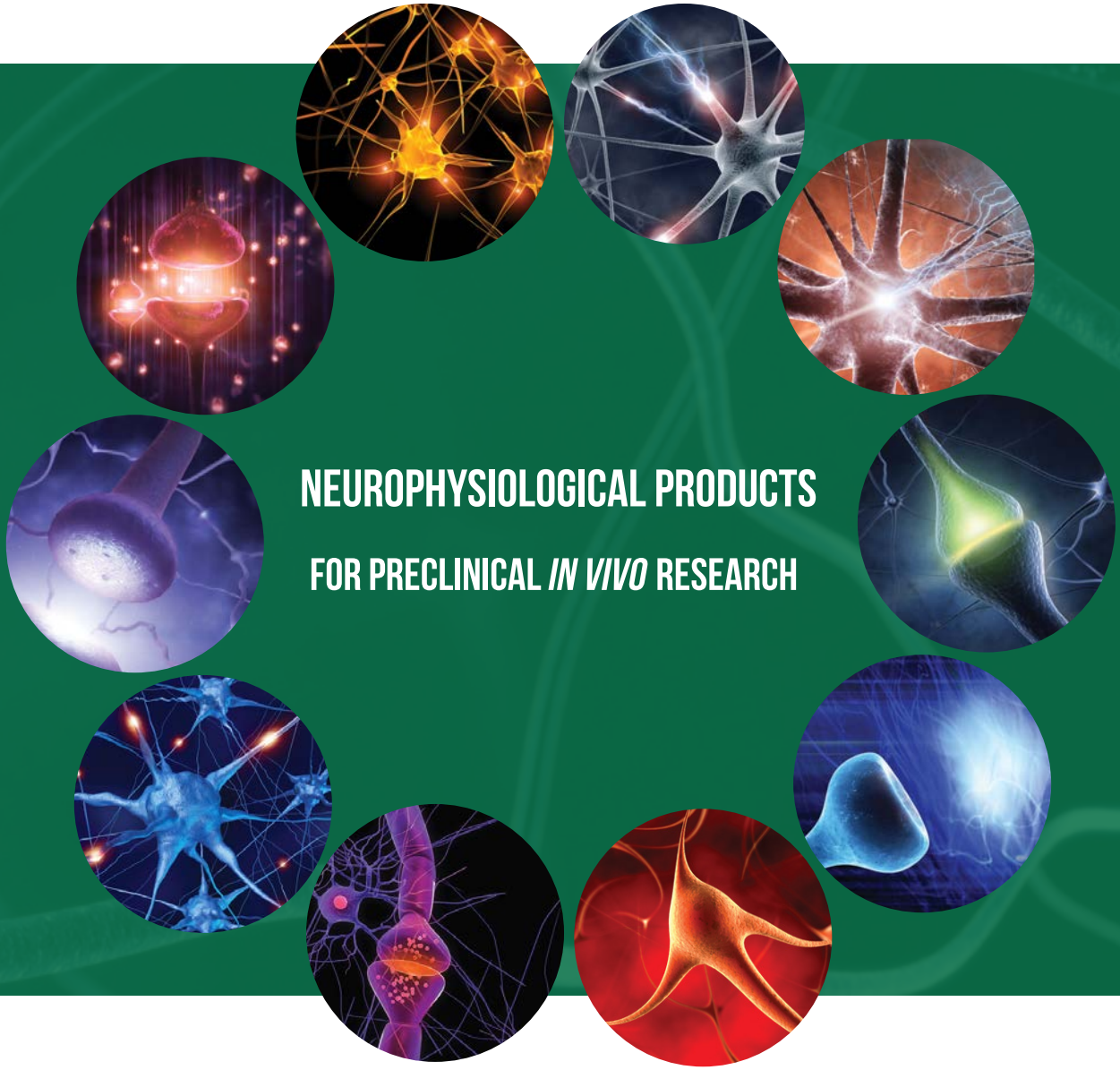
2024 PRODUCT CATALOG

PINNACLE TECHNOLOGY



NEUROPHYSIOLOGICAL PRODUCTS

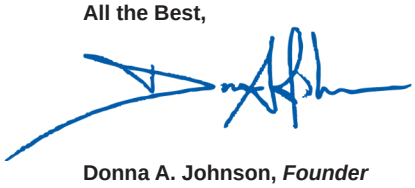
FOR PRECLINICAL *IN VIVO* RESEARCH

PINNACLE TECHNOLOGY | WWW.PINNACLET.COM
2721 OREGON STREET | LAWRENCE, KS 66046
PHONE: (785) 832-8866 | FAX: (785) 749-9214
SALES@PINNACLET.COM

Thank you for choosing Pinnacle Technology for your research needs. We offer a range of turn-key systems for neurophysiological studies using freely moving animals and are committed to developing new tools that simplify measurement, reduce cost and enable new research. In addition, Pinnacle offers a host of supporting products ranging from cages to software analysis suites. We pride ourselves in providing exceptional customer service and are available to assist you with every stage of your research process.

By forging collaborative relationships with our clients, we are able to develop cutting-edge tools that improve and simplify your research. We look forward to working with you.

All the Best,



Donna A. Johnson, *Founder*

INFORMATION & POLICIES

Website: www.pinnaclet.com
Email: sales@pinnaclet.com
Phone: (785) 832-8866
Fax: (785) 749-9214
Shipping Address: 2721 Oregon Street
Lawrence, KS 66046
USA

Ordering Information:

General: Products may be ordered directly from Pinnacle Technology Inc. or from one of our approved distributors (see: www.pinnaclet.com/distributors.html). Some products may not be available in all countries.

Biosensors and Carbon Fiber Electrodes: Pinnacle Technology Inc., requires seven business days notice prior to requested date of shipment for biosensor or carbon fiber electrode orders.

Payment Terms: Net 30 days from date of invoice for customers with established credit. Prepayment or COD may be required if credit has not been established. Major credit cards are accepted. Unpaid balances are subject to a late payment fee of 1.5% per month. Pro-forma invoices are available for international orders.

Use of Products: All Pinnacle Technology Inc. products are sold for laboratory research use only. Pinnacle Technology Inc. products have not been approved by any government agency for use in human subjects or human testing.

Shipping Information:

United States: All orders ship F.O.B. Lawrence, KS. Standard orders are shipped FedEx® Ground (biosensor orders are shipped FedEx® 2Day). Freight charges are added to the final invoice.

International: Purchaser is responsible for payment of all import duties, tariffs, taxes, insurance and other related charges. Pinnacle Technology Inc. ships via the purchaser's courier of choice (UPS®, FedEx®, DHL®) using the purchaser's courier account number. Orders WILL NOT BE SHIPPED without this information. Pinnacle Technology Inc. accommodates orders shipped through domestic shipping brokers.

Discrepancies and damaged goods: Order discrepancies (quantity, type, or damage) must be reported to our sales and technical support address at sales@pinnaclet.com within 30 days after delivery.

Product/Price Notices: Prices and specifications are subject to change without notice.

Product Return Policy: All product returns require a Return Merchandise Authorization (RMA) number. Contact a Pinnacle Technology Inc. representative to obtain an RMA number and proper RMA documentation. Returns should be shipped to Pinnacle Technology Inc. within 30 days of RMA number issuance. RMA documentation must be included in the return shipment and the customer is responsible for all shipping and handling charges. Standard items that have not been used or damaged may be returned within 10 days of original delivery for a credit or refund. A 25% restocking charge will be deducted from the refund or credit at Pinnacle Technology Inc.'s discretion. Pinnacle Technology Inc. does not offer refunds or credits on special, custom, or made-to-order products with custom modifications. **All products returned for repair or replacement must be sanitary, cleaned appropriately and securely packaged.**

Warranty Information: In general, products are warranted against defects in material and workmanship. Purchasers must comply with Pinnacle Technology Inc.'s policy regarding returns. Refer to Pinnacle Technology Inc.'s website (www.pinnaclet.com/general-product-info.html) for detailed warranty information.

TABLE OF CONTENTS

1-6 SENSORS

1 CNS Biosensors Overview
2 Biosensors and Guide Cannulas
2 Oxygen Sensors
3 Wireless Systems for Rats
4 Tethered Systems for Mice and Rats
5 Subcutaneous System for Rats
6 Desktop Potentiostat
6 Calibration Kits

7-13 EEG/EMG SYSTEMS

7 Wireless Systems for Mice and Rats
8 Tethered EEG/EMG Systems Overview
9-10 Tethered Systems for Mice and Rats
10 How Our Preamplifiers Work
11 Tethered Three-Channel Systems
12 Tethered Four-Channel Systems
13 Headmounts, Depth Electrodes and Screws

14 SLEEP DEPRIVATION

14 Sleep Deprivation System

15-18 OPTOGENETICS

15 Optogenetics Systems Overview
16 Wireless Systems for Rats
16 Add Optogenetics to FSCV
16 LED Fiber Probes
17-18 Tethered Systems for Mice and Rats
18 Hardware and Accessories

19-20 FAST SCAN CYCLIC VOLTAMMETRY

19 FSCV Systems Overview
19 Wireless Systems for Rats
19 FSCV Software
20 Tethered Systems for Mice and Rats
20 Carbon Fiber Electrodes

21 SYNCHRONIZED VIDEO

21 Synchronized Video Capability
21 Camera Options

22-23 ANIMAL HOUSING

22 Animal Housing
23 Group Housing
23 Mix and Match Panel Options
23 Behavioral and Tracking Components

24-25 ADDITIONAL PRODUCTS

24 Stimulus Controller Kit
24 Illuminators
25 Commutators
25 Analog Adapters
25 Isolated Wireless Potentiostat
25 TTL Plus
25 Master Clock

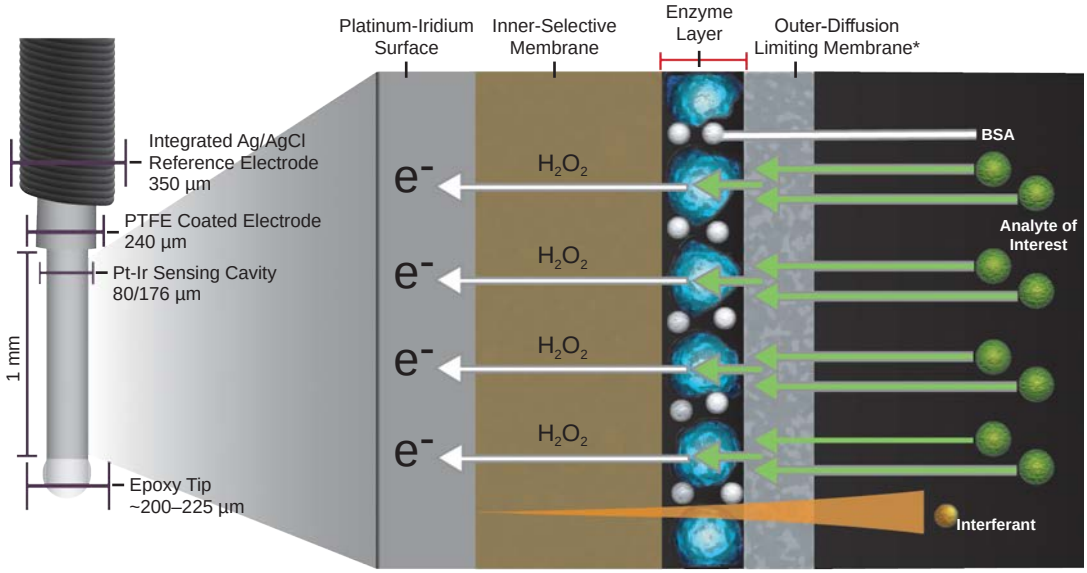
26-28 SOFTWARE

26 Sirenia® Overview
26 Sirenia® Acquisition
26-27 Premium Modules
27 Sirenia® Sleep Pro
27 Sirenia® Seizure Pro
28 Sirenia® Feedback Pro
28 Sirenia® X-Y Tracking
28 Sirenia® Multiple Animal Tracking

PINNACLE TECHNOLOGY

CNS BIOSENSORS OVERVIEW

CNS BIOSENSORS monitor real-time changes in neurochemical concentrations. With Pinnacle's turn-key electronic and software systems, users can record and analyze second-by-second concentration changes of neurochemicals in freely moving animals. Pinnacle currently offers glutamate, glucose, lactate and ethanol biosensors. Our biosensors function by the enzyme-mediated processing of the analyte of interest. This results in the production of hydrogen peroxide that is then detected by oxidation at a Pt-Ir electrode. Electroactive interferents present in the brain are excluded via a passive selective membrane and through active removal when necessary. Our sensors are shipped within seven business days of order receipt and include a warranty. Custom sensor sizes are also available.



*Outer-diffusion limiting membrane may not be present on all Pinnacle biosensors

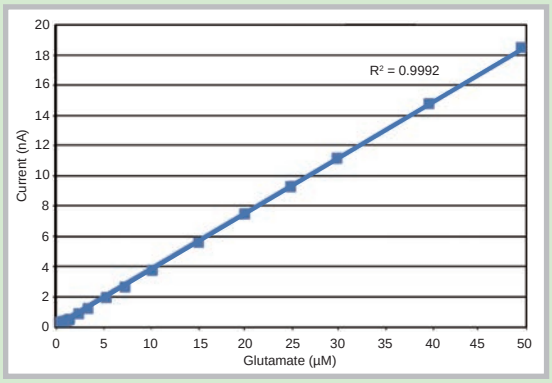
CNS BIOSENSOR CHARACTERISTICS

	In Vivo Lifetime	Limit of Detection 180 µm	Limit of Detection 80 µm
Glutamate	36 hours	0.02–0.08 µM	0.06–0.3 µM
Glucose	96+ hours	1.3–4 µM	1.9–15.2 µM
Lactate	96+ hours	0.2–0.6 µM	1.4–3.5 µM
Ethanol	6–8 hours	0.1–0.5 µM	N/A

COMMON USES

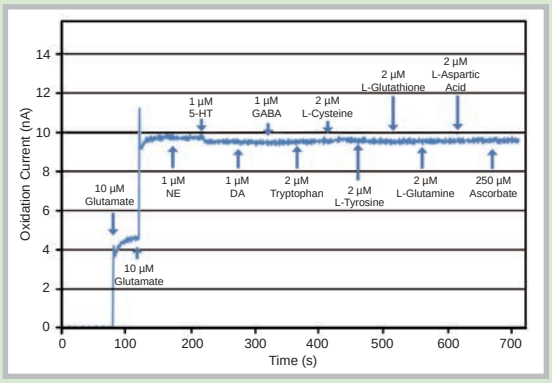
- ◊ *In vivo* monitoring of brain chemical microenvironments
- ◊ Neurochemical monitoring during behavioral and physiological activities
- ◊ Drug screening, including neuropharmacological effects
- ◊ Identification of biomarkers
- ◊ Investigating cognition, behavior, circadian cycles, stress, learning, memory, sleep, seizure, vigilance state and new drug effects

GLUTAMATE BIOSENSOR LINEARITY



LINEAR SELECTIVE FAST

GLUTAMATE INTERFERENCE RESPONSE



Linear Response: Responds over a physiologically relevant concentration range at physiologic oxygen levels

High Specificity: Excludes endogenous electroactive interferents present in the brain

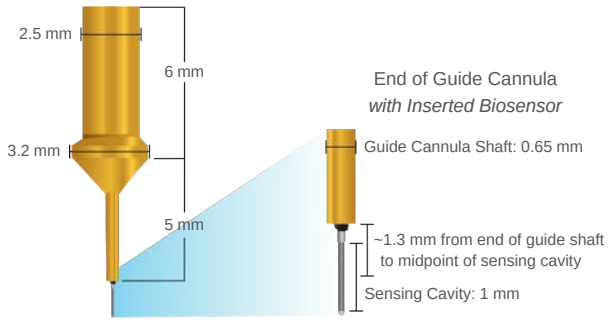
Fast Response: Capable of monitoring rapid physiological events

BIOSENSORS & GUIDE CANNULAS

Biosensors are purchased by size, cannula type and analyte of interest. Pinnacle recommends the use of a **GUIDE CANNULA** system for optimal results when implanting and recording from sensors in freely moving animals. We manufacture standard biosensor electrodes (Pt-Ir wire with an integrated Ag/AgCl reference) that are compatible with multiple guide cannula types; our standard configurations use BASi cannulas. Sensors with no cannula and custom sensors are also available for purchase. **All sensors sold by Pinnacle are for non-human use only**.

