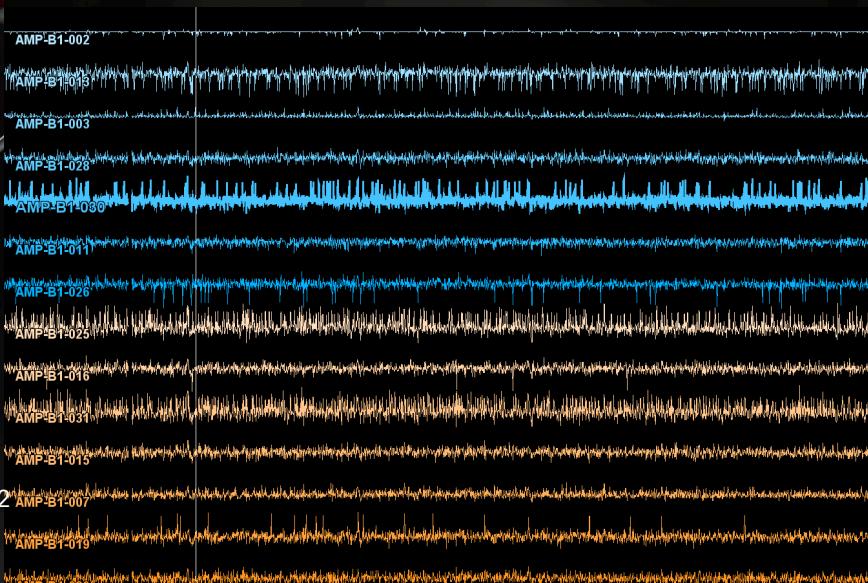
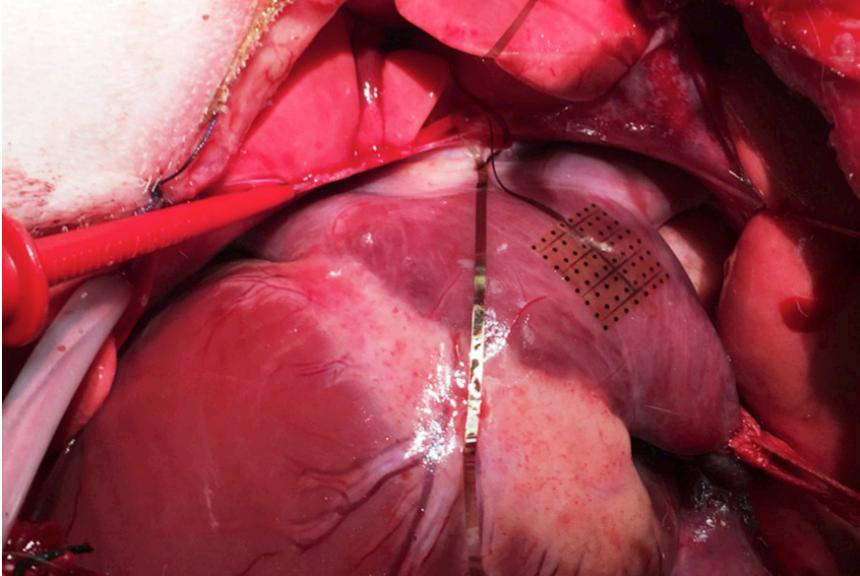




NeuroNexus

Advancing Autonomic Nervous System Research



Advancing Autonomic Nervous System research with disruptive technologies and innovative solutions.

Originally developed at the University of Michigan, NeuroNexus' suite of commercialized technologies has, for over a decade, led to hundreds of publications from research labs all around the world. Our products include **conventional and high-density leads, recording and stimulation systems, and software for data analytics**.

NeuroNexus is currently working to make our state-of-the-art technologies and systems available for autonomic nervous system research. NeuroNexus works closely with researchers to develop our products, and utilize advanced manufacturing techniques to make these designs a reality. If you are interested in a tailored neural interface, please get in touch with us for a consultation.

