

NeuroView User's Guide

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The NeuroSky product families consist of hardware and software components for simple integration of this bio-sensor technology into consumer and industrial end-applications. All products are designed and manufactured to meet exacting consumer specifications for quality, pricing, and feature sets. NeuroSky sets itself apart by providing building-block component solutions that offer friendly synergies with related and complementary technological solutions.

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Introduction

NeuroView is a Windows application that allows you to:

1. **Connect** to ThinkGear modules/headsets through the COM ports on your computer
2. **Record** data from connected ThinkGear modules/headsets into log files, which can then be opened in Excel, MATLAB, or other programs for further analysis
3. **View** data in meters and graphs received in real-time from connected ThinkGear modules/headsets for immediate feedback during data collection experiments
4. **Send** Command Bytes to connected ThinkGear modules/headsets to customize and configure them (such as enabling raw sampling wave output on headsets that do not output raw wave data by default)

This User's Guide will show you how to install, run, and use NeuroView to perform the tasks described above.

Installation

NeuroView is distributed as a Research tool as part of NeuroSky's [MindSet Research Tools \(MRT\)](#).

To install NeuroView, browse to the **MindSet Research Tools/NeuroView/** directory in the [MRT](#), and run the **setup.exe** program located there. The installer will copy NeuroView to your Program Files, along with any required .dll files. It will also create a NeuroView program group in your Start menu, and a shortcut on your desktop.

Running NeuroView

To run NeuroView, double-click on the **NeuroView icon** on your desktop, or click on **All Programs** > **NeuroSky** > **NeuroView** in your **Start Menu**.

Connecting To A Data Source

NeuroView is able to connect to, and read data from, any ThinkGear module or headset that is connected to one of the Operating System's COM ports.

1. Make sure the ThinkGear module or headset is **turned on** and is actually **connected to a COM port** on the system that NeuroView is running on.
 - ThinkGear modules or headsets connected though Bluetooth must already be paired and authenticated with key "0000", with Bluetooth SPP service detected by the system's Bluetooth stack, in order for NeuroView to be able to connect.
 - Please refer to the MindSet Quick Start Guide, or other documentation that accompanied your ThinkGear module or headset, for detailed instructions on how to properly connect your module or headset to your system's COM ports (referred to as headset "Pairing" or "Setup").
2. Select **File > Connect** (or click the Connect icon on the toolbar) in NeuroView to bring up the **Connection dialog**.
3. Select the correct **name of the COM port** that the ThinkGear is connected to.
 - Again, please refer to the MindSet Quick Start Guide, or other documentation that accompanied your ThinkGear module or headset, for detailed instructions on how determine which COM port your module or headset is connected to (for Bluetooth connections, it may be referred to as the "Outgoing Port").
 - If you know the name or number of the COM port, you can type either the name, or even just the number, directly into the field (If typing the name, remember that on Windows systems, COM port 10 and higher are named like `\\.\COM10`).
4. Select the correct communication **baud rate** for your ThinkGear module.
 - Standard MindSet headsets are configured to communicate at 57600 baud, while some older ThinkGear modules and headsets may be configured to be 9600 baud. Refer to the documentation that accompanied your module or headset or purchase to determine the baud rate it was configured for at the factory.
 - Remember, if you previously changed the configuration of your module or headset by sending it a Command Byte, then as long as the module or headset stays powered on, it will continue operating with the configuration you instructed it to, even if you close the NeuroView application, so be sure to have NeuroView attempt to connect at the baud rate of the current configuration. To reset a module or headset back to its original factory configuration, simply turn the module/headset completely off, and then back on.
5. Click **OK** to attempt the connection.
 - If unable to open the selected COM port, or if ThinkGear data cannot be detected on the selected COM port, a message will pop up indicating the problem, and suggestions for resolving the problem.

6. Select **File** > **Disconnect** (or click the Disconnect icon on the toolbar) to disconnect from the ThinkGear.

Real-time Data Viewing/Graphing

Graphs, meters, and messages show you the data that NeuroView is receiving from the ThinkGear module/headset in real-time. Most ThinkGear modules and headsets are configured at the factory to at least output Attention, Meditation, and Poor Signal Quality by default. Other types of data may be requested by sending certain Command Bytes to the system (only applicable to certain hardware models, see [Sending Command Bytes](#) for details).

Poor Signal Quality Messages

The status bar at the bottom of the window will continually display Poor Signal Quality messages sent from the ThinkGear module/headset. A Poor Signal Quality value of 0 indicates a relatively clean signal, while higher values indicate progressively poorer signals. A value of 200 has a special meaning, namely that the electrodes of the ThinkGear module/headset are not contacting the skin of the head at all.

