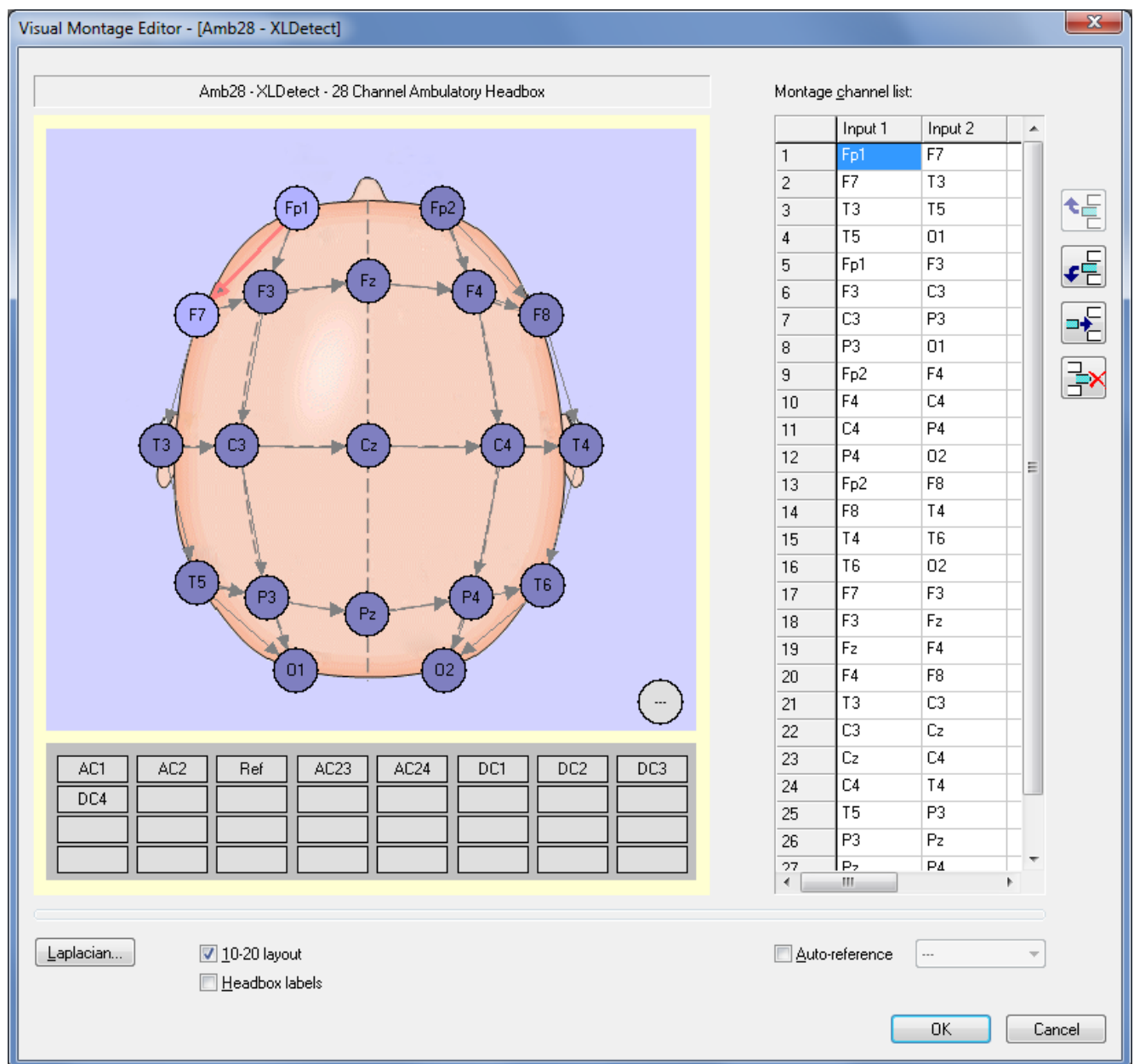
The **Visual Montage Editor** is a tool for creating and editing montages. It provides an easy WYSIWYG graphical interface where only tabular tools existed before.



NOTE: Linked Ears is included in the list of predefined channels accessible when you click the Auto-reference check box. It is labeled $(A1+A2)/2$.

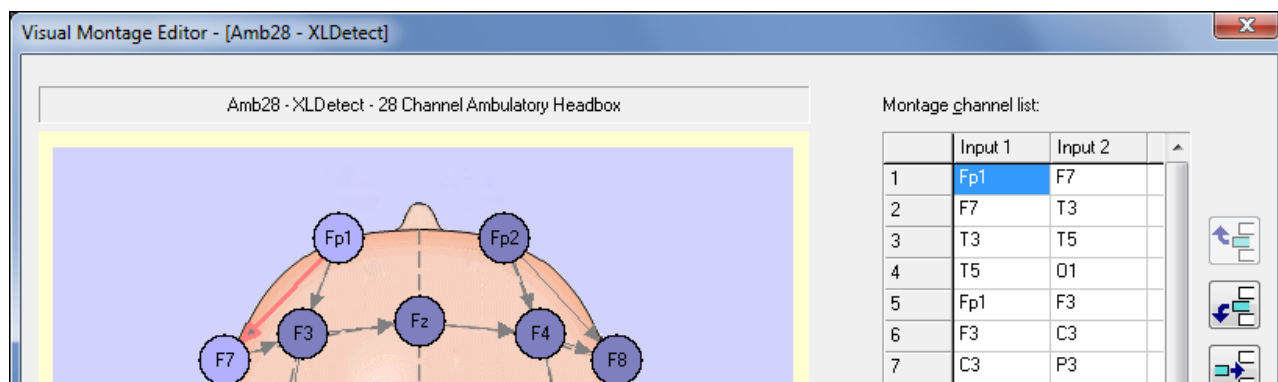
To access the visual montage editor:

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.

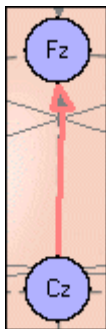


Creating an Input Pair

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... ☒ Auto-reference Fz ... clicking Cz will add the pair Cz–Fz to the montage. <table><tr><th></th><th>Input 1</th><th>Input 2</th></tr><tr><td>1</td><td>F7</td><td>T3</td></tr><tr><td>2</td><td>Cz</td><td>Fz</td></tr></table>		Input 1	Input 2	1	F7	T3	2	Cz	Fz
	Input 1	Input 2								
1	F7	T3								
2	Cz	Fz								
“Null” channel (---).	The “Null” channel is indicated as “---”. ☒ Auto-reference --- 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 empty input pair below the selected channel.									
	Delete Channel button. Deletes the selected channel.									
	Next / Previous Page buttons. These buttons only appear when there are more channels than can be displayed on a single page.									

16.6.Organizing Channels into Sets

Putting channels into sets is helpful when viewing a large number of channels, as in the case of the EMU128FS 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.

Set	Color	Detectio	Polarity	C
1		EEG	+ Down	C
1		<none>		
1		1		
1		2		
1		3		
1		4		
1		5		
1		6		
1		7		
1		8		
1		9		
1		10		
1		11		
1		12		
1		13		
1		14		
1		15		
1		16		
1		Multiple...		

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, choose the **Channel Sets** icon  on the Montages menu within NeuroWorks, or choose **Trace > Switch Set**. Alternately you can press CTRL + ` (key next to 1 key) to move through sets sequentially.

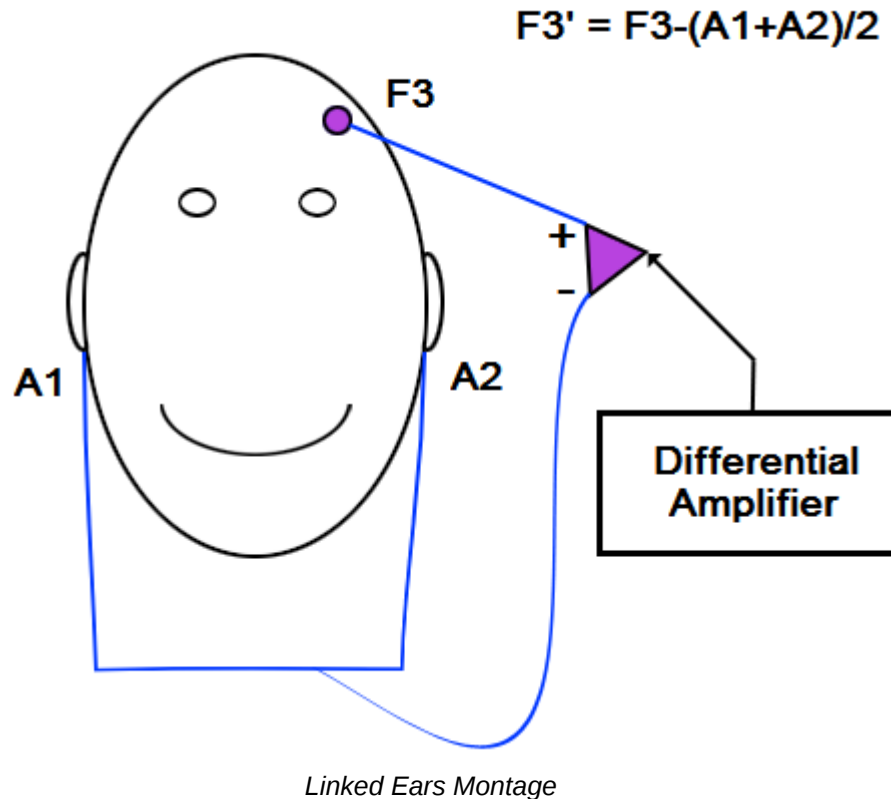
16.7. Linked Ears Montage

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.



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.

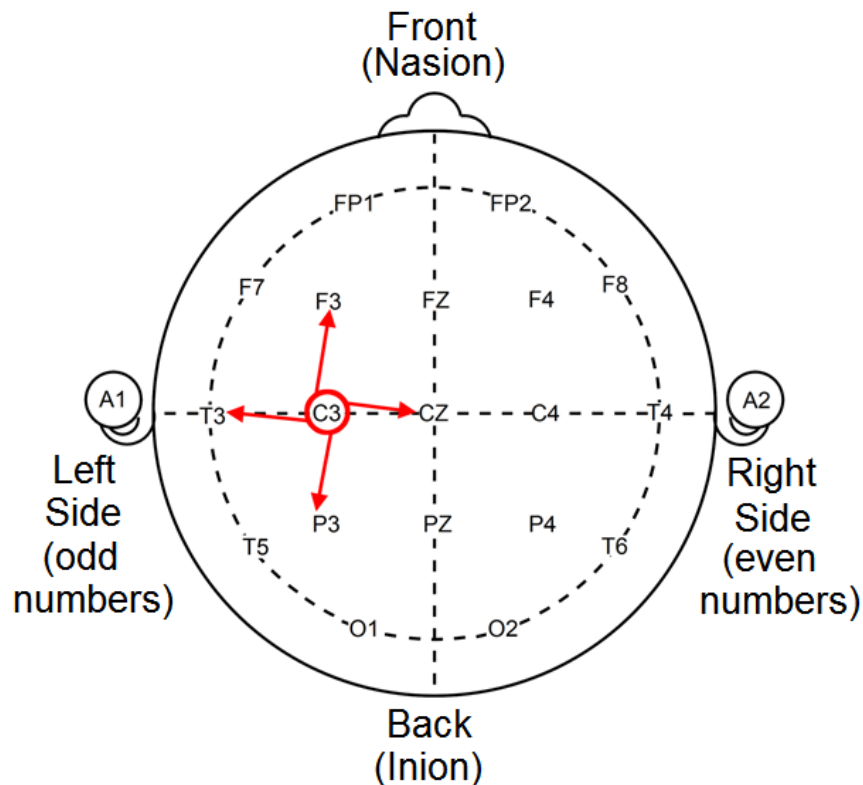
A **Linked Ears** montage is created in NeuroWorks using the **Laplacian Channels** feature.

16.8. 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!

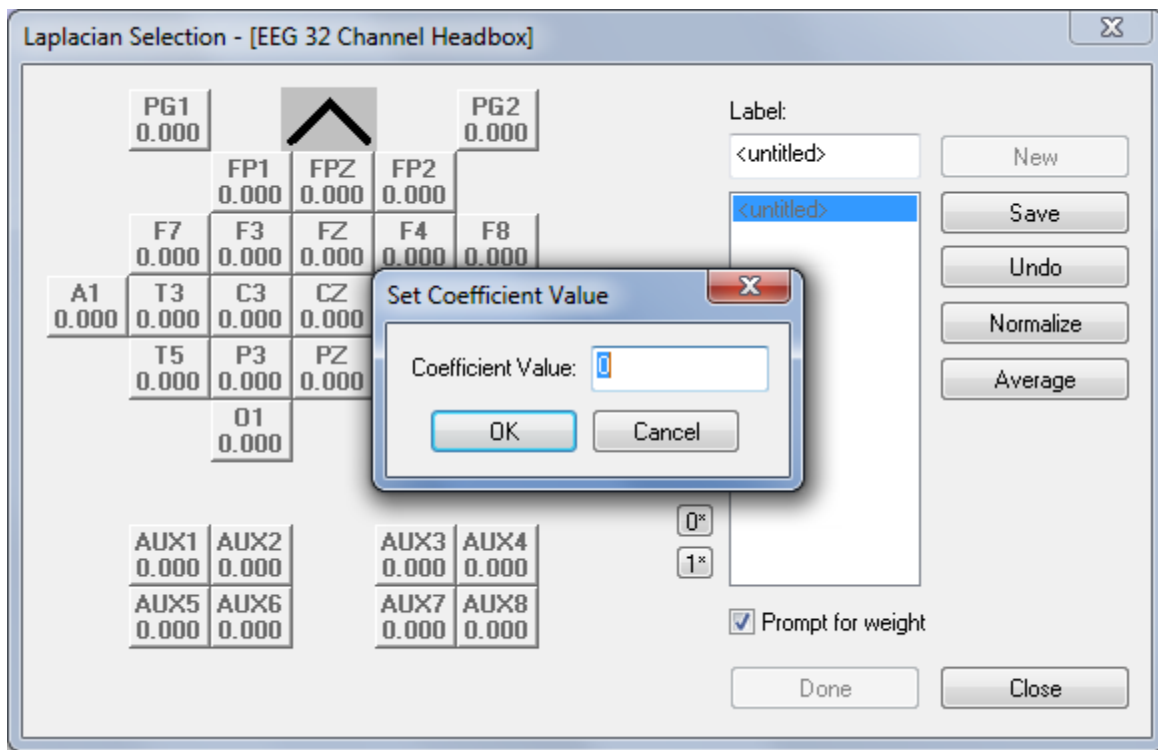


NOTE: Clicking **Normalize** “normalizes” coefficient values to a value of 1. For example, if you had entered 1 for the first value of two values, and 9 for the second, clicking **Normalize** would adjust the values to .1 and .9 (or 10% and 90%, respectively). If you fail to click **Normalize**, the 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

Target Electrode	Local Reference Electrodes (Prime Combination)
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

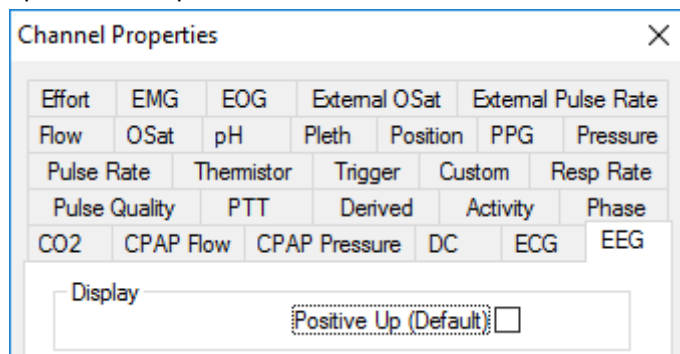
After entering these values individually, you can create a new montage where the Target electrodes are sourced in Input 1 and the reference definitions (Prime combination) are sourced in Input 2 of the various channels.

IMPORTANT! Make sure you **Normalize** each definition so that a valid comparison can be made.

16.9.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**.

16.10. 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](#).

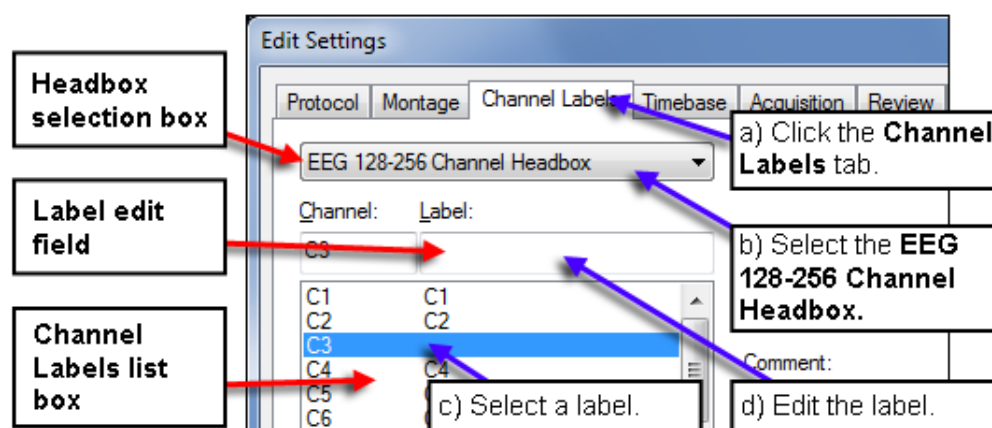
16.11. Editing Channel Labels

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.

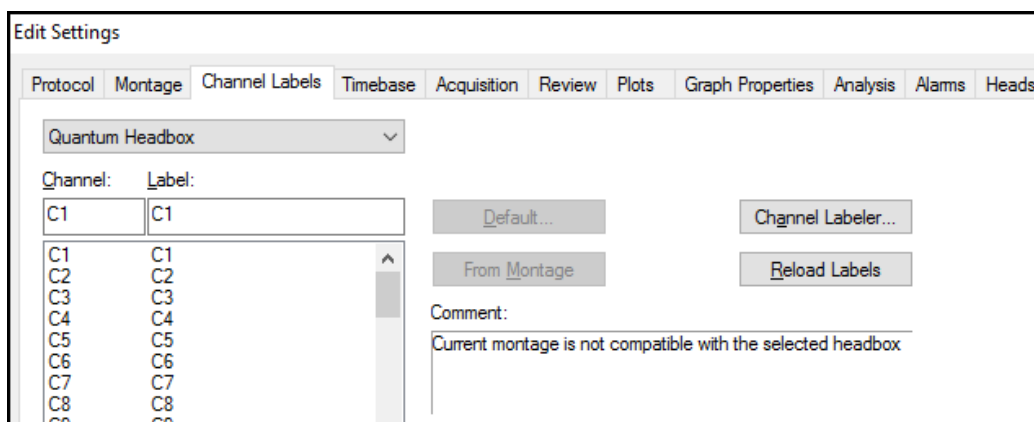
To customize Channel Labels for a particular headbox:

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

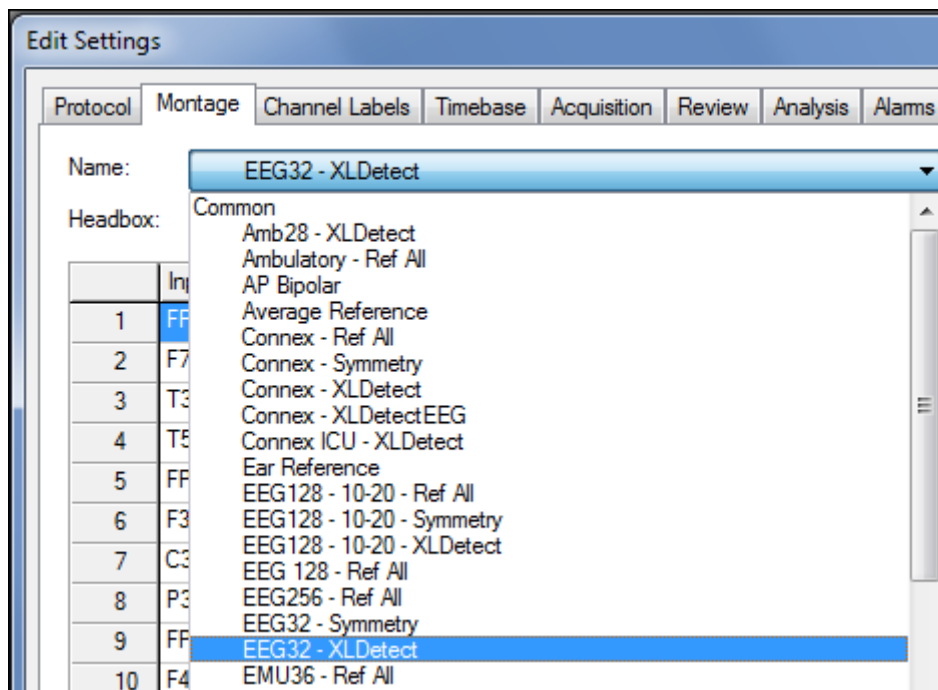
Button	Function/Description
	Default returns montage labels to factory defaults.
	From Montage adds the labels from the current montage to the Channel Labels list. However, the labels saved on your machine must be different from those of the current montage.
	Channel Labeler is a graphical label set editor. To enable it you need to install channel labeler (or DSM function in installation) and have a Quantum, EMU128FS, or NeuroLink IP study open or have the Quantum, EMU128FS, or NeuroLink IP set on acquisition page as your current headbox (if you open NeuroWorks with no study). See Channel Labeler section.
	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.

16.12. Extracting Channel Labels from a Montage

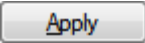
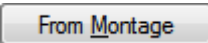
To further improve workflow for multi-electrode studies, it is possible to extract labels from a given montage. This makes it possible for you to modify an existing set of labels rather than create a full channel set from scratch.

To extract labels from a montage:

1. Choose Edit > Settings > Montage (tab).
2. Select the montage from which you want to extract labels.

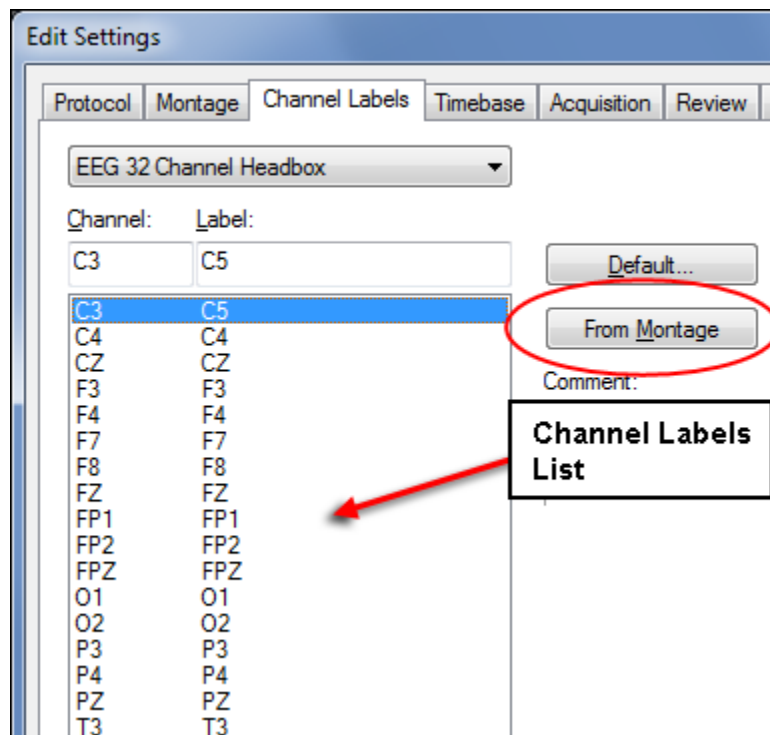


Montage Selected

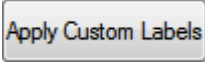
3. Press the **Apply**  button.
4. Click the **Channel Labels** tab to switch to the **Channel Labels** page.
5. Press the **From Montage**  button to add the labels from the current montage to your Channel Labels list.



NOTE: For the **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.

16.13. 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**.

Paper Speed

Click an option button to select the speed of the Sweep Edge. This simulates actual paper movement as the data is recorded.

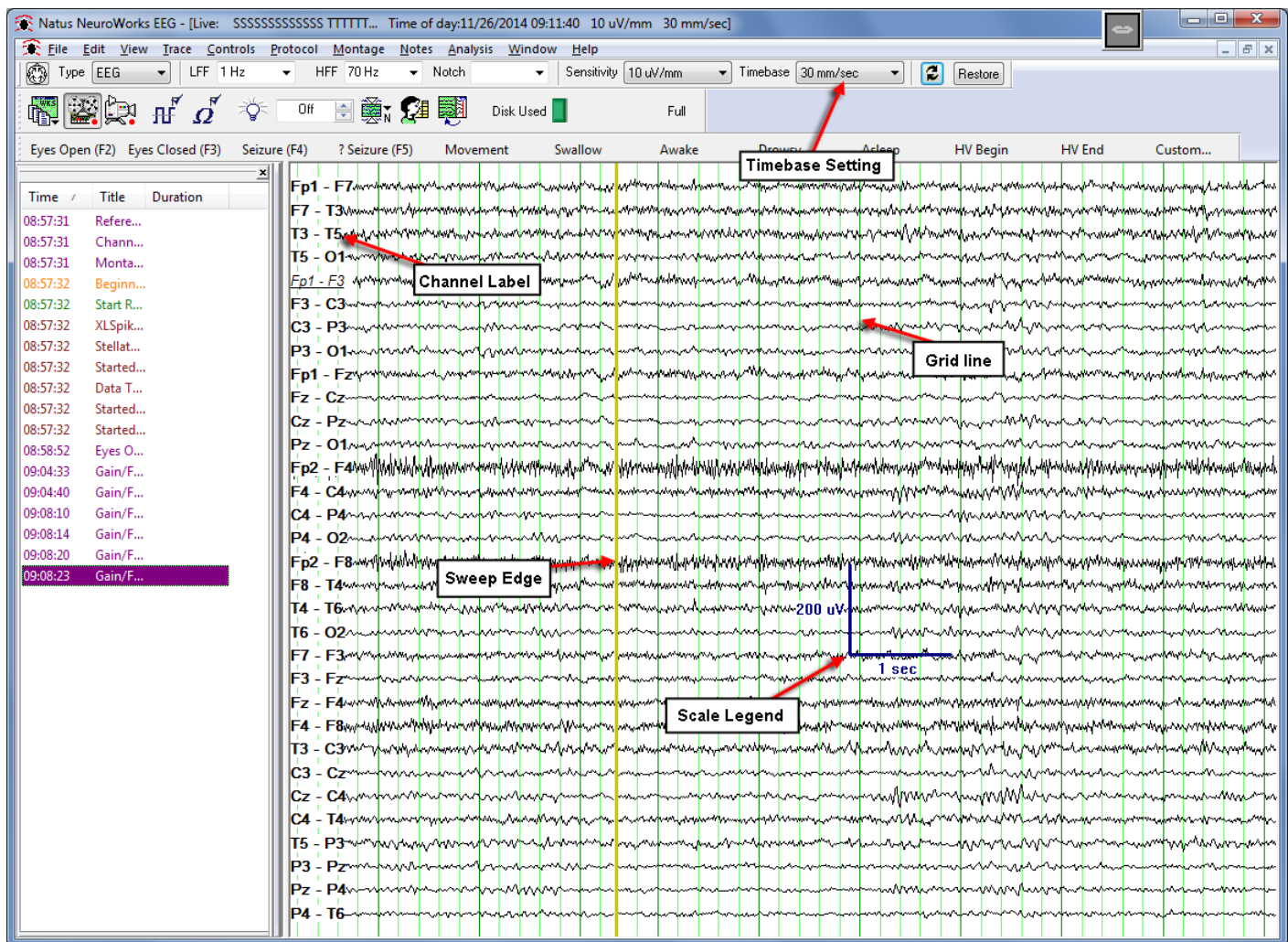
Paper Speed	Major Gridlines
☐ 120 mm/sec	12 cm/div
☐ 60 mm/sec	6 cm/div
☒ 30 mm/sec	12 cm/div
☐ 15 mm/sec	1.5 cm/div
☐ 10 mm/sec	10 mm/div
☐ 5 mm/sec	5 mm/div
☐ 2 mm/sec	2 mm/div
☐ 1 mm/sec	1 mm/div
☐ 30 mm/min	3 cm/div
☐ 15 mm/min	1.5 cm/div
☐ 10 mm/min	10 mm/div

Major Grid Lines

Click the list arrow and select the grid spacing.

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

16.14. 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.
Display a large sine wave signal when an electrode becomes disconnected	Select the Electrode Detection check box.

To...	Do this...
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	Select the desired Acquisition Profile from the dropdown list. To setup an acquisition profile for this list, refer to the Creating an Acquisition Profile section of this manual.



NOTE: When using the Quantum Amplifier, you can set the Pinboard Usage for each breakout box, which automatically turns channels on or off in 64-Channel increments. You may also switch the last 8 inputs of a Quantum pinboard from referential to differential by clicking the **Ref/Diff** indicator per each pinboard. For sampling frequencies $\geq 1024\text{Hz}$, the secondary “fast-paging” decimated data stream is automatically set to 512Hz. 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.
- Configure the Trex/Trex HD 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.

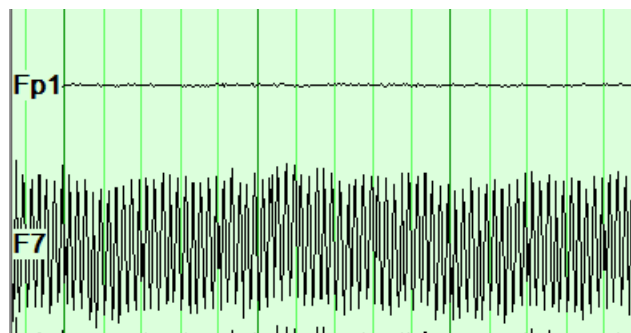


NOTE: Select a preset protocol from the drop-down list. The list becomes active once **Run protocol ...** is selected.

Study Start Options

Loose Electrode Detection

Some Natus 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:

- EMU40 and EMU40EX with firmware version 2.61 or higher (NeuroWorks 7.1.1591 or higher)
- EEG32 with firmware version 3.4 or higher

During a live study, the **Electrode Detection** check box is grayed out when an EEG32 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 an EMU40 or EEG32 is selected on the Acquisition tab. If the connected EMU40 or EEG32 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 scalp), 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.

16.15. Editing Review Settings

To determine default system settings for reviewing studies, choose **Edit > Settings > Review**.

Use the **Review** tab to:

- **Playback** – Set Playback rates for **By Page** (pages/sec), **By Event** (events/sec), and **With Video** (playback speed). Enable **Stop play on event** to stop the playback when an event is found in the study.
- **Initial Montage** – Select from the options of **As Recorded**, **As Reviewed**, or with the **Default** montage for the selected amplifier.
- **Auto-save** – Allows options for auto-saving of scoring and review montages. Enable **Auto-save every:** to save scoring at regulator intervals (in minutes). Enable **Auto-save “As Reviewed” montages, gains, and filters after:** to save montage display settings during review (in seconds).
- **Video Squeeze** – Check the **Enable video squeeze during pruning/cropping** option to reduce the video frame rate during editing. Use the **sec/frame** slide bar to set a squeeze rate of 1, 2, 3, 4, or 5 seconds for every frame of video. 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](#).
- **Slow Connection** – Enable the **Optimize for slow connection** option to reduce lag during review in slow network environments (i.e. - if slowness occurs when adding, deleting, or editing annotations or events). When enabled, NeuroWorks caches key files locally during the review session and then incorporates those changes with the remote study when saves occur.
- **Channel Valid Ranges** – Enable the **Modify after acquisition** option to allow editing of DC channel validity ranges post-acquisition. Values outside of the validity range are ignored in reports.

Edit Settings

Protocol Montage Channel Labels Timebase Acquisition **Review** Plots Graph Properties Analysis Alarms Heads Up Display

Playback

By Page: 1 pages per second

By Event: 0.5 events per second

With Video: 1 real time

☐ Stop play on event

Initial Montage

☒ As Recorded

☐ As Reviewed

☐ Default:

AP Bipolar - BM

Auto-save

☒ Auto-save every: 5 minutes

☐ Auto-save "As Reviewed" montages, gains and filters after: 2 seconds

Video Squeeze

☐ Enable video squeeze during pruning/cropping 2 sec/frame

Slow Connection

☐ Optimize for slow connection

Channel Valid Ranges

☐ Modify after acquisition

Screen Buffer Control

☐ Override screen buffer channel count 0 channels

Memory allocation (click here to reset) 60 percent 150 pages

Embedded Snapshot Images

☐ Enable clipboard snapshots (restart required)

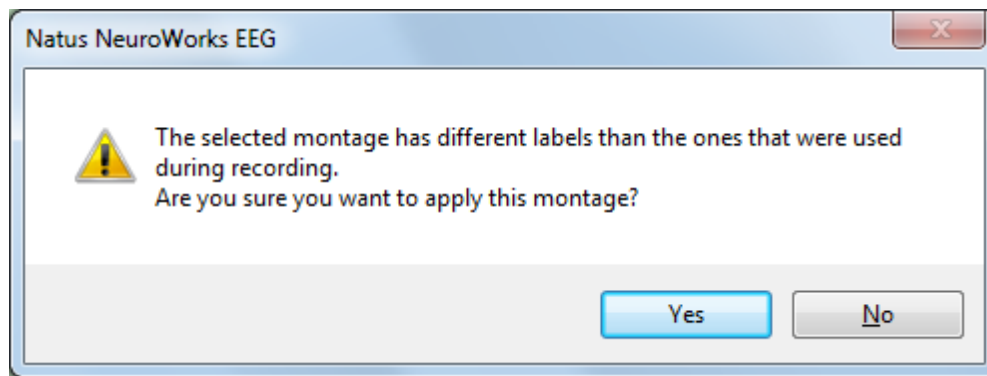
OK Cancel Apply

Options in the Review Tab of the Edit Settings Window

Mismatched Labels Warning

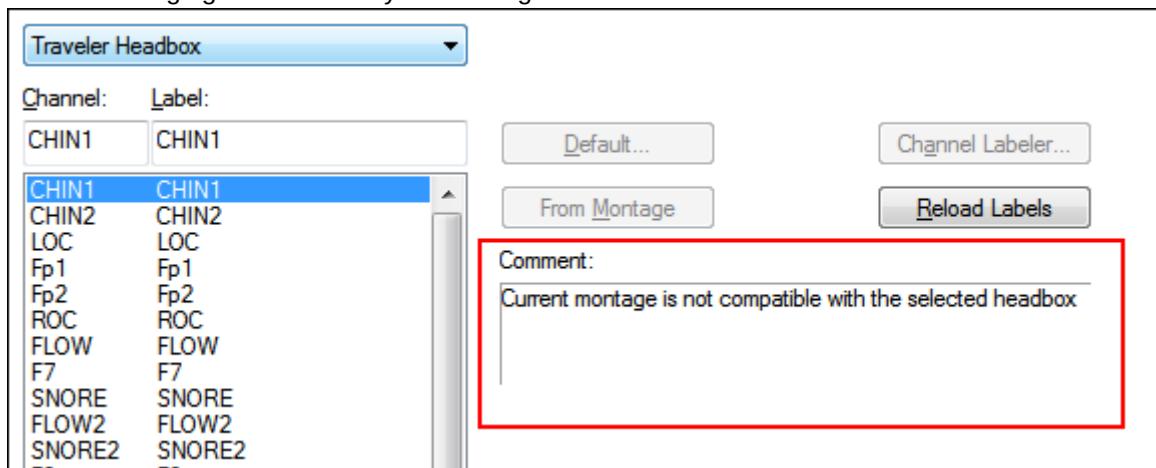
When a recording is made with a multi-channel headbox such as a Quantum or EMU128FS, labels are typically created for each patient or type of study. It is therefore possible that during review a wrong set of labels may be applied to a study, thus making viewing the correct montage labels problematic.

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

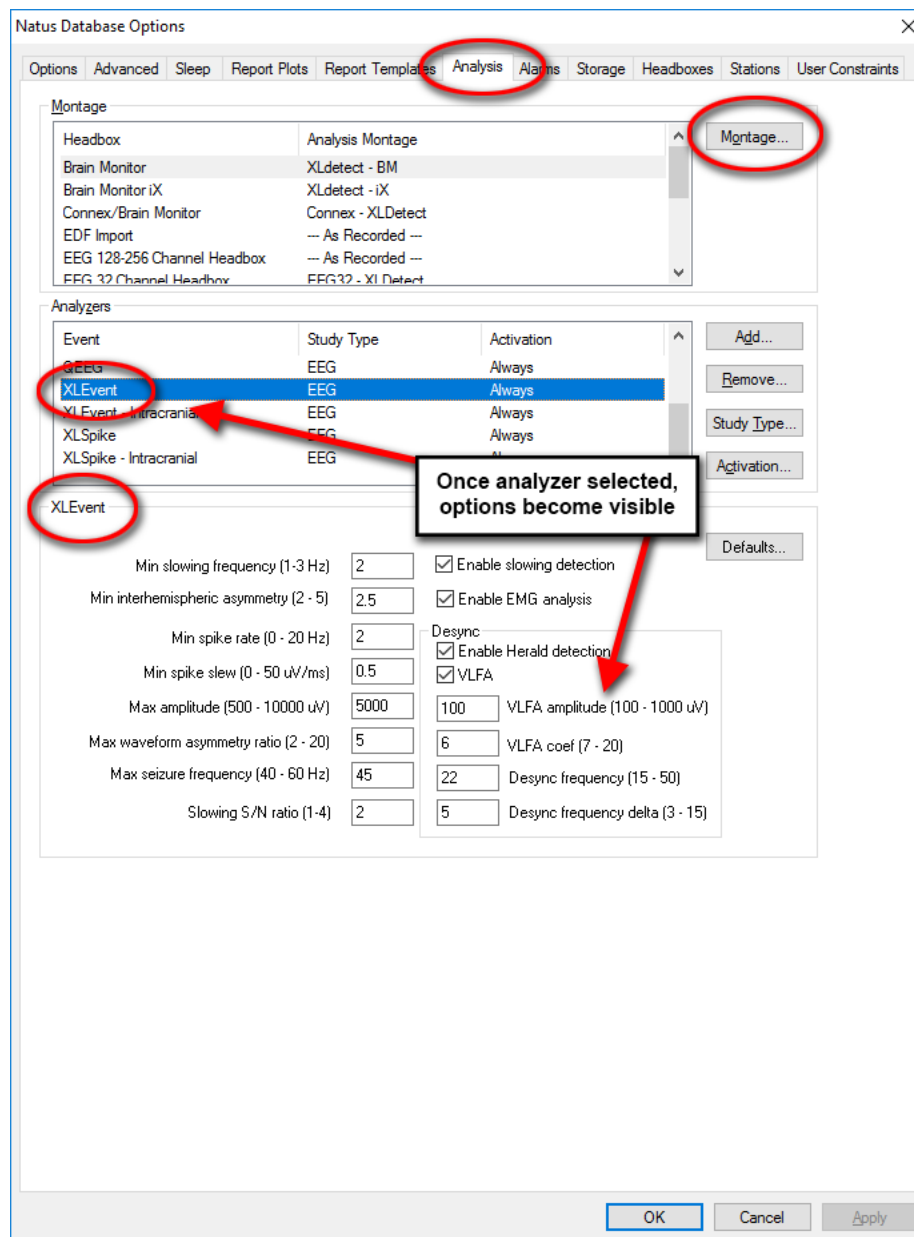
16.16. Editing Analysis Settings

Depending on the options available in the NeuroWorks license, you can add a number of analyzers to your study to benefit from trending features or event detection features..

It is recommended to create and customize analyzer profiles with appropriate settings for each use case, for example for monitoring EEG in the ICU or during LTM studies, or even ambulatory EEG. These analyzers are set to factory defaults that work well for the majority of studies. However, settings can be customized using the Analysis tab.

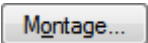
To edit Analysis settings:

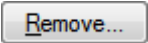
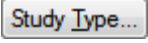
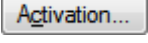
1. Choose Edit > Settings > Analysis.
2. In the **Analyzers pane**, select the analyzer whose options you want to edit.
3. Once the analyzer is selected, its options appear in the pane below.



Analysis Tab in Edit Settings Dialog

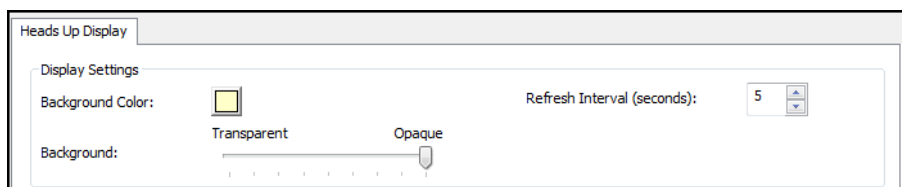
Analysis Tab Options

Option	Description/Function
	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.

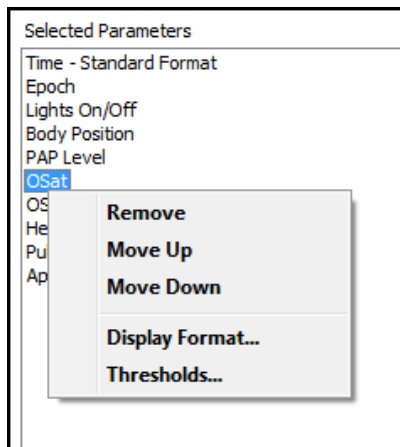
Option	Description/Function
	Select an analyzer in the Analyzers pane. Click the Remove button to remove it
	Click the Study Type button to see a pop-up list of available study types. Choose EEG .
	Click the Activation button to see a pop-up list of study activation options. Choose between: Never , Always , Lights Off , or Schedule (enter schedule time in resultant dialog box).
	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.

16.17. Heads Up Display Settings

1. Right click in the Heads up Display Window or go to **Edit > Settings > Heads Up Display**.
2. Use the **Display Settings** section to set the following options:



- **Background Color:** Select the background color by clicking on the , and selecting the desired background color.
 - **Background Transparency:** Determine how opaque or transparent the HUD display should be shown by moving the slider to the desired position. Note, this is only applied to a Heads Up Display window that is not docked.
 - **Refresh Interval:** Set how frequently the information in the Heads Up Display is refreshed by using either the up and down arrows  or by manually entering the desired number of seconds in the box.
3. From the **Parameters** section, select the desired parameter(s) to be added from the **Available Parameters** column and click the **Add -->** button. After clicking **Add**, the chosen parameter(s) will be added to the **Selected Parameters** column.
 4. Change the position of the parameters by selecting the desired parameter from the Selected Parameters column, and use the **Move Up** or **Move Down** buttons to position them as desired. Alternately, you can right click on the channel in the Selected Parameters column to change the position and set additional parameter properties.



5. Channels that output numeric values (e.g. OSat) can be configured with thresholds that change the color of the parameter within the Heads Up Display window once the desired threshold is reached.

The Heads Up Display window is available in both Acquisition and Review, and configuration settings are saved to workspaces for both applications.



NOTE: If a parameter is not in the displayed montage the parameter value will not be displayed in the Heads Up Display Window

16.18. Frequency Tool Settings

Display Configuration Settings

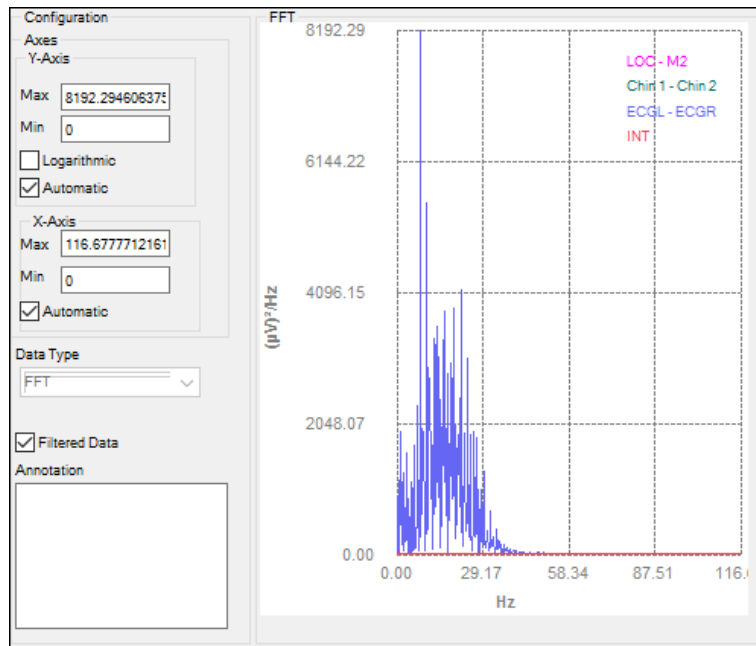
The display configuration of the Frequency tool can be adjusted to reflect the details that the end user would like to view in the Spectrum Graph. You can show or hide the configuration details for the Spectrum graph display by clicking the Display Config checkbox in the Frequency tool dialog.

To adjust the Display Configuration for the Frequency Tool

1. Once a study is opened in **Review Mode**, select the **Frequency Tool**  from the toolbar.
2. Highlight the desired signal by clicking and dragging the cursor on the signal to place a **Frequency Tool Event**.

The **Frequency Tool Dialog** opens showing the Spectrum Graph.

3. From below the Spectrum Graph, select the **Config**  checkbox to show the Configuration panel.



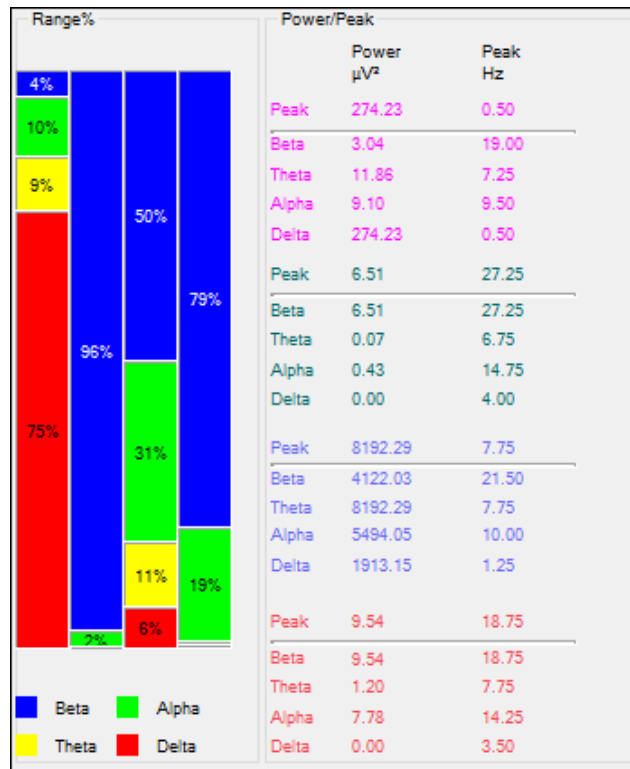
4. From the Configuration panel, adjust desired options to reflect the desired display:
 - **Axes** – Adjust the Min/Max on both the X and Y axes. Selecting the Automatic checkbox in either X or Y Axis will automatically fit the entirety of the selection into the available window. Selecting Logarithmic under the Y-axis will redisplay the FFT data logarithmically, which compresses the Y-axis view into a smoother view with fewer spikes in the Y-axis.
 - **Data type** – this is a fixed FFT Data Type.
 - **Filtered Data** – Selecting this checkbox filters the visual data according to the filters that are currently applied to the selected channel. This checkbox, by default, is unchecked and displays the raw, unfiltered data on the channel.
 - **Annotation** – The annotation box displays current available annotations for each study. The details input in this box are persistent throughout the current study,
5. Once the desired information details are displayed, you can copy or save the event by selecting the appropriate buttons located below the Spectrum Graph. Clicking **Close** will close the dialog without saving or copying the data.

Display Value in the Frequency Tool

The values for the Power/Peak for each selected channel can be displayed alongside of the Spectrum Graph in the Frequency Tool Dialog.

To Display the Values in the Frequency Tool:

1. Once a study is opened in **Review Mode**, and a Frequency Tool Event has been created, the **Frequency Tool Dialog** opens showing the Spectrum Graph.
2. From below the Spectrum Graph, select the **Value** ☒ checkbox to show the Range % and Power/Peak value panels. This selection displays up to 4 color bars corresponding to the Range percentage and the Power/Peak of the selected trace(s) for each of the different sleep bands: Alpha, Beta, Theta, and Delta. Each selection is represented in the same color as it is displayed in the Spectrum Graph. The Range percent columns correspond to the displayed Power/Peak details with the first column representing the data from the first Power/Peak set etc.



- Once the desired details are displayed, you can copy or save the event by selecting the appropriate buttons located below the Spectrum Graph. Clicking **Close** will close the dialog without saving or copying the data.

Display Additional Data in the Frequency Tool

Additional Data information can be displayed alongside of the Spectrum Graph in the Frequency Tool Dialog. This can also be displayed alongside of the Display Values configured in the previous section.

To Display Additional Data in the Frequency Tool:

- Once a study is opened in **Review Mode**, and a Frequency Tool Event has been created, the **Frequency Tool Dialog** opens showing the Spectrum Graph.
- From below the Spectrum Graph, select the **Additional Data** ☒ checkbox to show the Additional Data panel. This selection displays the following details for each selected channel to a maximum of 4:

Channel Name

Selected Duration (Sec)

Max in selection (μV)

Mean Frequency in Hz

Standard Deviation of Frequency (μV²)

Channel Unit

Number of Selected sample points

Min in selection (μV)

Mean frequency in BPM

Standard Deviation of Amplitude (μV)

Additional Data			
Channel Name	LOC - M2	Channel Unit	µV
Selected Duration (Sec)	4.05	No. Selected Sample Points	1024.00
Max in Selection (µV)	28.14	Min in Selection (µV)	-32.28
Mean Frequency in Hz	3.52	Mean Frequency in BPM	211.09
Standard Deviation of Power (µV²)	12.40	Standard Deviation of Signal (µV)	12.34
Channel Name	Chin 1 - Chin 2	Channel Unit	µV
Selected Duration (Sec)	4.00	No. Selected Sample Points	1024.00
Max in Selection (µV)	18.67	Min in Selection (µV)	-20.12
Mean Frequency in Hz	38.89	Mean Frequency in BPM	2333.56
Standard Deviation of Power (µV²)	0.68	Standard Deviation of Signal (µV)	6.25
Channel Name	ECGL - ECGR	Channel Unit	bpm
Selected Duration (Sec)	5.98	No. Selected Sample Points	1024.00
Max in Selection (µV)	924.93	Min in Selection (µV)	-1182.83
Mean Frequency in Hz	15.53	Mean Frequency in BPM	931.58
Standard Deviation of Power (µV²)	782.50	Standard Deviation of Signal (µV)	188.46
Channel Name	INT	Channel Unit	µV
Selected Duration (Sec)	3.95	No. Selected Sample Points	1024.00
Max in Selection (µV)	45.75	Min in Selection (µV)	-32.25
Mean Frequency in Hz	25.50	Mean Frequency in BPM	1530.01
Standard Deviation of Power (µV²)	1.19	Standard Deviation of Signal (µV)	7.79

Each section is displayed in the colors corresponding to the color shown in the Spectrum Graph

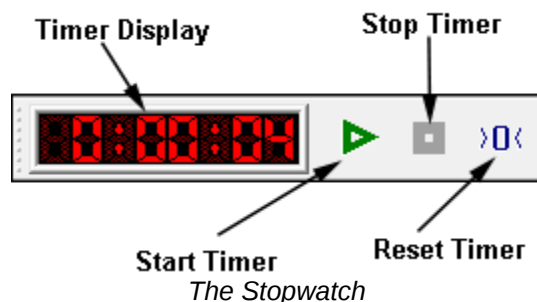
- Once the desired details are displayed, you can copy or save the event by selecting the appropriate buttons located below the Spectrum Graph. Clicking Close will close the dialog without saving or copying the data.