NeuroNexus is proud to participate in and help facilitate the initiatives of the SPARC U18 program, sponsored by the NIH. The experimental images within this brochure were taken in the lab of principal investigator Jeffrey Ardell at UCLA, under Subaward Number 1553 G TC436.

Cardiac Surface Probe

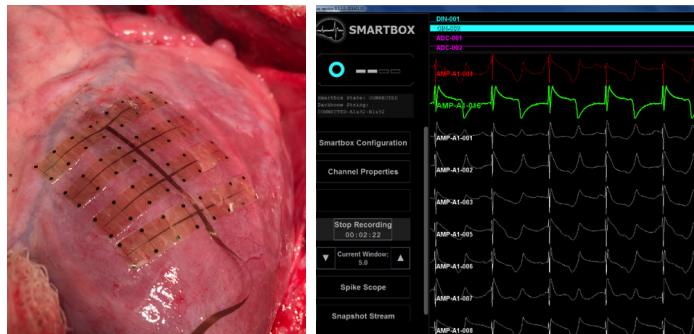
SPECIFICATIONS

Electrode Site Material	Platinum
Array Thickness	20 µm

Flexible polymer surface grids with high recording resolution.

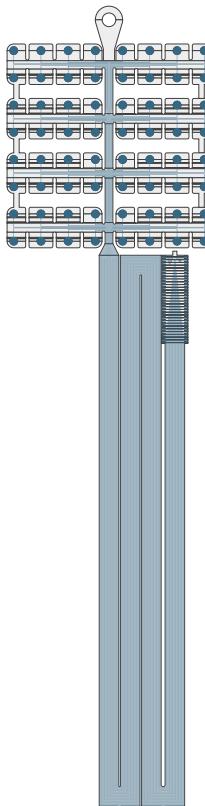
Cardiac Surface Probes are fabricated using our polymer MEMS technology, resulting in an ultra-flexible substrate designed to conform to the cardiac surface. The vast design space allows for special features to be integrated into our probes to cope with the demands of neurocardiology. Surface grids may be combined with Penetrating probes to establish concurrent surface and depth interfaces. Surface probes can also interface with a variety of nerves.

To see our complete catalog of Surface probes, visit neuronexus.com, or ask for our Probe Catalog.



Above: Cardiac Accordion probe on heart surface

Above: EKG Recordings with SmartBox



Above: An illustration of a Cardiac Surface Probe

Cardiac Penetrating Probes

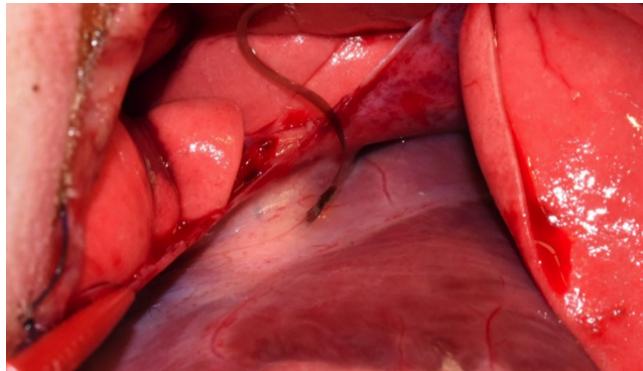
SPECIFICATIONS

Electrode Site Material	Iridium (standard), Platinum (custom), Gold (custom)
Electrode Thickness	200 µm or 400 µm (varies by design)
Electrode Length	2, 3, 4, 5, 6, 10, 15 mm (varies by design)
Channel Count	8, 16, 32, 64, 128, 256 (varies by design)

Leading-edge silicon probes with precise characteristics.

NeuroNexus **Penetrating Probes** are fabricated using state-of-the-art silicon MEMS technology. While maintaining an almost infinite design space, our technology has been refined to produce smaller and more versatile devices with precise and highly reproducible mechanical, geometric, and electrical characteristics.

To see our complete catalog of Penetrating probes, visit neuronexus.com, or ask for our Probe Catalog.