Poor signal may be caused by a number of different things. In order of severity, they are:

- Sensor, ground, or reference electrodes not being on a person's head (i.e. when nobody is wearing the ThinkGear).
- Poor contact of the sensor, ground, or reference electrodes to a person's skin (i.e. hair in the way, or headset which does not properly fit a person's head, or headset not properly placed on the head).
- Excessive motion of the wearer (i.e. moving head or body excessively, jostling the headset).
- Excessive environmental electrostatic noise (some environments have strong electric signals or static electricity buildup in the person wearing the sensor).
- Excessive non-EEG biometric noise (i.e. EMG, EKG/ECG, EOG, etc)

A certain amount of noise is unavoidable in normal usage of ThinkGear, and both NeuroSky's filtering technology and eSense™ algorithm have been designed to detect, correct, compensate for, account for, and tolerate many types of non-EEG noise. Most typical users who are only interested in using the eSense values, such as Attention and Meditation, do not need to worry too much about the `POOR_SIGNAL` Quality value, except to note that the Attention and Meditation values will not be updated while `POOR_SIGNAL` is detected. The `POOR_SIGNAL` Quality value is more useful to some applications which need to be more sensitive to noise (such as some medical or research applications), or applications which need to know right away when there is even minor noise detected.

eSense™ Meters

Select **View > Attention eSense Meter** or **View > Meditation eSense Meter** (or click the corresponding toolbar button) to view Attention or Meditation meter values sent from the ThinkGear module/headset.

For all the different types of eSenses (i.e. Attention, Meditation), the meter value is reported on a relative eSense scale of 1 to 100. On this scale, a value between 40 to 60 at any given moment in time is considered "neutral", and is similar in notion to "baselines" that are established in conventional EEG measurement techniques (though the method for determining a ThinkGear baseline is proprietary and may differ from conventional EEG). A value from 60 to 80 is considered "slightly elevated", and may be interpreted as levels being possibly higher than normal (levels of Attention or Meditation that may be higher than normal for a given person). Values from 80 to 100 are considered "elevated", meaning they are strongly indicative of heightened levels of that eSense.

Similarly, on the other end of the scale, a value between 20 to 40 indicates "reduced" levels of the eSense, while a value between 1 to 20 indicates "strongly lowered" levels of the eSense. These levels may indicate states of distraction, agitation, or abnormality, according to the opposite of each eSense.

An eSense meter value of 0 is a special value indicating the ThinkGear is unable to calculate an eSense level with a reasonable amount of reliability. This may be (and usually is) due to excessive noise as described in the `POOR_SIGNAL` Quality section above.

The reason for the somewhat wide ranges for each interpretation is that some parts of the eSense algorithm are dynamically learning, and at times employ some "slow-adaptive" algorithms to adjust to natural fluctuations and trends of each user, accounting for and compensating for the fact that EEG in the human brain is subject to normal ranges of variance and fluctuation. This is part of the reason why ThinkGear sensors are able to operate on a wide range of individuals under an extremely wide range of personal and environmental conditions while still giving good accuracy and reliability. Developers are encouraged to further interpret and adapt these guideline ranges to be fine-tuned for their application (as one example, an application could disregard values below 60 and only react to values between 60-100, interpreting them as the onset of heightened attention levels).

ATTENTION eSense

This unsigned one-byte value reports the current eSense Attention meter of the user, which indicates the intensity of a user's level of mental "focus" or "attention", such as that which occurs during intense concentration and directed (but stable) mental activity. Its value ranges from 0 to 100. Distractions, wandering thoughts, lack of focus, or anxiety may lower the Attention meter levels. See [eSense\texttrademark Meters](#) above for details about interpreting eSense levels in general.

MEDITATION eSense

This unsigned one-byte value reports the current eSense Meditation meter of the user, which indicates the level of a user's mental "calmness" or "relaxation". Its value ranges from 0 to 100. Note that Meditation is a measure of a person's **mental** levels, not **physical** levels, so simply relaxing all the muscles of the body may not immediately result in a heightened Meditation level. However, for most people in most normal circumstances, relaxing the body often helps the mind to relax as well. Meditation is related to reduced activity by the active mental processes in the brain, and it has long been an observed effect that closing one's eyes turns off the mental activities which process images from the eyes, so closing the eyes is often an effective method for increasing the Meditation meter level. Distractions, wandering thoughts, anxiety, agitation, and sensory stimuli may lower the Meditation meter levels. See [eSense Meters](#) above for details about interpreting eSense levels in general.

Graphs

Select any of the Graphs under the View menu (or click the corresponding toolbar button) to toggle show/hide the selected graph.

For each graph, you may adjust the maximum and minimum displayed ranges of the X and Y axis, allowing you to zoom in and out of each graph as desired.

