



**NEUROPHYSIOLOGICAL PRODUCTS  
FOR PRECLINICAL *IN VIVO* RESEARCH**

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Pinnacle offers a range of turn-key systems for neurophysiological studies using freely moving animals. From surgical headmounts, hardware, and cage setups to analysis and recording software, **we provide everything you need for a fully equipped research setup - ready to go, right out of the box.**

We are committed to developing new tools that combine and simplify measurement, reduce cost and enable new research. We pride ourselves in providing exceptional customer service. By forging collaborative relationships with our clients, we develop cutting-edge tools that improve and simplify your research. We look forward to working with you.

## INFORMATION & POLICIES

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### **Ordering Information:**

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

**Biosensors and Carbon Fiber Electrodes:** Pinnacle Technology DE, LLC, 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 DE, LLC products are sold for laboratory research use only. Pinnacle Technology DE, LLC 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 DE, LLC 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 DE, LLC 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](mailto: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 DE, LLC representative to obtain an RMA number and proper RMA documentation. Returns should be shipped to Pinnacle Technology DE, LLC 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 DE, LLC's discretion. **Products that have made direct animal contact, including wireless devices, preamplifiers, and cages, are not eligible for return.** Pinnacle Technology DE, LLC 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 DE, LLC's policy regarding returns. Refer to Pinnacle Technology DE, LLC's website ([www.pinnaclet.com/general-product-info.html](http://www.pinnaclet.com/general-product-info.html)) for detailed warranty information.

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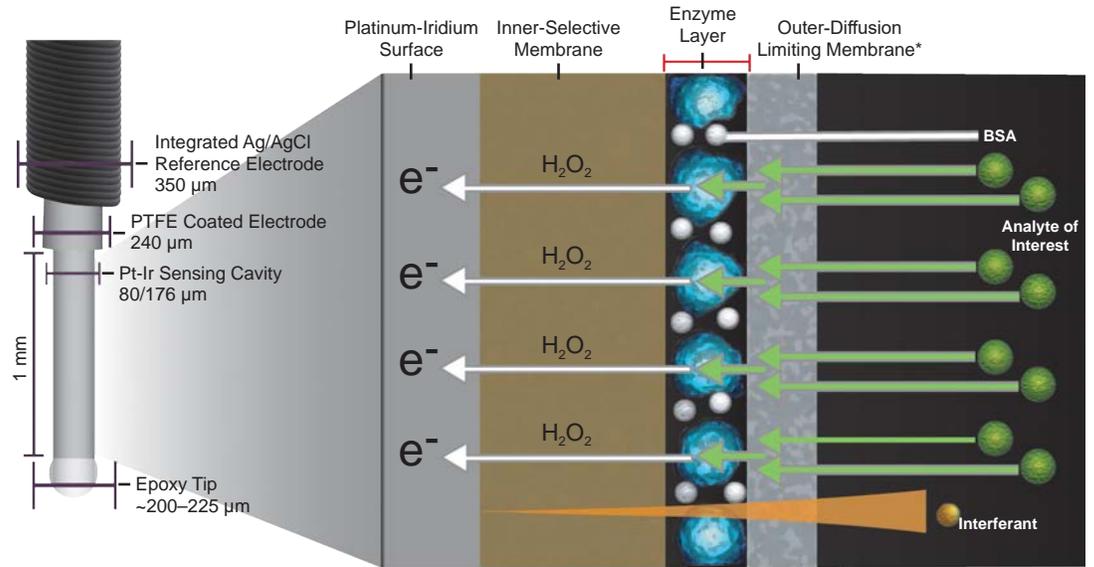
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## CNS BIOSENSORS OVERVIEW

**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 interferences 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

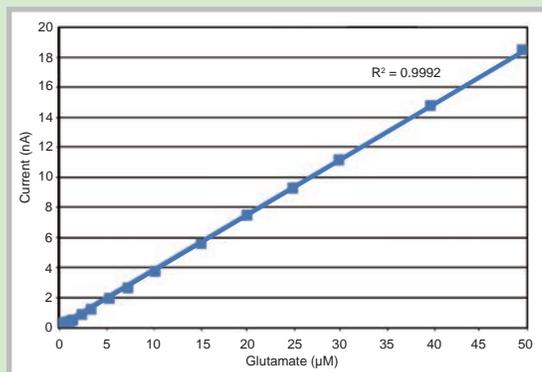
## CNS BIOSENSOR CHARACTERISTICS

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

## COMMON USES

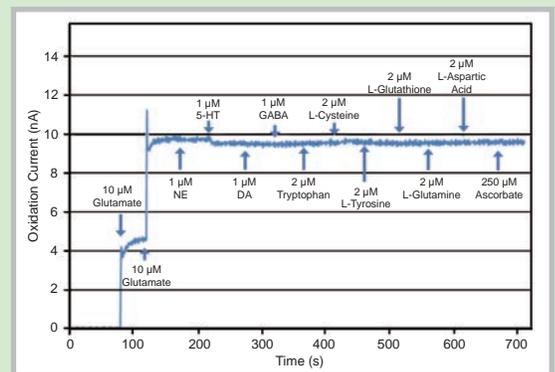
- ◇ **In vivo monitoring** of brain chemical microenvironments
- ◇ **Neurochemical tracking** during behavioral and physiological activity
- ◇ **Drug screening, & neuropharmacology effects**
- ◇ **Biomarker Identification**
- ◇ **Investigating** cognition, behavior, sleep, seizures, stress, & drug effects

## GLUTAMATE BIOSENSOR LINEARITY



**LINEAR  
SELECTIVE  
FAST**

## GLUTAMATE INTERFERENCE RESPONSE



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

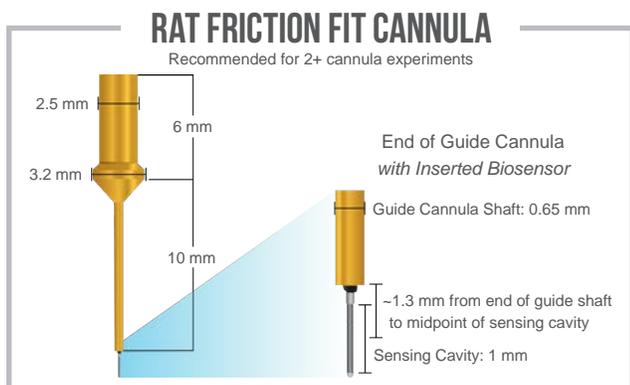
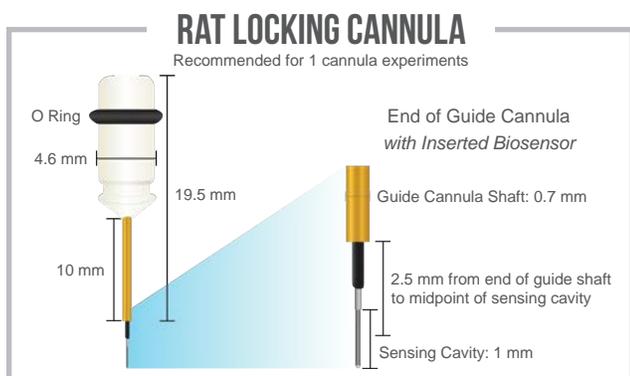
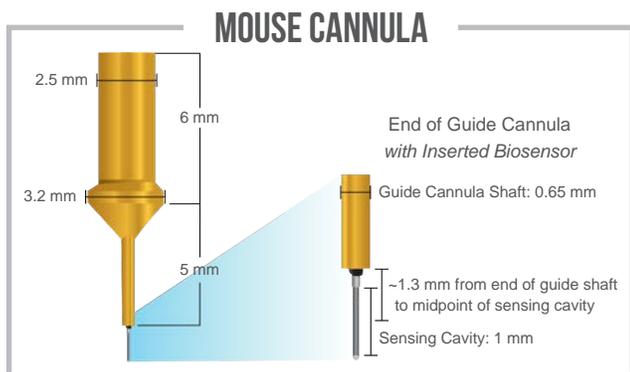
**High Specificity:** Excludes endogenous electroactive interferences present in the brain

**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.**

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



CNS BIOSENSOR TYPES	180 $\mu$ m	80 $\mu$ m
<b>No Cannula Biosensor</b>	7001	7001-80
7001-Glutamate	7001-Ethanol	
7001-Glucose	7001-Lactate	
<b>Mouse Biosensor</b>	7004	7004-80
<b>Wireless Rat Locking Biosensor</b>	7002	7002-80
<b>Wireless Rat Friction Fit Biosensor</b>	7007	7007-80
<b>Tethered Rat Locking Biosensor</b>	7011	7011-80
<b>Tethered Rat Friction Fit Biosensor</b>	7012	7012-80

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

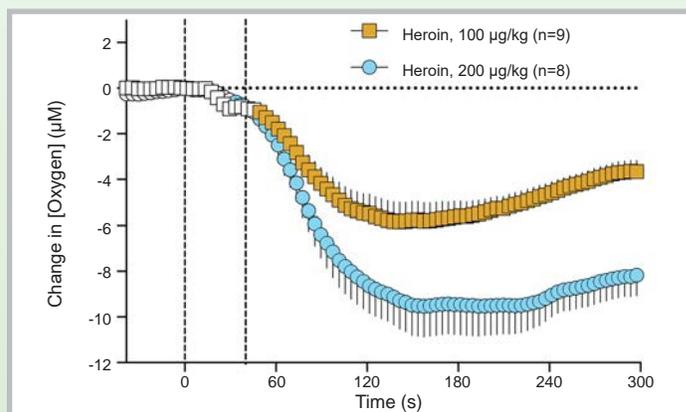
MICRO-BIOSENSOR (25 $\mu$ m)	
In Vitro	7020-L
In Vivo	7020-S

25  $\mu$ m biosensors are available for glucose and lactate only. Order using analyte name in item number. For example, a 25  $\mu$ m *In Vitro* glucose biosensor is ordered as 7020-L-Glucose.

