The background of the entire image is a complex, interconnected network of neurons, rendered in a light blue color against a dark blue background. The neurons consist of cell bodies (soma) and numerous branching processes (dendrites and axons). A prominent, thick, blue fiber optic cable or optical fiber runs diagonally across the center of the image, from the upper left towards the lower right. The cable has a smooth, reflective surface and appears to be integrated into the neural network.

Deuteron Technologies Ltd.
Electronics for Neuroscience

Wireless Neural Loggers

On-animal neural recording

Deuteron Technologies provides a family of animal-borne neural data loggers for recording 8, 16, 32, 64 or 128 channels of neural data. All of Deuteron's loggers amplify and digitize the neural signals and store the data in memory media on the animal. They are especially suitable for extra-cellular recordings, with a typical bandwidth of 7kHz and a conversion rate of 32000 samples per second on each channel.

Guaranteed data integrity

Storing data on animal-borne memory cards ensures that the stored data is never interrupted and is free of artifacts.

Full control via radio link

All of the settings of a logger are controlled from a computer by radio link. This is done using one of Deuteron's synchronizing transceivers. A single transceiver can control multiple loggers.

Ultra-low power

Deuteron's animal-borne instruments have the lowest power consumption of any wireless device capable of recording neural spikes. This allows very small batteries to be used for comparatively long recording sessions.

Real time monitoring over a radio link

Selected neural signals can be previewed on a computer screen using the radio link.

Synchronization

Many synchronization options are provided to ensure that the time scale of the recorded data is perfectly correlated with events on other laboratory equipment. The radio transceiver includes a synchronization processor and has several BNC connectors for connection to fixed laboratory equipment.

Single-board and modular loggers

Deuteron offers both single-board loggers and modular designs. Modular loggers, having separate boards for digital processing and analog amplification, make customization for a given experiment much easier. Single board loggers have the advantage of being slightly smaller and lighter

Very large Arenas

Deuteron's radio link can operate over hundreds of meters allowing experiments with rodents, birds, bats, fish and primates in unusually large arenas.

Control multiple loggers

The synchronizing transceiver can control up to 12 loggers simultaneously. The internal clocks of all the loggers are automatically maintained in synchrony to ensure that there is no relative clock drift between them.

Single-board Loggers



16-channel loggers

MouseLog16C

is Deuteron's latest and lightest logger. In addition to neural logging, it can record ultrasonic audio up to 80kHz, and has a 9-axis motion sensor.

Several other variants of 16-channel neural loggers are available, including the MouseLog 16B horizontal logger and the MouseLog 16V vertical logger. A demountable, waterproof variant is also available for aquatic animals



MouseLogB (Horizontal)



- ▶ 3.5g total mass including battery
- ▶ 16 channels
- ▶ 31.25kHz sampling rate
- ▶ 2 hours recording time

MouseLog16V (Vertical)

SpikeLog-64

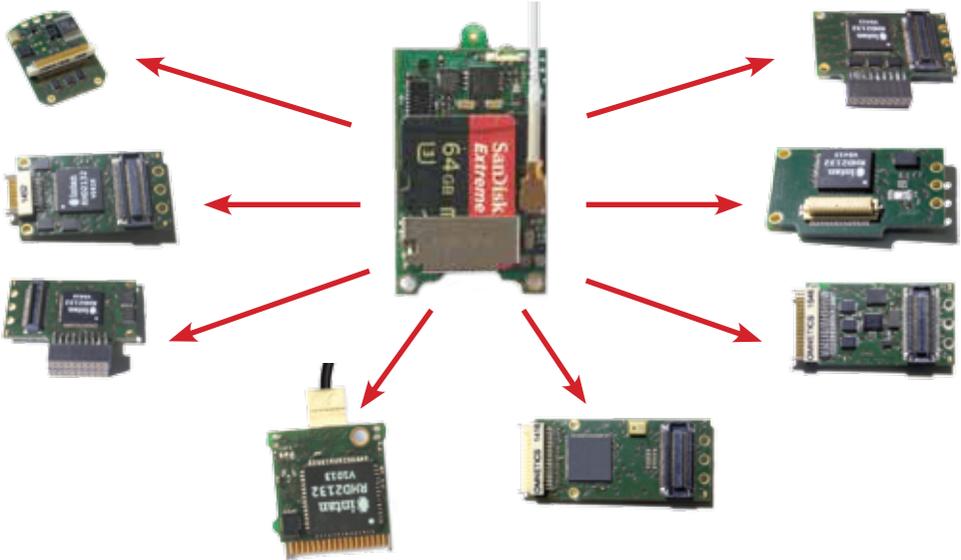
SpikeLog-64 is a 32 or 64 channel neural logger that includes audio logging up to 80kHz from its on-board microphone, and logging of animal movement from its 9-axis motion sensor.



