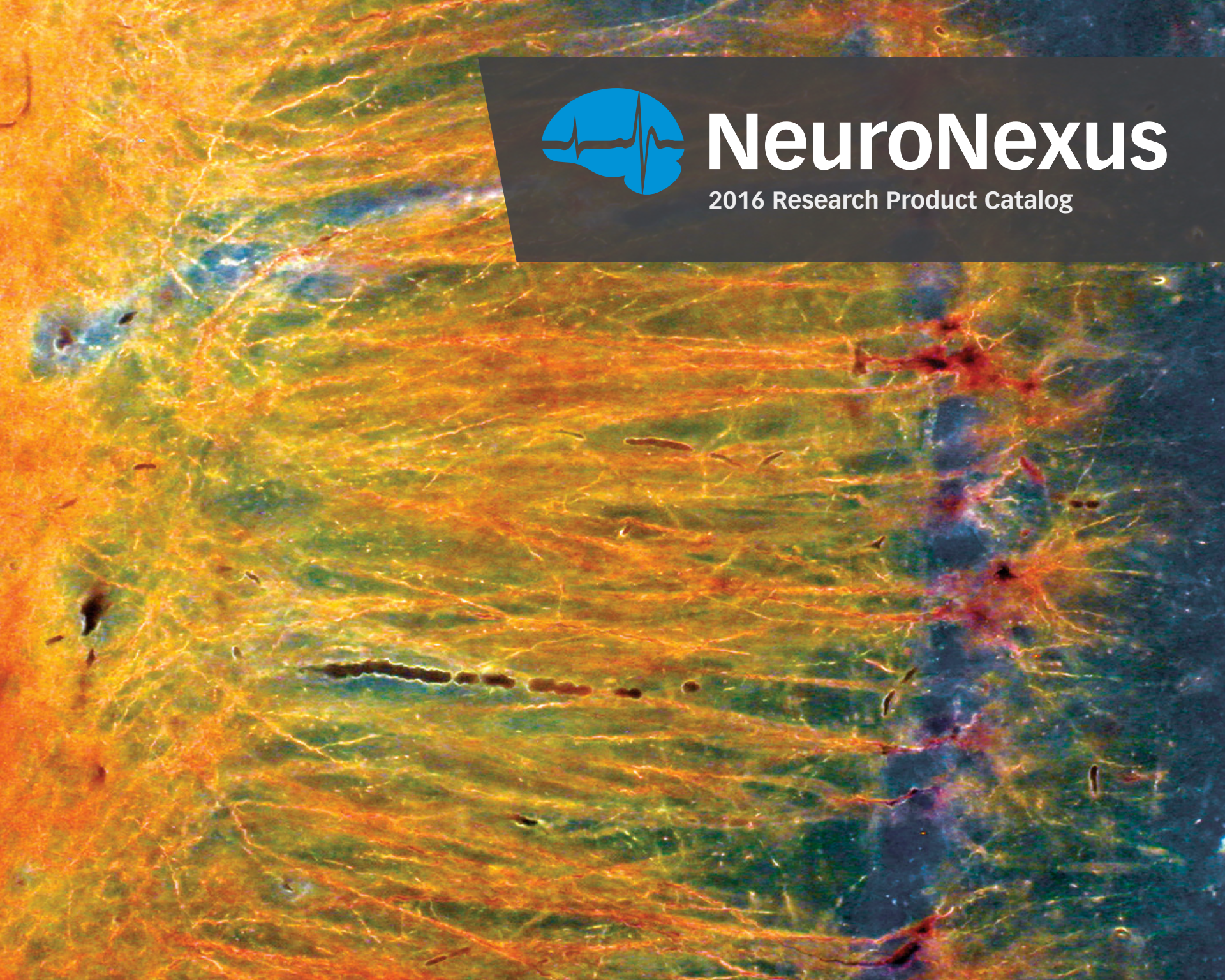

NeuroNexus

2016 Research Product Catalog

Thank you for your interest in NeuroNexus.

We pride ourselves on being at the forefront of neural interface technologies and translating these technologies into innovative products to help fuel neuroscience advances.

At our core, we are a research-focused company, with deep roots in neuroscience and neurotechnology. Through both our own work as well as our support of thousands of investigators around the world, we appreciate the challenges and nuances of neurophysiology research. We remain focused on developing high-quality, advanced electrodes and systems to interface with diverse, precise targets throughout the nervous system – brain, spinal cord, and periphery – in species ranging from nonhuman primates to small animals to insects. And for 2016, we are excited to expand to offer innovative neural interface products for exploratory clinical research.