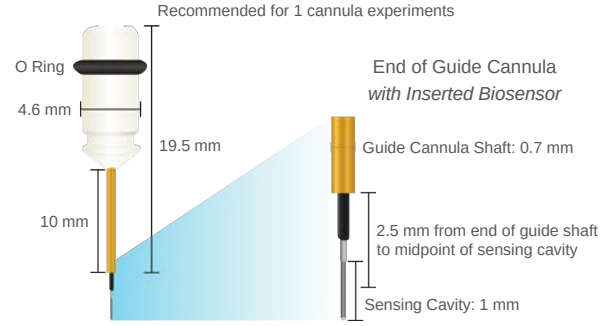
Pinnacle offers one cannula option for mouse biosensors and two cannula options for rat biosensors. When only one cannula is being used in an experiment, the rat locking cannula is the recommended option. However, when using two or more cannulas simultaneously (e.g. 2 biosensors or 1 biosensor/1 LED probe), the rat friction fit cannula will allow for greater placement freedom.

MOUSE CANNULA



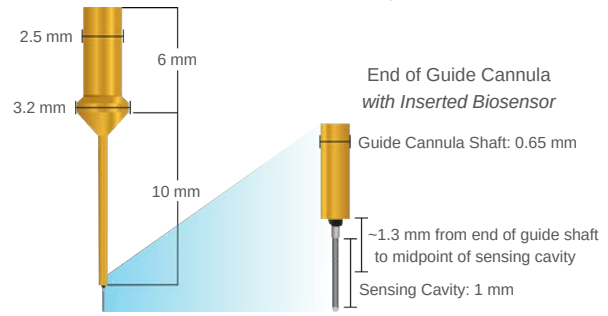
RAT LOCKING CANNULA

Recommended for 1 cannula experiments



RAT FRICTION FIT CANNULA

Recommended for 2+ cannula experiments



CNS BIOSENSOR TYPES		180 µm	80 µm
No Cannula Biosensor		7001	7001-80
7001-Glutamate	7001-Ethanol		
7001-Glucose	7001-Lactate		
Mouse Biosensor		7004	7004-80
Wireless Rat Locking Biosensor		7002	7002-80
Wireless Rat Friction Fit Biosensor		7007	7007-80
Tethered Rat Locking Biosensor		7011	7011-80
Tethered Rat Friction Fit Biosensor		7012	7012-80

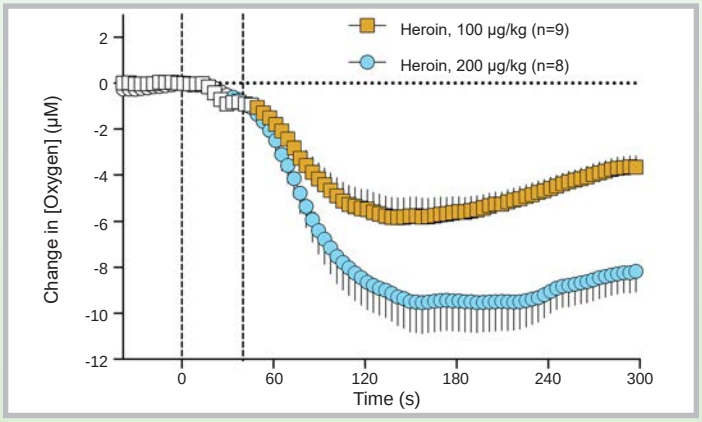
All biosensor types can be ordered in any of the analytes/configurations listed under 7001. For example, a 180 µm glutamate biosensor with a mouse cannula headpiece is ordered as 7004-Glutamate.

GUIDE CANNULA TYPES	
Guide Cannula for Mice	7032
Locking Guide Cannula for Rats	7030
Friction Fit Guide Cannula for Rats	7034

OXYGEN SENSORS

Pinnacle's **OXYGEN SENSORS** can be used with Pinnacle's electronics and software to routinely record and analyze second-by-second concentration changes in the brains of freely moving animals. Our oxygen sensor is a 180 µm disc electrode with an integrated reference and operates under a -0.6 V bias.

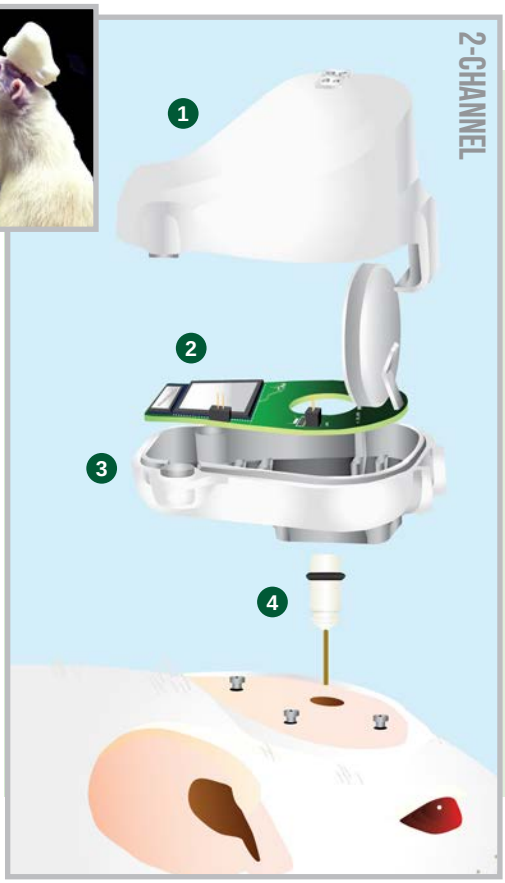
OXYGEN SENSORS	
Mouse Sensor with Integrated Reference	7004-O2
Wireless Rat Locking Sensor with Integrated Reference	7002-O2
Wireless Rat Friction Fit Sensor with Integrated Reference	7007-O2
Tethered Rat Locking Sensor with Integrated Reference	7011-O2



Intravenous heroin induces rapid oxygen changes in the rat nucleus accumbens. Colored symbols (4-s mean, ±SEM) are significantly different from the preinjection baseline. Solis et al. eNeuro (2017) Jun 7;4(3).

WIRELESS SYSTEMS FOR RATS

TWO-CHANNEL and **THREE-CHANNEL WIRELESS BIOSENSOR SYSTEMS** are available for recording neurochemical concentrations in freely moving rats. Both turn-key systems use Bluetooth® technology to wirelessly transmit data to Pinnacle's Sirenia® Acquisition software via a USB dongle. They provide a platform for high-capacity biosensor studies and are well-suited for behavioral experiments.



1. The Rat Hat top protects the system.
2. A low-powered, wireless, two- or three-channel potentiostat applies a bias and transmits up to three digitized signals to a paired Bluetooth® USB dongle that interfaces with Pinnacle's Sirenia® Acquisition software for data recording.
3. The Rat Hat bottom is affixed to the skull with bone screws and dental acrylic. It houses the wireless electronics, battery, guide cannulas and biosensors.
4. Stereotaxically placed guide cannula(s) allow for the insertion of biosensors post-surgery.

KEY FEATURES

- ◊ Up to 3 channels
- ◊ Transmission radius: 6 m
- ◊ Untethered freely moving animals
- ◊ Supports simultaneous biosensor recordings

ALSO AVAILABLE AS A BACKPACK

WIRELESS HARDWARE KITS

2-Channel Wireless Biosensor System	**8100-K5**
Bluetooth® wireless potentiostat	8172
Bluetooth® dongle	9054
2-Channel +/- Wireless Sensor System	**8100-K13**
Bluetooth® +/- wireless potentiostat	8172-O2
Bluetooth® dongle	9054
3-Channel Wireless Biosensor System	**8100-K9**
Kit contents for the three-channel biosensor system are available on our website.	

WIRELESS ACCESSORY KITS

2-Channel Wireless Biosensor Accessory Kit			**8100-K7**
Rat locking guide cannula (4)	7030	Drill bit (2)	8112
BASi rat guide cannula holder	7035-R-BAS	Test load (2)	8134-20M
Rat Hat top	8107-BLE	Screwdriver for 1/8" screws	8241-S
Rat Hat bottom (4)	8108-BLE	Powered USB hub	9005
1/8" Screws (pkg. of 12)	8111	Battery (pkg. of 5)	9033-CR2032
3-Channel Wireless Biosensor Accessory Kit			**8100-K10**
Kit contents for the three-channel biosensor system are available on our website.			

All kits include cables for one animal, software and manuals. Biosensors sold separately.

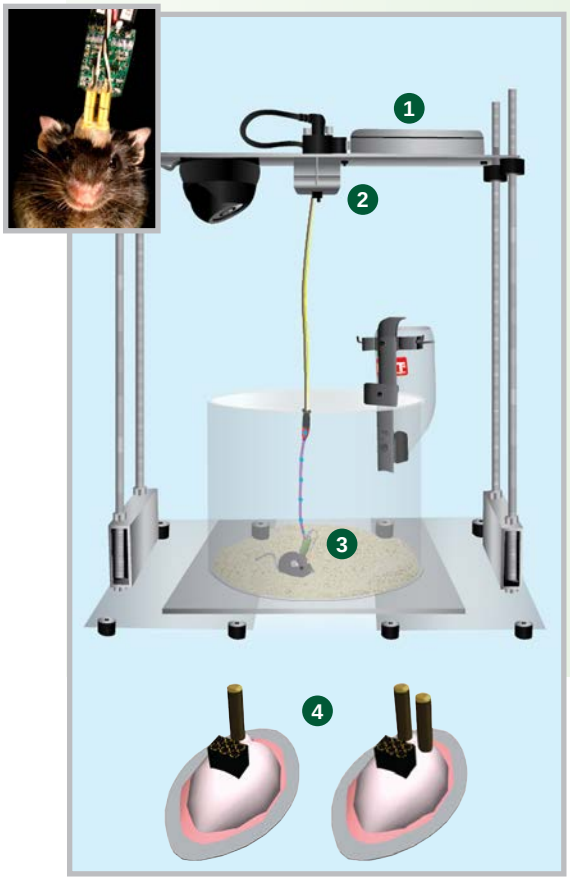
DISPOSABLE ITEMS

RATS

7030	Rat locking cannula
7034	Rat friction fit cannula
7040-S	Single-barrel cannula
7041-S	Tri-barrel cannula
8108-BLE	Rat Hat bottom for 2-channel
8108-3C	Rat Hat bottom for 3-channel
8111-16	1/8" Screws (pkg. of 16)
8112	Drill bit
9033-CR2032	Battery for 2-channel (pkg. of 5)
9033-AZ675	Battery for 3-channel

TETHERED SYSTEMS FOR MICE & RATS

The **TETHERED BIOSENSOR SYSTEM** features configurable input channels to record neurochemical concentration changes. These systems employ a head-mounted preamplifier for measuring up to two biosensors simultaneously in one animal, providing a turn-key solution for biosensor recordings in rodents.



1. The data conditioning and acquisition system performs secondary amplification and filtering before sending data to Pinnacle's Sirenia® Acquisition software for collection.
2. A low-torque commutator allows for unencumbered freedom of movement.
3. Head-mounted preamplifiers house two connectors for biosensors. The rigid connection ensures high-quality, artifact-free data.
4. Stereotaxically placed guide cannulas allow for the insertion of biosensors post-surgery. Prefabricated headmounts are affixed to the skull with dental acrylic and act as a connection port for the two-channel biosensor preamplifier.

KEY FEATURES

- ◊ Low-torque
- ◊ Weight: 1.5 g
- ◊ Head-mounted amplification
- ◊ Supports up to 2 simultaneous biosensor recordings

HARDWARE KITS

Tethered Mouse Biosensor System	**8400-K1**
Data conditioning and acquisition system	8401-HR
Commutator/swivel	8408
18" mounting plate	8426
Tethered Rat Biosensor System	**8400-K2**
Components of this kit are the same as above except 8408 is replaced with 8409.	

All kits include cables for one animal, software and manuals. Biosensors sold separately.

PREAMPLIFIER KITS

Mouse Preamplifier Kit for Two Biosensors			**8400-K3-2BIO**
Guide cannula for mice (12)	7032	Screwdriver for mouse screws	8241-F
Bio-only headmount (6)	7033	Flathead screwdriver	82 8241-M 54
Probe holder for cannula (2)	7035-M-BAS	23-Gauge needle (6)	8254
Test load (2)	8143-10M	Mouse preamplifier	8406-2BIO
0.10" Screws (3 pkgs. of 8)	8209	Powered USB hub	9005
Rat Preamplifier Kit for Two Biosensors			**8400-K4-2BIO**
Rat locking guide cannula (4)	7030	Screwdriver for bone screws	8241-S
BASi rat guide cannula holder	7035-R-BAS	Rat preamplifier	8407-BIO
1/8" Bone screws (2 pkgs. of 12)	8111	Cable from 8401-8409	8413-R-BIO
Drill bit for bone screws	8112	Backmount adapter for 8218 (4)	8423
363 Pedestal base (4)	8218	Test load (2)	8427-10M
Flathead screwdriver	8241-M	Powered USB hub	9005

MICE

7032	Mouse cannula
7033	Bio-only headmount
8209	0.10" Screws (pkg. of 8)
8254	23-Gauge needle

ADD OPTOGENETICS

See pages 15–18 for details.

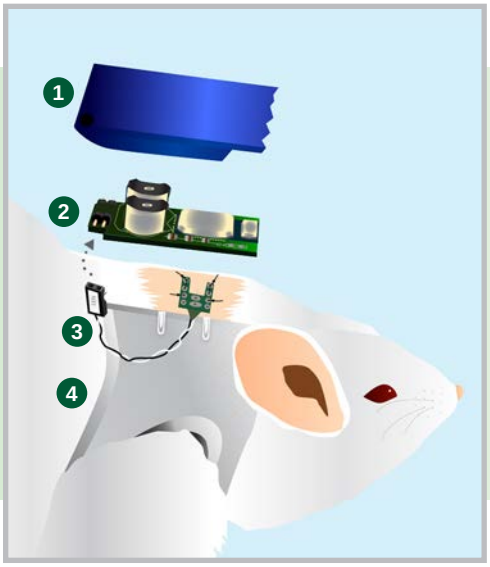
ADD CARBON FIBER ELECTRODES

(Includes standard and enzyme-modified)

See page 20 for details.

SUBCUTANEOUS SYSTEM FOR RATS

Pinnacle's **SUBCUTANEOUS MONITORING SYSTEM** captures real-time interstitial measurements in freely moving rats with one-second temporal resolution. Our turn-key system is designed for easy implantation, allowing for rapid and simple surgery. The subcutaneous system provides second-by-second data collection for real-time analysis, making it ideal for diabetes and metabolic studies. The sensor connects to a backpack-mounted wireless Bluetooth® transmitter.



1. A durable, tear-resistant, water-resistant pouch houses the electronics and battery.
2. A low-powered, wireless potentiostat applies a bias and transmits up to two digitized signals to a Bluetooth® USB dongle that interfaces with Pinnacle's Sirenia® Acquisition software for data recording.
3. The sensor penetrates the animal's subcutaneous space on the dorsal surface and is held in place with four surgical sutures.
4. The system uses a jacket to secure the pouch and stabilize the sensor.

HARDWARE SPECIFICATIONS

- ◊ **System Weight:** 5.9 g
- ◊ **Channels:** 2
- ◊ **Battery Life:** 25+ days
- ◊ **Transmission Radius:** 20 ft

HARDWARE KIT

2-Channel Potentiostat Backpack Kit	8100-K5-BP
2-Channel LE Bluetooth® wireless potentiostat backpack	8164
Zinc air battery (pkg. of 4)	9033-AZ675
USB extension cable	9052
Bluetooth® dongle	9054

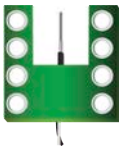
ACCESSORY KIT

2-Channel Potentiostat Backpack Accessory Kit	8100-K7-BP
Test load	8134-10M
Battery remover (plastic)	8156
Rat jacket (2)	8165
Electronics pouch	8166
Suture packets: 3-0 silk (16)	8167
Tegaderm: 1624W (6 cm x 7 cm) (4)	8168
18-Gauge needle (4)	8169
Powered USB hub	9005
Zinc air battery (pkg. of 4)	9033-AZ675

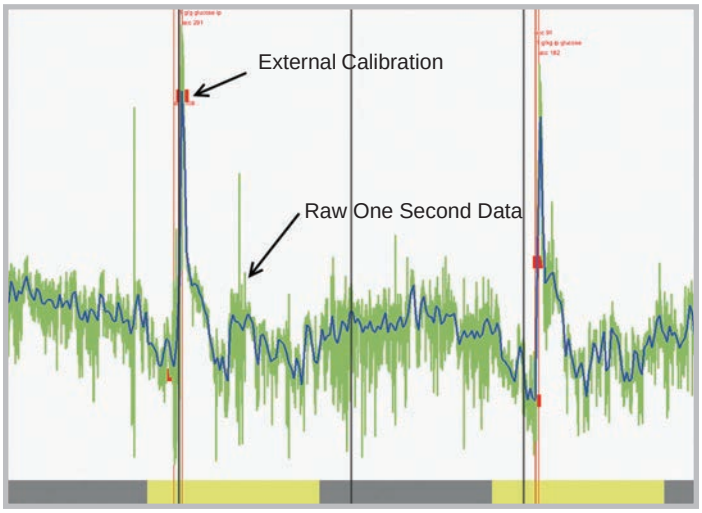
SUB-Q SENSOR SPECIFICATIONS

- ◊ **Sensor Range:** 10–500 mg/dL
- ◊ **Sensor Life:** 17+ days

Our subcutaneous glucose sensors do not react to the following interferents: galactose, creatinine, urate, xylose, warfarin, acetaminophen, naproxen, maltose, xanthine and aspirin.