17. 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.

17.1.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.



17.2.Montage Toolbar

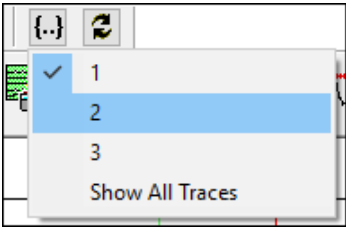
You can use the Montage toolbar to modify the channel settings. The ranges of settings for the montage are indicated by the values available on the toolbar.



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.

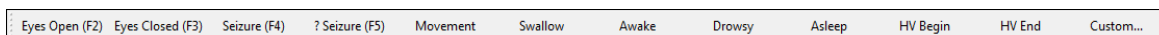
LFF (Low Frequency Filter)	Filters out low frequency interference below the set value.
HFF (High Frequency Filter)	Filters out high frequency interference above the set value.
Notch Filter	Minimizes interference from nearby electrical equipment.
Sensitivity	Adjusts the sensitivity, or gain, of the channels. 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 on the Channel Sets button, a list of available channel sets will be displayed for selection. Selecting one of the available sets will filter the channels based on the Channel Sets defined in the Edit Settings Montage (tab). See <i>Section 16.4 Editing Montage Channel Settings</i>. 
	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.

17.3.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

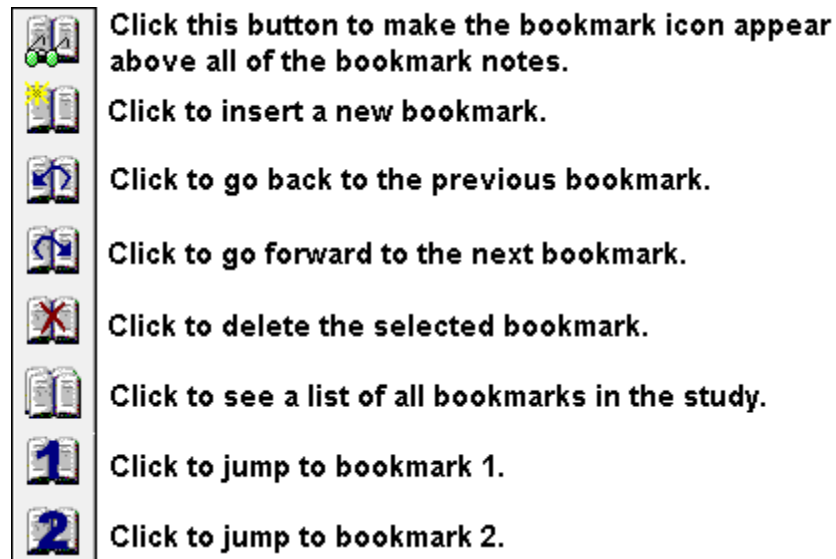
Click a Note button to instantly insert a note at the current location of the **Sweep Edge**.

17.4.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.

17.5.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**.



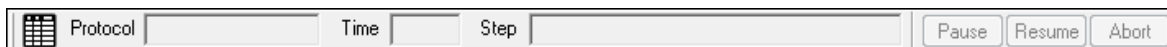
Feature Marks Toolbar

TIP: To see the function of each button, point to a button and a ToolTip for that button will pop up.

17.6. 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

17.7. 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:

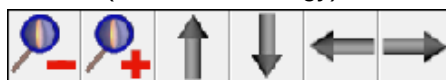
- Choose **View > Toolbars > Camera**.
- Or, right-click in the gray area around the visible toolbars, then select **Camera** from the pop-up list.

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 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.



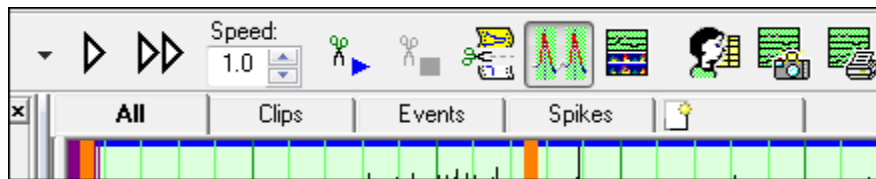
NOTE: Switching the cameras on the toolbar will also switch the video input that is captured – i.e. it replaces the swap cameras functionality previously handled by the swap camera buttons on the Video and Workflow toolbars.

17.8. 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:

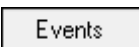
1. Select a study in the Natus Database and click **Review**. NeuroWorks opens with the study in Review mode.
2. Click the **Instant Pruned View**  button on the Review toolbar (OR **choose View > Instant Pruning** OR press **Alt + L**). The Instant Pruned View toolbar opens:



Instant Pruned View Toolbar

To hide the Instant Pruned View toolbar, reverse the above steps.

Instant Pruned View Toolbar Buttons

	Exits Instant Pruned View and redisplayes the normal view.
	Displays only any clips that have already been made.
	Displays only events that occurred during the study.
	Displays only spikes that occurred during the study.
	Opens a dialog box where you can set rules for instant pruning.

17.9.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:

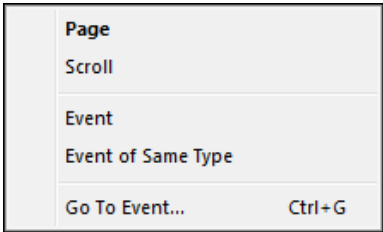
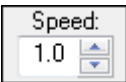
- Choose View > Toolbars > Review.



Review Toolbar

Review Toolbar Button Functions

Button	Function/Description
	Toggles video on/off.
	Plays study in reverse .
	Goes to the previous item.

Button	Function/Description
Page ▼ Event ▼ (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 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.

Button	Function/Description
	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.
	Frequency Tool button. Click to open the Frequency Tool. (For details, see Section 17.15 <i>Frequency Tool</i> on page 270.)
	Waveform cursors button. Inserts a cursor with accompanying info box wherever you click on a waveform. To turn off, click button a second time.
	Enable Mouse Click Annotation Mode button. Allows for the insertion of annotations using a single mouse click in a study. To disable, click the button a second time.
	Video Page Play Mode button. When this button is enabled, the video screen will play back based on the page view for the EEG screen. So when paging through the study, using page view.
	Go to Previous Study Segment button. Only visible with a Slideshow open. Allows you to navigate to the previous slideshow segment.
	Go to Next Study Segment button. Only visible with a Slideshow open. Allows you to navigate to the next slideshow segment.
	Go to Previous Slideshow Note button. Only visible with a Slideshow open. Allows you to navigate to the previous slideshow note.

Button	Function/Description
	Go to Next Slideshow Note button. Only visible with a Slideshow open. Allows you to navigate to the next slideshow note.
	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.

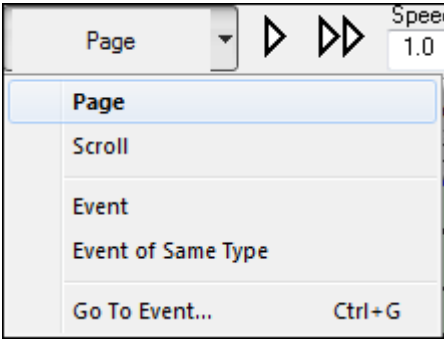
TIP: The **Waveform Cursor** can be used to measure waveform amplitude.



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.

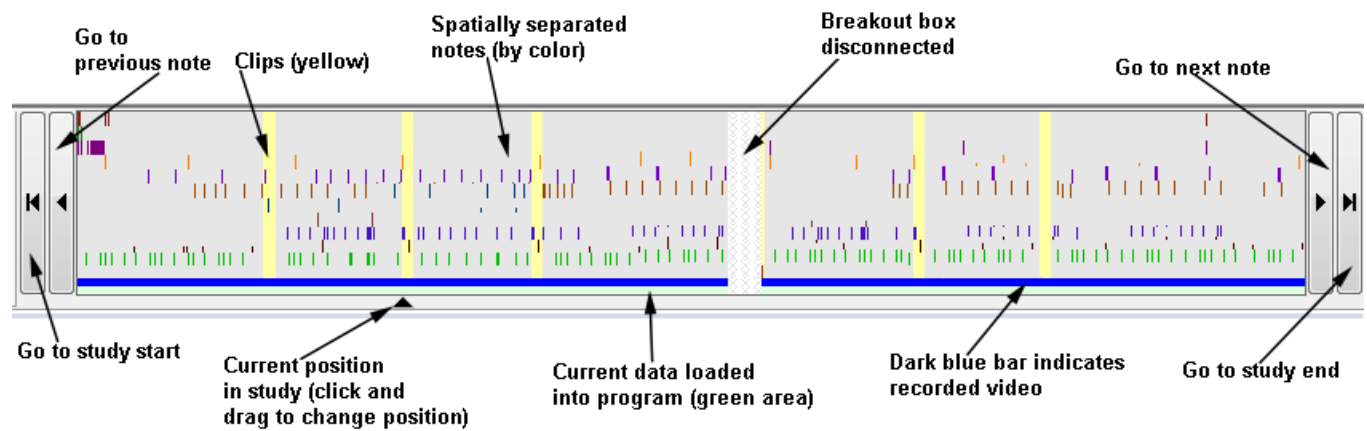
17.10. Study Toolbar

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).

17.11. 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.
	Disk usage indicator.
	Start analog printing.

Button	Function
	Stop analog printing.
	Analog printing options.

17.12. Trend Summary Toolbar

Use the **Trend Summary** toolbar to display the Density Spectral Array (DSA) 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.

*Add new picture of DSA trend
Trend Summary Toolbar*

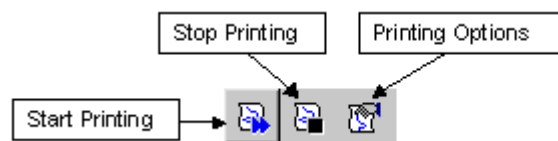
It is possible to configure multiple trends bars by clicking on any of the numbered tabs located on the right side of the trend toolbar. Each tab “remembers” one or more trend plots. Switching between the tabs is usually faster than reconfiguring the whole Trend Summary tool. To show which graphs are 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.

17.13. 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.

17.14. Heads Up Display Toolbar

The **Heads Up Display** toolbar is used to display parameters recorded during collection or in review. The parameters displayed are configurable and can be saved to a Workspace.

To open the Heads Up Display toolbar:

- Choose View > Toolbars > Heads Up Display. Alternately you can access the Heads Up Display toolbar by right clicking in the toolbar and selecting from the context menu.

Time	Seizure Count	Spike Count	Seizure Index	Spike Index	OSat - min, avg, max	Pulse - min, avg, max
0:00:53.250	3	2	7.5	5.0	94.7 95.0 95.6	67 68 68
Elapsed			evt/h	evt/h	%	bpm

If the Heads Up Display is docked, clicking on the small arrow in the upper right hand corner of the window will allow you to show or hide the toolbar.

17.15. Frequency Tool

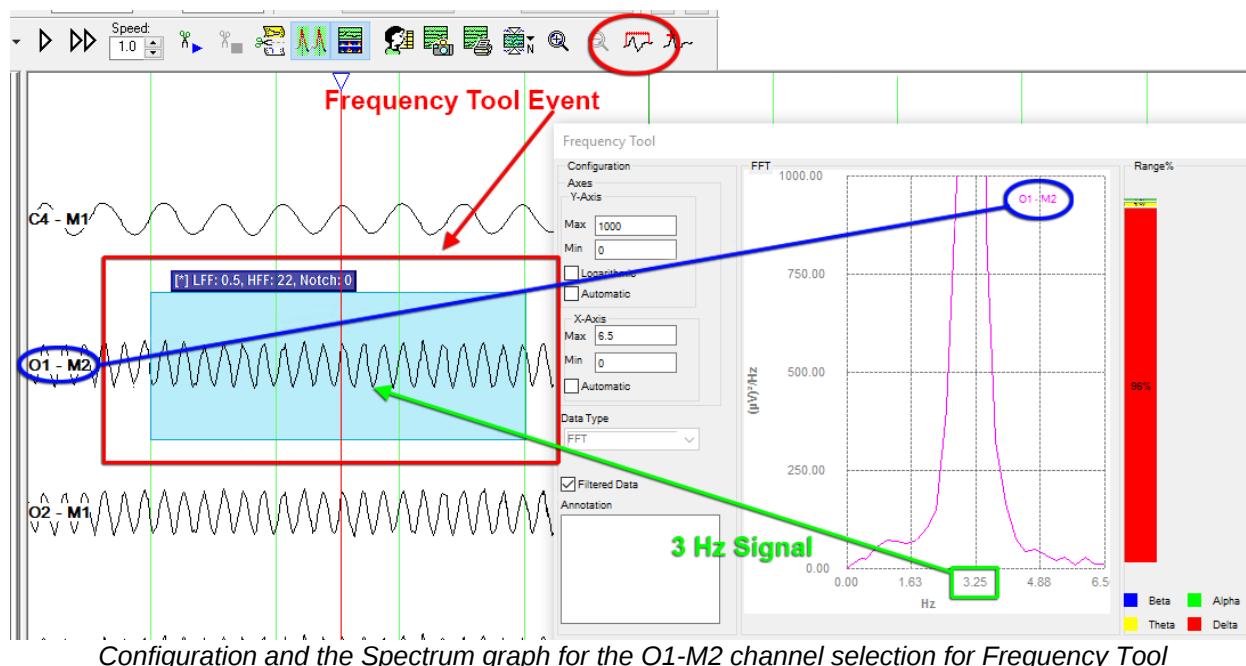
The **Frequency tool** is used to display FFT information and data statistics in the frequency domain during review. The Spectrum graph and detail options are configurable and can be saved as an event for later review or copied to the clipboard as an image for insertion into another application.

To use the Frequency tool:

- Open up a study in **Review** mode.
- Select the **Frequency Tool**  from the toolbar.
- Highlight the desired signal by clicking and dragging the cursor on the signal to place a Frequency Tool Event.

The Frequency Tool dialog displays only the Spectrum graph of the highlighted signal from the start point to the end point of the selection. Additional display options can be selected from the options listed below the Spectrum graph.

To	Select
Show the configuration details for the Spectrum graph display for the Axes and Data type details	Config
Display up to 4 color bars corresponding to the Range percentage and the Power/Peak of the selected trace for each of the different sleep bands: Alpha, Beta, Theta, and Delta.	Value
Show the additional detailed information for each selected channel.	Additional Data



Configuration and the Spectrum graph for the O1-M2 channel selection for Frequency Tool



NOTE: Multiple channels can be selected for the Frequency tool, but only the last 4 selected channels will be displayed in the dialog. Once the dialog is saved and closed only the channels shown are saved.

- Once the desired information is displayed, you can select one of the following button options:
 - Save Events** – This will save the events of the selected traces (max of 4) as an event in the event pane for future use. Once saved, you can close the dialog by clicking the **X** or on the **Close** button displayed. Double-click the saved event to open the Frequency Tool and view the event details.
 - Copy to Clipboard** – Displays the information on the Frequency Tool dialog box as an image which can be pasted into another software package e.g. Paint or Microsoft Word.
 - Close** – Closes the dialog without saving or copying the data.

☒ Config	☒ Value	☒ Additional Data
Save Events	Copy to Clipboard	Close

17.16. 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).

18. 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**.

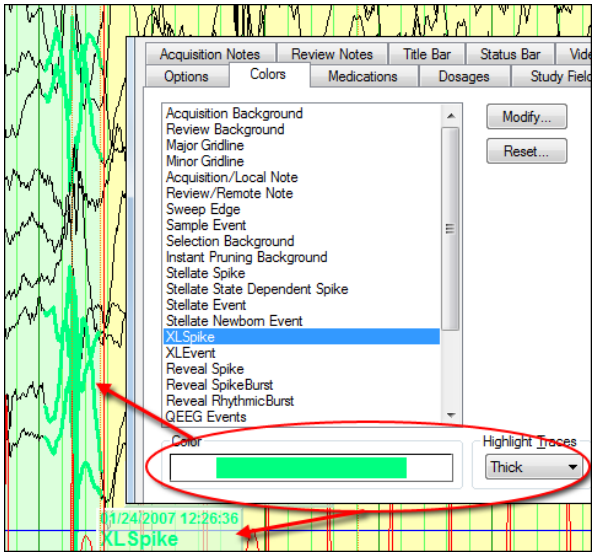
18.1. Customizing Acquisition Options

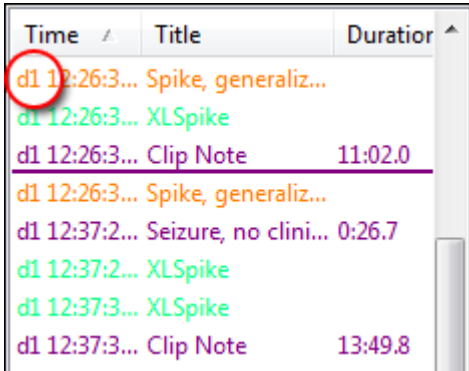
To customize NeuroWorks Acquisition options:

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]
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.

Option	Comment	Setting
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]
Highlight Traces in Detected Events	Highlights traces in detected events with a specific color which is set in the Color tab. 	[OFF]

Option	Comment	Setting
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

18.2. Customizing Display Colors

To change the colors of components of the NeuroWorks display:

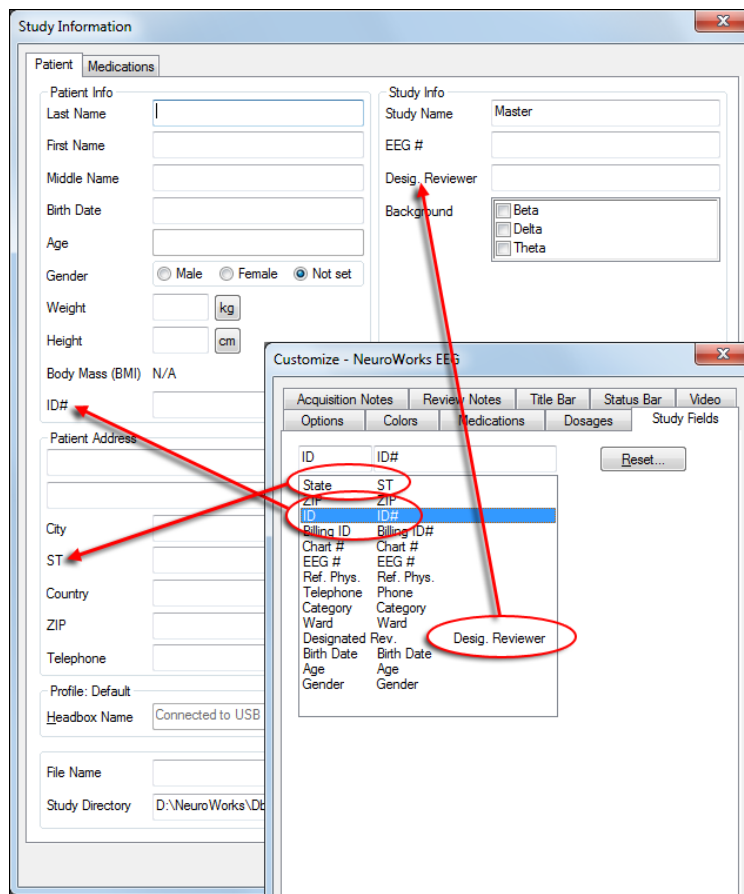
1. Choose **File > Customize**.
2. Click the **Colors** tab.
3. Select an item to modify from the list box (Acquisition Background, for example).
4. To open the color palette, click **Modify**.
5. Select a color.
6. Click **OK**.

The color of the selected screen element will now be the color you selected.

18.3. 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

4. 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.

18.4. 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.

18.5. 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.

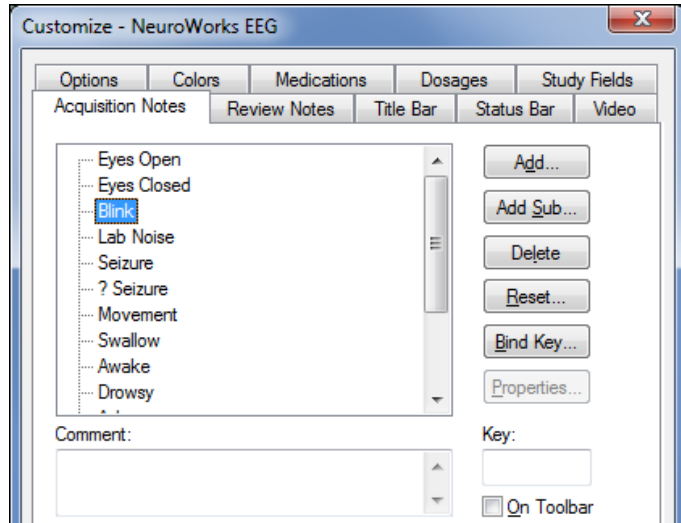
Assigning a Function Key to a Note

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**.



18.6. Customizing Display for Events Visualization

You can customize the display of annotations that have non-zero duration.

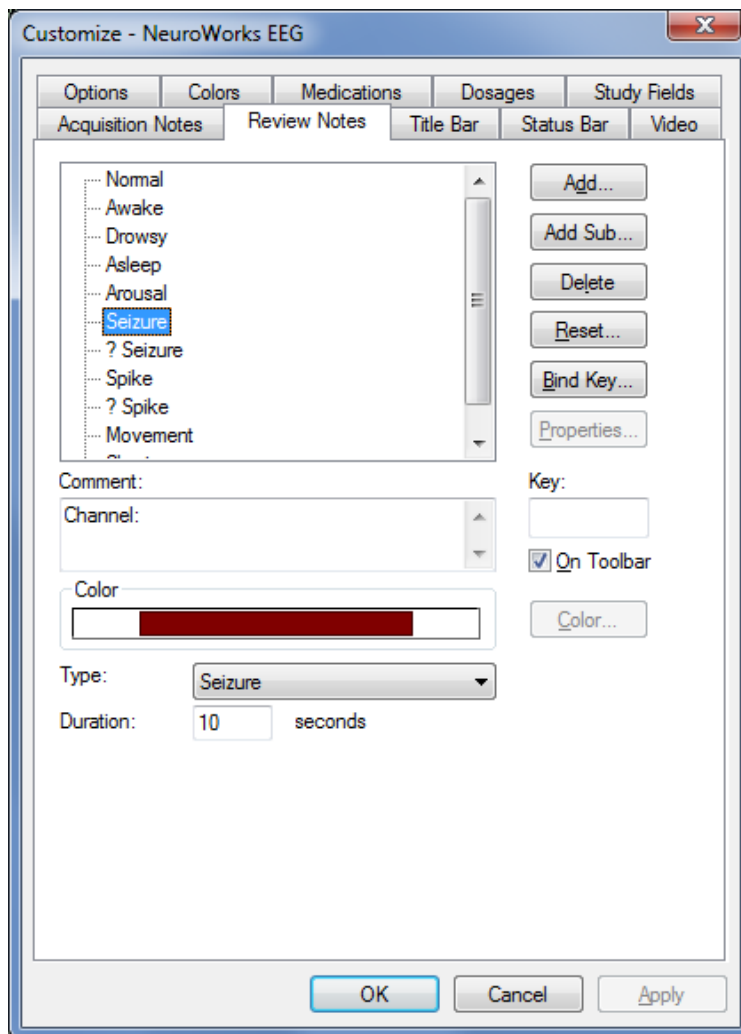
To configure an annotation type that provides the ability to enter duration, follow these steps:

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 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

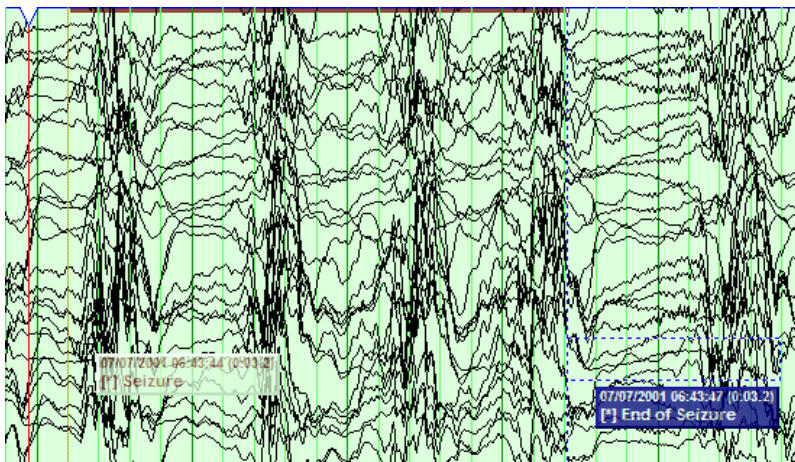
- Click with a mouse a toolbar button on the **Note** toolbar (if a note type was added to Note toolbar in **Wave > File > Customize** (Acquisition Notes or Review Notes pages))

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.



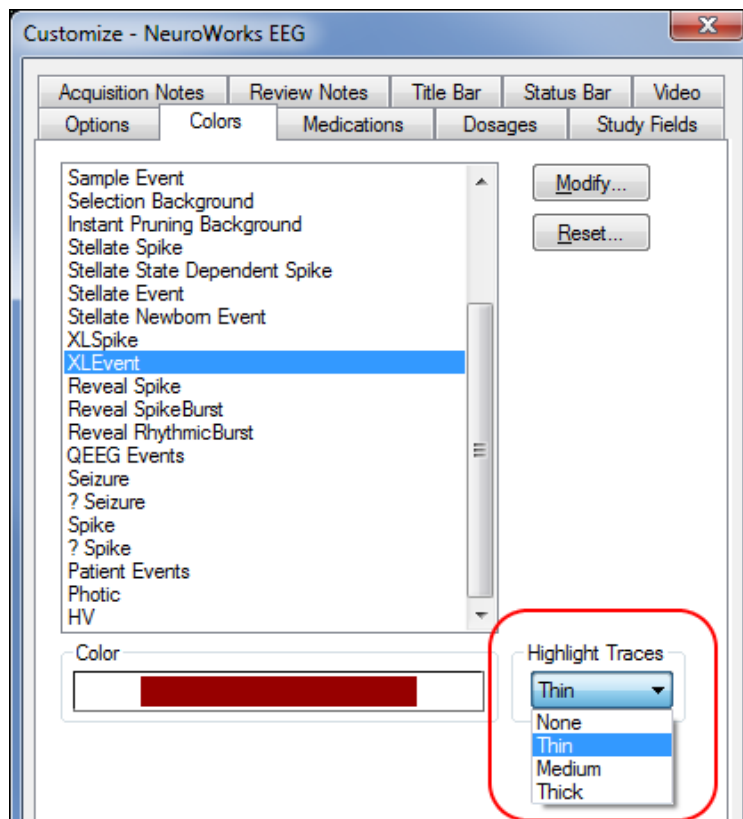
Example of Event Duration Displayed with Customizable Color in Wave Window

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.

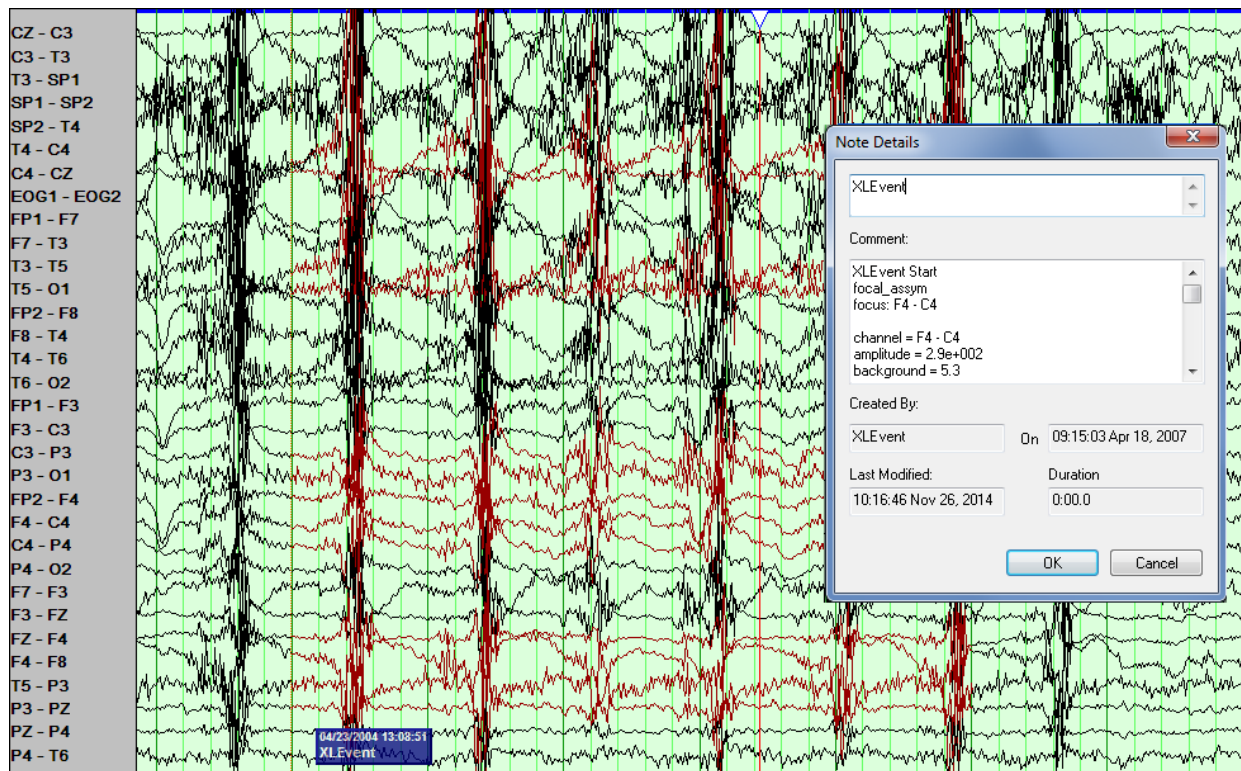
For certain automated events (e.g. automatic event detections), the ability to visualize duration also includes extracting information about specific focal channels and displaying traces from those channels with a different color and/or thickness from background traces.

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**.



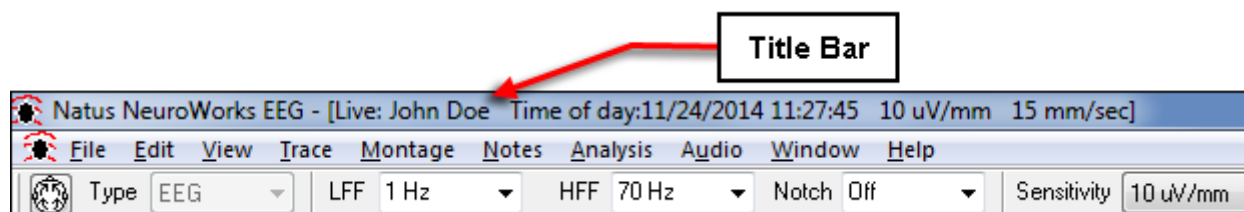
Customizing Event Trace Display in Colors Tab



Example of an Automatic Event Trace Displayed in Select Color in Wave Window

18.7. 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 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.

18.8. 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](#).

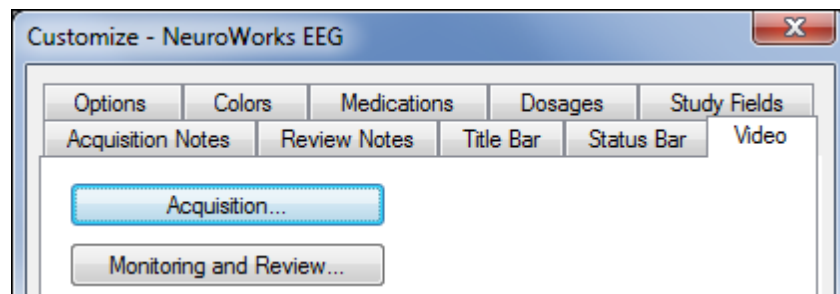
19. Customizing Video

19.1. 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.

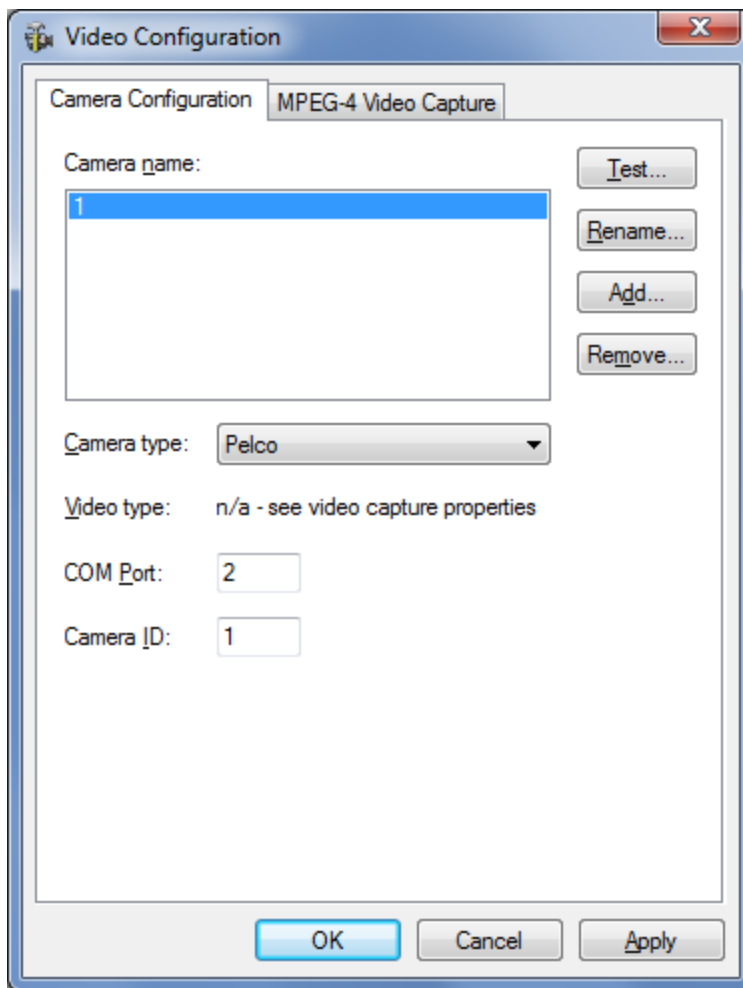
For Trex HD video ambulatory system, video settings are applied through the supported camcorder (see **Trex HD Technical Quick Guide** p/n 009318).

19.2. 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.



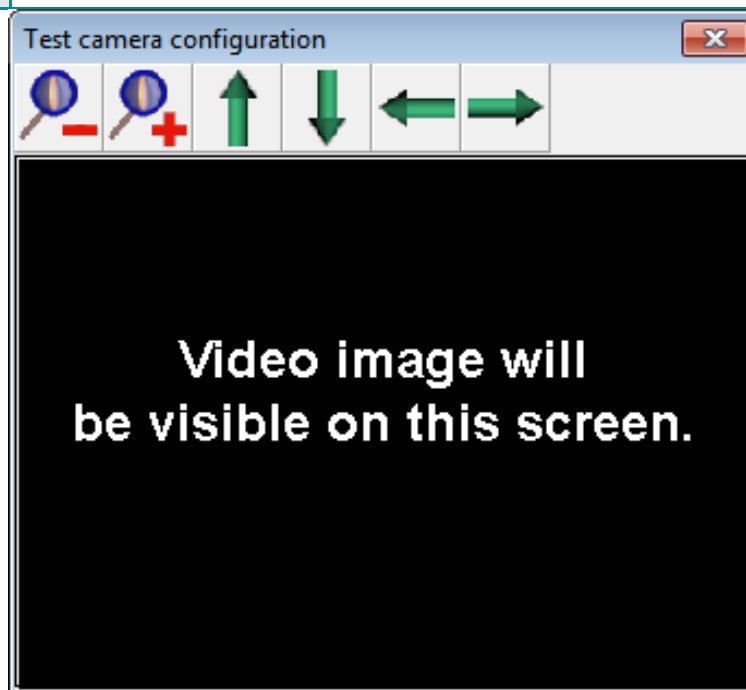
Camera Configuration Tab

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.
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.

Option	Description
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.



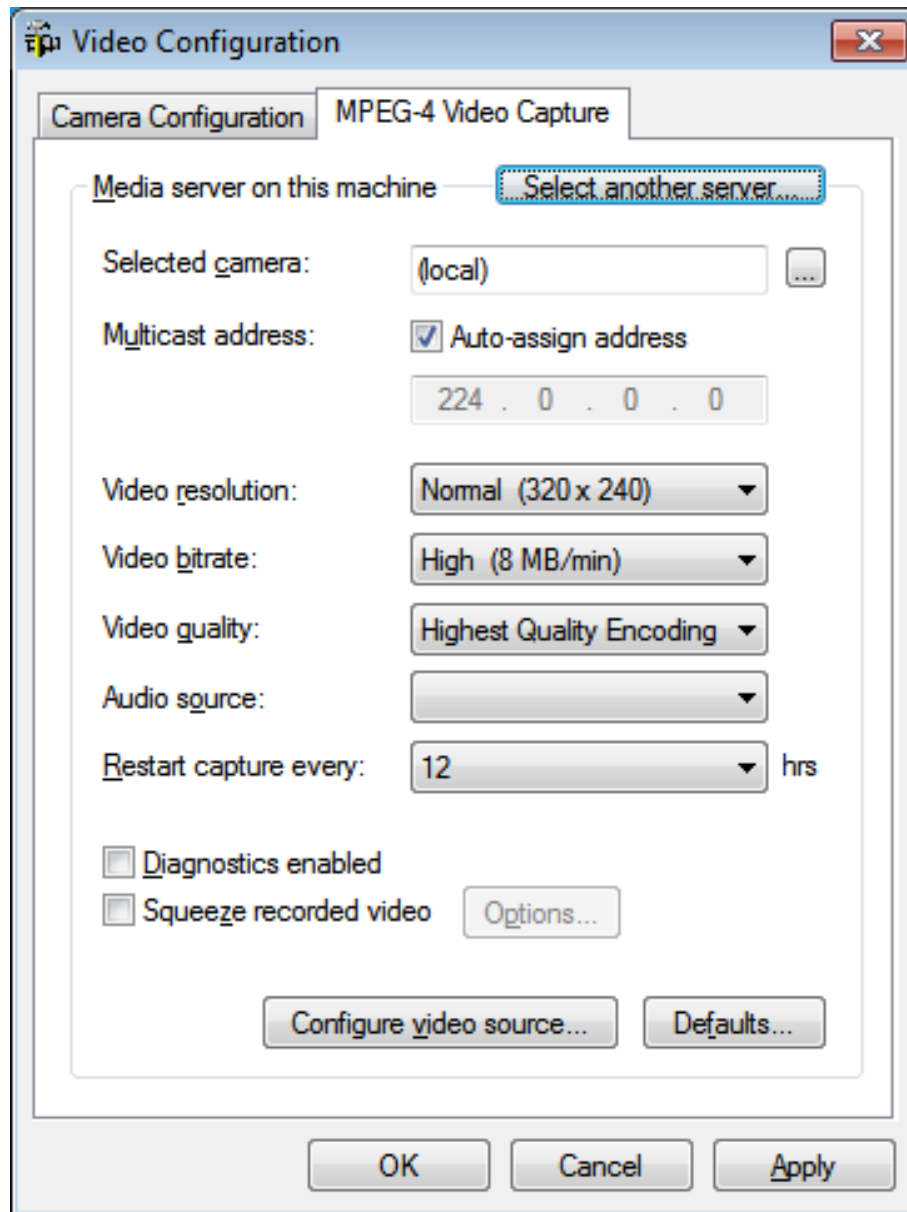
Test Camera Configuration Window

New Camera Settings Dialog

MPEG-4 Video Capture

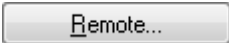
Note the following:

- 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

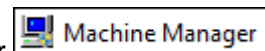
Option	Description
Media server on this machine	If you are using an IP camera (such as the Sony IPELA): - Click the Select another Server  button. - Click the Remote  button. - Choose the remote server and click OK.
Selected camera	If you are using an IP camera (such as the Sony IPELA) that is connected to a remote server: - Click the  button. - Click the IP Camera  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)

Option	Description	
		NOTE: Normal resolution is the default. To use High resolution, you require a considerably more powerful machine. For IP cameras, resolution is configured through Natus Machine Manager.
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.)	

19.3.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:

- Full HD – 1920 x 1080
- HD - 1280 x 720
- VGA - 640 x 480
- QVGA - 320 x 240



NOTE: Full HD & HD video are available when supported cameras are used.

Machine Manager – Video Resource Utility

19.4.USB Webcam and Internal Camera Configuration

USB webcams and internal cameras are supported with NeuroWorks 9.3 and later, on portable tablet computers. The steps to configure USB webcams and internal cameras may vary slightly depending on the brand and model of the Natus-approved tablet, however, the following instructions may help guide the setup.

The following instructions are specific to the Microsoft Surface Pro (for use with Trex HD Monitoring only).

1. Connect the webcam to a USB port on the tablet.
2. Open **Windows Device Manager > System Devices > disable the “Microsoft IR Camera Front”**.

3. Click the **Windows button > All apps > Excel Tech > MediaServer Diagnostic > Settings > Advanced Settings > Capture device(s)**. In the **Specify Capture Device Hint(s)** dialogue, enter a hint for video and audio devices being used. Click **OK** and close the Local Settings window.
4. In **MediaServer Diagnostic**, click **Configure**. In the **Video Configuration** dialogue that opens, select the **MPEG-4 Video Capture (tab)** and:
 - a. Choose Selected camera: **local**;
 - b. Entire the desired Video resolution and bitrate (the video resolution should not exceed that supported by the webcam);
 - c. Set Audio source to **"Master Volume"**.
5. Open **NeuroWorks EEG > File > Customize > Video (tab) > Monitoring and Review**. In the **Video Client Configuration** dialogue, enable **"Force Unicast Connections"**.
6. Right-click the **Speakers icon** on the right of the taskbar, and **select Recording Devices > Recording (tab)**. Double-click the microphone you intend to use to open the **Microphone Array Properties**. Set the **Microphone Array** level on the **Levels** tab, and ensure the microphone is not muted by default.

Adjusted the settings as needed for the USB webcam or internal camera. Note that internal (built-in) microphone is not recommended for recording audio.

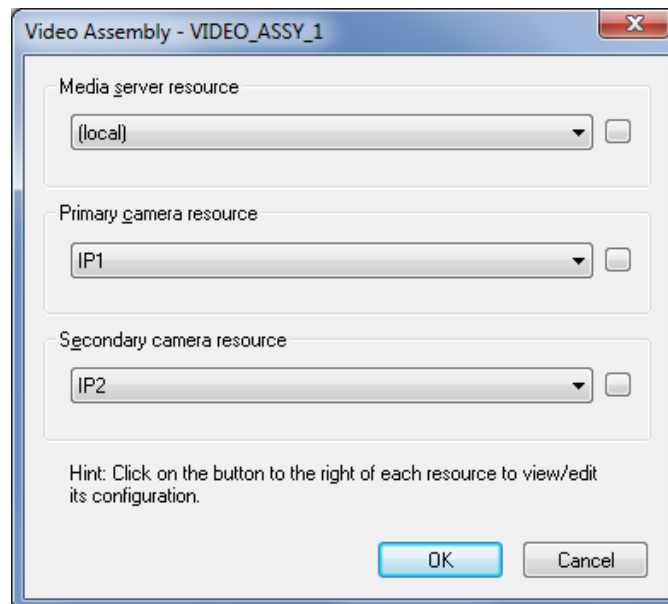
19.5. Two Simultaneously Recorded Streams of Video

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:

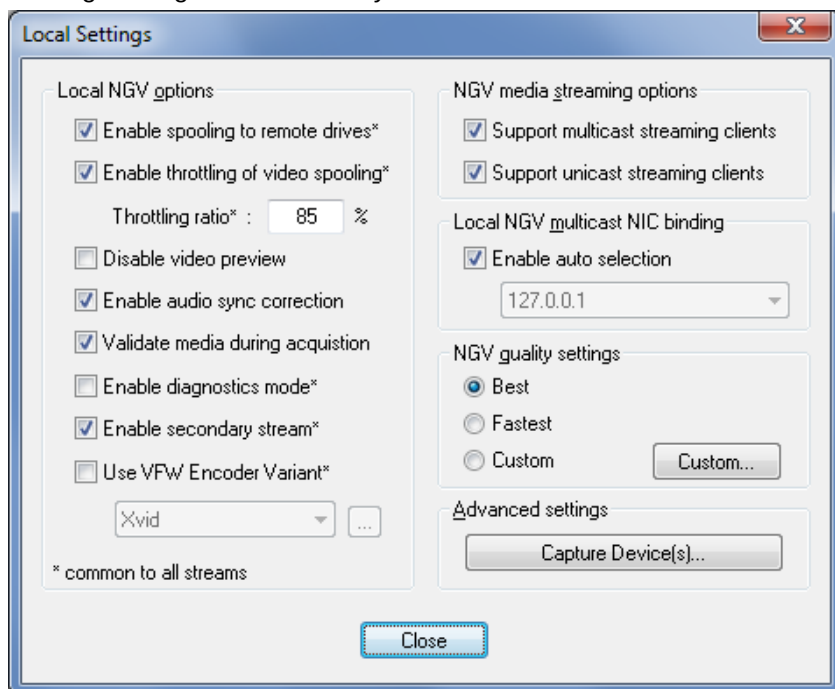


Video Assembly Dialog displaying Dual Camera Resources

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).

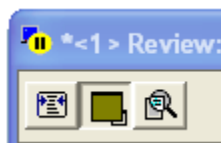
To manipulate video windows:

- 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

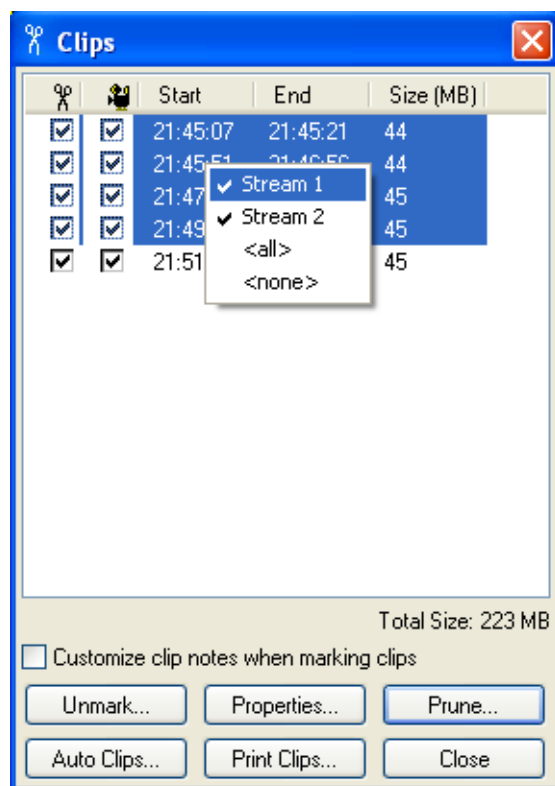
Opening video during review of a study recorded with dual-stream video will display two video windows tagged with <1> and <2>.



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

19.6. 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.

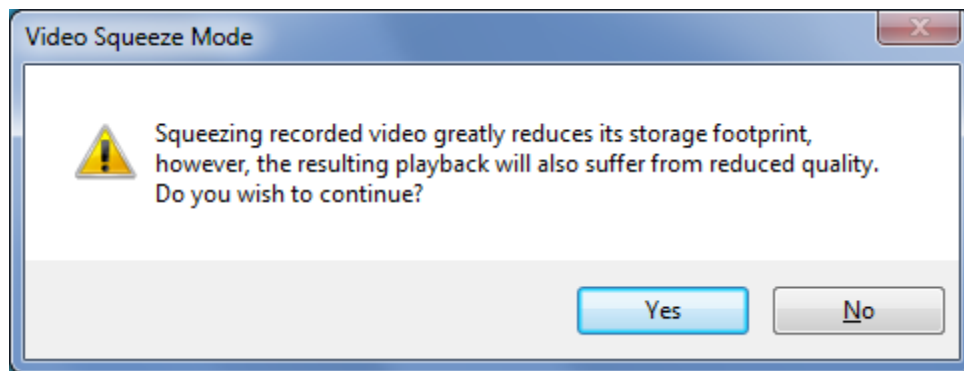
Temporal accuracy: Higher temporal accuracy enables you to see large scale movements (such as limb movements or facial changes) but the image will be fuzzy or blocky.

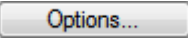
Spatial accuracy: Higher spatial accuracy enables you to see subtle image detail (facial expression and overall body position) but the number of video frames displayed per second is reduced.

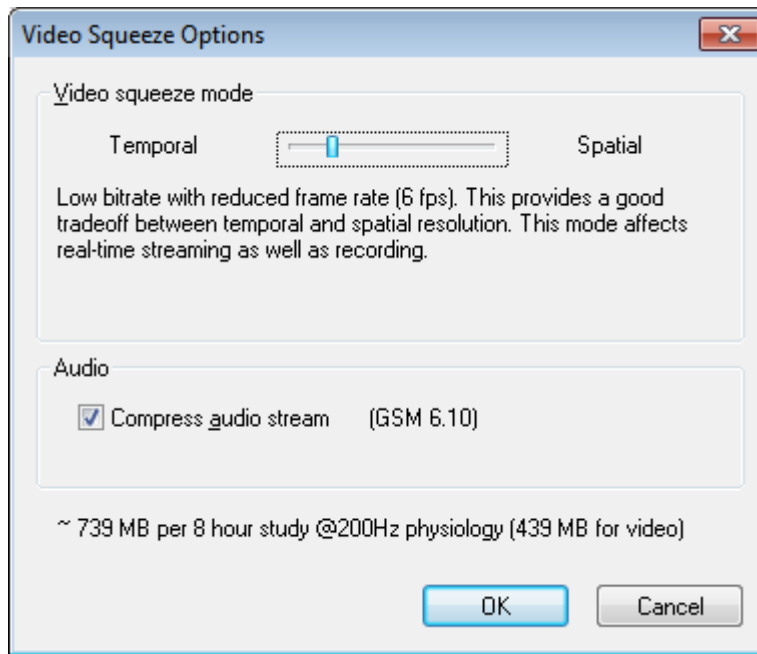
TIP: You can also squeeze video when you are reviewing a study. For information, see [Editing Review Settings](#) and [Processing Clips in the Clips Box](#).

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  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**.

