

NeuroPhys Users' Manual

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Overview

This User Manual contains instructions on how to use NeuroPhys software with our hardware JAGA16 device or JAGA penny device. JAGA systems (JAGA16 or JAGA penny) are wireless neural recording acquisition devices.

NeuroPhys is the neural recording acquisition software

For JAGA Penny, you will also need to install a USB driver for our receiver once you install NeuroPhys. The instruction on installing the driver is on our website www.jinga-hi.com
>Document>Software>Installation NeuroPhys/NeuroSorter/USB driver for JAGA Penny

The data output from NeuroPhys is .PLX or can be converted to .CVS using NeuroSorter data analysis or a matlab array based on our matlab codes

Please contact us at info@jinga-hi.com with your inquiries.

System Requirement

The current version of NeuroPhys runs and is fully tested on Windows 10. It may also run on Windows 8 and 7 but is untested. Listed below is the computer system we used for testing. Specifications for your computer should meet or exceed these to ensure compatibility and performance.

System Manufacturer Dell Inc.

System Model XPS 15 7590

Processor Intel(R) Core(TM) i7-9750H CPU @ 2.60GHz, 2592 Mhz, 6 Core(s), 12 Logical Processor(s)

Installed Physical Memory (RAM) 16.0 GB

OS Name Microsoft Windows 10 Home

Video card NVIDIA GeForce GTX 1650

Systems with lower specifications *may* be sufficient, particularly if graphics are less than 4K UHD quality, as the real-time data display tends to be the most resource intensive part of the

software, and the resources needed scales with display resolution.

Install Software

1. Download the installer from www.neurosysllc.com/Software.html and run it. It should install two programs: **NeuroPhys** - main data acquisition program **SpikeSorter** - offline data analysis program
2. Launch NeuroPhys by clicking the brain icon 
3. At first launch, NeuroPhys will ask you to register the product.



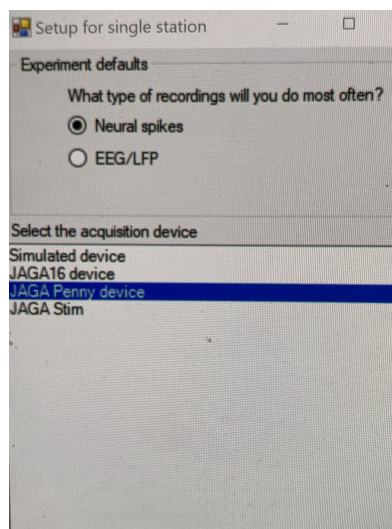
If you did not purchase a device, you can click **Run a FREE version!**. This version will be fully functional without a time limit. The free version allows only 4 active channels.

No longer Required. Skip This part: Click **Register Product**. Then select Import **license from XML file**, and choose the license file you were sent.

Configure Software

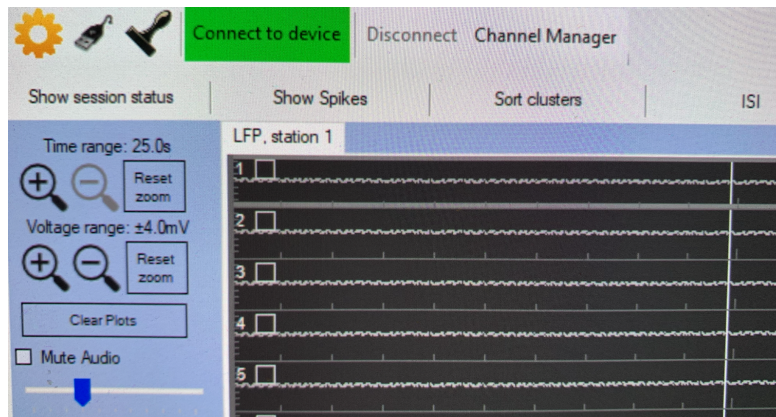
The first time you run NeuroPhys on your computer, you will be asked to confirm the configuration. You can change this setting at any later time by going to:

1. **Tools>Basic Setup** The program defaults to **Neural Spikes** for the recording type. If you will be conducting EEG/LFP recordings for most of your experiments, select **EEG/LFP**.