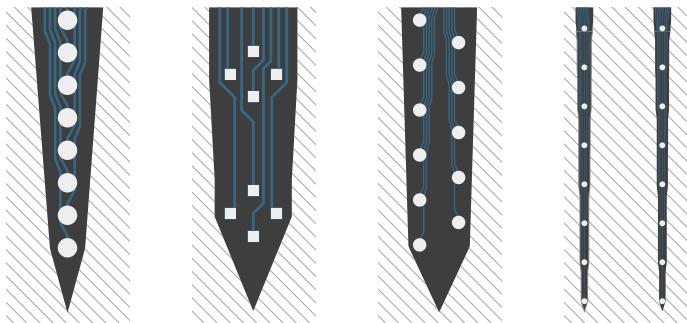
Above: Multi-shank Cardiac Penetrating Probe inserted into intrinsic cardiac ganglia



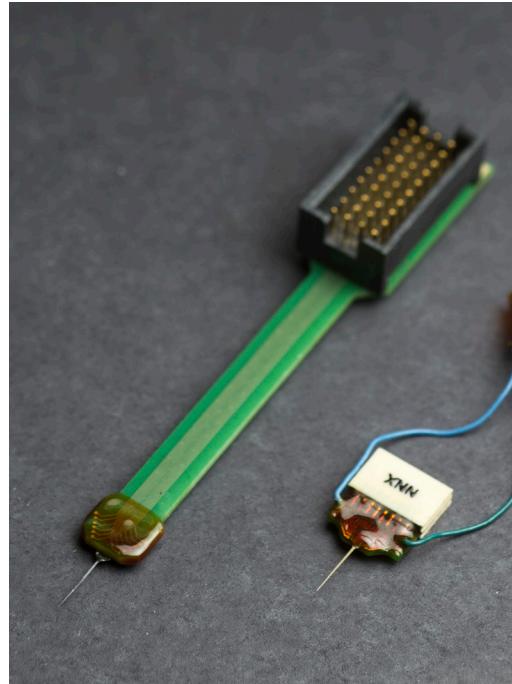
Above: Close-up view of a 256-channel custom design probe. (Recording sites on bottom, 32 sites per shank)

NeuroNexus offers a wide variety of silicon electrode arrays for **single-unit**, **multi-unit**, and **local field potential (LFP)** recording and stimulation. To help researchers target different structures, Penetrating probes come in a vast collection of designs, each with different parameters, including: **length** (to span layers), **number of shanks** (to span columns), **electrode site area** (to target individual or groups of neurons), **electrode site spacing** (to target specific areas), and **site layout** (see below).

To start configuring a probe, find an electrode array that meets your needs. Once you have selected an electrode array design, match it to a **connector package** so it can interface with your headstage.



L-R: Linear, Tetrode, Polytrode, and Multi-shank. These are just a few of the precise electrode site layouts available.



Above: A32 (left) and CM16LP (right) Packages

Matrix Array™

SPECIFICATIONS

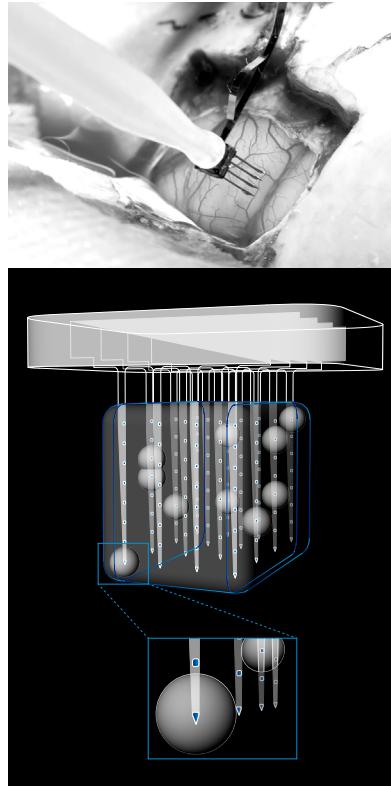
Channel Count	64, 128 256 (custom)
X-Y Span	1.8 mm x 1.8 mm / 1.8 mm x 3 mm (customizable)
Z Span	Up to 15 mm (customizable)
Array Spacing	300 µm, 600 µm, 1000 µm (specify when ordering)
Cable Length	30 mm (Customizable)
Electrode Site Material	Iridium
Electrode Thickness	50 µm

