



EEG/EMG SYSTEMS



PINNACLE OFFERS three-channel and four-channel biopotential recording systems for sleep, seizure, and general behavioral paradigms in freely moving mice and rats. Both EEG/EMG systems use headmounted preamplifiers to produce exceptionally clean waveforms, even during animal movement. The four-channel system provides all the great features of the three-channel system along with an extra channel, configuration flexibility, and the added capability of incorporating simultaneous biosensor measurements. See the "System Features" chart to determine which system better fits your research needs.

TWO TURN-KEY SYSTEMS

COMMON USES



SLEEP STUDIES



SEIZURE RESEARCH



DEPTH ELECTRODES



CORTICAL RECORDINGS

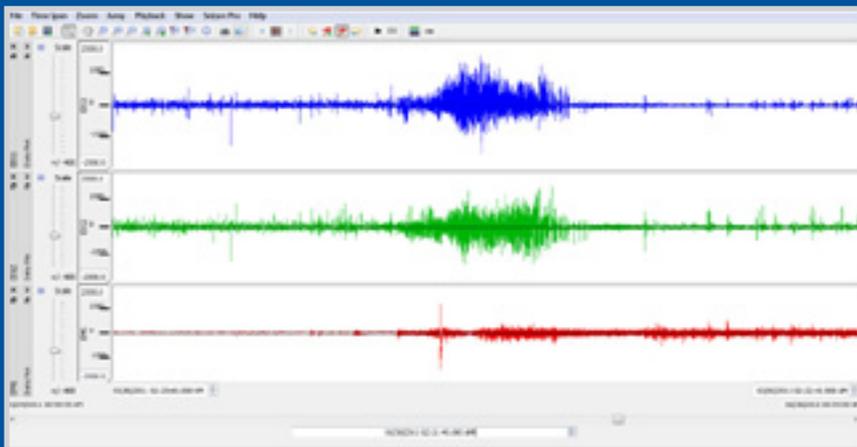


LOCAL FIELD POTENTIAL



COGNITIVE STUDIES

SYSTEM FEATURES	3 CHANNEL	4 CHANNEL
Available for both mice and rats	✓	✓
Optimized for sleep and seizure experiments	✓	✓
No cable artifact	✓	✓
Adjustable gain and low-pass filters	✓	✓
Sampling rate up to 2000 Hz per channel	✓	✓
Digital input/output controls	✓	✓
Analog output option	✓	
Fully configurable channels		✓
Biosensor support		✓
Reconfigurable via preamplifier exchange		✓



Seizure event from a C57 mouse model captured using Pinnacle's three-channel EEG/EMG system.

Data courtesy of Drs. Philip Haydon and Jerome Clasadonte
 Tufts University School of Medicine, Department of Neuroscience

LOW NOISE

TURN-KEY SYSTEM

ADVANTAGES

FREE ACQUISITION SOFTWARE

SYNCHRONIZED VIDEO

ADVANCED ANALYSIS TOOLS

SIMPLE SURGERIES

SYSTEM BREAKDOWN

OUR TURN-KEY SYSTEMS are engineered to deliver clean, artifact-free data. EEG and EMG waveforms are amplified and filtered at the head of the animal by the preamplifier. Signals are then passed through the low-torque swivel to the data conditioning and acquisition system for final-stage amplification and filtering. Each channel in our three- and four-channel systems features independent, adjustable gain and filter settings.

DATA CONDITIONING AND ACQUISITION SYSTEM

A data conditioning and acquisition system (DCAS) performs secondary amplification and filtering before sending data to Pinnacle's Sirenia® Acquisition software for collection via a USB connection.

SPECIFICATIONS

- Adjustable Sampling Rates: 200 - 2,000 Hz
- Software Configurable Low-Pass Filters: 10 Hz - 1 kHz

TETHERED SYSTEMS FOR RATS

COMMUTATOR



A Plastics One commutator is mounted above the cage. The commutator's two-plug setup allows for even rotation of the rotor.