NOTE: The Power Spectrum in NeuroView is calculated from the Filtered Wave, which in turn is calculated from the Raw Wave. So in order for the Raw Wave Graph, Filtered Wave Graph, and Power Spectrum Graphs to have any data to display, NeuroView must be receiving Raw Wave information from the ThinkGear module or headset. However, because many applications do not require Raw Wave information, or don't have the ability to use it in any meaningful way, some ThinkGear modules and headset models are configured to not output Raw Wave information by default. If this is the case with your module/headset, refer to the [Sending Command Bytes](#) section for information on how to enable it, based on the module/headset that you have.

Recording Data Logs

To begin recording data, select **Record > Start Recording** from the menu (or click the red Record button on the toolbar). Any data received by NeuroView from that moment on will be recorded to temporary files in the program's execution directory. You can Start Recording even before a connection to a COM port is established, in which case data will begin to be recorded to the temporary files as soon as a connection is made and data is received.

Recording Options

You may customize the recorded file formats in several ways. Typically, you should select your recording settings before clicking Start Recording, although it is possible to change the settings at any time during a recording. Note that some options are enabled only if other options are enabled first.

- **UNIX Timestamps** - The recorded log files will use UNIX-style timestamps, which are defined as the "number of seconds since the EPOCH, Jan 1, 1970, 0:00". These timestamps are in units of seconds, with 3 decimal places, so that they actually provide up to millisecond precision. If UNIX Timestamps are not enabled, then HH:MM:SS format will be used for the timestamps instead.
- **Relative Time** - The recorded log files will use timestamps indicating relative time, defined as "number of seconds from the time the first data Packet was received from the ThinkGear module/headset".
- **Reset Relative Time** - Resets the relative time to zero each time the Start Recording is pressed, instead of each time the program is started.
- **MATLAB formatting** - Comments out the CSV header line using a MATLAB-style comment (%), so that recorded data files can be easily loaded into MATLAB without any modification required.

Saving Recorded Data

When enough data has been collected, you may stop the recording and save the recorded data to permanent files by selecting **Record > Save Recorded Data** from the menu (or clicking the corresponding button on the toolbar). A dialog will pop up that will allow you to save all the files with a Common Filename Prefix (which defaults to the current timestamp at the moment Save Recorded Data was selected). You may use the Common Filename Prefix to put your own appropriate description on that set of log files. You can see the actual file names that the individual log files will be saved to in the greyed-out boxes below. You may disable the saving of individual log files by clearing the "Enabled?" checkbox next to each one. You may also separately name individual log files by clearing the checkbox for the Common Filename Prefix at the top, at which point you can specify names for individual log files. Checking the Common Filename Prefix box again will revert the names to a common prefix.

Discarding Recorded Data

At any time, you may stop the recording and discard the accumulated data up to that point by selecting **Record > Save Recorded Data** from the menu (or by clicking the corresponding button on the toolbar). The temporary recording files will be deleted, and a new recording can be started.

Sending Command Bytes

Command Bytes are advanced commands which are sent to ThinkGear modules/headsets in order to change its state or perform an action. Command Bytes are intended for **advanced users** who need to reconfigure their ThinkGear modules/headsets for some particular purpose not available from the standard default factory configuration. Use Command Bytes with caution, as sending improper command bytes to a ThinkGear module may put it into an unusable state until it is turned off and turned back on (ThinkGear modules always return to their default settings each time they are powered on).

The following are examples of Command Bytes that are useful ThinkGear modules (MindSet Pro) with FWv1.7.13 and earlier. These headsets do not output raw wave data by default, so these Command Bytes instruct the headset to begin outputting the raw wave data. To enable:

- a) full-resolution raw wave data on a 57.6k MindSet:
 send Command Byte: 0x13 (decimal: 19, binary: 00010011b).
- b) low-resolution raw wave data on a 9600 or 57.6k MindSet:
 send Command Byte: 0x11 (decimal: 17, binary: 00010001b).

ThinkGear ASICs (MindSets) by default already output all the ThinkGear Data Types relevant to NeuroView (Attention, Meditation, Poor Signal Quality, Raw Wave) at 57.6k baud, so it should typically NOT be necessary to send Command Bytes to these headsets. If you really need to use Command Bytes, please refer to the Communication Protocol document that accompanied your ThinkGear headset, module, or chip (i.e. the MindSet Communications Protocol) for full details on how other Command Bytes are formed and to see which commands are available and applicable to your particular module/headset model and version.

Troubleshooting

- If the program inexplicably hangs or freezes sometimes when attempting to connect to a headset, it may be due to a conflict from a previously installed version of NeuroView. If this is the case, try uninstalling NeuroView by running the `unins000.exe` in the `Program Files/NeuroView` directory, and then reinstalling NeuroView according to the [Installation](#) instructions above once again.