Subcutaneous Glucose Biosensor	7006-Glucose



Within the Pinnacle software environment, data are under the control of the researcher. The graph above represents 48 hours of data (gray bar = lights off).

DESKTOP POTENTIOSTAT

Pinnacle's **FOUR-CHANNEL DESKTOP POTENTIOSTAT** is a cost-effective, easy-to-use and highly accurate system for the development and use of high impedance, amperometric biosensors and biosensor arrays. It is well-suited for anesthetized animal experiments, brain slices and other *in vitro* studies. Each of the system's four channels has one TTL input, one TTL output and one analog output. The potentiostat is compatible with Pinnacle's biosensors and third-party sensors.

COMPATIBLE WITH THIRD-PARTY SENSORS

SYSTEM SPECIFICATIONS

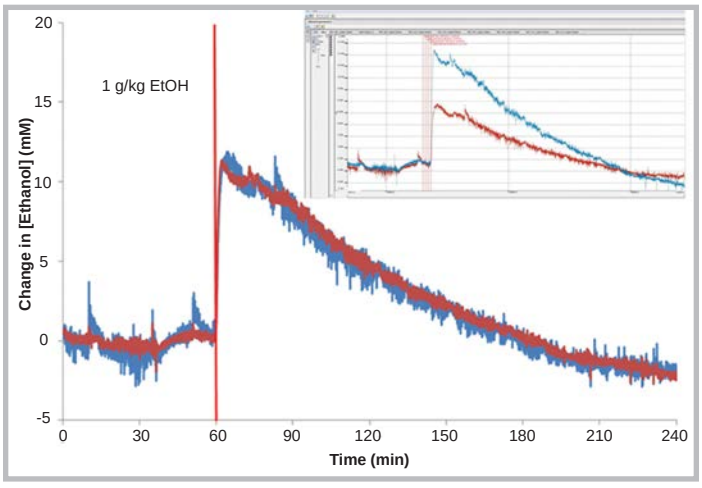
- **Channels:** 4
- **Current range:** 0–20 µA
- **Resolution:** 3 fA
- **Maximum sampling rate:** 4 Hz
- **Bias range:** -2.048–+2.048 V
- 2 terminal, fixed potential
- 4 TTL inputs
- 4 TTL outputs
- 4 analog outputs

HARDWARE KIT

Desktop Potentiostat System	8100-K4
Desktop potentiostat	8102N
Sensor adapter cable (4)	8109
Power supply	8118
BNC to alligator leads cable (4)	8125
BNC test load (4)	8155-10M
Shorting cap	8155-75
Flathead screwdriver	8241-M
Powered USB hub	9005
Cables, software and manuals are also included.	

CALIBRATION KITS

Pinnacle offers a number of ***IN VITRO* CALIBRATION SYSTEMS** that allow the simultaneous calibration of up to four biosensors. To relate the *in vivo* current changes measured by a CNS biosensor to actual changes in analyte concentration, it is necessary to calibrate the biosensor at the conclusion of the *in vivo* experiment.



CALIBRATION KITS

Tethered Mouse *In Vitro* Calibration Kit	7000-K1-T
Tethered Rat *In Vitro* Calibration Kit (Use with BAS Cannulas)	7000-K2-T-BAS
Wireless Rat *In Vitro* Calibration Kit (Use with BAS Cannulas)	7000-K2-W-BAS
Wireless Rat Calibration Kit for Pinnacle Biosensors	7000-K2-W-P

CORRELATING CURRENT TO CONCENTRATION

Above: *In vivo* recordings from two ethanol biosensors implanted contralaterally in the cortex of a Wistar rat. An ethanol bolus (1 g/kg) was delivered at the 60-minute mark. Data were transformed to changes in ethanol concentration based on each sensor's post-calibration.
Inset: The raw, untransformed current (nA) from the two ethanol biosensors, as acquired through Pinnacle's acquisition software.

WIRELESS SYSTEMS FOR MICE & RATS

Pinnacle offers **THREE-CHANNEL WIRELESS EEG/EMG SYSTEMS** for long-term studies in mice and rats. The lightweight, head-mounted Bluetooth® wireless amplifier streams data to a computer in real-time using a small USB dongle receiver and the Sirenia® software suite. When combined with Pinnacle's prefabricated headmounts, EEG/EMG electrode placement is simple and straightforward to ensure consistent, reliable results. Our wireless systems use off-the-shelf batteries, making electrophysiology telemetry easy and cost-effective.

WIRELESS HARDWARE KITS

2 EEG/1 EMG Wireless Sleep or Seizure System	**8200-K9-SL/SE**
Bluetooth® wireless EEG/EMG system	8274-SL/SE
Bluetooth® dongle	8274-D
3 EEG Wireless Seizure System	**8200-K9-SE3**
3 EEG Wireless Seizure System (Extended Input)	**8200-K9-SE3-EI**

Components of these kits are the same as above except 8274-SL is replaced with 8274-SE3 or 8274-SE3-EI. Kits include software and manuals.

TECHNICAL SPECIFICATIONS

Size and Weight	Mice	17.1 x 16.2 x 11.0 mm; 3.8 g
	Rats	32.1 x 21.2 x 18.3 mm; 6.8 g
Resolution	12 bits	
Input Range	+/- 480 µV; EI version +/- 960 µV	
Sample Rate	up to 1024 samples per second (sps) on each channel	
Battery Life*	256 - Battery Life 5 + days; 512 - Battery Life 3 + days; 1024 - Battery Life 1 + day	

Battery life can vary based on bluetooth environment in the recording area.

WIRELESS ACCESSORY KITS FOR MICE

Wireless Mouse System for Sleep or Seizure Accessory Kit	**8200-K10-SL/ SE**
Mouse headmount (4)	8201-SS
0.10" Screws (pkg. of 8)	8209
0.12" Screws (pkg. of 8)	8212
Twin pack of silver epoxy (2)	8226
Screwdriver for EEG screws	8241-F
Size 13 Zinc-Air Battery (Box of 60)	9033-AZ-PR48
Battery Cap (2)	8275
EEG/EMG test source	8249
23-Gauge needle (4)	8254
Multimeter	8255
Powered USB hub	9005
Supplemental Battery for 8274 Firmware Upgrades	8276
Tablet for 8274 Firmware Upgrades	8276-Tab
Wireless Mouse System for Seizure Accessory Kit	**8200-K10-SE3/ SE3EI**

Components of this kit are the same as above except 8201-SS is replaced with 8235-SM. In addition, it contains 24 0.10" screws with wire leads (8403) instead of products 8209, 8212 and 8226.

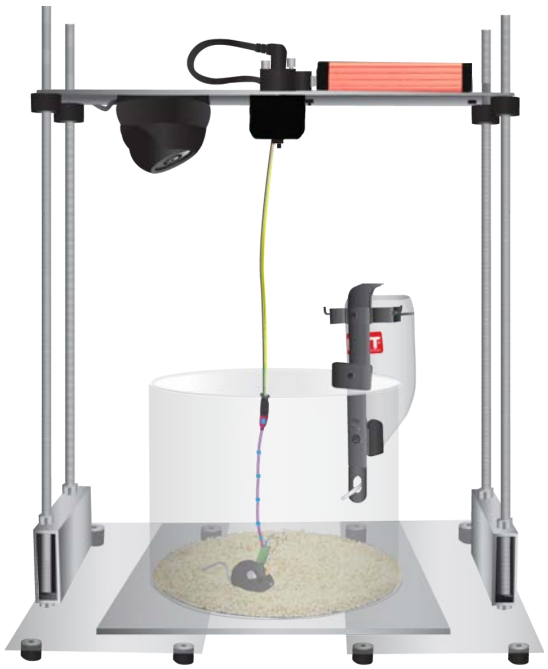
WIRELESS ACCESSORY KITS FOR RATS

Wireless Rat System for Sleep Accessory Kit	**8200-K11-SL**
Rat Hat top for 8274	8107-NRH
Rat Hat bottom for 8274 (4)	8108-NRH
Rat Headmount for the 8274 (4)	8239-W
1/8" EEG screw with wire leads for rats (16)	8247
EEG/EMG test source	8249
Multimeter	8255
Screwdriver for rat bone/EEG screws	8241-S
Drill bit for 1/8" bone/EEG screws	8112
Hex screwdriver for rat hat	8147-A
Powered USB hub	9005
Size 13 Zinc air battery (Box of 60)	9033-AZ-PR48
Supplemental Battery for 8274 Firmware Upgrades	8276
Tablet for 8274 Firmware Upgrades	8276-Tab
Wireless Rat System for Seizure Accessory Kit	**8200-K11-SE3/ SE3EI**

Components of this kit are the same as above except the 8239-W is replaced with the 8239-W-SE3

TETHERED EEG/EMG SYSTEMS OVERVIEW

THREE-CHANNEL and **FOUR-CHANNEL BIOPOTENTIAL RECORDING SYSTEMS** are available for sleep, seizure and general behavioral paradigms in freely moving mice and rats. Both EEG/EMG systems use head-mounted 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 ability to incorporate simultaneous accelerometer, optogenetics, electrical stimulation, and CNS biosensor measurements.



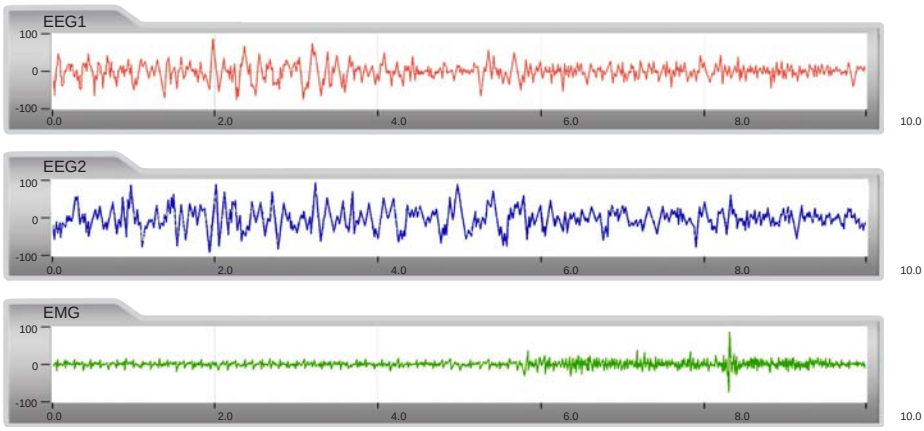
SYSTEM FEATURES	3-CHANNEL	4-CHANNEL
Available for both mice and rats	✓	✓
Optimized for sleep and seizure experiments	✓	✓
No cable artifact	✓	✓
Optional video recording	✓	✓
Digital input/output controls	✓	✓
Low-pass filters	✓	✓
Adjustable input range		✓
Optogenetics compatible		✓
Biosensor compatible		✓
Accelerometer compatible		✓
Sampling rate up to 20,000 Hz per channel		✓
TTL as analog inputs		✓
Change system configuration via preamplifier		✓
Electrical stimulation compatible		✓

ADVANTAGES

- ◊ Low noise
- ◊ Turn-key systems
- ◊ Synchronized video
- ◊ Simple surgeries
- ◊ Advanced analysis tools
- ◊ Free acquisition software

COMMON USES

- SLEEP STUDIES
- SEIZURE RESEARCH
- DEPTH ELECTRODES
- CORTICAL RECORDINGS
- COGNITIVE STUDIES
- LOCAL FIELD POTENTIAL



Two channels of EEG data can be captured alongside EMG data using Pinnacle's three-channel biopotential recording system.

ADD BIOSENSORS OR ACCELEROMETER

See page 12 for details.

ADD OPTOGENETICS

See pages 15–18 for details.

ADD ELECTRICAL STIMULATION

See page 24 for details.

TETHERED SYSTEMS FOR MICE & RATS

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 a preamplifier. Signals are then passed through the low-torque swivel to the data conditioning and acquisition system for final-stage amplification and filtering.

Data are collected using Pinnacle's free Sirenia® Acquisition software. The software allows users to view EEG/EMG recordings in user-defined time periods, manually score sleep and review seizure events. All data can be configured for export to most spreadsheet and database programs and are compatible with our advanced analysis software packages. *See pages 26–28 for additional information on Pinnacle software.*

TETHERED SYSTEMS FOR RATS

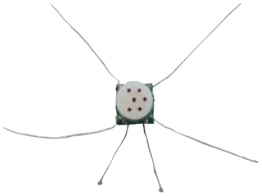
COMMUTATOR

A P1 Technologies commutator is mounted above the cage. The commutator's two-plug set-up allows for even rotation of the rotor.

PREAMPLIFIER

Signals are amplified and filtered at the animal's head using our preamplifiers This ensures the delivery of clean, artifact-free data. An 18-inch cable connects from the preamplifier to the commutator, and the wires are protected by a metal spring coil. A P1 Technologies screw connector is used to secure the preamplifier to the animal's head.

HEADMOUNT

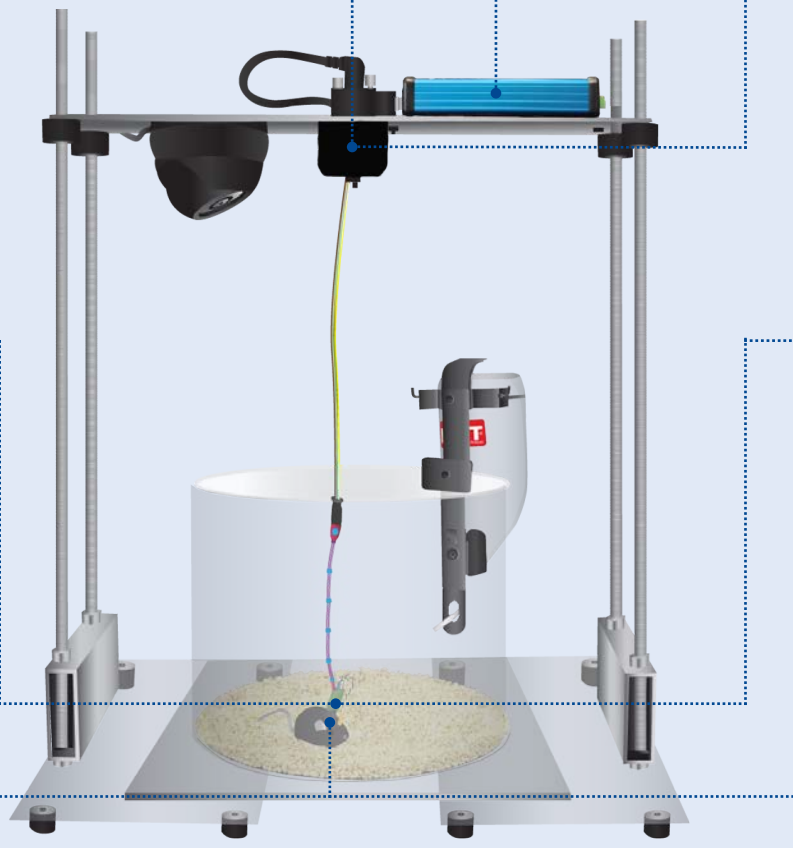


Prefabricated rat headmounts use fittings mounted on a 9 X 9 millimeter board with EEG or EMG electrode wires attached. For 4 EEG configurations, an additional two-pin electrode is used. *See page 13 for details.*

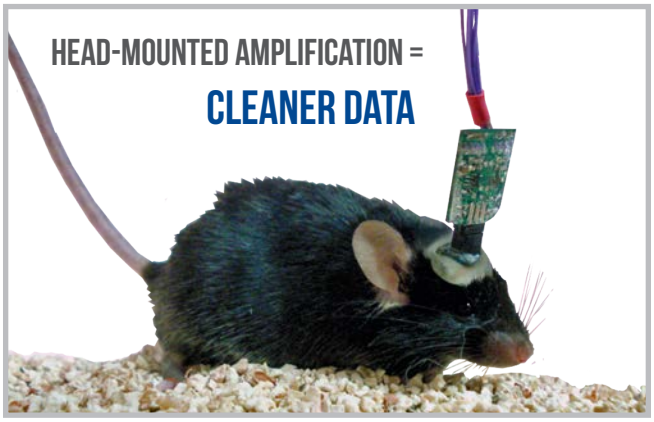
DATA CONDITIONING AND ACQUISITION SYSTEM

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

SPECIFICATIONS	3-CHANNEL	4-CHANNEL
Adjustable Sampling Rates	200–2,000 Hz	200–20,000 Hz
Software Configurable Low-Pass Filters	11 Hz–1 kHz	21 Hz–15 kHz
ADC Resolution	16-bit	18-bit
TTL Support	4 TTL Input/Outputs	4 TTL Input/Outputs



3-Channel Systems: page 11 **4-Channel Systems:** page 12



TETHERED SYSTEMS FOR MICE

COMMUTATOR

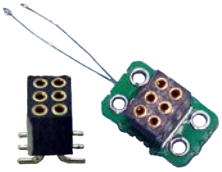
A low-torque commutator (< 2 x 10^{-4} N-m), mounted above the cage, allows for unencumbered freedom of movement. A seven-inch cable extends from the commutator.