CABLE



An 18" tether from Plastics One connects the commutator to the preamplifier. The cable's wires are protected by a metal spring coil.

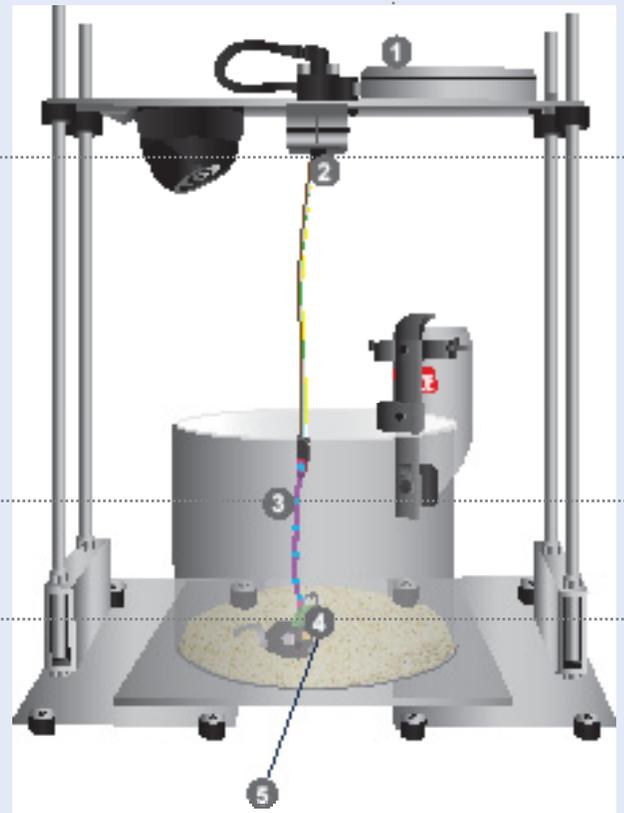
PREAMPLIFIER



Signals are amplified and filtered at the head of the animal using our preamplifiers, ensuring the delivery of clean, artifact-free data. A Plastics One screw connector is used to secure the preamplifier to the head of the animal.

High-Pass Filters: 0.5 Hz EEG, 10 Hz EMG for sleep; 1.0 Hz EEG, 10 Hz EMG for seizure
Gain: X100 for sleep; X10 for seizure

CONFIGURATION	SLEEP	SEIZURE	3 CHANNEL	4 CHANNEL
2 EEG/ 1 EMG	●	●	●	
2 EEG/ 1 EMG/ 1 BIO	●	●		●
3 EEG		●	●	
3 EEG/ 1 EMG	●	●		●
3 EEG/ 1 BIO		●		●
4 EEG		●		●



RAT HEADMOUNT

Prefabricated rat headmounts use Plastics One fittings mounted on a 9 mm X 9 mm board with EEG or EMG electrode wires attached. An additional two-pin electrode is used for 4 EEG configurations.



MOUSE HEADMOUNT

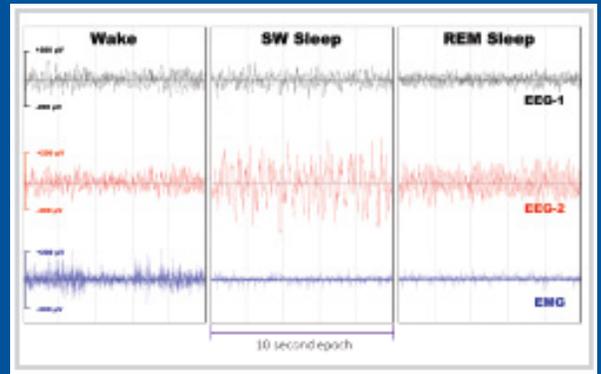
Prefabricated headmounts reduce surgery time, allow for reproducible electrode placement, and provide ready-to-insert EMG leads.