## 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  $\mu$ m disc electrode with an integrated reference and operates under a -0.6 V bias.

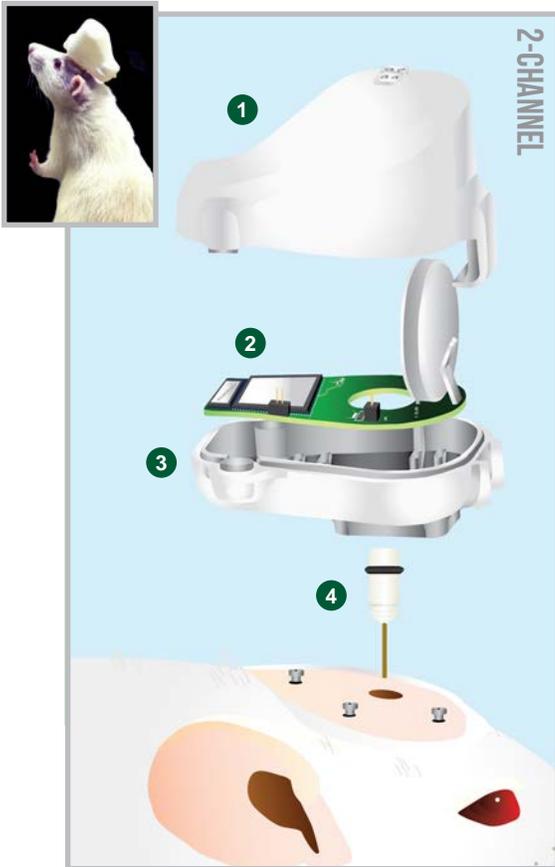
OXYGEN SENSORS	
Mouse Sensor with Integrated Reference	7004-O2
Wireless Rat Locking Sensor with Integrated Reference	7002-O2
Wireless Rat Friction Fit Sensor with Integrated Reference	7007-O2
Tethered Rat Locking Sensor with Integrated Reference	7011-O2



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

## WIRELESS SYSTEMS FOR RATS

**TWO-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-power, wireless, two-channel potentiostat applies a bias and transmits up to two 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 2 channels
- ◇ Untethered freely moving animals
- ◇ Transmission radius: 6 m
- ◇ Supports simultaneous biosensor recordings

### ALSO AVAILABLE AS A BACKPACK

#### WIRELESS HARDWARE KITS

WIRELESS HARDWARE KITS	
<b>2-Channel Wireless Biosensor System</b>	<b>8100-K5</b>
Bluetooth® wireless potentiostat	8172
Bluetooth® dongle	9054
<b>2-Channel +/- Wireless Sensor System</b>	<b>8100-K13</b>
Bluetooth® +/- wireless potentiostat	8172-O2
Bluetooth® dongle	9054

#### WIRELESS ACCESSORY KITS

WIRELESS ACCESSORY KITS			
<b>2-Channel Wireless Biosensor Accessory Kit</b>			<b>8100-K7</b>
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

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

**DISPOSABLE  
ITEMS**

#### RATS

<b>7030</b>	Rat locking cannula
<b>7034</b>	Rat friction fit cannula
<b>7040-S</b>	Single-barrel cannula
<b>7041-S</b>	Tri-barrel cannula

<b>8108-BLE</b>	Rat Hat bottom for 2-channel
<b>8111-16</b>	1/8" Screws (pkg. of 16)
<b>8112</b>	Drill bit
<b>9033-CR2032</b>	Battery for 2-channel (pkg. of 5)

# 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
- ◇ Head-mounted amplification
- ◇ Weight: 1.5 g
- ◇ Supports up to 2 simultaneous biosensor recordings

## HARDWARE KITS

HARDWARE KITS	
<b>Tethered Mouse Biosensor System</b>	<b>8400-K1</b>
Data conditioning and acquisition system	8401-HR
Commutator/swivel	8408
Monopod mounting plate	9009-PL
<b>Tethered Rat Biosensor System</b>	<b>8400-K2</b>
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

PREAMPLIFIER KITS			
<b>Mouse Preamplifier Kit for Two Biosensors</b>			<b>8400-K3-2BIO</b>
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
<b>Rat Preamplifier Kit for Two Biosensors</b>			<b>8400-K4-2BIO</b>
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

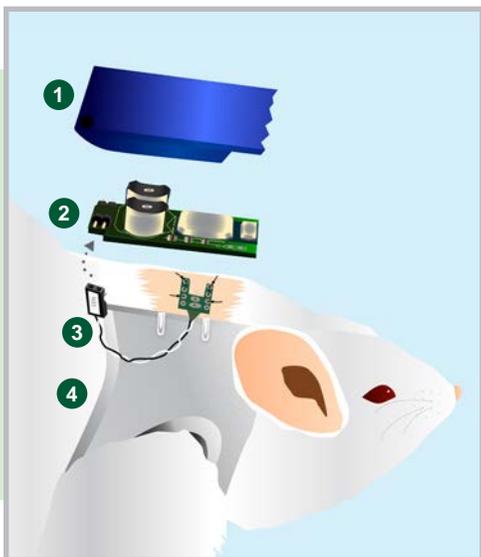
See pages 15–18 for details.

## 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-power, 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

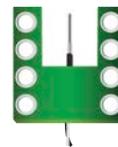
### ACCESSORY KIT

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

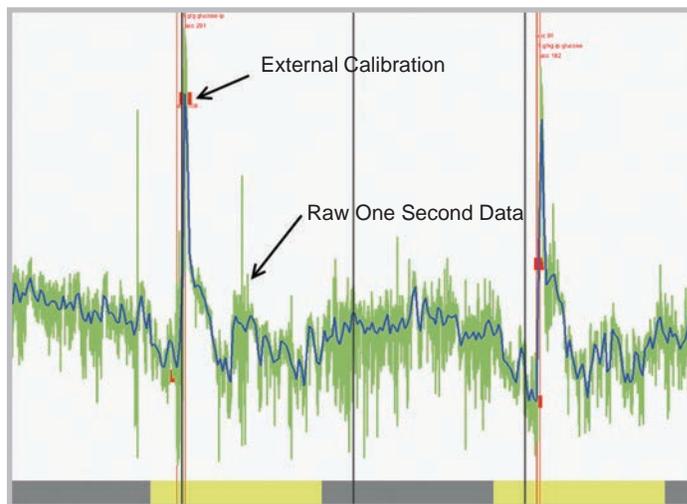
- ◇ **Sensor Range:** 10–500 mg/dL
- ◇ **Sensor Life:** 17+ days

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

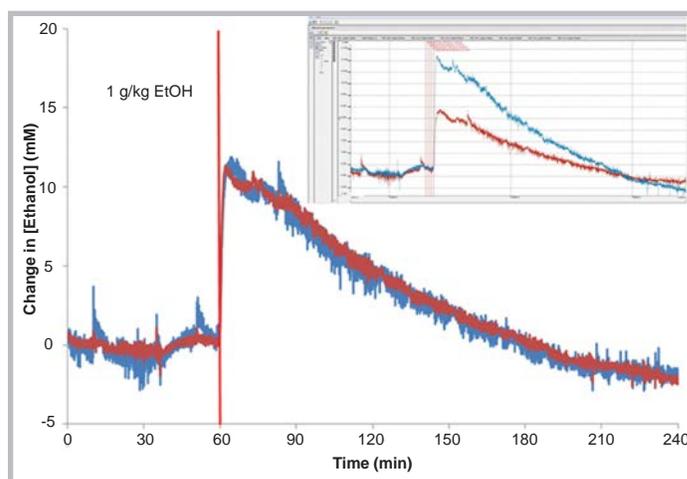
- ◇ Channels: 4
- ◇ Current range: 0–20  $\mu$ A
- ◇ Resolution: 3 fA
- ◇ Maximum sampling rate: 4 Hz
- ◇ Bias range: -2.048–+2.048 V
- ◇ 2 terminal, fixed potential
- ◇ 4 TTL inputs
- ◇ 4 TTL outputs
- ◇ 4 analog outputs

### 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 <i>In Vitro</i> Calibration Kit	7000-K1-T
Tethered Rat <i>In Vitro</i> Calibration Kit (Use with BAS Cannulas)	7000-K2-T-BAS
Wireless Rat <i>In Vitro</i> Calibration Kit (Use with BAS Cannulas)	7000-K2-W-BAS
Wireless Rat Calibration Kit for Pinnacle Biosensors	7000-K2-W-P
FSCV Calibration Kit	8500-K5

### 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 AND FOUR-CHANNEL WIRELESS EEG/EMG SYSTEMS** designed for long-term studies in mice and rats. The lightweight, head-mounted Bluetooth® wireless amplifier streams real-time data to a computer via a USB dongle receiver and Sirenia® software suite. When used with Pinnacle's prefabricated headmounts, electrode placement is straightforward and reproducible, ensuring consistent and reliable results. Unlike traditional telemetry solutions, Pinnacle's wireless systems use off-the-shelf batteries, making electrophysiology studies more cost-effective and user-friendly.

