

Q&A Report - Measuring Long-Term, Wireless EEG in Rodents using Epitel-Epoch and BIOPAC Systems

1. Can mice be group housed and recordings made from multiple mice at a time?

Epitel is currently testing a system to allow recording from multiple co-housed animals (rats and mice). Stay tuned! We hope to offer this system shortly.

2. Can the pup transmitter tray be used for an adult mouse?

It is not recommended. To function properly, the size of the receiver is designed to reflect the size of the animal.

3. I have questions regarding the weight of the transmitter-eg for a mouse. And do these affect locomotor activity

Below is a table of the transmitter specifications. We recommend the 2-week transmitter for P10+ mice and P6+ rats. 2-month transmitter for P21+ mice and P6+ rats. 6-month transmitter for P21+ rats only.

Size	Footprint	Height	Weight	Volume
2 week	4x6 mm	8 mm	0.5g	0.19 cc
2 month	8.5x9.5 mm	14 mm	2.3g	0.76 cc
6 month	9.3x12.4 mm	18 mm	4.0g	1.34 cc

4. What kind of glue are you using for securing the transmitter to the skull?

We recommend cyanoacrylate approved for medical use. One example is Loctite® 4541. (accelerant 7452). Dental cement, polymethyl methacrylate (PMMA), can be used to cover the cyanoacrylate.

5. Do we need to have the receiver under the cage, or could it be oriented differently in relation to the base of the cage?

The Epoch transmitter uses capacitive coupling which requires the animal to have at least one foot over the receiver antenna, and therefore must be placed directly underneath the cage to receive the signal. The receiver will not work if positioned alongside the cage. Also, each receiver has an auxiliary antenna connection that allows you to clip to the wire top (food and water bin) of the animal cage that makes the wire top an antenna as well. This is especially critical for mice and young rats that like to crawl across the wire top without losing the signal. In some cases, such as with T-mazes, we've been able to make custom solutions for customers. As another example, we can provide you with a receiver specifically to record from an animal running on a virtual reality ball. If you have a unique set-up for recording outside of the standard cage environment, please contact Epitel and we can help devise the best solution to get you started. Send us your design!

6. Can you use the *AcqKnowledge* software for EEG analysis on a Mac?

AcqKnowledge software is available for Mac and Windows operating systems. The only difference between the two systems is that the Windows version has the media option that allows the user to synchronize video with the physiological data. The Mac does not offer this functionality. The following links will provide you with access to the software page on our website and the demonstration version of *AcqKnowledge*. The demo version contains sample files that can be used for analyzing the data.

<https://www.biopac.com/product-category/research/software/acqknowledge-upgrades/>

<https://www.biopac.com/demo/acqknowledge-5-demo/>

7. Is your software based on Audacity OS Signal/sound processing software?

AcqKnowledge software is not built on Audacity signal/sound processing software. BIOPAC developed *AcqKnowledge* for physiological data acquisition and analysis and it has evolved over many years of development and customer feedback. The software has a rich list of features and tools for signal processing but they are geared towards physiological data. The software includes individual tools for signal processing and detailed analysis routines for physiological signals.

The following links will provide you with additional information about the software and applications that it is used for.

<https://www.biopac.com/applications/>

<https://www.biopac.com/product-category/research/software/>

8. Is it possible to stimulate instead of acquire data?

No, it is not possible to deliver stimulation through the Epoch transmitters at this time.

9. Is it possible to install this set up for experiments in Skinner boxes?

It depends on the type of Skinner box. One advantage is that it may be possible to use the Skinner box itself as a Faraday cage. However, any electrical components (levers, etc.) may interfere with the signal. Please contact Epitel directly and we can help you determine the best solution (epoch@epitelinc.com).

10. Is there any sales office in India for Epoch?

BIOPAC has a reseller in India that can provide you with local sales support. The following link will provide you with additional information. <https://www.biopac.com/international-offices/?country=IN>

11. Is the 60hz filter an on-line one? i.e. is it filtering the acquisition or is it subtracting data after the acquisition?