SpikeLog-128

SpikeLog-128 is a single-board 128 channel logger that includes a 9-axis motion sensor. The neural inputs are connected via a pair of 70-pin molex connectors. In general, it will connect to the electrode assembly via an adaptor board

Modular Loggers

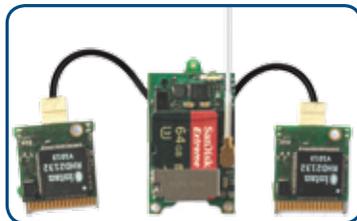


RatLog-128 is a modular logger system consisting of a processor board and one, two or four headstage amplifier boards. The headstage amplifier boards can either be connected to the processor with an ultra-lexible short cable, or they can be plugged directly into the processor. Most headstages can be stacked, that is, connected to another headstage to provide multiples of 32 channels.

Customized headstages can easily be made to interface with the user's electrode assembly. At present Deuteron offers ten different compatible headstages with a variety of orientations, options, and connectors.



RatLog-128 with two stacked headstages



RatLog-128 with two headstages connected with ultra-flexible cable



Example of headstages stacked 4-high.

Synchronizing Transceiver

The logger is controlled by radio commands from the synchronizing transceiver, which is connected via USB to the host Windows computer. It allows you to synchronize static equipment in the lab to the wireless logger. It has 4 BNC connectors for digital inputs and one BNC for digital outputs.

- ▶ All input and output events can be recorded with timestamp on neural logger
- ▶ Accurate timing independent of host computer's latency
- ▶ Four BNC connectors for digital inputs
- ▶ Programmable pulse train outputs
- ▶ IRIG time signal outputs
- ▶ User-upgradeable internal software allows custom features to be sent to users by email



PC Software Suite

A suite of software for a Windows computer is provided. Included is a general control panel for controlling all of the loggers, features, controlling the synchronizing transceiver logging external events, and for preview monitoring signals in real time.

Wired Data Streaming

Some of the modular headstages can be operated by wire by connection to an Intan or Open-Ephys data acquisition system. When this connection is made, the logger relinquishes its control of the analog parts of the headstage and allows the data acquisition system to control them. This allows data to be streamed continuously by wire to a host computer, and also allows electrode impedance to be measured.

This allows loggers to be connected by wire to a host computer, allowing real-time viewing and data streaming between the logger and a host computer. This makes it much easier to position electrodes and test them before beginning a wireless logging experiment.

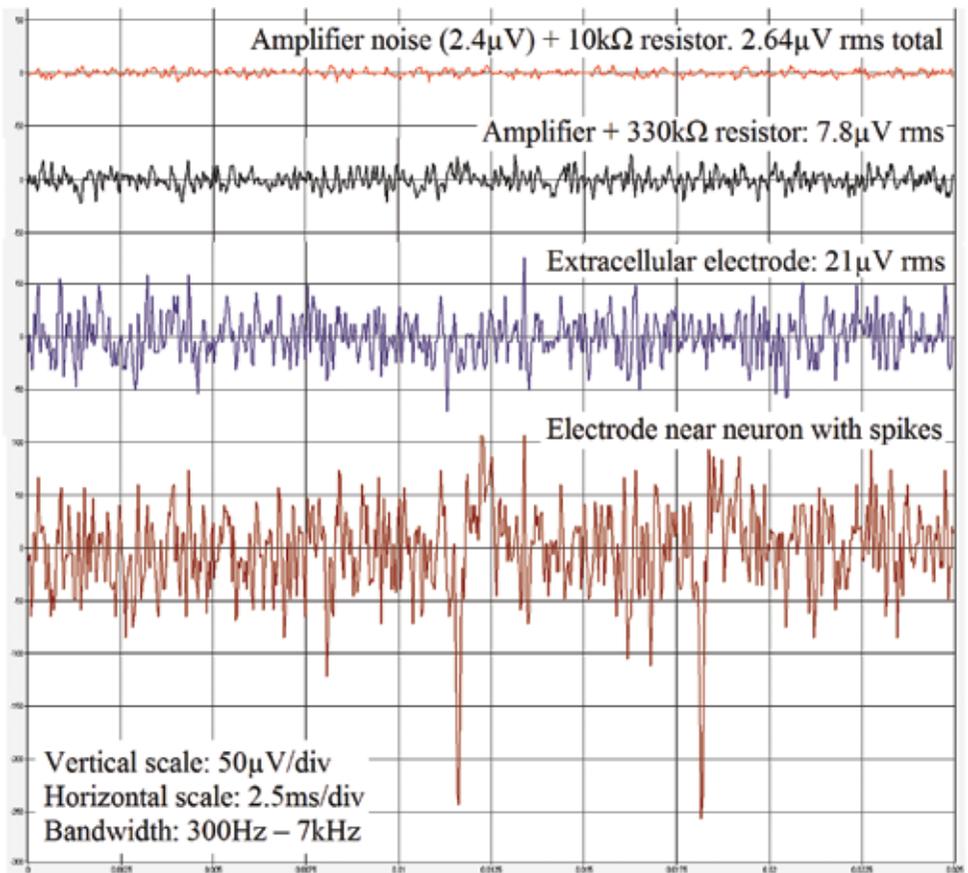
Specifications of selected Deuteron Wireless Loggers.