### WIRELESS HARDWARE KITS

<b>2 EEG/1 EMG Wireless Sleep or Seizure System</b>	<b>8200-K9-SL/SE</b>
Bluetooth® wireless EEG/EMG system	8274-HR-SL/SE
Bluetooth® dongle	8274-D
<b>3 EEG Wireless Seizure System</b>	<b>8200-K9-SE3</b>
<b>4 EEG Wireless Seizure System</b>	<b>8400-K40-SE4REF</b>
Components of these kits are the same as above except 8474-HR-SL is replaced with 8274-HR-SE3 or 8474-HR-SE4REF. Kits include software and manuals.	

### WIRELESS ACCESSORY KITS FOR MICE

<b>Wireless Mouse System for Sleep or Seizure Accessory Kit</b>	<b>8200-K10-SL/SE</b>
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-HCAZ-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, 8274-HR, 8474-HR	8276
<b>Wireless Mouse System for Seizure Accessory Kit</b>	<b>8200-K10-SE3</b>
Components of this kit are the same as above except 8201-SS is replaced with 8201-X. In addition, it contains 24 0.10" screws with wire leads (8403) instead of products 8209, 8212 and 8226.	

### TECHNICAL SPECIFICATIONS

<b>Size and Weight</b>	Mice	17.1 x 16.2 x 11.0 mm; 3.9 g	
	Rats	32.1 x 21.2 x 18.3 mm; 6.8 g	
<b>Resolution</b>	14 bits		
<b>Input Range</b>	+/- 465 µV		
<b>Battery Life* (in days)</b>	<b>Sample Rate</b>	<b>3-Channel</b>	<b>4-Channel</b>
	256Hz	7	N/A
	512Hz	6	5
	1024Hz	3	3
	2000Hz	2	1

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

### WIRELESS ACCESSORY KITS FOR RATS

<b>Wireless Rat System for Sleep Accessory Kit</b>	<b>8200-K11-SL</b>
Rat Hat top for 8274-HR	8107-NRH
Rat Hat bottom for 8274-HR (4)	8108-NRH
Rat Headmount for the 8274-HR (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-HCAZ-PR48
Supplemental Battery for 8274, 8274-HR, 8474-HR	8276
<b>Wireless Rat System for Seizure Accessory Kit</b>	<b>8200-K11-SE3</b>
Components of this kit are the same as above except the 8239-W is replaced with the 8239-WSE3-VH.	



## 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 (gain)		✓
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
- ◇ Synchronized video
- ◇ Advanced analysis tools
- ◇ Turn-key systems
- ◇ Simple surgeries
- ◇ Free acquisition software

### COMMON USES



SLEEP STUDIES



SEIZURE RESEARCH



DEPTH ELECTRODES



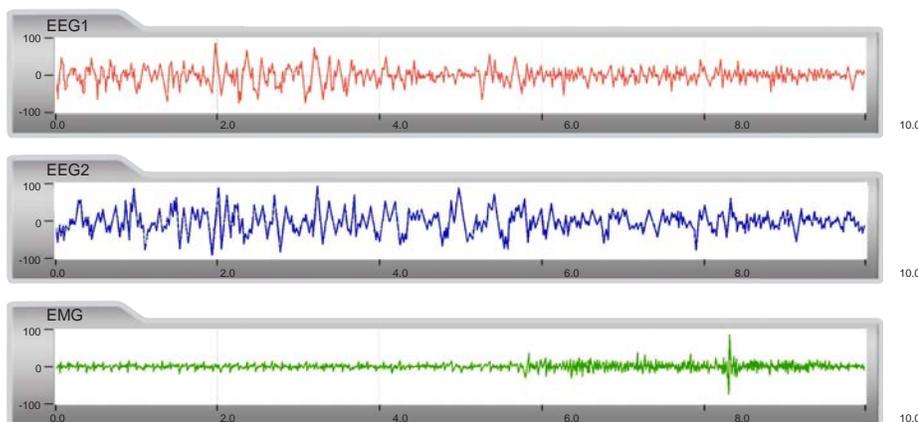
CORTICAL RECORDINGS



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 16 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



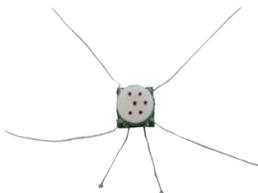
A low-torque commutator mounts above the cage for free, unencumbered movement. A 1.5-inch cable extends from the commutator.

#### PREAMPLIFIER



Preamplifiers amplify and filter signals at the head, ensuring clean, artifact-free data. An 17.5-inch cable, protected by a metal spring coil, connects the preamplifier to the commutator. A P1 Technologies screw connector secures the preamplifier to the animal's head.

#### HEADMOUNT



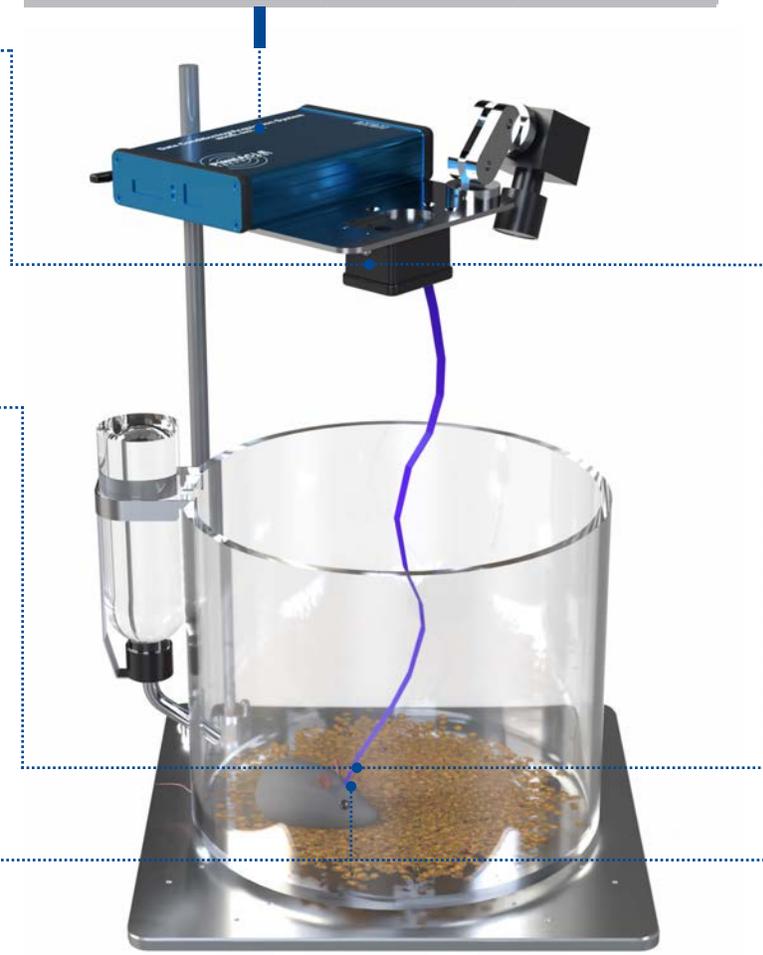
Prefabricated rat headmounts use fittings mounted on a 9 X 9 millimeter board with EEG or EMG electrode wires attached. See page 13 for details.

#### 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	4x TTL Configurable as Digital In/Out or 12-bit Analog



3-Channel Systems: page 11

4-Channel Systems: page 12

## 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.

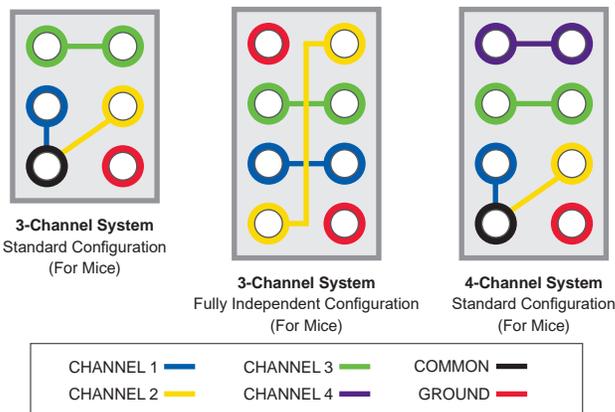
MOUSE CONFIGURATIONS		GAIN	HIGH-PASS FILTERS
EEG Channel(s)	Seizure	X10 or X100	1.0 Hz
	Sleep	X100	0.5 Hz
EMG Channel	Seizure	X10 or X100	10 Hz
	Sleep	X100	10 Hz

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@pinnacle.com](mailto:sales@pinnacle.com) or (785) 832-8866

HEAD-MOUNTED AMPLIFICATION =  
CLEANER DATA



## TETHERED SYSTEMS FOR MICE

### COMMUTATOR

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



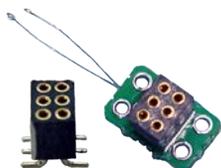
### PREAMPLIFIER

Preamplifiers amplify and filter signals at the head for clean, artifact-free data. The commutator connects to the preamplifier's seven-inch cable, made of six insulated, lightweight wires. The mouse preamplifier attaches to the 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.