Six-pin or eight-pin connectors support flexible electrode placement for customizable cortical or depth recordings.

“ The clarity of the data rivals anything I have ever seen! Quite simply, this is the best system for EEG and sleep recording on the market today. ”

Dr. Fred Turek (CEO - NuNetix, Inc.)



Three individual, non-consecutive epochs from a C57 mouse illustrating the vigilance states of wake, slow wave (SW) sleep, and rapid-eye-movement (REM) sleep. Data were collected using Pinnacle's three-channel EEG/EMG system.

TETHERED SYSTEMS FOR MICE

COMMUTATOR



A low-torque commutator, which is mounted above the cage, allows for unencumbered freedom of movement.

Rotational Torque: $<2 \times 10^{-4}$ N-m

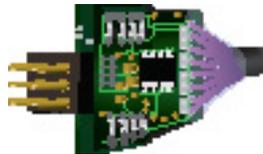
CABLE



A 14" tether connects the commutator to the preamplifier. Six insulated wires are banded together to create this lightweight cable that is ideal for use with very small animals.

PREAMPLIFIER

Signals are amplified and filtered at the head of the animal using our preamplifiers. This ensures the delivery of clean, artifact-free data. The mouse preamplifier connects to a headmount via a friction fit.



High-Pass Filters: 0.5 Hz EEG, 10 Hz EMG for sleep; 1.0 Hz EEG, 10 Hz EMG for seizure
Gain: X100 for sleep and seizure

CONFIGURATION	SLEEP	SEIZURE	3 CHANNEL	4 CHANNEL
1 EEG/1 EMG/2 BIO	●	●		●
2 EEG/1 EMG	●	●	●	
2 EEG/1 EMG (Independent)	●	●	●	
2 EEG/1 EMG/1 BIO	●	●		●
2 EEG/1 EMG/2 BIO	●	●		●
3 EEG		●	●	
3 EEG (Independent)		●	●	
3 EEG/ 1 EMG	●	●		●
3 EEG/ 1 BIO		●		●
3 EEG/ 2 BIO		●		●
4 EEG		●		●

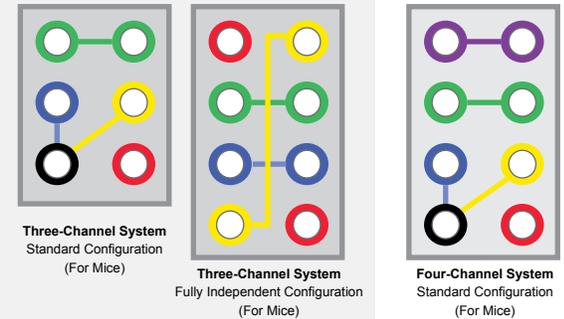
CUSTOM CONFIGURATIONS AVAILABLE

Contact a Pinnacle representative at (785) 832-8866

HOW OUR PREAMPLIFIERS WORK

Pinnacle's preamplifiers perform X100 (X10 in seizure rat configuration) amplification of differential measurements between two electrodes. Standard three- and four-channel preamplifiers have two channels sharing a common electrode and either one or two independent channels, respectively. Fully independent, differential preamplifiers are also available. See diagrams below.

Perspective: Pins extending from preamplifier



CHANNEL 1 — CHANNEL 3 — SHARED —
 CHANNEL 2 — CHANNEL 4 — GROUND —

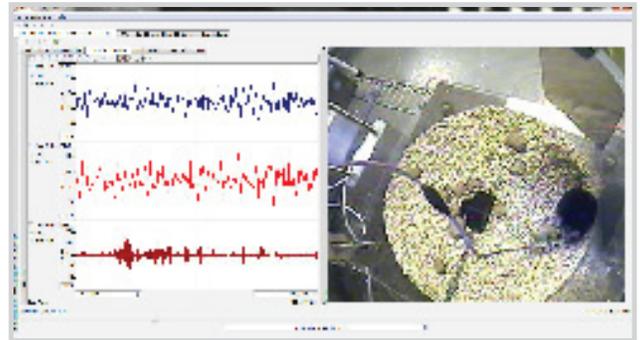
HAVE YOUR OWN AMPLIFIER?