	RatLog128	MouseLog16B MouseLog16V
Configuration	Modular	Single board
Orientation options	Vertical, horizontal or flexibly wired	16B Horizontal 16V Vertical
Neural inputs	16,32,64 or 128	16
Sampling rate, kHz, each channel	32kHz	31.25kHz
Resolution, bits	16	12 -16
Input ange	± 5mV	± 6mV
Noise rms	2.4µV	2.2µV
Analog bandwidth, high limit	30Hz to 10kHz	7kHz
Analog bandwidth, low limit	0.2-500Hz	<1Hz, 10Hz, 60Hz o 300Hz
Number of possible reference channels	According to headstage 8-35 per headstage	6+Ground
9-Axis motion sensor	Yes	none
Audio recording, sampling rate	Optional, 32kHz	none
Recording time with 3g	64-channel: 2 Hr 32-channel 3.3 Hr (3- gram battery)	4 Hours (3g batte
Wired data streaming option.	32-channels (Some headstages only)	None
Board size, mm	15 x 22	17 x 24
Board mass, incl. memory card	Processor: 1.92g Headstages:1.5g typ each	Horizontal: 1.9g ; Vertical 2.25g
Headstage size, mm	13 x 13, standard wired 15 x 27, s tandard stacked	None
Connector	According to headstage Standard: Omnetics A79025. Also Molex, Mill- max, Hirose	Omneitcs A7904; profile Molex 5410 0204

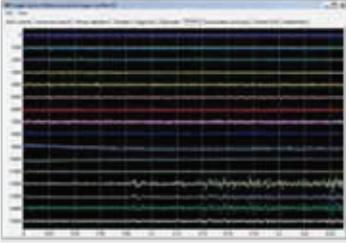
	MouseLog16C	SpikeLog64	SpikeLog128
	Single board	Single board	Single board
	Horizontal	Vertical.	Horizontal, adapter required
	16	32 or 64	128
	31.25	32kHz	32kHz
	12 - 16	16	16
	± 5mV	± 5mV	± 5mV
	2.2µV	2.4µV	2.4µV
	7kHz	30Hz to 10kHz	30Hz to 10kHz
z or	1Hz, 10Hz, 60Hz or 300Hz	0.2-500Hz	0.2-500Hz
	6+Ground	14+Ground	25
		yes	yes
	50kHz, 100kHz	50, 100, 200kHz	No
battery)	1.5 hours with 1.5g battery	2 Hours (3-gram battery)	128 channel: 3 Hours with 6g battery
	None	32-channels	Not available
		20 x 29	30x30
g ;	1.68g	3.3g	4.4g
	none	none	none
043 or low 4102-	Omneitcs A79041	Two Omnetics A79025	Two 7-0pin Molex connectors. Usually used with adapter

Recorded signal quality and noise performance

When neural spike waveforms are recorded with this system, most of the noise seen between the spikes originates within the brain tissue, and the noise due to the preamplifier's electronic noise is insignificant in comparison. The first waveform shown below is mostly the amplifier's $2.4\mu\text{V}$ rms electronic noise. The next waveform shows the Johnson noise of a $330\text{k}\Omega$ resistor; a typical electrode's impedance will produce at least this much Johnson noise. The next waveform shows the neural background noise from a relatively quiet extracellular location in a brain, and the last waveform shows spikes from a nearby electrode that picks up neural spikes. The electronic noise in the first waveform is clearly insignificant relative to the noise level observed between the spikes.