*A unique probe design to record
in 3-dimensional space. Versatile
configurations and reliable
performance.*

The **Matrix Array™** is our 3-dimensional probe, designed with proven silicon technology and optimized for both acute and chronic experiments in animal models as large as non-human primates. Using an array of 2D penetrating probes, the Matrix Array™ covers a volume of tissue and interfaces with large populations of neurons.

Both the array spacing and the 2D electrode arrays themselves can be customized, giving you unsurpassed flexibility in customizing a true 3D probe capable of spanning any anatomical structure. An ultra-flexible cable assembly connects the Matrix Array™ to conventional percutaneous connectors.

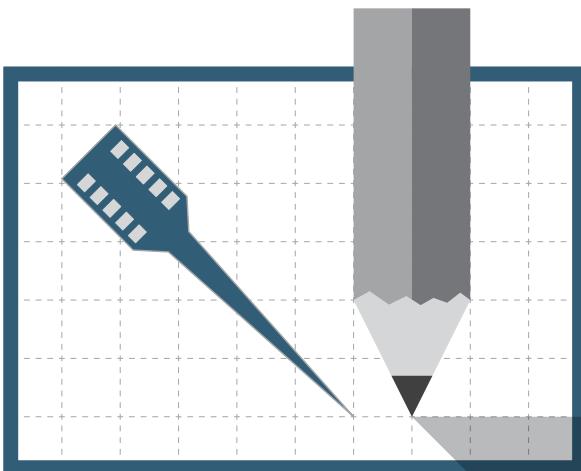
An extensive set of tools (including a measurement tool, mock assembly, screws etc.) is provided with every order to maximize your success rate.



Top: A 5mm Matrix Array™ being inserted with our computer-controlled insertion tool.

Bottom: Illustration of Matrix Array™ platform showing four 2D arrays installed, allowing electrode sites to record and stimulate in 3D space.

Custom Design



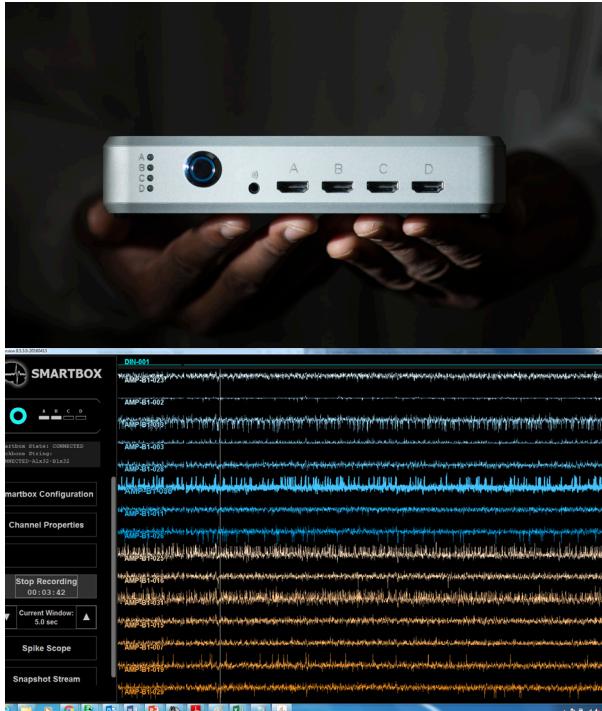
NeuroNexus offers a custom probe design service that provides unique access to a virtually unlimited design space. Almost any feature of a probe can be tailored to suit your application - and all it takes to get started is a sketch.

Each custom probe includes:

- Consultation with our engineering team to validate feasibility of your proposed design
- Translation of your design into a CAD layout
- Formal design review with our technical team
- State-of-the-art microfabrication of your design
- Packaging and testing of the fabricated probes
- Ability to imprint text (such as your name) on the electrode shank

To learn more about Custom Design, visit neuronexus.com.

