

CMOS-APS Electrode

SiNAPS

Simultaneous Neural Recording
Active Pixel Sensor

Introduction

SiNAPS probes are high-channel count, active electrodes, similar to other active silicon probes available and popular today (E.g., Neuropixels). However, what makes SiNAPS probes unique is the ability to record from all the electrode sites, not only a subset. This means a user can record from all 256 pixels of a 256 pixels SiNAPS probe. The same is true for the 512 pixels and 1,024 pixels probes.

SiNAPS probes require an OmniPlex or Recorder-S data acquisition system from Plexon.

Please contact your salesperson at Plexon for more information or reach out via info@plexon.com.

SiNAPS

Simultaneous Neural Recording Active Pixel Sensor Technology

SiNAPS probes from Corticale utilize Active Pixel Sensor (APS), CMOS technology to enable high-channel, high-density configurations, which are now fully integrated into the OmniPlex & Recorder-S hardware and software packages.

With SiNAPS and OmniPlex, Plexon users can record from hundreds to thousands of channels in a high-density package and benefit from all sophisticated online processing functionality of OmniPlex such as online spike sorting. Online functionality is available across up to four SiNAPS probes simultaneously (up to 2,048 channels).

With SiNAPS and Recorder-S, users who do not need online processing, can get started with the SiNAPS probe technology by recording from one probe (up to 1,024 channels).

Advantages of SiNAPS

Acquisition From All Pixels

Not a subset like other active silicon probes

Fully Supported Software, Hardware and Peripherals

New OmniPlex and Recorder-S software features specific to SiNAPS probes

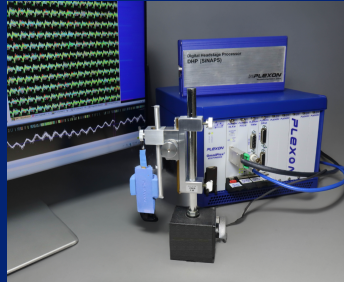
Single-Shank and Multi-Shank Configurations

256, 512, and 1024 pixels available now

SiNAPS Hardware

OMNIPLEX

- + OmniPlex Chassis
- + High Density Processor (HDP)
- + SiNAPS Adaptor
- + Probe Tester unit
- + System Tester Unit



RECORDER-S

- + Recorder-S box
- + SiNAPS Adaptor
- + Probe Tester unit
- + System Tester Unit



Probe Tester Unit (PTU)



System Tester Unit (STU)



SiNAPS Technical Specs

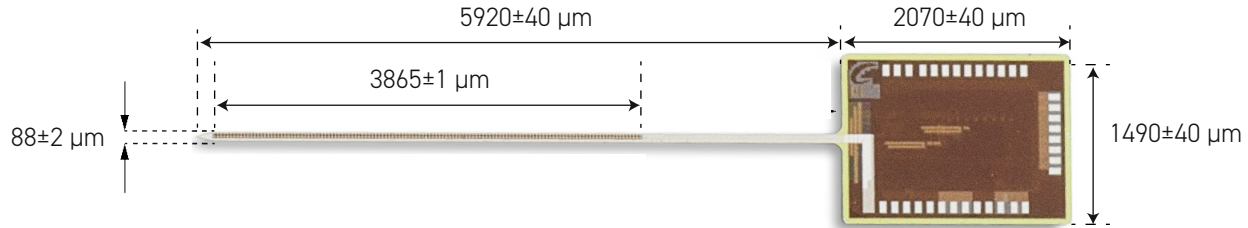
These small-area, ultra low-power active implantable devices enable high-resolution brain activity recordings with the highest electrode array density and minimal wiring available on the market.

Probe Name	1S256 [^] M0001	1S512 [^] M0003	1S512 M0005 NHP*	4S1024 [^] M0002	8S1024 [^] M0004
Number of Shanks	1	1	1	4	8
Number of Pixels	256	512	512	1024	1024
Base Width	1490±40 µm	2780±40 µm	320±8 µm	2780±40 µm	2780±40 µm
Base Length	2070±40 µm	2660±40 µm	5211±2 µm	2730±30 µm	2730±30 µm
Base Thickness	50±5 µm	50±5 µm	50±5 µm	50±5 µm	50±5 µm
Shank Width	88±2 µm	88±2 µm	156±2 µm	88±2 µm	88±2 µm
Shank Length	5920±40 µm	9706±20 µm	6900±25 µm	5800±20 µm	5070±10 µm
Active Area Length	3865±1 µm	7749±1 µm	3866±1 µm	3865±1 µm	1924±1 µm
Shank Thickness	50±5 µm	50±5 µm	50±5 µm	50±5 µm	50±5 µm
Tip Angle	26°±3°	26°±3°	26°±3°	26°±3°	26°±3°