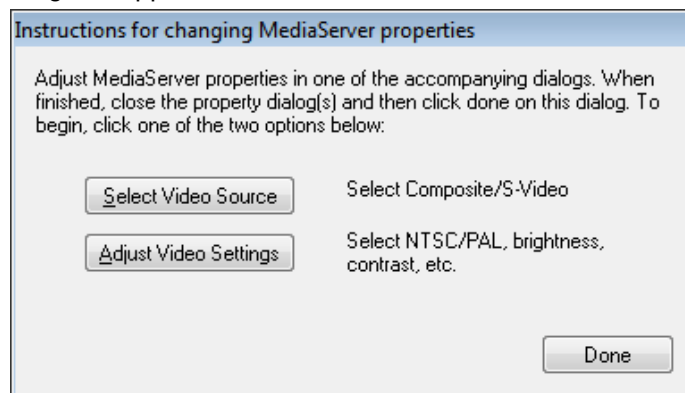
19.7. Configuring the Video Source

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.

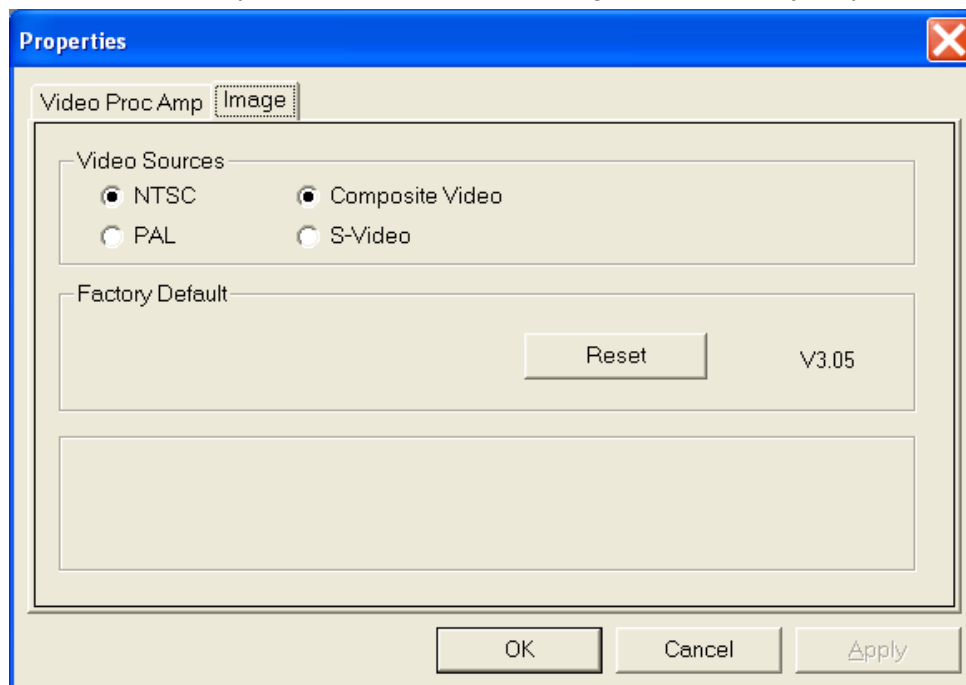
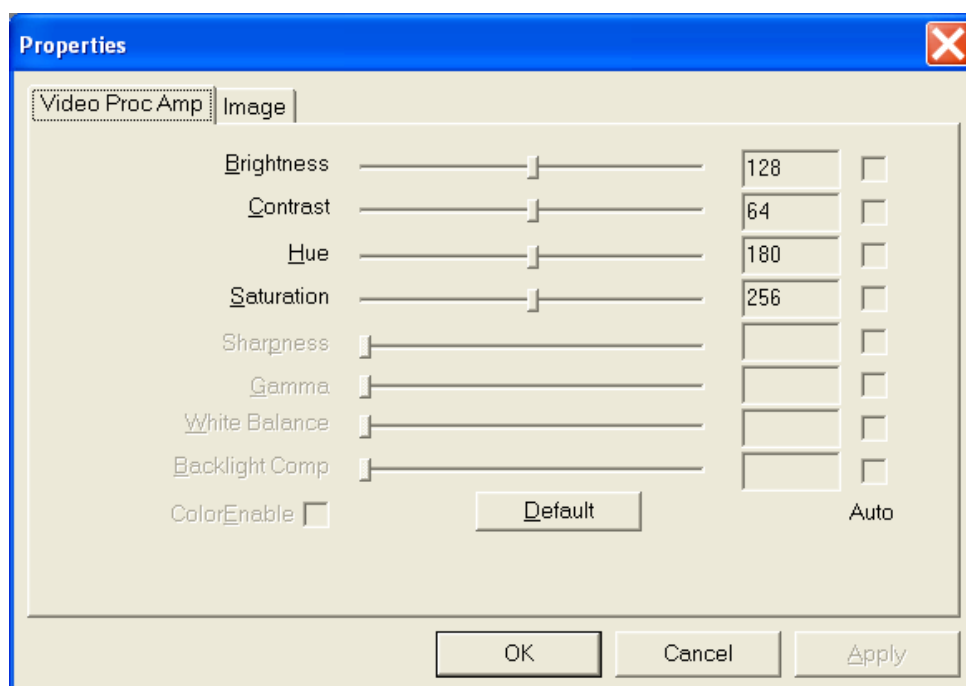


Image Tab



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.
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.

19.8. Two Network Adaptors Conflict

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.

20. Cortical Stimulator Controls

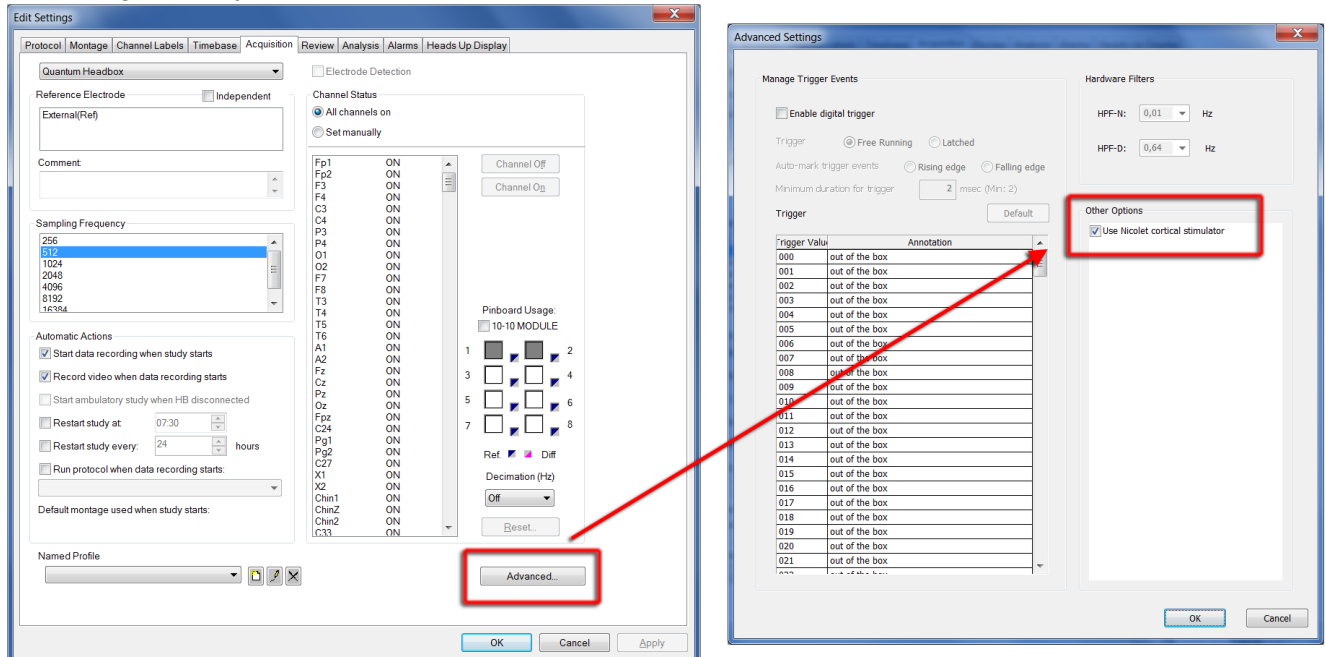


NOTE: This feature requires the Nicolet Cortical Stimulator and the Natus Quantum with the + logo.

20.1.Support of the Nicolet Cortical Stimulator

NeuroWorks 9 and higher support software control for the Nicolet Cortical Stimulator.

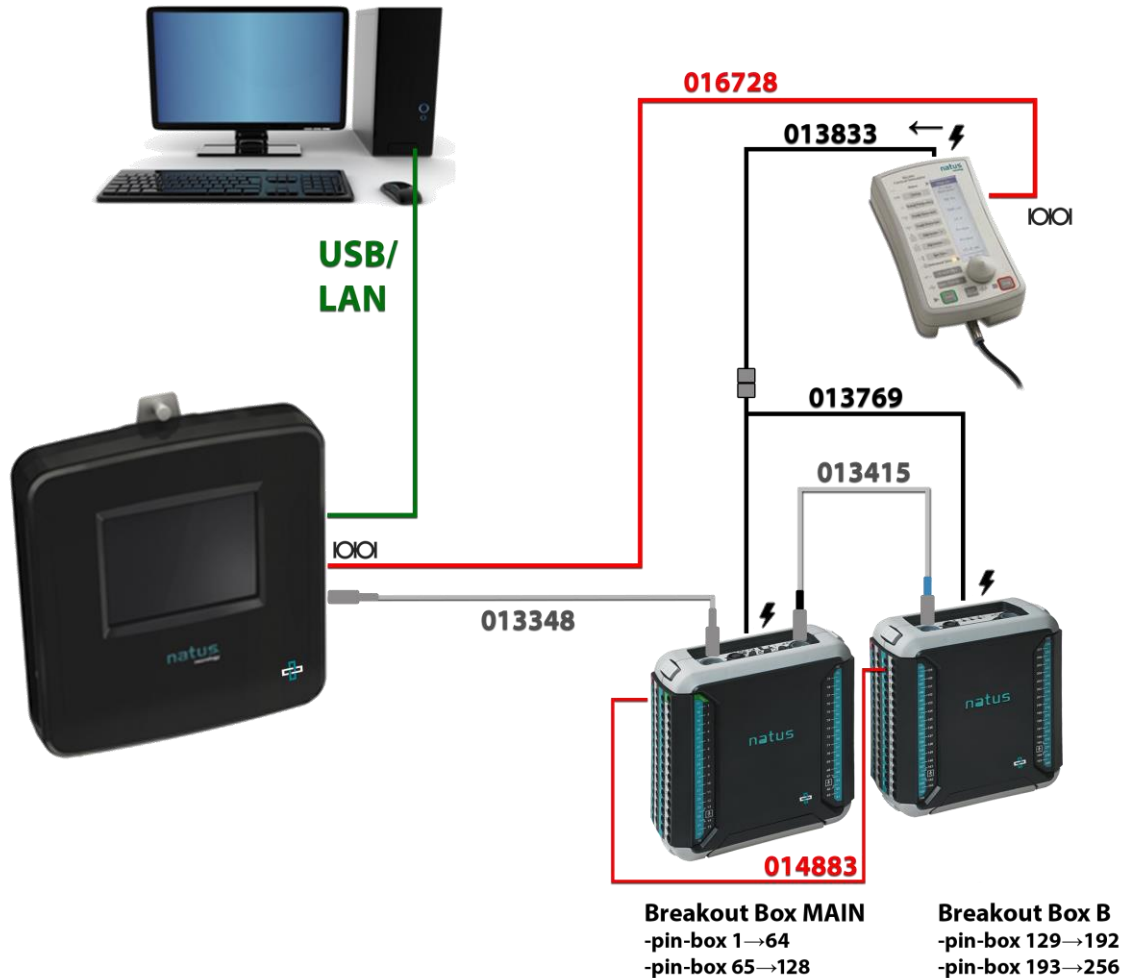
The feature for software controlled cortical stimulation needs to be activated in the acquisition profile used for starting the study.



If **Use Nicolet Cortical stimulator** is not selected, the DSM Stimulation window will only control the relays from the DSM (Digital Switch Matrix) in the Breakout(s).

20.2. System Setup

1. Connect interface cable with p/n 016728 between the connectors labeled with **IOIO** on the Natus Base and the Nicolet Cortical Stimulator. In a 128 channel setup with single Breakout box, connect the output of the Nicolet Cortical Stimulator directly to Breakout Main stimulator input (labeled with ⚡) using the 013833 stimulator input cable.
2. In a 256 channel setup with two Breakout boxes, use the cable with p/n 013833 to connect the output of the Nicolet Cortical Stimulator to the daisy chain cable with p/n 013769. Then connect this daisy chain cable to the stimulator inputs on both breakouts (labeled with ⚡).

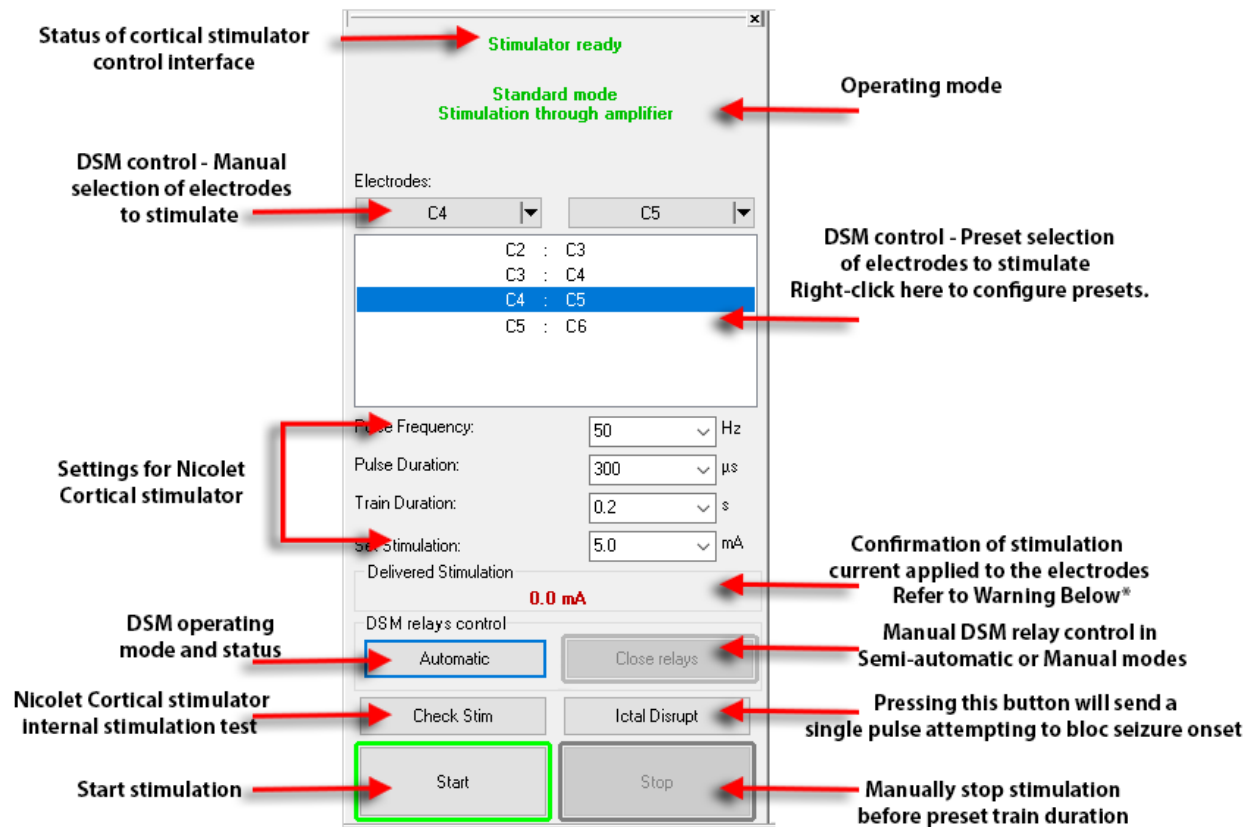


Setup for Cortical stimulation with Nicolet Cortical stimulator



Although NeuroWorks and the Natus Base allow for software control of the Nicolet Cortical Stimulator, ensure that the Nicolet Cortical Stimulator is accessible for manual operation. Manual control of the stimulator device is required to stop stimulation in case the connection between NeuroWorks and the Stimulator is interrupted.

Select **DSM stimulation** in the **Control** menu during acquisition to display the Cortical stimulation control window:



* When stimulation is initiated and stopped from the controlling software, it is possible that half the stimulation amplitude will be recorded as a result of the timing of opening Switch Matrix Relays while the stimulator is still sending stimulus and measuring delivered output.

20.3.Starting a Stimulation

To start a stimulation:

1. Select the electrodes either using the drop down lists or using the presets. For bipolar stimulation, select a pair of active electrodes. For monopolar stimulation, select one active electrode and GND.
2. Select the **Pulse Frequency**, **Pulse Duration**, and **Train Duration**.



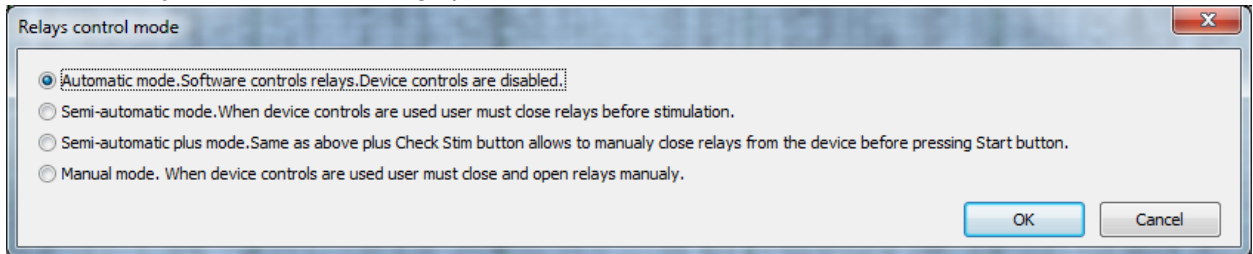
Manual entry of Stimulation parameters is not available. Parameters must be selected from the dropdown menu.

3. Select the **stimulation** current.



NOTE: The stimulation current is automatically reset to 0mA when any of the other stimulation parameters are changed.

4. Set the desired Relay Control mode by clicking on the **Automatic** button.
The Relays control mode dialog opens.



Recommended workflow: In cases where it is desired to **Start** and **Stop** the stimulation directly from the Cortical Stimulator device, do the following:

1. Select **Semi-automatic** mode from the Relays control mode dialog, and click **OK**.
2. Select **electrode pairs** for stimulation.
3. Set the **stimulation parameters** as desired.
4. Click the **Close Relays** button.
5. Use **Start** and as needed **Stop** on the stimulator device.

In this mode stimulation parameters can be adjusted on the cortical stimulator itself, parameters will be sent to the study when used.

5. Select the radio button next to the desired mode: **Automatic**, **Semi-automatic**, **Semi-automatic plus**, or **Manual**, and click **OK** to close the dialog.
6. Press **START**.

NeuroWorks will connect the selected electrodes to the stimulator, apply stimulation, and reconnect the electrodes to the amplifier immediately after stimulation. NeuroWorks also applies the De-Block feature to recover quickly from saturation after stimulation.

Mode	Use case	Operating mode
Automatic mode	Used in case of full Cortical stimulation procedure from NeuroWorks software, not from Nicolet Cortical stimulator device	- DSM relays are automatically closed prior to starting stimulation and opened after stimulation end. - In this mode, buttons on stimulator are deactivated to prevent from starting/stopping stimulation from the device. This is due to the fact that when pressing the “Start” button on the stimulator, the relays in Quantum would close slightly too late with potential missed stimulation pulses.
Semi-Automatic mode	User can still operate in full automatic relay control mode from the software. Or ... User can start stimulation from the Nicolet Cortical stimulator device but Used if closing DSM relays is done from NeuroWorks software before stimulation.	DSM relays are opened automatically from NeuroWorks software after stimulation end
Semi-Automatic plus mode	Similar to Semi-Automatic mode, but possibility to close relays remotely from the stimulator by pressing “Check Stim” button prior to starting stimulation	
Manual mode	In this mode DSM control and are controlled independently	- DSM is controlled from software - Stimulation is controlled from software or device



If for any reason the communication between the Natus Base and the stimulator is interrupted during stimulation, NeuroWorks will immediately open relays in DSM which will interrupt the stimulation applied to the patient. A message in NeuroWorks will instruct the user to stop stimulation immediately on the stimulator.



When Nicolet Cortical Stimulation is initiated from NeuroWorks software, the manual **Stop** button on the Stimulator unit is disabled. To stop the stimulation use one of the following three methods:

- Using **Stop** in NeuroWorks software
- Pressing **Esc** key on the keyboard
- Pressing first the **Start** and then the **Stop** buttons on a Nicolet Cortical Stimulator

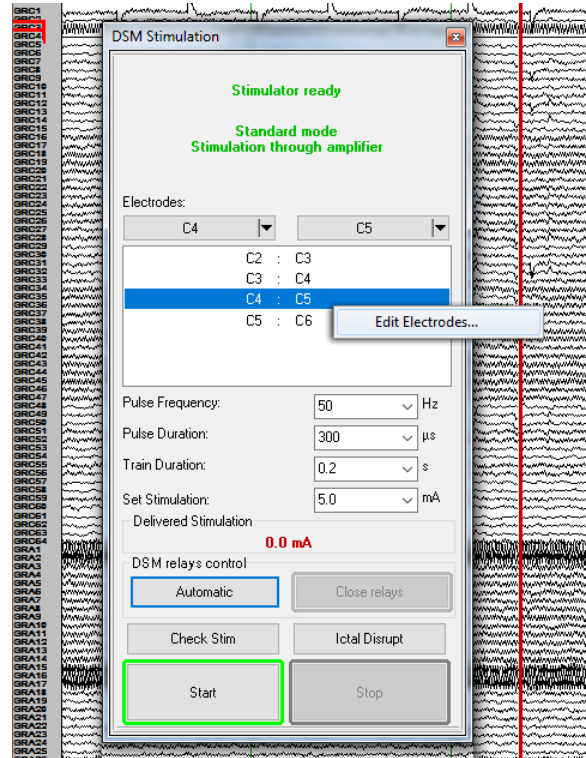


To quickly stop stimulation in an emergency, push the power button on the stimulator unit.

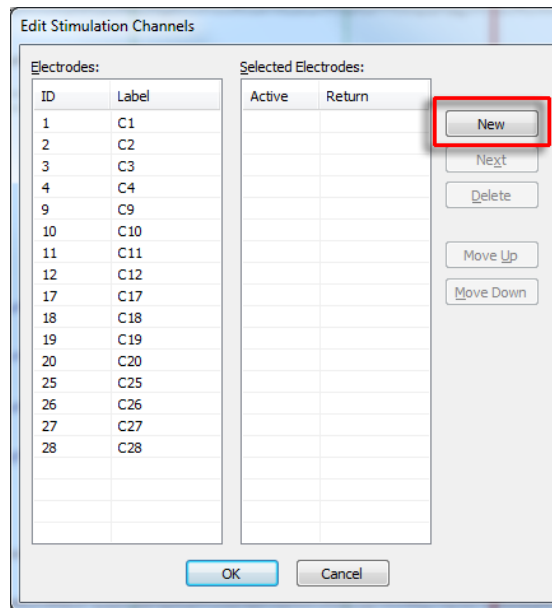
20.4. Creating & Editing Preset Electrodes for Stimulation

To Create/Edit a Protocol of preset electrodes for Stimulation:

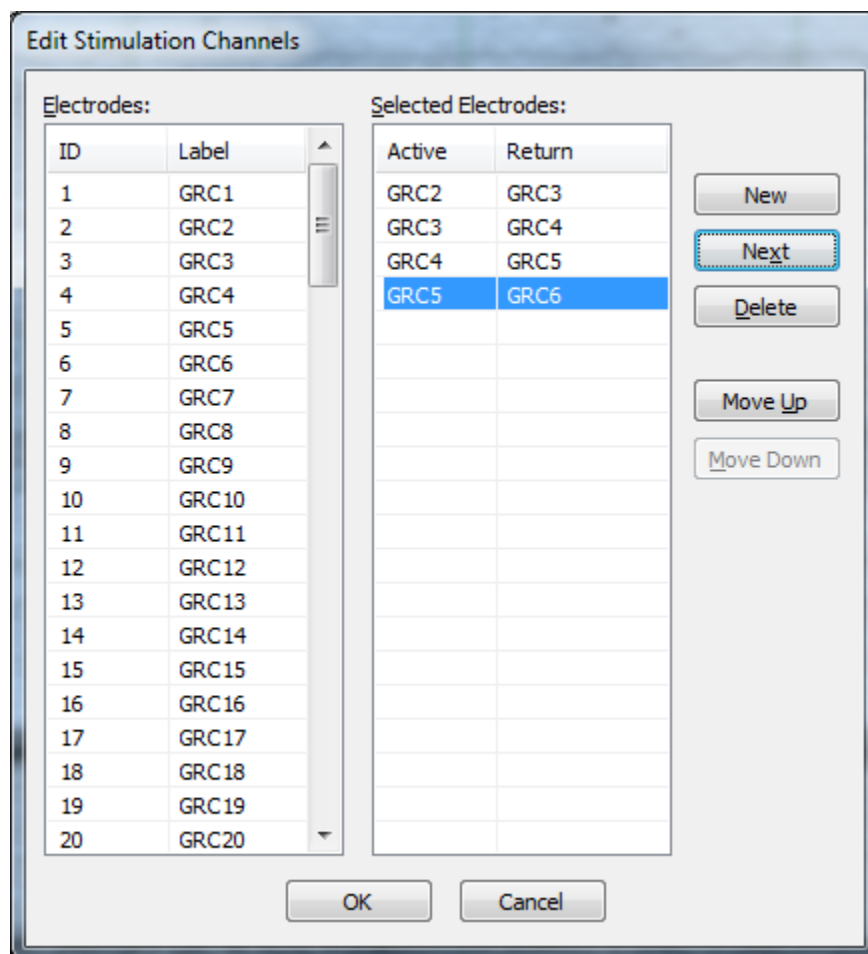
1. Right-click the Cortical stimulation panel, and select **Edit Electrodes**.



2. In the Edit Stimulation Channels, select the **New** button.

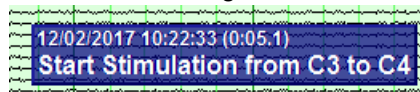


- Double-click two electrodes in the **Electrodes** list to populate the **Active** and **Return** Electrodes for stimulation. Clicking on **Next** will automatically add the next electrodes.

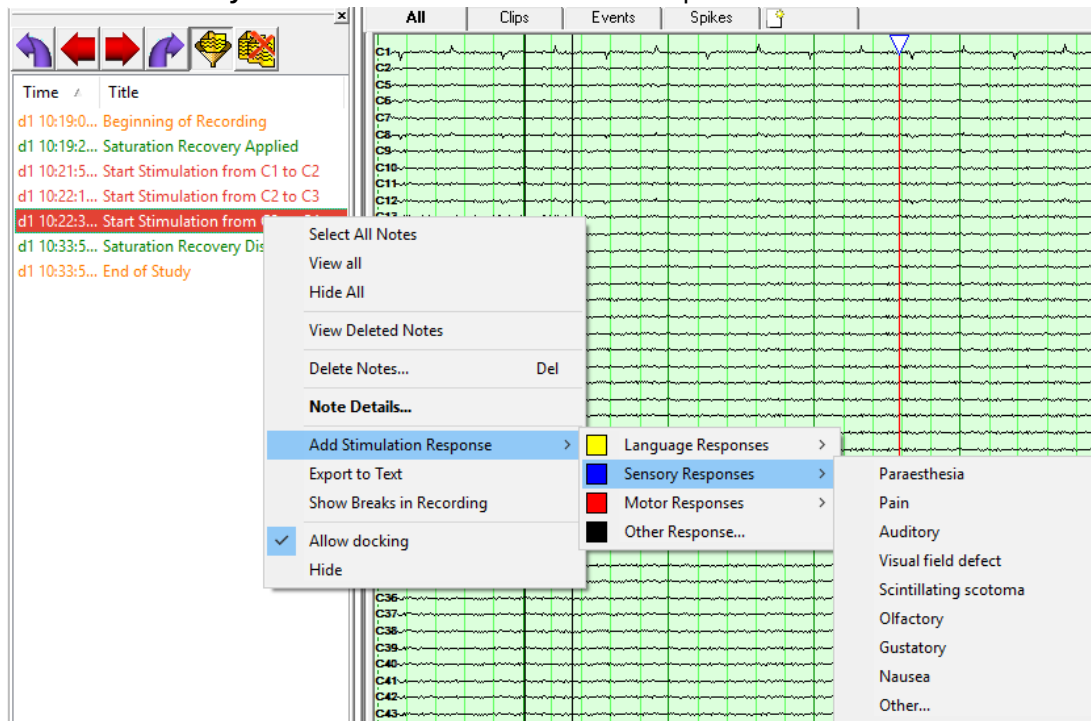


- Select **OK** once the presets are defined.

Stimulation events are automatically annotated in the study. The stimulation annotation includes the stimulated electrodes as well as the stimulation settings.



Right-click the relevant stimulation event in the **Annotation Viewer** of the **Live recording** window or in the **Review current study** window to annotate a stimulation response.



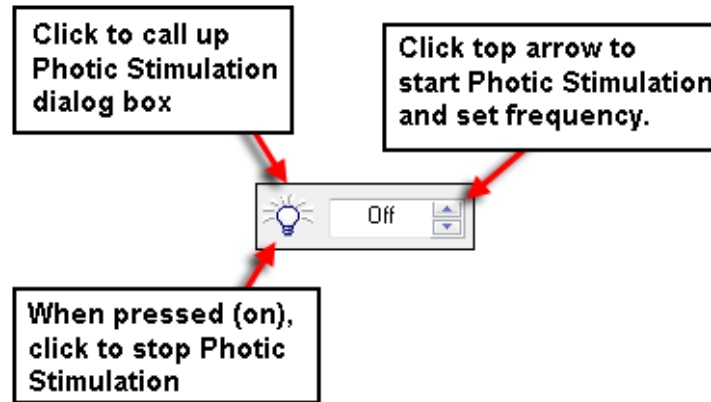
The resulting response is added to the current window.



21. Photostimulation using NeuroWorks

21.1. Photic Stimulator Controls

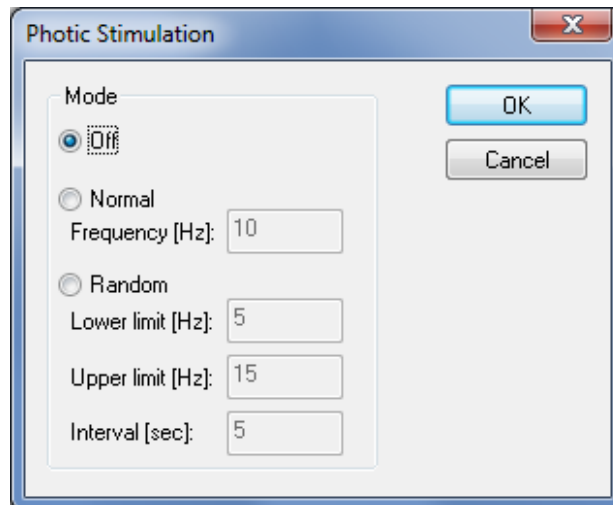
Photic stimulation controls are available in the **Workflow** toolbar.



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 between 0.5 and 60 Hz 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

21.2. 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 pre-set 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.

21.3. 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:

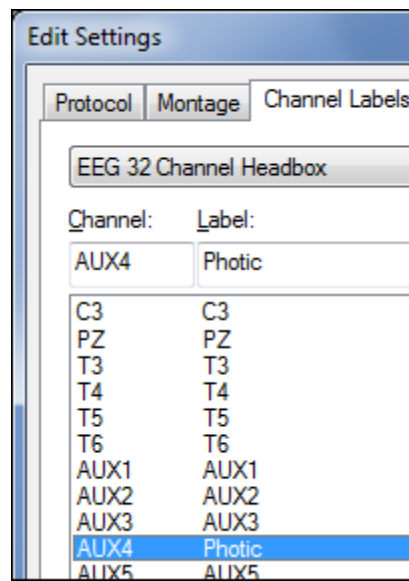
1. To add a new channel to the bottom of the montage table, click **Append**.
2. To insert a new channel after a selected channel, select a cell and click **Insert**.
3. To designate an input for the channel, right-click the cell in the Input 1 column and select one of the **AUX** inputs (for example: AUX4 or DC1).
4. Leave **Input2** empty. (The designated photic sensor input automatically references to ground.)
5. Right-click the cell in the **Gain** column and select 100 μ V/mm.



NOTE: 100 μ V/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

Apply Custom Labels

5. Click **OK**.

22. Natus Database

22.1. 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:

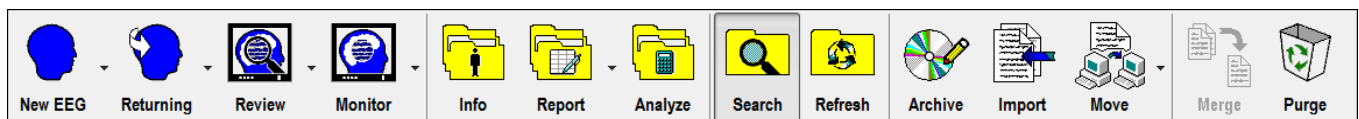
- A combined list of all the studies is maintained and kept in sync so that all stations share the same view of the database. There is no need to switch databases, or aliases, to see studies stored in multiple locations. The system maintains a home storage resource link for each study and accesses it 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**.

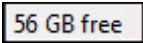
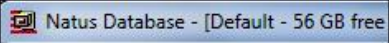


Red Status Bar Information after Search

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.

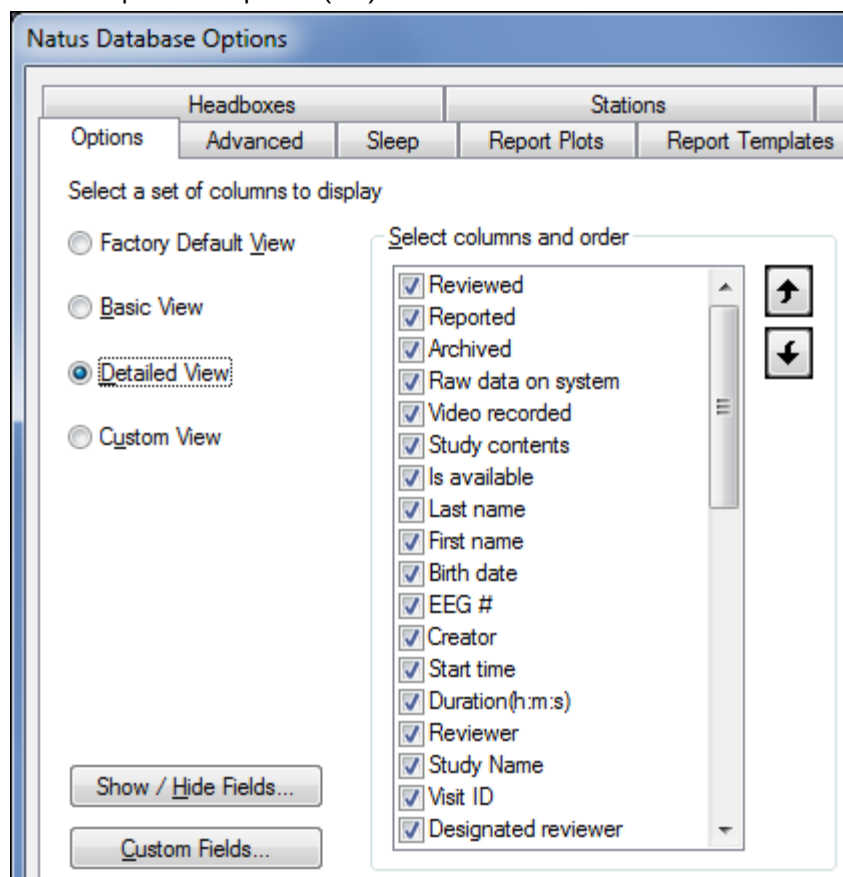


NOTE: The leftmost indicator in the **Status bar** , as well as the one in the **Title bar** , displays the amount of free space available on local storage.

22.2. 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).

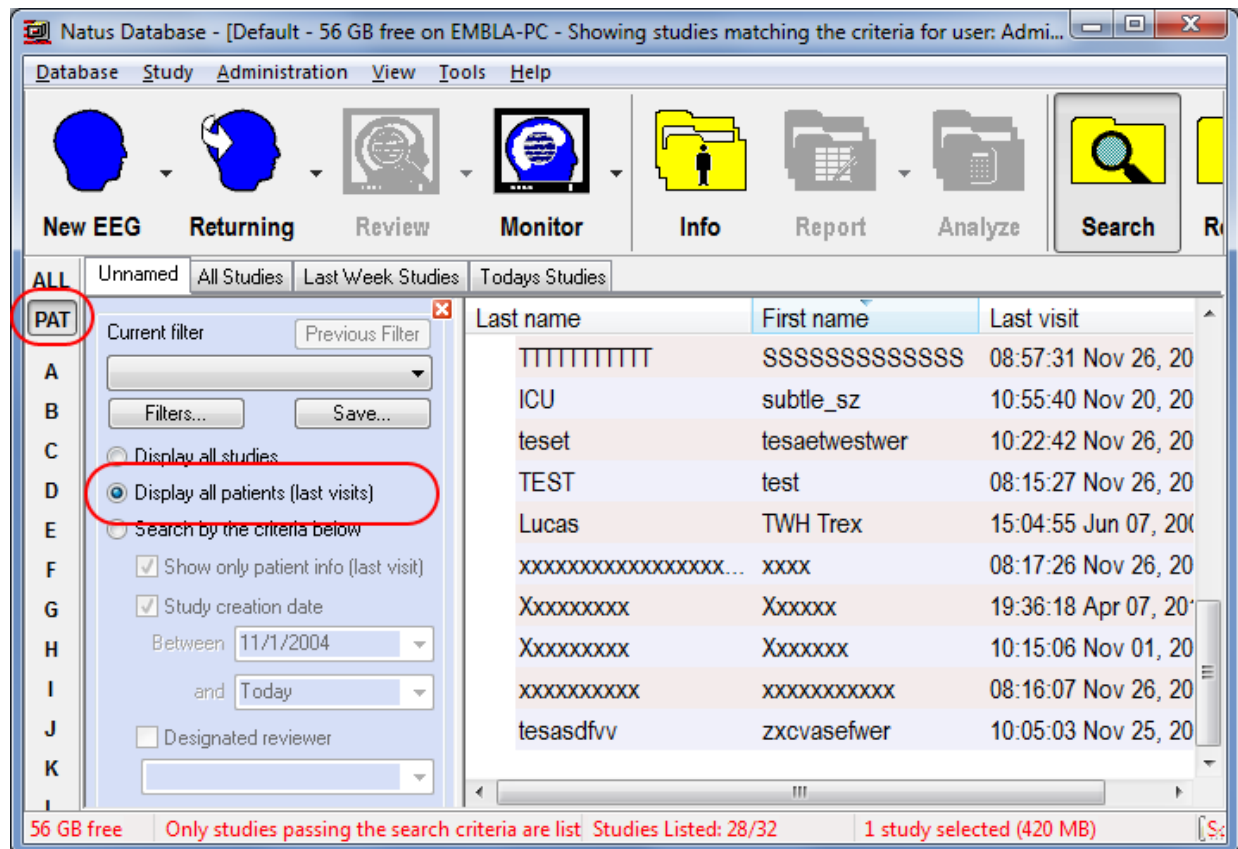
Moving and Resizing Database Elements

To...	Do This...
Change the width of the column	Click and drag any dividing line to the right or left.
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**”.



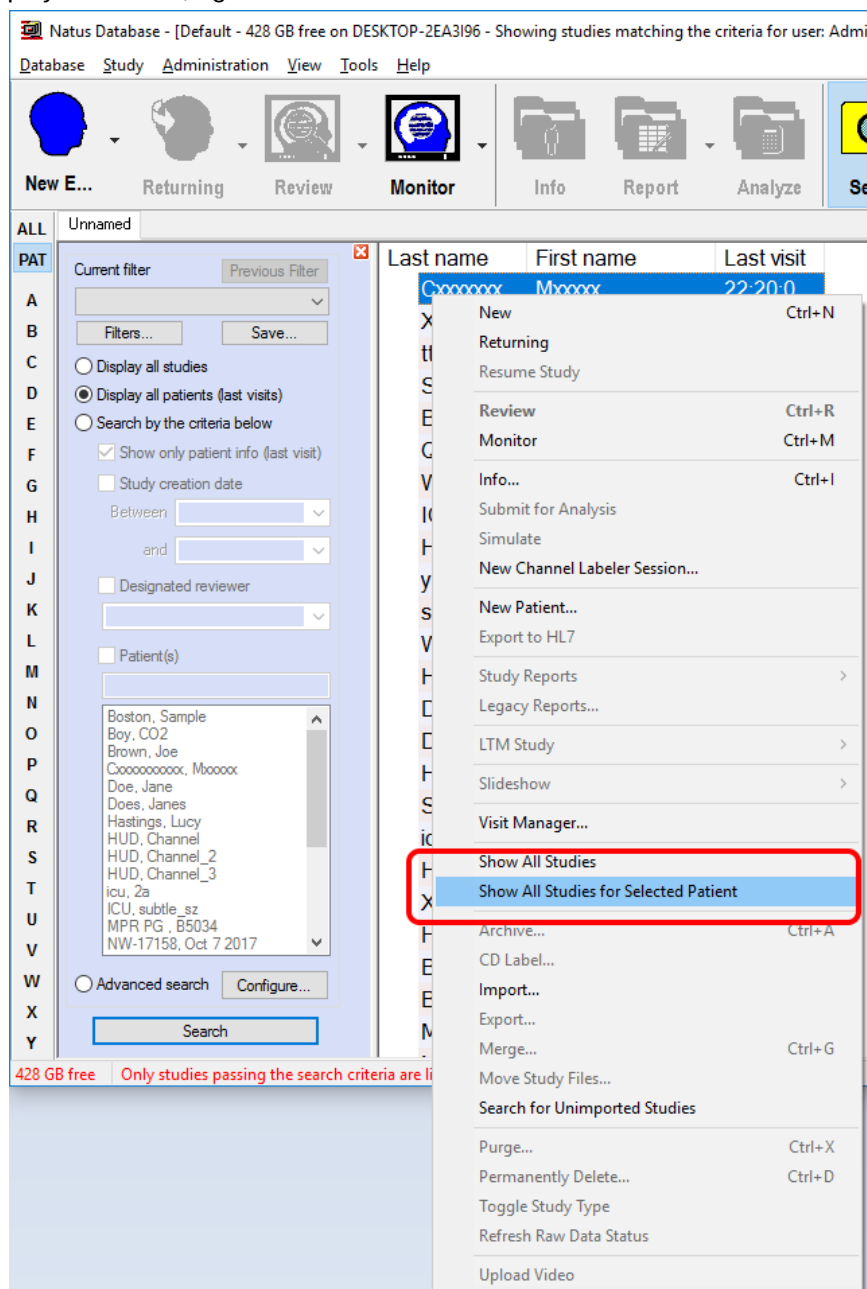
Patient View in Natus Database

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.

Natus Database - [Default - 56 GB free on EMBLA-PC - Showing studies matching the criteria for user: Administrator]

Database Study Administration View Tools Help

New EEG Returning Review Monitor Info Report Analyze Search Refresh Archive Import Move Merge Purge

ALL Unnamed All Studies Last Week Studies Todays Studies

PAT Current filter Previous Filter

A Filters... Save...

B

C ☐ Display all studies

D ☐ Display all patients (last visits)

E ☒ Search by the criteria below

F ☐ Show only patient info (last visit)

G ☐ Study creation date

H Between 11/1/2004

I and Today

J ☐ Designated reviewer

K

L ☒ Patient(s)

M Doe,Jane

N Doe, Jane

O Doe, John

P FENLON, James

Q Holmes, Sherlock

R ICU, 2a

S ICU, subtle_sz

T Ischemia, Cea

U Jungle, George

V Lindner, Peter

W Lucas, TWH Trex

X MISTRY D4, 05060D4

Y Smith, John

Suppression, Burst

tesasdv, zxcvaselwer

☐ Advanced search Configure...

Search

Only studies for the selected patient now appear.

Search Companion Automatically opens

Status Bar changes to red as a reminder that only selected studies appear.

56 GB free Only studies passing the search criteria are list Studies Listed: 2/32 Sorted by ' Synchronization completed at 13:15 Sync

All Studies Displayed for Single Patient

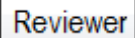
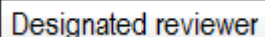
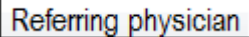
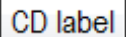
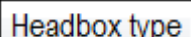
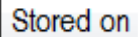
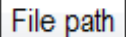
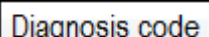
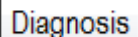
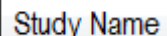
22.3.Column Headings

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.														
	A slideshow symbol in this column indicates this study is a part of a current slideshow. By default, this column is not visible.														
📄	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. <table><tr><th>Icon</th><th>Description</th></tr><tr><td>👤</td><td>Patient info has been added to database but no studies have been performed.</td></tr><tr><td>📶</td><td>Raw data has been collected</td></tr><tr><td>📶</td><td>Pruned study</td></tr><tr><td>📶</td><td>Live study</td></tr><tr><td>📶</td><td>Study has been analyzed</td></tr><tr><td>📶</td><td>Study has been analyzed with the Batch Analyzer and pruned</td></tr></table>	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
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														

Icon	Description									
		Study is a part of an LTM Study Set. A Long Term Monitoring (LTM) Study Set is a collection of EEG or Sleep Studies.								
		On-going study is a part of an active Study Set, and is actively recording a study.								
	?	Contains data from a legacy version of the NeuroWorks software.								
	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>		Icon	Description		Study is stored on the local database (the computer you are using). Your local machine is always available.		Study is stored on a remote computer (or server) and remote location is available.		Study is stored on a remote computer (or server) and remote location is unavailable (network down; problems with database authentication, file permissions, etc.)
Icon	Description									
	Study is stored on the local database (the computer you are using). Your local machine is always available.									
	Study is stored on a remote computer (or server) and remote location is available.									
	Study is stored on a remote computer (or server) and remote location is unavailable (network down; problems with database authentication, file permissions, etc.)									
Last name	Lists the acquired studies by the patient's last name.									
First name	Lists the acquired studies by first name.									
Birth date	Lists the acquired studies by the patient's birth date in day-month-year format.									
EEG #	Shows the EEG number assigned in the Patient tab of the Study Information window. Characters other than numbers may be entered for this field.									
Creator	Shows the Local Account User Name (from Tools > Customize > Options) at the time the study was started.									
Study type	Appears only when both SleepWorks and NeuroWorks are installed on the system. Shows the study type, either EEG or SLEEP .									
Start time	Shows the date the study was started in day-month-year format: 17-Aug-04.									

Icon	Description
	Shows the duration of the study in hour-minute-second format: 1:09:05.
	For studies acquired with NeuroWorks , shows the reviewer's name. This column is not used with SleepWorks.
	Shows the name of the Designated Reviewer that is assigned in Advanced Options of the Patient tab in the Study Information window.
	Shows the name of the Referring Physician that is assigned in Advanced Options of the Patient tab in the Study Information window.
	Shows the CD ID number automatically generated by Natus Database which can be used to locate the CD.
	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.
	Shows the type of headbox used for the study.
	Shows which machine on network study is stored on.
	Shows the last name, first name_filepath designation associated with the study.
	Shows the ICDS (International Classification of Sleep Disorders) Code associated with the diagnosis (SleepWorks only).
	Shows the diagnosis associated with the study (SleepWorks only).
	Displays name given to study initially in Study Information box.

22.4. 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:

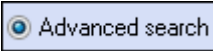


1. Click the **Search** button on the toolbar.
2. Enter your search or filter criteria and click **Search**.

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.

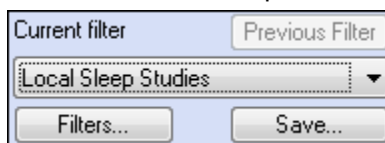


NOTE: When not all studies are shown, the status bar at the bottom of the screen turns red and presents a count of selected and all studies.

56 GB free | Only studies passing the search criteria are list: Studies Listed: 25/32 | Sorted by: Synchronization completed at 12:55 | Sync

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.

The screenshot shows the Natus Database application window. The top toolbar includes buttons for New EEG, Returning, Review, Monitor, Info, Report, Analyze, Search, Refresh, Archive, and Import. The Search bar is active, showing 'Local Sleep Studies' as the current filter. The Database window displays a list of studies with columns for Patient (PAT), Last name, First name, and Start time. The filter tabs at the bottom of the Database window include: ALL, All, Scored Studies, Last Week Studies, Pediatric Studies, Research Studies, Sleep Studies, Todays Studies, Dr Smith Studies, and Unscored Studies. The 'Research Studies' tab is currently selected.

PAT	Last name	First name	Start time
A	Jungle	George	07:38:39 N
B	Doe	James	
C	Doe	Jane	09:31:31 N
D	Doe	Jane	12:55:34 N
E	Brown	Joe	08:46:23 N

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

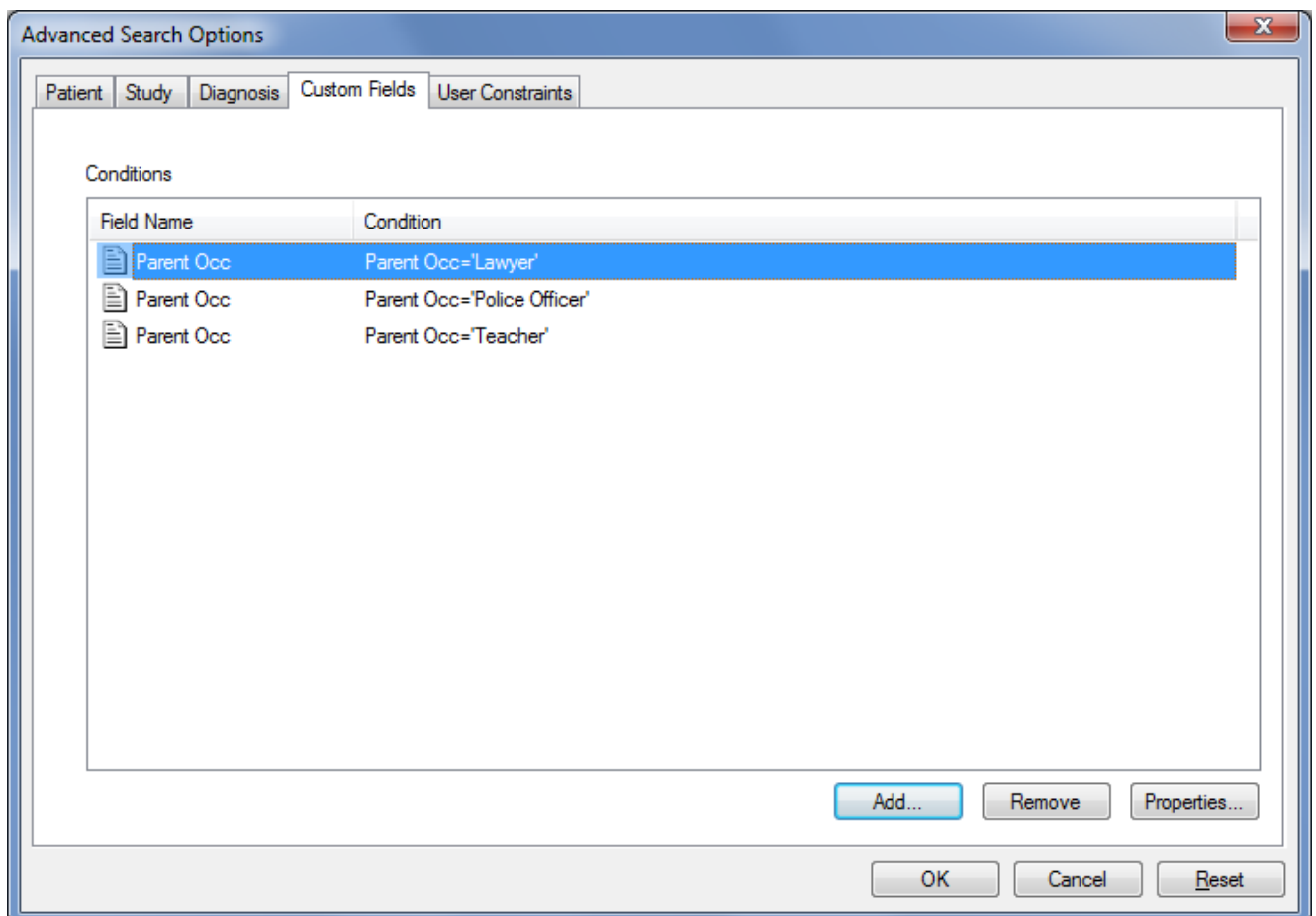
To filter studies based on custom fields you have added:



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.