I invite you to browse our catalog and, even more importantly, to feel free to contact us directly to discuss new ideas, needs, and opportunities. Enjoy!

Daryl Kipke, PhD
President

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NeuroNexus products included in this document have not been approved for use in humans.

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Cover art courtesy of Gyorgy Buzsaki.

Volume 6, Version 3
January 15, 2016

CONTENTS

NEURAL PROBES

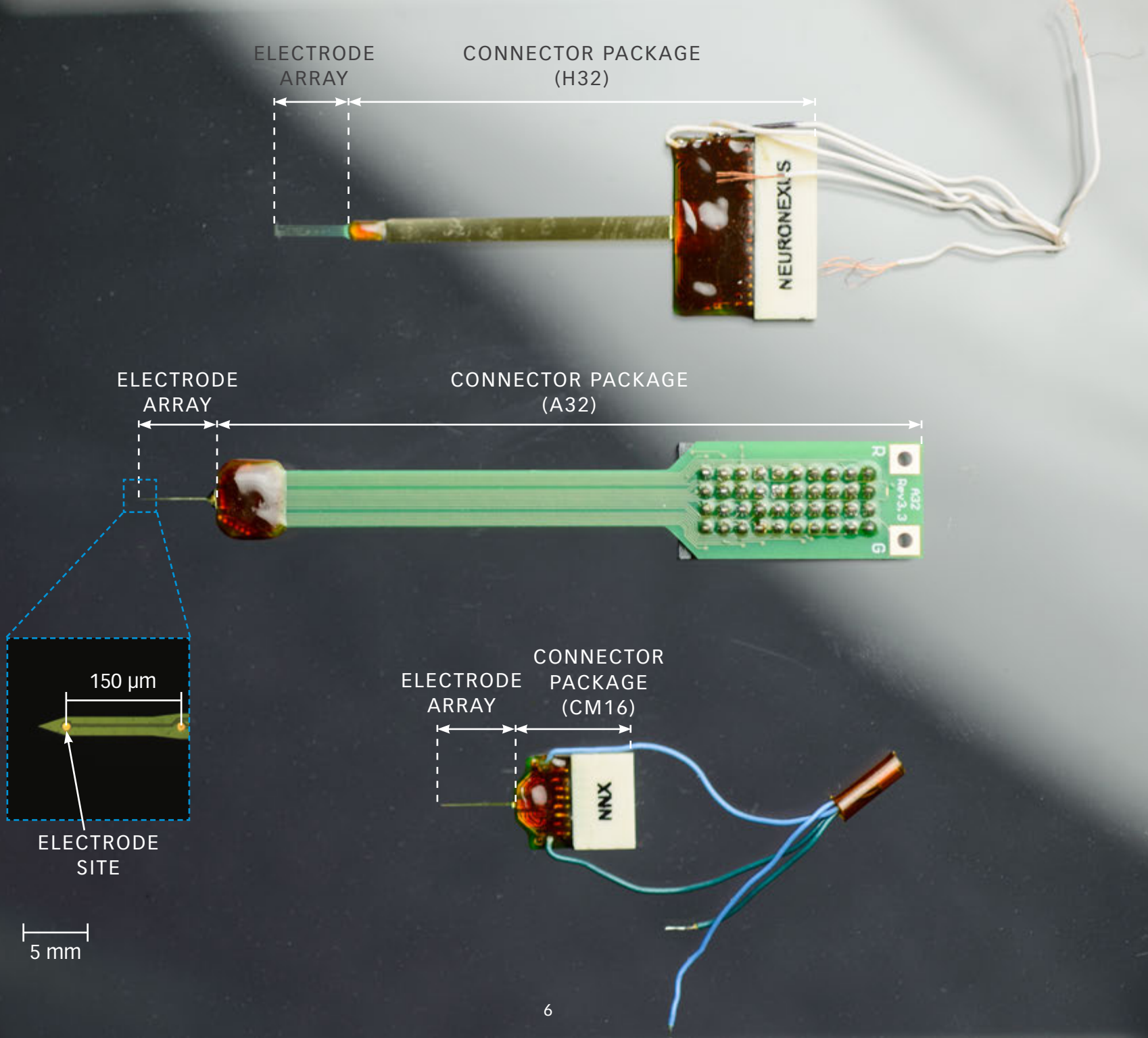
NeuroNexus products are at the forefront of neural interface technology. Our meticulously crafted neural probes can be broken down into two parts: the **electrode array** and the **connector package.**

The **electrode array** interfaces with neural tissue by recording brain activity or delivering stimuli through precisely placed electrode sites. NeuroNexus probes are suitable for implanting into cortex or deep structures, as well as for interfacing with the brain or nerve surface.