SmartBox Data Acquisition System



The **SmartBox** is a complete, cost-effective, high performance instrument for neurophysiology and experimental control, designed to replace or supplement rack-mounted workstations. Now with a completely revamped probe-centric software interface.

NeuroNexus incorporated groundbreaking features into our new probe-centric software, including integrated mapping, flexible screen layouts, I/O synchronization with data streaming, and in-experiment data stream pausing. The integrated mapping feature saves time, reduces complexity when switching between different electrode designs, and makes experiment management intuitive. This seamless user experience arises from our ability to integrate probes, mapping, and software. Data is streamed to file, where it can be read into commercial analysis software.

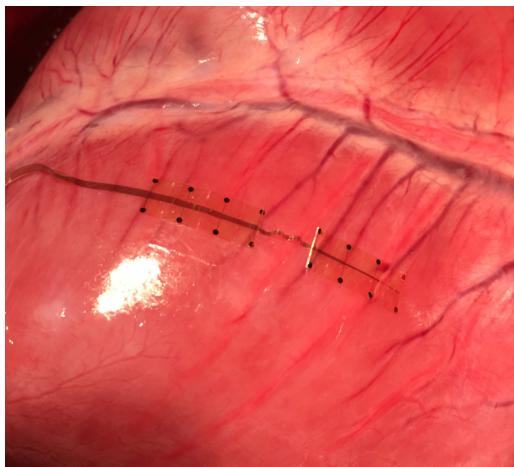
SMARTBOX™ SPECIFICATIONS		SMARTBOX™ SPECIFICATIONS	
Acquisition Channel Count	16, 32, 64, 128, 256 Up to 4 independent experiments	Input Range	± 5 mV
A/D Resolution	16-bit, 0.15 μ V	Smallest Detectable Signal	≈ 15 μ V
Sampling Rates	1 kS/s - 30 kS/s	PC Requirement	PC, Windows 7, USB 2.0
Peripheral Output	2 Analog, BNC (\pm 3.3 V) 2 Digital, BNC (0 - 5 V) 14 Digital + 6 DAC Out via DB50 port	Laptop Specs	Lenovo ThinkPad T440, Intel Core i7 4600U / 2.1 GHz, Windows 7 Pro 64-bit, 8 GB RAM, 256 GB SSD eDrive (contact us for RAM or Storage upgrades)
Peripheral Input	2 Analog, BNC (0 - 3.3 V) 2 Digital, BNC (3.3 V) 14 Digital + 6 ADC In via DB50 port	Included in box	SmartBox™, Power cable, USB cable, HDMI cable, SmartLink headstages (if ordered) with one extra HDMI cable/headstage
Audio Monitoring	1 stereo line out (3.5 mm), user selectable		
Cutoff Frequency	Adjustable: 0.1 - 20,000 Hz		
Low Input-referred noise	2.4 μ V _{rms}		