22.4.1.1. 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.

22.4.1.2. The AND Operation

- Adding different fields will perform the logical **AND operation** between the criteria.

Field Name	Condition
Admitted	DateValue>='11/26/2014 09:00:19' and DateValue<='11/26/2014 21:22:19'
Parent Occ	Parent Occ='Teacher'
Parent Occ	Parent Occ='Police Officer'
Parent Occ	Parent Occ='Lawyer'

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

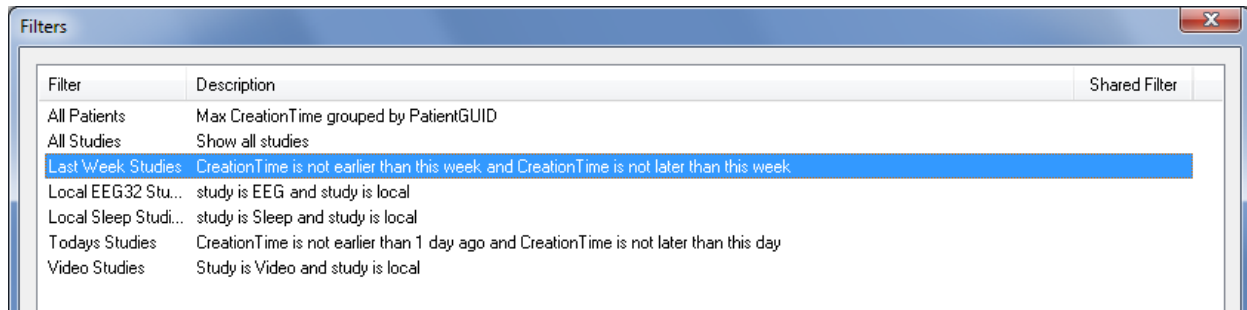
There are often too many studies in the database for you to easily find a given study or perform operations on a group of studies. To allow easier operation, the Search Companion allows custom filters to be created and assigned friendly names and saved for quick access.

Current filter: Todays Studies
Previous Filter
Filters... Save...

Filters Selector in Search Companion

Note the following:

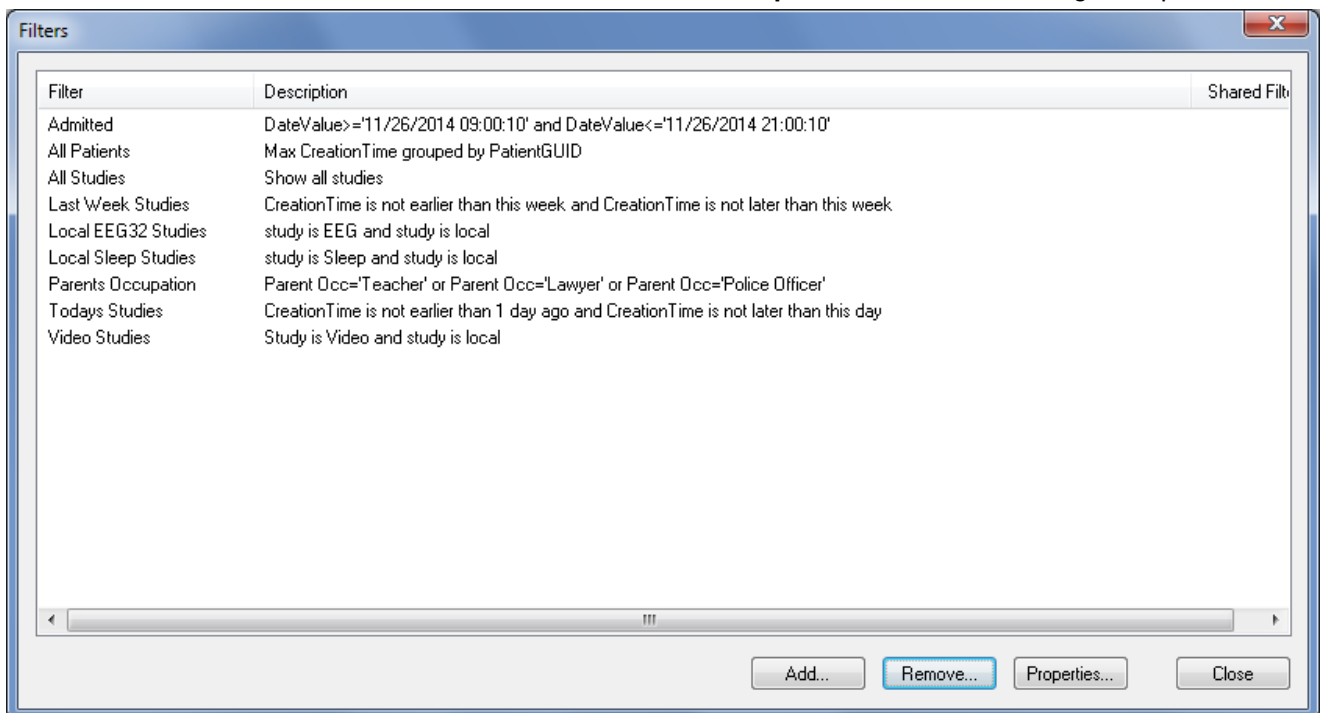
- You create a search filter as usual, and then click the **Save** button. In the dialog box, enter a name and click **OK** to save the filter.
- Use the **Filters** button to see all of the saved filters. You can also Add, Remove, Rename and/or change the search criteria (Properties) for any of the existing filters through the **Filters** dialog.



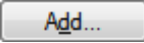
Filters Dialog showing Saved Filters

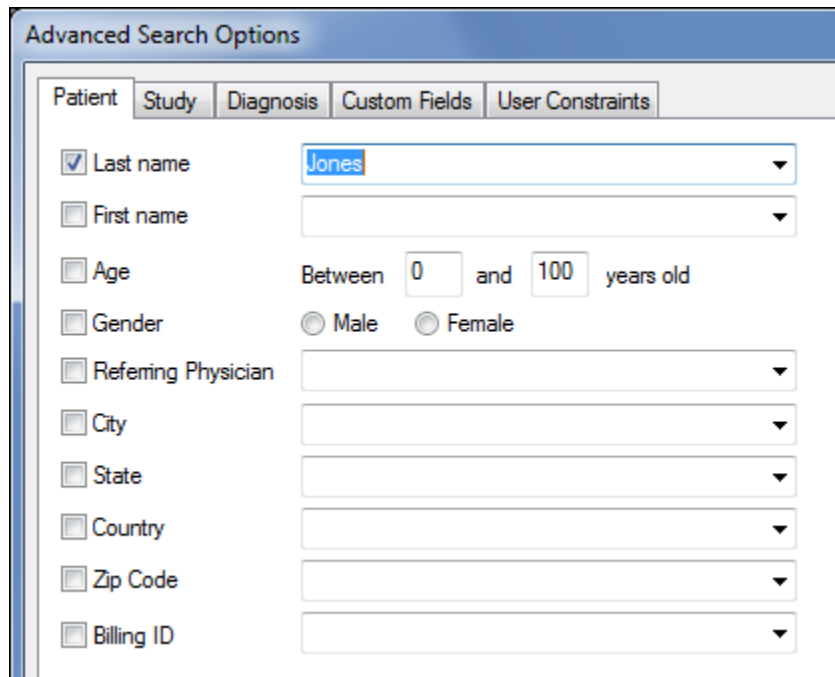
To create a search filter based on last name:

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**.



The 'Advanced Search Options' dialog box has a 'Patient' tab selected. It contains several search criteria with checkboxes and input fields:

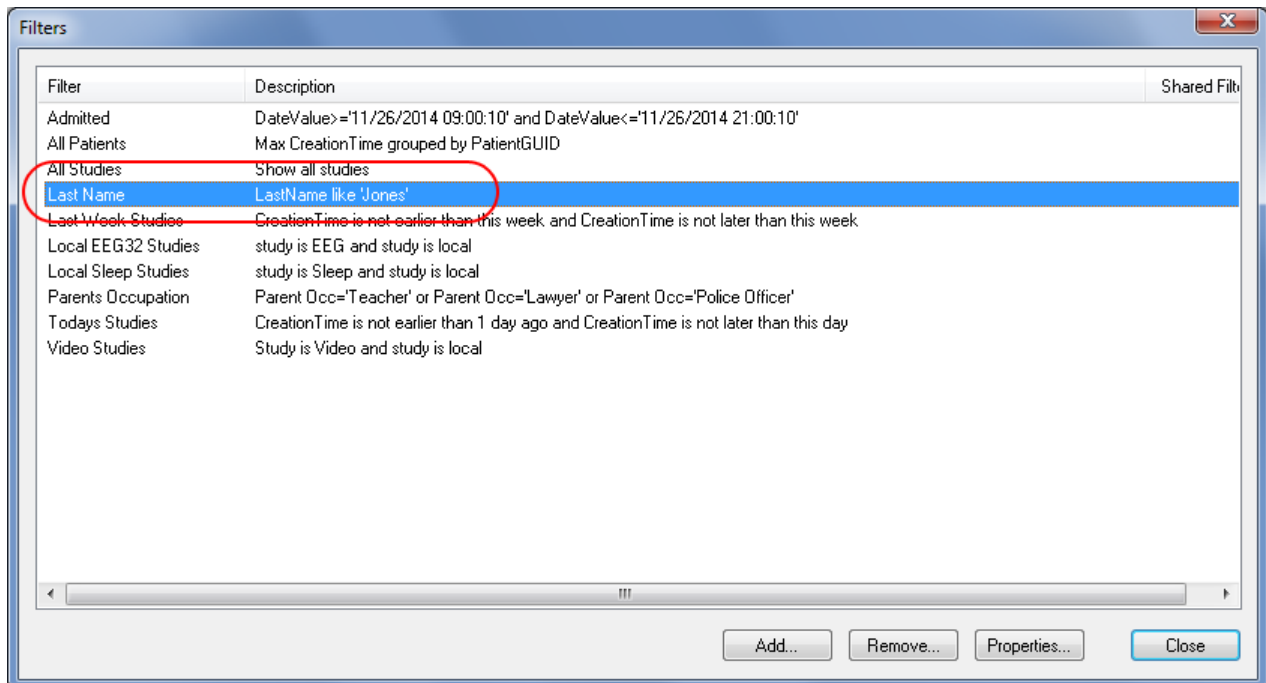
- ☒ Last name: Jones
- ☐ First name:
- ☐ Age: Between 0 and 100 years old
- ☐ Gender: ☐ Male ☐ Female
- ☐ Referring Physician:
- ☐ City:
- ☐ State:
- ☐ Country:
- ☐ Zip Code:
- ☐ Billing ID:

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**.

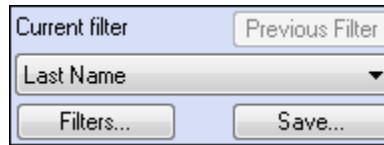


The 'Filters' dialog box shows a list of filters. The 'Last Name' filter is highlighted with a red circle. The list includes:

Filter	Description	Shared Filter
Admitted	DateValue>='11/26/2014 09:00:10' and DateValue<='11/26/2014 21:00:10'	
All Patients	Max CreationTime grouped by PatientGUID	
All Studies	Show all studies	
Last Name	LastName like 'Jones'	
Last Week Studies	CreationTime is not earlier than this week and CreationTime is not later than this week	
Local EEG32 Studies	study is EEG and study is local	
Local Sleep Studies	study is Sleep and study is local	
Parents Occupation	Parent Occ='Teacher' or Parent Occ='Lawyer' or Parent Occ='Police Officer'	
Today's Studies	CreationTime is not earlier than 1 day ago and CreationTime is not later than this day	
Video Studies	Study is Video and study is local	

Buttons at the bottom: Add..., Remove..., Properties..., Close

6. Your new filter is now selected as the Current filter in the Search Companion. To save it, click the **Save**  button.



Last Name as Current Filter

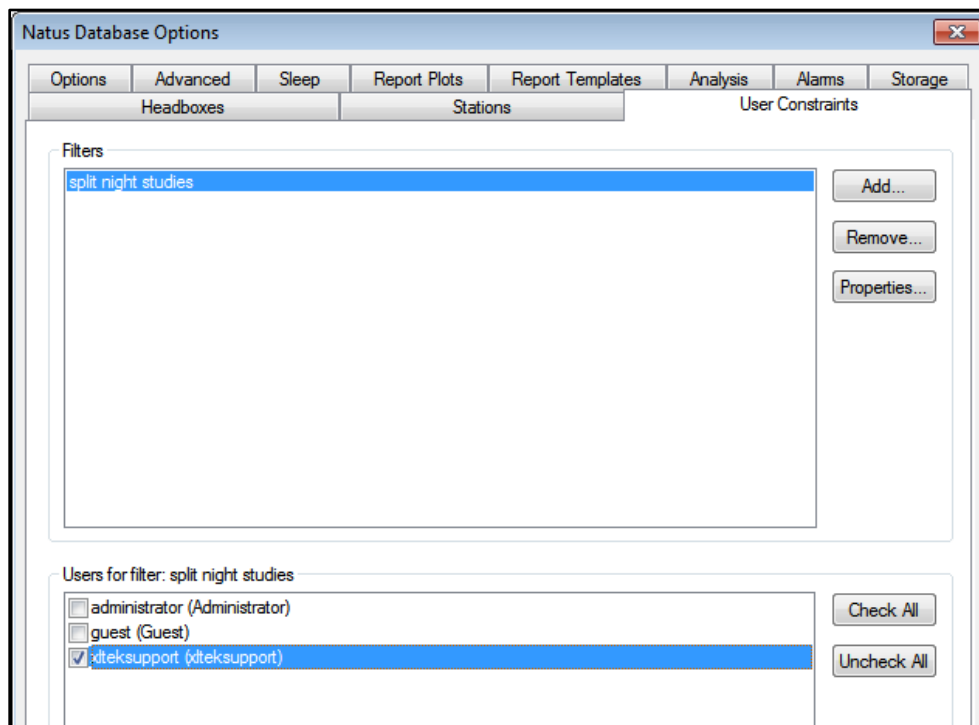
Filtering Studies Based on Logged In User

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



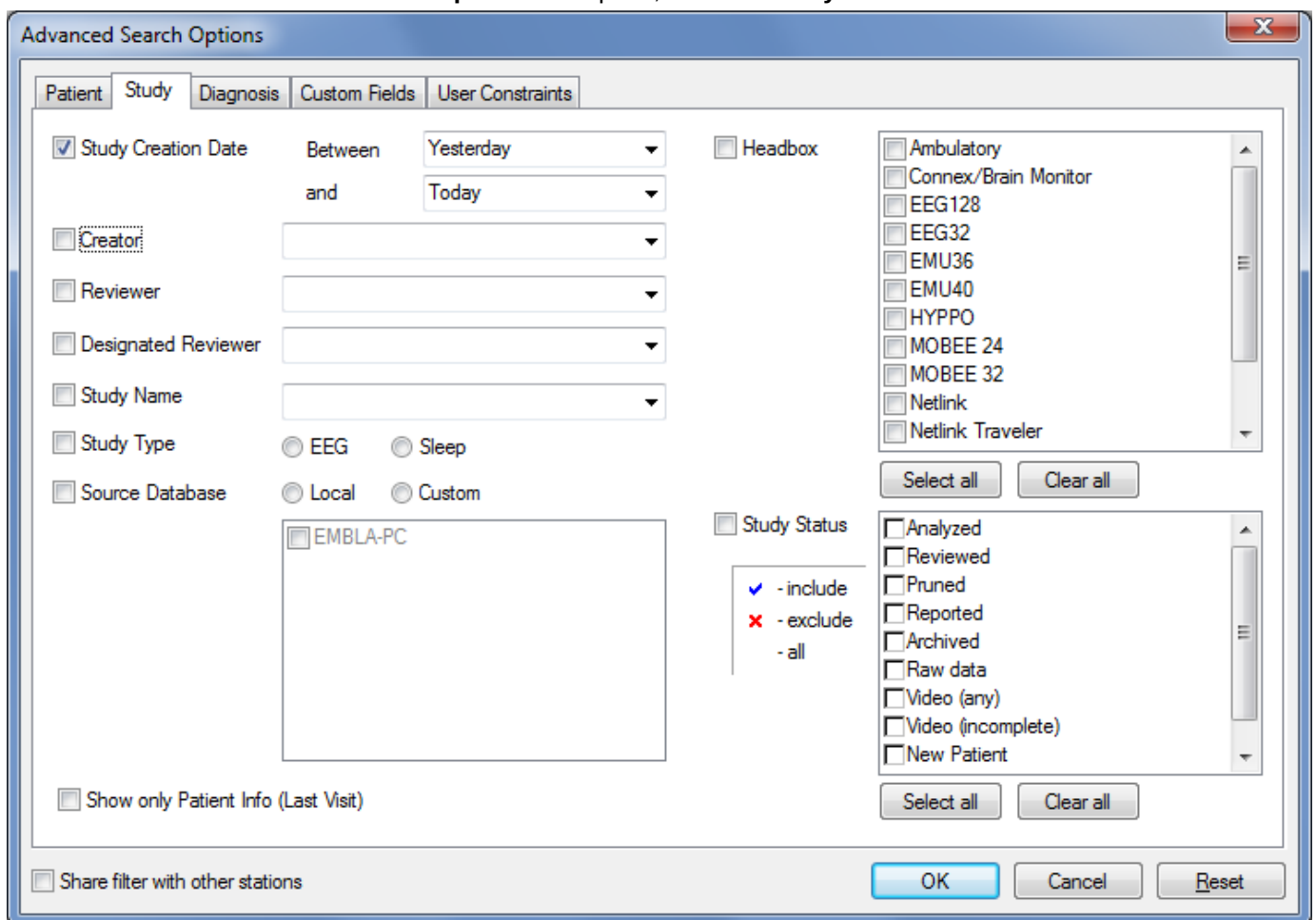
NOTE: More than one user can use the same filter. This is especially useful with the filters that use **<Current User>** tag in place of the actual user name in such fields as Creator, Reviewer or Designated Reviewer. It allows creation of a single filter that acts as a *personal studies* filter for 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**  button).
3. When the **Advanced Search Options** box opens, click the **Study** tab.



The screenshot shows the 'Advanced Search Options' dialog box with the 'Study' tab selected. The dialog has several sections for configuring search criteria:

- Study Creation Date:** A checkbox is checked. The range is set to 'Between' 'Yesterday' and 'Today'.
- User Constraints:** A list of checkboxes for user roles: Creator, Reviewer, Designated Reviewer, and Study Name. The 'Designated Reviewer' checkbox is highlighted.
- Study Type:** Radio buttons for EEG, Sleep, and Source Database (Local, Custom).
- Headbox:** A list of checkboxes for study types: Ambulatory, Connex/Brain Monitor, EEG128, EEG32, EMU36, EMU40, HYPPO, MOBEE 24, MOBEE 32, Netlink, and Netlink Traveler. 'Select all' and 'Clear all' buttons are present.
- Study Status:** A list of checkboxes for study status: Analyzed, Reviewed, Pruned, Reported, Archived, Raw data, Video (any), Video (incomplete), and New Patient. 'Select all' and 'Clear all' buttons are present.
- Study Status Legend:** A legend showing a blue checkmark for '- include', a red X for '- exclude', and a grey square for '- all'.
- Other options:** 'Show only Patient Info (Last Visit)' and 'Share filter with other stations' checkboxes.
- Buttons:** 'OK', 'Cancel', and 'Reset' buttons at the bottom right.

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**.



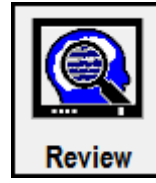
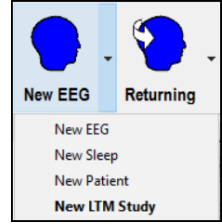
NOTE: You can filter on the Creator, Reviewer and Referring Physician fields in exactly the same way as the Designated Reviewer field.

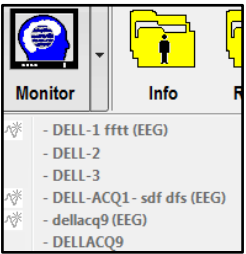
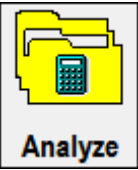
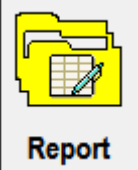
22.5.Toolbars

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.

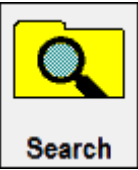
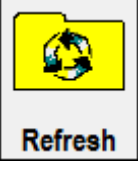
- Patient Related Buttons
- Database Related Buttons
- Administration Related Buttons
- Database Column Heading Buttons

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. • Select New LTM Study to open a new long term monitoring study in NeuroWorks.

 Monitor - DELL-1 fftt (EEG) - DELL-2 - DELL-3 - DELL-ACQ1- sdf dfs (EEG) - dellacq9 (EEG) - DELLACQ9	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.
 Info	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.
 Analyze	Use the Analyze button to submit selected studies for batch analysis.
 Report	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 <i>Microsoft Word</i> 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 <i>Microsoft Word</i> document, the Sleep Report loads automatically.

Database Related Buttons

 Search	Click the Search toolbar button to search the database for patients.
 Refresh	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

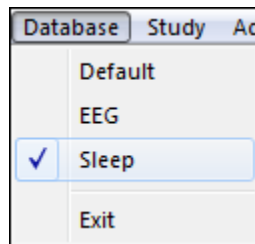
 Archive	Click the Archive button to store data on a CD or other electronic media. Once saved to a CD, study information can be purged from the hard drive and reviewed remotely or copied back into the database if needed.	
 Import	Use the Import button to import studies from either a database or a local file location.	
 Move	Use the Move button to move studies between databases that are inside the distributed virtual database.	
 Merge	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.	
 Purge	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.

22.6.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.

Item	Function/Description										
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, or Sleep analyzers are installed and one or more studies are selected.										
Study Reports	<table><tr><th>Item</th><th>Function/Description</th></tr><tr><td>Create Report</td><td> If an EEG study is selected, three reports are automatically generated in <i>MS Word</i>: Study Report, Technologist's Report and Physician's Report. Click the <i>MS Word</i> 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. </td></tr><tr><td>Edit Report</td><td>If a Sleep report exists, choosing this option opens the report in <i>MS Word</i> for editing. This option is not available for EEG studies.</td></tr><tr><td>Attach Reports</td><td>Choose this option to attach a report to the study. Select the report from the dialog that opens.</td></tr><tr><td>Delete Report</td><td>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.</td></tr></table>	Item	Function/Description	Create Report	If an EEG study is selected, three reports are automatically generated in <i>MS Word</i>: Study Report, Technologist's Report and Physician's Report. Click the <i>MS Word</i> 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 <i>MS Word</i> for editing. This option is not available for EEG studies.	Attach Reports	Choose this option to attach a report to the study. Select the report from the dialog that opens.	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.
	Item	Function/Description									
	Create Report	If an EEG study is selected, three reports are automatically generated in <i>MS Word</i>: Study Report, Technologist's Report and Physician's Report. Click the <i>MS Word</i> 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 <i>MS Word</i> for editing. This option is not available for EEG studies.									
	Attach Reports	Choose this option to attach a report to the study. Select the report from the dialog that opens.									
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.										
Legacy Reports	Select this option to open or attach a legacy report.										

Item	Function/Description	
LTM Study	Item	Function/Description
	Begin (New) LTM Study	Start a new Long Term Monitoring study.
	Continue LTM Study	Continue an LTM study. Starts a new study in the study set.
	Open LTM Study	Opens the LTM study.
	Select LTM Set	Selects all the studies located in the LTM set.
	Create LTM Report	Generates a report based on the LTM set.
	Show All Studies for Selected LTM	When this option is selected, the member studies and the LTM Study Set are filtered so that they are the only visible studies, and all others are hidden. This is based on the presence of a manual filter being setup and applied.
Slideshow	Item	Function/Description
	Open Slideshow	Opens the selected slideshow.
	Add to Slideshow	Add a new study to the selected slideshow.
	Select Slideshow Set	Selects all the studies in the slideshow set.
	Create Slideshow Report	Generate a slideshow report based on the studies included in the set.
	Create Slideshow	Create a new slideshow based on the selected studies.
	Delete Slideshow	Delete the slideshow.



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.
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.

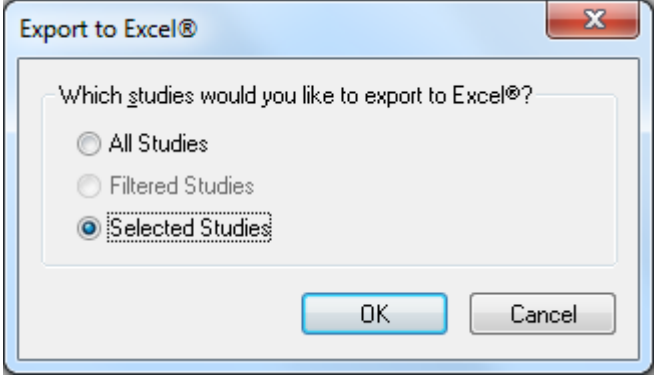
View Menu Options

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.

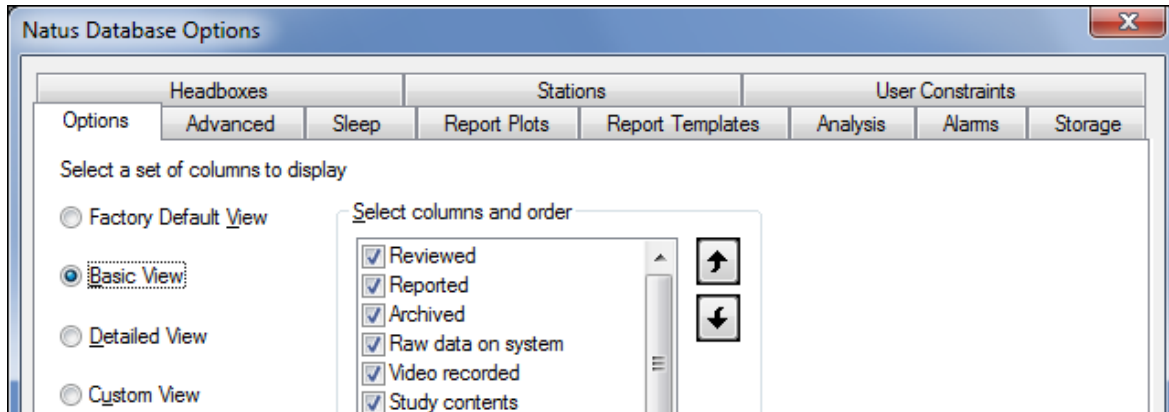
Tools Menu Options

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 <i>MS Word</i> document. It appears as a taskbar button on your Windows taskbar. Click the taskbar button to view the report.
Export to Excel®	Creates a CSV File for the selected studies. 
Ambulatory Manager	Opens the Ambulatory Headbox Manager . Used to monitor or upload an ambulatory study and clear the memory of the ambulatory headbox.
Background Exporter	Refer to Export Project Manager Site Administrator Reference (DOC-008992) for additional details.
Legacy Product Settings	The options within Legacy Product Settings are used post-migration of a Nicolet, Coherence, or TWin database into the Natus Database. The settings mainly allow the user to configure the pathway and accessibility for Nicolet, Coherence, and TWin review applications and related studies. Additional options allow for dual-monitor configuration and report file extension programming.
Options	Opens the Natus Database Options box which has the following tabs: • Options • Advanced Sleep • Report Plots • Report Templates • Analysis • Alarms • Storage • Headboxes • Stations • User Constraints

22.7. 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)**.

Natus Database Options

Headboxes: Options, Advanced, Sleep
Stations: Report Plots, Report Templates
User Constraints: Analysis, Alarms, Storage

Select a set of columns to display

☐ Factory Default View
☒ Basic View
☐ Detailed View
☐ Custom View

Show / Hide Fields...
Custom Fields...

Select columns and order

- ☒ 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
- ☒ Patient Occupation
- ☒ Parent Occ
- ☒ Admitted

Display Options:

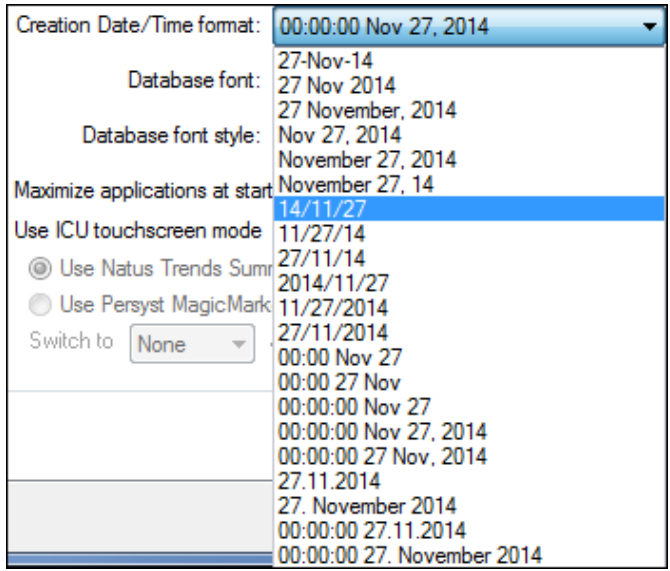
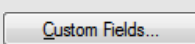
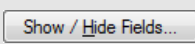
Creation Date/Time format: 00:00:00 Nov 26, 2014
Database font: Microsoft Sans Serif
Database font style: Regular DB font size: 12
Menu font size: 8
☒ Maximize applications at startup
☐ Use ICU touchscreen mode
 ☒ Use Natus Trends Summary
 ☐ Use Persyst MagicMarker
Switch to: None after 01:00 [mm:ss] of inactivity

Reset to non-ICU Defaults

OK Cancel Apply

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.  The screenshot shows a dropdown menu for 'Creation Date/Time format'. The selected option is '00:00:00 Nov 27, 2014'. Other visible options include '27-Nov-14', '27 Nov 2014', '27 November, 2014', 'Nov 27, 2014', 'November 27, 2014', 'November 27, 14', '14/11/27', '11/27/14', '27/11/14', '2014/11/27', '11/27/2014', '27/11/2014', '00:00 Nov 27', '00:00 27 Nov', '00:00:00 Nov 27', '00:00:00 Nov 27, 2014', '00:00:00 27 Nov, 2014', '27.11.2014', '27. November 2014', '00:00:00 27.11.2014', and '00:00:00 27. November 2014'.
	Use to add, remove or change the order of custom fields in the database and in reports.	
	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).

The screenshot shows the 'Natus Database Options' dialog box with the 'Advanced' tab selected. The dialog has a title bar with a close button (X). Below the title bar is a tabbed interface with three main sections: 'Headboxes', 'Stations', and 'User Constraints'. The 'Advanced' tab is active, showing various configuration options.

Headboxes

- ☒ **Enable Abnormal Termination Recovery:**
 - Local Account User Name:
 - Local Account Password:
 - Logon Domain:
 -

Stations

HL7 Import / Export:

- ☐ **Import ADT messages from path (XMLIn*.*) :** every: minutes
 -
- ☐ **Delete "New Patient" entries older than:** days
- Export ORU messages to path (XMLOut*.*) :**
 -
- ☐ **Export reports to HL7:** ☐ **Convert Word reports to PDF**
 - ☐ Embed reports in HL7 message using Base64
 - ☒ Copy report files to this path and provide a link in HL7 message:
 -

Auto-export to HL7 after:

- ☐ Acquiring a study
- ☐ Reviewing a study
- ☐ Changing study information
- ☐ Purging a study
- ☐ Merging a study
- ☐ Marking a study "reviewed"

Epoch duration (seconds):

EEG: Sleep:

Patient Information:

- ☐ Add existing 'Reviewer' and 'Physician' users to selection lists
- ☐ Use ICD-10 diagnosis codes

Background Export Engine:

- ☐ Run automatic export in background
-

Buttons:

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.

The screenshot shows the 'Natus Database Options' dialog box with the 'Sleep' tab selected. The 'Report Options' section includes settings for 'Stage assigned to disconnected time' (Wake, Carry forward, Lights On), 'Sleep Onset' (The first 1 total epochs of stage: N1, N2, N3, REM), and 'REM Onset' (The first 1 total epochs of stage REM). The 'PLMS' section defines a sequence of at least 4 limb movement events, separated by at most 90 seconds. The 'Event Associations' section lists various events (Apnea/Hypopnea/RERA to Arousal, Limb Movement to Arousal, Snoring to Arousal, Apnea/Hypop/RERA to Desaturation, Apnea/Hypop/RERA to Limb Movement) with their occurrence windows and association rules. The 'Oximeter' section specifies the use of internal oximeter readings. The 'Event Filtering' section allows filtering of Arousal, Limb Movements, and Respiratory events. The 'MSLT/MWT nap latency' section provides options for when there is no sleep, with MSLT and MWT both set to 'Equal to the nap duration'.

Natus Database Options

Headboxes Stations User Constraints
Options Advanced Sleep Report Plots Report Templates Analysis Alarms Storage

Report Options: Adult AASM Pediatric AASM Infant AASM Adult R&K Pediatric R&K Infant R&K

Stage assigned to disconnected time: ☒ Wake ☐ Carry forward ☐ Lights On

Sleep Onset: The first 1 total epochs of stage: ☒ N1 ☒ N2 ☒ N3 ☒ REM

REM Onset: The first 1 total epochs of stage REM

PLMS: A sequence of at least 4 (☐ but not more than 0) limb movement events, separated by at most 90 (☒ but not less than 5) seconds between the start of one limb movement and the start of the next (☐ with the total sequence duration not to exceed 0 seconds.)

Event Associations: Apnea/Hypopnea/RERA to Arousal: events occur within 2 sec end to start
Limb Movement to Arousal: events occur within 2 sec end to start
Snoring to Arousal: events occur within 2 sec end to start
Apnea/Hypop/RERA to Desaturation: events occur within 5 sec end to start
Apnea/Hypop/RERA to Limb Movement: events occur within 2 sec end to start

Only the closest qualifying event can be associated with an Arousal

Oximeter: Use the internal oximeter readings for the oximeter and pulse rate values in the reports.

Event Filtering: Count Arousal events in Wake and Sleep Stages
Count Limb Movements events in Stages of Sleep
Count Respiratory events in Stages of Sleep, and in Wake if ending in Sleep

MSLT/MWT nap latency: When there is no sleep the latency is:
MSLT: ☐ Not Applicable ☒ Equal to the nap duration ☐ Equal to 20 minutes
MWT: ☐ Not Applicable ☒ Equal to the nap duration ☐ Equal to 30 minutes

Reset to Defaults

OK Cancel Apply

Sleep Tab Options

Report Plots Tab

To access the Natus Database Report Plots tab, choose **Tools > Options > Report Plots** (tab).

The screenshot shows the 'Natus Database Options' dialog box with the 'Report Plots' tab selected. The dialog is organized into three main sections: 'Headboxes', 'Stations', and 'User Constraints'. The 'Report Plots' section is active, showing various plot configuration options.

Headboxes			Stations		User Constraints		
Options	Advanced	Sleep	Report Plots	Report Templates	Analysis	Alarms	Storage
Axes							
Include for every plot:	☐ Epoch Number	☐ Elapsed Time	☒ Time of Day				
Include for axis plot:	☐ Epoch Number	☐ Elapsed Time	☒ Time of Day				
Oxygen Saturation Plots							
Oxygen Saturation Scale:	☐ Auto Scale	From: 50	To: 100				
Include Channels:	☒ Minimum	☒ Average	☒ Maximum				
☒ Show Artifacts							
Pulse Rate Plot							
Y-Axis Scale:	☐ Auto Scale	From: 50	To: 100				
Include Channels:	☒ Minimum	☒ Average	☒ Maximum				
☒ Show Artifacts							
CO2 Plot							
Y-Axis Scale:	☐ Auto Scale	From: 0	To: 100				
Include Channels:	☒ Minimum	☒ Average	☒ Maximum				
☒ Show Artifacts							
pH Plot							
Y-Axis Scale:	☐ Auto Scale	From: 0	To: 14				
Include Channels:	☒ Minimum	☒ Average	☒ Maximum				
☒ Show Artifacts							
Supplemental O2 Plot							
Y-Axis Scale:	☐ Auto Scale	From: 0	To: 10				
Pressure Titration Plot							
Y-Axis Scale:	☐ Auto Scale	From: 0	To: 20				
Sleep Event Plots							
☐ Display event category plots (Artifact, Movement, Respiratory, Apnea, Hypopnea, Sleep States)							

At the bottom of the dialog are three buttons: 'OK', 'Cancel', and 'Apply'.

Report Plots Tab Options

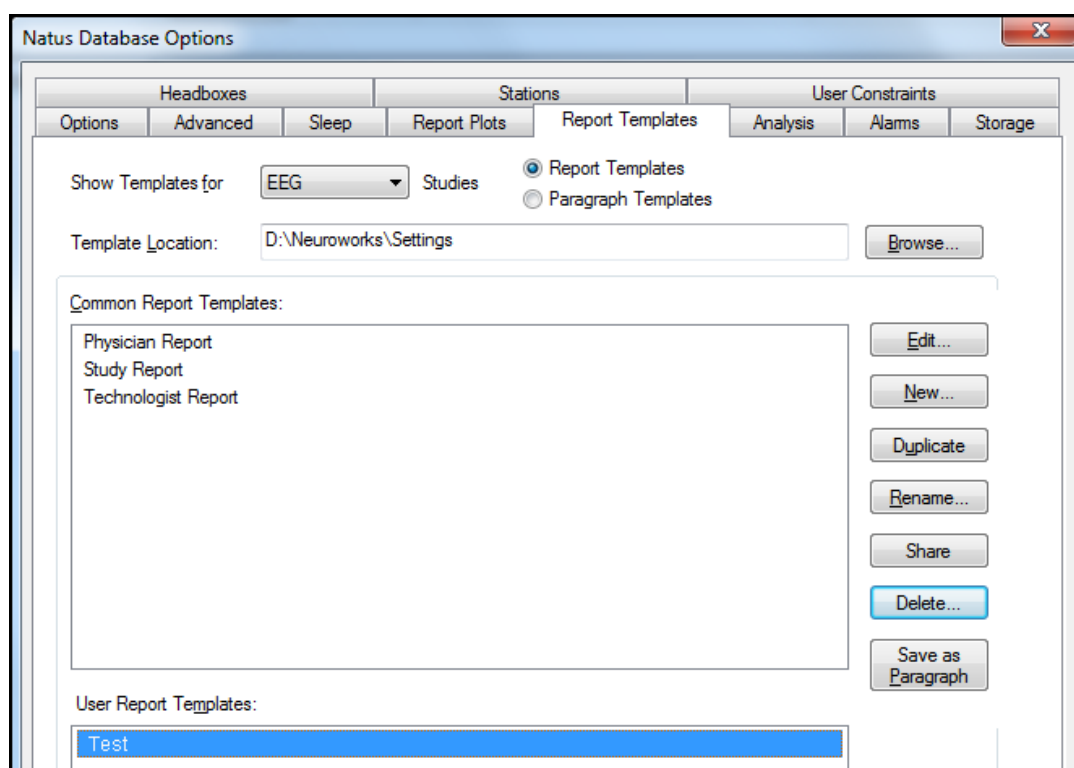
Report Plots Tab Options

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 O2 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 EEG Study

Report Templates Tab Options

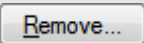
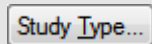
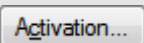
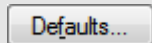
Option	Description
Edit	Select an existing template and click Edit . Microsoft Word launches with the selected template loaded.
New	Click New . The Template name box appears. Type a name and click OK . Microsoft Word launches with the new (and blank) template loaded. You must

Option	Description
	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 .
	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).
	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**.

Natus Database Options

Options | Advanced | Sleep | Stations | Report Plots | Report Templates | Analysis | User Constraints | Alarms | Storage

Montage

Headbox	Analysis Montage
28 Channel Ambulatory Headbox	Amb28 - XLDetect
36 Channel EMU Headbox	EMU36 - XLDetect
Connex/Brain Monitor	Connex - XLDetect
EEG 128-256 Channel Headbox	--- As Recorded ---
EEG 32 Channel Headbox	EEG32 - XLDetect
FMI 140 Headbox	FMI 140 - XLDetect

Analyzers

Event	Study Type	Activation
QEEG	EEG	Always
XLEvent	EEG	Always
XLEvent - Intracranial	EEG	Always
XLSpoke	EEG	Always
XLSpoke - Intracranial	EEG	Always

XLEvent

Min slowing frequency (1-3 Hz): 2 ☒ Enable slowing detection

Min interhemispheric asymmetry (2 - 5): 2.5 ☒ Enable EMG analysis

Min spike rate (0 - 20 Hz): 2

Min spike slew (0 - 50 uV/ms): 0.5

Max amplitude (500 - 10000 uV): 5000

Max waveform asymmetry ratio (2 - 20): 5

Max seizure frequency (40 - 60 Hz): 45

Slowing S/N ratio (1-4): 2

Desync

☒ Enable Herald detection

☒ VLFA

100 VLFA amplitude (100 - 1000 uV)

6 VLFA coef (7 - 20)

22 Desync frequency (15 - 50)

5 Desync frequency delta (3 - 15)

Defaults...

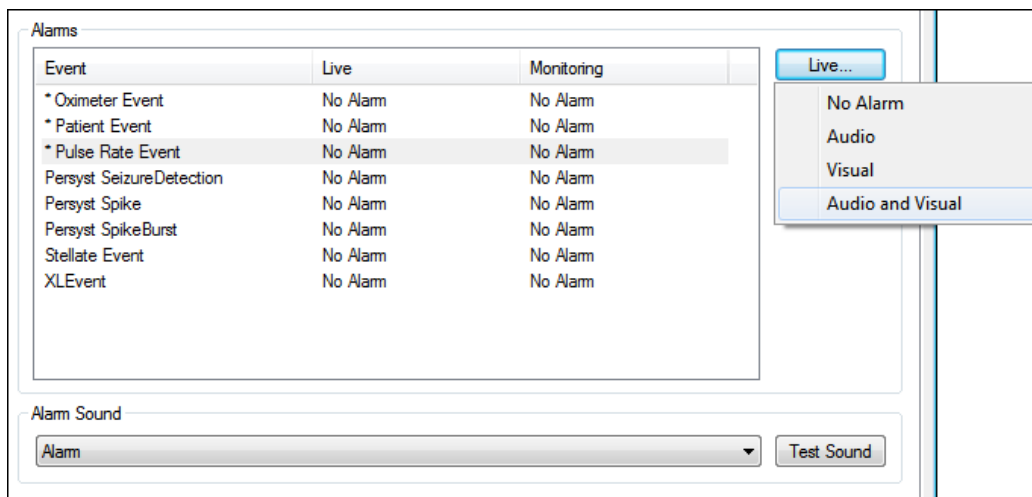
OK Cancel Apply

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

22.7.1.1. 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.



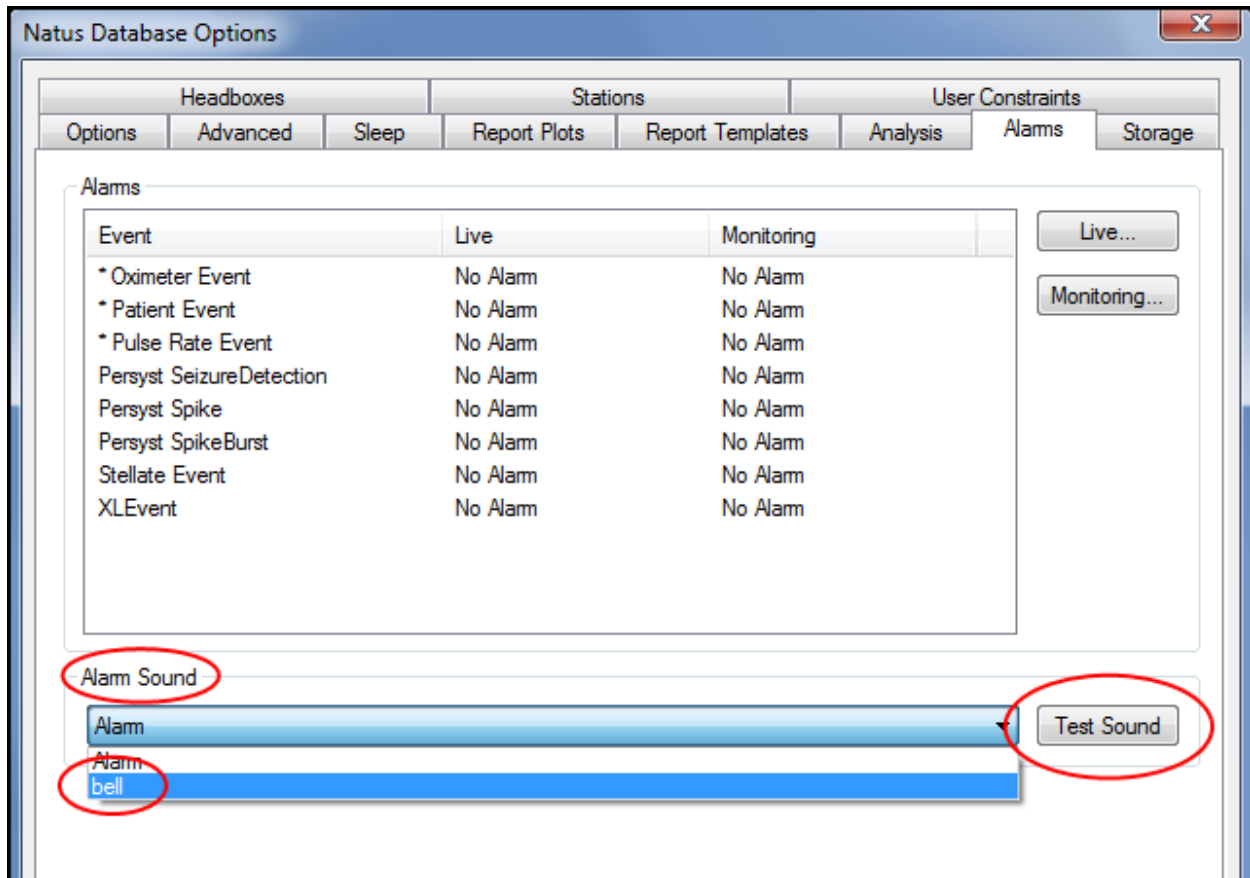
Caution: There is no alarm system for pulse rate or OSat.

22.7.1.2. 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.