PREAMPLIFIER

Signals are amplified and filtered at the animal's head using our preamplifiers. This ensures the delivery of clean, artifact-free data. The cable from the commutator connects to the seven-inch cable of the preamplifier. Six insulated wires are banded together to create this lightweight cable. The mouse preamplifier connects to a headmount via a friction fit.

HEADMOUNT

Prefabricated headmounts reduce surgery time, allow for reproducible electrode placement and provide ready-to-insert EMG leads. Six- or eight-pin headmounts support flexible electrode placement for customizable cortical or depth recordings. *See page 13 for details*.



HOW OUR PREAMPLIFIERS WORK

GAIN AND HIGH-PASS FILTERS

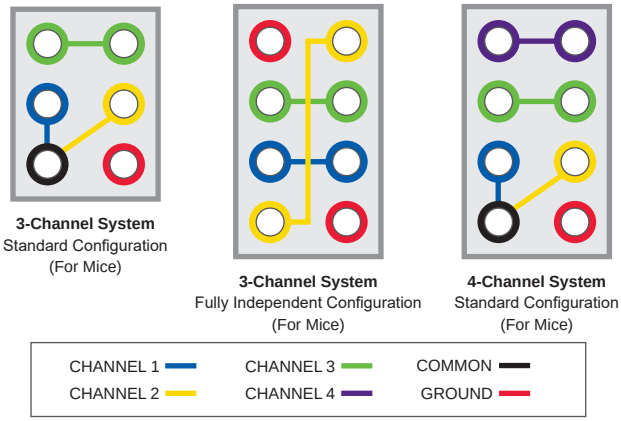
Pinnacle's preamplifiers perform X10 or X100 amplification of differential measurements between two electrodes. Each channel also features 0.5, 1.0 or 10 Hz high-pass filters. Use the chart below to identify the exact preamplifier specifications for each channel type in your selected configuration.

Example: A 2 EEG/1 EMG preamplifier configured for seizure studies in mice has a gain of X100 on all channels, 1.0 Hz high-pass filters on the EEG channels, and 10 Hz high-pass filters on the EMG channel.

MOUSE CONFIGURATIONS		GAIN	HIGH-PASS FILTERS
EEG Channel(s)	Seizure	X10 or X100	1.0 Hz
	Sleep	X100	0.5 Hz
EMG Channel	Seizure	X10 or X100	10 Hz
	Sleep	X100	10 Hz
RAT CONFIGURATIONS		**GAIN**	**HIGH-PASS FILTERS**
EEG Channel(s)	Seizure	X10	1.0 Hz
	Sleep	X100	0.5 Hz
EMG Channel	Seizure	X10	10 Hz
	Sleep	X100	10 Hz

SHARED AND FULLY REFERENTIAL/DIFFERENTIAL CHANNELS

Our standard three and four-channel preamplifiers have two referential channels and one or two differential channels. Fully referential and fully differential versions are also available. See diagrams below. ***Perspective:*** *Pins extending from preamplifier*



CUSTOM CONFIGURATIONS AVAILABLE

Contact a Pinnacle representative at
sales@pinnaclet.com or (785) 832-8866

TETHERED THREE-CHANNEL SYSTEMS

Pinnacle's **THREE-CHANNEL SYSTEM** allows researchers to simultaneously record three channels of EEG and/or EMG data. The data conditioning and acquisition system (DCAS) and preamplifier are preconfigured and ordered as a matching pair. Standard configurations include 2 EEG/1 EMG and 3 EEG. Fully independent preamplifiers and 3 EEG kindling systems for rats are also available. *Learn more about preamplifiers and how our turn-key systems work on pages 9–10.*

SYSTEMS FOR RATS

HARDWARE KITS

2 EEG/1 EMG for Sleep or Seizure	**8200-K2-SL/SE**
3 EEG for Seizure	**8200-K2-SE3**

Contents:
- **8206-HR:** Data conditioning and acquisition system
- **8213:** Rat preamplifier
- **8214:** Rat commutator/swivel
- **8258-723:** 14" Mounting plate

All kits include cables for one animal, software and manuals.
Note: 8206-HR and 8213 come in three varieties: SL, SE and SE3.

ACCESSORY KITS

2 EEG/1 EMG for Sleep or Seizure		**8200-K4-SL/SE**	
Drill bit	8112	Test source	8249
Rat headmount (4)	8239	Multimeter	8255
Screwdriver for 1/8" screws	8241-S	Powered USB hub	9005
1/8" Screws with wire leads (16)	8247		
3 EEG for Seizure		**8200-K4-SE3**	

Components of this kit are the same as above except for the quantity of 8247 (24). In addition, 8239 is replaced with 8239-SE3.

SYSTEMS FOR MICE

HARDWARE KITS

2 EEG/1 EMG for Sleep or Seizure	**8200-K1-SL/SE**
3 EEG for Seizure	**8200-K1-SE3**
2 EEG/1 EMG for Sleep or Seizure*	**8200-K1-iSL/iSE**
3 EEG for Seizure*	**8200-K1-iSE3**

Contents:
- **8202:** Mouse preamplifier
- **8204-723:** Mouse commutator/swivel
- **8206-HR:** Data conditioning and acquisition system
- **8258-723:** 14" Mounting plate

All kits include cables for one animal, software and manuals.
Note: 8202 and 8206-HR come in multiple varieties: SL, SE, SE-10, SE3, SE3-10, DSL*, DSE* and DSE3*.

*** Fully Independent**

All accessory kits contain items needed for completion of initial surgeries. All quantities are one unless otherwise noted after the product description.

ACCESSORY KITS

2 EEG/1 EMG for Sleep or Seizure		**8200-K3-SL/SE**	
Mouse headmount (4)	8201	Test source	8249
0.10" Screws (pkg. of 8)	8209	23-Gauge needle (4)	8254
0.12" Screws (pkg. of 8)	8212	Multimeter	8255
Silver epoxy	8226	Powered USB hub	9005
Screwdriver for EEG screws	8241-F		
3 EEG for Seizure		**8200-K3-SE3**	

Components of this kit are the same as above except 8201 is replaced with 8235-SM. In addition, it contains 24 0.10" screws with wire leads (8403) instead of products 8209, 8212 and 8226.

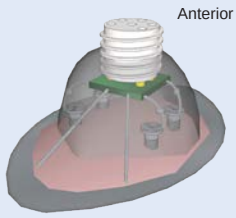
2 EEG/1 EMG for Sleep or Seizure*	**8200-K3-iSL/iSE**

Components of this kit are the same as above except 8201 is replaced with 8431-SM. In addition, it contains an 8-pin to 6-pin adapter (8272) and 20 0.10" screws with wire leads (8403) instead of products 8209, 8212 and 8226.

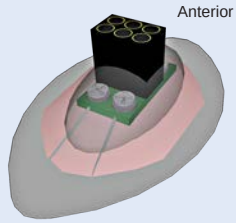
3 EEG for Seizure*	**8200-K3-iSE3**

Components of this kit are the same as above except 8201 is replaced with 8415-SM. In addition, it contains an 8-pin to 6-pin adapter (8272) and 28 0.10" screws with wire leads (8403) instead of products 8209, 8212 and 8226.

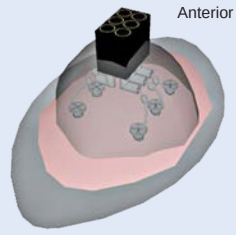
SIMPLE SURGERIES



2 EEG/1 EMG for Rats



2 EEG/1 EMG for Mice



3 EEG for Mice

DISPOSABLE ITEMS

RATS

8111	1/8" Bone screws
8112	Drill bit
8247	1/8" Screws with wire leads
8425	2-Pin electrode

MICE

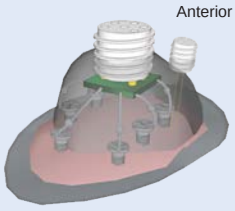
8209	0.10" Screws (pkg. of 8)
8210	0.08" Screws (pkg. of 8)
8212	0.12" Screws (pkg. of 8)
8226	Silver epoxy
8254	23-Gauge needle
8403	0.10" Screws with wire leads
8403-HP	8403 with headmount pins
8405	0.08" Screws with wire leads

ADD SYNCHRONIZED VIDEO
See page 21 for details.

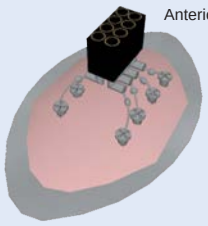
TETHERED FOUR-CHANNEL SYSTEMS

The **FOUR-CHANNEL SYSTEM** supports up to four biopotential input channels. This system is among the most flexible of Pinnacle's hardware devices because the configuration can be easily modified by changing only the preamplifier. Users can add biosensors, accelerometers, optogenetics or electrical stimulation.

Pinnacle's prefabricated and standard headmounts provide fast and easy solutions for connecting electrodes to preamplifiers. Stainless steel screws affix to the skull, doubling as anchors and electrodes for EEG data acquisition. Depth electrodes can be soldered to headmounts for LFP recordings. For configurations supporting muscle movement, EMG leads easily insert into the back or neck muscles.



4 EEG for Rats



4 EEG for Mice

SYSTEMS FOR RATS

HARDWARE KIT	
Rat EEG/EMG System	**8400-K2**
Data conditioning and acquisition system	8401-HR
Rat commutator/swivel	8409
18" Mounting plate	8426
Kit includes cables for one animal, software and manuals.	

PREAMPLIFIER KITS	
2 EEG/1 EMG/1 Biosensor for Sleep or Seizure	**8400-K4-SL/SE**
2 EEG/1 EMG/1 Accelerometer for Sleep or Seizure	**8400-K4-SL/SE-AXL**
3 EEG/1 EMG for Seizure	**8400-K4-SE31M**
3 EEG/1 Biosensor for Seizure	**8400-K4-SE3**
3 EEG/1 Accelerometer for Seizure	**8400-K4-SE3-AXL**
4 EEG for Seizure	**8400-K4-SE4**
4 EEG Fully Referential	**8400-K4-SE4-REF**
2 Biosensor	**8400-K4-2BIO**
All preamplifier kits include one preamplifier, one-time purchase items and surgical disposables to complete four surgeries. Biosensors sold separately.	

SYSTEMS FOR MICE

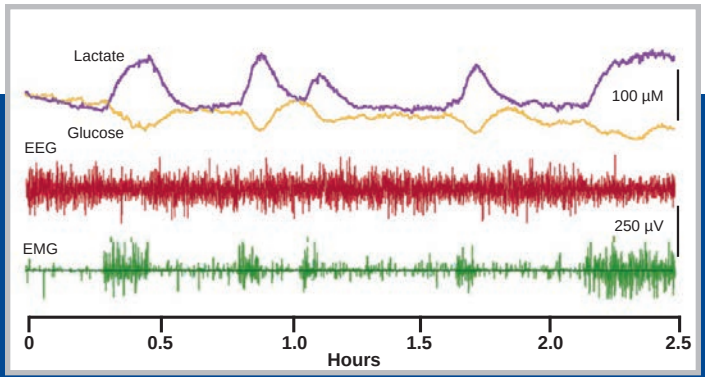
HARDWARE KIT	
Mouse EEG/EMG System	**8400-K1**
Data conditioning and acquisition system	8401-HR
Mouse commutator/swivel	8408
18" Mounting plate	8426
Kit includes cables for one animal, software and manuals.	

PREAMPLIFIER KITS	
2 EEG/1 EMG/1 Biosensor for Sleep or Seizure	**8400-K3-SL/SE**
2 EEG/1 EMG/2 Biosensor for Sleep or Seizure	**8400-K3-5SL/5SE**
2 EEG/1 EMG/1 Accelerometer for Sleep or Seizure	**8400-K3-SL/SE-AXL**
3 EEG/1 EMG for Seizure	**8400-K3-SE31M**
3 EEG/1 Biosensor for Seizure	**8400-K3-SE3**
3 EEG/2 Biosensor for Seizure	**8400-K3-5SE3**
3 EEG/1 Accelerometer for Seizure	**8400-K3-SE3-AXL**
4 EEG for Seizure	**8400-K3-SE4**
4 EEG Fully Referential for Seizure	**8400-K3-SE4-REF**
All preamplifier kits include one preamplifier, one-time purchase items and surgical disposables to complete initial surgeries. Biosensors sold separately.	

HAVE YOUR OWN AMPLIFIER?

Learn more about using Pinnacle's preamplifiers with third-party systems on page 25.

COMBINED EEG/EMG/BIOSENSOR SYSTEMS



EEG and EMG waveforms are plotted simultaneously with calibrated biosensor traces for lactate and glucose recorded from a single animal.

ADD ELECTRICAL STIMULATION

See page 24 for details.

ADD OPTOGENETICS

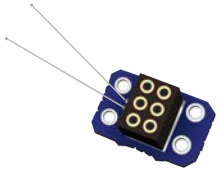
See pages 15–18 for details.

HEADMOUNTS

Pinnacle offers a variety of **HEADMOUNT CONFIGURATIONS** that simplify surgery and provide reliable, reproducible, low-noise EEG/EMG connections. Additional items are also available to support the headmount surgery. Conduct surgeries using Pinnacle's step-by-step guides or adapt them into your own surgical protocol.

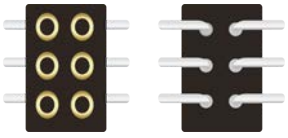
PREFABRICATED HEADMOUNTS

PREFABRICATED HEADMOUNTS for mice and rats reduce surgery time and allow for reproducible electrode placement. Mouse headmounts consist of a six- or eight-pin connector soldered to a board. They contain holes for EEG attachments and are available with pre-soldered, ready-to-insert depth electrodes or EMG leads. Rat headmounts are pre-soldered with EMG leads and/or EEG wires.



STANDARD HEADMOUNTS

STANDARD HEADMOUNTS for mice allow flexible electrode placement for customizable cortical depth recordings. Use these with Pinnacle's screws with wire leads to simplify soldering during surgery. Pre-soldered EEG or EMG leads are available.



CUSTOM HEADMOUNT AND STERILIZATION SERVICES AVAILABLE

Contact a Pinnacle representative at
sales@pinnaclet.com or (785) 832-8866

SCREWS

SCREWS help anchor the headmount to the skull and function as recording electrodes. Mouse screws are available in packages of eight and rat screws are available in packages of 12. Mouse and rat screws with wire leads are sold individually.

SCREWS	
0.08" Mouse Screws (pkg. of 8)	8210
0.10" Mouse Screws (pkg. of 8)	8209
0.12" Mouse Screws (pkg. of 8)	8212
0.125" Rat Screws (pkg. of 12)	8111
0.10" Mouse Screw with Wire Lead	8403
0.08" Mouse Screw with Wire Lead	8405
0.125" Rat Screw with Wire Lead	8247

PREFABRICATED HEADMOUNTS FOR RATS	Tethered	Wireless	Wireless with Via Holes
2 EEG/1 EMG Headmount	8239	8239-W	8239-W-VH
3 EEG Headmount	8239-SE3	8239-W-SE3	8239-W-SE3-VH

PREFABRICATED HEADMOUNTS FOR MICE	
Bio-Only Headmount	7033
2 EEG/1 EMG Headmount with Platinum Iridium Leads	8201
2 EEG/1 EMG Headmount with Stainless Steel Leads	8201-SS
2 EEG/1 EMG Headmount with Stainless Steel Leads (270°)	8201-SS-270
3 EEG Headmount (No EMG Leads)	8201-EEG
3 EEG / 4 EEG REF with Via Holes Headmount	8201-6P
3 EEG / 4 EEG REF with Via Holes Plus Layout Headmount	8201-X
2 EEG/1 EMG/Biosensor Headmount with Pt-Ir Leads	8402
2 EEG/1 EMG/Bio Headmount with Stainless Steel Leads	8402-SS
2 EEG/1 EMG/Bio Headmount with Stainless Steel Leads (90°)	8402-SS-90

STANDARD HEADMOUNTS FOR MICE	
6-Pin Surface Mount Headmount with EMG Leads	8231-SM
6-Pin Headmount	8235
6-Pin Surface Mount Headmount	8235-SM
6-Pin Headmount (No Pins)	8235-OP
8-Pin Headmount	8415
8-Pin Surface Mount Headmount	8415-SM
8-Pin Headmount with EMG Leads	8431
8-Pin Surface Mount Headmount with EMG Wires	8431-SM

DEPTH ELECTRODES

Pinnacle has several **DEPTH ELECTRODE** options available. They can be purchased individually, pre-soldered to headmounts, or soldered to cannulas for deep brain recordings during optical stimulation or biosensor recordings.