When you first install *AcqKnowledge* software, the installer will ask whether you are in a 50Hz or 60Hz power line region. The installer will then set the necessary software settings to reflect the selected option, which is why in the demonstration, the Comb Band Stop filter automatically defaulted to 60Hz. When the software was first installed, the 60Hz setting was selected for the USA.

12. Can we recharge or change the battery for the reusable transmitter?

The re-usable transmitters do not have the ability to be recharged. However, they can be turned off with the Activator when not in use to preserve their battery life. The re-usable transmitters come in the 2-month form factor.

13. How good is the software in detecting chronic seizures? Do you have any advice as to how best do this?

AcqKnowledge includes a fully automated analysis routine that can be used to identify chronic seizures. The analysis routine is based on the spike frequency method using the maximum slope algorithm for spike detection. The following link will provide you with additional information and a detailed screencast of the analysis routine. <https://www.biopac.com/?app-advanced-feature=seizure-detection>

The following publication will provide additional information about the method employed:

White AM, et al. [Efficient unsupervised algorithms for the detection of seizures in continuous EEG recordings from rats after brain injury](#) *J Neurosci Methods*. 2006 Apr 15;152(1-2):255-66.

14. Can these systems [Epoch and BIOPAC *AcqKnowledge*] be used with optogenetic equipment?

Yes, as long as the optogenetic equipment does not induce electrical interference in the system.

15. Do you know of anyone using this system for 26h continuous acquisition with integrated video and if so, are they using it for seizure detection or sleep analysis?

Yes, we have many users who are recording continuous video-EEG in rats for up to 6-months and mice up to 2-months, with and without video. In either case, we recommend breaking the files into smaller periods by automatically stopping and restarting the software throughout the recording. This makes the video and data files more manageable for analysis. The video can be saved to a unique hard drive and *AcqKnowledge* can be set to start and stop as many times as the researcher would like. For example, the software can be set to record for six hours, stop and then restart. This will create four files every twenty-four hours and each file will have a unique extension number for the physiological file and the video file.

The following link will provide you with additional information about the camera systems that BIOPAC offers.

<https://www.biopac.com/product-category/research/video-monitoring-systems/multi-camera-systems/>

16. How is the system powered? Battery or wireless power transfer? If it's battery, what's the capacity?

All transmitters use battery power. The size of the transmitter is based on the battery capacity. Regardless of the configuration or number of channels, all Epoch transmitters are available in the 2-week, 2-month, and 6-month form factors. Below is a table of all available transmitter biopotential and channel combinations.

Transmitter and Receiver Compatibility Table

Tx P/N	Characteristics			Receiver System Compatibility (Bandwith Limit: 0.1 - X Hz)		
	Record Time	Channels	Biopotential	Epoch Base	Epoch2	Epoch6
10128	2 month	2	EEG	100 Hz		
10129	6 month	2	EEG	100 Hz		
10165	2 week	2	EEG	100 Hz		
10217	2 month	2	EEG Reuseable	100 Hz		
10161	2 month	1	ECG or EMG		200 Hz	
10162	6 month	1	ECG or EMG		200 Hz	
10208	2 month	6	EEG			60 Hz
10209	6 month	6	EEG			60 Hz
10210	2 month	4	EEG			60 Hz
10211	6 month	4	EEG			60 Hz
10212	2 month	2	EEG		100 Hz	60 Hz
10213	6 month	2	EEG		100 Hz	60 Hz
10214	2 month	2	EEG Reuseable		100 Hz	60 Hz
10215	2 month	2 Differential	EEG, EMG, or ECG		100 Hz (EEG) 200 Hz (EXG)	
10216	6 month	2 Differential	EEG, EMG, or ECG		100 Hz (EEG) 200 Hz (EXG)	

common reference electrode layout

Example 2-Ch
Ch 1 = A - C
Ch 2 = B - C



looking up at the bottom of the transmitter

differential reference electrode layout

Example 2-Ch
Ch 1 = A - B
Ch 2 = C - D



looking up at the bottom of the transmitter

17. What is the youngest aged mouse can you safely implant a transmitter? Can Epitel Epoch be used for neonatal mice (P8)?

We recommend the 2-week transmitter in mice as young as P10. You may be able to implant younger mice but we recommend carefully monitoring the animals after the surgery to ensure they are gaining appropriate weight.