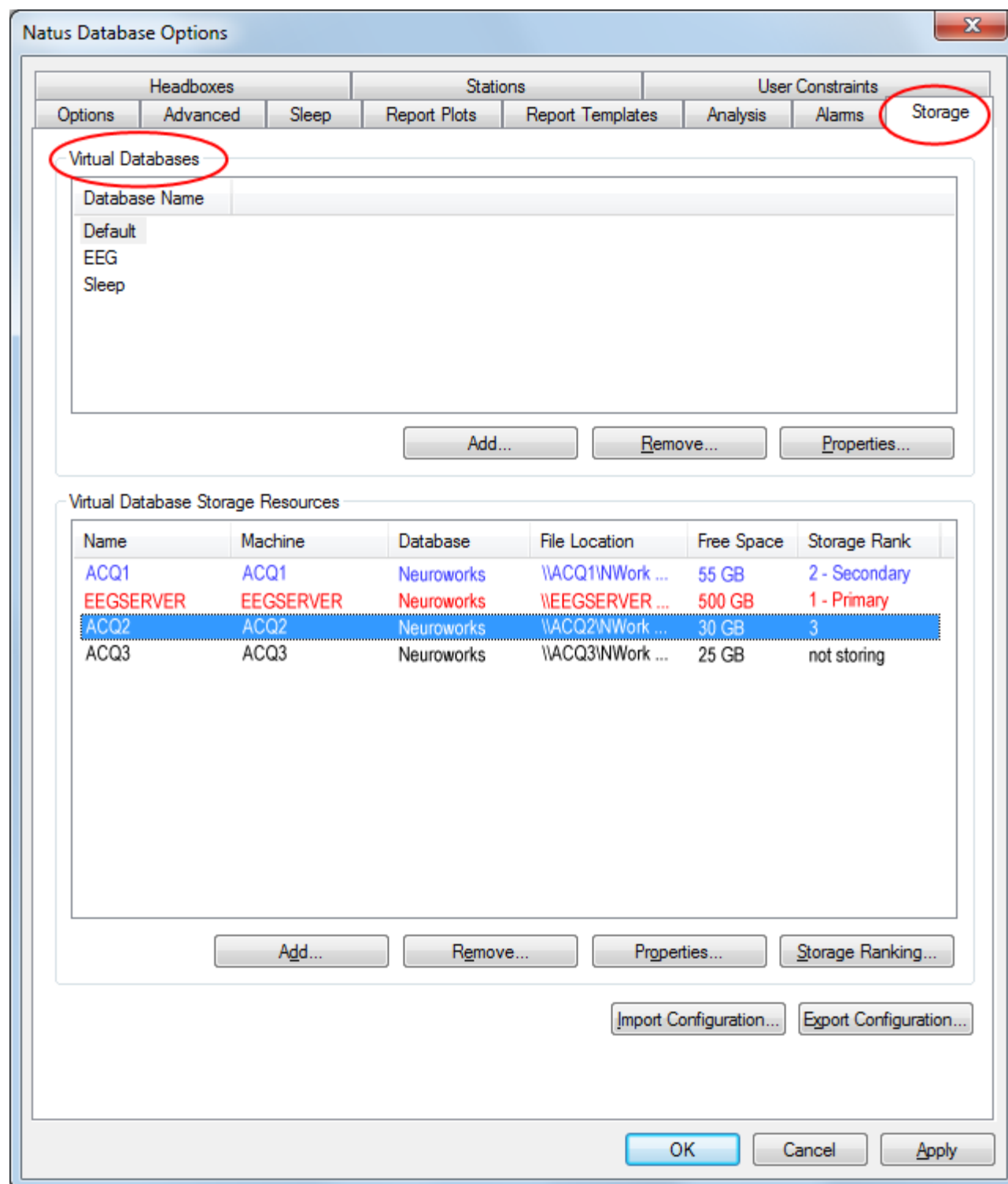


Custom "bell" Alarm Added to Alarm Sound List

6. To confirm that your custom alarm is working, select it and click the **Test Sound** button.

Storage Tab

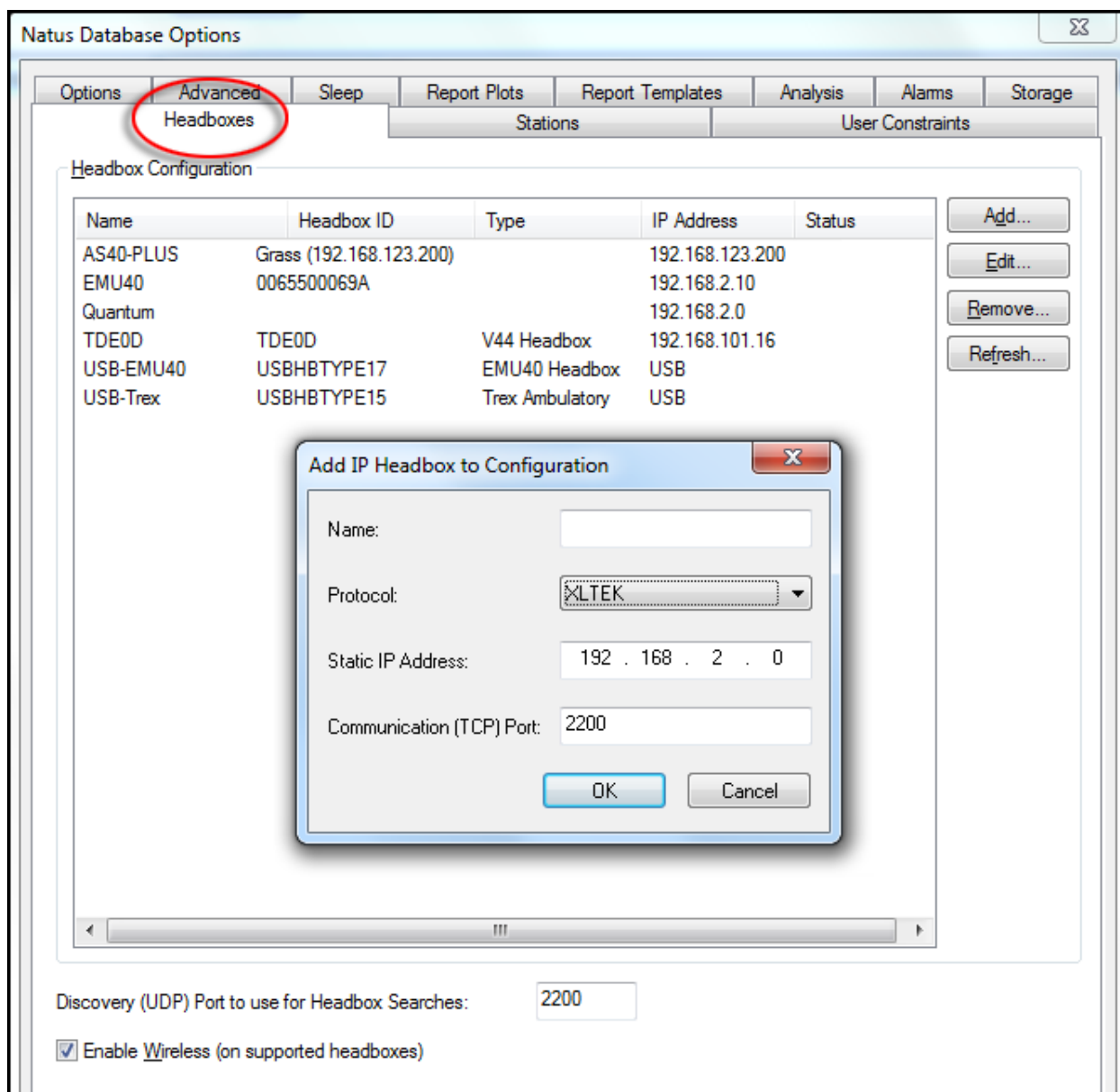
To access the Natus Database Storage tab, choose **Tools > Options > Storage** (tab).



Storage Tab

Headboxes Tab

To access the Natus Database Headboxes tab, choose **Tools > Options > Headboxes** (tab).

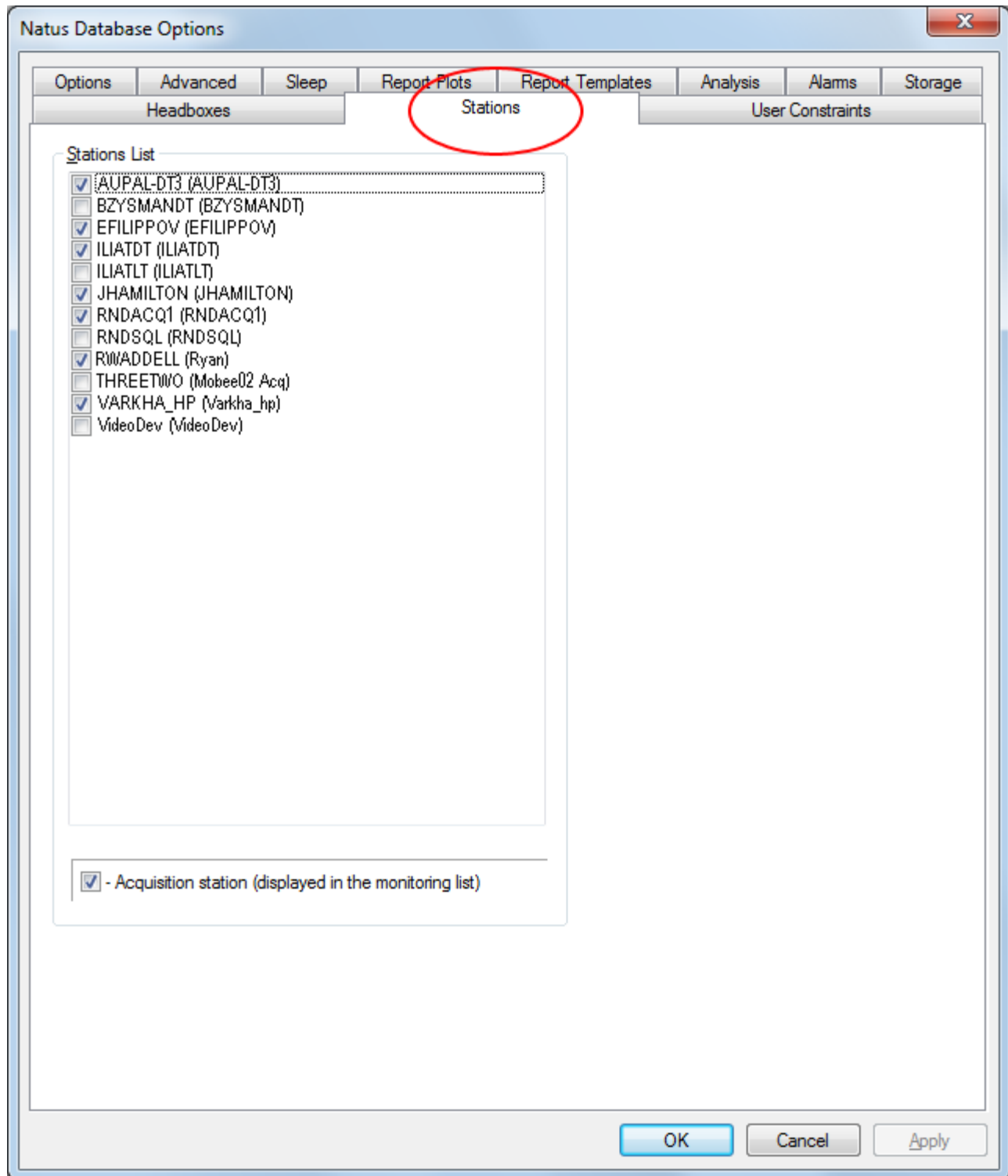


Headboxes Tab with Add IP Headbox Dialog (detail)

The Headboxes tab is can be used to configure IP-connected headboxes.

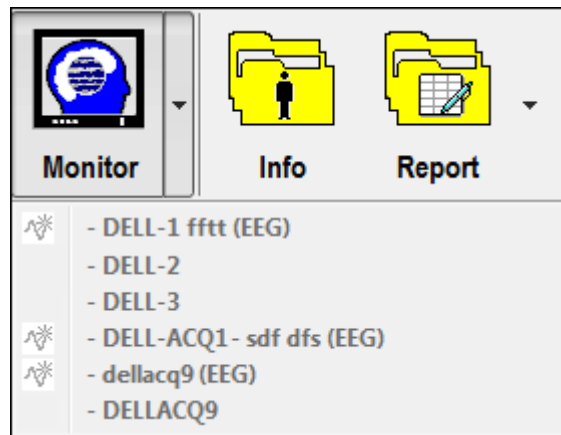
Stations Tab

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**.

22.8. Custom Fields in Natus Database

Displaying and Editing Custom Fields

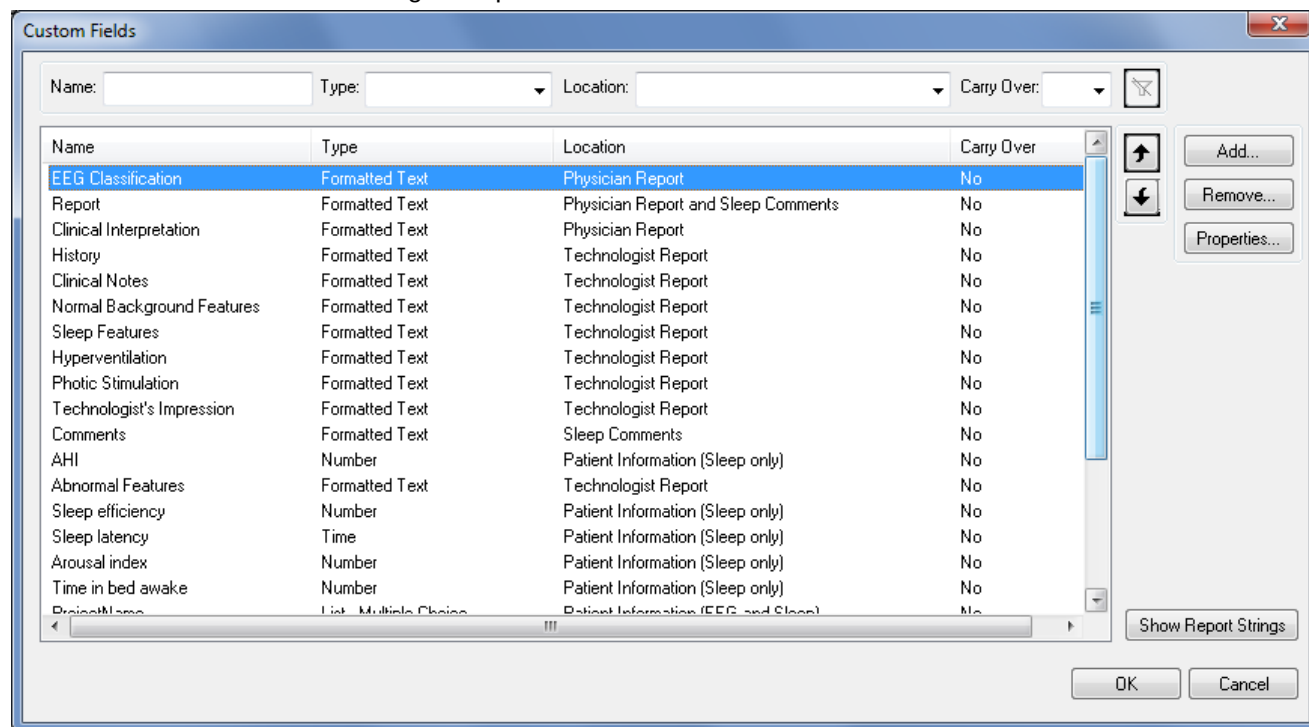
All custom fields are displayed/edited in the **Patient Info** dialog box. To access the **Patient Info** box in Natus Database, choose **Study > Info**.

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.



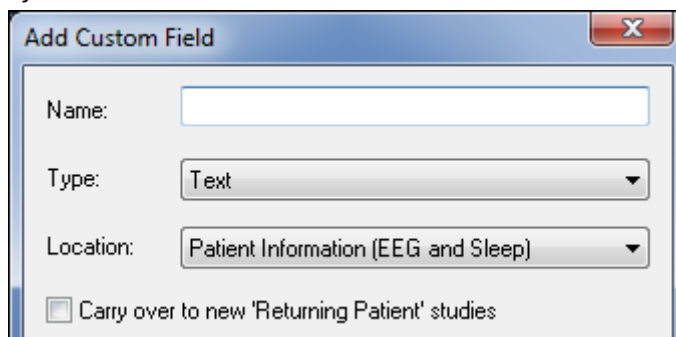
Custom Fields Dialog

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: Text

Location: Date, Date and Time, Formatted Text, List - Multiple Choice, List - Single Choice, Number, Strings, Text, Time

☐ Carry over

Type Options

Location: Patient Information (EEG and Sleep)

☐ Carry over

Patient Information (EEG only), Patient Information (Sleep only)

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.

Natus Database Options

Options: Headboxes, Stations, Report Plots, Report Templates

Select a set of columns to display

☐ Factory Default View

☒ Basic View

☐ Detailed View

☐ Custom View

Show / Hide Fields...

Custom Fields...

Select columns and order

- ☒ 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
- ☒ Patient Occupation
- ☐ Reviewer
- ☐ Weight(lb)

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.

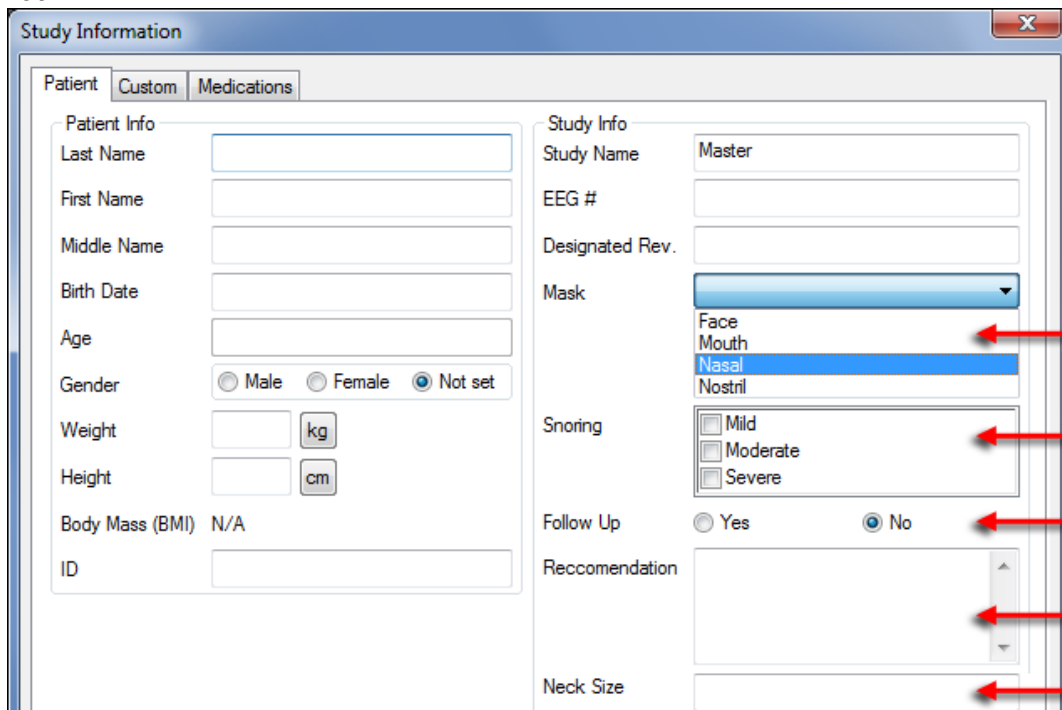
To change the properties of a custom field:

1. Click the **Properties**  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

List - Single Choice

List - Multiple Choice

Boolean

Strings

Text

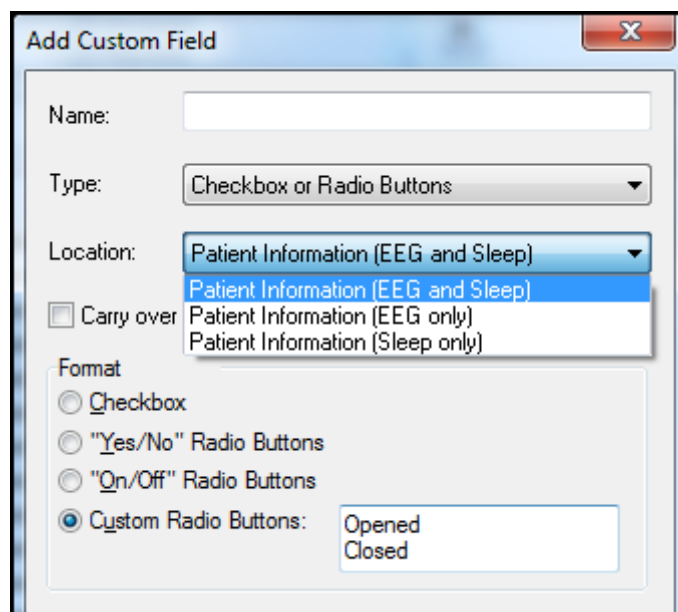
Custom Field Types in Patient tab on Study Information Dialog

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 <i>Custom</i> 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.

22.8.1.1. Checkboxes or Radio Buttons

The Checkboxes or Radio buttons 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 this option, you must choose a format.



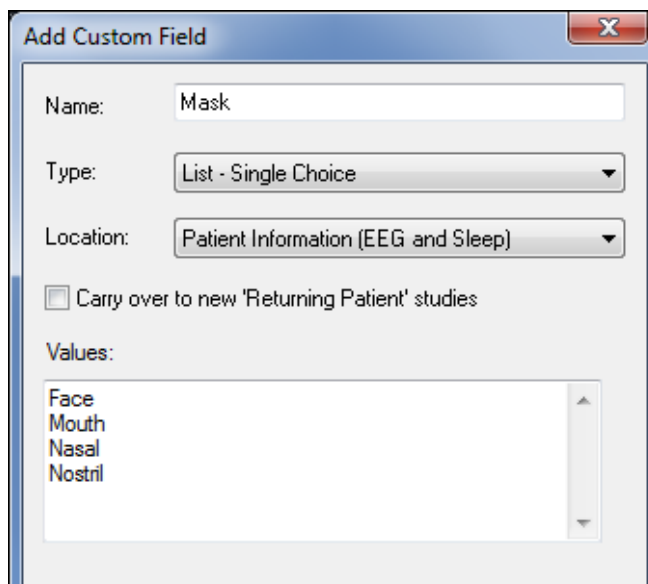
The screenshot shows the 'Add Custom Field' dialog box. The 'Name' field is empty. The 'Type' is set to 'Checkbox or Radio Buttons'. The 'Location' is set to 'Patient Information (EEG and Sleep)'. The 'Carry over' checkbox is unchecked. The 'Format' section has four radio buttons: 'Checkbox', '"Yes/No" Radio Buttons', '"On/Off" Radio Buttons', and 'Custom Radio Buttons'. The 'Custom Radio Buttons' option is selected, and the text 'Opened' and 'Closed' is entered in the adjacent text box. A dropdown menu is open next to the 'Location' field, showing the following options: 'Patient Information (EEG and Sleep)', 'Patient Information (EEG only)', and 'Patient Information (Sleep only)'.

Checkboxes or Radio Buttons 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.

22.8.1.2. List - Single Choice

Use this field type to add a dropdown box to your **Study/Patient Info** form.



The screenshot shows the 'Add Custom Field' dialog box. The 'Name' field contains the text 'Mask'. The 'Type' is set to 'List - Single Choice'. The 'Location' is set to 'Patient Information (EEG and Sleep)'. The 'Carry over to new 'Returning Patient' studies' checkbox is unchecked. The 'Values' section contains a list box with the following items: 'Face', 'Mouth', 'Nasal', and 'Nostril'.

List – Single Choice Option

22.8.1.3. 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.

Add Custom Field

Name:

Type:

Location:

☐ Carry over to new 'Returning Patient' studies

Values:

- Mild
- Moderate
- Severe

Report Settings:

☐ Put each string on a separate line

☒ Separate strings by:

List – Multiple Choice Option

22.8.1.4. 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.

Background	☐ Beta ☐ Delta ☒ Theta
------------	--

Custom Field Properties

Name:

Background

Type:

List - Multiple Choice

Location:

Patient Information (EEG and Sleep)

☐ Carry over to new 'Returning Patient' studies

Values:

Beta

Delta

Theta

Report Settings:

☐ Put each string on a separate line
☒ Separate strings by .

OK

Cancel

List – Multiple Choice Option

22.8.1.5. 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**.

- 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).

The screenshot shows the 'Study Information' dialog box with tabs for Patient, Medications, Technologist's Report, and Physician's Report. The 'Patient' tab is active, showing fields for Patient Name (testing test), Date (Nov 27, 2014), Time (10:40:14), Age, and Reviewer (Administrator). A 'Mark As Reviewed' button is visible. Below these fields is a section for EEG Classification, Clinical Interpretation, Report, and Clinical Notes. A dropdown menu is open, showing 'Common Paragraphs' with options: Basic Patient Info, Hello, and Sleep Architecture.

Paragraph Dropdown Menu in Study Information Dialog

The screenshot shows the 'Natus Database Options' dialog box with the 'Report Templates' tab selected. It includes sections for Headboxes, Stations, and User Const. The 'Show Templates for' dropdown is set to 'EEG'. The 'Template Location' is 'D:\NeuroWorks\Settings'. The 'Custom Field' dropdown is set to 'Abnormal Features'. A table lists 'Common Paragraph Templates' with columns 'Name' and 'Show in Menu'.

Name	Show in Menu
Basic Patient Info	☒
Hello	☒
Sleep Architecture	☒

Report Templates Tab in Options Dialog

22.9. 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.

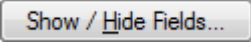
Custom fields can be utilized for the implementation of pre and post questionnaires – one tab for each – or for standard questionnaires such as the Stanford Sleepiness scale.

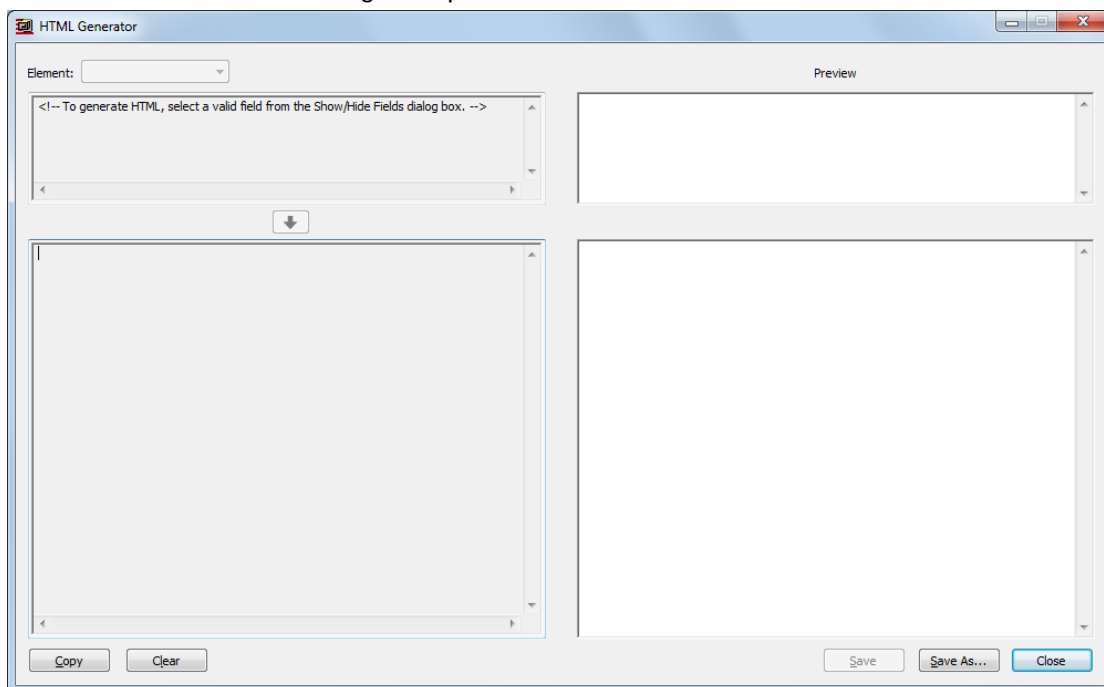
HTML forms can be used to pre-fill content during study review. This content can then be drawn into the reports during report generation.

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.

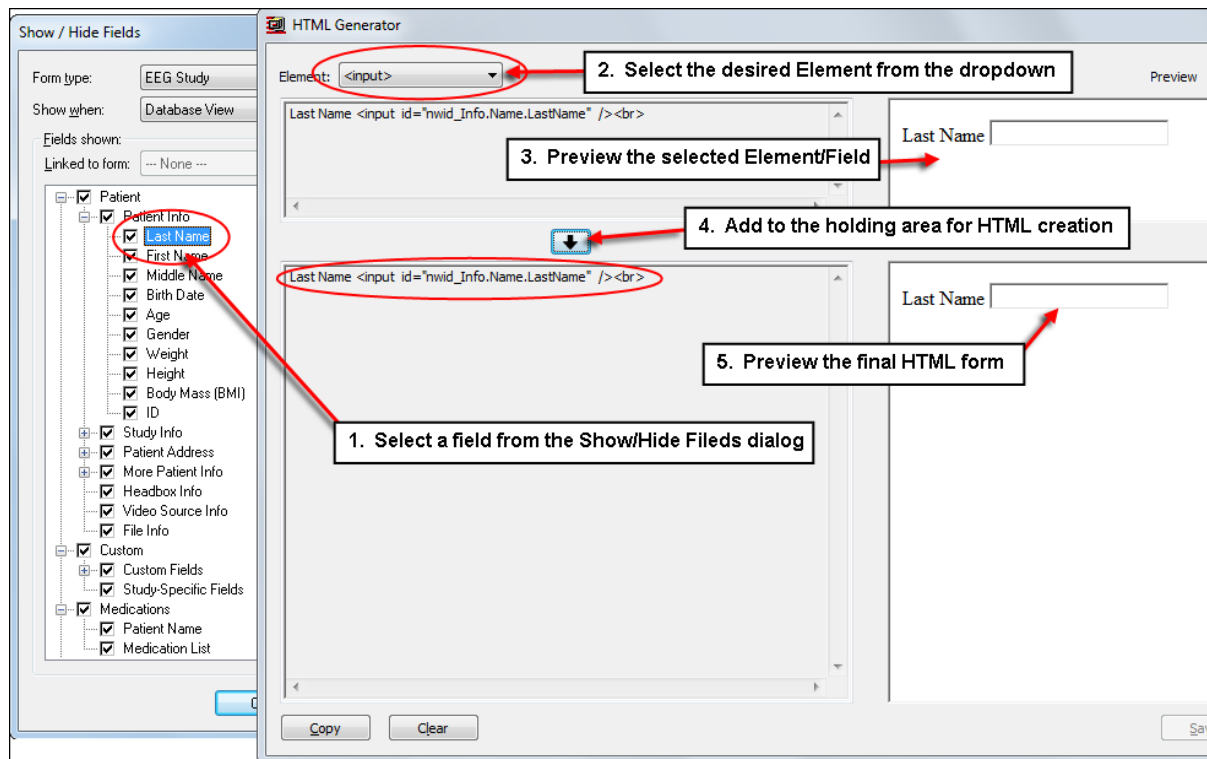
To add a field into the HTML Generator

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.



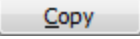
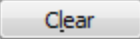
NOTE: Each field can only be added once unless the edit box is cleared.

The two edit boxes on the right side of the dialog show previews for the currently selected field and all added fields, respectively.

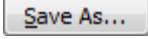
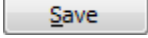


HTML Generator Dialog Showing Field Added

22.9.1.1. 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

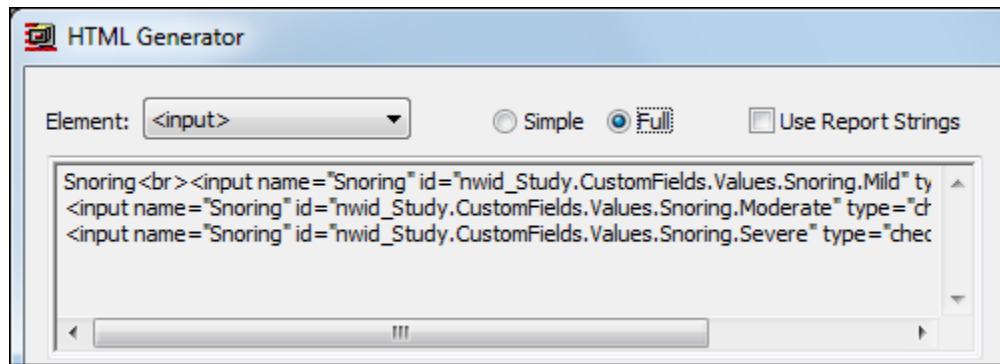
1. All currently added fields can be saved to HTML by clicking the **Save As...**  button.
2. A prompt asking for the save location and file name will appear.
3. If changes are made to the HTML code after the HTML file has already been saved, the **Save**  button is enabled. Clicking this button will automatically save to HTML, without any additional prompts.

Additional Options for Single/Multiple Choice List Fields

22.9.1.2. 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

22.9.1.3. 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.

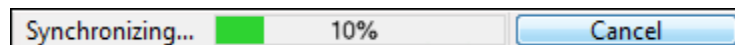
22.10. Synchronizing with Storage Resources

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:

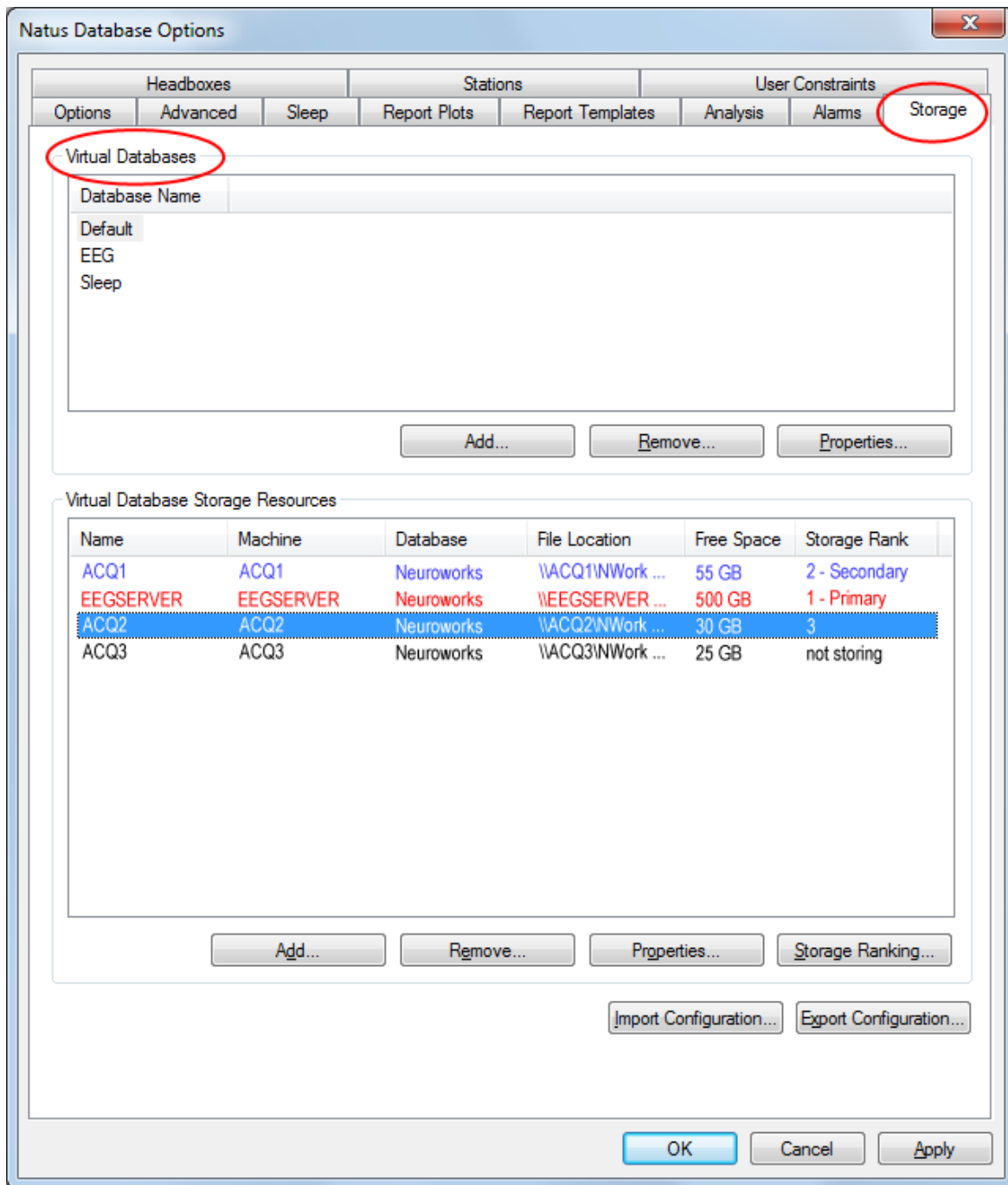
- Synchronization takes place automatically every 10 minutes.
- During synchronization progress percentage is displayed in the status bar.



- 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:

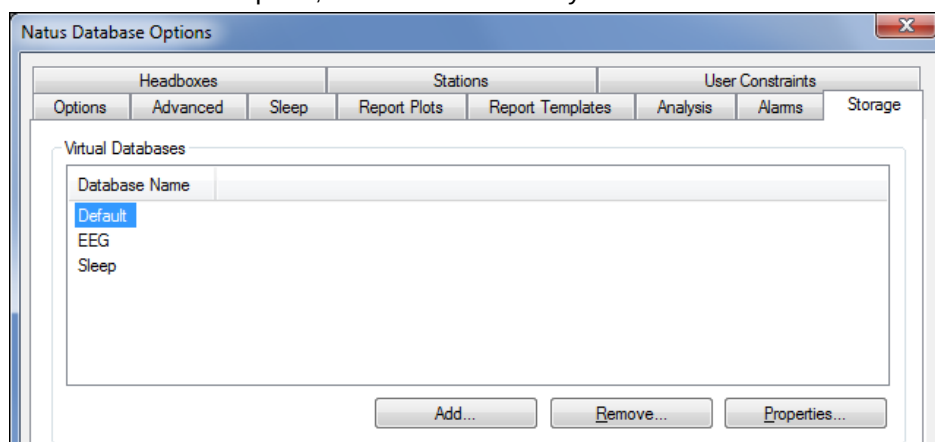
- Not Recording (for example, a review station)
- Recording
- Removable

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.

22.10.1.1. Adding a Not Recording or Recording Resource

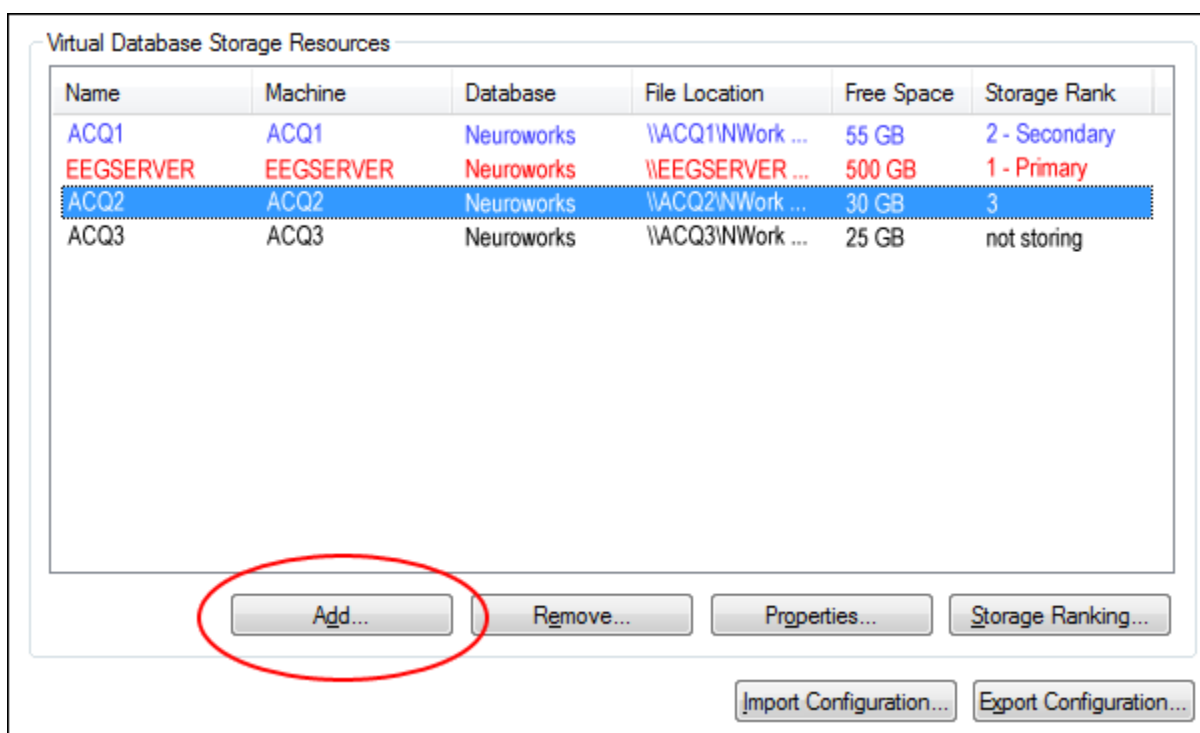
To add the resource:

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.



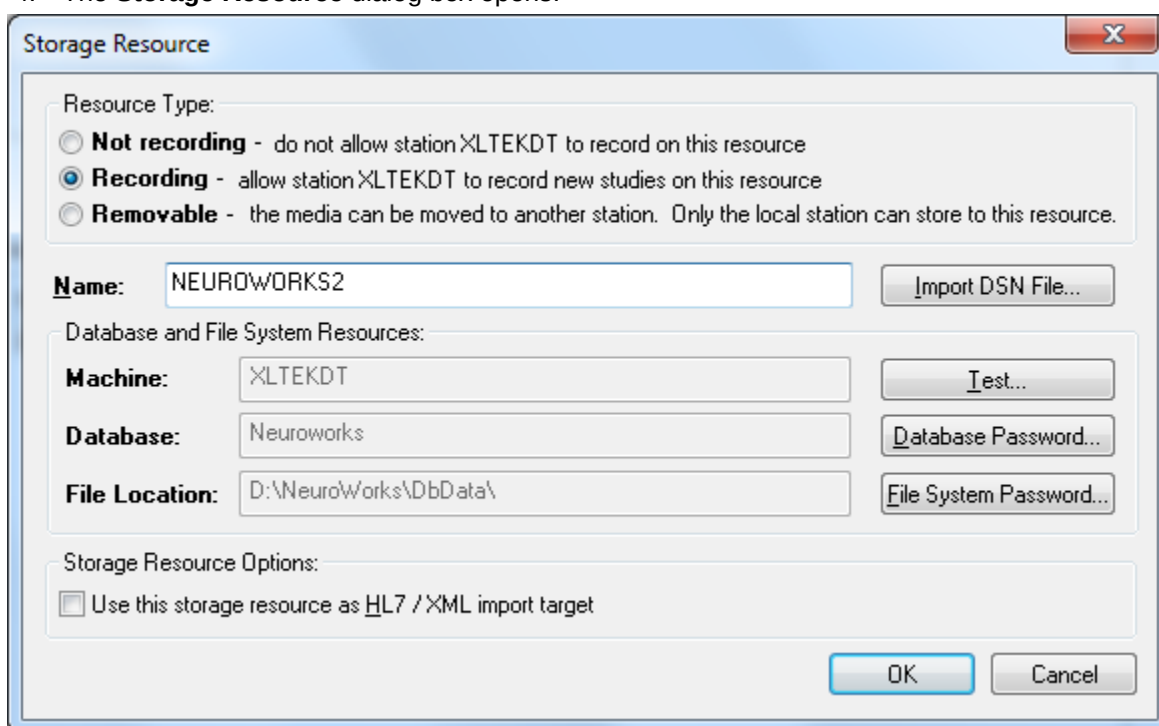
Virtual Databases Pane

3. Click the **Add** button below the lower, Storage Resources, pane.



Storage Resources Pane

- The **Storage Resource** dialog box opens.



- Click the **Import DSN File...** button, and browse to the DSN file (typically NeuroWorks.dsn) on the resource you want to add, and then click **OK**.
- Click **Apply** and then **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 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

22.10.1.2. 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.

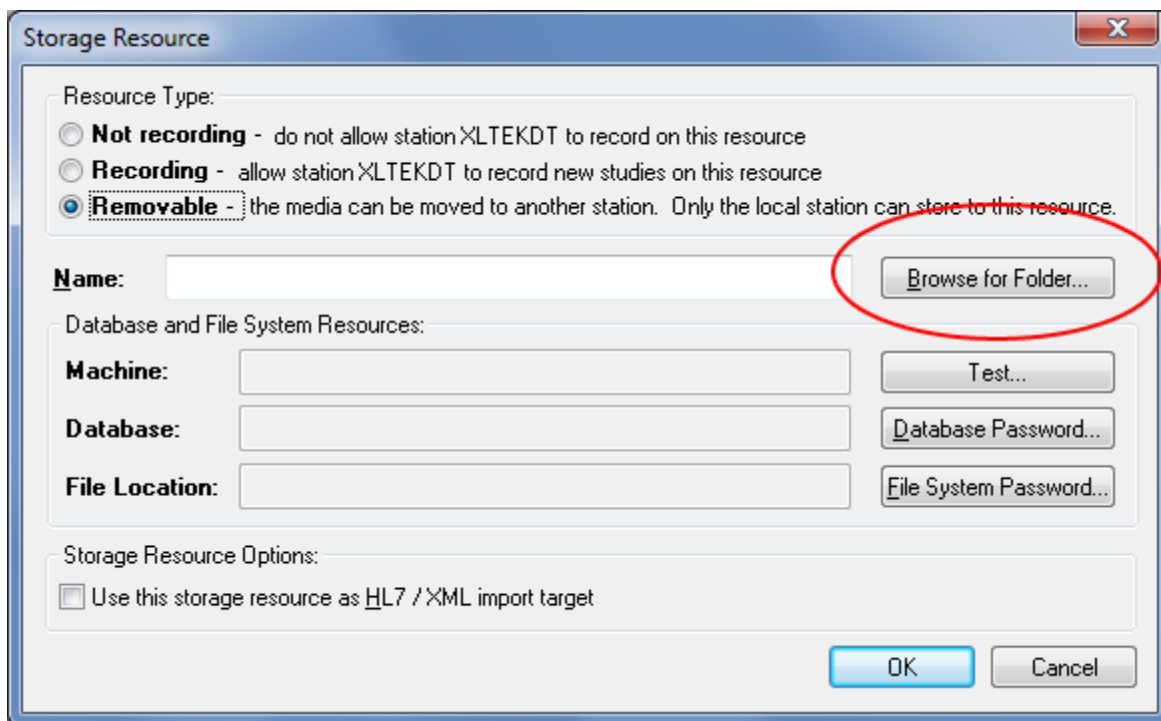
In order to allow for drive letter changes, the system scans the removable drives attached to it and modifies **Storage Resource** configuration to correspond to the current drive letter assignment. The scan begins whenever Natus Database starts, or every time the user clicks the **Refresh** button. If a removable drive resource is discovered during a refresh, the system performs an import to synchronize local database with files on the drive.

22.10.1.3. 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:

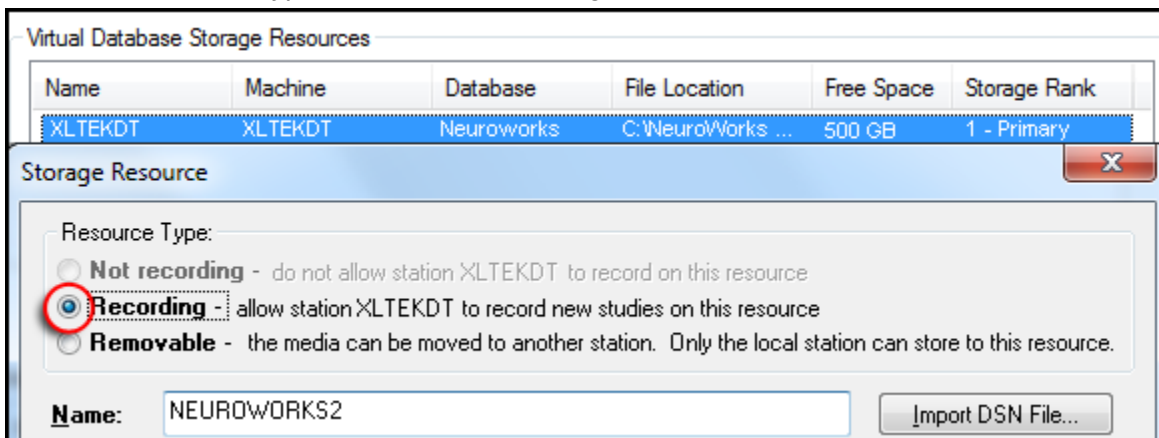
1. Select a removable drive root (for example, E:\).
2. If the folder does not contain a DSN file, a system prompt asks:
 4. Are you sure you want to prepare E:\ for removable workflow?
5. If the folder does contain a DSN file, the system prompt says:
 6. E:\ is already prepared for removable workflow. Would you like to create database "NWRemovableDDMMYYYYHHMMSS" on this machine?
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.

22.11. Working with Databases

About Virtual Databases

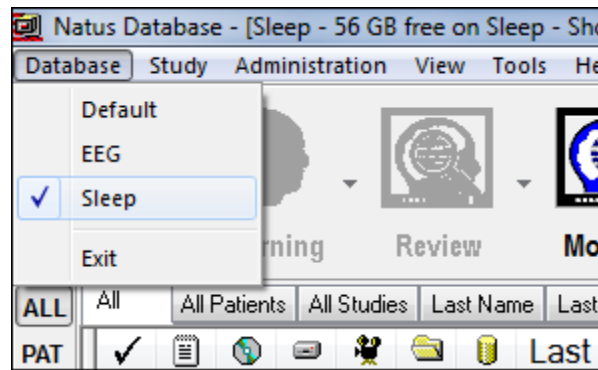
In addition to a Primary and a Secondary database, NeuroWorks allows you to create as many virtual databases as you like.

Primarily, virtual databases are used to distinguish between different sets of studies. For example, you could create Adult / Pediatric databases or 2014 / 2015 / 2016 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.

22.11.1.1. No Server

The acquisition machines store data locally. There is one virtual database which includes all the acquisitions.

22.11.1.2. 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.

22.11.1.3. 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.

22.11.1.4. 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).

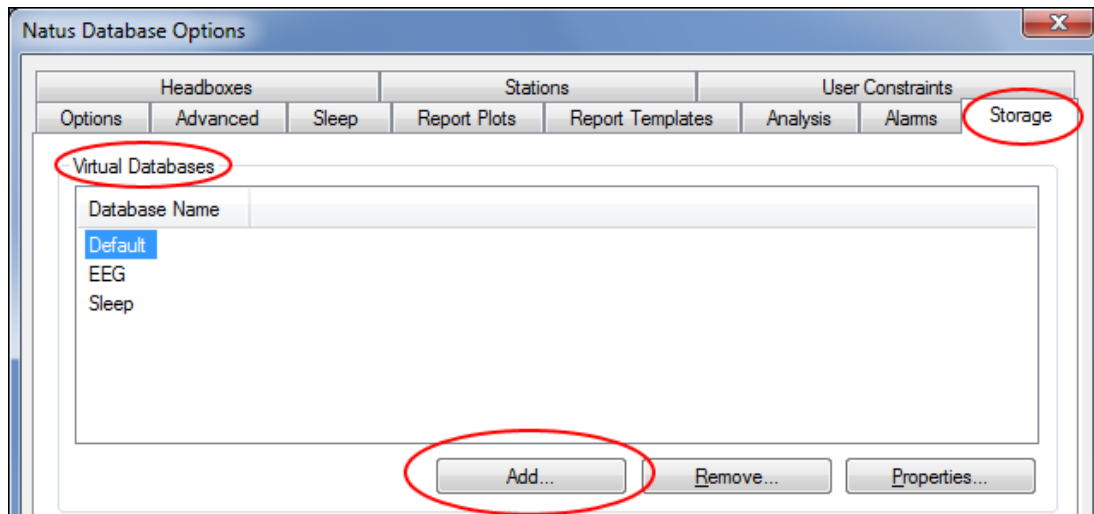
22.11.1.5. Removable Storage

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

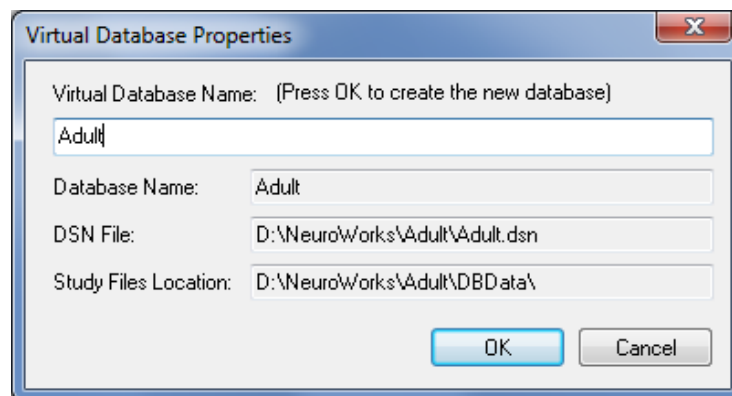
To add a virtual database:

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.

22.11.1.6. 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.