Our technology offers a comprehensive design space capable of covering a 2-dimensional plane where electrode sites can be tailored to span cortical layers, cortical columns, or the brain surface. Alternatively, a volume of tissue can be covered by combining multiple 2-dimensional arrays. NeuroNexus offers a wide variety of catalog designs and offers Custom Design services (page 38) to meet each and every unique requirement.

The **connector package** provides the interface between the electrode array and the external instrumentation. Each package includes a specific **connector** type. The same electrode array can be paired with different connector packages, giving you a high degree of flexibility in configuring the best neural probe to suit your experimental requirements.

In some configurations, the package can also augment the functionality of the neural probe to include **optical stimulation, drug delivery, MR compatibility, microdrive compatibility,** and **chemical sensing.**


ELECTRODE ARRAY
CONNECTOR PACKAGE (H32)
NEURONEXUS
ELECTRODE ARRAY
CONNECTOR PACKAGE (A32)
R
A32
Rev3.3
G
150 µm
ELECTRODE SITE
ELECTRODE ARRAY
CONNECTOR PACKAGE (CM16)
NNX
5 mm

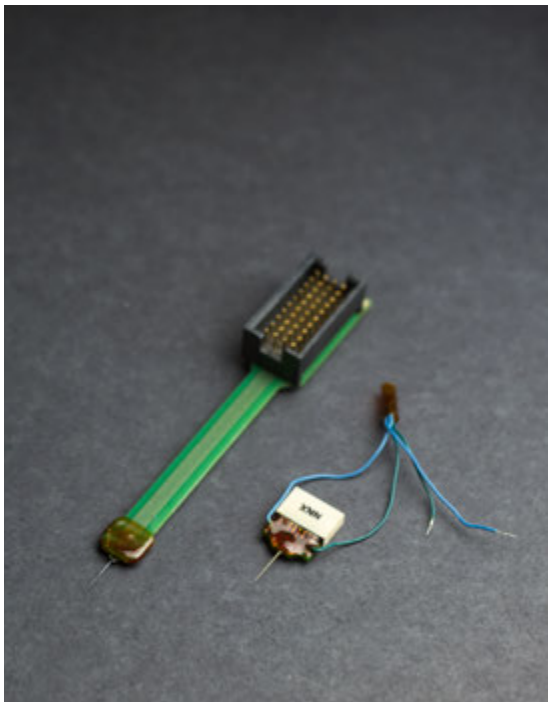
Standard Probes

NeuroNexus Standard Probes are fabricated using state-of-the-art silicon MEMS technology, initially developed at the University of Michigan. NeuroNexus has refined the technology to produce smaller and more versatile devices with precise and highly reproducible mechanical, geometric, and electrical characteristics. As a result, NeuroNexus users can expect consistent recording results every time they use our probes.

SPECIFICATIONS

Electrode Site Material	Iridium (standard), Platinum (custom), Gold (custom)
Electrode Thickness	15 µm or 50 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)

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 in the brain, Standard electrodes come in a vast collection of designs, each with different parameters, including: **length** (to span cortical layers), **number of shanks** (to span cortical columns), **electrode site area** (to target individual or groups of neurons), **electrode site spacing** (to target specific areas), and **site layout** (see page 8).

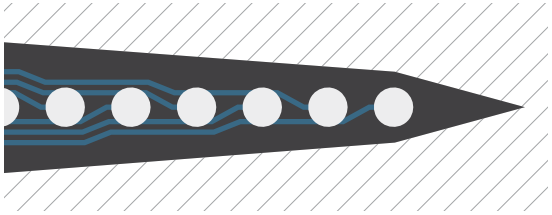


ARRAY DESIGNS

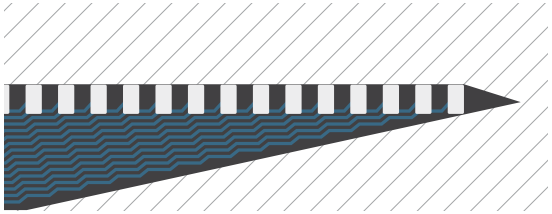
To start configuring a probe, turn to the **Electrode Array Design section** on page 87 to find an electrode array that meets your needs, or contact us directly. Once you have selected an electrode array design, match it to a **connector package** so it can interface with your headstage. Detailed specifications of our packages can be found on page 28.