18. Would the transmitter have issues in animals tested in a water maze?

While in the water, the transmitter will couple with the water making the signal extremely weak. Once the animal is out of the water recordings can continue when the animal is placed back in its cage on top of the receiver. The transmitters are waterproof and capable of being submerged.

19. Is the transmitter capable of recording LFP signals?

Yes, it is possible to record local field potentials from deep brain structures (such as the hippocampus). Epitel has surgical manuals for implanting the Epoch transmitter for LFP recordings, please contact us if you would like a copy (epoch@epitelinc.com).

20. Are the transmitters autoclavable?

No, we recommend placing the transmitters in 70% ethanol to sterilize.

21. Can the pup transmitter be used for p21 mice?

Yes, the 2-week and 2-month transmitters will fit well on the skull of a P21 mouse.

22. What is the name/brand of Sleep software that was mentioned during the software demonstration?

BIOPAC offers the SleepSign software and it is compatible with the *AcqKnowledge* file format.

The following link will provide additional information about the software.

<https://www.biopac.com/product-category/research/software/sleepsign-licensing/>

23. How do you determine the depth of your electrode in the cortex?

The best method would be to use a stereotaxic micromanipulator to hold on to the transmitter while implanting the electrodes. For example, one could use either the brain maps for rat or mice in stereotaxic coordinates to first locate the x-y coordinate on the skull to make the craniotomy.

Next, the transmitter could be mounted in an electrode holder in a micromanipulator arm. Gently locating the tip of the transmitter electrode on Bregma will provide the x, y, and z reference. The transmitter electrodes can then be driven in the z direction with the stereotaxic micromanipulator to the desired depth and held in place while the cyanoacrylate and polymethylmethacrylate set up. Once set, the micromanipulator can be disengaged from the transmitter.

As always, final depth should be verified post-mortem with histological techniques.

24. Can you elaborate on the reusable transmitter that was mentioned during the presentation? How does the implant procedure differ? Are there differences in signal acquisition, or are there limits/benefits in comparison to the standard transmitters?

The re-usable transmitter replaces the cable used to connect Plastics1 3-electrode systems to a commutator mounted on the top of the cage. One advantage of the Plastics1 electrodes are the electrode options available ranging from polyamide-insulated stainless steel to Teflon-insulated platinum/iridium and customizable lengths. The specifications of the Plastics1 electrodes are as follows:

- Three individually insulated stainless steel, platinum iridium or tungsten wire electrodes (twisted or untwisted) extending below threaded plastic pedestal
- Pedestal Height: 8 mm (.315")
- Pedestal Diameter: 3.5 mm (.138")

The re-usable transmitter is available in the 2-month transmitter package. Other advantages of the re-usable transmitter include:

- Ability to turn the transmitter off when not in use
- Move the transmitter from animal to animal
- Compatible with a variety of Plastics1 3-electrode systems

25. Do you have recommendations for multi-channel video recording, either multiple recordings for a single subject, or for a high-throughput system with multiple animals being recorded simultaneously.

BIOPAC has developed a range of multi-camera systems for use with *AcqKnowledge*. These can be used for the both long-term study of small animals or human subjects. There is also a high frame rate camera option for customers that want to synchronize precise physical actions with the physiological data. This last option is more suitable for short recordings where synchronization and frame-by-frame viewing is critical.

<https://www.biopac.com/product-category/research/video-monitoring-systems/multi-camera-systems/>

<https://www.biopac.com/product-category/research/video-monitoring-systems/high-frame-rate-synchronization/>

26. Where did the methodology for seizure detection come from? Has it been validated

The following publication will provide you with additional information concerning the analysis method that is employed by the *AcqKnowledge* software.

White AM, et al. [Efficient unsupervised algorithms for the detection of seizures in continuous EEG recordings from rats after brain injury](#) *J Neurosci Methods*. 2006 Apr 15;152(1-2):255-66.

If you have additional questions for [BIOPAC Systems](#) and [Epitel](#) regarding content from their webinar or wish to receive additional information about their products, please contact them by phone or email. Sales inquiries for both BIOPAC and Epitel products should be directed to BIOPAC:



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