DEPTH ELECTRODES	MICE	RATS
Depth Electrode + Prefabricated Headmount	8201-DEP	
Depth Elec. + Prefab. Headmount Stainless	8201-DEP-SS	
Depth Electrode	8425-M	8425
Depth Electrode + 8235-SM Headmount	8443-M	8443-R

SLEEP DEPRIVATION SYSTEM

Pinnacle's **AUTOMATED SLEEP DEPRIVATION SYSTEM** is a unique solution for sleep deprivation and fragmentation studies. It provides user controls for sleep-depriving mice and rats without direct human intervention. Sleep deprivation simulates gentle handling by a rotating bar placed a short distance above the cage floor, lightly nudging the animal from sleep and encouraging the animal to maintain wakefulness without excessive exercise. The system is sold either as a core system or with Pinnacle's Sirenia® Feedback Pro software and EEG hardware. Adding Feedback Pro allows real-time EEG/EMG signals to be used to determine sleep/wake state and initiate deprivation as required.

SYSTEM FEATURES	CORE SYSTEM	+ FEEDBACK
Available for both mice and rats	✓	✓
Adjustable speed and motor control	✓	✓
Calendar-based scheduling	✓	✓
Suitable for short-term, long-term and chronic studies	✓	✓
Optional video recording	✓	✓
Compatible with third-party systems	✓	
Real-time biopotential analysis and feedback		✓
Rule-based programming		✓
Yoked control functionality		✓
Requires Pinnacle's EEG/EMG system		✓

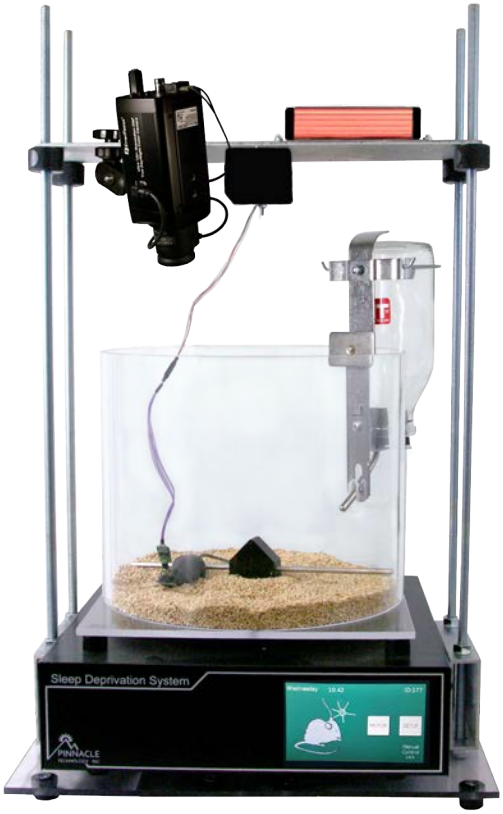
ADVANTAGES

Simulates gentle handling

Prevents sleep acclimation and habituation

Minimizes resources compared to manual deprivation

Reduces unnecessary exercise



Sleep deprivation system with EEG, video and stand

COMMON USES

- SIMULATED SHIFT WORK
- AUTOMATED DEPRIVATION
- SLEEP FRAG-MENTATION

SLEEP DEPRIVATION SYSTEMS	
Sleep Deprivation for Mice (10" Cage)	9000-K5-S
Sleep Deprivation for Rats (12" Cage)	9000-K6-S
Sleep Deprivation for Rats (14" Cage)	9000-K6-S-14

CORE SYSTEM

The core system provides calendar-based functionality for programming the bar to rotate at discrete intervals. Programming options range from a second-by-second basis to hourly, daily, weekly or monthly intervals. Use the device's touchscreen to operate the system without a computer connection. The system is compatible with most EEG/EMG hardware and physiological measurement systems.

FEEDBACK PRO

Feedback Pro software provides calendar-scheduling functionality plus the capability of adding real-time EEG/EMG feedback to ensure the bar rotates only when the animal enters a sleep-like state. Bar rotation starts and stops automatically based on user-established rule sets for the animal's sleep state and users can easily incorporate delays, shifts in bar rotation and time restrictions into the experimental set-up.

ADD SYNCHRONIZED VIDEO TO YOUR SYSTEM

See pages 21 for details.

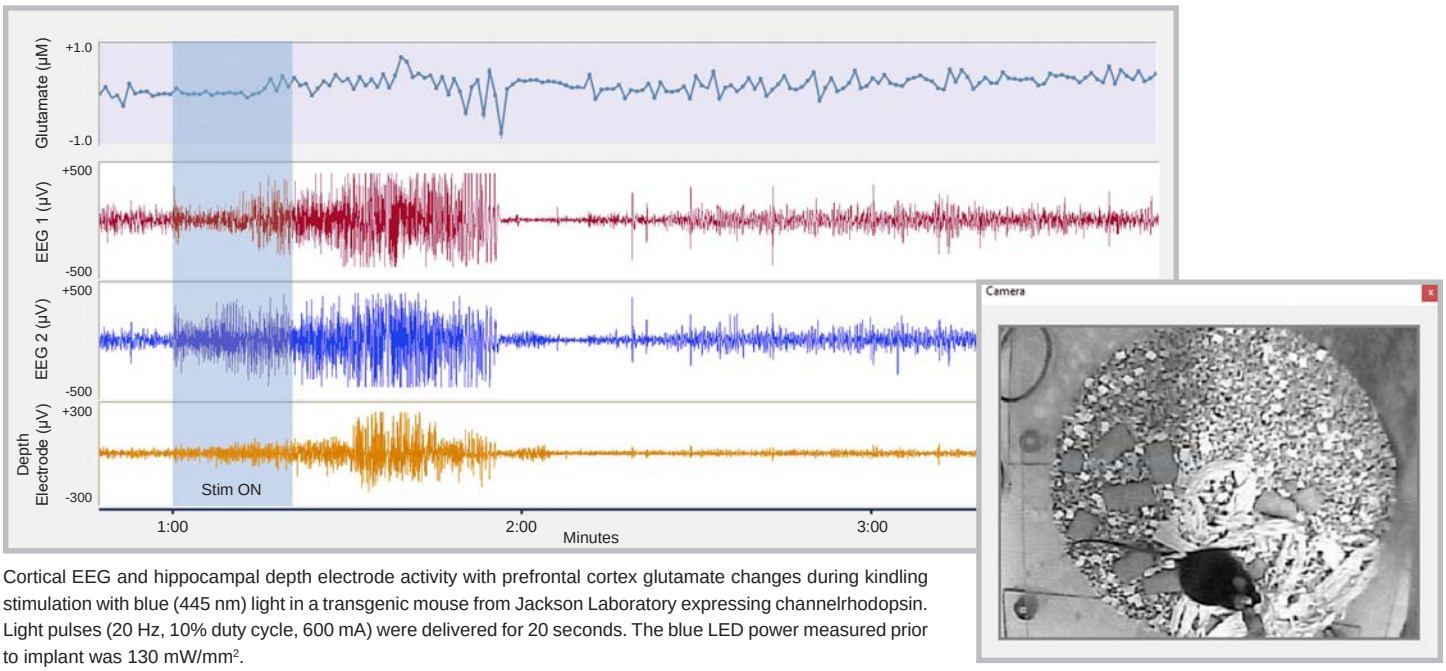
OPTOGENETICS SYSTEMS OVERVIEW

Pinnacle's user-friendly, turn-key **OPTOGENETICS** systems provide simple solutions for a wide range of experimental designs. Our hardware and software platforms seamlessly integrate optogenetic control with simultaneous biopotential, neurotransmitter and behavioral recordings. The system uses LED fiber probes that are compatible with standard cannula placement techniques. Tethered solutions are available for both mice and rats, and wireless options are available for rats.

KEY FEATURES

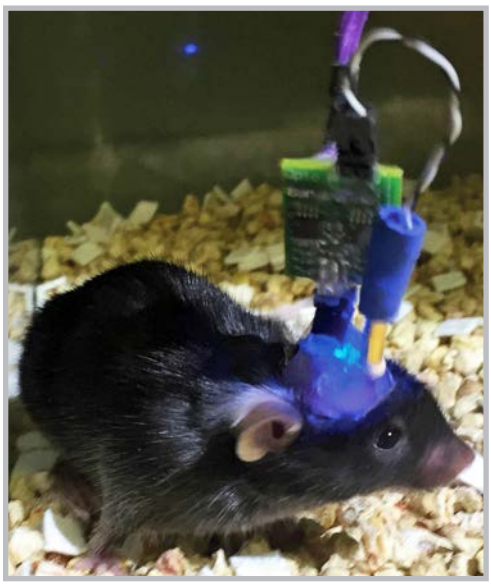
- ◊ Precision timing
- ◊ TTL functionality
- ◊ Optogenetic stimulation with EEG/biosensor recordings
- ◊ Power > 100 mW/mm^2 with most LED probes (depending on wavelength)

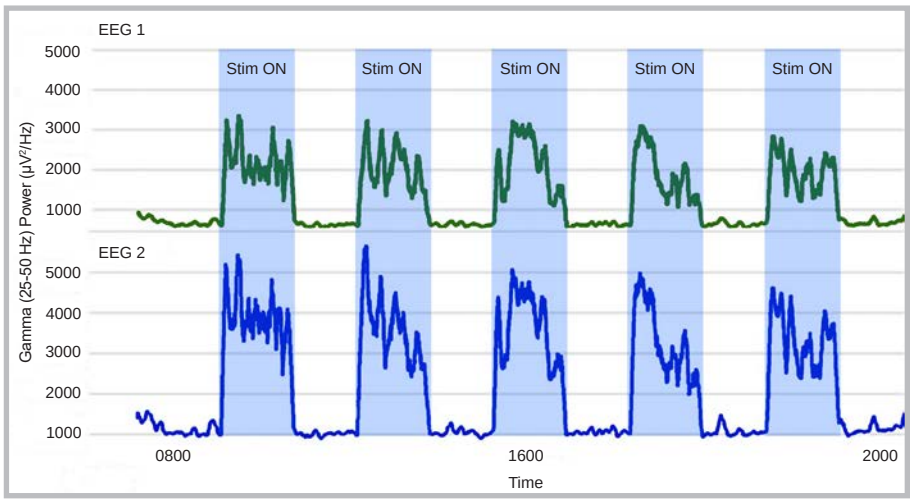
KINDLING SEIZURES USING OPTOGENETICS



Cortical EEG and hippocampal depth electrode activity with prefrontal cortex glutamate changes during kindling stimulation with blue (445 nm) light in a transgenic mouse from Jackson Laboratory expressing channelrhodopsin. Light pulses (20 Hz, 10% duty cycle, 600 mA) were delivered for 20 seconds. The blue LED power measured prior to implant was 130 mW/mm^2.

ALTERING SLEEP USING OPTOGENETICS





Application of 40 Hz stim frequency (10% duty cycle, 600 mA) 10 seconds ON, 10 seconds OFF periods for one hour intervals (blue bars) results in increased power in the Gamma frequency (25-50 Hz) range and decreased NREM sleep by an average of 42 percent during time when stim was applied.

WIRELESS OPTOGENETICS SYSTEMS FOR RATS

Pinnacle's **WIRELESS BLUETOOTH® OPTOGENETICS SYSTEMS** for rats are capable of driving our LED fiber probes at the rated 600 mA pulse current. The device is built in a flex-board format for easy use with our standard rat headmount enclosures. In conjunction with the Bluetooth® dongle, the device can be configured and all data recorded via the Sirenia® software suite.

WIRELESS HARDWARE KITS

1 or 2 Opto	**8400-K19-Opto**
2 Opto rat potentiostat	8489-2opt
Bluetooth dongle®	8489-D
USB extension cable	9052
2 Opto/1 Biosensor	**8400-K19-O2/BIO**
Components of this kit are the same as above except 8489-2opt is replaced with 8489-2opt1Bio.	
2 Opto/1 Accelerometer	**8400-K19-O2-AXL**
Components of this kit are the same as above except 8489-2opt is replaced with 8489-2opt1bio1axl.	
2 Opto/1 Bio/1 Accelerometer	**8400-K19-O2-BIO-AXL**
Components of this kit are the same as above except 8489-2opt is replaced with 8489-2opt1bio1axl.	
1 Opto/2 EEG/1 EMG for Sleep	**8400-K19-O1/2EEG/1EMG**
Components of this kit are the same as above except 8489-2opt is replaced with 8489-1optSL.	
All kits include cables for one animal, software and manuals. LED fiber probes and biosensors sold separately.	

WIRELESS ACCESSORY KITS

1 or 2 Opto Accessory Kit	**8400-K21-Opto**
Rat Hat top	8507
Rat Hat bottom	8508
Zinc air battery (pkg. of 4)	9033-AZ675
Guide cannula	7032 or 7034
1/8" Screws (pkg. of 12)	8111
Screwdriver for 1/8" screws	8241-S
2 Opto/1 Biosensor Accessory Kit	**8400-K21-O2/BIO**
Components of this kit are the same as above.	
2 Opto/1 Accelerometer Accessory Kit	**8400-K21-O2-AXL**
Components of this kit are the same as above.	
2 Opto/1 Bio/1 Accelerometer Accessory Kit	**8400-K21-O2-BIO-AXL**
Components of this kit are the same as above.	
1 Opto/2 EEG/1 EMG for Sleep Accessory Kit	**8400-K21-O1/2EEG/1EMG**
Components of this kit are the same as above. In addition, it contains a test source (8242), screws with wire leads (8247) and a multimeter (8255).	

ADD OPTOGENETICS TO FSCV

Pinnacle's turn-key optogenetics and fast scan cyclic voltammetry (FSCV) system offers a simple, straightforward solution for a wide range of optogenetics experiments in conjunction with FSCV in both rats and mice. Researchers can seamlessly integrate optogenetics with simultaneous voltammetric recordings enabling precise control of complex neuronal circuitry activation and monitoring. The stimulus output on any of Pinnacle's optogenetics FSCV systems can be used for either optogenetics or conventional electrical stimulus, providing optimal flexibility. *See pages 19-20 for information about FSCV.*

LED FIBER PROBES

Pinnacle's optogenetic stimulation uses LEDs coupled to 200/250 µm fiber optic stub. Fiber length is 0.5 millimeters beyond the cannula. The **LED FIBER PROBES** are implanted using a guide cannula and standard stereotaxic techniques. The assembly plugs directly into an electrical header on the headstage, eliminating the need for an optical commutator. Custom lengths are also available. *See page 2 for cannula descriptions.*

LED FIBER PROBES				POWER (mW/mm²)	
Mouse	**Rat Locking**	**Rat Friction**	**Peak Wavelength (nm)**	**@ 300 mA**	**@ 600 mA**
7080-445-A	7081-445-A	7082-445-A	445 Blue	68	110
7080-465-A	7081-465-A	7082-465-A	465 Blue	62	101
7080-515-A	7081-515-A	7082-515-A	515 Green	34	60
7080-590-A	7081-590-A	7082-590-A	590 Yellow	78	108
7080-620-A	7081-620-A	7082-620-A	620 Amber	77	145
7080-640-A	7081-640-A	7082-640-A	640 Red	82	104
7080-660-A	7081-660-A	7082-660-A	660 Deep Red	97	163
*Not recommended.					

TETHERED SYSTEMS FOR MICE & RATS

Our **TETHERED OPTOGENETICS SYSTEMS** use a stimulus controller module that controls the frequency, duration and intensity of illumination events. As the system's key component, it drives the headstage-mounted LED probes through an electrical commutator (no optical commutator required). Pinnacle's LED fiber probes are compatible with standard cannulas and surgical techniques.