## TETHERED THREE-CHANNEL SYSTEMS

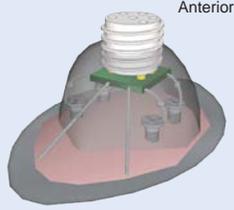
Pinnacle's **THREE-CHANNEL SYSTEM** allows researchers to simultaneously record three channels of EEG and/or EMG data. The data conditioning and acquisition system (DCAS) and preamplifier are preconfigured and ordered as a matching pair. Standard configurations include 2 EEG/1 EMG and 3 EEG. Fully independent 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
<b>Contents:</b> 8206-HR: Data conditioning and acquisition system 8213: Rat preamplifier 8214: Rat commutator/swivel 8409-CLP: Attachment clip for commutator 9009-PL-125: Monopod 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.			

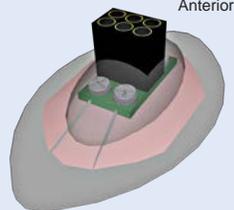
### SIMPLE SURGERIES



Anterior

Posterior

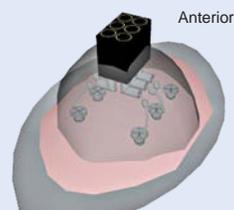
**2 EEG/1 EMG for Rats**



Anterior

Posterior

**2 EEG/1 EMG for Mice**



Anterior

Posterior

**3 EEG for Mice**

### 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
<b>Contents:</b> 8202: Mouse preamplifier 8204-723: Mouse commutator/swivel 8206-HR: Data conditioning and acquisition system 9009-PL: Monopod 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*.	

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.			

\* Fully Independent

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



#### 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

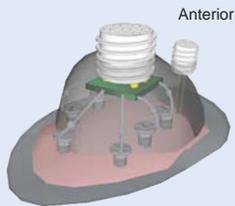
### ADD SYNCHRONIZED VIDEO

See page 21 for details.

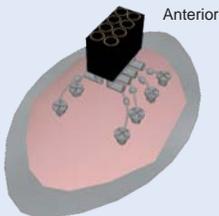
# TETHERED FOUR-CHANNEL SYSTEMS

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	
<b>Rat EEG/EMG System</b>	<b>8400-K2</b>
Data conditioning and acquisition system	8401-HR
Rat commutator/swivel	8409-924
Monopod Mounting plate	9009-PL-125
Kit includes cables for one animal, software and manuals.	

## SYSTEMS FOR MICE

HARDWARE KIT	
<b>Mouse EEG/EMG System</b>	<b>8400-K1</b>
Data conditioning and acquisition system	8401-HR
Mouse commutator/swivel	8408
Monopod Mounting plate	9009-PL
Kit includes cables for one animal, software and manuals.	

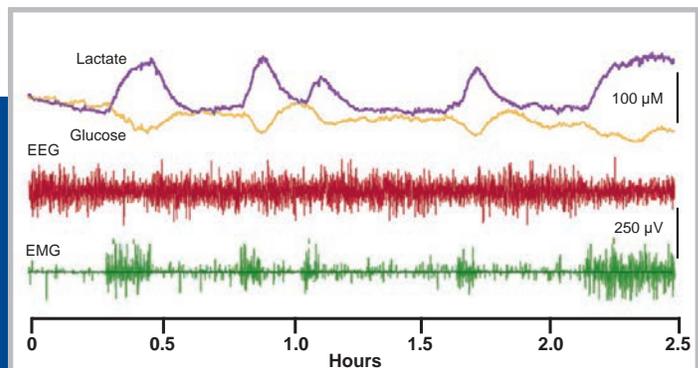
## HAVE YOUR OWN AMPLIFIER?

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

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.	

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.	

## 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 16 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.

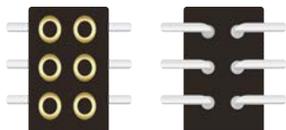
### PREFABRICATED HEADMOUNTS

**PREFABRICATED HEADMOUNTS** for mice and rats reduce surgery time and ensure reproducible electrode placement. Headmounts feature a 6 to 8 pin connector soldered to a board with EEG holes. Pre-soldered wires, depth electrodes, and EMG leads are also available.



### STANDARD HEADMOUNTS

**STANDARD HEADMOUNTS** for mice enable flexible electrode placement for cortical depth recordings. Compatible with Pinnacle's screw leads for easy soldering. Pre-soldered EEG or EMG leads available.



### CUSTOM HEADMOUNT AND STERILIZATION SERVICES AVAILABLE

## DEPTH ELECTRODES

**DEPTH ELECTRODES** can be purchased individually, pre-soldered to headmounts, or soldered to cannulas for deep brain recordings. Ideal for optical stimulation or biosensor recordings.

DEPTH ELECTRODES	MICE	RATS
Depth Electrode + Prefabricated Headmount	8201-DEP	N/A
Depth Elec. + Prefab. Headmount Stainless	8201-DEP-SS	N/A
Depth Electrode	8425	
Depth Electrode + 8235-SM Headmount	8443-M	8443-R
Single-ended Pt/Ir Depth Electrode (3mm)	8425-PR-3	
Single-ended Pt/Ir Depth Electrode (5mm)	8425-PR-5	
Single-ended Pt/Ir Depth Electrode (8mm)	8425-PR-8	

### 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	8-Pin
Surface Mounts		
Headmount w/EMG Leads	8231-SM	8431-SM
Headmount (Straight Pins)	8235	8415
Headmount (Bent Pins)	8235-SM	8415-SM

## SCREWS

**SCREWS** help anchor the headmount to the skull and function as recording electrodes.

	W/O Wire Lead (pkgs of 8-12)	With Wire Lead (sold individually)
0.08" Mouse Screws	8210	8405
0.10" Mouse Screws	8209	8403
0.12" Mouse Screws	8212	N/A
0.125" Rat Screws	8111	8247

# 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. Operating at 3dB or less, its low-noise performance minimizes external stressors. The system is sold either as a standalone unit or with Pinnacle's Sirenia® Feedback Prosoftware 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		✓



Sleep deprivation system with EEG, video and stand

**ADVANTAGES**

- Simulates** gentle handling
- Prevents** sleep acclimation and habituation
- Minimizes** resources compared to manual deprivation
- Reduces** unnecessary exercise
- Low noise** operation at 3dB or less

**COMMON USES**



**SIMULATED SHIFT WORK**



**AUTOMATED DEPRIVATION**



**SLEEP FRAGMENTATION**

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

## 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.

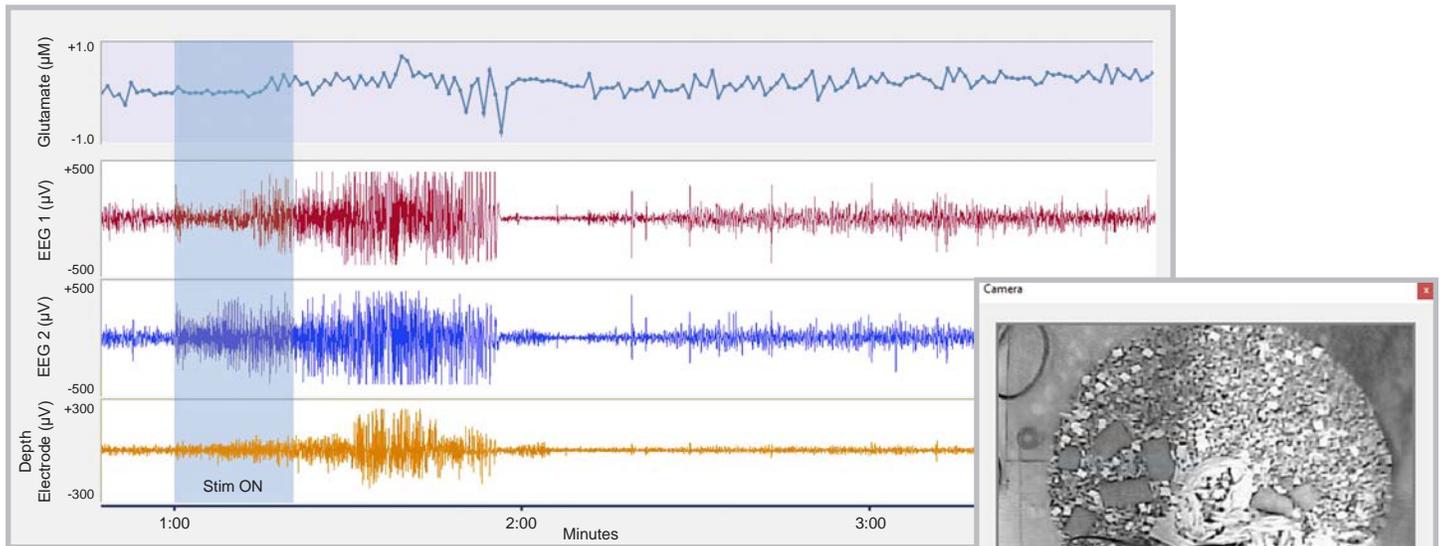
## OPTOGENETICS SYSTEMS OVERVIEW

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.

