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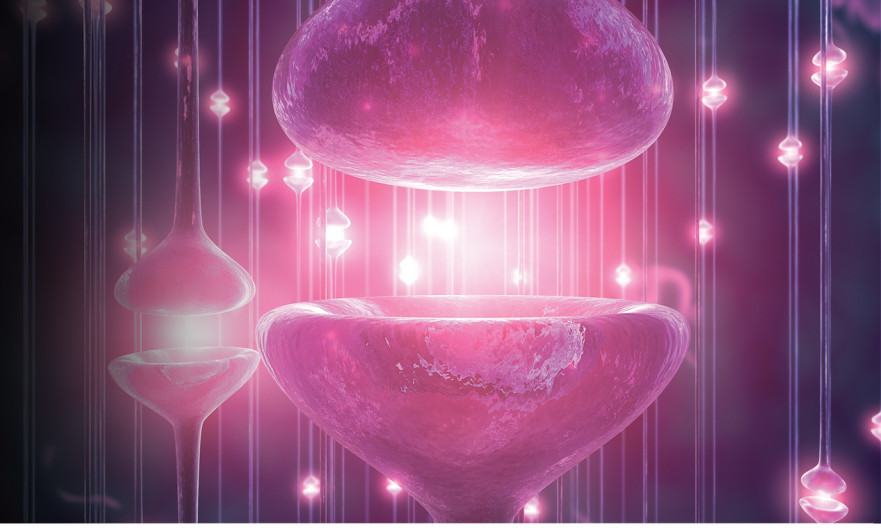


#LabHacks

How to reduce the noise around your electrophysiology rig

Introduction

Electrical noise is a constant source of annoyance and frustration to electrophysiologists. By taking a systematic approach, it is feasible to reduce the noise on a patch clamp electrophysiology rig to a level where single-molecule activity can be recorded with micro-second resolution.

Strategy for reducing noise

Reduce background noise around your rig by up to 90%

1. Use a digital oscilloscope

An excellent tool to check for sources of noise. Digital oscilloscopes are now relatively cheap and allow you to measure noise on the fly.

2. Stripping down your rig

Remove all peripheral equipment. The only items inside your faraday cage shoud be your headstage, manipulators, sample holder and microscope. The camera, light source and perfusion tubing can all be removed.

3. Ensure all electrical equipment is properly grounded

It is important to make sure that you have not created any grounding loops. Ground all electrical equipment at one point, not in series. Limit the total number and test them all for electrical integrity.

4. Put back peripheral equipment one by one

This will enable you to identify if any of them is a significant source of noise. If for example, you add your camera back to the setup and find it is causing electrical noise, you may be able to switch it off once you've found your cell of interest to eliminate this problem.

5. Do multiple rounds of troubleshooting

The greatest cause of noise will likely drown out the noise from all other sources. Once you have identified one primary source, go back and check all previously ineffective changes, as they may now be the major source.

6. Check the perfusion system

To minimise its impact, it is best to remove all unnecessary tubing. Next, keep the level of the bath low and hold the patch near the top to reduce the immersion of the pipette and its capacitance.

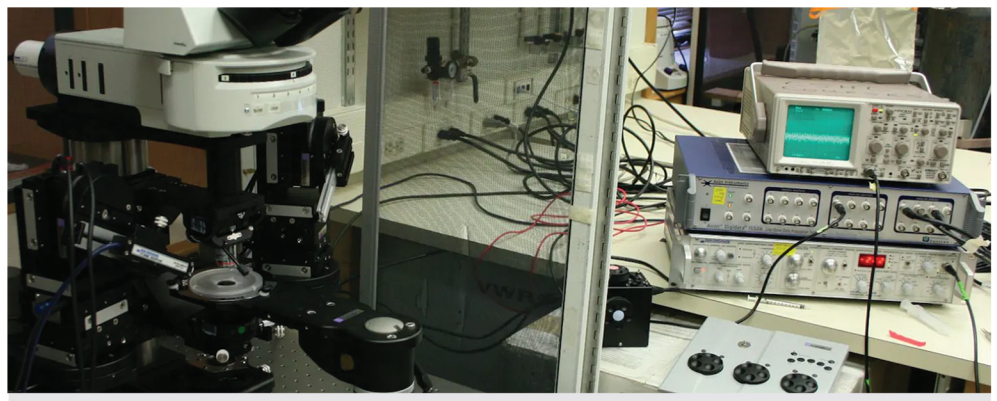
7. Persistent cause of noise

For persistent causes of noise, an additional structural shielding of the entire setup with wire mesh or metallic fabric can help. The metallic material can also be of benefit as a curtain at the front of the Faraday cage.

8. Get a tight seal

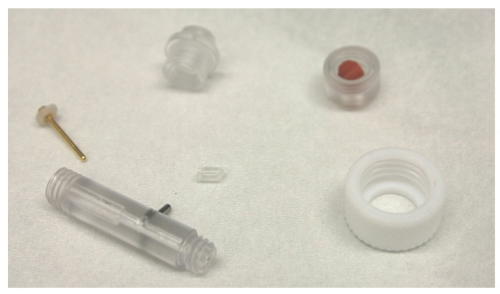
When all of the noise levels at the setup have been minimised, the greatest cause of noise will come from the seal of your pipette and the cell. At this point, getting a tight seal is the most important aspect for eliminating noise.

Sources of electrical noise

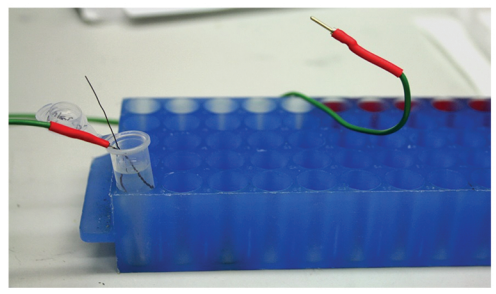


- Mains electricity supplies
- Cheap power supplies
- Computers and monitors
- Mobile phones
- Refrigerators
- Centrifuges
- Light sources
- Microscopes and manipulators
- Cameras
- Stages and platforms
- Perfusion systems
- Headstages
- Pipette holders
- Amplifiers

Troubleshooting checklist



The pipette holder can be a significant cause of electrical noise. Cleaning it thoroughly can help to reduce it.



Chloride your grounding wires and electrodes to make sure they are clean and free from oxidation.

- Switch off manipulator
- Switch off camera
- Insulate lamp cable
- Clean pipette holder (with ethanol, then rinse with water and air dry)
- Chloride grounding wires, electrode and reference electrode
- Rewire to remove grounding loops

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