STIMULUS CONTROLLER MODULE

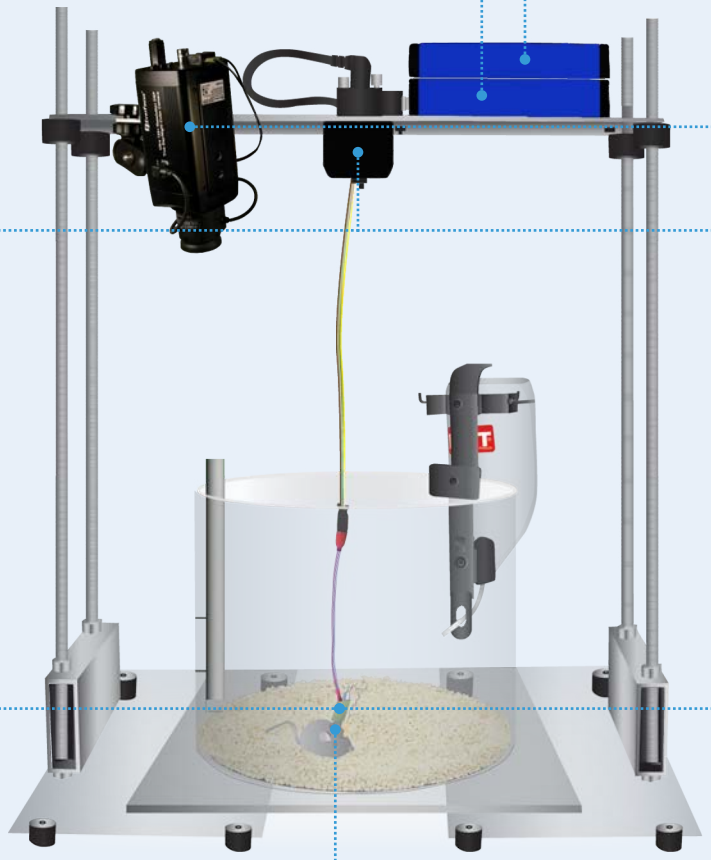
The stimulus controller module offers precise control of optical stimulation frequency, duration and intensity for both continuous and discrete events.

- Highly accurate clock ensures < 1 ppm precision timing
- Capable of optical or electrical stimulus
- Store and run two independent stimulus paradigms

DATA CONDITIONING AND ACQUISITION SYSTEM

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

TETHERED SYSTEMS FOR RATS



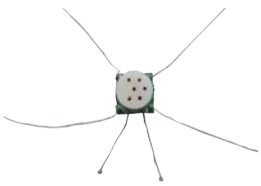
COMMUTATOR

A P1 Technologies commutator's two-plug set-up allows for even rotation of the rotor. Since Pinnacle systems place the light source at the headmount, no optical commutator is needed.

HEADSTAGE

Signals are amplified and filtered at the animal's head using our preamplifiers, which ensure the delivery of clean, artifact-free data. An 18-inch cable connects from the preamplifier to the commutator. The cable's wires are protected by a metal spring coil. A P1 Technologies screw connector secures the preamplifier to the animal's head.

HEADMOUNT



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

HARDWARE & ACCESSORIES

The optogenetics system is sold in three kits. **HARDWARE KITS** for mice and rats include all system components except the interchangeable headstages. **HEADSTAGE KITS** include a headstage and EEG/biosensor-related surgical and testing supplies. Lastly, an **OPTOGENETICS ACCESSORY KIT** includes optogenetic-specific surgical and testing equipment.

SYNCHRONIZED VIDEO (OPTIONAL)

Our optional synchronized video system adds video of an animal's behavior to the biopotential and biosensor data. The system includes everything you need to add video capture to your research. *See page 21 for details.*

TETHERED SYSTEMS FOR MICE

COMMUTATOR

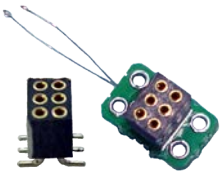
A low-torque commutator (< 0.002 Nm) allows for unencumbered movement for mice. Since Pinnacle systems place the light source at the headmount, no optical commutator is needed. A seven-inch cable extends from the commutator.

HEADSTAGE

Our headstages amplify and filter the signal at the headmount to deliver clean, artifact-free data. A secure friction fit connects the mouse headstage to the headmount. A seven-inch cable extends from the headmount, connecting to the seven-inch cable of the commutator. Six insulated wires are banded together to create this lightweight cable.

HEADMOUNT

Prefabricated headmounts reduce surgery time, allow for reproducible electrode placement and provide ready-to-insert EMG leads. Multiple configurations are available, with EMG placement at 90° or 270° rotation. Custom configurations are available, as well.



HARDWARE KITS	MICE	RATS
Optogenetics Biopotential System	**8400-K11**	**8400-K12**
Data conditioning and acquisition system	8401-HR	8401-HR
Stimulus Controller module	8480-SC	8480-SC
Commutator	8481-M	8214-KIN
Optogenetics Only System	**8400-K15**	**8400-K16**
The components of this kit are the same as above, except the 8401-HR is not included.		
All kits include cables for one animal, software and manuals.		

HEADSTAGE KITS	MICE	RATS
1 Stim/1 Biosensor	**8400-K13-O1/1BIO**	**8400-K14-O1/1BIO**
1 Stim/2 EEG/1 EMG for Sleep	**8400-K13-O1/SL**	**8400-K14-O1/SL**
2 Stim/2 EEG/1 EMG for Sleep	**8400-K13-O2/SL**	**8400-K14-O2/SL**
1 Stim/2 EEG/1 EMG/1 Bio for Sleep	**8400-K13-O1/SL/BIO**	**8400-K14-O1/SL/BIO**
1 Stim/3 EEG for Seizure	**8400-K13-O1/SE3**	**8400-K14-O1/SE3**
2 Stim/3 EEG for Seizure	**8400-K13-O2/SE3**	**8400-K14-O2/SE3**
1 Stim/3 EEG/1 Bio for Seizure	**8400-K13-O1/SE3/BIO**	**8400-K14-O1/SE3/BIO**
1 Stim/4 EEG for Seizure	**8400-K13-O1/SE4**	**8400-K14-O1/SE4**
1 or 2 Stim Only	**8400-K17-Opto**	**8400-K18-Opto**
All headstage kits include one headstage, one-time purchase items and surgical disposables to complete initial surgeries. LED fiber probes and biosensors sold separately.		

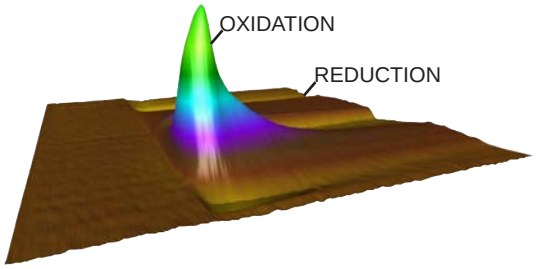
ACCESSORY KITS	MICE	RATS
Optogenetics	**8400-K28**	**8400-K29**
Optogenetics Friction Fit		**8400-K30**
Includes optogenetics-specific surgical and testing equipment.		

ALREADY HAVE PINNACLE'S 8401 DATA ACQUISITION SYSTEM?

ADD OPTOGENETIC AND ELECTRICAL STIMULATION TO YOUR EXISTING SETUP WITH OUR EXPANSION KITS ON PAGE 24

FSCV SYSTEMS OVERVIEW

Pinnacle's robust, turn-key **FAST SCAN CYCLIC VOLTAMMETRY (FSCV) SYSTEMS** are designed to simplify the detection and quantification of catecholamines and other electroactive analytes. It functions by rapidly cycling a voltage across an implanted carbon fiber electrode and measuring the resultant current. All of Pinnacle's FSCV systems (tethered and wireless) are compatible with Pinnacle's stimulus controller. The system comes with Pinnacle's Sirenia® FSCV software.



KEY FEATURES

- ◊ Background subtraction
- ◊ 3D visualization
- ◊ User-selectable filters
- ◊ Data export
- ◊ Video recording
- ◊ Custom waveforms
- ◊ Real-time color plots

SYSTEM SPECIFICATIONS

Voltage span: -0.6 – +1.5 V
Max sweeps/second: 10
Max scan rate: 1000 V/s
Max points/sweep: 1000
Standard sweeps: Dopamine, Serotonin, Norepinephrine, Adenosine

WIRELESS SYSTEMS FOR RATS

WIRELESS RAT SYSTEMS transmit data from multiple animals to a single computer using Bluetooth®. A head-mounted enclosure makes the battery easily accessible and exchangeable to support extended recordings. The system is ideal for mazes, metabolic and behavioral chambers, as well as enclosed environments.

WIRELESS HARDWARE KITS

34 µm Wireless Rat System	**8500-K2**
Components of this kit are the same as above except 8501-7 is replaced with 8501.	
Wireless Rat FSCV + Opto System	**8500-K12**
Components of this kit are the same as above except 8501-7 is replaced with 8501-Opto.	
All kits include cables for one animal, software and manuals. Carbon fiber electrodes and Ag/AgCl reference electrodes are sold separately.	

WIRELESS ACCESSORY KITS

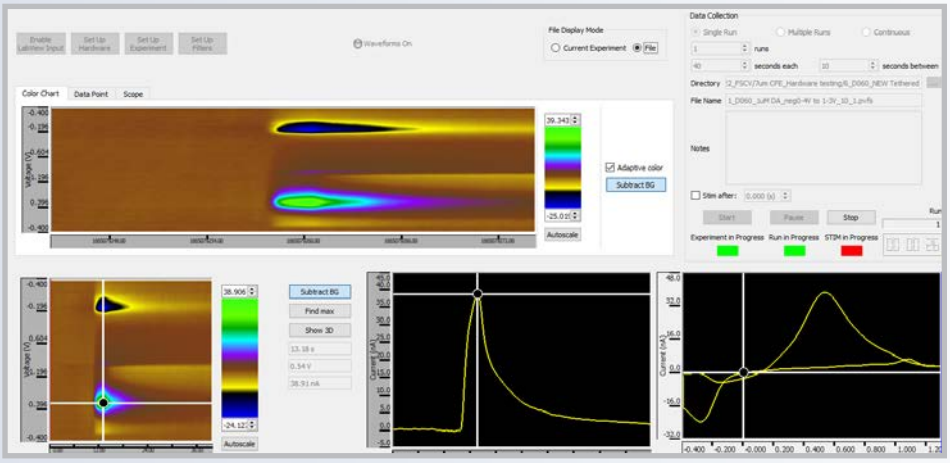
34 µm Wireless Rat Accessory Kit	**8500-K4**
Components of this kit are the same as above except 8134-1G and 8134-1M are replaced with 8134-100K and 8134-100M.	
Wireless Rat FSCV + Optogenetics Accessory Kit	**8500-K13**
Components of this kit are the same as above except 8134-1G and 8134-1M are replaced with 8134-100K and 8134-100M. In addition, it contains a rat opto cannula holder (7035-R-LED) and a powered USB hub (9005).	

FSCV SOFTWARE

The free **FSCV SOFTWARE** offers preprogrammed and custom waveforms associated with the commonly studied analytes: dopamine, norepinephrine, serotonin and adenosine. Custom waveforms can be easily uploaded and stored for quick selection.

The FSCV software supports traditional, short recording paradigms (recordings of two minutes or less), as well as longer-term recordings using an extended, continuous mode.

DOPAMINE RESPONSE IN A FLOW CELL



Representative data from a flow cell. **Top left:** Real-time color plot. **Bottom from left to right:** Color plot, current response, voltammogram.

DISPOSABLE ITEMS

RATS

8111	1/8" Screws (pkg. of 12)
8112	Drill bit
8508	Rat Hat bottom

MICE

7033	Bio-only headmount
8212	0.12" Screws (pkg. of 8)
8254	23-Gauge needle

TETHERED SYSTEMS FOR MICE & RATS

TETHERED FSCV SYSTEMS allow researchers to detect and quantify neurotransmitter release and uptake in real-time. A head-mounted FSCV board sends signals through a low-torque commutator to an interface box that streams data to the host computer.

TETHERED HARDWARE KITS	MICE	RATS
7 µm Tethered System	8500-K1-7	8500-K6-7
34 µm Tethered System	8500-K1	8500-K6
Tethered FSCV + Opto System	8500-K11	8500-K10
All kits include cables for one animal, software and manuals. Carbon fiber electrodes, Ag/AgCl reference electrodes and LED fiber probes are sold separately.		

TETHERED ACCESSORY KITS	MICE	RATS
7 µm Tethered Accessory Kit	8500-K3-7	8500-K7-7
34 µm Tethered Accessory Kit	8500-K3	8500-K7
Tethered FSCV + Opto Accessory Kit	8500-K15	8500-K14
Kits include one-time purchase items and surgical disposables to complete initial surgeries.		

CALIBRATION KIT FOR RATS AND MICE	
FSCV Calibration Kit	8500-K5

STIMULATOR KITS	TETHERED	WIRELESS
FSCV Stimulator Kit	8500-K8	8500-K9

CARBON FIBER ELECTRODES

CARBON FIBER ELECTRODES (CFEs) are used with all FSCV systems and come in two diameters: 7 µm and 34 µm. The 7 µm are used only in tethered systems and the 34 µm is compatible with both potentiostats to measure the presence of biogenic amines in the brain using fixed potential amperometry (FPA). All Pinnacle CFEs require an Ag/AgCl reference electrode.

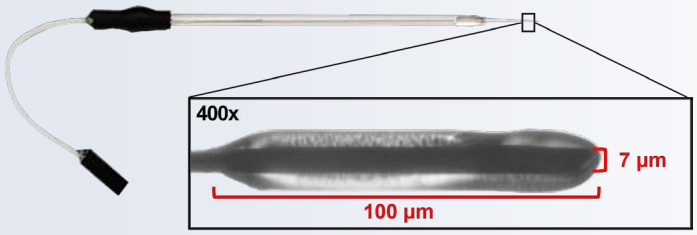
7 µm CARBON FIBER ELECTRODES	
7 µm Carbon Fiber Electrode for *In Vitro*, Brain Slices	7014-L
7 µm Carbon Fiber Electrode for Freely Moving *In Vivo*	7014-S
7 µm Carbon Fiber Electrode – No Connector	7015
Silver Wire + Pin for 7015	7016-SWP
Silver Wire + Pin + Connector for 7015	7016-SWPC
All 7 µm CFEs are bought by cannula type. See page 2 for details.	

34 µm CARBON FIBER ELECTRODES	
34 µm Carbon Fiber Electrode for Rats (Wireless)	7002-CFE
34 µm Carbon Fiber Electrode for Mice	7004-CFE
All 34 µm CFEs are bought by cannula type. See page 2 for details.	

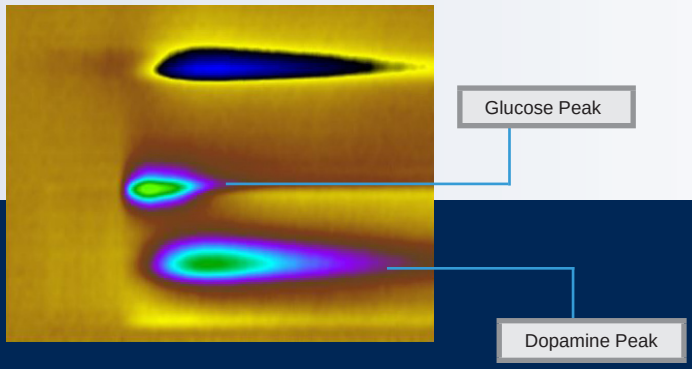
REFERENCE ELECTRODE	
Ag/AgCl Reference Electrode	7065

7 µM ENZYME-MODIFIED CARBON FIBER ELECTRODES FOR DETECTION OF GLUCOSE AND DOPAMINE

GLUCOSE ENZYME-MODIFIED CARBON FIBER ELECTRODES (EM-CFEs) are used to monitor real-time, sub-second, changes in concentration of multiple analytes using a single electrode. Glucose oxidase is entrapped in a hydrogel matrix allowing for the simultaneous detection of non-electroactive species (glucose and DA) via Fast Scan Cyclic Voltammetry (FSCV).



7 µm ENZYME-MODIFIED CFE	
7 µm EM-CFE for *In Vitro*, Brain Slices	7017-L-Glucose
7 µm EM-CFE (Wireless) for Freely Moving *In Vivo*	7017-S-Glucose
7 µm EM-CFE – No Connector	7018-Glucose



GLUCOSE EM-CFE SPECIFICATIONS	
Electrode Diameter	7 µm
Active Area Length	~ 100 µm
Glucose Linear Range	0.05 to 2 mM
Pulled Capillary Electrode (includes connector wire)	
For Use in Brain Slices or *In Vivo*	

SYNCHRONIZED VIDEO CAPABILITY

Pinnacle's **VIDEO SYSTEM** can record up to four simultaneous *in vivo* experiments on one computer. Our Sirenia® video software licenses unlock the ability to synchronize video recordings ± one video frame up to 30 frames per second to simultaneous EEG, EMG or biosensor data. This provides an accurate representation of an animal's overt behavior in conjunction with its physiological response. The video system consists of a base computer package and a camera package, including a synchronized video license which provides everything you need to incorporate video capture into your research. Order it as an accessory to a new system or easily integrate it into your current Pinnacle setup.