### KEY FEATURES

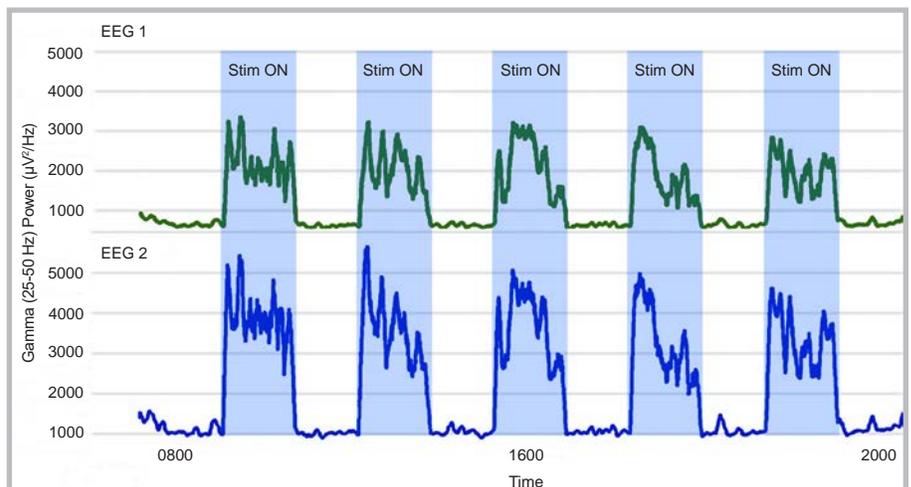
- ◇ Precision timing
- ◇ TTL functionality
- ◇ Optogenetic stimulation with EEG/biosensor recordings
- ◇ Power > 50 mW/mm<sup>2</sup> with most LED probes (depending on wavelength)

## 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<sup>2</sup>.

## 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.

## STIMULUS CONTROLLER KIT

Pinnacle's Stimulus Controller module offers precise control of electrical or optical stimulation frequency, duration and intensity for both continuous and discrete events. The device integrates directly with our 4-channel multi-modal EEG systems. It can also be used as a stand-alone device. The optogenetic expansion kit is 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

- ◆ **Versatile Stimulation** - Electrical or Optical Simulation
- ◆ **Precision Timing** - High accurate clock for precise stimulus control and schedules
- ◆ **Hardware Synchronization** - ensures per-sample accuracy of stimulus events with data acquisition system
- ◆ **Broad Compatibility** - Works with most electrical stimulus isolators
- ◆ **Flexible Triggering** - Supports external stimulus control via TTL inputs

## ADD OPTOGENETICS TO FSCV

Seamlessly integrate optical or electrical stimulation with simultaneous fast-scan cyclic voltammetry. See pages 19-20 for information about FSCV.

## LED FIBER PROBES

Pinnacle's optogenetic stimulation uses LEDs coupled to 200/250  $\mu\text{m}$  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 ( $\text{mW}/\text{mm}^2$ )	
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 low-torque commutator mounts above the cage for free, unencumbered movement. A 1.5-inch cable extends from the commutator.

### HEADSTAGE

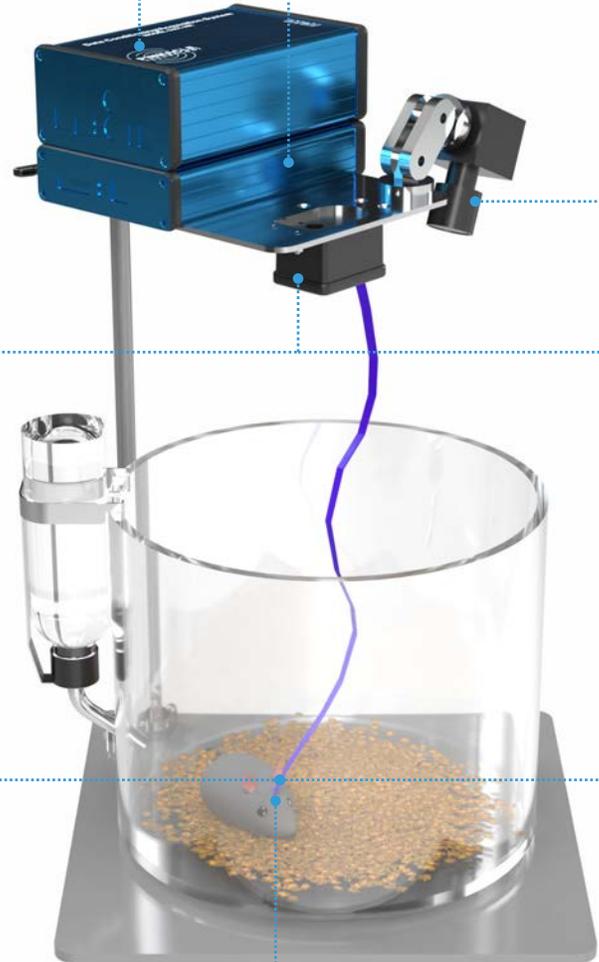


Preamplifiers amplify and filter signals at the head, ensuring clean, artifact-free data. An 17.5-inch cable, protected by a metal spring coil, connects the preamplifier to the commutator. A P1 Technologies screw connector secures the preamplifier to the animal's head.

### HEADMOUNT



Prefabricated rat headmounts use fittings mounted on a 9X9 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 ( $< 2 \times 10^{-4}$  N-m), mounted above the cage, allows for unencumbered freedom of movement. A seven-inch cable extends from the commutator. The 8200 3-channel rat system comes with the P1 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
<b>Optogenetics Biopotential System</b>	<b>8400-K11</b>	<b>8400-K12</b>
Data conditioning and acquisition system	8401-HR	8401-HR
Stimulus Controller module	8480-SC	8480-SC
Commutator	8481-M	8409-924
<b>Optogenetics Only System</b>	<b>8400-K15</b>	<b>8400-K16</b>
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.		

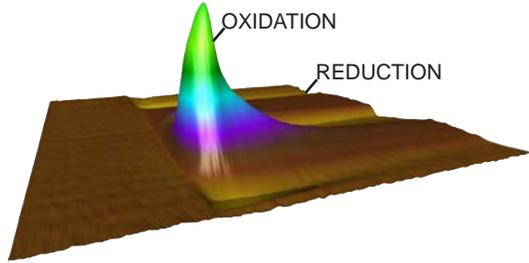
HEADSTAGE KITS	MICE	RATS
<b>1 Stim/1 Biosensor</b>	<b>8400-K13-O1/1BIO</b>	<b>8400-K14-O1/1BIO</b>
<b>1 Stim/2 EEG/1 EMG for Sleep</b>	<b>8400-K13-O1/SL</b>	<b>8400-K14-O1/SL</b>
<b>2 Stim/2 EEG/1 EMG for Sleep</b>	<b>8400-K13-O2/SL</b>	<b>8400-K14-O2/SL</b>
<b>1 Stim/2 EEG/1 EMG/1 Bio for Sleep</b>	<b>8400-K13-O1/SL/BIO</b>	<b>8400-K14-O1/SL/BIO</b>
<b>1 Stim/3 EEG for Seizure</b>	<b>8400-K13-O1/SE3</b>	<b>8400-K14-O1/SE3</b>
<b>2 Stim/3 EEG for Seizure</b>	<b>8400-K13-O2/SE3</b>	<b>8400-K14-O2/SE3</b>
<b>1 Stim/3 EEG/1 Bio for Seizure</b>	<b>8400-K13-O1/SE3/BIO</b>	<b>8400-K14-O1/SE3/BIO</b>
<b>1 Stim/4 EEG for Seizure</b>	<b>8400-K13-O1/SE4</b>	<b>8400-K14-O1/SE4</b>
<b>1 or 2 Stim Only</b>	<b>8400-K17-Opto</b>	<b>8400-K18-Opto</b>
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
<b>Optogenetics</b>	<b>8400-K28</b>	<b>8400-K29</b>
<b>Optogenetics Friction Fit</b>		<b>8400-K30</b>
Includes optogenetics-specific surgical and testing equipment.		

**ADD OPTOGENETIC AND ELECTRICAL STIMULATION TO YOUR EXISTING SETUP WITH OUR EXPANSION KITS ON PAGE 16**

# 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

<b>Voltage span:</b> -0.6 – +1.5 V
<b>Max sweeps/second:</b> 60
<b>Max scan rate:</b> 1000 V/s
<b>Max points/sweep:</b> 1000
<b>Standard sweeps:</b> 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

<b>Wireless Rat FSCV System</b>	<b>8500-K2</b>
Components of this kit are the same as above except 8501-7 is replaced with 8501.	
<b>Wireless Rat FSCV + Opto System</b>	<b>8500-K12</b>
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

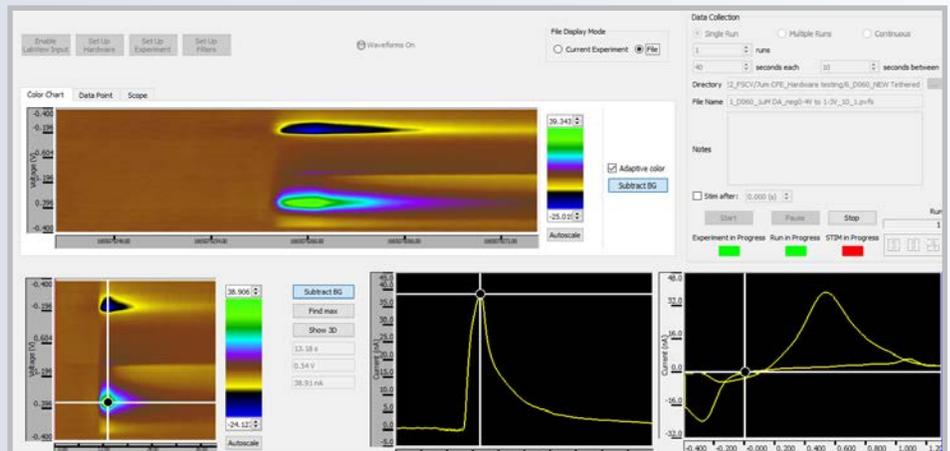
<b>Wireless Rat FSCV Accessory Kit</b>	<b>8500-K4</b>
Components of this kit are the same as above except 8134-1G and 8134-1M are replaced with 8134-100K and 8134-100M.	
<b>Wireless Rat FSCV + Optogenetics Accessory Kit</b>	<b>8500-K13</b>
Components of this kit are the same as above except 8134-1G and 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.