* NHP probes can be cannulated to reach deeper structures

[^] Non-NHP probes available in chronic packages

SiNAPS Probe 1 Shank 256 Pixels



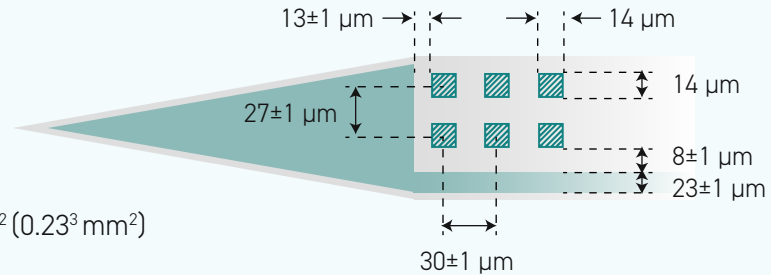
Base Thickness: $50 \pm 5 \mu\text{m}$
Shank Thickness: $50 \pm 5 \mu\text{m}$
Tip Angle: $26^\circ \pm 3^\circ$

Electrodes

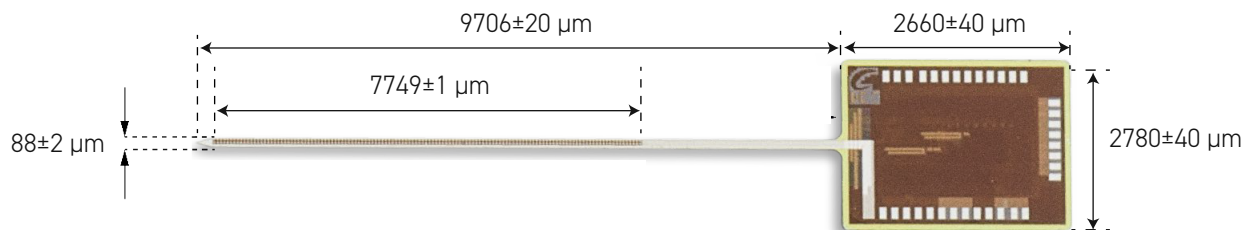
Number: 256
Pattern: 2 Columns
Material: Platinum

Internal Reference

Internal Reference Area: 0.095^2 mm^2 (0.23^3 mm^2)
Material: Platinum



SiNAPS Probe 1 Shank 512 Pixels



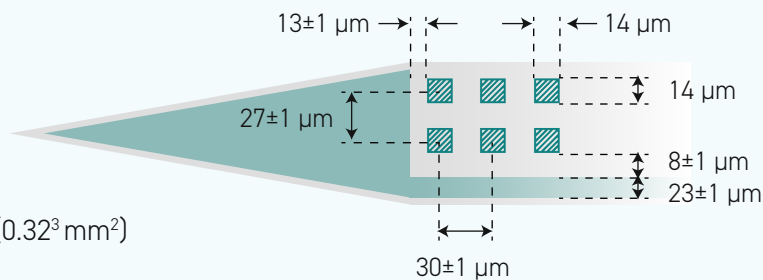
Base Thickness: $50 \pm 5 \mu\text{m}$
Shank Thickness: $50 \pm 5 \mu\text{m}$
Tip Angle: $26^\circ \pm 3^\circ$

Electrodes

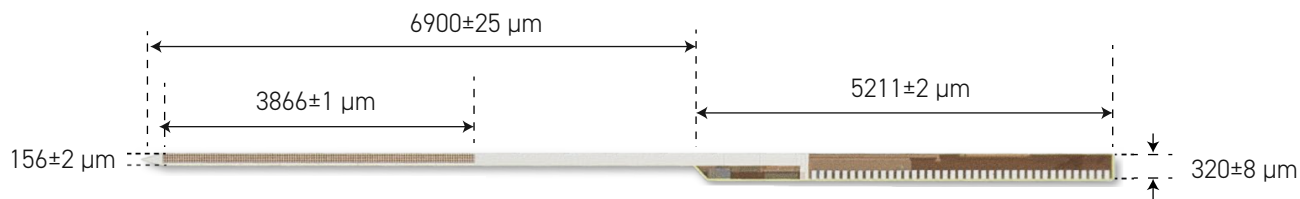
Number: 512
Number per Shank: 512
Pattern: 2 Columns
Material: Platinum