Features of all of Deuteron's loggers



Preview monitor

You can view some of the signals in real time on the host computer using the radio link. This can be used to check signal quality before starting a long recording.

Reference Channel Control

You can select one of the input channels, or ground, or a dedicated reference input pin to be the reference voltages. This voltage is subtracted from all other signals before amplification.

Bandwidth Control

The upper and lower limits of the bandwidth of the amplifier can be controlled from the PC. 16-channel loggers allow you to choose between a small number of bandwidth options. All other loggers allow full control of both the upper and lower cutoff frequencies.

Customized Versions

Many researchers have unique requirements for the experiments they are planning, so customized versions of the software or hardware can be provided where needed.

Battery Options

The user can decide on the best size of battery for his application. The required battery mass is about 1 gram for every 40 minutes of recording time for a 32-channel system.

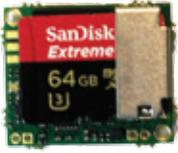
Tracking LEDs

Loggers have omnidirectional LEDs on their upper corners to allow camera tracking and synchronization.

Magnetic Switch

Loggers have magnetic on/off switches, so that the loggers can be sealed in enclosures, and so that there is no need to physically touch the animal to turn the logger on

Audio Loggers



Deuteron's audio loggers record ultrasonic and audible sounds. They are full members of the Deuteron family of loggers and are operated by the same software suite as the neural loggers. They are only slightly larger than their MicroSD memory cards.

Motion Sensor Specifications

Accelerometer sampling rate, each channel	1kHz
Gyroscope sampling rate, each channel	1kHz
Magnetometer sampling rate	110Hz
Accelerometer ranges	2g, 4g, 8g, 16g
Gyroscope ranges	250–2000 deg/s

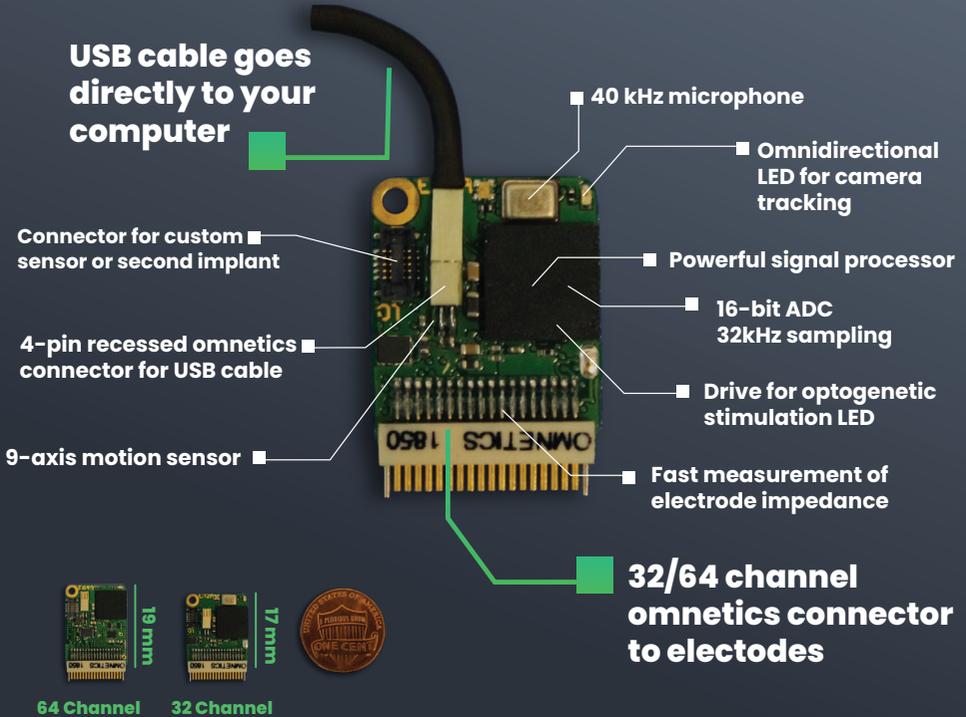


Complete Kits

Loggers are supplied as part of a complete kit. Typically a kit comprises four neural logger boards, two radio transmitters, a signal test accessory, software and all other minor items such as cables, batteries, magnets and antennas.

Coming in 2023...