### RATS

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

### MICE

<b>7033</b>	Bio-only headmount
<b>8212</b>	0.12" Screws (pkg. of 8)
<b>8254</b>	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
Tethered FSCV Hardware Kit	8500-K1	8500-K6
All kits include cables for one animal, software and manuals. Carbon fiber electrodes, Ag/AgCl reference electrodes and LED fiber probes are sold separately.		

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

TETHERED ACCESSORY KITS	MICE	RATS
Tethered FSCV Accessory Kit	8500-K3	8500-K7
Optogenetics Tethered FSCV Accessory Kit	8500-K11	8500-K10
Kits include one-time purchase items and surgical disposables to complete initial surgeries.		

STIMULATOR KITS	TETHERED	WIRELESS
Stimulator Accessory Kit for Tethered FSCV	8500-K8	8500-K9

## CARBON FIBER ELECTRODES

**CARBON FIBER ELECTRODES (CFEs)** are used with all FSCV systems and come in two diameters: 7  $\mu\text{m}$  and 34  $\mu\text{m}$ . The 7  $\mu\text{m}$  are used only in tethered systems and the 34  $\mu\text{m}$  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 $\mu\text{m}$ CARBON FIBER ELECTRODES	
7 $\mu\text{m}$ Carbon Fiber Electrode for <i>In Vitro</i> , Brain Slices	7014-L
7 $\mu\text{m}$ Carbon Fiber Electrode for Freely Moving <i>In Vivo</i>	7014-S
7 $\mu\text{m}$ Carbon Fiber Electrode – No Connector	7015
Silver Wire + Pin for 7015	7016-SWP
Silver Wire + Pin + Connector for 7015	7016-SWPC
All 7 $\mu\text{m}$ CFEs are bought by cannula type. See page 2 for details.	

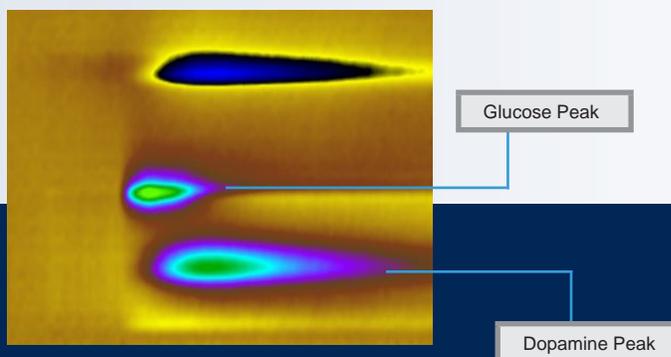
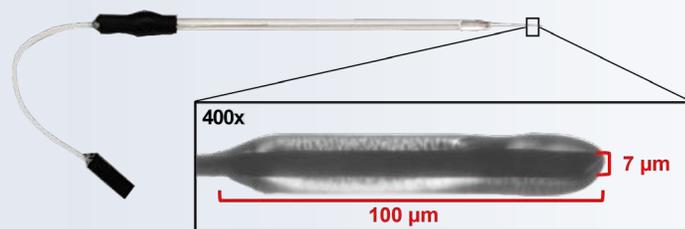
34 $\mu\text{m}$ CARBON FIBER ELECTRODES	
34 $\mu\text{m}$ Carbon Fiber Electrode for Rats (Wireless)	7002-CFE
34 $\mu\text{m}$ Carbon Fiber Electrode for Mice	7004-CFE
All 34 $\mu\text{m}$ CFEs are bought by cannula type. See page 2 for details.	
REFERENCE ELECTRODE	
Ag/AgCl Reference Electrode	7065

## 7 $\mu\text{m}$ 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 $\mu\text{m}$ ENZYME-MODIFIED CFE	
7 $\mu\text{m}$ EM-CFE for <i>In Vitro</i> , Brain Slices	7017-L-Glucose
7 $\mu\text{m}$ EM-CFE (Wireless) for Freely Moving <i>In Vivo</i>	7017-S-Glucose
7 $\mu\text{m}$ EM-CFE – No Connector	7018-Glucose

GLUCOSE EM-CFE SPECIFICATIONS	
Electrode Diameter	7 $\mu\text{m}$
Active Area Length	~ 100 $\mu\text{m}$
Glucose Linear Range	0.05 to 2 mM
Pulled Capillary Electrode (includes connector wire)	
For Use in Brain Slices or <i>In Vivo</i>	



## 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 FEATURES	
Lens	2.8–12 mm variable (external)
Max Resolution	640 x 480 pixels
Max Frame Rate	30 fps
Mount	Above, Side, Tripod
IR Source	Integrated
Color/Grayscale	Both
Interface	USB 2.1

### 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.

### KEY FEATURES

- ◇ Record in color or grayscale
- ◇ Record in low light or complete darkness
- ◇ Flexible file size management
- ◇ Synchronize video with data recordings
- ◇ Unrestricted video playback
- ◇ Record from any angle

## 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.

### SYNCHRONIZED VIDEO SYSTEM

<b>Pinnacle Acquisition Workstation</b>	<b>9000-K1-AW</b>
Includes a preconfigured computer, a high-definition monitor, a keyboard, mouse and cables. Up to four cameras can be added to a single video system. Cameras sold separately.	

### CAMERA PACKAGE

<b>USB Camera with Integrated IR Source</b>	<b>9000-K30</b>
All camera packages include a camera, IR source, mounting accessories, extension cable and one Sirenia® license key.	

### ADDITIONAL PRODUCTS

<b>Enhanced Illuminator</b>	<b>9057-EN</b>
<b>Tripod for USB Cameras</b>	<b>9059</b>

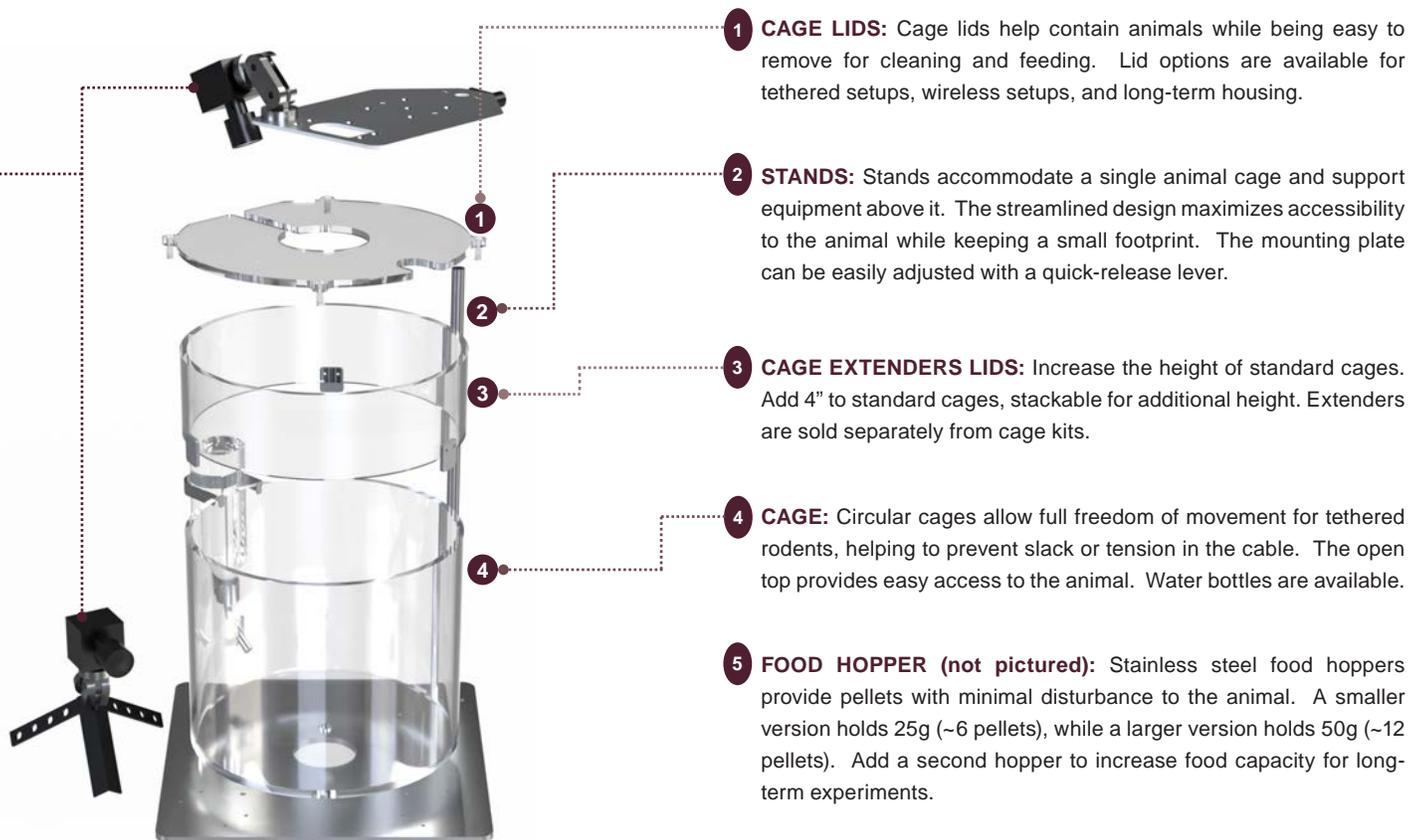
### ENHANCED ILLUMINATOR

Simulate dawn/dusk transitions and control light intensity in every chamber.