Internal Reference

Internal Reference Area: 0.20^2 mm^2 (0.32^3 mm^2)
Material: Platinum



SiNAPS NHP Probe 1 Shank 512 Pixels



Base Thickness: $50 \pm 5 \mu\text{m}$

Shank Thickness: $50 \pm 5 \mu\text{m}$

Tip Angle: $26^\circ \pm 3^\circ$

Electrodes

Number: 512

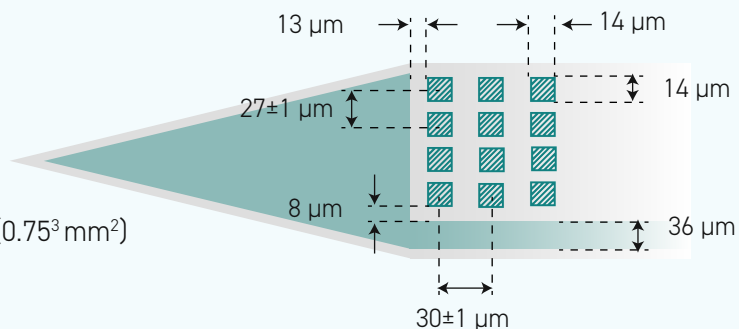
Pattern: 4 Columns

Material: Platinum

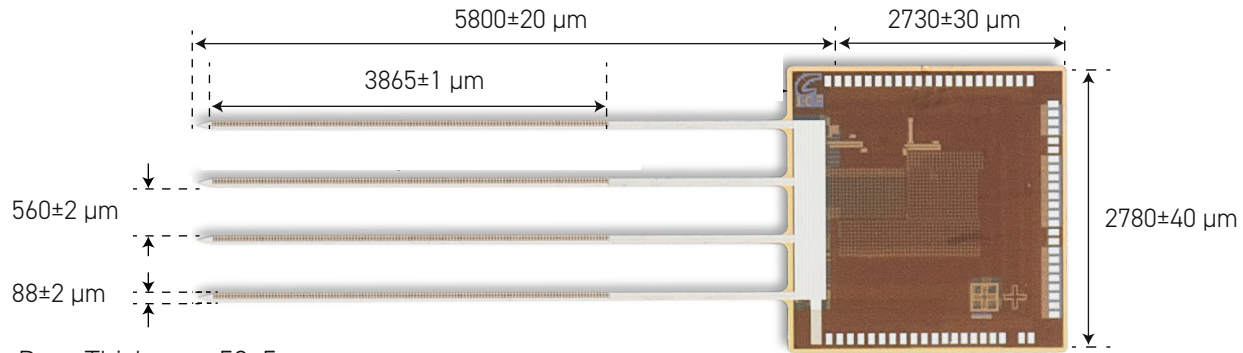
Internal Reference

Internal Reference Area: 0.18^2 mm^2 (0.75^3 mm^2)