2. Select the hardware you will be using by clicking **JAGA16 *** or **JAGA Penny device****.
3. If you are evaluating the software without any hardware, then select **Simulated device**. This gives demonstration waveforms that you can play with.
4. Click **OK** when you are done.

5. Once the program launches, click **Connect to device** to check whether the device and the software are working.



Software Display without any device:

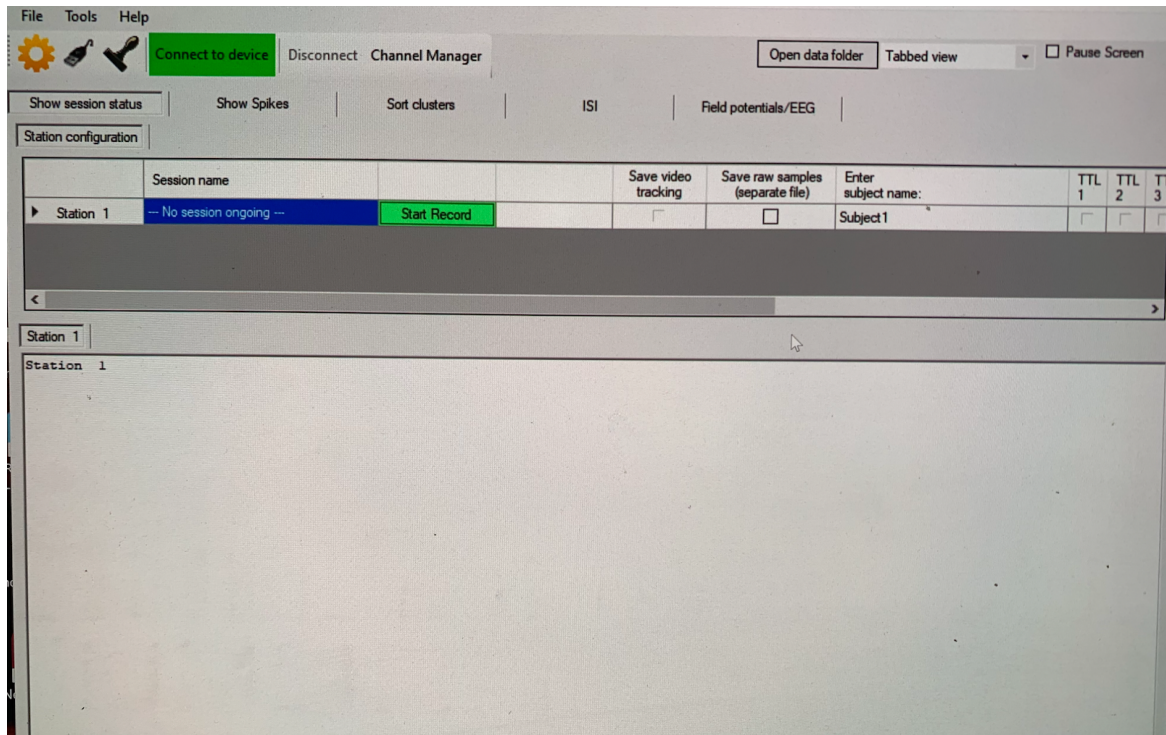
Without a hardware device, the software will automatically generate simulated signals. Select the Show **Spikes** tab after clicking **Connect to device** to see waveforms. The waveform updates every 50 milliseconds like below

Getting Started

Once you have configured the software and verified the test signals, you are ready to start recording. On your window, you will see the following buttons and tabs:

1. **Connect to device/Connected, Disconnect, Channel Manager** (first row)
2. **Show session status, Show Spikes, Sort clusters, ISI, Field potentials/EEG** (second row)

3. Toggle for **Tabbed view**, **Tiled view**, **Paneled view** (top right corner). **Paneled view** allows you to see Sort clusters, ISI, and Show spikes windows simultaneously, and this option is highly recommended, but works best with a widescreen monitor.