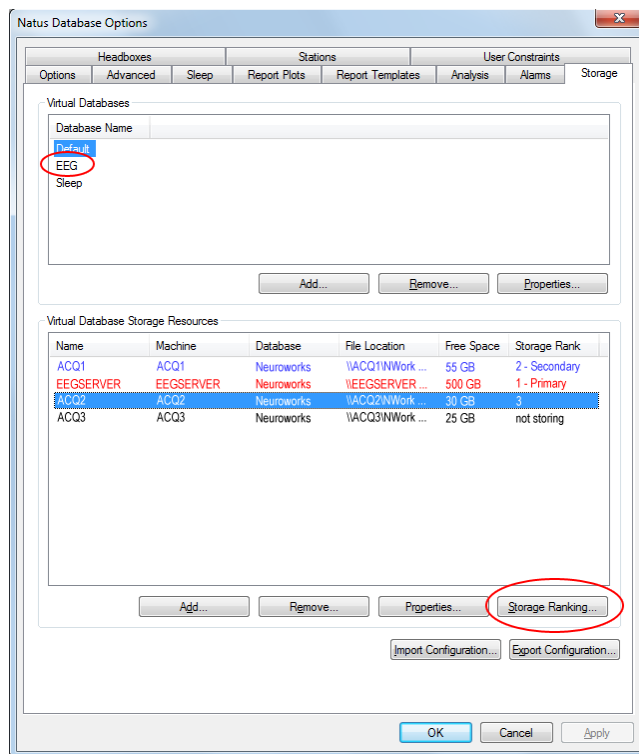
Database Storage Ranking

Virtual databases are ordered by ranking and may be customized by the user.

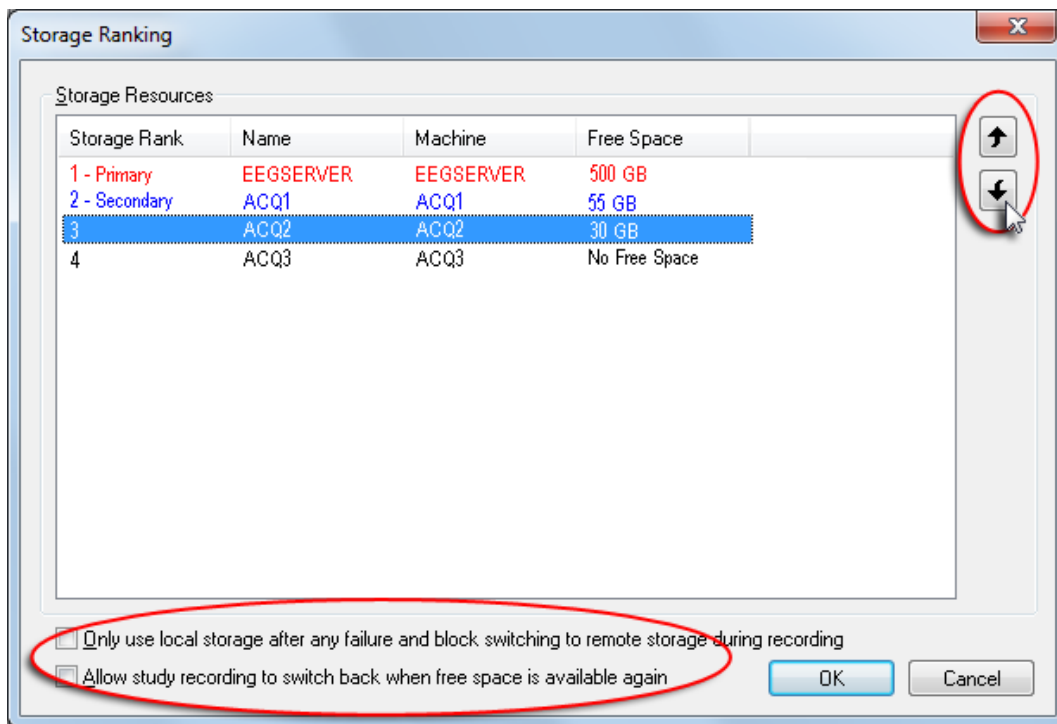
When a higher-ranking resource runs out of space, the program switches to the next-lower-ranking resource. When space becomes available again, the setting of an option in the **Storage Ranking** dialog box determines whether the program automatically switches back to the higher-ranking resource or not.

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.



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

22.11.1.7. 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.

22.11.1.8. 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.

22.11.1.9. 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:

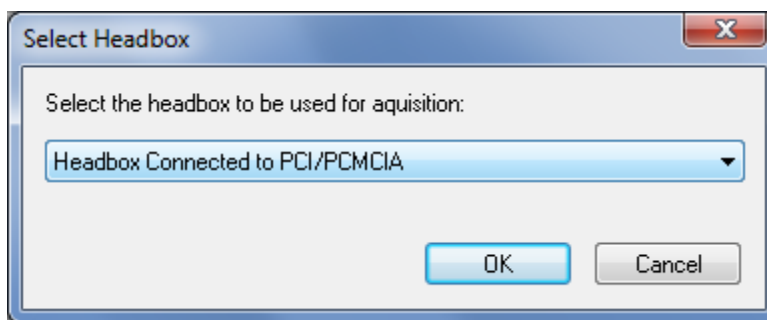
1. In Natus Database, select **Tools > Options > Storage** (tab).
2. Press **Storage Ranking...** button to open the Storage Ranking dialog.
3. Check the option "Only use local storage after any failure and block switching to remote storage during recording".

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.

22.12. 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.

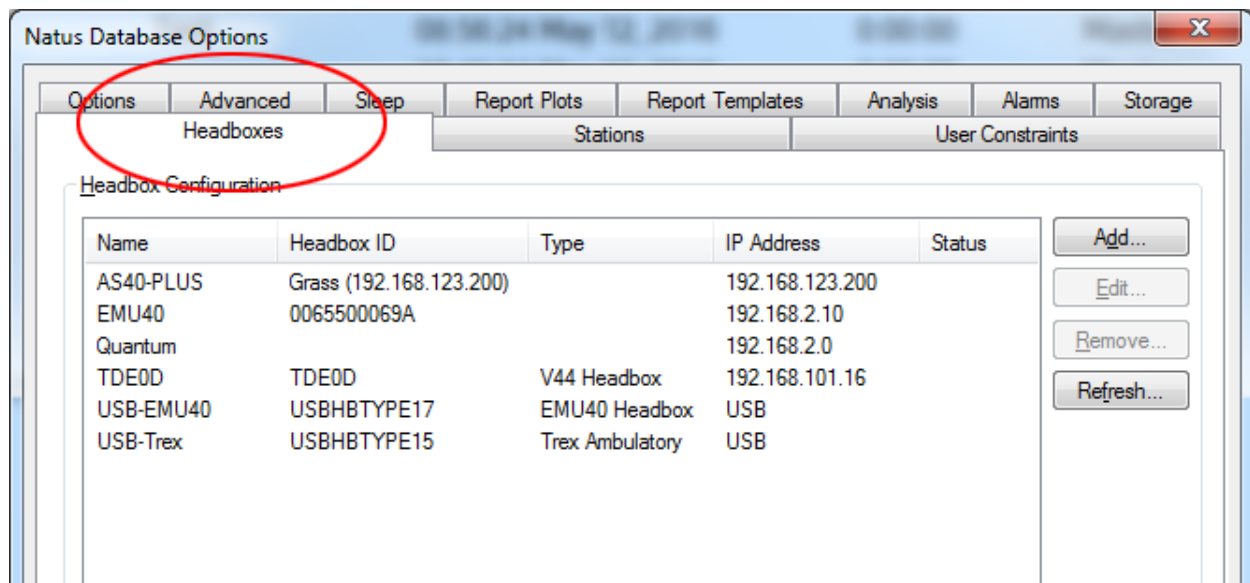


Select Headbox Box on Study Information Dialog

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

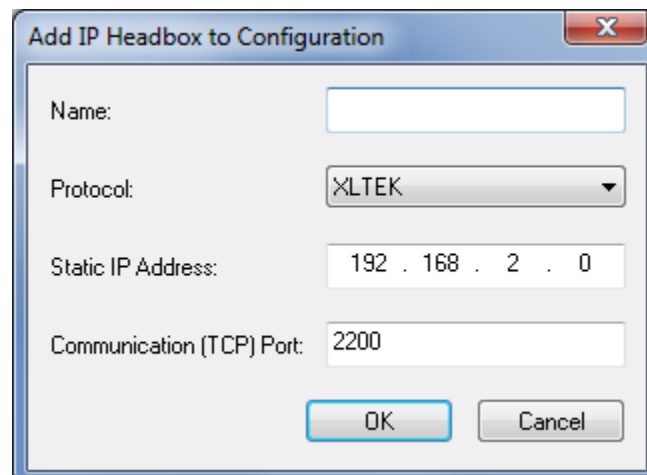
IP Headboxes can be configured by selecting **Tools > Options > Headboxes** (tab) in Natus Database.



Discovered IP Headboxes Configuration Box

Note the following:

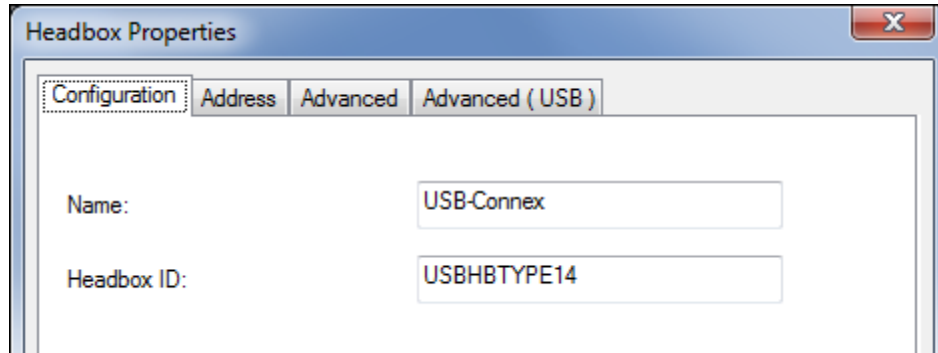
- Before the dialog box appears, the database is synchronized. Database synchronization is then disabled until you close the dialog box. When the dialog box first appears it is filled with the data in the database. When you select the Search button any discovered headboxes that are not already configured 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 headbox is removed from the database.
- Selecting the **Refresh** Button discovers new headboxes or refreshes the status of headboxes already in the list.



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.

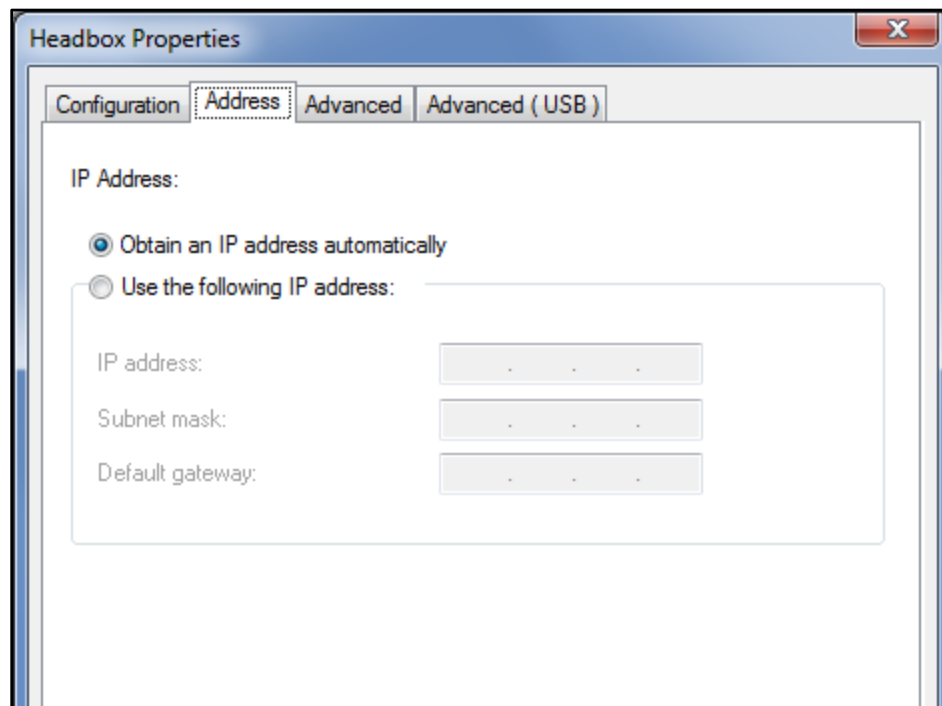


The screenshot shows the 'Headbox Properties' dialog box with the 'Configuration' tab selected. The 'Name' field contains 'USB-Connex' and the 'Headbox ID' field contains 'USBHBTYP14'. The 'Address', 'Advanced', and 'Advanced (USB)' tabs are also visible.

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.



The screenshot shows the 'Headbox Properties' dialog box with the 'Address' tab selected. The 'IP Address' section has two radio buttons: 'Obtain an IP address automatically' (selected) and 'Use the following IP address:'. Below the radio buttons are three input fields for 'IP address:', 'Subnet mask:', and 'Default gateway:', each containing a placeholder IP address '192.168.1.1'.

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.

The screenshot shows the 'Headbox Properties' dialog box with the 'Advanced' tab selected. The dialog has four tabs: 'Configuration', 'Address', 'Advanced', and 'Advanced (USB)'. The 'Advanced' tab is active, displaying various settings. At the bottom, there are buttons for 'Load Defaults...', 'Upgrade firmware... (ETH)', 'OK', 'Cancel', and 'Apply'.

Property	Value																				
Speed and Duplex:	Auto																				
Flow Control:	Auto																				
Communication (TCP) Port:	2200																				
Discovery (UDP) Port:	2200																				
MAC Address:	00-03-F4-04-B5-30																				
Current IP Address:	N/A (DHCP)																				
Headbox ID:	103881541C1																				
Version Information:	<table border="1"><tbody><tr><td>IP Software:</td><td>4.10.1</td></tr><tr><td>IP Hardware:</td><td>1</td></tr><tr><td>Base Type:</td><td>14</td></tr><tr><td>Breakout Box Software:</td><td>0.0.0</td></tr><tr><td>Breakout Box Hardware:</td><td>0.0</td></tr><tr><td>Breakout Box Type:</td><td>0</td></tr><tr><td>FPGA Version:</td><td>9</td></tr><tr><td>PLD Version:</td><td>0</td></tr><tr><td>USB Hardware:</td><td>1</td></tr><tr><td>USB Software:</td><td>3.11.5</td></tr></tbody></table>	IP Software:	4.10.1	IP Hardware:	1	Base Type:	14	Breakout Box Software:	0.0.0	Breakout Box Hardware:	0.0	Breakout Box Type:	0	FPGA Version:	9	PLD Version:	0	USB Hardware:	1	USB Software:	3.11.5
IP Software:	4.10.1																				
IP Hardware:	1																				
Base Type:	14																				
Breakout Box Software:	0.0.0																				
Breakout Box Hardware:	0.0																				
Breakout Box Type:	0																				
FPGA Version:	9																				
PLD Version:	0																				
USB Hardware:	1																				
USB Software:	3.11.5																				

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.

22.13. Study File Operations

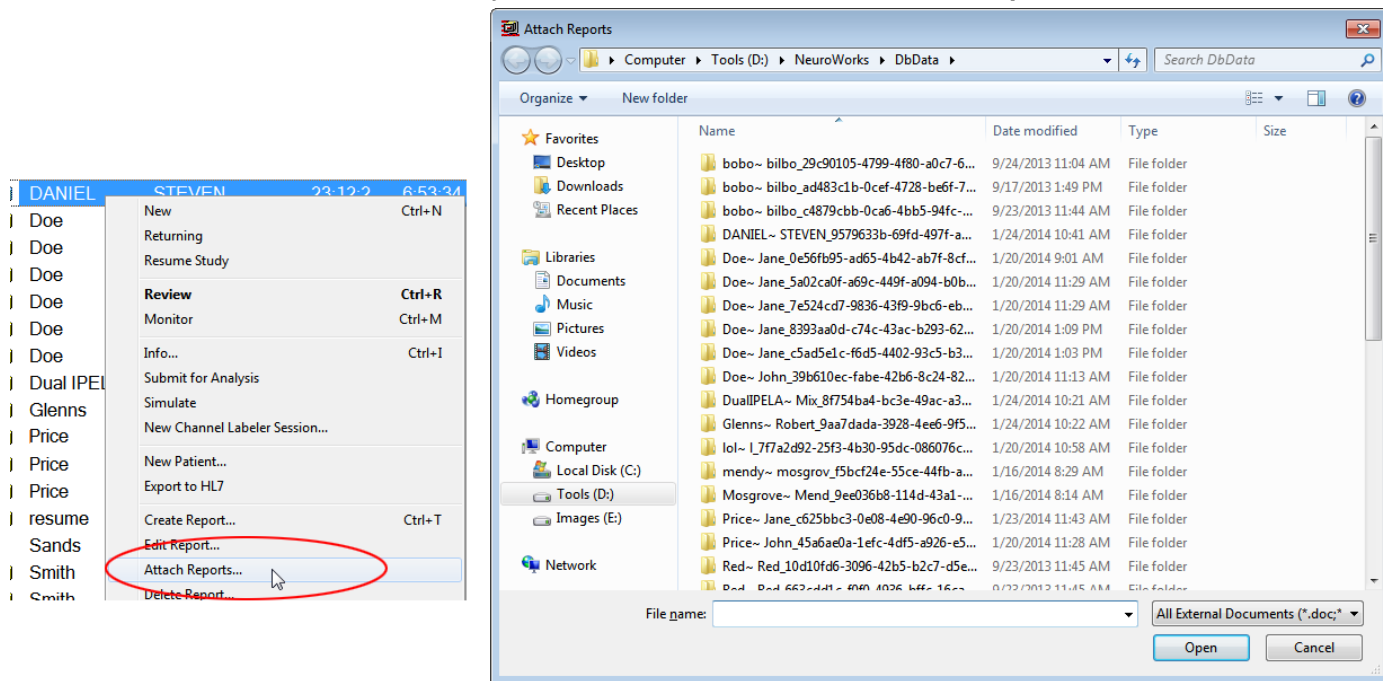
Attaching External Documents to a Study

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**".

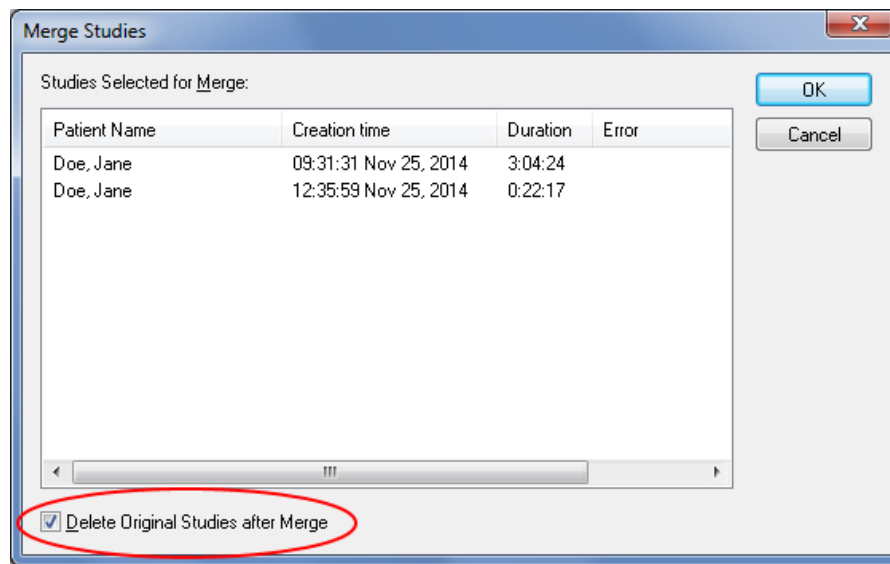
The screenshot shows a 'Patient Info' dialog box with a blue title bar and a close button (X) in the top right corner. Inside the dialog, there are four tabs: 'Patient', 'Medications', 'Technologist's Report', and 'Physician's Report'. The 'Patient' tab is selected. Under the 'Patient Info' section, there are three text input fields: 'Last Name' (containing 'Doe'), 'First Name' (containing 'Jane'), and 'Middle Name' (empty). To the right, under the 'Study Info' section, there are three text input fields: 'Study Name' (containing 'Master - merged' and circled in red), 'EEG #' (empty), and 'Designated Rev.' (empty).

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.
7. OR
8. Click the **Merge** toolbar button.
3. The **Merge Studies** box appears. You may choose to delete the original studies after the merge.



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).

22.14. 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)

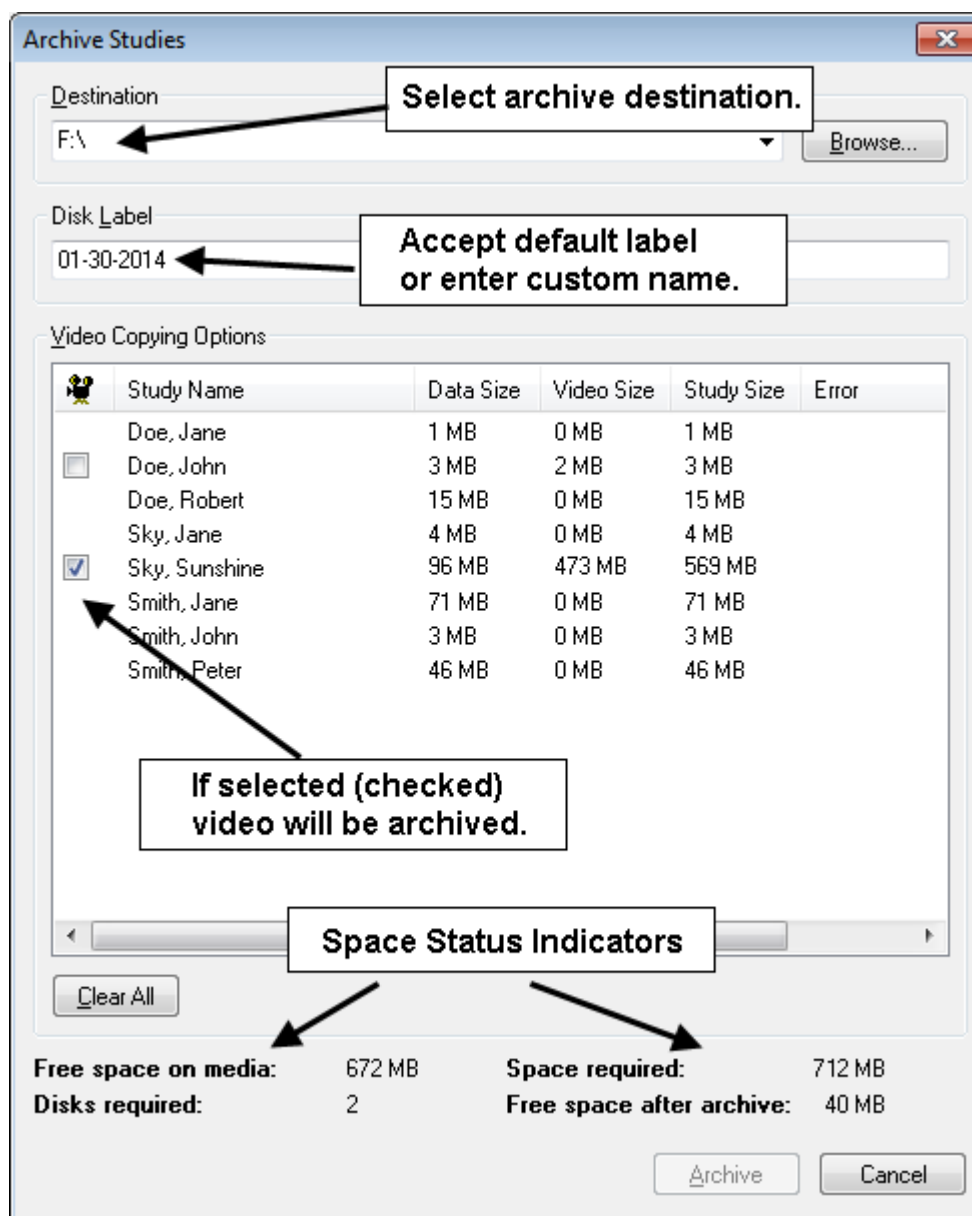
Since many studies are too large to fit on a CD, you should clip and prune studies before archiving. The procedure for pruning a study is different depending on whether the studies were recorded in SleepWorks or NeuroWorks EEG.

Please contact **Natus Technical Support** (OTS@natus.com) for additional information 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



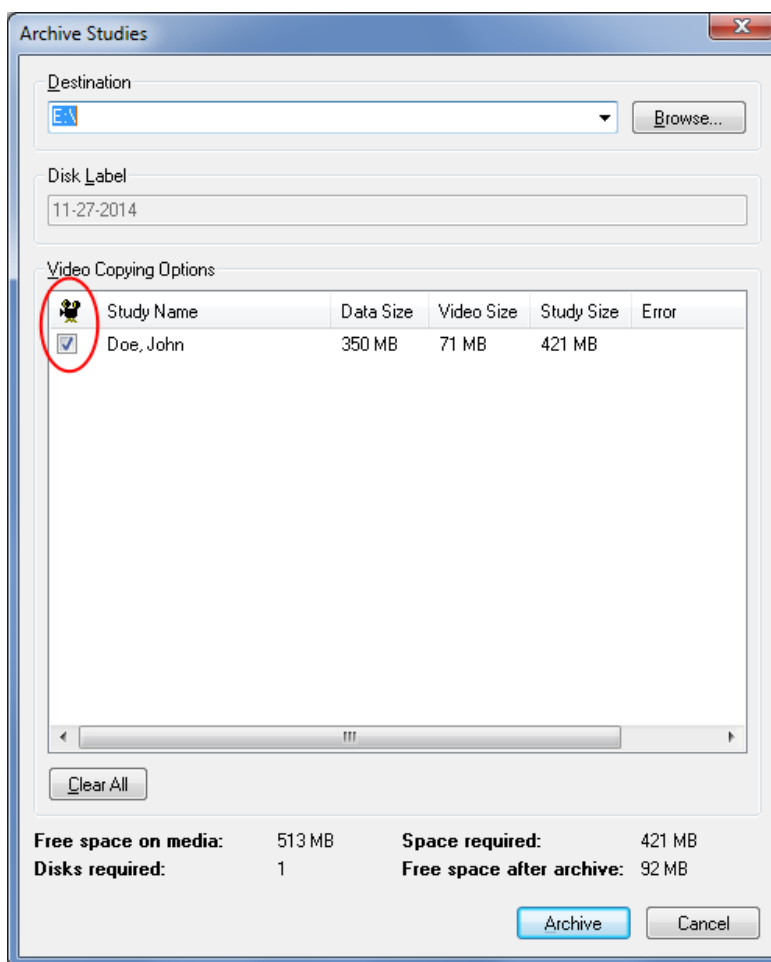
Archive Studies Dialog

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.



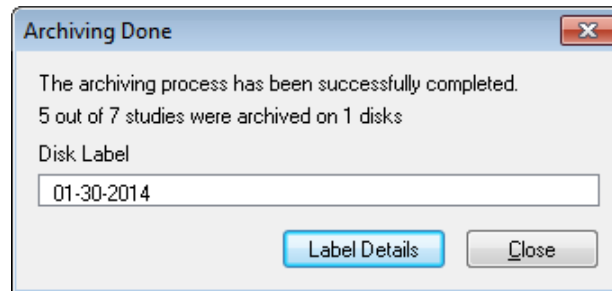
The screenshot shows the 'Archive Studies' dialog box. It has a 'Destination' dropdown menu with a 'Browse...' button. Below that is a 'Disk Label' text box containing '11-27-2014'. The 'Video Copying Options' section contains a table with columns: Study Name, Data Size, Video Size, Study Size, and Error. The first row shows 'Doe, John' with a checked checkbox in the first column. At the bottom of the table is a 'Clear All' button. Below the table, summary information is displayed: 'Free space on media: 513 MB', 'Disks required: 1', 'Space required: 421 MB', and 'Free space after archive: 92 MB'. At the very bottom are 'Archive' and 'Cancel' buttons.

Study Name	Data Size	Video Size	Study Size	Error
☒ Doe, John	350 MB	71 MB	421 MB	

Free space on media: 513 MB Space required: 421 MB
Disks required: 1 Free space after archive: 92 MB

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*.



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		-	
Doe, Robert		1/20/2014 1:58:57 PM		-	
Smith, 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.

22.14.1.1. 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.

			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		-	
Doe, Robert		1/20/2014 1:58:57 PM		-	
Smith, Heather		1/24/2014 11:26:57 AM		-	

CD Label

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, 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 > CD Label.

3. The **CD Label 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).

Current filter Previous Filter

Filters... Save...

☐ Display all studies
☐ Display all patients (last visits)
☒ Search by the criteria below

☐ Show only patient info (last visit)
☒ Study creation date
 Between 11/1/2010 and Today
☒ Designated reviewer
 Dr. John Doe
☒ Patient(s)
 Smith, Jane

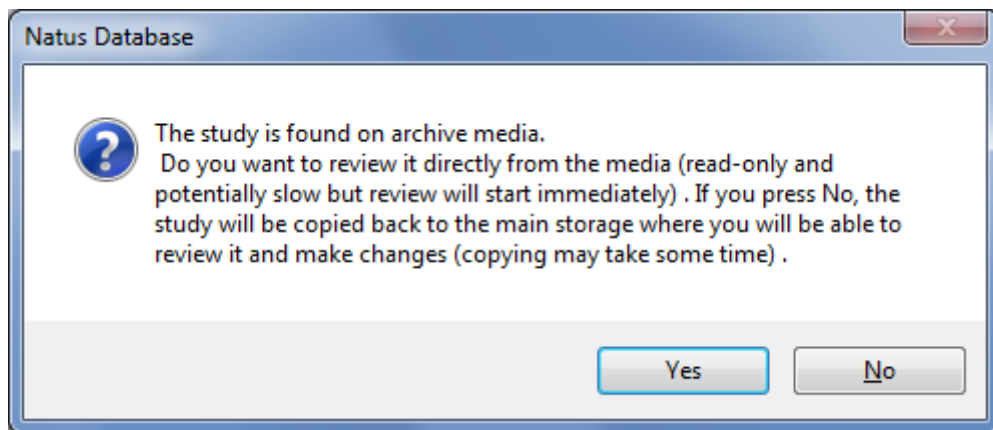
☐ Advanced search Configure...

Search



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**.

22.15. 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.

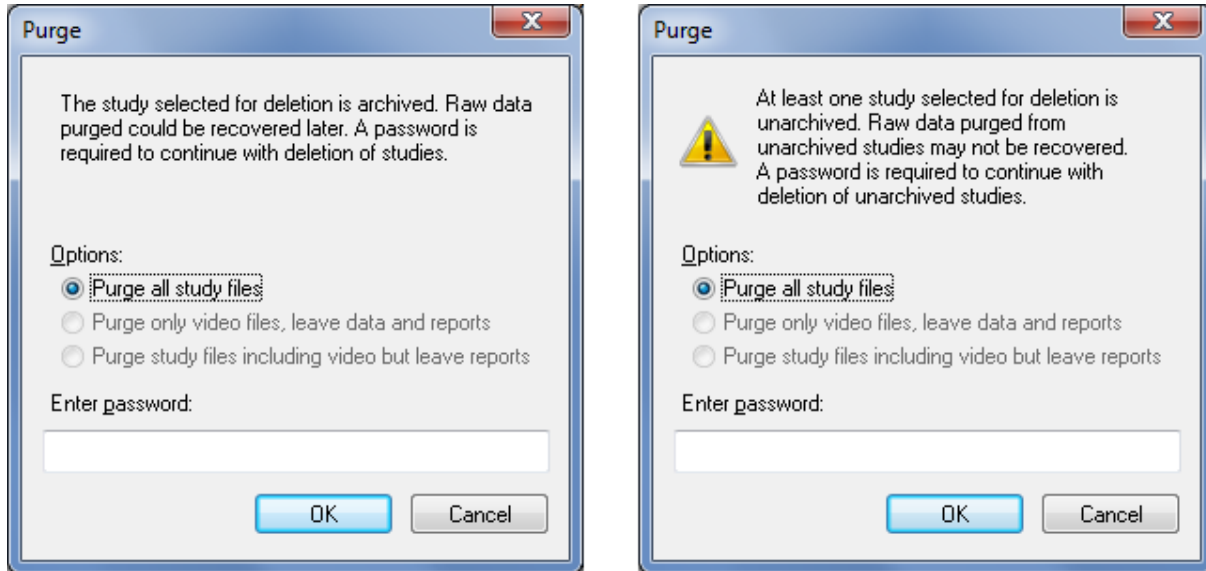
To purge a study:

1. Select the study record in Natus Database.
2. Do any of the following:

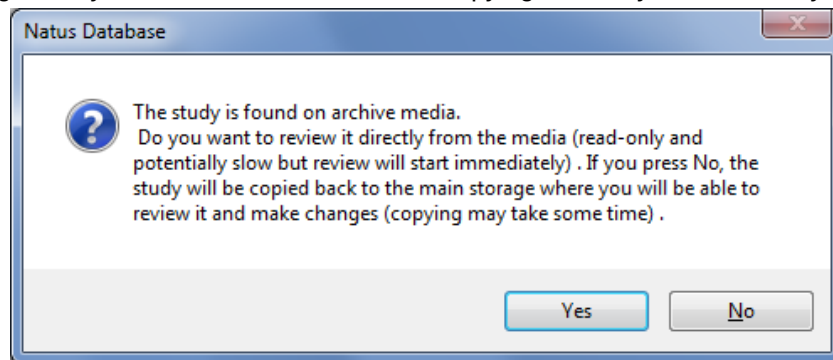


- Click the **Purge**  button.
- Choose Administration > Purge.

- 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**.



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.



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.

22.16. Importing and Exporting Studies

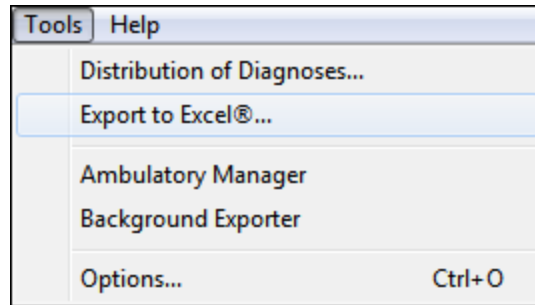
Exporting List of Studies to Excel

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 <i>without</i> 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.

You can use study data with...	Description...
HL7	An XML-compatible format to be used with Mirth HL7 connectivity products.
Other 3rd party software	EDF/EDF+ : A format that can be used with third-party software tools.

Please contact Natus Technical Support (OTS@natus.com) for additional information on this topic.

There are two cases where you can import updated study data back into the original system:

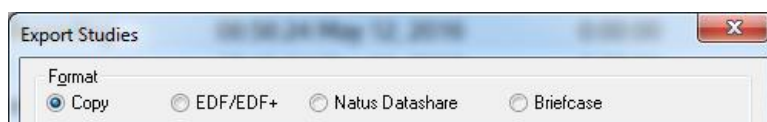
- If you update a study using another NeuroWorks you can import the updates back into the original system. The most common example of this is when a physician takes a study home to review it on a laptop with NeuroWorks then later imports the updates back into the clinic system.
- You can import updates to the original study using HL7.

22.16.1.1. Exporting Study Data to another System



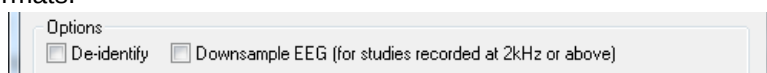
NOTE: When exporting a study collected at 2000Hz or higher, you can choose to keep only the down-sampled data with the export.

Four export formats are available:



- **Copy** – All the study data
- **EDF/EDF+** – Format to EDF/EDF+ to be used with third-party software
- **Natus Datashare** – Copy the study data to a CD/DVD along with a light version of the NeuroWorks software for computers that are not currently running NeuroWorks
- **Briefcase** – Copies only the study data that is updated as it is reviewed (excludes raw EEG/PSG data)

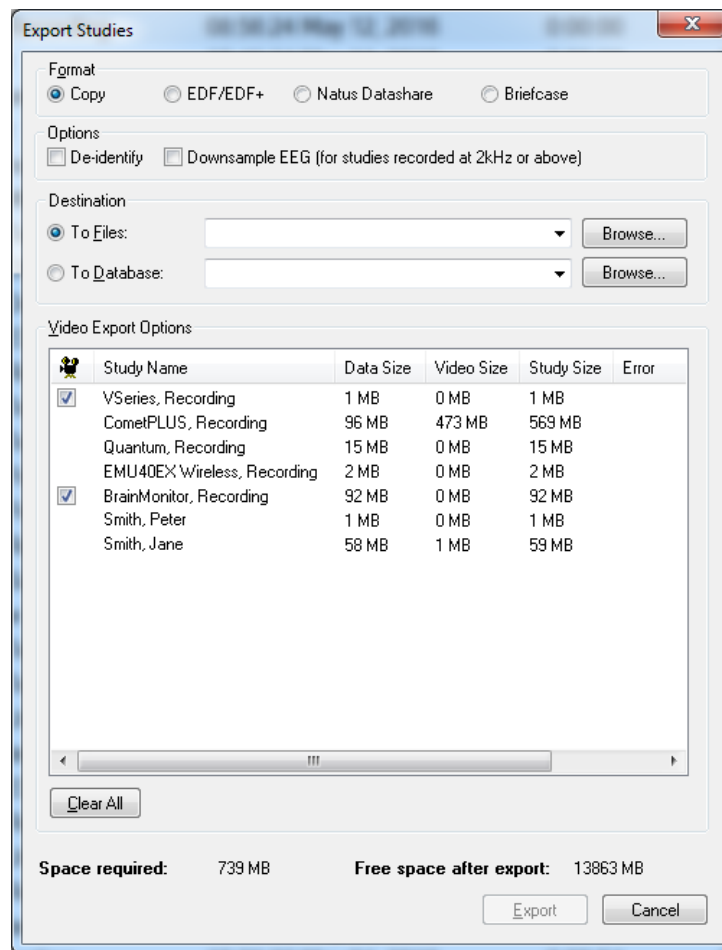
There are two additional export options only available when choosing the **Copy**, **Natus Database**, or **Briefcase** export formats.



- **De-Identify** – All the study data except for patient identification information
- **Downsample EEG** – Only the decimated data file versus the full data file
- Refer to the [EDF/EDF+ Import and Export](#) section for additional export options.

To export study data:

1. In Natus Database, select (highlight) the study or studies you want to export.
2. Choose **Administration > Export**. Alternately, you can right-click and select **Export...** from the context menu. 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/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 complete the export of the studies.

Export Format Options

22.16.1.2. Copy – Exporting Studies by Copying to a new location

If you would like to copy a study to a new data or database location, use the **Copy** option.

22.16.1.3. EDF/EDF+ – Exporting Studies for Use with 3rd Party Software

If you want to use study data with 3rd party software, use the **EDF/EDF+** option for exporting data.

TIP: If you want to exclude patient identification information from the exported data, select the De-identify checkbox in the export template prior to exporting the study using the EDF/EDF+ option. For more information on de-identification during export to EDF/EDF+, refer to Step #8 under the [Creating an Export Template](#) section.

22.16.1.4. 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.

22.16.1.5. 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.

Export Options

22.16.1.6. De-identify

If you want to exclude patient identification information from the exported data, select the **De-identify** checkbox before exporting the study. For more information on de-identification during export to EDF/EDF+, refer to Step #8 under the [Creating an Export Template](#) section.

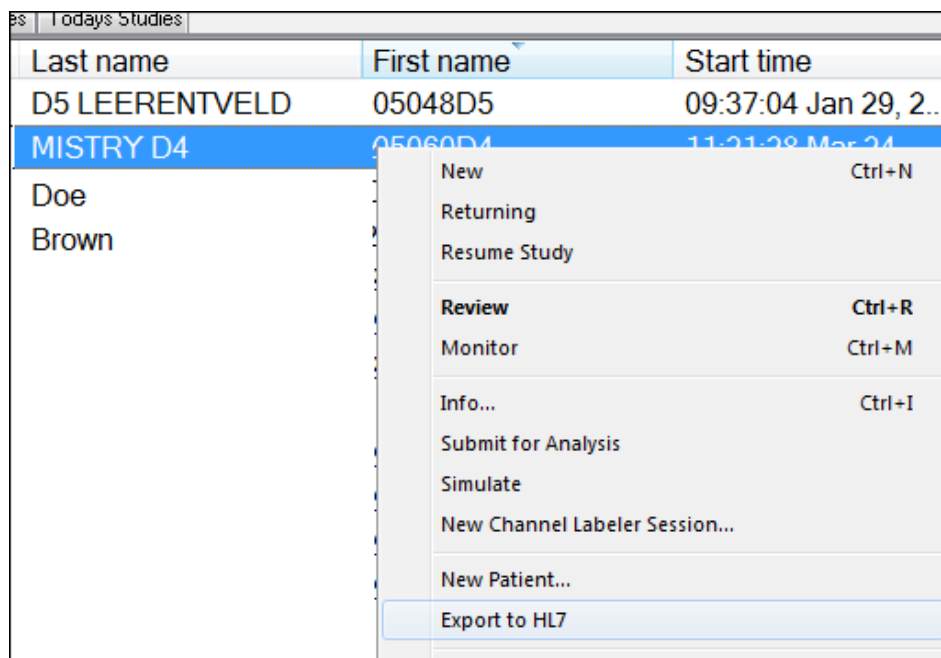
22.16.1.7. Downsample EEG (for studies recorded at 2kHz or above)

If you would like to export only the decimated data file versus the full data file, select the Downsample EEG (for studies recorded at 2kHz or above) checkbox prior to exporting the study.

22.16.1.8. 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.

22.16.1.9. Exporting of Reports to HL7 in PDF Format

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.

22.16.1.10. 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).

HL7 Import / Export:

☒ Import ADT messages from path (XMLIn*.*) every: 3 minutes
 D:\NeuroWorks\XMLInput\ Browse...

☐ Delete "New Patient" entries older than: 90 days

Export ORU messages to path (XMLOut*.*) :
 D:\NeuroWorks\XMLOutput\ Browse...

☒ Export reports to HL7: ☒ Convert Word reports to PDF
☐ Embed reports in HL7 message using Base64
☒ Copy report files to this path and provide a link in HL7 message:
 D:\NeuroWorks\XMLOutput\Reports\ Browse...

Auto-export to HL7 after:

- ☐ Acquiring a study
- ☐ Reviewing a study
- ☐ Changing study information
- ☐ Purging a study
- ☐ Merging a study
- ☐ Marking a study "reviewed"

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

22.16.1.11. Importing Study Data from another system

To import study data from another system:



1. In Natus Database, click the **Import** button on the main toolbar (or choose **Administration > Import**). The **Import Studies** box opens.

Import Studies

☒ From Files: C:\Users\xluser\Desktop\EDF Browse...
☐ From Database: Browse...
☐ From Briefcase: C:\Users\xluser\Desktop\XLtek studies\E\Brown~Joe_9e Browse...

Select Studies for Import: ☐ Native Studies ☒ EDF Studies

Patient Name	Creation Time	Durati...	Template
Female57yrs	00:00:00 Mar 07, 20...	0:15:00	default
XX	01:53:01 Oct 14, 2013	7:55:32	default
EtCO2,Test	01:53:01 Oct 14, 2013	7:48:54	default
Male35yrs	03:50:00 Oct 24, 2009	0:15:00	default

Selected: 1 Studies **Space Required:** 727 MB
Import target: XLLAP01 **Free space after import:** 37057 MB

Import Close

Import Studies Box

2. Select the import source (**File**, **Database**, or **Briefcase**). A list of studies eligible for import appears.
3. Select one of the following:
 - To import studies originally collected using the NeuroWorks software, select the **Native Studies** radio button.
 - To import studies originally collected using 3rd party software, and which are in EDF/EDF+ format, select the **EDF Studies** radio button.
4. Select one or more studies. Space required for their import is indicated at the bottom of the box.
5. 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.

22.16.1.12. Importing Patient and Study Data from HL7

To import patient and study data from HL7:

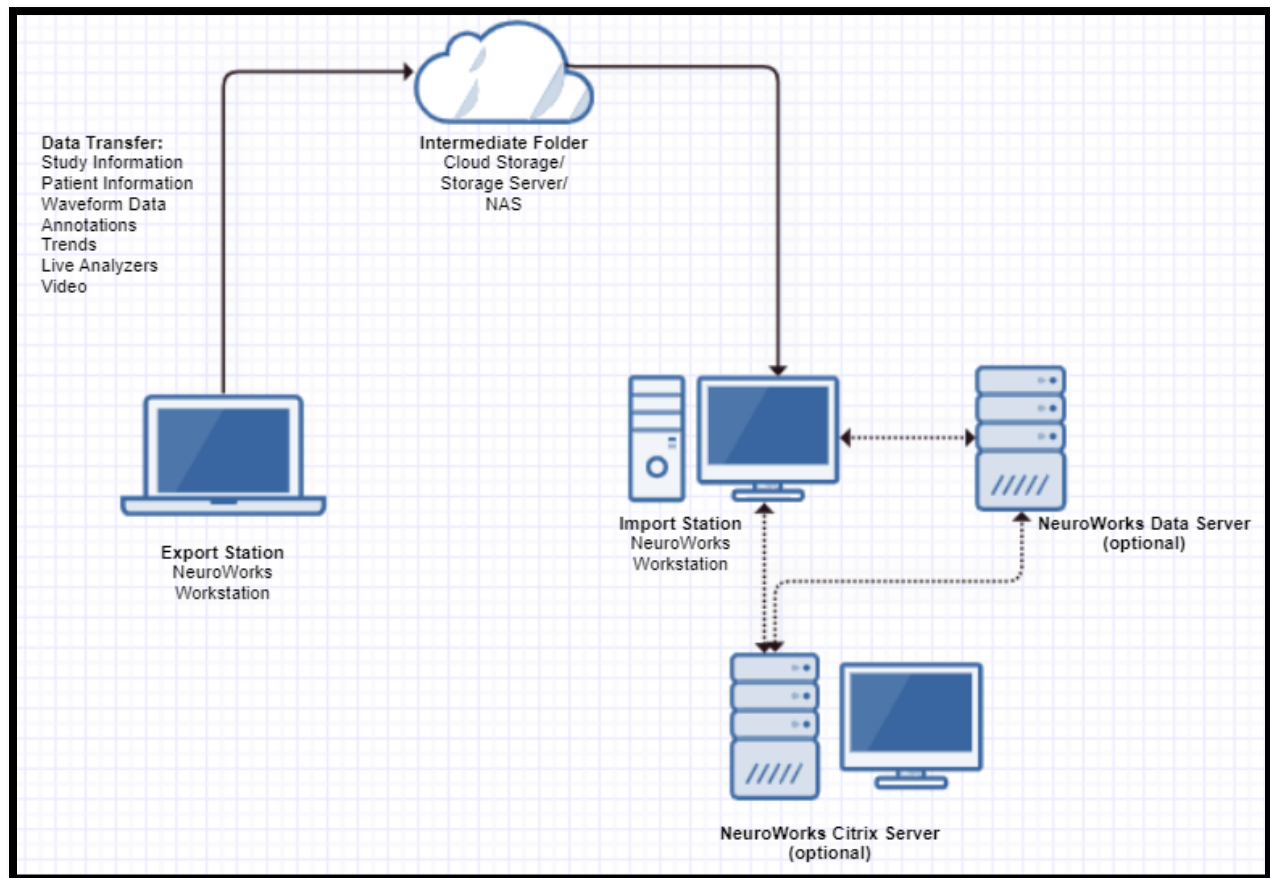
1. Copy the data into the **Import** directory, which is checked for updates (new patient data records) at a configurable frequency.

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.

22.17. Automated Export and Import to Remote Locations

22.17.1.1. Overview

Automated export and import is a new feature introduced in NeuroWorks v9.3. The tool facilitates automated transfer of a study from an acquisition station (export station) to a remote location (import station) for review or archiving. It is useful for transferring files among facilities that are not on the same network, but who have access to a common folder, such as a storage server or a cloud location.



Overview of Live Export/Import Data Transfer

NOTE: Export and import in the context of this section refers only to the process managed by the Export/Import Agent for file transfer between remote facilities. It does not describe legacy export tools designed for removable media drives, Datashare, EDF/EDF+, or locations on the same network, etc.

22.17.1.2. Pre-requisites for Automated Export and Import

The automated export and import setup requires three distinct resources:

1. **An export station:** A NeuroWorks workstation (acquisition or review station) with network or high-speed internet access to the intermediate folder. For ambulatory studies, the export station may be located in a patient's home.
2. **An intermediate folder:** A network file location accessible by both the export and import station with sufficient storage to host data from multiple studies during transfer. It is typically located on Microsoft Azure Cloud Storage or is a resource on the same network as the import station (accessible to the export station via VPN). A bandwidth of at least 3 MBps is recommended for typical NeuroWorks study sizes (<20 Gb/day). Export and import functionality with an intermediate cloud storage is limited to workstations on Windows 10 systems.
3. **An import station:** A NeuroWorks workstation (acquisition, review or monitoring station) with network access to the intermediate folder and access to the final destination database (local or networked). From the review workstation, the data can further be stored on a shared resource database (NeuroWorks Data or NAS Server). It can also be reviewed from a NeuroWorks Citrix station.

22.17.1.3. Terms and Definitions

Term	Definition
Export Station	The NeuroWorks workstation from which the source study data is exported. It can be at a satellite site where the study is acquired (and subsequently transferred to the primary hospital/clinic for final review and archiving). It can also be at a patient home in the case of ambulatory studies with Trex HD and Trex HD Monitoring.
Import Station	The NeuroWorks workstation that imports the study to a final destination database for review and archiving. It is located on the primary hospital/clinic which 'owns' the final study.
Automatic Export	A mechanism used to copy a study from a local storage resource to a remote intermediate folder (e.g. Azure cloud storage or network file location, including those accessed over a VPN). The study is copied in small segments periodically from the local storage location to this remote location.
Automatic Import	A mechanism used to import a study from an intermediate folder (e.g., Azure cloud or network file location) to a target storage resource. The target storage resource is considered to be the final destination of the study. Automatic Import mimics the process of receiving a recorded study and supports a workflow similar to 'Review Current Study'.
Intermediate Folder	A storage resource on Azure cloud or a networked location (accessible by VPN as needed). It is the target of the Automatic Export and source for the Automatic Import.
Remote/Live Review	Remote/Live Review in the context of the Automated Export/Import workflow refers to review of a study on the import station that has not yet been finalized. The study opens in a read-only mode and refreshes, or grows, as additional raw data, annotations, video files and trending information is acquired or added to the live study. This applies to both ongoing studies and pre-recorded studies introduced into the Export pipeline.

22.17.1.4. Creating Export and Import Profiles

The automated export and import process is configured in the Export/Import Agent tool via Export and Import profiles. An Export profile is created on an acquisition machine (or an Export station) and allows the user to specify an intermediate folder (typically located in a cloud storage or a remote file location accessed by VPN). An Import profile is created on the final storage location (connected to an Import station) and specifies the intermediate folder from which studies are accepted and imported into the final storage location.

The **Export/Import Agent Profile Editor** is used to configure export and import profiles. The following steps illustrate how to use this tool to create a new Export or Import profile.

To open the Export/Import Agent Profile Editor, perform the following steps:

1. In **Natus Database**, click on **Tools > Options > Advanced tab**, and under **Export/Import agent**, click on **Settings**.

Or

In **Natus Database**, click on **Tools > Export/Import Agent >** right-click a blank space in the window and select **Settings**.