CARDIAC ARRAYS

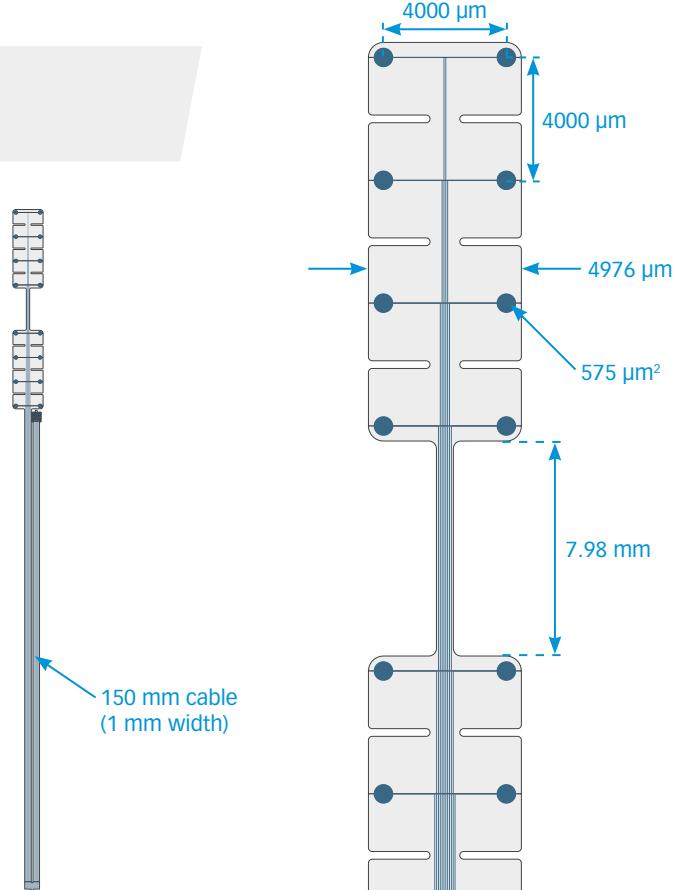
CS2x2x4-accord-4000-150-575

This probe design features an “accordion” section that allows the grid to move with the target surface and reduce motion artifact.

Below: Accordion array recording on heart surface



11



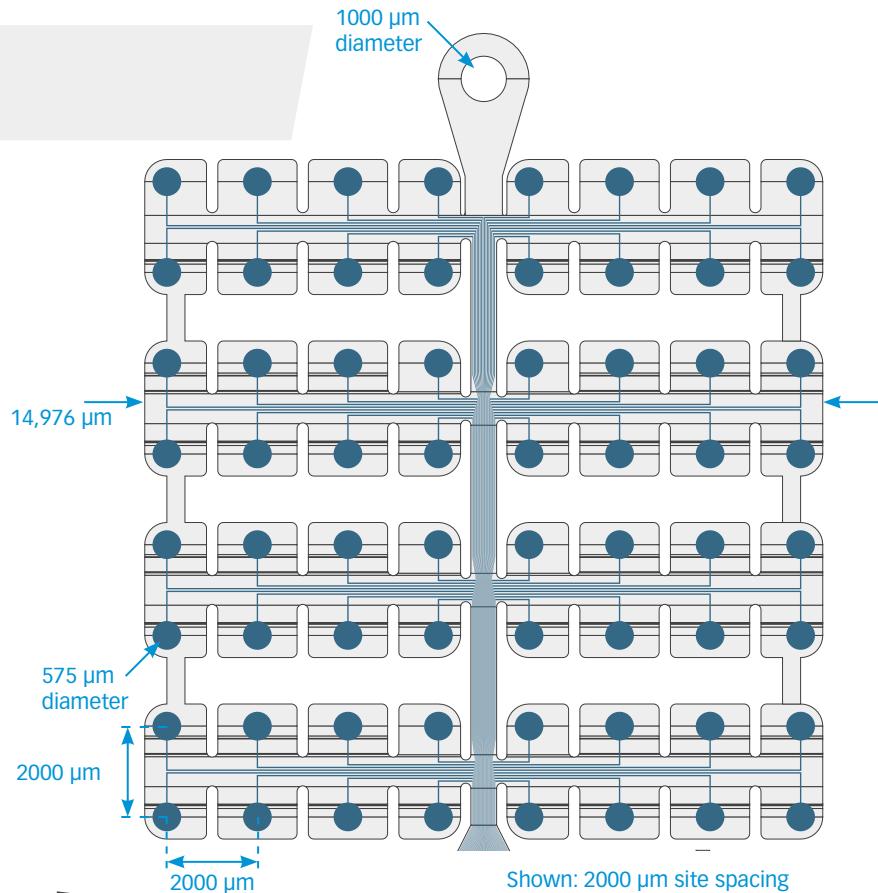
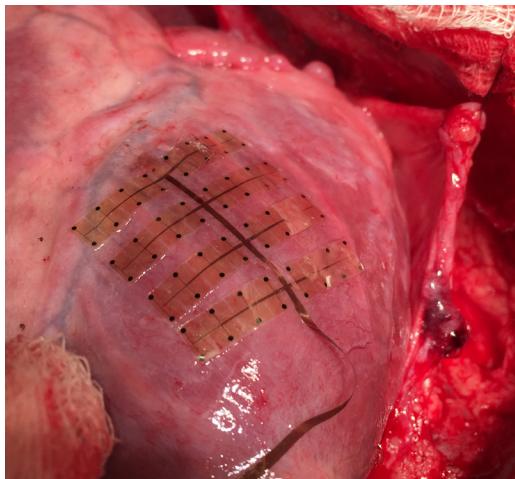
CARDIAC ARRAYS