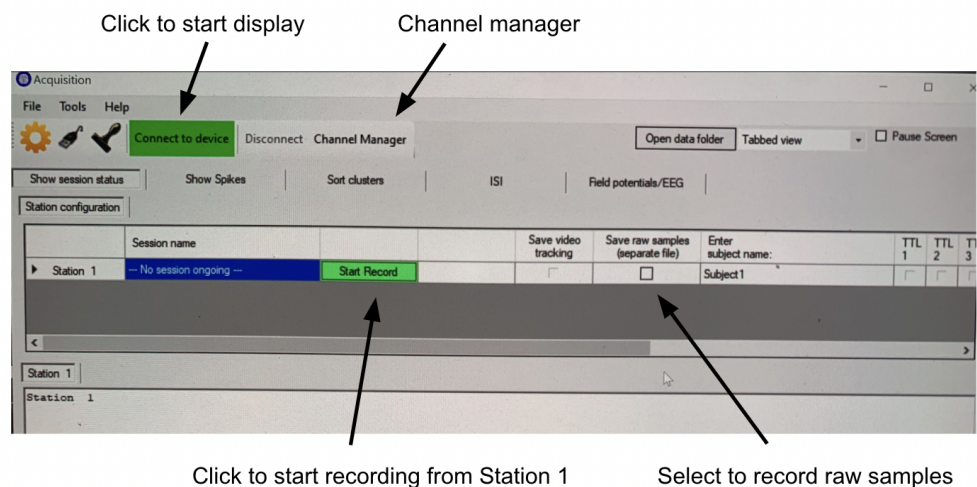
Start a Simple Recording Session

1. Select tab **Show session status**. Here, you will see a list with one row for every recording station (only one shown here) with a green button labeled Start Record.

2. When you are ready to record, press **Start Record**. (Make sure you already clicked **Connect to device**.)

3. By default, **ONLY DETECTED SPIKES** will be saved to disk. Waveforms in between detected spikes **will not** be saved by default. If you want to record raw samples (*i.e.* not spike sorted), select **Save raw samples** and press **Start Record**.

4. Each channel is referenced to ground by default. However, if you have a dedicated reference wire, you can go to **Channel Manager** on the first row of buttons, find the channel you want to change in the first column and change the **Reference for spike recording** or **Reference for EEG/LFP recording** (depending on what type of recording is being observed) in the second column from the corresponding dropdown menu of the matching row. (See section **Channel Manager** for details.)

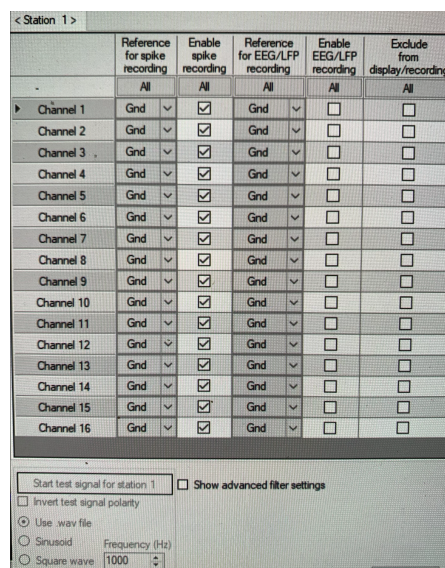


5. Select **Show Spikes** tab to visualize waveforms. The recording in each window represents 50milliseconds of data.

6. To take a closer look at waveforms in any of the channels, double-click on a panel. This will toggle the selected panel to full-screen and hide the remaining channels. If you double-click again it goes back to the multi-channel screens.

Channel Manager

For more precise control of recording settings, you can use the **Channel Manager** to view and change all settings at a glance. When you click **Channel Manager**, you will see this dialog box:



1. This Channel Manager display *may* vary in appearance if you have multiple recording stations configured. Channel Manager allows you to select a separate reference for each channel. In the above example, all channels are referenced to ground but this can be changed. The differential subtraction is performed prior to amplification, which allows for excellent common mode rejection.
2. Channel that is used as reference will be highlighted in green.