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:** Cage lids help contain animals while being easy to remove for cleaning and feeding. Lid options are available for tethered setups, wireless setups, and long-term housing.
- 2 STANDS:** Stands accommodate a single animal cage and support equipment above it. The streamlined design maximizes accessibility to the animal while keeping a small footprint. The mounting plate can be easily adjusted with a quick-release lever.
- 3 CAGE EXTENDERS LIDS:** Increase the height of standard cages. Add 4" to standard cages, stackable for additional height. Extenders are sold separately from cage kits.
- 4 CAGE:** Circular cages allow full freedom of movement for tethered rodents, helping to prevent slack or tension in the cable. The open top provides easy access to the animal. Water bottles are available.
- 5 FOOD HOPPER (not pictured):** Stainless steel food hoppers provide pellets with minimal disturbance to the animal. A smaller version holds 25g (~6 pellets), while a larger version holds 50g (~12 pellets). Add a second hopper to increase food capacity for long-term experiments.

SINGLE ANIMAL CAGE KITS	
10" Mouse Cage Set-up	9000-K20
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
Contents: Includes cage, cage lid, water bottle, food hopper, metal stand, and metal stand accessories. Items sized for cage dimensions.	

MONOPOD STANDS AND PLATES	
Monopod Stand Kit	9000-MOM-K
Monopod metal stand (adjustable to 20" tall [51 cm])	9009-MOM
Rubber Feet for Monopod Stand	9009-RB
Vertical Stop Shaft Collar for 9009-MOM	9009-SC
Hex Key for 9009-MOM	8241-KY
Mouse Mounting Plate for 9009-MOM	9009-PL
Rat Mounting Plate for 9009-MOM	9009-PL-125

CAGES	
Cage for mice (10" diameter, 8" tall)	8228
Cage for rat (12" diameter, 12" tall)	8238
Cage for rat (14" diameter, 12" tall)	8273

CAGE 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

WATER BOTTLES	
Water bottle for mice	8251-224-M
Water bottle for rat	8251-R

## MULTI-SYSTEM CAGE RACK



Our **MULTI-SYSTEM CAGE RACK** is built for high-throughput research, optimizing space and organization. We offer 4-system and 8-system racks that maximize the number of Pinnacle systems housed within an organized footprint, ensuring efficient use of valuable lab space. See page 22 for single-house cage items.

### KEY FEATURES

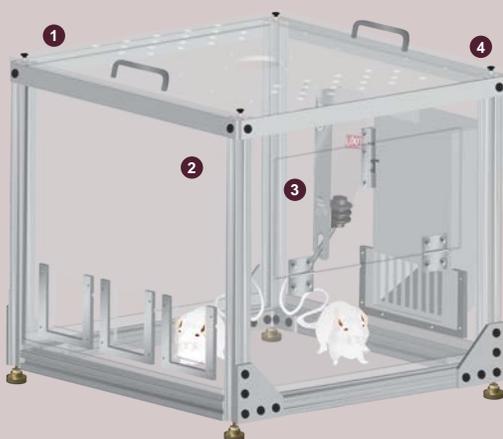
- ◇ Space-efficient racks
- ◇ Streamlined cable management
- ◇ Standardized footprint
- ◇ Optional cage accessories

ITEM NUMBERS	DESCRIPTION	RACK DIMENSIONS (inches)
9000-K40-4SY	Four-System Modular Assembly (Up to 4 systems)	69 x 18 x 30W
9000-K40-8SY	Four-System Modular Assembly (Up to 8 systems)	69 x 18 x 60W

## 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** - No additional features.
- 2 **Operant Panel** - Mount up to three fixtures compatible with third-party products.
- 3 **Door Panel** - Allows easy access to the animals without removing the lid.
- 4 **Food & Water Panel** - Includes a food hopper and water bottle holder.

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 follow a modular design strategy, allowing new measurement tools to be easily added to expand experimental capabilities within a single recording setup. Our devices can also integrate with third-party hardware to enhance existing systems. Key products include electrical and optical stimulation, illuminators, low-torque commutators, isolated potentiostats, and devices for third-party hardware integration.

### ENHANCED ILLUMINATOR

*IR and visible light source with dawn/dusk transitions*



The Pinnacle 9057-EN Illuminator provides infrared (IR) and visible lighting, meeting the strict illumination limits set by the *Guide for the Care and Use of Laboratory Animals* (8th Edition). It can be USB-controlled or

automatically synchronized with standard lighting schedules, supporting true dawn/dusk transitions and scheduled variations. A photosensor allows automatic activation with room lighting, while a lux meter enables quantifiable illumination measurements for consistent lighting across experiments.

#### KEY FEATURES

- ◇ Programmable lighting control
- ◇ Simulated Dawn/Dusk Transitions
- ◇ Provides consistent lighting for each animal setup

### IR SOURCE

*Record nighttime video in animal enclosures*

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



IR SOURCE	
IR Source	9057

ENHANCED ILLUMINATOR	
Enhanced Illuminator Kit*	9000-K15
Enhanced Illuminator	9057-EN
Lux, temperature and humidity cable	9057-LUX
Photoresistor cable	9057-PHO
*Cables, software and manuals are included in kit.	

### 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.

TTL PLUS	
TTL Plus	9085-N-K

### COMMUTATORS

*Low-torque electrical swivels for mice and rats*

Pinnacle's low-torque mouse and rat 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 built with a locking connector for secure tether connection.



COMMUTATORS	
6-Pin mouse commutator	8204-723
9-Pin mouse commutator	8408
10-Pin mouse commutator	8481-M
10-Pin rat commutator	8409-924

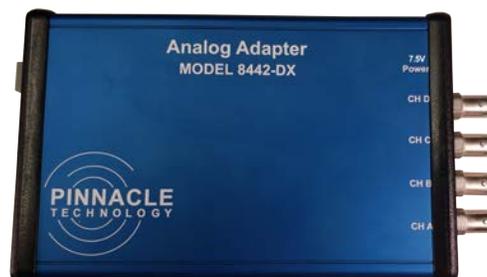
## ANALOG ADAPTERS

*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. The latest model combines power and battery supply options in a single device for added flexibility and includes factory-settable gain options for enhanced signal amplification. For researchers preferring battery power for lower-noise recordings, the recent model's expanded storage capacity extends battery life from two weeks to 4–6 weeks of continuous use.

### KEY FEATURES

- ◇ **Dual-power option** - Integrates both power supply and battery options in a single device
- ◇ **Third-party amplifier integration** - Connects Pinnacle's commutators and head-mounted preamplifiers to an existing amplifier
- ◇ **Uninterrupted operation** - Ensures per-sample accuracy of stimulus events with data acquisition system
- ◇ **Custom gain options** - Built with a unity gain amplifier or factory-configured gain upon request



### TECHNICAL SPECIFICATIONS

Model	8242-DX (3-Channel)	8442-DX (4-Channel)
Data type	EEG/EMG only	EEG/EMG/Biosensors
Battery Capacity	2 Lithium batteries	2–6 Lithium batteries
Battery Lifetime	2 weeks	4–6 weeks
Power Options	Battery or power supply	
Gain	Unity gain (factory-settable options available)	
Battery life can vary based on bluetooth environment in the recording area.		

### ANALOG ADAPTERS

3-channel analog adapter (dual power option) with cables and batteries			8200-DX-K
8242-DX	3-channel analog adapter (dual power option)	9016 (3)	BNC Cable
8417-PS	Power Supply	9033-14500 (2)	Replacement Battery
8417-AD	Adaptors for 8417-PS	8241-M	Flathead Screwdriver
4-channel analog adapter (dual power option) with cables and batteries			8400-DX-K
8442-DX	4-channel analog adapter (dual power option)	9016 (4)	BNC Cable
8417-PS	Power Supply	9033-14500 (6)	Replacement Battery
8417-AD	Adaptors for 8417-PS	8241-M	Flathead Screwdriver
*Cables, software and manuals are included in kit.			

CALL OR VISIT OUR WEBSITE FOR ADDITIONAL PRODUCTS TO SUPPORT YOUR RESEARCH

• (785) 832-8886 • [WWW.PINNACLET.COM](http://WWW.PINNACLET.COM) •

# SIRENIA® SUITE OVERVIEW

Pinnacle's **SIRENIA® SOFTWARE** offers robust tools tailored for preclinical research. This modular platform consists of a free acquisition package, included with our hardware, and premium modules that can be added at any time. For teams who prefer personalized acquisition and analysis workflows, a Python API is also available.