CS8x8-seg-2000-150-575

CS8x8-seg-4000-150-575

This probe design provides electrode coverage over a large area, while the segmented sections bend to accommodate motion.

Below: A Segmented Cardiac Surface Array recording EP signals from the ventricle surface.



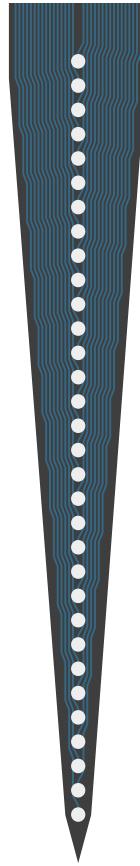
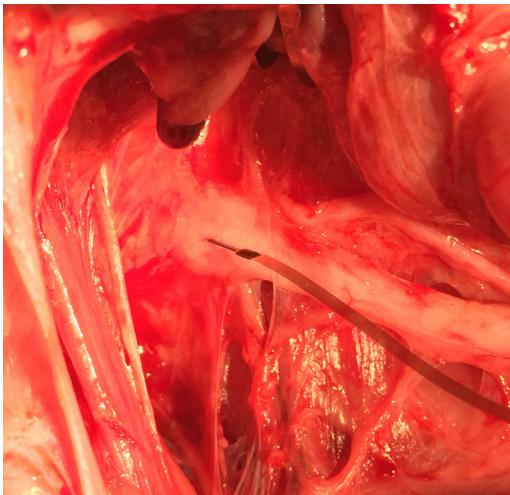
CARDIAC ARRAYS

A1x32 Linear Penetrating Array

(See Probe Catalog for more designs and complete specifications)

Linear electrode arrays allow for a longer area of coverage than a single tip site. Linear electrode arrays fit a wide range of applications.

Shown below: a linear penetrating array recording from the Nodose ganglia



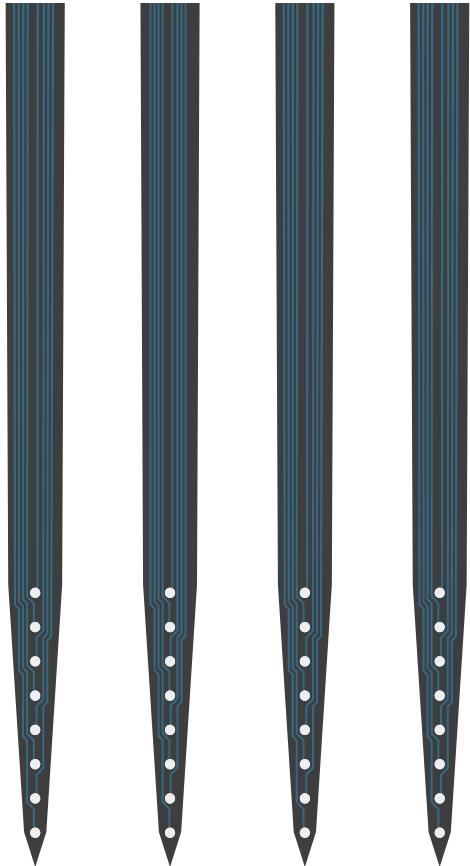
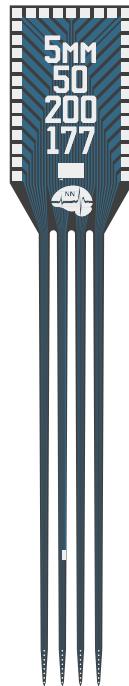
CARDIAC ARRAYS

A4x8 Multi-Shank Penetrating Array

(See Probe Catalog for more designs and complete specifications)

Multi-shank electrode arrays provide a 2D representation of the neural region being recorded. By controlling shank and site spacing, a more detailed understanding can be obtained of a larger space in the region.