Material: Platinum



SiNAPS Probe 4 Shanks 1024 Pixels



Base Thickness: $50 \pm 5 \mu\text{m}$

Shank Thickness: $50 \pm 5 \mu\text{m}$

Tip Angle: $26^\circ \pm 3^\circ$

Electrodes

Number: 1024

Number per Shank: 256

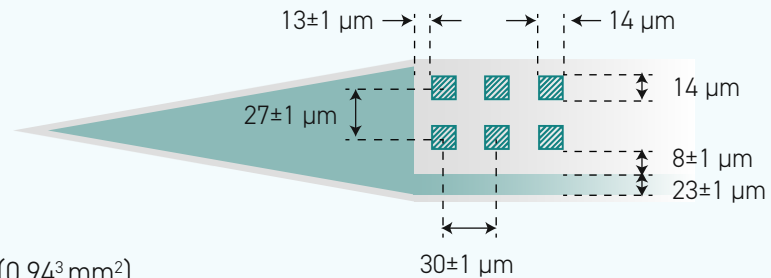
Pattern: 2 Columns

Material: Platinum

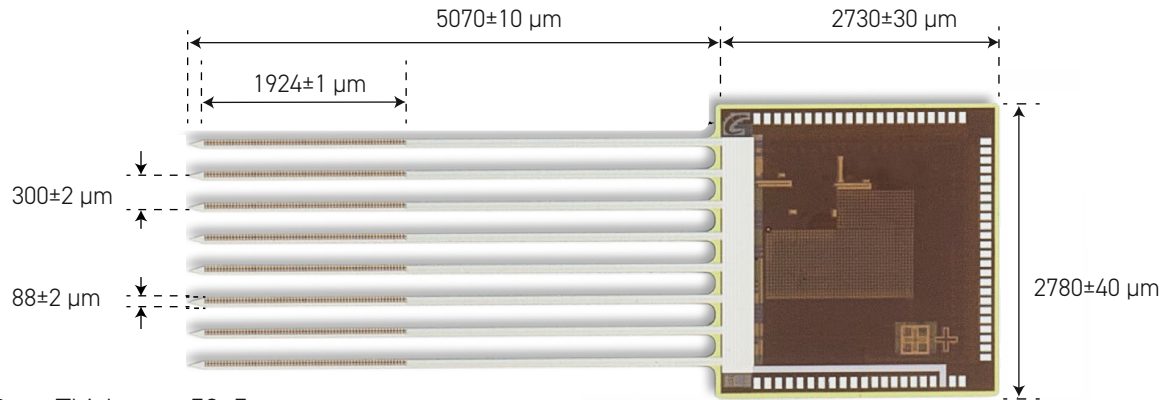
Internal Reference

Internal Reference Area: 0.38^2 mm^2 (0.94^3 mm^2)

Material: Platinum



SiNAPS Probe 8 Shanks 1024 Pixels



Base Thickness: $50 \pm 5 \mu\text{m}$

Shank Thickness: $50 \pm 5 \mu\text{m}$

Tip Angle: $26^\circ \pm 3^\circ$

Electrodes

Number: 1024

Number per Shank: 128

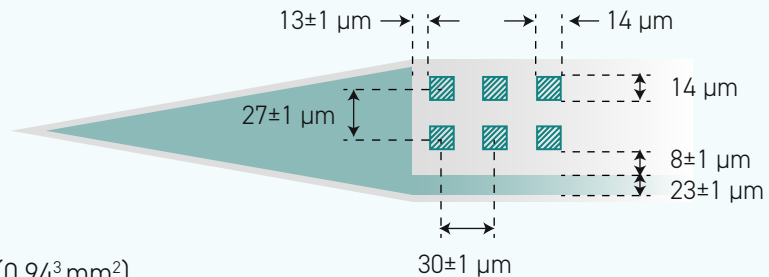
Pattern: 2 Columns

Material: Platinum

Internal Reference

Internal Reference Area: 0.38^2 mm^2 (0.94^3 mm^2)

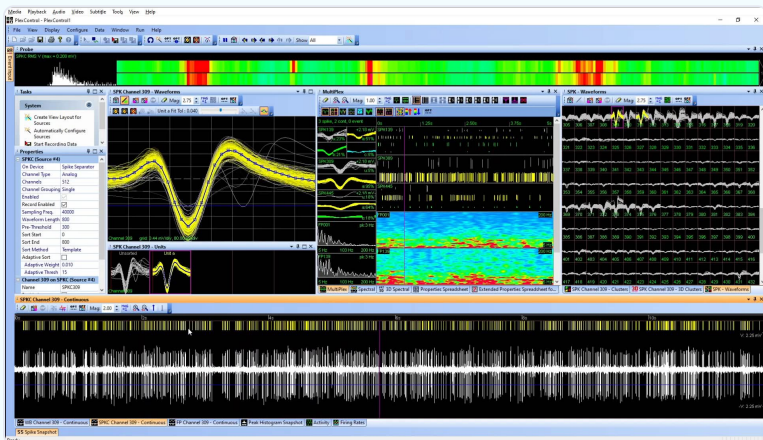
Material: Platinum



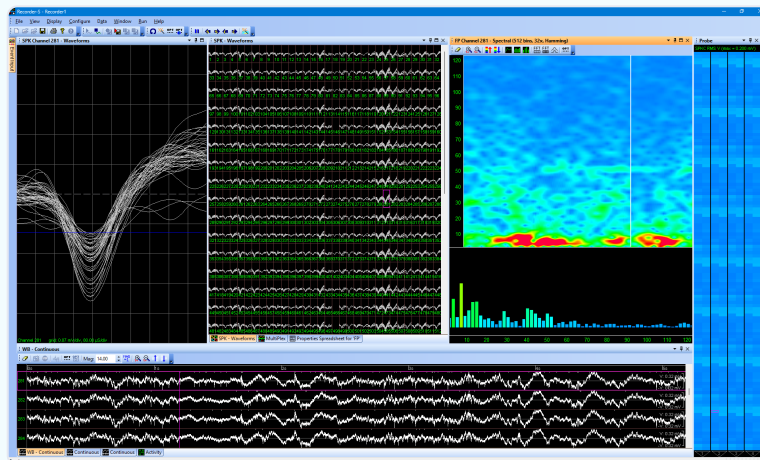
SiNAPS Data Acquisition

Researchers interested in high-channel, high-density active electrode recording options no longer need to select only a subset of channels to record from or settle for streaming-only acquisition systems with incomplete software. The OmniPlex system enables users to record from all channels of a SiNAPS probe and utilize powerful referencing, thresholding, culling, and spike sorting features only available from Plexon.