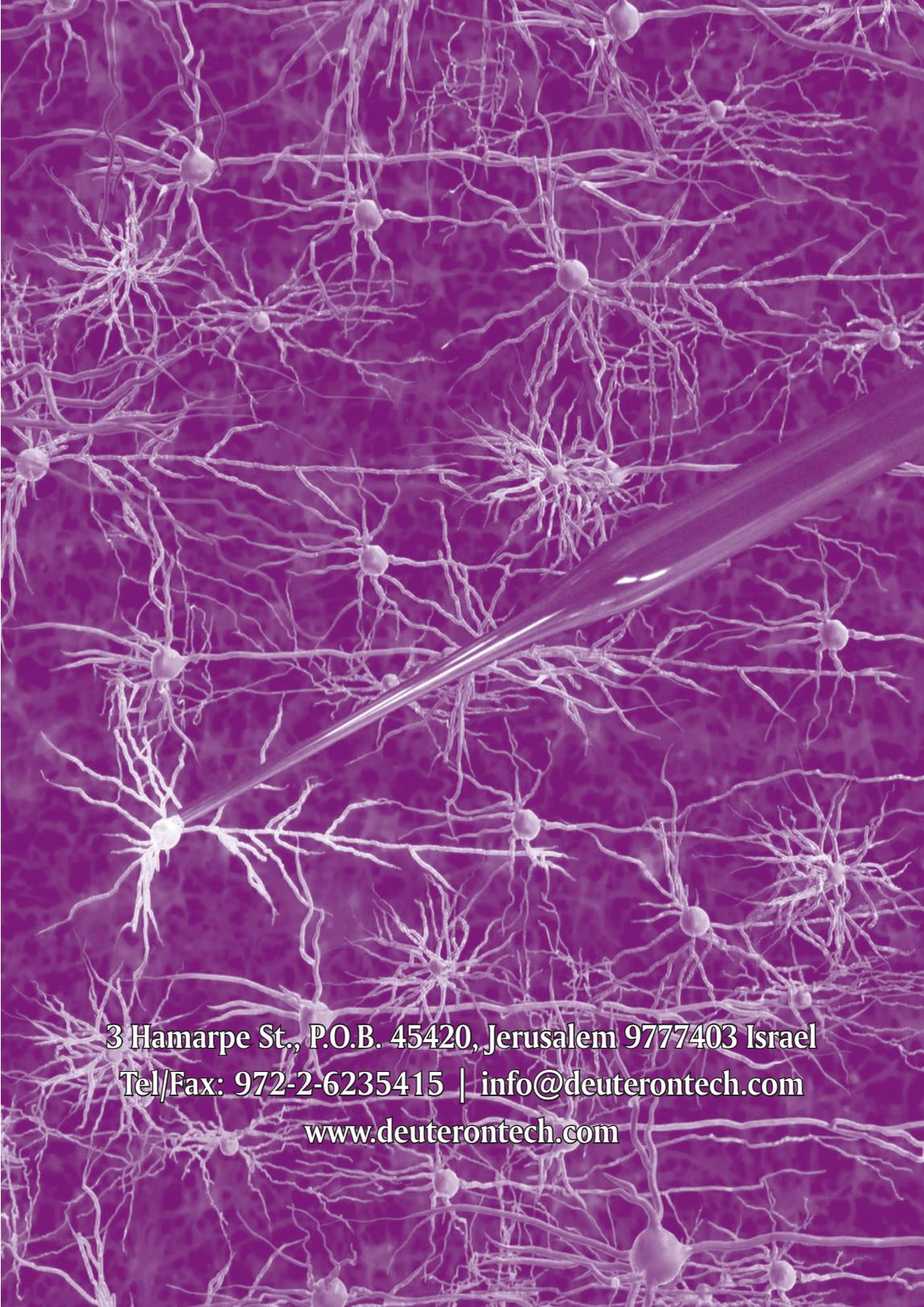
The world's smallest complete electrophysiology data acquisition system.



Also coming in 2023...

New versions of all our neural loggers

- 16, 32, 64 and 128 channels
- Smaller size and smaller batteries
- All with USB port for optional wired streaming
 - ★ All channels at full speed
 - ★ No need for additional wired system
- Dynamic impedance measurement

The image features a complex, interconnected network of thin, branching structures resembling neurons or a fiber optic mesh. The structures are rendered in a light, translucent purple color against a darker purple background. A prominent, bright, cylindrical fiber optic cable runs diagonally from the upper right towards the lower left, intersecting the network. The overall aesthetic is scientific and technological.

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