**FREE**

## SIRENIA® ACQUISITION

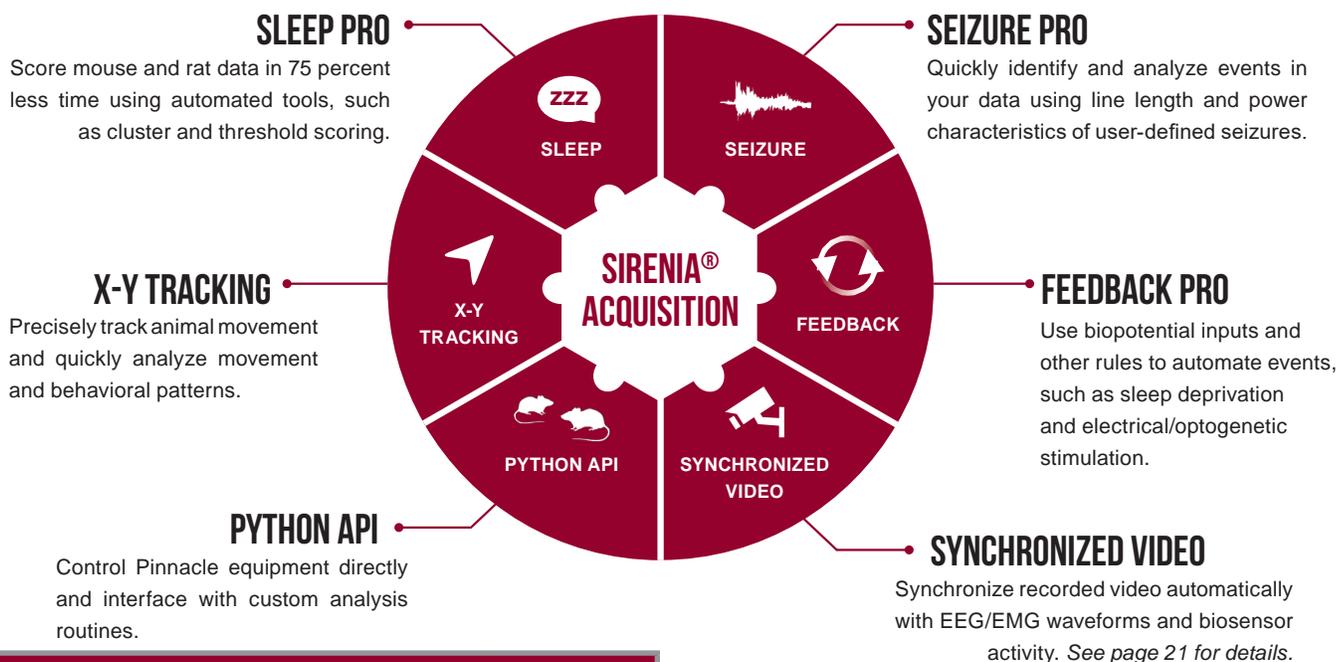
**SIRENIA® ACQUISITION** provides a single platform for recording data from any Pinnacle hardware system, except FSCV. The software features data stream synchronization, data consolidation, user-configurable settings and multiple export options. In addition, the download includes basic analysis modules 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.*



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

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

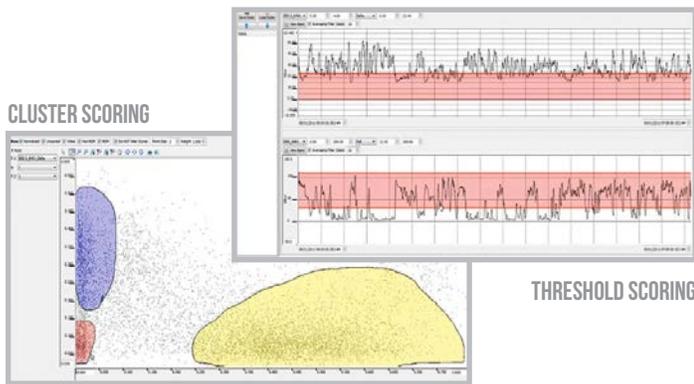
**30-DAY TRIAL**

# 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.

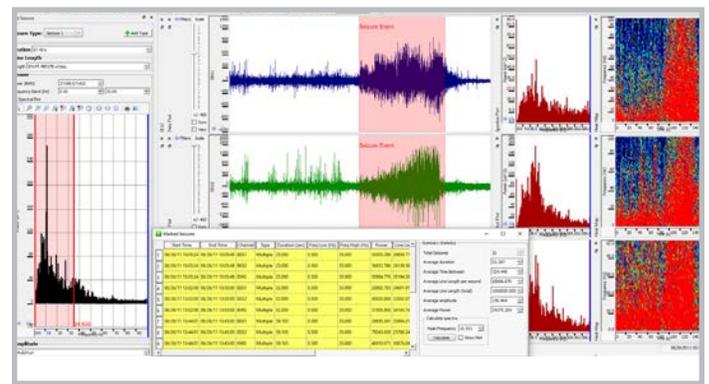


### KEY FEATURES

- ◇ 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.

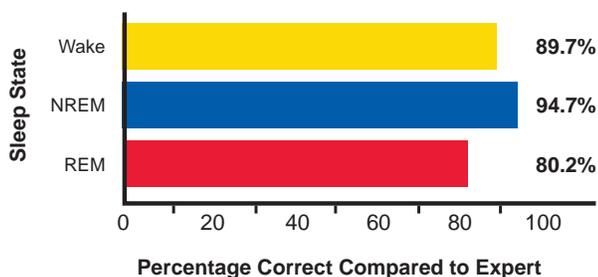


### KEY FEATURES

- ◇ 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

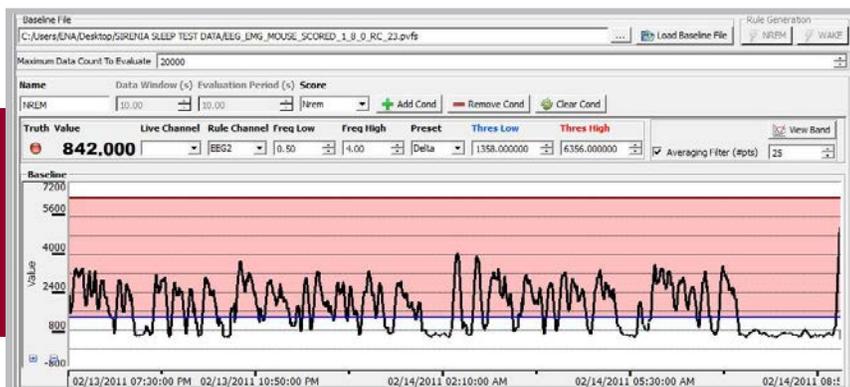
Seizure detection was performed using RMS power and line length separately on five individual mouse data files. All files were compared to an expert hand-scorer's files. Agreement of the two detection methods as compared to the expert is shown below.

	# 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

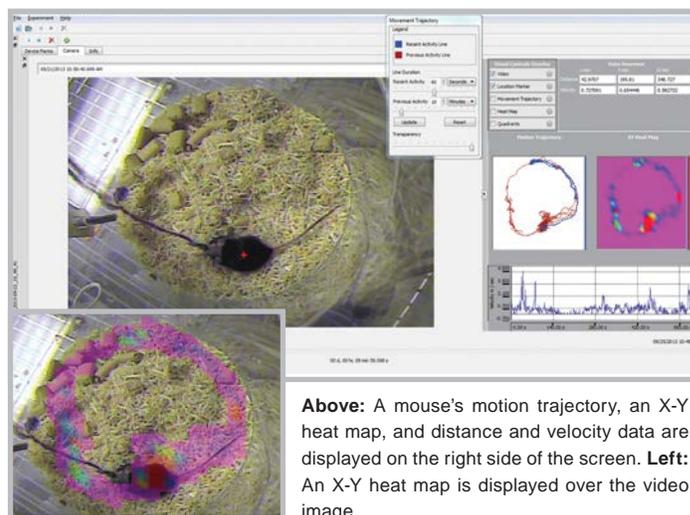
- ◇ Compatible with Pinnacle's optogenetics and electrical stimulation system
- ◇ Coordinate and schedule TTL signals
- ◇ Control stimuli based on physiological responses

## 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



## PYTHON

The new Python-based API is a free, open-source application programming interface (API) for Pinnacle Technology devices. This API provides users direct control over Pinnacle hardware and real-time data collection. Customize code to manage your experimental setup and parameter settings.

Supported devices:

- 8206-HR
- 8401-HR
- 8480-SC
- 8229

### KEY FEATURES

- ◇ Control experiment and device settings for multiple Pinnacle devices
- ◇ Compatible with Windows, IOS, and Linux
- ◇ Real-time data streaming
- ◇ Easy-to-use API guides

```

27 port = PodB206HR.ChoosePort()
28
29 # create object to control the B206-HR device
30 pod = PodB206HR(port, 10)
31
32 # set the sample rate of the device
33 samplerate = 100
34 w : PacketStandard = pod.WriteRead('SET SAMPLE RATE', samplerate)
35
36 # set file name. Must input a text or EDF file extension
37 file = str = Input('File name (.txt/.csv/.edf): ')
38
39 # create objects to collect and save streaming data
40 bkt : Bucket = Bucket(pod)
41 drn : DrainBucket = DrainBucket(bkt, file)
42
43 # get number of seconds to collect data for
44 nSec : float = float(input('Number of seconds to stream data: '))
45 if(nSec < 1.2) : nSec = 1.2
46
47 # start collecting data and saving to file
48 bucketThread : Thread = bkt.StartCollecting(nSec)
49 drainThread : Thread = drn.DrainBucketToFile()
50 print('Starting data collection...')
51
52 # wait for threads to finish
53 bucketThread.join()
54 print('Streaming Finished')
55 drainThread.join()

```

# Pinnacle Technology supports researchers worldwide through our growing network of global distributors.



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### PUBLICATIONS

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### POSTERS

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### 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](http://www.pinnaclet.com/conferences.html) for a complete list of events.



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