OmniPlex — PlexControl Software



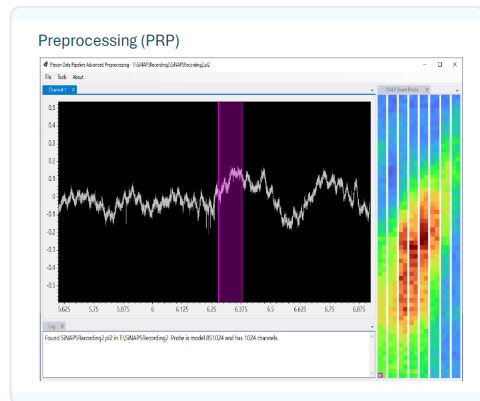
Recorder-S Software



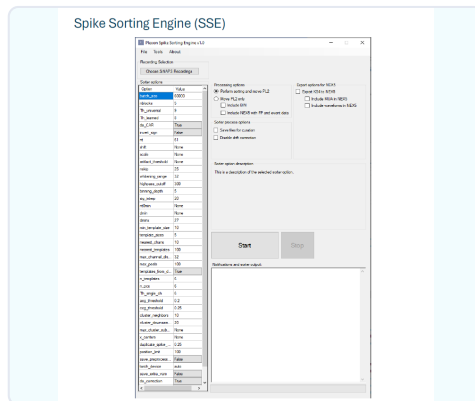
Plexon Data Pipeline

Plexon has developed the Plexon Data Pipeline (PDP), a collection of Plexon- and 3rd-party software tools that enable users to overcome the challenges inherent in sorting and analyzing HD neural data recorded into Plexon .pl2 files from OmniPlex and Recorder-S acquisition systems. Plexon Data Pipeline is an integrated package of applications for signal conditioning, spike sorting, and result curation applied to recordings of high density, high pixel count probes. PDP has three parts: preprocessing with visualization; spike sorting and file management with Kilosort4; and visualization with Bombcell for curation and validity checking.

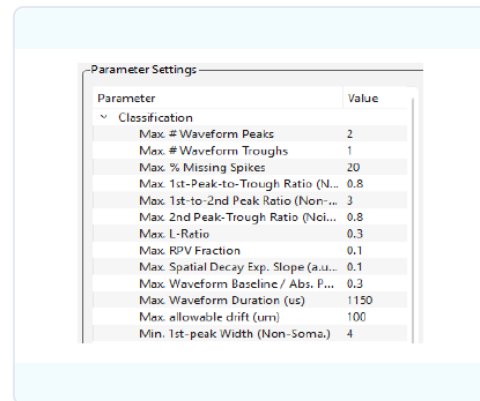
Preprocessing (PRP)



Spike Sorting Engine (SSE)



Curation (Bombcell)



References

1. Perna, A. et al. (2023). Advancing the interfacing performances of chronically implantable neural probes in the era of CMOS neuroelectronics
2. Ribeiro, J. F. et al. (2022) Channels, layout and size scalability of implantable CMOS-based multielectrode array probes
3. Boi, F. et al.(2021) Coupling sinaps high-density neural recording CMOS-probes with optogenetic light stimulation.
4. Ribeiro, J. F. et al. (2021) Bioelectrodes for high-channel count and small form factor CMOS neural probes
5. Boi, F. et al. (2020) Multi-shanks SiNAPS Active Pixel Sensor CMOS probe: 1024 simultaneously recording channels for high-density intracortical brain mapping
6. Angotzi, GN. et al. (2019) SiNAPS: An implantable active pixel sensor CMOS-probe for simultaneous large-scale neural recordings

About Plexon Inc

Plexon is a pioneer and leading innovator of custom, high-performance data acquisition, behavior and analysis solutions specifically designed for scientific research. We collaborate with and supply thousands of customers including the most prestigious neuroscience laboratories around the globe driving new frontiers in areas including basic science, brain-machine interfaces (BMI), neurodegenerative diseases, addictive behaviors and neuroprosthetics. Plexon offers integrated solutions for in vivo neurophysiology, optogenetics, and behavioral research – backed by its industry-leading commitment to quality and customer support. For more information, please visit www.plexon.com.