3. You can exclude some channels from processing by checking the very last column “Exclude”. These channels will not be displayed, and no calculations will be performed on them, reducing CPU load. This should be done if some wires are not connected on a particular animal, or if a wire has gone bad and carries only noise. Excluding a channel will prevent a user from accidentally recording from it or using it as reference.
4. Note that excluded channels still contribute to the system’s overall sample throughput. Hence, if you want to sample at a higher sampling rate than the default, you should reduce the number of active channels under Options rather than simply excluding them.

Show Spikes

For **spike recording**, you will want to selectively view amplitudes that rise above background noise. The program can selectively display and save such waveforms.

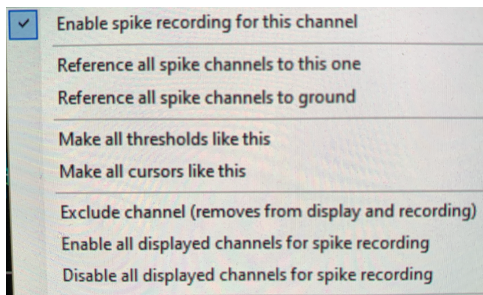
1. Select **Show Spikes** tab.
2. Click **Show thresholded** (on the blue left panel) to toggle to the thresholded mode. This mode will display only those waveforms that exceed a set voltage. The threshold appears as a *horizontal yellow line* across each plot (red arrow below), which you can drag up and down with the mouse. If the threshold line seems to be missing, it is sometimes at the *top or bottom edge* of the window.
3. To listen for spikes during your recording session, unclick **Mute Audio**.

Note:

- You can also set thresholds automatically by clicking and *holding* the **Auto threshold** button (on the blue left panel) – this will set the threshold to be 2 standard deviations below the mean voltage. You have to *hold down* this button for a second or two for this to take effect. Once you let go, the threshold will lock in place

- In the thresholded mode, you will see 800 μ s of each spike waveform, with 200 μ s shown before and 600 μ s shown after the threshold is hit. These time settings can be changed in the settings.

More options for Spikes



Appears after right clicking a spike display. Here is an explanation of each option:

Enable spike recording for this channel: By default, detected spikes are saved for each channel. If you toggle this off, then detected spikes are not saved and waveforms will display in grey instead of in color. You should disable spike recording for channels that do not appear to have any useful neural spikes.

Reference all spike channels to this one: If you want some channels to have one reference, and some to have another, you can do this by using the Channel Manager (further described in section “Channel Manager”).

Reference all spike channels to ground: This is the default state when the program is first launched.

Make all thresholds like this: This refers to the threshold used to detect whether a spike has occurred or not. This option makes all channels in this box have the same threshold as the window you just clicked.

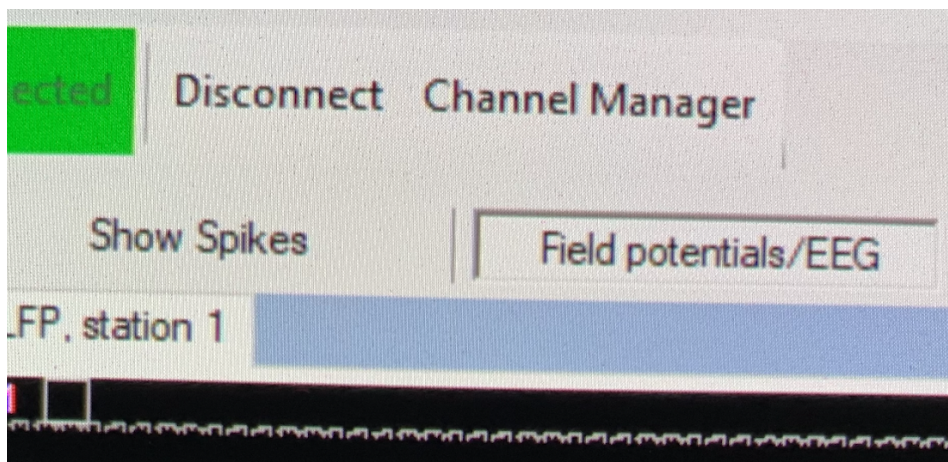
Make all cursors like this: This refers to the vertical cursors used to calculate the voltages in the 2-D cluster plots. This option makes all channels to have the same cursor as the window you just clicked.