CAMERA OPTIONS

SYNCHRONIZED VIDEO SYSTEM	
Base Video Computer Package for Box/Dome Camera	**9000-K1**
Base Video Computer Package for USB Camera	**9000-K1-USB**
Includes a preconfigured computer, a high-definition monitor, a docking station for easy data transfer, a keyboard, mouse and cables. Up to four cameras can be added to a single video system. Cameras sold separately.	

CAMERA PACKAGES	
Dome Camera with Integrated IR Source	**9000-K9**
Box Camera with Independent IR Source	**9000-K10**
USB Camera with Integrated IR Source	**9000-K30**
All camera packages include a camera, IR source, mounting accessories, extension cable and one Sirenia® license key.	

ADDITIONAL PRODUCTS	
Variable Focus Lens for Box Camera	**9056-VF**
Tripod for Box and USB Cameras	**9059**

KEY FEATURES

- ◊ Record in color or grayscale
- ◊ Flexible file size management
- ◊ Unrestricted video playback
- ◊ Record in low light or complete darkness
- ◊ Synchronize video with data recordings
- ◊ Record from any angle (Box/USB)

FEATURES	DOME	BOX	USB
Lens	3.6 mm (internal)	4 mm (external)*	2.8–12 mm variable (external)
Max Resolution	704 x 480 pixels**	704 x 480 pixels**	640 x 480 pixels
Max Frame Rate	30 fps	30 fps	30 fps
Mount	Above	Above, Side, Tripod	Above, Side, Tripod
IR Source	Integrated	Independent	Integrated
Color/Grayscale	Both	Both	Both
Interface	Analog	Analog	USB 2.1
*Accepts standard C-mount lens **Capture Card Specific			

DOME CAMERA

Pinnacle's dome camera mounts above the cage. Its built-in infrared illumination adjusts to lighting conditions automatically, allowing video recording in reduced lighting and complete darkness.

BOX CAMERA

The box camera has improved optics and low-light performance compared to the dome camera. It can be mounted above the cage, on the cage stand or to a tripod for recording at lower angles. A separate automatic infrared illumination source allows video capture in conditions of low light and complete darkness. An external IR source is included.

USB CAMERA

The low-latency, USB camera use a single cable for power and data transfer. Similar to our dome camera, the USB camera has a built-in IR source that automatically adapts to lighting conditions, ensuring high-quality video recording even in low light and complete darkness. The camera can be connected by plugging in via USB port or hub and does not require a video capture card.

SYNCHRONIZED VIDEO CAPABILITY

ACQUIRE

Pinnacle's Sirenia® software uses frame-by-frame timestamping to synchronize video within +/- 1 video frame to simultaneous EEG, EMG or biosensor data.

ANALYZE

A visual sync bar allows users to easily match the displayed video frame with corresponding data for an accurate visual representation of animal activity.

MANAGE

Extract segments from long recordings for simplified data transfer or archival. Plus, export video with associated data for playback during presentations.

UPGRADE TO ENHANCED ILLUMINATOR

See page 24 for details.

ANIMAL HOUSING

CIRCULAR CAGES and **CAGE ACCESSORIES** allow tethered rodents to have complete freedom of movement. All cages are made of one-fourth inch clear acrylic and are suitable for use with most commercial cage washing equipment. Multiple sizes are available. Circular cages are ideal for both wireless and tethered experiments. Cage accessories include items such as cage lids, stands and illuminators. Housing items can be purchased individually or in kits that include necessary components for an experimental set-up.

1. Cage lids allow for additional containment of active animals, can be easily removed for cleaning and feeding. Standard cage lids are designed for tethered experiments. **FILTER CAGE LIDS** can be used for wireless experiments or when using the cage for long-term housing.

2. Increase the height of our standard cages using cage extenders. The extenders fit snugly on top of Pinnacle's cages and add 4" (per extension) to cage height. Extenders can be stacked for additional height. *Not included with the purchase of cage kit.*

3. Pinnacle's cages are ideal for tethered rodent research. The circular design allows the animal complete freedom of movement around the circumference of the cage. The open top makes cleaning and feeding easy and accessible. For tethered set-ups, our circular cage design prevents excessive slack and tension in the cable.

4. Pinnacle's stands accommodate a single animal cage and mounting plate. The split design is compatible with both mouse and rat cages and all of Pinnacle's tethered recording systems. A new option, a **MONOPOD STAND**, provides a simplified design with increased access to the animal. Mounting plate sold separately.

5. A detachable food hopper can be added to any Pinnacle cage. The stainless steel food hopper attaches to the inside of the cage, holds approximately 50 grams of food (~12 standard pellets) and dispenses one pellet at a time. It reduces disturbance to the animal and requires little maintenance during long-term experiments. Add a second food hopper to increase the amount of food available.

ADDITIONAL PRODUCTS

14" Mounting Plate (35.5 cm)	**8258-723**
18" Mounting Plate (45.7 cm)	**8426**
10" Mouse Cage Extender	**8228-4ex**
12" Rat Cage Extender	**8238-4ex**
14" Rat Cage Extender	**8273-4ex**
Cage Stands	
Cage Stand (Adjustable to 24" tall [61 cm])	9009
Cage Stand (Adjustable to 36" tall [91 cm])	9009-RSD
Monopod Cage Stand (Adjustable to 20" tall [51 cm])	9009-MOM
Mounting Plate for Monopod Cage Stand	**9009-PL**
Filter Lids	
10" filter lid for mice	8265-M-F
12" filter lid for rats	8265-R-F
14" filter lid for rats	8265-R14-F
Grid Filter Paper	**8265-FP**

CAGE KITS

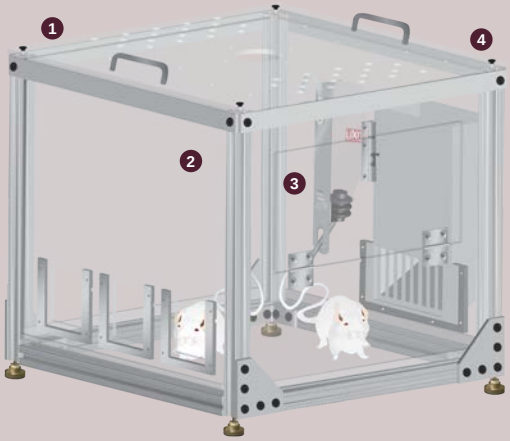
10" Mouse Cage Set-up	**9000-K20**
Cage for mice (10" diameter, 8" tall [25.4 x 20.3 cm])	8228
Cage lid for mice	8265-M
Monopod metal stand (adjustable to 20" tall [61 cm])	9009-MOM
Rubber Bumpers for Monopod Stand	9009-RB
T-Handle hex key	8241-KY
Shaft collar	9009-SC
Water bottle for mice	8251-M
Mouse food hopper	9066-M
10" Mouse Cage Set-up (Wireless)*	**9000-K26**
12" Rat Cage Set-up**	**9000-K21**
12" Rat Cage Set-up (Wireless)***	**9000-K27**
14" Rat Cage Set-up****	**9000-K22**

* Components of this kit are similar to above but includes filter lid accessories.
** Components of this kit are similar to above but sized for larger cage dimensions.
*** Components of kit are similar to above but includes filter lid accessories and is sized for larger cage dimensions.
**** Components of this kit are similar to above but include 9009 stand and is sized for larger cage dimensions.

GROUP HOUSING

Pinnacle's **GROUP HOUSING SYSTEM** is a modular, customizable social housing chamber for studies using up to four rats. The system allows for a variety of experimental set-ups, including behavioral and physiological studies. It can also be used as a home cage for long-term experiments. The cage has easily interchangeable panels and an option to add video and RFID tracking.

MIX & MATCH



Choose any four walls to be added to your core cage set-up. Order additional panels to swap out for different experiments. Select behavioral and tracking components to enhance your group housing system.

PANEL OPTIONS

1. Blank panel with no additional features.
2. Operant panels include mountings for up to three fixtures compatible with third -party products.
3. Door panel for easy access to the animals without removing the lid.
4. Food hopper and water bottle panel.

BEHAVIORAL & TRACKING COMPONENTS

TRACKING

Our **MULTIPLE ANIMAL TRACKING SOFTWARE** is used to track animal movement and analyze behavioral patterns based on speed, distance, trajectory and animal position. The software can be combined with RFID to automatically resolve collision events and ensure positive identification of animals. Alternatively, RFID can be used aloe for zone-based animal identification.

BEHAVIOR AND OPERANT CONTROLS

Third-party operant devices can be integrated into the group housing system. Hardware can be connected through Pinnacle's **DIGITAL INSTRUMENTATION INTERFACE** and controlled through within the Sirenia® software platform. Sirenia **FEEDBACK PRO** software gives users control over input rules and output device function.

LIGHTING

Use Pinnacle's illuminators to calibrate and control cage lighting. Basic and enhanced illuminators provide optimal lighting conditions for video recordings in a day or night setting and are ideal for studies that require strict lighting conditions.

BEHAVIORAL AND TRACKING COMPONENTS	
RFID System*	**9000-K25**
RFID module	9087
Video and Lighting Systems	
Box camera with independent IR source	9000-K10-GH
IP camera with independent IR source	9000-K11-GH
Enhanced Illuminator	9000-K15
IR Source/Illuminator	9057
Premium Software Modules	
Sirenia® Feedback Pro software	9030
Sirenia® Multiple Animal Tracking software	9040

* All necessary cables are also included.

CORE CAGE KIT	16" CAGE	22" CAGE
Group Housing Core Cage	**9000-K23**	**9000-K24**
Cage strut (2)	9088-16	9088-22
Angle bracket sides (2)	9089-16	9089-22
Top brace bar (2)	9088-T16	9088-T22
Floor with sides	9092-16	9092-22
Lid	9091-16	9091-22

WALL PANEL KITS	16" CAGE	22" CAGE
Blank Panel	**9083-16**	**9083-22**
Door Panel	**9083-D16**	**9083-D22**
Operant Panel	**9000-K23-OP**	**9000-K24-OP**
Operant panel	9083-O16	9083-O22
Digital instrumentation interface	9084	9084
Food and Water Panel	**9000-K23-FW**	**9000-K24-FW**

SUPPORTING PRODUCTS

Pinnacle's neurophysiological systems implement a modular design strategy, allowing the easy addition of new measurement tools to expand the range of experiments possible within a single recording setup. Our devices can also be integrated with third-party hardware in order to add new functionality to existing systems. Several key products include electrical or optical stimulation, illuminators, low-torque commutators, isolated potentiostats and devices to integrate third-party hardware.

STIMULUS CONTROLLER KIT

Add optical or electrical stimulation to Pinnacle recording systems

The addition of a **Stimulus Controller** module for either electrical or optical stimulation unlocks the ability to perform neuronal control with simultaneous biopotential, neurotransmitter and behavioral recordings. Pinnacle's Stimulus Controller module offers precise control of electrical or optical stimulation frequency, duration and intensity for both continuous and discrete events. The stimulus controller integrates directly with our 8400 4-channel systems and preamplifiers. It can also be used as a stand-alone device. The optogenetic expansion kit is also sold with an accessory kit that includes surgical and testing equipment.

STIMULUS CONTROLLER HARDWARE KITS	MICE	RATS
Electrical Stimulator & Biopotential Kit	8400-K22	8400-K23
Optogenetics Expansion Kit	8400-K24	8400-K25
Electrical Stimulation Expansion Kit	8400-K26	8400-K27
All kits include cables and manuals.		

OPTOGENETICS ACCESSORY KIT	MICE	RATS
Optogenetics	8400-K28	8400-K29
Optogenetics Friction Fit		8400-K30
Includes optogenetics-specific surgical and testing equipment.		

KEY FEATURES

- ◊ Highly accurate clock ensures precision timing
- ◊ Gate and stimulus control simplify connection to stimulus isolators
- ◊ Capable of controlling either electrical or optical stimulus
- ◊ Two TTL inputs configurable as hardware stimulus triggers
- ◊ Store and run two independent stimulus paradigms
- ◊ Hardware signaling to the data acquisition system ensures per-sample accuracy of stimulus events

IR SOURCE

Record nighttime video in animal enclosures

Our IR source has a built-in photoresistor to automatically turn on IR lighting in darkness makes it ideal for long-term video recordings.

ENHANCED ILLUMINATOR

IR and visible light source with dawn/dusk transitions

This programmable illuminator controls lighting and monitors temperature, humidity and light intensity in or near the enclosure. The device provides both IR and visible light and can also simulate dawn/dusk transitions.

COMMUTATORS

Low-torque electrical swivels

Pinnacle's low-torque mouse commutators provide excellent freedom of movement while maintaining clean and constant electrical signals. Custom modifications are available for use with third-party cabling and connection schemes. Rat commutators are also available.

ANALOG ADDAPTERS

Use your own acquisition system with Pinnacle hardware

Pinnacle's three- and four-channel analog adapters allow researchers with third-party data collection systems to take advantage of the excellent noise reduction provided by our commutators and head-mounted preamplifiers. These adapters are compatible with both Pinnacle's mouse or rat preamplifiers.

Analog Adapters can be powered by batteries or a power supply. DX models are built with both power and battery supply options integrated into a single device, and have factory-settable gain options available for researchers that need additional signal amplification.

ISOLATED WIRELESS POTENTIOSTAT

Hand-held isolated electrochemical measurements

The wireless two-channel potentiostat comes in standard or extended range models and is suitable for a wide range of amperometric systems, including lab-on-chip and biosensors. Its isolated design makes it uniquely suited for in-channel and end-channel detection in capillary electrophoresis systems. Powered by a standard 9 V battery, the device uses Smart Bluetooth® telemetry for reliable data transfer via a USB dongle and is fully supported by Pinnacle's Sirenia® software.

VISIT OUR WEBSITE FOR ADDITIONAL PRODUCTS TO SUPPORT YOUR RESEARCH

www.pinnaclet.com

TTL PLUS

Synchronize external signals or third-party devices in Sirenia

The TTL+ adds four multipurpose I/O connections, enabling the integration of TTL signals to a wireless system or expansion of TTL recording capabilities in tethered systems. Each I/O connection can be configured as a 5V digital output, 5V digital input, or 10-bit analog input, with sampling rates of up to 2000Hz. Digital inputs can be configured to create annotations in electrophysiology recordings acquired by other Pinnacle devices, and digital outputs can be used to trigger external events based on real-time analysis of electrophysiology events.

MASTER CLOCK

Synchronize timing between independent USB devices

The master clock provides centralized ultra-precise timing for the synchronization of multiple devices such as video and data interfaces, making it perfect for optogenetics, behavioral studies and other protocols. The Master Clock works seamlessly with our Sirenia® software offering < 1 ppm accuracy from 0 to 70°C and three TTL I/O ports. It connects to the system using a standard USB cable.

ADDITIONAL PRODUCTS	
IR Source	**9057**
Enhanced Illuminator Kit*	**9000-K15**
Enhanced Illuminator	9057-EN
Lux, temperature and humidity cable	9057-LUX
Photoresistor cable	9057-PHO
Commutators	
6-Pin mouse commutator	8204-723
9-Pin mouse commutator	8408
10-Pin mouse commutator	8481-M
Analog Adapters	
3-Channel analog adapter (Dual-powered option)*	8242-DX-K
4-Channel analog adapter (Dual-powered option)*	8442-DX-K
Isolated Wireless Potentiostats	
Isolated wireless potentiostat*	9000-K7
Extended range wireless potentiostat*	9000-K7-ER
TTL Plus	**9085-N-K**
Master Clock*	**9000-K8**
*Cables, software and manuals are included in kit.	

SIRENIA® SUITE OVERVIEW

Pinnacle's **SIRENIA® SOFTWARE** provides powerful tools for preclinical research. This modular platform consists of a free acquisition package, which is included with our hardware, and premium modules that can be added at any time.

FREE

SIRENIA® ACQUISITION

SIRENIA® ACQUISITION provides a single platform for recording data from any Pinnacle hardware system, except FSCV. The software features data stream synchronization, data consolidation, user-configurable settings and multiple export options. In addition, the download includes basic analysis modules for biosensors, sleep and seizure recordings. Sirenia® delivers all-in-one software for data acquisition and review.