Analogue adapters are excellent solutions for researchers who require the low noise provided by Pinnacle's headmounted preamplifiers and commutators but who have existing amplification/acquisition systems in place. The adapters can be used to connect Pinnacle mouse and rat preamplifiers with third-party data collection systems.



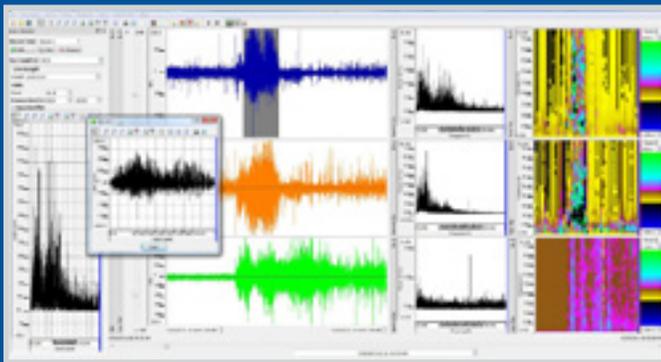
SYNCHRONIZED VIDEO

Integrated video recording provides a platform for synchronizing EEG and EMG changes with observable behavioral states. Video can be added to any new or existing hardware system. Captured video is displayed live on screen as it is streamed from the animal and is synchronized with other recorded data in playback mode.



EEG and EMG data are recorded simultaneously with full-color video.

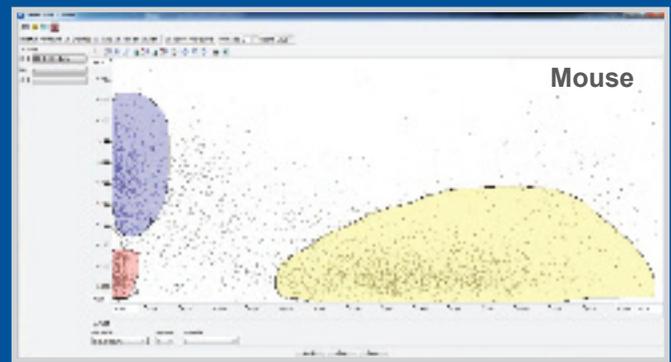
ADVANCED ANALYSIS SOFTWARE



A seizure event in a C57 mouse identified and selected for automated analysis using Sirenia® Seizure Pro.

SIRENIA® SEIZURE PRO

Our advanced seizure analysis software package provides a platform for users to quickly identify, analyze, and log user-defined seizure events throughout a given time period. Analysis tools include spectral power and peak frequency computation, heat maps, line length, Racine's scale rating, seizure duration, and time between seizure events. In addition, custom reports and graphs can be generated based on aggregate seizure data.



Data from a C57 mouse are quickly scored using Sirenia® Sleep Pro's semi-automated cluster scoring tool.

SIRENIA® SLEEP PRO

Pinnacle's sleep analysis software allows users to reduce scoring and analysis time by automating the process with tools such as cluster scoring, threshold scoring, hypnograms, and spectral plots. The software's analysis features allow users to quickly compare scores, perform bout and sleep analyses, and customize high-quality charts and graphs.

ADD A BIOSENSOR

Any Pinnacle biosensor can be used in conjunction with our four-channel EEG/EMG system for recording up to two simultaneous biosensor channels. The addition of biosensors enables the correlation of biopotential and neurochemical activity in freely moving mice and rats.

SLEEP DEPRIVATION

Pinnacle's automated sleep deprivation and fragmentation system uses a rotating metal bar to gently sleep deprive mice and rats without direct human intervention. It can be programmed to analyze real-time EEG/EMG activity and trigger bar rotation in response to sleep state.