Shown: A4x8-5mm-50-200-177 design on long polyimide cable, implanted into an intrinsic cardiac ganglia



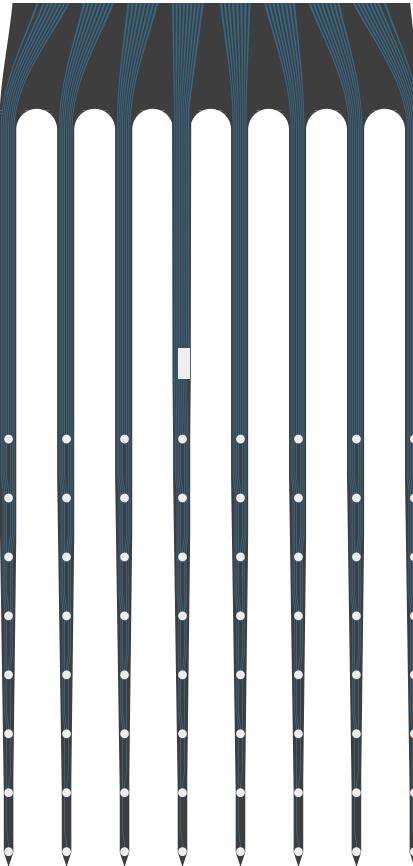
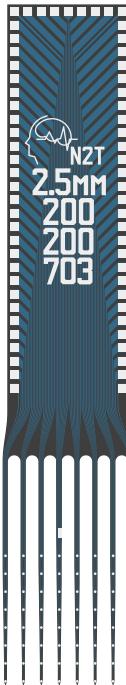
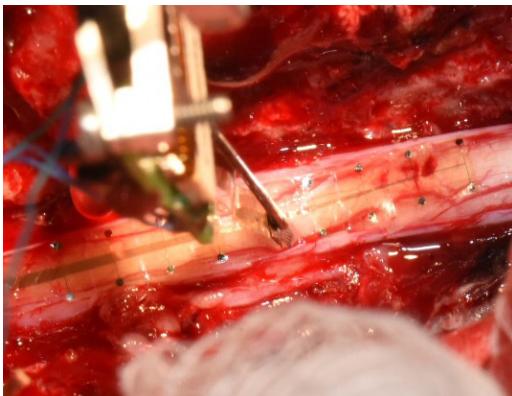
CARDIAC ARRAYS

A8x8 Multi-Shank Penetrating Array

(See Probe Catalog for more designs and complete specifications)

The wide design space of NeuroNexus probes allows for the design and fabrication of reliable high channel count probes, up to 256 channels and beyond.

Below: In this experiment, stimulation was applied to the surface of the spinal cord through the Accordion Surface array (p.11) while single units were recorded with the A8x8-2.5mm-200-200-703 penetrating multi-shank electrode array.



NOTES



FIND US ON YOUTUBE

The NeuroNexus YouTube channel provides detailed information and usage strategies for various products, including the SmartBox and Matrix Array.

youtube.com/TheNeuroNexus

Grant Information (page 3)

Source: NIH U18 EB021799-01

9/01/15 to 7/31/17

Title: Distributed electrode system for high-fidelity cardio-neural mapping

Multi-PI: Ardell, Jeffrey L. (Project Director); Shivkumar, Kalyanam; Kipke, Daryl R.

Objective: The primary focus of this proposal is to: 1) Development implantable electrode arrays that allow for chronic, high-fidelity 3D neural recording from peripheral autonomic and sensory ganglia and 2) to then interlace such neural recording with chronic high-fidelity recording of cardiac electrical activity.



NeuroNexus

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