KEY FEATURES

- ◊ Record from Pinnacle devices on a single platform
- ◊ Annotate in real-time or review
- ◊ Export to multiple formats
- ◊ Save and load device configurations
- ◊ Schedule recording
- ◊ TTL functionality

PREMIUM MODULES

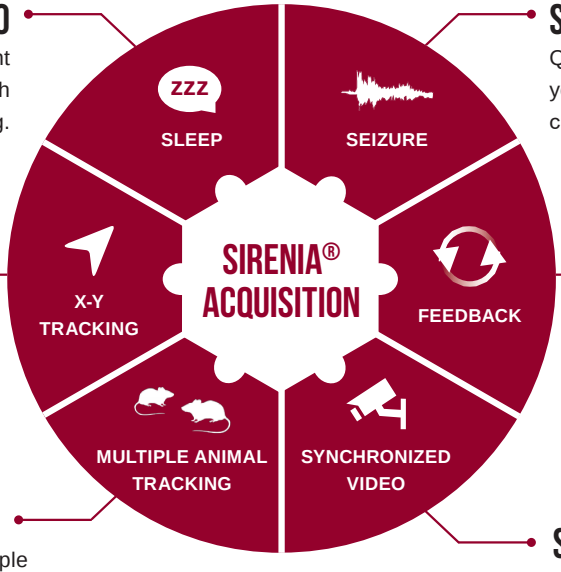
PREMIUM MODULES can be plugged seamlessly into the free core acquisition package. *Learn more about these time-saving modules on pages 27-28.*

SLEEP PRO

Score mouse and rat data in 75 percent less time using automated tools, such as cluster and threshold scoring.

SEIZURE PRO

Quickly identify and analyze events in your data using line length and power characteristics of user-defined seizures.



X-Y TRACKING

Precisely track animal movement and quickly analyze movement and behavioral patterns.

FEEDBACK PRO

Use biopotential inputs and other rules to automate events, such as sleep deprivation and electrical/optogenetic stimulation.

MULTIPLE ANIMAL TRACKING

Simultaneously record and track multiple animals within a single enclosure and analyze behavioral patterns.

SYNCHRONIZED VIDEO

Synchronize recorded video automatically with EEG/EMG waveforms and biosensor activity. *See page 21 for details.*

PREMIUM SOFTWARE MODULES	
Sirenia® Sleep Pro	9035-K-E
Sirenia® Seizure Pro	9037-K-E
Sirenia® Synchronized Video	9021
Sirenia® Feedback Pro	9030-K-E
Sirenia® X-Y Tracking	9039-K-E
Sirenia® Multiple Animal Tracking	9040-K-E

All electronic software packages include a Sirenia® software manual and license key.

Contact a Pinnacle representative to request a free trial: sales@pinnaclet.com

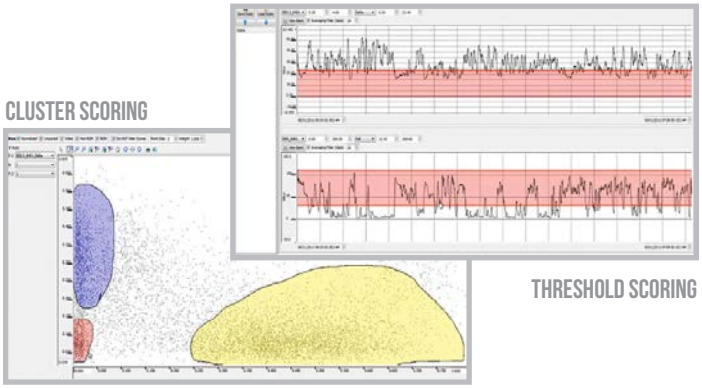
30-DAY TRIAL

PREMIUM SIRENIA® MODULES

Pinnacle's premium modules offer enhanced features for data collection and analysis. Data recorded with Pinnacle software, as well as third-party EDF files, can be imported into all analysis software platforms. Premium software packages can be installed on multiple computers but are limited to one computer running the program at a time. Purchase includes one year of free upgrades.

SIRENIA® SLEEP PRO

SLEEP PRO provides two automated methods for scoring sleep data—cluster and threshold scoring—as well as a manual scoring option. Custom scoring and analysis are also available. Multiple methods can be combined to quickly and accurately score both mouse and rat files. Epoch lengths are user-configurable and numerous scoring sessions can be created for the same file. Powerful analysis tools such as sleep stage/sleep bout analysis and user score comparison make reviewing and exporting data easy.

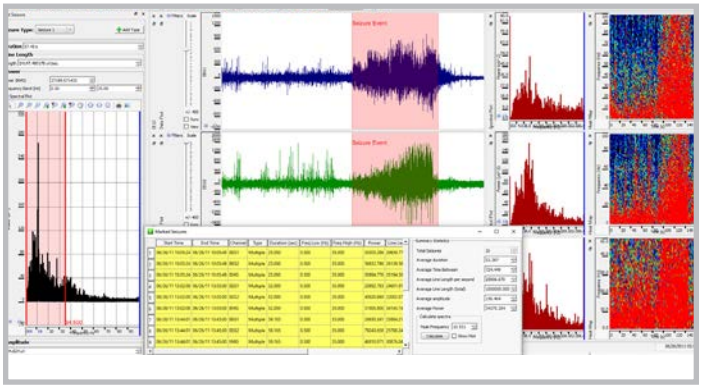


KEY FEATURES

- ◊ Multiple scoring tools
- ◊ Hypnograms
- ◊ Spectral plots/Heat maps
- ◊ Peak frequency analysis
- ◊ Coherence plots
- ◊ Power analysis

SIRENIA® SEIZURE PRO

SEIZURE PRO is designed for efficient seizure event analysis, allowing users to quickly identify and examine specific seizure events. Users can construct a seizure database by manually selecting events or establishing chosen parameters to find seizures. Once added, statistics such as amplitude, average duration, temporal intervals between seizures, frequency power, line length, and seizure type can be generated. Additional tools, like coherence and spike counter, are available with simple parameter-setting options.

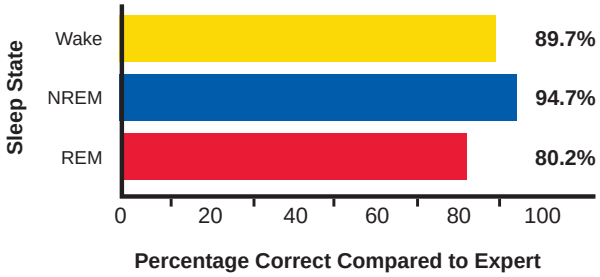


KEY FEATURES

- ◊ Automated seizure identification
- ◊ Spectral plot/Heat maps
- ◊ Power analysis
- ◊ Seizure statistics
- ◊ Coherence plots
- ◊ Spike Counter

ACCURACY OF SLEEP DETECTION

A combination of cluster, threshold and manual scoring tools were used by four experienced and novice scorers to separately score three different mouse data files. All files were compared to expert hand-scored data files. The overall average agreement of the four scorers for all the files as compared to the expert is shown below.



ACCURACY OF SEIZURE DETECTION

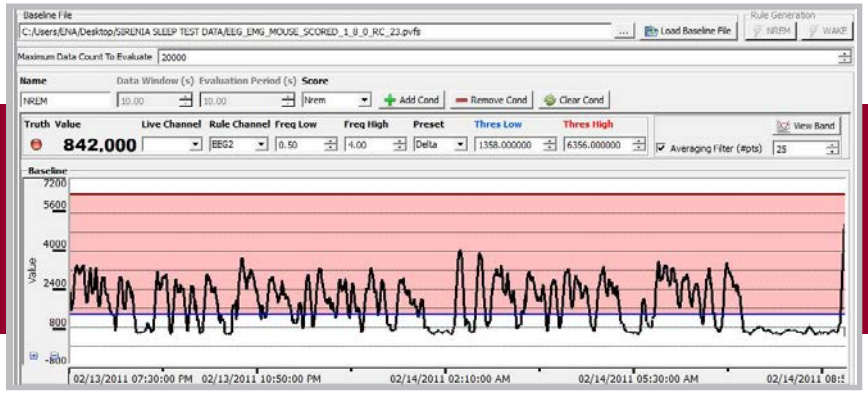
Seizure detection was performed using RMS power and line length separately on five individual mouse data files. All files were compared to an expert hand-scorer's files. Agreement of the two detection methods as compared to the expert is shown below.

	# of Seizure Events Marked	Accuracy vs. Expert Scorer	# of False Positives
Expert Scorer	21	N/A	N/A
RMS Power	23	100%	2
Line Length	21	100%	0

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

SIRENIA® FEEDBACK PRO

SIRENIA® FEEDBACK PRO software enables users to create rule sets based on baseline data, thresholds and power analysis to initiate stimuli in a variety of sleep, seizure, optogenetics, and behavioral studies. When used in conjunction with Pinnacle EEG/EMG recording devices, real-time signals can be analyzed by the software based on user-programmed rules. Additionally, our software allows researchers to connect and synchronize the settings of multiple units. Other features include TTL controls for third-party systems, interface for third-party modular behavioral components, such as levers, lights, dispensers, single and parallel state machines, flexible inputs including entry into zones defined by video or RFID and support for group-housed animals.



KEY FEATURES

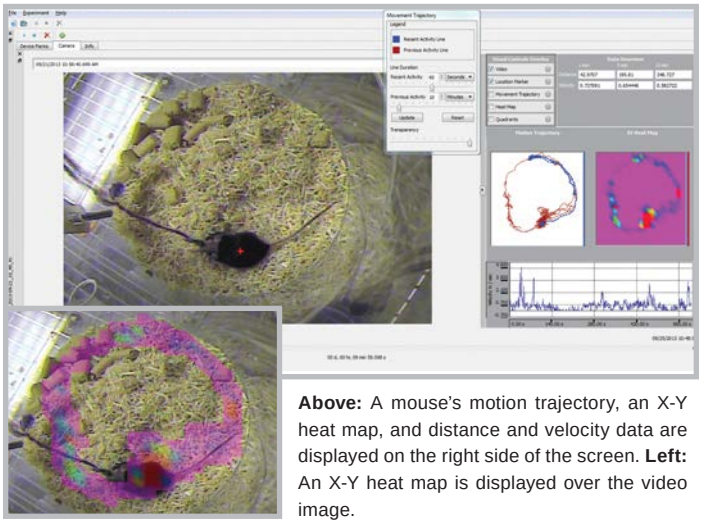
- Compatible with Pinnacle's optogenetics and electrical stimulation system
- Coordinate and schedule TTL signals
- Control stimuli based on physiological responses

SIRENIA® X-Y TRACKING

SIRENIA® X-Y TRACKING enables users to accurately detect and analyze animal movement within a cage. Users can track locomotor behavior in real-time or in previously recorded video data. In addition, the software can be calibrated to different cage types and is compatible with tethered and wireless animals, making X-Y Tracking applicable to a variety of experimental paradigms including sleep/wake activity.

KEY FEATURES

- Real-time tracking
- Heat maps
- Motion trajectory analysis
- Distance and velocity traveled
- User-defined regions
- Quadrant analysis



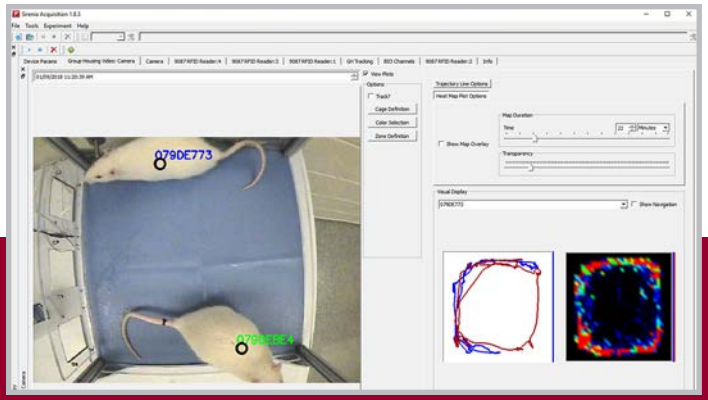
Above: A mouse's motion trajectory, an X-Y heat map, and distance and velocity data are displayed on the right side of the screen. **Left:** An X-Y heat map is displayed over the video image.

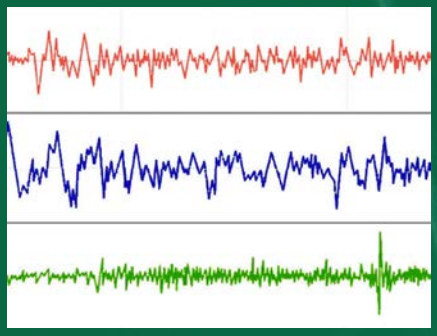
SIRENIA® MULTIPLE ANIMAL TRACKING

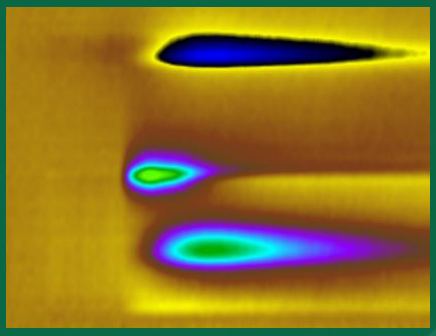
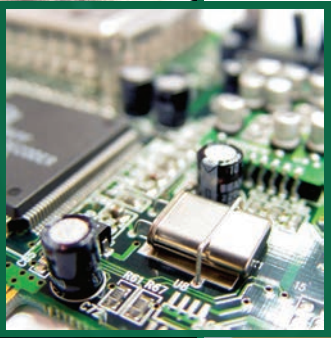
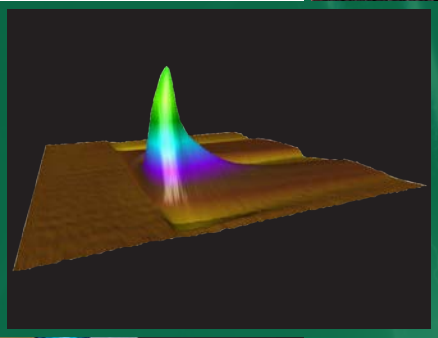
Simultaneously record and track multiple animals within a single cage using **SIRENIA® MULTIPLE ANIMAL TRACKING**. Users have the ability to monitor and analyze animal movement based on speed, distance, trajectory, and animal position. RFID modules can be added to automatically resolve collision events.

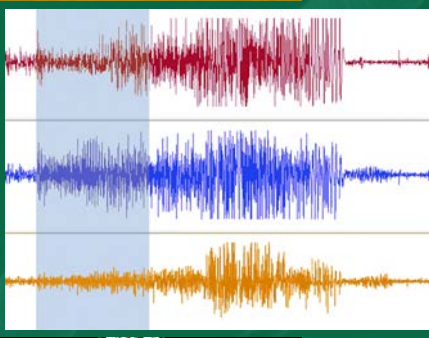
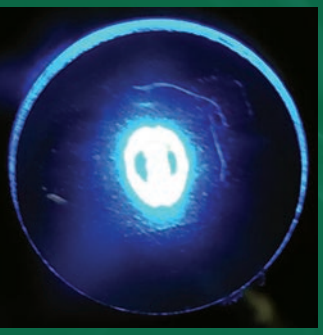
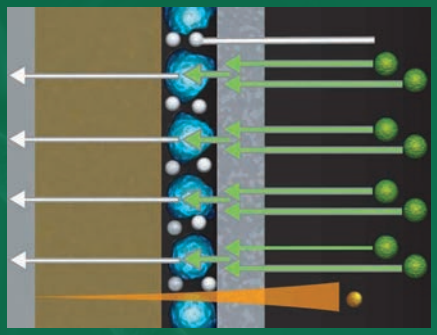
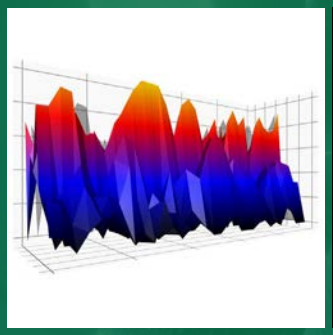
KEY FEATURES

- Heat maps
- Integrated RFID tracking
- Motion trajectory plots
- Automatically resolve collision events




LEARN MORE

Pinnacle's products are used daily to advance research at academic institutions, research hospitals, government laboratories, contract research organizations and pharmaceutical companies across the world. Learn more about how current customers are using our products by visiting the Info Center on our website at ***www.pinnaclet.com/info-center.html***.

PUBLICATIONS

Many Pinnacle customers regularly publish their scientific work in peer-reviewed journals. This space is dedicated to sharing our customers' research with other users of Pinnacle products and systems. Visit our website at ***www.pinnaclet.com/publications.html*** for a complete list of publications.

POSTERS

Missed a conference? Visit us online to review posters presented by Pinnacle and our customers at SfN Neuroscience, AES, FENS and other major conferences. If you've presented a poster recently using Pinnacle products, let us know! We may be able to post it online to share with other researchers.

CONFERENCES

Pinnacle Technology regularly attends scientific conferences and meetings hosted both in the United States and internationally. Please stop by our booth at upcoming conferences to chat with a representative about how our cutting-edge tools can improve and simplify your research. Visit our website at ***www.pinnaclet.com/conferences.html*** for a complete list of events.

DISTRIBUTORS

Pinnacle Technology is proud to make our products available to an international customer base by teaming with a growing list of distributors from across the globe. Visit our website at ***www.pinnaclet.com/distributors.html*** for an updated list.

PINNACLE
TECHNOLOGY