Export/Import Agent Profile Editor [EXPORT2]

Profile Settings

☒ Profile enabled ☒ Export ☐ Import

Intermediate folder: \\192.168.30.30\g\test

Destination path: \\02tonb056\neuroworks\neuroworks.dsn

Destination type: ☐ File ☒ Database

Recovery interval (sec): 0

Max retry count: 15

Ping threshold (sec): 45

Throttle delay (ms): 50

☒ Expedite raw data transfer

☒ Remove finalized tasks

☐ Auto-finalize on completion

☒ Transfer finalized raw data only

☐ Suspend video export until finalizing

Bandwidth Test

Write MB/sec : -

Read MB/sec : -

Start Stop

Profiles: * EXPORT2

Advanced... Defaults... Apply Cancel

Export/Import Agent Profile Editor

2. In the **Export/Import Agent Profile** window, select “**Profile enabled**”, and click **Export** or **Import**.
3. For an Export profile:

- a. Enter an Intermediate folder location in a UNC format (this can be a verified Azure Cloud location or VPN storage).
- b. Next to “**Profiles**”, press the **New** icon and enter a profile name. The profile name can be edited using the **Edit** icon.
- c. Click **Apply**.

NOTE: It is highly recommended that an export machine (i.e. a station that never intends to receive studies) be configured as an export location only. To do this, click **Advanced** and under **Agent transaction type**, select **Export only (typical for acquisition stations)**. In turn, the same is recommended for an import location that does not acquire studies.

4. For an Import profile:
 - a. Enter the same Intermediate folder location in a UNC format (this can be a verified Cloud location or VPN storage) as the intended paired Export profile.
 - b. Enter a Destination path in UNC format, to a folder or DSN file to a NeuroWorks database on the final destination.
 - c. Select Destination type **File** (to import into a DSN folder for later transfer into NeuroWorks database) or **Database** (to automatically import into the NeuroWorks database).
 - d. Next to “**Profiles**”, press the **New** icon and enter a profile name. The profile name can be edited using the **Edit** icon.
 - e. Click **Apply**.

Note: Only one of each Export or Import profile can point to the same Intermediate folder. For multiple active profiles, separate intermediate folders must be used (an intermediate folder should NEVER be nested within another).

Once an Export profile is created and saved, the export profile is selected when starting a new study on the Study Information dialogue, under **Profile > Live Export**. The selected profile is retained for Resuming studies, but may be overridden for Returning studies.

An Import profile, on the other hand, once configured and saved on an Import location becomes active immediately and imports any study data that is transferred to its intermediate location. Multiple import profiles may be active on an import location. The maximum simultaneous export and import sessions may be configured using the **Export/Import Agent Profile Options > Advanced Settings**.

22.17.1.5. Default Custom Fields for Export and Import

The following Export and Import (EIA) custom fields are available to add to the Natus Database:

- **EIA Profile** – the name of the import profile used to import the study.
- **EIA Status** – the transfer and study status.
- **EIA Owner** – the name of the station on which the study was recorded.
- **EIA Hint** – tells the Export/Import Agent that the source study has been finalized. It is also used on the import-side in the special case where the study in the final destination has been pre-finalized.
- **Study Status**  – the symbol  indicates that the study is participating in the automated export / import pipeline.

22.17.1.6. Export/Import Workflow Quick Guide

Transferring Live Studies

Recommended Export Profile Settings....	
✓	Expedite raw data transfer
✓	Remove finalized tasks
✓	Transfer finalized raw data only
✓	Retain LTM member study ID (LTM studies only)

1. Ensure the **Export/Import Agent** is enabled on both the Export and Import workstations. In Natus database, click **Tools > Options > Advanced (tab)** > click to enable “**Run export/import agent in background**”.
2. Start a new EEG study and on the **Study Information** dialogue, select a **Live Export** profile from the dropdown menu. Enter all other pertinent information and press **Start**.
3. Confirm the export is logged by the job viewer on the acquisition station. In Natus database, select **Tools > Export/Import Agent**.
4. On the Import station, open the job viewer and check if the import is logged. Note that it may take a few minutes for the job viewer to process the data on the Import station.
5. The study record will appear on the database of the Import station once the first segment of study data is written (this can take 1.5 hours or more).
6. The first segment of EEG data is available for read-only review (or remote review) on the Import station.
7. When ready, stop study acquisition on the acquisition station. The job viewer will show the Status as **Completed** when outstanding study and video data is transferred.*
8. On the Export station, mark the study as **Finalized** by right-clicking the record in the job viewer or in Natus database and select **Finalize**
9. After finalizing, the study can be opened for editable review on the Import station**.

**During the Completed state, the study can be Resumed if needed (forcing the status back to In Process).*

***The Export station must remain online and connected until the study reaches the Finalized state.*

For more information on LTM studies, see the section “LTM Study Sets” below.

Transferring Live Studies with Ambulatory Headboxes

Recommended Export Profile Settings....	
✓	Expedite raw data transfer
✓	Remove finalized tasks
✓	Transfer finalized raw data only
✓	Suspend video export until finalizing (recommended to reduce bandwidth requirement at Export station)

1. Follow steps 1 – 6 as above.
2. When ready, stop study acquisition on the acquisition station. The job viewer will show the **Status** as **In Process** or **Complete**. Upload any remaining ambulatory data recorded to the headbox using Ambulatory Manager.
3. On the Export station, mark the study as Pre-finalized by right-clicking the record in the job viewer or in Natus database and select **Pre-finalize**.
4. After pre-finalizing, the study can be opened for editable review on the Import station.
5. When video is ready to be transferred, on the Export station, mark the study as **Finalized** to push video files.

Transferring Pre-recorded Studies

Recommended Export Profile Settings....	
✓	Expedite raw data transfer
✓	Remove finalized tasks
✓	Transfer finalized raw data only
✓	Auto-finalize on completion

1. Ensure the **Export/Import Agent** is enabled on both the Export and Import workstations. In Natus database, **click Tools > Options > Advanced (tab) > click to enable “Run export/import agent in background”**.
2. Right-click on the study record in Natus database on the Export station and select **Live Export > Add to Live Export**.
3. In the Select Export Profile dialogue, select an Export profile. Click **OK**.
4. Confirm the export is logged by the job viewer on the acquisition station. In Natus database, select **Tools > Export/Import Agent**.
5. On the Import station, open the job viewer and check if the import is logged. Note that it may take a few minutes for the job viewer to process the data on the Import station
6. The study record will appear on the database of the Import station once the first segment of study data is written. The first segment of EEG data is available for read-only review (or remote review) on the Import station. When the transfer is complete, the Status in the job viewer will show as “Finalized”.

In each of the above scenarios, “Expedite raw data transfer” should also be enabled on the Import profile. Once transfer is complete, the study owner can release the study from the Import/Export pipeline by right-

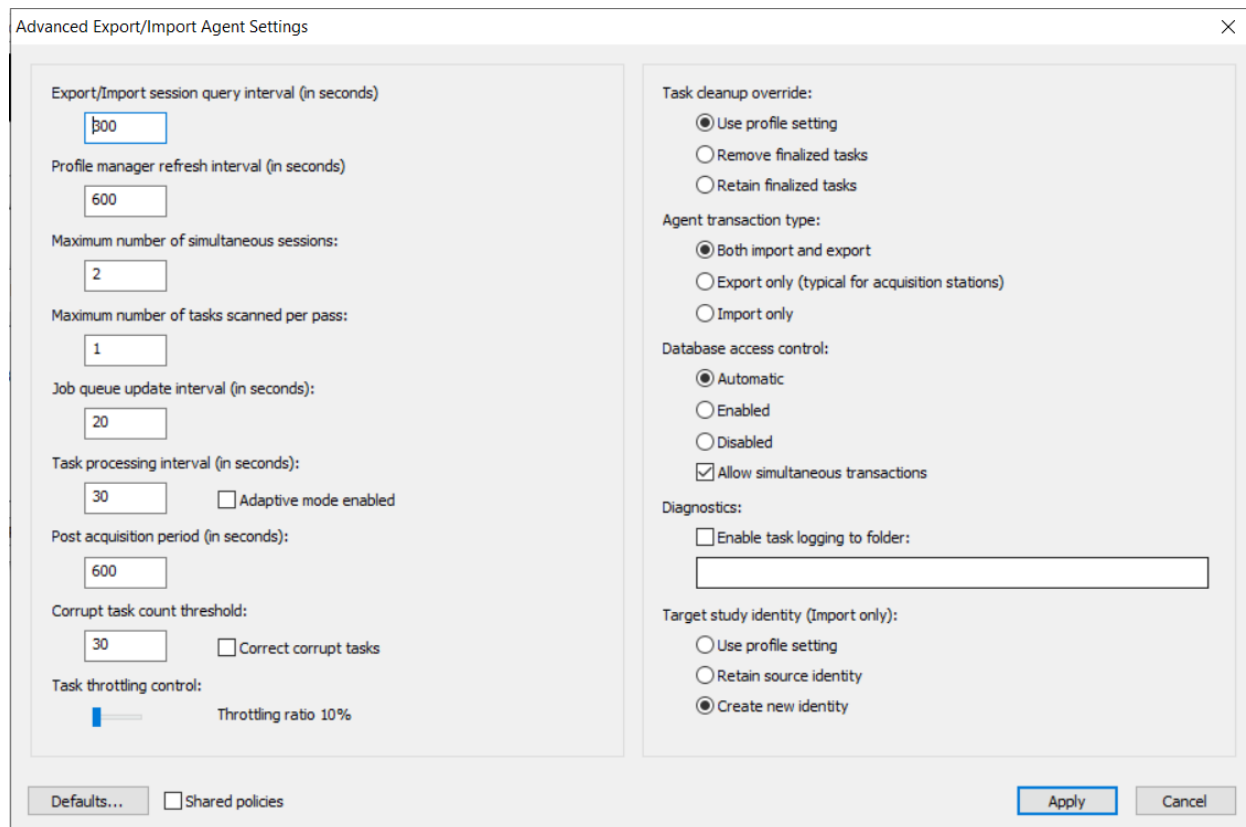
clicking on the study record in the Natus database (on the Export station) and selecting **Live Export > Release from Live Export**.

Select Export/Import Agent Profile Options

Option	Purpose
Expedite raw data transfer	For transfer of a pre-recorded study, this option copies peripheral files and the first ETC/ERD pair initially, and then successive pairs of ETC/ERD files. This allows the study to be reviewed sooner in the final destination even though it will be shorter. When this option is enabled, video (AVI) files are also copied in batches in order to provide early video review as well. This option is also recommended in order to allow tracking of the progress of a study transfer such that if it is interrupted, the transfer can resume instead of starting over.
Remove finalized tasks	This option removes bulky study files and also smaller session tracking files from the the intermediate folder once the study is Finalized in the import destination. When this option is not enabled, only session tracking files are retained in the Intermediate folder.
Auto-finalize on completion	This option enables auto-finalizing of imported studies. It is recommended only for transfer of pre-recorded or live studies which have no possibility of additional uploaded/backfill data (specifically, non-ambulatory headboxes). It does not apply to LTM Study Sets (but it does apply to their member studies).
Transfer finalized raw data only	This option ensures each study segment (or ETC/ERD pair) must be finalized (no longer being written) before it is a candidate for export.
Suspend video export until finalizing	This option suspends transfer of video (AVI) files from the export station to the intermediate folder until the study is marked as Finalized.
Retain LTM member study ID	In the default workflow, each source study transferred through the Export pipeline is assigned a new study ID (GUID) during the transfer from the intermediate folder to the final destination. This option retains the source study GUID through to the import station for each member study of an LTM Study Set.

22.17.1.7. Export/Import Agent Profile Options – Advanced Settings

Options in the Advanced Settings dialog apply to the local agent for the export/import agent (unless they are synchronized to other workstations using the “Shared policies” option).



The dialog box is titled "Advanced Export/Import Agent Settings" and contains two main panels of settings. The left panel includes input fields for "Export/Import session query interval (in seconds)" (300), "Profile manager refresh interval (in seconds)" (600), "Maximum number of simultaneous sessions" (2), "Maximum number of tasks scanned per pass" (1), "Job queue update interval (in seconds)" (20), "Task processing interval (in seconds)" (30) with an "Adaptive mode enabled" checkbox, "Post acquisition period (in seconds)" (600), "Corrupt task count threshold" (30) with a "Correct corrupt tasks" checkbox, and a "Task throttling control" slider set to 10% with a "Throttling ratio 10%" label. The right panel includes "Task cleanup override" with radio buttons for "Use profile setting" (selected), "Remove finalized tasks", and "Retain finalized tasks"; "Agent transaction type" with radio buttons for "Both import and export" (selected), "Export only (typical for acquisition stations)", and "Import only"; "Database access control" with radio buttons for "Automatic" (selected), "Enabled", and "Disabled", plus a checked "Allow simultaneous transactions" checkbox; "Diagnostics" with an unchecked "Enable task logging to folder:" checkbox and an empty text field; and "Target study identity (Import only)" with radio buttons for "Use profile setting", "Retain source identity", and "Create new identity" (selected). At the bottom, there is a "Defaults..." button, a "Shared policies" checkbox, and "Apply" and "Cancel" buttons.

Advanced Export/Import Agent Settings

Export/Import session query interval (in seconds): 300

Profile manager refresh interval (in seconds): 600

Maximum number of simultaneous sessions: 2

Maximum number of tasks scanned per pass: 1

Job queue update interval (in seconds): 20

Task processing interval (in seconds): 30 ☐ Adaptive mode enabled

Post acquisition period (in seconds): 600

Corrupt task count threshold: 30 ☐ Correct corrupt tasks

Task throttling control: Throttling ratio 10%

Task cleanup override:

- ☒ Use profile setting
- ☐ Remove finalized tasks
- ☐ Retain finalized tasks

Agent transaction type:

- ☒ Both import and export
- ☐ Export only (typical for acquisition stations)
- ☐ Import only

Database access control:

- ☒ Automatic
- ☐ Enabled
- ☐ Disabled
- ☒ Allow simultaneous transactions

Diagnostics:

- ☐ Enable task logging to folder:

Target study identity (Import only):

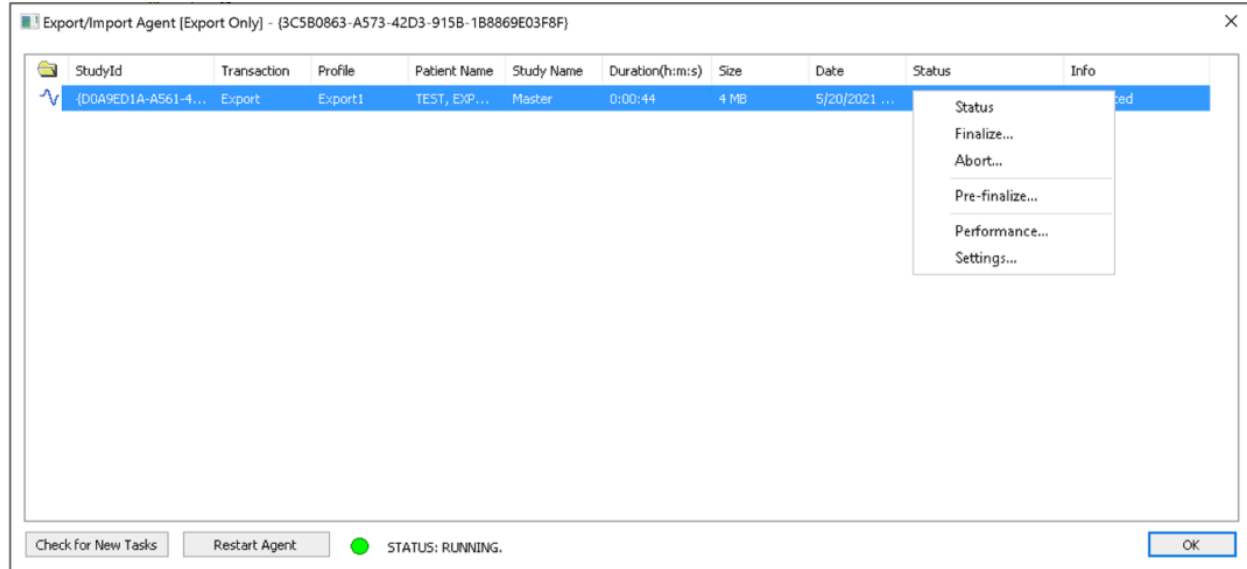
- ☐ Use profile setting
- ☐ Retain source identity
- ☒ Create new identity

Defaults... ☐ Shared policies Apply Cancel

Export/Import Agent Profile Options – Advanced Settings

22.17.1.8. Using the Export/Import Agent Job Viewer

The data transfer progress may be tracked using the Export/Import Agent job viewer on both the Export and Import station. This agent acts as a job viewer for the automated export/import pipeline pertaining to its workstation, and is located by clicking on: **Natus Database > Tools > Export/Import Agent.**



Export/Import Agent Job Viewer

Several options are available to view the details of the transfer. The job viewer can also be used to mark the state of the study (abort, finalize and pre-finalize the study) and to check on the network performance by right-clicking on the study and selecting one of the menu options.

The following study states apply:

Study state	Description	User controlled
In process	The state of study when it is actively being transferred through the Automatic Export/Import pipeline. During this state, the study is available for review in “read-only” mode on the import station.	No
Completed	The state of a study reached when the Automatic Export/Import indicates that the source study has ended (meaning acquisition has ended and all study files have been transferred). In this state, additional data can be appended to the source study via ambulatory upload / back-fill, or Resume Study operations.	No
Pre-finalized	The state of a study reached when Automatic Export/Import cannot receive any further study updates with the exception of video files. This option is only available when “Suspend Video Transfer until Finalizing” is checked on the export profile.	Yes
Finalized	The state of a study reached when the Automatic Export/Import cannot receive further updates and has completed any outstanding integration (merge) operations (including ambulatory upload / back-fill). Resume Study is also unavailable in this state.	Yes

22.17.1.9. Suspend Video Transfer until Finalizing Feature

The “**Suspend Video Transfer until Finalizing**” is a feature option in Export profiles. This option is recommended in environments with potential or known bandwidth limitations, such as patient home settings used for ambulatory studies. The purpose of the feature is to reduce the bandwidth requirements of the transfer by holding back the video files from automated transfer process.

*Note: For ambulatory studies recorded with Trex HD and Trex HD Monitoring, after a study has stopped recording, all remaining ambulatory data is uploaded using Ambulatory Manager, and all non-video study data is transferred through the pipeline, the **Info** section in the Export/Import agent states “**Pre-finalize**”, prompting the user to pre-finalize the study.*

Video can be manually transferred once the study is in Completed state, or marked to Pre-finalized state. During this state, the Info section in the Export/Import Agent states “**Pending Video**”. The study can also now be opened for Review in *editable mode* on the import station.

To transfer video data, simply mark the study to **Finalized** using the job viewer or by right-clicking the record in the Natus database and selecting the Finalize option. The study state registers as Finalized once all pending video data has transferred.

22.17.1.10. Reviewing Live Studies within the Export / Import Framework

Study data that is transferred is available for read-only review until it is Finalized in the live export pipeline. Information added to any tab in the “**Study Information**” window on the acquisition station is also transferred.

The following information is auto-synchronized periodically between the export station (acquisition station) and import station during study acquisition:

- Patient information
- Waveform data
- Annotations
- Trends
- Live Analyzers
- Study Information
- Video

Various options are available for reviewing studies that are actively being transferred through the Export/Import pipeline, depending on user needs for reviewing and reporting on the data:

- **Option 1: Configure live trends, analyzers and add annotations to acquisition window.**
Annotations and trends in the acquisition window are transferred along with the waveform data. This includes annotations added even after the segment of waveform data is already transferred.
- **Option 2: Add annotations when study is opened for Review on acquisition station.**
Annotations added when the study is opened for review using “Review Current Study” option are transferred to the import destination.
- **Option 3: Open study in read-only review on import station.**
- **Option 4: Stop a live study after the required amount of study data is transferred. Use Returning Study option to restart recording and to create a new study record.**
Alternatively, configure the study to automatically Restart according to the desired schedule.

Once a study stops recording and all data is transferred through the pipeline, it can be marked as Finalized and opened in editable Review. This process is followed for the next segment, and so on.

22.17.1.11. Exporting Pre-recorded Studies

Pre-recorded studies may be transferred through the Automated Export and Import pipeline similarly to actively acquired studies. To transfer pre-recorded studies:

1. Create a pair of Export and Import profiles that point to the same intermediate destination. It is recommended to select “**Auto-finalize on completion**” option in the Export profile.
2. In the export station, select the study record in Natus database. Right-click on the study record and select **Live Export > Add to Live Export**.
3. If needed, mark the study on the import database as **Finalized**.

Note that the study record will not appear in the import station database until the entire study has been transferred. To mitigate this, select the “**Expedite raw data transfer**” option in both the Export and Import profiles. This allows earlier access to the review data as it becomes available, however, it can take more time to transfer the entire study using this method.

A useful indicator of the status of the transfer is the **percentage** (a numerical value in parenthesis) under the **Info** tab of the Export/Import agent. On the export station, this value indicates the approximate percentage of study data that has been transferred to the intermediate destination. On the Import station, the value indicates the approximate percentage of *intermediate folder data* that has been imported to the final destination.

If multiple studies are intended to be transferred at the same time, configure the “Maximum number of simultaneous sessions” for each station accordingly, using the **Advanced** settings in the **Export/Import Profile Editor** (see **Scaling and Load-balancing Import Agents** below)..

22.17.1.12. LTM Study Sets Exporting LTM Study Sets

To export a pre-recorded LTM Study Set:

1. In Natus database, right-click on one of the LTM study set records and select **LTM Study > Select LTM Set**.
2. Right-click on one of the highlighted study records and click **Live Export > Add to Live Export**.
3. Select an Export profile and click **OK**.

Note: It is recommended to enable the “**Auto-finalize on completion**” option in the desired Export profile. The user should also make note of the maximum number of simultaneous transactions on both the export and import stations (configured in the Advanced settings of the Export/Import Profile Editor).

This process transfers the individual member studies as well as the Study Set file. While the member studies can be auto-finalized, the Study Set remains in Completed state until it is manually marked to **Finalized** after the member studies are auto-finalized.

Retaining LTM Member Study IDs

Normally, a study imported to the import location is provided with a new study ID (GUID). This section describes the steps to retain the GUID of the member studies of an LTM Study Set (in order to maintain a link to all member studies in the import database).

To retain the GUID of the member studies, enable the “**Retain LTM Member Study ID**” option on the Import profile.

If this procedure is not performed, the source (exported) and target (imported) LTM Study Set members may combine in the same virtual database in XLDB.

Maintaining the LTM Study Set Slideshow

The **LTM Study Set Slideshow** must be refreshed at the import station in order to capture any Slideshow annotations added to each of the member studies.

To refresh the Slideshow:

1. Open the Study Set for Review on the import station.
2. Expand the Slideshow window and click "**Refresh**" to scan the member studies for annotations marked with Slideshow memberships.

To force a rebuild of the Slideshow*:

1. Open the Study Set for Review on the import station.
2. Expand the Slideshow window and hold the CTRL key on the keyboard while clicking the "Refresh" button (this applies to Slideshows created for LTM Study Sets, and not those created by the Slideshow > Create Slideshow menu item in Natus Database).

** A rebuild of the Slideshow discards any customization of the order of slideshow annotations.*

22.17.1.13. Transferring Ownership when Acquisition Station is Unavailable

Studies that are exported from an acquisition station into an import station are "owned" by the acquisition station. The acquisition station must remain online and active on the automated export/import pipeline in order for its study to be finalized in the import database. This is not always possible, for example, if the acquisition station goes offline. During this time, the imported study can still be finalized by transferring after the owner releases ownership of the source study to another workstation's Export agent (the workstation must share the same storage resource as the acquisition station in Natus database).

To transfer ownership:

1. On the acquisition station's database, prior to going offline, release ownership of the study by right-clicking on the study record and in the dropdown menu, go to **Live Export > Release from Life Export**.
2. In the alternate workstation's database, right-click on the same study record and in the dropdown menu, go to **Live Export > Tools > Transfer ownership of live export**. Select an Export profile that points to the original intermediate folder.
3. Ensure the update is complete by observing the status in the job viewer of the alternate workstation (now the new export owner).

Note: Various study management options in Natus database are unavailable while a study is being transferred through the Export/Import agent (prior to being Finalized). If, for any reason, releasing from live export is blocked, the operation can be forced by right-clicking on the study record, holding Ctrl + Shift on the keyboard, and choosing **Live Export > Release from Live Export** in the dropdown menu.

22.17.1.14. Configuring Automated Export/Import Permissions with XLSecurity

Administrator can block selected users from exporting studies and creating / editing import profiles. To configure permissions for automated export/import:

1. Open **Natus Security Configurator**.
2. Select the Roles tab and double-click on the desired Role to open the Role Properties window.
3. In the Role Properties window, scroll down to **Live Export Operations** under Data Management, and click to mark an **X**.

22.17.1.15. Export/Import Performance and Limitations

Studies that are actively acquiring are transferred through the agent in periodic “segments” (or ETC/ERD pairs). It may take 1.5 hours or more for a typical study, recorded with 32 channels and 200Hz, to first appear in the Natus database of the import station. The next set of waveform data is received 1.5 hours or more later, and so on (when a new ETC/ERD pair is finalized). Studies recorded with more channels and a higher frequency can take longer to transfer through the pipeline.

Note: *In some cases, it has been observed that an initial short ERD file is generated and transferred to the import database within the first 10 minutes of recording, allowing the study to be opened for read-only review but with no EEG traces. This has minimal impact on the generation of the next ETC/ERD pair of study data. The record will eventually populate with the EEG traces and other study information as expected.*

The job viewer displays whether the task has been logged by the Export/Import agent, even before the study first appears in the database.

The above referenced delay is limited only to waveform data (along with analyzers, trends and annotations added during live acquisition). Other study data, including video and annotations added to portions of the live or review study that have already been imported, may transfer separately and often more quickly than waveform data segments. In either case, this information can only be viewed on the Import station after the waveform data has been transferred.

22.17.1.16. Scaling and Load-balancing Import Agents

A site importing studies may have one more Import Agents enabled on multiple workstations. The Import stations are typically NeuroWorks Monitoring or Review stations which have high up-times and excellent connectivity to the intermediate folders. An Import agent can support multiple simultaneous import tasks, however, at the expense of the transfer speed.

The following guidelines are recommended for scaling up and load-balancing Import agents:

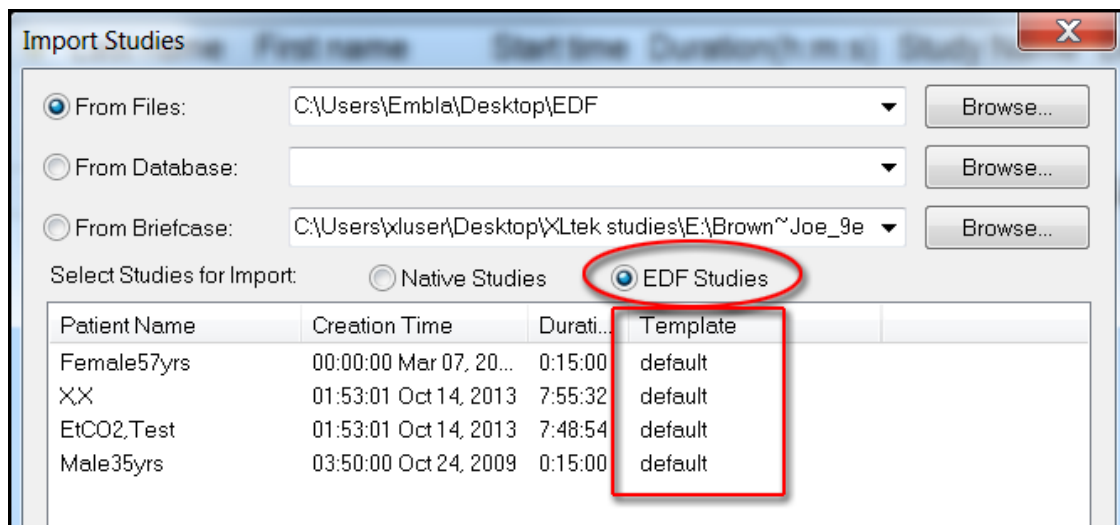
- Enable fewer simultaneous transactions per Import agent. No more than 3 simultaneous imports are recommended per Import agent on an individual workstation.
- Enable fewer Import agents. Workstations that are not intending to import studies should have the “Run Export/Import Agent in Background” option disabled.

22.18. EDF/EDF+ Import and Export

When importing or exporting studies from the Natus Database, if the **EDF Studies** (Import) or **EDF/EDF+** (Export) format is chosen, the list of studies will be updated to include a Template column which indicates the template to be used for importing or exporting the study. The template column during import contains the name of the chosen template. For exports, the template column contains a brief description of the template, beginning with the name, and followed by the channels/montage selected and which format (EDF or EDF+) is chosen.

Importing an EDF/EDF+ study

1. In Natus Database, click the **Import**  button on the main toolbar (or choose **Administration > Import**). The Import Studies box opens.
2. Select the import source (**File**, **Database**, or **Briefcase**). A list of studies eligible for import appears.
3. Before selecting the **Import** button, ensure that **EDF Studies** on the open dialog is selected. The list of studies will update to include a **Template** column.

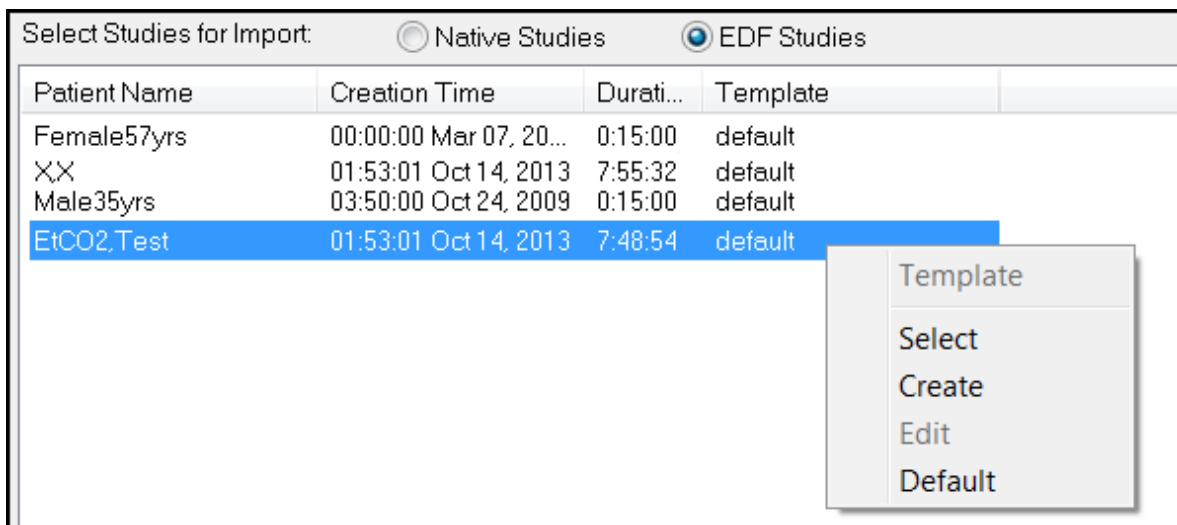


Import Studies Box

4. Select the desired study from the list. The Template column is pre-populated with the **default**.
5. Right-click on the displayed template for the desired study. The context menu displays showing the Template options. From the context menu, you can choose one of the following options:



NOTE: Each study can be imported using a different template, but a new template is not required for each import. Customized templates can be saved for future use.



Import Studies Context Menu

- **Select** – Select the desired template from the existing list of created templates. The templates are based on study type and can be sorted appropriately by selecting the **Sleep** or **EEG** study type in the dialog.
- **Create** – Create a new template based on the study type. This opens the **EDF Import Template Editor** where the desired template can be created.
- **Edit** – Edit an existing, selected template. If this option is greyed out, the **Edit** function is not available, and a new template should either be selected or created.
- **Default** – To revert the template to the default template, select **Default** from the context menu. The default template is a 1:1 mapping of all channels in the recorded study which includes the number of channels and the units of measure.

6. Select the desired template, and click the **Import** button.

22.18.1.1. Creating an Import Template

A new import template can be created for both EEG and Sleep studies using the Import dialog.

To create an import template:

1. From the context menu in the **Import** dialog, select **Create**. The EDF Import Template Editor dialog displays.
2. Give the template a new name by typing it in the **Name** box.
3. Select the study **Type**: **Sleep** or **EEG**. This should be selected based on the type of study being imported. This is how the study is identified in the Natus Database.
4. From this dialog, you can change the **Channel Label**, **Type**, and **Unit** by right-clicking on the channel under the **Label**, **Type**, or **Unit** columns and selecting the desired information. The available options vary based on which column is being modified.

	Label	Type	Unit	Invert	Select
1	Pg1	EEG	uV	☐	☒
2	Pg2	EEG	uV	☐	☒
3	Fp1	EEG	uV	☐	☒
4	Fp2	EEG	uV	☐	☒
5	F7	EEG	uV	☐	☒
6	F8	EEG	uV	☐	☒
7	F3	EEG	uV	☐	☒
8	F4	EEG	uV	☐	☒
9	T3	EEG	uV	☐	☒
10	T4	EEG	uV	☐	☒
11	C3	EEG	uV	☐	☒
12	C4	EEG	uV	☐	☒
13	T5	EEG	uV	☐	☒
14	T6	EEG	uV	☐	☒
15	P3	EEG	uV	☐	☒
16	P4	EEG	uV	☐	☒
17	O1	EEG	uV	☐	☒
18	O2	EEG	uV	☐	☒
19	Fz	EEG	uV	☐	☒
20	Cz	EEG	uV	☐	☒
21	Pz	EEG	uV	☐	☒
22	A1	EEG	uV	☐	☒
23	A2	EEG	uV	☐	☒
24	ECG1	EEG	uV	☐	☒
25	ECG2	EEG	uV	☐	☒
26	26	EEG	uV	☐	☒
27	27	EEG	uV	☐	☒

5. To invert a displayed channel, select the checkbox under the **Invert** column.
6. In this dialog the channels to be imported can also be selected. This can be completed by selecting or de-selecting the checkbox under the **Select** column.
7. Click **Save** to save the template.
8. Click **OK** to close the EDF Import Template Editor dialog and apply the template to the imported study.

22.18.1.2. Selecting an Existing Import Template

An existing import template can be selected for a study using the Import dialog.

To select an existing import template:

1. Once a study has been selected for import, right-click on the Template column.
2. From the context menu, choose **Select**. The **Select Import Template** dialog opens.

3. Toggle between **EEG** and **Sleep** study types by selecting the radio button next to the appropriate type.
4. Choose the desired template from the list and click **OK** to apply it to the study.



NOTE: If the name of the desired template is not in the list, ensure that the correct study type has been selected.

5. Click **Import** to finalize and import the study to the Natus Database.

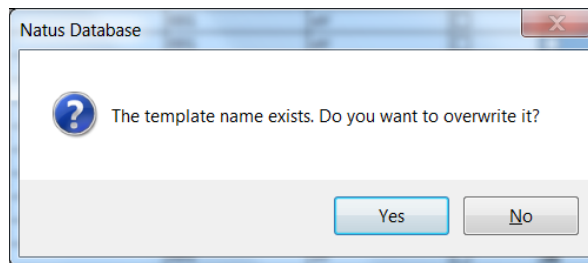
22.18.1.3. Modifying an Import Template

To modify an import template:

1. From the context menu in the **Import** dialog, select **Edit**. The EDF Import Template Editor dialog displays.
2. Edit the template as desired and click **OK**.



NOTE: If the name of the template is not changed, a confirmation dialog will appear asking to overwrite the existing template.



- Clicking **Yes** will overwrite the existing template and save the changes.
- Clicking **No** will cancel the save, and return to the template editor.

3. Click **Import** to finalize and import the study to the Natus Database.

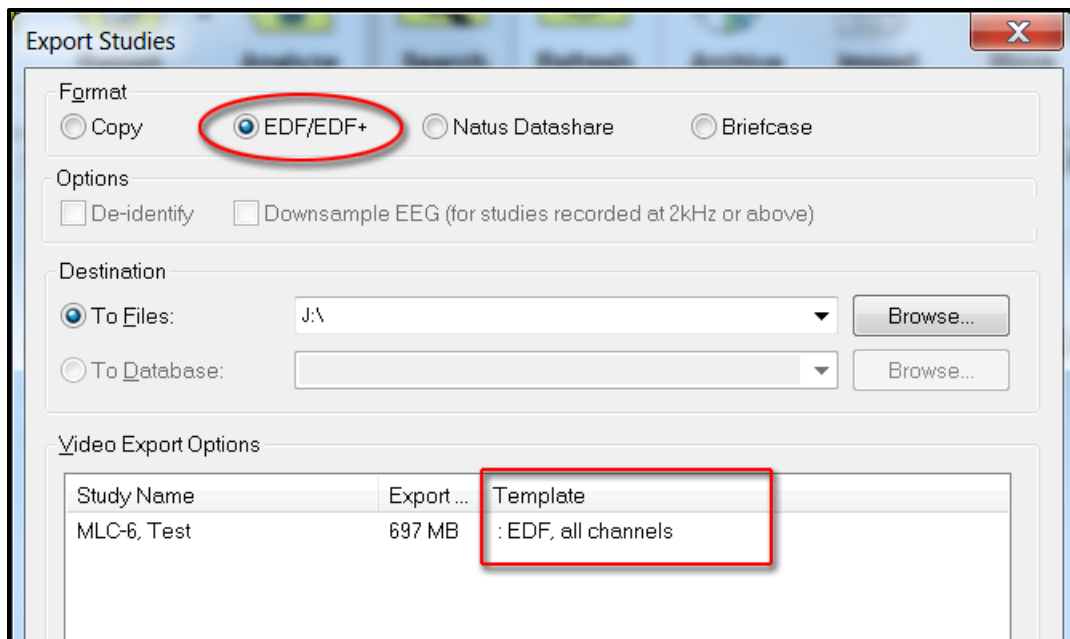
22.18.1.4. Deleting a template

To delete an existing import template:

1. From the context menu in the **Import** dialog, choose **Select**. The **Select Import Template** dialog opens.
2. Toggle between **EEG** and **Sleep** study types by selecting the radio button next to the appropriate type.
3. Choose the desired template, right-click on it, and then select **Delete**. This deletes the import template from the existing list.

Exporting an EDF study

1. In Natus Database, select (highlight) the study or studies you want to export.
2. Choose **Administration > Export**. Alternately, you can right-click and select **Export...** from the context menu. The Export Studies dialog opens.
3. Before selecting the **Export** button, ensure that **EDF/EDF+** on the open dialog is selected. The list of studies will update to include a **Template** column.

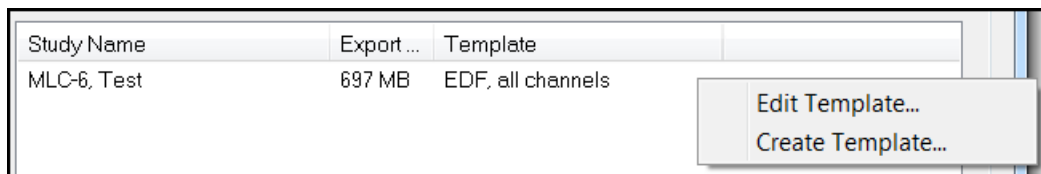


Export Studies Dialog

4. Right-click on the displayed information for the study. The context menu displays showing the options available. From the context menu, you can choose one of the following:



NOTE: Each study can be exported using a different template; however a new template is not required for each export. Customized templates can be saved for future use.



- **Edit Template...** Edit an existing, selected template.
- **Create Template...** Create a new template based on the study type.



NOTE: The initial selection list may be populated with additional options for selection. Existing templates using the same headbox and the same study type will be shown in the context menu. The default template has no name and shows that the study will be exported to EDF with all channels selected. See the sections below on creating and modifying export templates.

5. Select the desired template, and click the **Export** button.

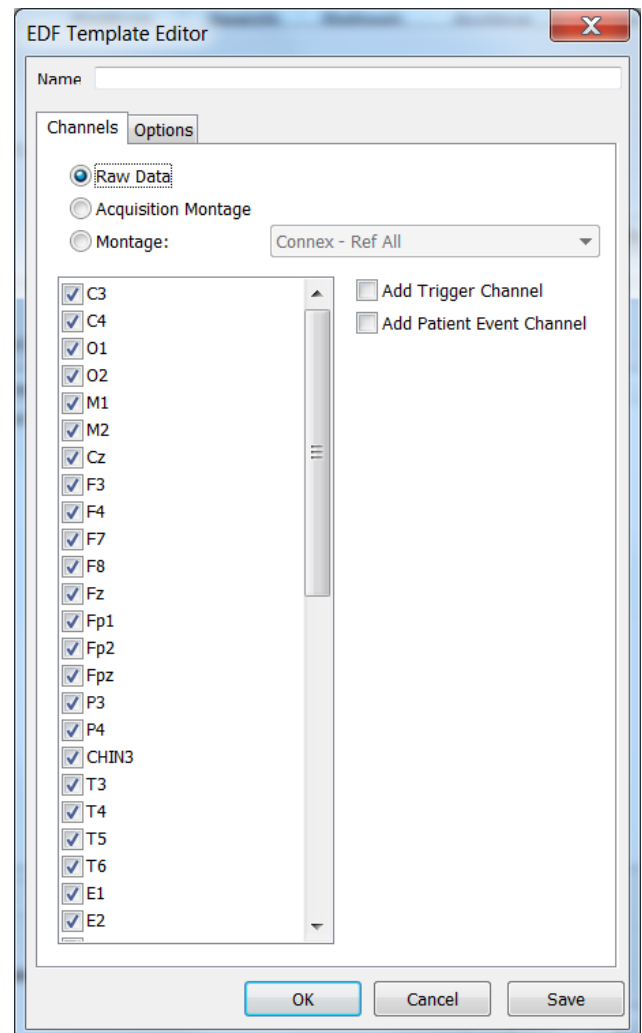
22.18.1.5. Creating an Export Template

To create an export template:

1. From the context menu in the **Export** dialog, select **Create Template....** The **EDF Template Editor** dialog displays showing the **Channels Tab**.
2. Give the template a new name by typing it in the **Name** box.
3. The **Channels** tab dialog allows for the selection of which channels will be exported in the EDF file, as well as the definition of those channels.
 - **Raw Data** – Select this option to export the study with no montage associated.
 - **Acquisition Montage** – Select this option to export the study using the montage used during acquisition.
 - **Montage** – Select this option to export the study using a compatible montage based on headbox and study type. This can be chosen from the available dropdown menu.



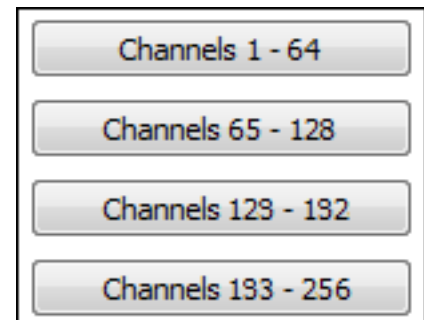
NOTE: The channels can be further modified to remove specific channels by deselecting the checkbox from the dialog.



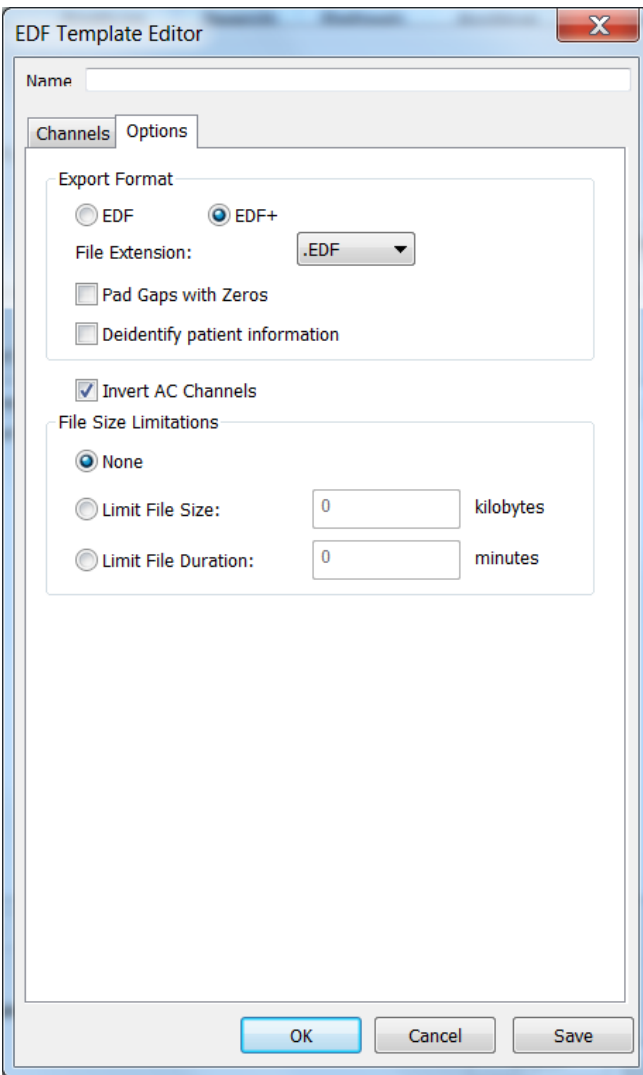
4. Select the checkbox next to **Add Trigger Channel** or **Add Patient Event Channel** to include one or both of these channels in the export.



NOTE: Additional functionality is provided for users of the Quantum Amplifier. Extra buttons appear in the Channels dialog to assist the user with the higher number of available channels. These buttons allow the user to quickly select or de-select a pre-set number of channels without having to scroll through them one-by-one. The buttons are made available based on the number of breakouts the study was configured with. Pressing the button multiple times will either select all, or de-select all the channels. If only some of the channels are selected, pressing the button will re-select all channels.



5. Select the **Options** tab to modify the various options associated with exporting the studies to EDF/EDF+.



6. Select the **EDF** or **EDF+** radio button to choose the format of the export.
7. Choose the desired **File Extension** (.EDF or .REC) from the dropdown.
8. To remove sensitive patient information from the exported study, select the checkbox next to **Deidentify Patient Information** to include this option in the export.
9. If the EDF+ option has been selected, the **Pad Gaps with Zeros** checkbox is enabled. Selecting this checkbox disables the EDF+ functionality which supports gaps (disconnects) in the studies, and instead fills the gaps with zero values.
10. Select the checkbox next to **Invert AC Channels** to invert the polarity of the AC channels when the study is exported.
11. Configure the **File Size Limitations** using one of the following options:
 - **None** – No file size or duration limitation is present.
 - **Limit File Size** – Select the file size for the exported study. This option allows for a minimum of 100 kB to a maximum of 4 GB (4,194,304 kB).
 - **Limit File Duration** – Select the file duration for the exported study. This option allows for a minimum of 1 minute to a maximum of 24 hours (1, 440 minutes).

Once the exported file reaches the size or duration specified, a new file is created and appended with a numerical suffix.



NOTE: For studies which have decimated data, the **Decimated Data** option becomes available. This allows the study to be exported at the decimated data rate rather than the full data rate.

12. Click **OK** to apply the template to the study for export. To save the template as an option for multiple exports, click the **Save** button on the **Channels** tab prior to clicking **OK**.

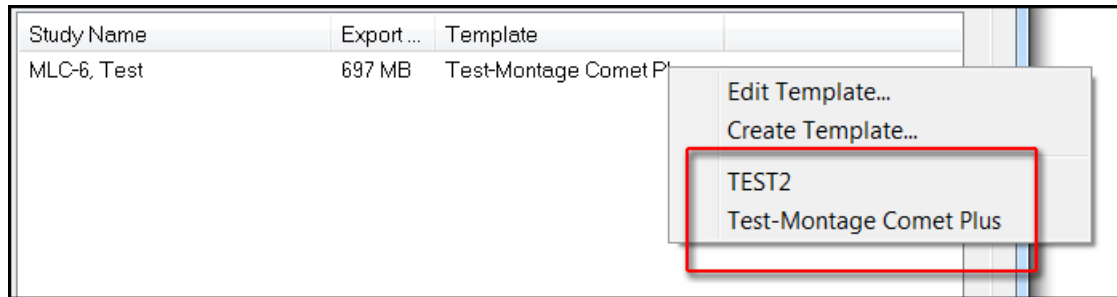
13. Click **Export** to finalize and export the study.

22.18.1.6. Selecting an Existing Export Template

To select an existing export template:

1. Once a study has been selected for export, right-click on the Template column.

- From the context menu, choose any of the available template options. These are based on the templates that were previously created for the Headbox type. If there are no listed templates, create a new template or edit the existing default template as shown in the previous section.



22.18.1.7. Modifying an Export Template

To modify an export template:

- From the context menu in the **Export** dialog, select **Edit Template....** The EDF Template Editor dialog displays.
- Edit the template as desired and click **OK**. To save the template as an option for multiple exports, click the **Save** button on the **Channels** tab prior to clicking **OK**.

22.19. Long Term Monitoring Studies

A Long Term Monitoring Study (LTM) encapsulates a collection of NeuroWorks studies into one Slideshow, which can be reviewed, reported upon, deleted, exported, imported, archived, and printed. The primary purpose of an LTM study is to act as a single point of reference for patients who are a part of long term monitoring studies, and for sites who wish to treat the collection of studies as a single unit. LTM study details shown in the Natus Database show on the first, or main, study in the set. Details such as duration, start time, and end time, automatically roll up based on the studies included in the study set.

Option	Function/Description
Begin (New) LTM Study	Begin a New Long Term Monitoring Study Set using this option. Once one study has been completed, a new study can be started.
Continue LTM Study	Create additional members of the LTM study set, using this option. This starts a new recording and adds it to the existing LTM Study set.
Open LTM Study	Open an LTM Study set using this option. This launches the Slideshow dialog, which allows you to navigate through the LTM study.
Select LTM Set	Selects all the studies that are a part of the current LTM study set.
Create LTM Report	Create a Multi-study LTM report based on all the studies within the LTM set. The patient demographics for the report is drawn from the first study of the set.

Option	Function/Description
Show All Studies for Selected LTM	In order to enable this feature, a special database filter has to be defined manually. When this option is selected, the member studies and the LTM Study Set are filtered so that they are the only visible studies, and all others are hidden. To define this filter: Select Advanced Search Options from the Filter settings in the Natus Database. Select Custom Fields (tab), and Add a new custom field condition for StudySetGUID. Select the value from the dropdown and click OK to close the dialog and OK again to close the Search Options. Click the Save button to save the defined filter.



NOTE: Deleting an LTM study will delete each of the set members followed by the LTM study itself.



NOTE: Exporting an LTM study exports the selected set members and the main LTM study. To export all the studies in an LTM set, first select the LTM set, and then right-click on the main LTM study and select Export from the context menu.

22.20. 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 7 or Windows 10. 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 (OTS@natus.com).

22.21. 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

22.21.1.1. 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.

22.21.1.2. 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 or assistance, contact Natus Technical Support (OTS@natus.com).

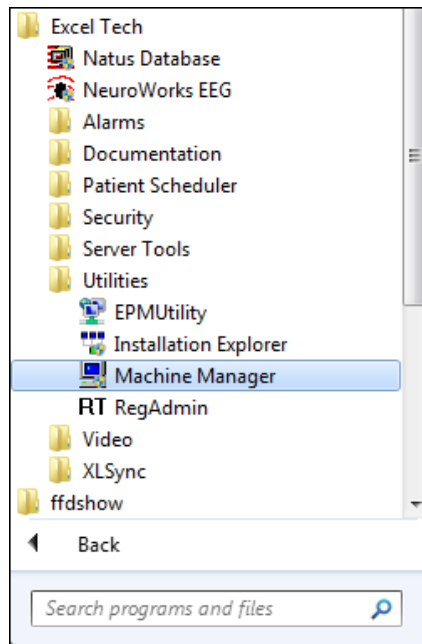
Cached Settings on Portable Stations

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

22.22. 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.