Exclude channel: This disables recording for this channel, similar to the effect of disabling “spike recording”. However, when a channel is excluded, its waveforms are no longer visible, not even in greyed out form. Also, excluding a channel will significantly reduce CPU load because the computer will no longer have to calculate and display waveforms for this channel

Field Potential

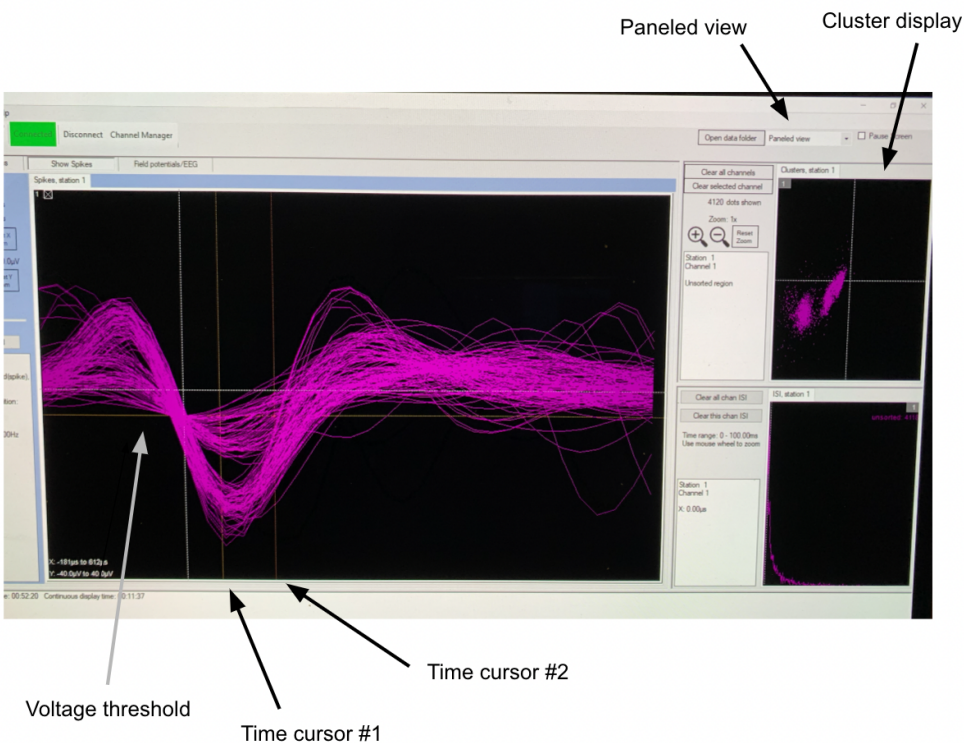
You can also view field potentials, which are the input signals down-sampled to one kilohertz.

1. Select **Field potentials/EEG** tab.
2. You will see data displayed in all channels.



Real Time Spike Sorting

Neurophys software has the ability to sort (*i.e.* classify) spikes in real time. To demonstrate these capabilities, you can start a self-test session as described above. Select **Paneled View** mode using the toggle menu in the upper right of the main screen. Your screen will look something like this when you are running the self-test:

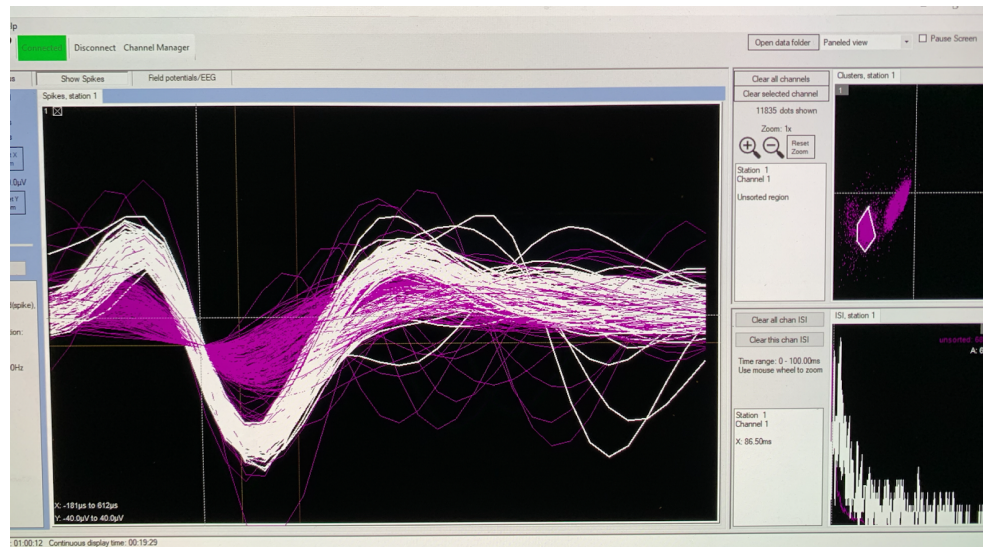


In the example above, Channel 1 is enlarged by double-clicking on it so that only this channel is displayed. If you look closely, you will notice three cursors on this window, shown by **yellow dashed lines**: Each of these cursors can be adjusted by dragging it with the mouse.

The yellow lines represent:

1. See gray arrow above: This horizontal line sets the voltage threshold of detected spikes.
 2. See black arrows at bottom of image above: These two vertical lines define start and end time points.
-
2. The “Sort clusters” display panel in the upper right corner shows a scattering of dots.
The dots work as follows:
-
3. Each dot corresponds to one detected spike, *i.e.* a waveform that exceeds the specified voltage threshold.
-
4. The X and Y coordinates of each dot are the *voltages at which each spike waveform intersects time cursor #1 and time cursor #2 respectively.*
-
5. The dots are mostly in the upper-left quadrant of the screen, because most waveforms intersect the first time cursor at a negative voltage (corresponding to an X value to the left of center), and the second cursor at a positive voltage (corresponding to a Y value above the center).
-
6. The time cursor was placed on #1 and #2 where the waveforms reach their approximate minimum and maximum voltages, respectively. This causes the dots corresponding to neural spikes to be as far as possible from background noise.
-
7. Notice also how the dots segregate into multiple distinct clusters – these clusters correspond to distinct neurons having distinct waveform shapes. You can click and drag the mouse to outline a polygon that encircles one of the clusters. This will cause all the waveforms corresponding to that cluster to display in a distinct color. You can place multiple polygons, and each will show up as a different color, with successive clusters receiving a designated letter “a”, “b”, “c”, etc. This designation is saved along with the spike timestamp and waveform during a recording session. The result should look

something like the window below. You'll see that I have outlined a cluster that shows up in white:



When you complete a session, click on the red **Stop Session** button under the **Show session status** tab. This button is immediately next to the green button you clicked to start the session.



You can now view your data file in the NeuroSorter program.

Find the icon like this.

JAGA16_CH32

You can connect two JAGA16 devices and record up to 32 channels. If you record in .PLX form, the generated data will have all 32 channels in one file. Two files (channel 1-16 and channel 17-32 files) will be generated.

Where is my data?

By default, all recorded waveforms are saved to the folder "NeuroPhysData", found in the folder "My Documents". Each session will generate two files, .TXT and .PLX. A third file format .CVS

can also be obtained using SpikeSorter software. The files are described below:

1. A text (.TXT) file containing session log details – currently the session log shows the session duration and any text sent by Med Associates programs running concurrently with the recording session.
2. A Plexon-format (.PLX) file containing spike timestamps and waveforms. You can convert this .PLX file to matlab file using a package [plx2mat](#) available on our website.
3. You can also convert from .PLX to .CVS file format using SpikeSorter (See User Guide for SpikeSorter for more details).

You can change the folder options by clicking **Tools>Options**.