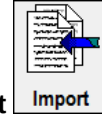
Networked Mode (Acquisition LT)

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 (off-line). Select **Administration > Import** or click the **Import** button to import the acquired studies.

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

23. XLSecurity

23.1. 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
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

Feature	Description
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

23.1.1.1. 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.

23.1.1.2. Password Confirmation

- Password confirmation within the NeuroWorks family of products is the *XLSecurity administrator password* (the factory default is *Natus*).



NOTE: This password can be changed using the Security Configurator.

23.1.1.3. 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

23.1.1.4. Password Confirmation

- In secure access mode, password confirmation is the password of the current XLSecurity user.

23.1.1.5. 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.

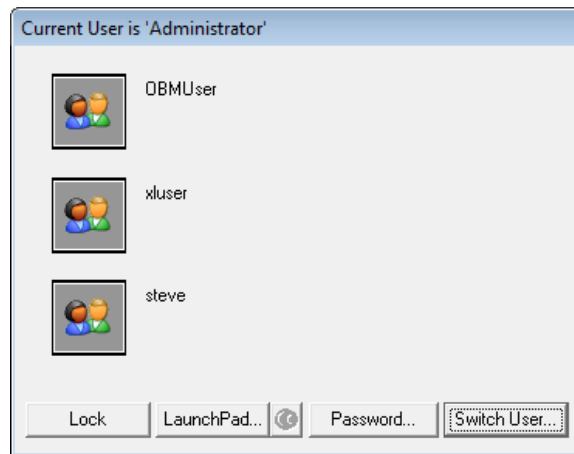
23.2.XLSecurity Brief Tutorial

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 CTRL + ALT + F12.



Quick Click List in Current User Box



NOTE: Built-in accounts such as **administrator**, **Guest** and **xltek support** 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.

23.3.Launch Pad

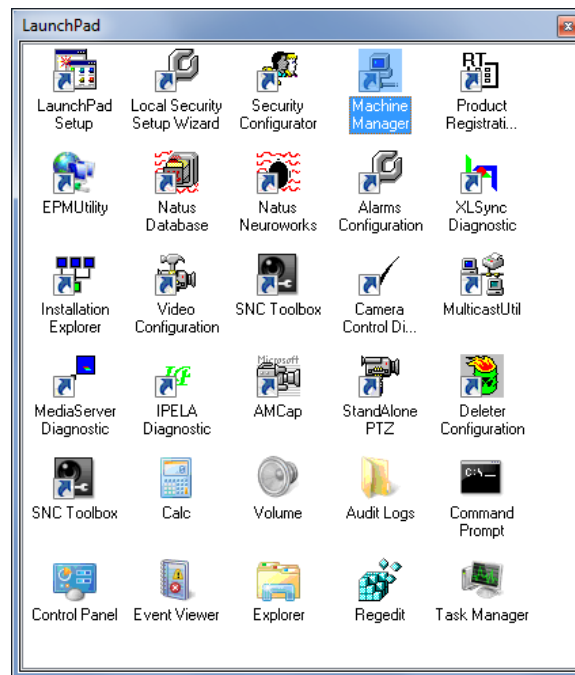
The Launchpad is a pop-up dialog from which the user can launch NeuroWorks software as well as configuration and diagnostic utilities. The Launchpad is aware of the current logged-on user and can be configured to allow or deny access to individual programs. If desktop restrictions are applied during 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 CTRL + ALT + F11.



NOTE: On Windows 10 operating systems, the Windows 10 Key +Z shortcut is not available. This is a pre-defined shortcut key for the Windows10 operating system. Use CTRL + ALT + F11 to access the Launchpad.



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.

23.4.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.

23.5.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 ### 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 **xltksupport** 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.

23.6.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.

23.7.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).

23.8.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 .



NOTE: On Windows 10 operating systems, the Windows 10 Key +Z & Windows 10 Key + X shortcuts are not available. These are pre-defined shortcut keys for the Windows 10 operating system. Use CTRL + ALT + F11 to access the Launchpad and CTRL + ALT + F9 to lock the system.

23.9.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 **xlteksupport** 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).



NOTE: On Windows 10 operating systems, the Windows 10 Key +X shortcut is not available. This is a pre-defined shortcut key for the Windows10 operating system. Use CTRL + ALT + F9 to lock the system.

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
- 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 CTRL + ALT + F11.



NOTE: A shortcut to the Launch Pad can, or may have been, added to the Start menu.



NOTE: On Windows 10 operating systems, the Windows 10 Key +Z shortcut is not available. This is a pre-defined shortcut key for the Windows10 operating system. Use CTRL + ALT + F11 to access the Launchpad.

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.

24. 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.

24.1. 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.
- ☒ 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.

24.2. Software and Hardware Troubleshooting

A. Cannot install 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 data files are being collected.

If too many .erd data 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**.

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 8 select **View > Internet Options**.)
3. Click the **Security** tab.
4. Click the **Custom Level** button. (In IE 8 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.

24.3.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.

24.4.Video Troubleshooting

A. 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.

B. 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.

C. 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.

D. 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.

E. 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

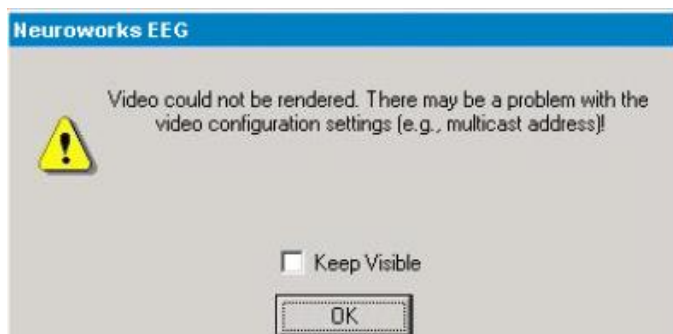
F. Need to adjust video to solve flickering with 50 Hz ballast for fluorescent lighting.

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.

G. Receiving "Video could not be rendered..." message.

If you receive the following message and have a wireless network adapter Enabled, the wireless network adapter could be causing the error. To correct this, disable the wireless network adapter. This ensures only the wired Network Interface Card (NIC) is used for multicast...



24.5.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 k Ohms)?

- 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.



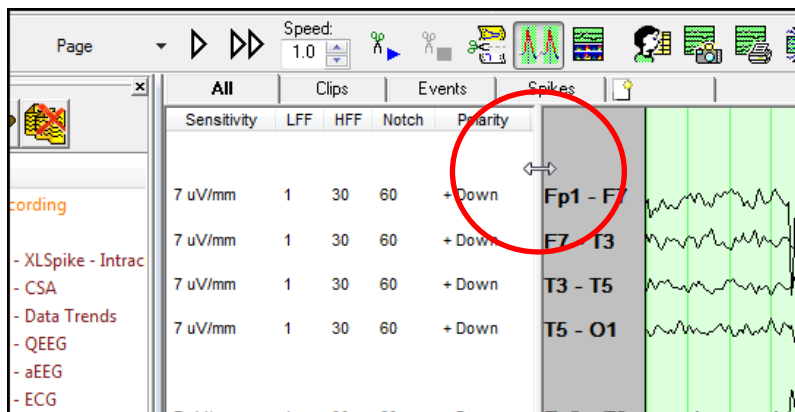
NOTE: You can only move custom notes that have been placed on the study manually (blink or eyes closed, for example). You cannot move notes that are automatically generated by the system (Gain filter notes or Spike and Event notes, for example).

K. How do I change the color of the acquisition background?

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)

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.

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**.

24.6.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, do the following:



1. Click the **Search** toolbar button.
2. Click **Reset**, and then click **OK**.

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 forward or backward based on the selection in the Review Toolbar: Page, Scroll, Event, or Event of Same Type	Use the Scroll wheel on your mouse.
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**  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**  button.

D. How do I adjust the sensitivity and 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.
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24.7. 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. Wait for the Natus Database screen to appear... You may see the message, **Attempting to connect to the network.**
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.

25. Shortcut Keys

25.1.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

Shortcut 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 Channel set
CTRL + 1	Switch to Channel Set 1
CTRL + 2	Switch to Channel Set 2

Shortcut Keys	Action
CTRL + 3	Switch to Channel Set 3
CTRL + 4	Switch to Channel 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
* (on number pad)	Montage Menu
ESC	Stop Photic Stimulation (and exit from other dialog boxes)
Alpha/Function Keys	Start entering a note.

25.2.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
CTRL + L	Edit pruning clips
ALT + L	Collated view (pruning preview)
CTRL + M	Open remote study monitoring session
CTRL + N	Use <i>rapid</i> event marking mode
CTRL + SHIFT + N	Use event marking mode
CTRL + O	Open a study for review

Shortcut Keys	Action
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
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

Shortcut Keys	Action
CTRL + LEFT Arrow	Move the study backward by a ½ page
CTRL + RIGHT Arrow	Move the study forward by a ½ page
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
– (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

Shortcut Keys	Action
/ (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
CTRL + Left Mouse Click	Add a note during review without using the Note Menu. Causes a note context menu to display, and when the note type is selected from the menu, it is added at the point where the mouse was clicked regardless of where the time mark is located.

26. Configuring NeuroWorks

26.1. Restoring Automatic Login

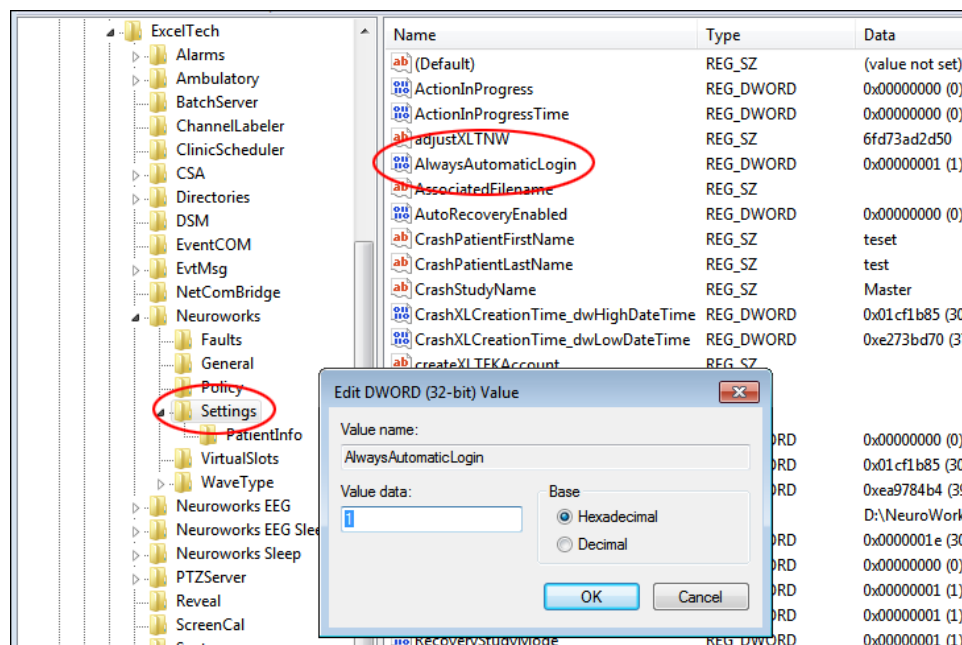


WARNING: This topic describes registry keys that can be set to customize NeuroWorks software. Only experienced computer users with previous knowledge of registry keys should alter these settings. Please contact Natus Technical Support for more information.

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

26.2.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 percent into the buffer.
BufferPortionFromBottomToStop	Stops look-ahead reading when there is less than BufferPortionFromBottomToStop percent 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 (percent, Default = 40)
- BufferPortionFromBottomToStop (percent, 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:
HKEY_CURRENT_USER\Software\ExcelTech\NeuroWorks EEG\Settings
4. Locate the DWORD values titled the following:
 - BufferPortionFromBottomToRestart
 - BufferPortionFromBottomToStop

- NumberBufferPages
 - PageRateMax
5. 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.

26.3.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.

26.4.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.

27. System Tools

27.1. 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.

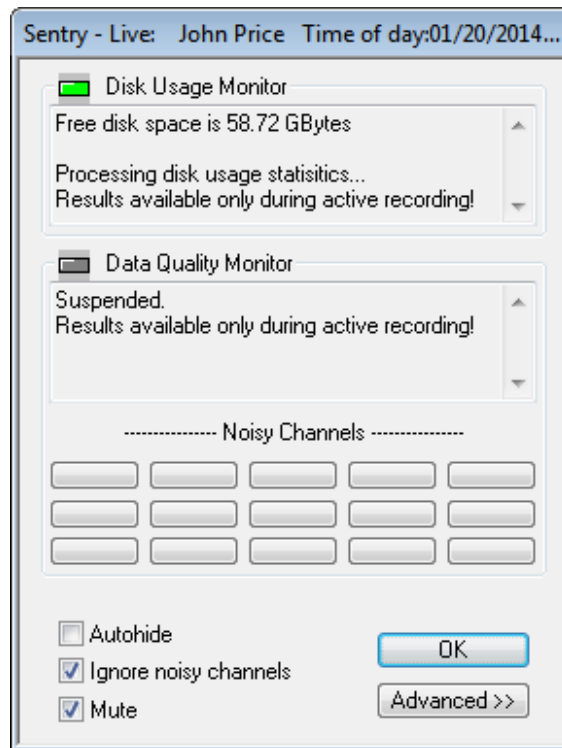
The **Data Quality Monitor** checks for electrical noise per recording channel and the rate of file growth for the study file. To save disk space, data is compressed as it is stored. The compression process stores the main acquisition data and then records the variations, rather than storing the complete 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

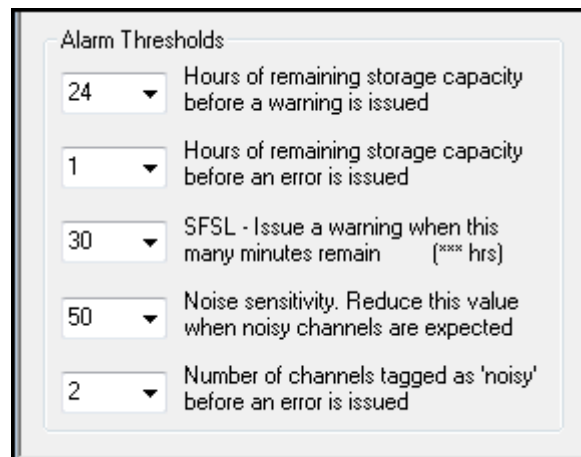
The Sentry tool appears automatically, if conditions require it, but you can open the Sentry tool at any time when you are recording a study.

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.

Default Value	Alarm Threshold Parameter	Description
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. Should not need adjustment. 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.

27.2.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:

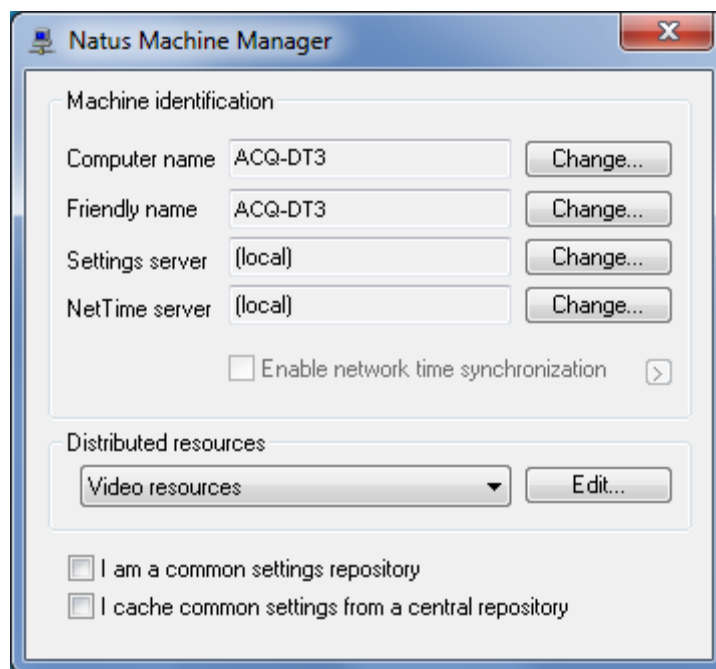
- Sentry alarms
- Video recording alarms

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.

27.3. 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' 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

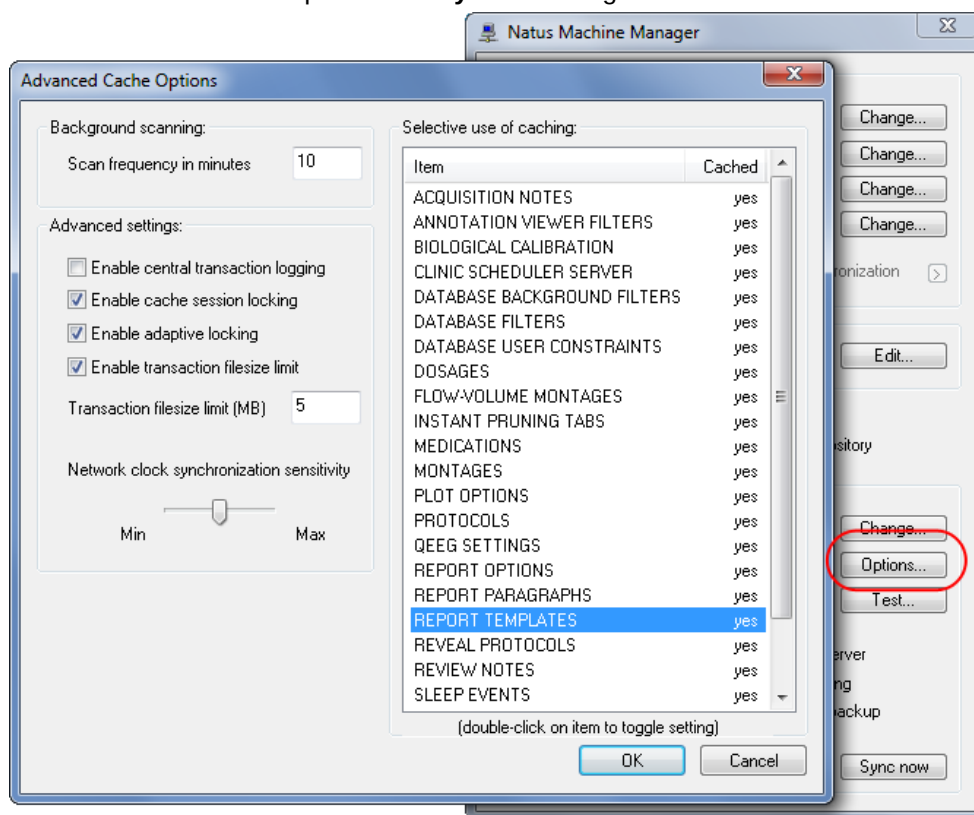
Machine Manager allows you to set up automatic periodic time synchronization between the central location of your choice (usually the **Central Settings Server**) and the local PC. This ensures time consistency between the stations that are sharing database and allows consistent time order for changes 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

28. Appendix

28.1. 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 $\pm$ 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' 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.

28.2. Disposal at the end of operating life

Natus is committed to meeting the requirements of the European Union WEEE (Waste Electrical and Electronic Equipment) Regulations 2014. These regulations state that electrical and electronic waste must be separately collected for the proper treatment and recovery to ensure that WEEE is reused or recycled safely. In line with that commitment Natus may pass along the obligation for take back and recycling to the end user, unless other arrangements have been made. Please contact us for details on the collection and recovery systems available to you in your region at www.natus.com.

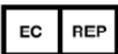
Electrical and electronic equipment (EEE) contains materials, components and substances that may be hazardous and present a risk to human health and the environment when WEEE is not handled correctly. Therefore, end users also have a role to play in ensuring that WEEE is reused and recycled safely. Users of electrical and electronic equipment must not discard WEEE together with other wastes. Users must use the municipal collection schemes or the producer/importers take-back obligation or licensed waste carriers to reduce adverse environmental impacts in connection with disposal of waste electrical and electronic equipment and to increase opportunities for reuse, recycling and recovery of waste electrical and electronic equipment.

Equipment marked with the below crossed-out wheeled bin is electrical and electronic equipment. The crossed-out wheeled bin symbol indicates that waste electrical and electronic equipment should not be discarded together with unseparated waste but must be collected separately.



28.3. Appendix B: Description of Equipment Symbols

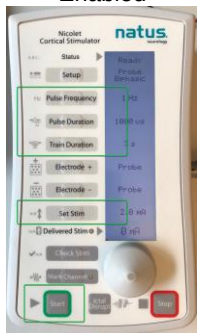
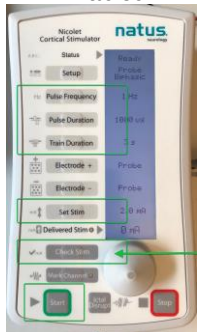
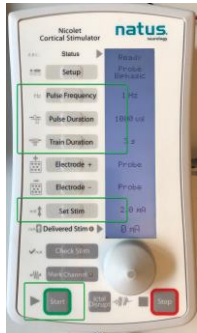
The following table lists and describes the symbols that may appear on various pieces of Natus NeuroWorks systems.

Symbol	Symbol Title	Standard reference & title of symbols used
	Legal Manufacturer	ISO-15223-1, Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied, Symbol 5.1.1
	Catalog Number	ISO-15223-1, Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied, Symbol 5.1.6
	Serial Number	ISO-15223-1, Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied, Symbol 5.1.7
	Authorized representative in the European Community	ISO-15223-1, Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied, Symbol 5.1.2
	Follow Instructions for Use	ISO-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #10
	Caution	ISO-15223-1, Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied, Symbol 5.4.4
	Consult Instructions for use	ISO-15223-1, Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied, Symbol 5.4.3
	Protective Earth (Ground)	ISO-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #11
	Type BF Applied Part	ISO-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #20
	Dangerous Voltage	ISO-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #24
	Alternating Current	IEC-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #1

Symbol	Symbol Title	Standard reference & title of symbols used
	Direct Current	IEC-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #4
	“On” (power)	IEC-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #12
	Power Off	IEC-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #13
	Disposal at the end of operating life	EN-50419, Marking of electrical and electronic equipment in accordance with article 11(2) of Directive 2002/96/EC (WEEE)
	CE Mark	- MDD 93/42/EEC, EC Medical Device Directive Or - MDR 2017/745, EU Medical Device Regulation
	Class II Equipment	IEC-60601-1, International standard – Medical electrical equipment – Part 1, Table D.1 #9
	Electrostatic Sensitive Devices	ISO-7000/IEC-60417, Graphical Symbols for use on equipment – Registered symbols, Symbol 5134
	Non-ionizing Electromagnetic Radiation	ISO-7000/IEC-60417, Graphical Symbols for use on equipment – Registered symbols, Symbol 5140
	Keep away from rain	ISO-15223-1, Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied, Symbol 5.3.4
	Fragile, handle with care	ISO-7000/IEC-60417, Graphical Symbols for use on equipment – Registered symbols, Symbol 0621
IPX0	No protection	IEC-60529, IP Code, International Protection Marking
IPX1	Protection against dripping water	IEC-60529, IP Code, International Protection Marking

Symbol	Symbol Title	Standard reference & title of symbols used
Rx Only	Device is cleared for the US market as requiring a prescription.	21 CFR 801.109
	Stand-by	ISO-7000/IEC-60417, Graphical Symbols for use on equipment – Registered symbols, Symbol 5009
	Humidity Limitation	ISO-7000/IEC-60417, Graphical Symbols for use on equipment – Registered symbols, Symbol 0224
	Temperature Limitation	ISO-7000/IEC-60417, Graphical Symbols for use on equipment – Registered symbols, Symbol 0632
UK CA	UKCA Mark	UK MDR 2002, UKCA Medical Device Regulation
	Authorized Representative in Switzerland	Swiss Medical Device Ordinance (MedDO), Swiss Medical Device

28.4. Appendix C: Cortical Stimulation control quick guide

DSM relays Mode	Use case	NeuroWorks Stimulation control	NeuroWorks Relays control	Nicolet Cortical Stimulator control
Auto	User performs Cortical Stimulation exclusively from NW software		N/A Close relays	Disabled 
Semi-Auto* *Recommended mode	User can start stimulation from software with automatic relay control Or User can start stimulation from Nicolet stimulator closing relays from NW/SW.	Start	Close relays	Enabled 
Semi-Auto plus	User can start stimulation from software with automatic relay control Or User can start stimulation from Nicolet stimulator after closing relays from NW/SW or device (with "Check Stim" button)	NW software control always available, providing automatic relay control	Close relays	Enabled 
Manual	User can start stimulation from software with automatic relay control Or User can start stimulation from Nicolet stimulator with closing and opening relays from NW/SW		Close relays + Open relays	Enabled 

28.5. Appendix E: Security Hardening

Overview

At Natus, we understand the need to have a security strategy to protect your organization and patients. This document provides recommendations to secure NeuroWorks/SleepWorks systems as much as possible in the intended use environment without affecting their essential performance and intended use. Natus is not responsible for on-going management and maintenance of Anti-Virus systems or Microsoft Windows updates. Our warranty and service contracts do not cover virus removal or onsite service visits related to virus attacks or security vulnerability exploits. Natus does not test specific anti-virus solutions, instead, we provide a list of files and folders that must be excluded. When possible, network access to NeuroWorks/SleepWorks systems should be limited through segmentation. Natus may ask customers to remove security software and configurations as a troubleshooting step when attempting to determine the root cause of an issue with NeuroWorks/SleepWorks.

28.5.1.1. Purpose and Scope

The recommendations in this document provide guidance for secure network deployment and servicing of NeuroWorks/SleepWorks systems in the intended use environment.

28.5.1.2. Target Audience

Individuals responsible for the security and management of NeuroWorks/SleepWorks systems, as well as:

- EEG / PSG Patient Care
- Security and Anti-Virus Software
- Application Software
- Desktop and Servers
- Network and Storage

Intended Use Environment

28.5.1.3. Microsoft Windows Firewall

It is not recommended to turn ON Windows Firewall. NeuroWorks/SleepWorks systems are currently not tested with Windows Firewall turned ON and may not function as intended if it is ON.

28.5.1.4. Microsoft Windows Security Updates

Natus systems are shipped with Windows automatic updates disabled. We recommend that IT teams keep the automatic updates disabled or use group policies push planned updates. IT teams should work closely with patient care teams to schedule and push updates when the system is idle, as Windows updates can trigger a system reboot during a live recording.

A list of Natus tested Microsoft Windows Updates can be found at <https://neuro.natus.com/neuro-support>. Customers are permitted to install Microsoft Windows Updates not tested by Natus as soon as they are published by Microsoft. This will not nullify any warranty or service contract in place with Natus. If an update is suspected to be in conflict with NeuroWorks/SleepWorks, Natus will ask the customer to remove the update. Natus recommends customers deploy Microsoft Windows Updates not yet tested by Natus in a test environment when possible, before deploying to the production environment.

28.5.1.5. Access Controls

A Windows user with local administrator privileges must be used to install NeuroWorks/SleepWorks. The initial system setup and configuration (e.g. network configuration, auto-login, auto-recovery login and drivers) must also be done with local administrative privileges.

Natus recommends that the Service Account or the Windows User running NeuroWorks/SleepWorks have local administrator privileges to ensure sufficient access is granted to the application. The local XLUser account must be granted Full Control to all resources listed in this section.

If the Service Account or Windows User running NeuroWorks/SleepWorks cannot have local administrator privileges, the following local system resources must be granted Full Control:

Windows Registry Permissions

- HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\ExcelTech

Folder Permissions: Desktops and Workstations

- C:\ and D:\ (if D:\ is used by NeuroWorks)
- C:\Neuroworks or D:\Neuroworks (Share is folder)
- C:\Users\%user%\AppData\Roaming\NeuroWorks
- C:\Users\<SERVICE_ACCOUNT>\AppData\Roaming\NeuroWorks (domain service account)
- C:\Program Files (x86)\XLTEK
- C:\Users\Public\Documents

Folder Permissions: Application Server and Network Storage

- Study Data Folders: These folders will at a minimum contain a *.DSN file, a folder called 'DBData' and folder called 'Deleter'.
- Common Settings Repositories: These folders will at a minimum contain folders called 'Settings', 'SettingsSleep', 'SettingsGeneral' and 'SettingsStatic'.

28.5.1.6. Anti-Virus Configuration

The following apply to all Anti-Virus solutions and must be enforced on all NeuroWorks/SleepWorks systems.

Known Conflicts

- Sophos Security Products: Historically, this is the only Anti-Virus solution that continues to be problematic when configured to follow these recommendations. This prevents NeuroWorks/SleepWorks from achieving its intended use. For this reason, Sophos is not recommended to be used with NeuroWorks/SleepWorks systems.
- Advanced features or security products that use heuristics, artificial intelligence or other next generation antivirus functionality to analyze the behavior of an application or its processes. While no conflicts have been reported to Natus, we do not test these types of security solutions and customers may be asked to remove the security software as a troubleshooting step to determine if it is the cause of NeuroWorks/SleepWorks not meeting its intended use. Natus recommends customers test these types of security solutions in non-production environments before use in production environments.
- Advanced Networking features that act as a software firewall and an Intrusion Prevention System.
- Advanced behavioral based engines and intelligence-based technologies.
- Real-Time Scanning should be disabled when possible. System scans should not be performed when the Natus application software is in-use. It is recommended to only run system scans when the system is idle.
- Virus definitions should not be configured to automatically update (if possible). Updates that occur during system use could cause system reboots or interfere with Natus application software when in-use. It is recommended that updating of Anti-Virus software and definitions occur only when the system is idle. Systems should not be configured to reboot automatically.

Folder Exclusions

The following folders must be excluded from all virus scans.

Application Server and Network Storage:

- Study Data Folders: These folders will at a minimum contain a *.DSN file, a folder called 'DBData' and folder called 'Deleter'.
- Common Settings Repositories: These folders will at a minimum contain folders called 'Settings', 'SettingsSleep', 'SettingsGeneral' and 'SettingsStatic'.

Desktop Acquisition and Review Stations:

- C:\Neuroworks or D:\Neuroworks
- C:\Users\xluser\AppData\Roaming\NeuroWorks
- C:\Users\<SERVICE_ACCOUNT>\AppData\Roaming\NeuroWorks (domain user)
- C:\Program Files x86\Microsoft SQL Server (default SQL installation location)
- C:\XLTekAudit or D:\XLTekAudit (NeuroWorks/SleepWorks Audit log location)
- C:\SQLBACKUP or D:\SQLBACKUP (Desktop SQL backup location)
- File Exclusions

Anti-Virus Natus file types (extensions) exclusions

ACP	Acquisition Profile
AF1, AF2	Persyst
AR	Persyst
AVI	MPEG-4 video files
BIN	Generic configuration file in binary format
BMP	BMP (images attached to the study)
CSV	CSV (comma-separated-value text files attached to the study)
CFG	Configuration
DNE	Natus encrypted report document (reports attached to the study)
DOC	Microsoft Word Document (reports attached to the study)
DOT	Microsoft Word Template
DSS	Slideshow data (reports attached to the study)
EDF	EDF - European data format used for EEG data exchange (current default)
EEG	Patient demographics and study information
EIA	Export/Import Agent profile (configuration file)
ENT	Annotations and events
ENT.OLD	Annotations and events (backup)
ENT.TXT	Annotations and events (exported to plain text)
EPO	Epoch data (EEG trends and sleep staging information)
EPR	EEG trends
ERD	EEG raw data
ETC	EEG raw data table of contents

FSS	Slideshow filter definition (configuration file)
FVL	Flow Volume Loop Montage
GIF	GIF (images attached to the study)
IPS	Instant Pruning Settings
JPEG	JPEG (images attached to the study)
JPG	JPG (images attached to the study)
LDF	Microsoft SQL Large Transaction Log File
LFP	Label Factory Package (configuration file)
MDF	Microsoft SQL Server Database
MPG	MPEG-1 video files
MTF	Montage List Filter (configuration file)
MTG	Montage
NFS	Note Toolbars
NIF	NeuroWorks Image File (JPEG format image attached to studies)
NWTP	Trend profile (study file)
OSS	Slideshow options file (configuration file)
OVM	Visit Manager options file (configuration file)
PCL	Protocol
PDF	PDF (reports attached to the study)
PNG	PGN (images attached to the study)
QEEG	Quantitative Electroencephalography
RAW	Persyst housekeeping file
REC	EDF - European data format used for EEG data exchange (default before 6.1)
RTC	RTC (report table of contents file attached to the study)
SNC	EEG-to-video synchronization
STC	EEG segment table
TIF	TIF (reports attached to the study)
TXT	Plain text (reports attached to the study)
VTC	Video table of contents

VTP	Video table of contents (temporary file before being copied to .VTC)
VT2	Video table of contents (backup)
WKS	Workspace
XLR	Video Resources
MMX	Persyst
MG2	Persyst
MG2.INDX	Persyst
MG2.XML	Persyst
MG2.BACKFILL	Persyst
SD4	Persyst
SD4.INDX	Persyst
PSX	Persyst
LAY	Persyst

Network Ports (TCP & UDP)

This is a list of ports NeuroWorks/SleepWorks uses to communicate over a network. This list is provided for informational purposes only; it does not imply support for the use of Windows Firewall. Note that disabling unused ports has not been tested by Natus at this time.

TCP Port	Service
2000	Signal - message socket
2001	Signal - event socket
2010	Storage - metadata message socket
2011	Storage - metadata event socket
2020	Chatsrv - message socket
2021	Chatsrv - event socket
2040	Storage - EEG data streaming message socket
2041	Storage - EEG data streaming event socket
2100	Sentry - message socket
2101	Sentry - event socket
2200	IP headboxes - TCP communication
5301	AVMediaServer - video multicast stream #1
5302	AVMediaServer - audio multicast stream #1

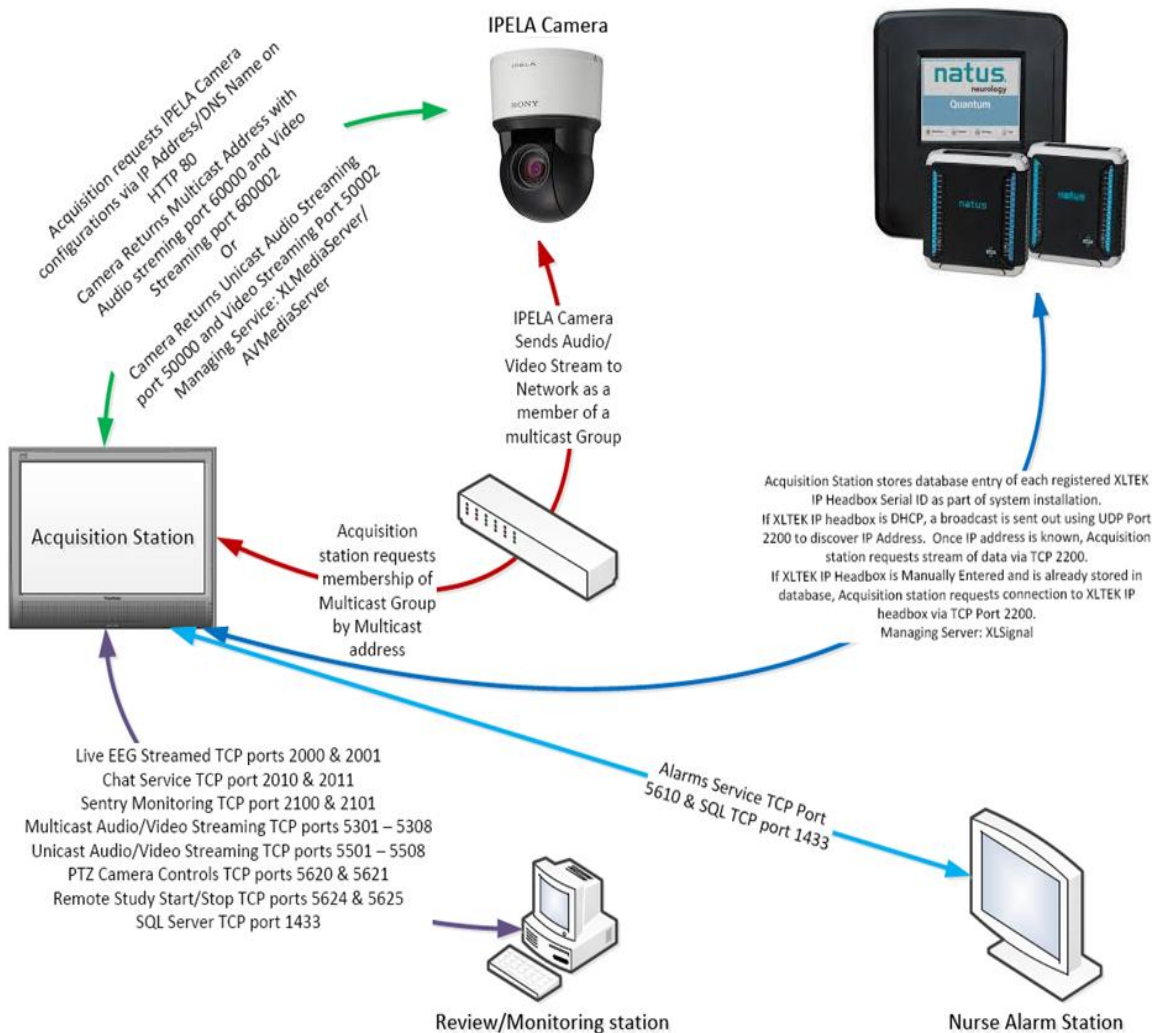
5303	AVMediaServer - video multicast stream #2
5304	AVMediaServer - audio multicast stream #2
5305	AVMediaServer - video multicast stream #3
5306	AVMediaServer - audio multicast stream #3
5307	AVMediaServer - video multicast stream #4
5308	AVMediaServer - audio multicast stream #4
5500	AVMediaServer - server discovery
5501	AVMediaServer - video unicast stream #1
5502	AVMediaServer - audio unicast stream #1
5503	AVMediaServer - video unicast stream #2
5504	AVMediaServer - audio unicast stream #2
5505	AVMediaServer - video unicast stream #3
5506	AVMediaServer - audio unicast stream #3
5507	AVMediaServer - video unicast stream #4
5508	AVMediaServer - audio unicast stream #4
5509	NetServer (default port)
5610	XLAlarmsSvc - "fast" alarms updates – Used on Acquisition and Nurse Alarms Station
5611	NetCOMBridge - Monitoring drop-down list server/acquisition side
5612	EvtMsgSvc - Monitoring drop-down list client/review side
5620	EvtMsgSvc - PTZ Control server/acquisition side
5621	EvtMsgSvc - PTZ Control client/review side
5624	XLDB - Remotely starting a study - client/review side
5625	XLDB - Remotely starting a study - server/acquisition side
5900	WinVNC (default setting)
6603	License Server (default port)
UDP	Service
2200	IP headboxes - discovery
Microsoft Ports	Service
135/TCP	(epmap) Windows NT Endpoint Mapper - RPC / DCOM / DCE

445/TCP	(microsoft-ds) SMB (Windows 2000, XP if NetBIOS over TCP/IP is disabled)
1433/TCP	(ms-sql-s) SQL Server
80/http	HTTP server (used by IPELA cameras)
Optional Ports	Service
137/UDP	(netbios-ns) NetBIOS
137/TCP	(netbios-ns) NetBIOS
138/UDP	(netbios-dgm) NetBIOS
139/TCP	(netbios-ssn) SMB

Data Flow Diagram

The diagram below provides a high-level view of data flow in the NeuroWorks/SleepWorks ecosystem.

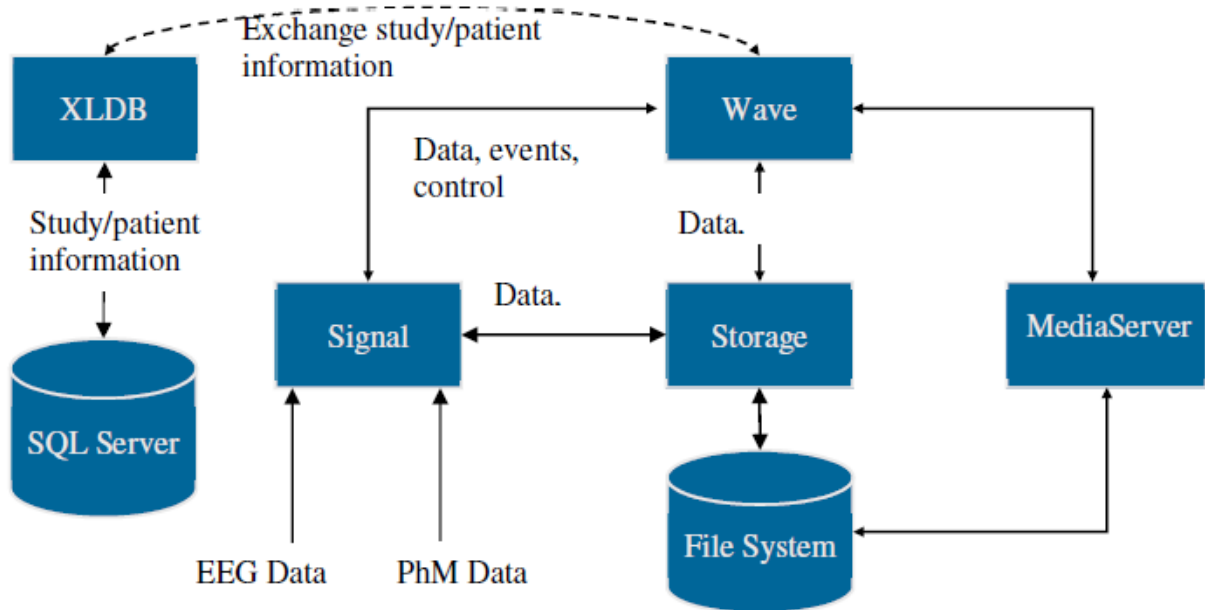
Note: Unicast streaming has a maximum of four concurrent streams, the video window client on the local acquisition station counts as one of the four connections.



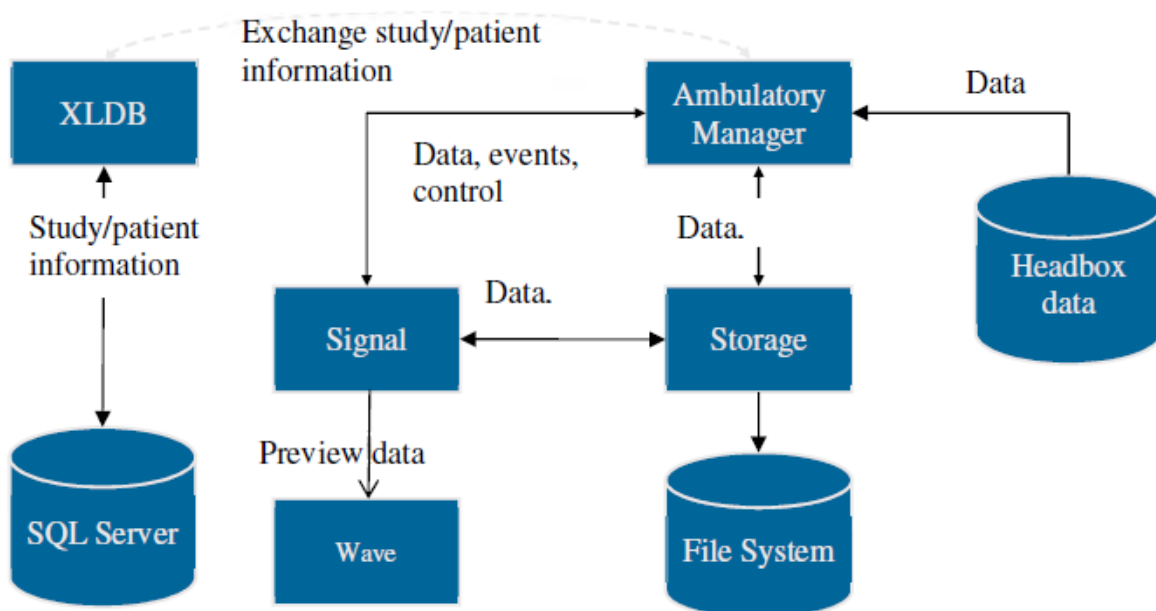
System Architecture

Below are two diagrams of a NeuroWorks/SleepWorks data acquisition system in laboratory mode and ambulatory mode.

Data acquisition in laboratory mode



Data acquisition in ambulatory mode



Security Features

28.5.1.7. XLSecurity

A software package which contains a set of services utilized by the NeuroWorks / SleepWorks family of Natus products. See '*DOC-007279: XLSecurity Site Administrator Reference*' for more details.

28.5.1.8. Hard Drive Encryption

Windows BitLocker Encryption is supported on the local hard drive of NeuroWorks / SleepWorks systems.

28.5.1.9. Internal Process Communication Encryption

Data are encrypted with hash for NeuroWorks / SleepWorks internal process and service communication. (Introduced in NW8.5 GMA3 & 9.0 GMA2)

28.5.1.10. TLS 1.2 Support

NeuroWorks / SleepWorks support TLS 1.2 for SQL communication. (Introduced in NW9.2 GMA2)

Security Events and Logs

28.5.1.11. The Local XLTekAudit Service (XLAuditSvc) and XLAuditLogs

Each time a user logs-on through XLSecurity, that user becomes the "current" user. This action is logged by the XLSecurity audit service (XLAuditSvc). From the time a user logs-on until they log-off, every key interaction with a NeuroWorks device creates an audit entry combining the activity or action name with a date and time stamp and description. Audit logs are created periodically. They are stored in plain text in an XML format. They can be viewed using a web browser such as Internet Explorer. Their displayed format is controlled by a style sheet (XSL). By default, audit logs are saved on the local PC in a folder called XLTekAudit. The XLTekAudit folder is usually in the same location as the NeuroWorks folder on the local PC.

28.5.1.12. Centralized XLAuditLogs

As of NeuroWorks 8.0, audit logs are automatically copied to the common settings cache "root" folder under a folder called "XLAuditLogs" and into a subfolder by the name of the workstation from which the logs were generated. See '*DOC-007279: XLSecurity Site Administrator Reference*' for more details.

Backup, Restore, Retention and Recovery of Device Configuration

28.5.1.13. Data Management

- **Copy, Move and Archive**

The copy, move and archive features allows the end user to send study data to electronic media or a network storage location.

- **Purge and Permanently Delete**

Study data cannot be recovered after using the permanently delete feature (see User Manual regarding the XLDeleter Service). Purging removes all study data from the storage location but the patient name and information are retained in the database. Study data can be recovered from an archived study that has been purged.

28.5.1.14. Natus Computer Images

The Windows operating system is preconfigured for NeuroWorks / SleepWorks on NeuroWorks / SleepWorks computer images. Images are created and deployed using write-protected USB keys, the imaging process will take approximately 10 to 15 minutes.

28.5.1.15. Application Software License

The NeuroWorks / SleepWorks application software license contains the software configuration options and features purchased. This license can be found on a label attached to computers purchased from Natus. Activation or reactivation of a license can only be done with assistance of a Natus Service representative.

28.5.1.16. Reimage and Reactivation

If a device is required to be cleaned, the NeuroWorks / SleepWorks computer image, installation media and software license can be used to configure the device to a factory default state. Study data can then be imported to the system as needed. Contact the Natus Technical Service at 1-800 387-7516 or email Oakville_Technical_Service@natus.com for more details.

Application Software Security Update/Patch Deployment

28.5.1.17.How to Obtain Updates/Patches

NeuroWorks / SleepWorks application software and hardware firmware updates are available for download (including maintenance and security updates). Contact the Natus Technical Service at 1-800 387-7516 or email Oakville_Technical_Service@natus.com for information on how to obtain the specific version and build for the intended use environment.

Detection of a Cybersecurity Vulnerability or Incident

28.5.1.18.Incident and Vulnerability Handling

In the event that a cybersecurity vulnerability or incident occurs and involves a NeuroWorks / SleepWorks system, contact Natus Technical Service immediately at 1-800 387-7516 or email Oakville_Technical_Service@natus.com. Natus will follow our internal Complaint Handling process.

Cybersecurity or Security Bill-Of-Materials (CBOM or SBOM)

The following 3rd party software items have been incorporated into the NeuroWorks-SleepWorks software:

Component	Purpose
CAIN SDK	Interface to Physiological Monitoring Devices
Xvid, ffdshow	Video Codec
Ultimate Grid	Grid UI Element
StingRay	Various UI Components (Library with Source)
Persyst	Analysis
Microsoft Word	Reports
Microsoft SQL Server	Database
Mirth	HL7 / GDT Interface
Matroska	DirectShow Component (Splitter) for H.264 (TrexHD Video)
MatLab	Filter Coefficient Calculation (Pen / Notch)
LibSampleRate	Audio Re-Sampler
IPP	Filter Coefficient Calculation (High / Low Pass)
CodeJock Calendar	Calendar UI Element in Scheduler

End of Life

Please refer to your warranty and/or service contract as needed. Natus products within warranty are not impacted by this End of Life statement. The nature of information technology prevents Natus from providing support for products when third party suppliers stop releasing security updates and patches for third party software, hardware and firmware components. Third party components include Kernels, Operating Systems, Open Source Software, Closed Source Software, Drivers, Firmware and more.

28.5.1.19.Supported Product

When a product is actively sold by Natus. Service Support (technical and engineering) is still provided and may result in new features, enhancements, integrations or cybersecurity updates.

28.5.1.20.End of Sales

When a product is no longer sold by Natus. Service Support is still provided but new features, enhancements, integrations and cybersecurity updates are no longer available.

28.5.1.21.End of Service

When a product is no longer sold by Natus. Limited best effort Service Support is provided. New features, enhancements, integrations and cybersecurity updates are no longer available.

28.5.1.22.Product Version Support

- **Application Software**

If supported by hardware, NeuroWorks / SleepWorks application software upgrades are free within the same major version. Here is the application software version support strategy for NeuroWorks / SleepWorks:

Product Version	Description
Current Release	This is the current major version actively developed, supported and sold by Natus.
Previous Release	This is one major version behind the current major version. Development is extremely limited. This version is still supported and sold by Natus.
Legacy Release	Any version two or more major versions behind the current major version. No development available and Natus will provide best effort support. These versions are End of Sales and are either in or approaching End of Support.

- **Hardware and Firmware**

If supported by hardware, firmware upgrades are free. Once Natus Hardware is EOL, security updates and patches will not be developed and released for that product. Customers are encouraged to upgrade Natus Hardware once legacy hardware becomes EOL.

28.6.Appendix D: 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 Trex/Trex HD 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.

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, EEG32 and EMU128FS.

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).

P

pH—A measure of the concentration of hydrogen ions in a solution, and therefore of its acidity or alkalinity.

Photoc Stimulator—A strobe-light-like device used for photic activation of the EEG, routine clinical procedures in visual evoked potentials, electroretinography and neuro-ophthalmology.

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

SaO2/SpO2—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.