STANDARD ARRAY SITE LAYOUTS

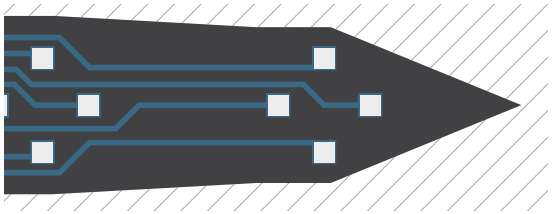
Below are examples of the different types of electrode array tips you can find in our **Electrode Array Design section** (page 87).



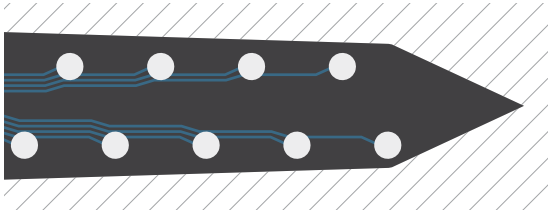
Linear electrode arrays are the foundation for multi-channel recordings. The laminar design allows for a longer area of coverage than a single tip site, and either facilitates or replaces the need for passage-type experiments. Linear electrode arrays fit the widest range of applications.



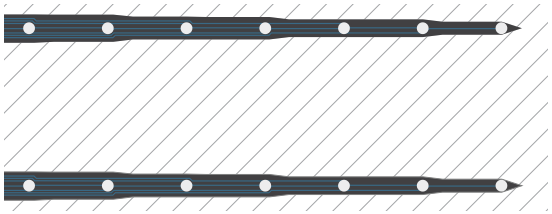
Edge sites are similar to the Linear layout, but electrode sites are strategically positioned at the edge of the substrate.



A **Tetrode** is an arrangement of four electrode sites placed close together, allowing for high-quality cell discrimination in recordings.



Polytrode electrode site layouts come in two variations: Poly2 (two columns of sites, shown left), or Poly3 (three columns of sites). They have a mix of linear and tetrode benefits, with sites close enough together to allow a degree of multiple representation across different sites, while sampling a larger space.



Multi-shank electrode arrays provide a two-dimensional representation of the brain. By controlling shank and site spacing, a more detailed understanding can be obtained of a larger space in the brain. Some multi-shank designs incorporate tetrode and polytrode site arrangements.

ELECTRODE ARRAY DESIGNS

Turn to **page 87** to see all available Standard electrode array designs. Find one that suits your application, and match it with a package to make a NeuroNexus probe!

DESIGN YOUR OWN PROBE

NeuroNexus offers Custom Design services, offering researchers access to a virtually unlimited design space.

Turn to page 38 to learn more.

REFERENCES:

Aizawa, Hidenori et al. "The Synchronous Activity of Lateral Habenular Neurons is Essential for Regulating Hippocampal Theta Oscillation." J Neurosci 2013

Ogawa, Takeshi et al. "Large-Scale Heterogeneous Representation of Sound Attributes in Rat Primary Auditory Cortex: From Unit Activity to Population Dynamics." J Neurosci 2011

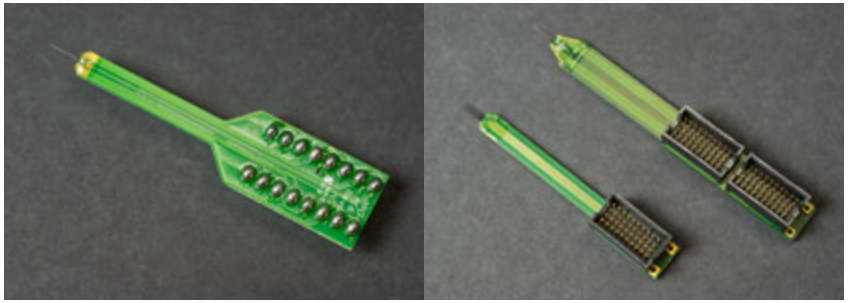
Jackson et al., Fast and slow gamma rhythms are intrinsically and independently generated in the subiculum. J Neurosci. 2011

Visit **neuronexus.com/science-update** for additional references.

CONNECTOR PACKAGE AND HEADSTAGE INTERFACE

Standard probes can interface with almost any commercially available headstage via the **connector package,** which consists of a specialized circuit board and your choice of connector. Packages can be classified as acute or chronic. Below is a list of our most commonly requested connector packages:

ACUTE



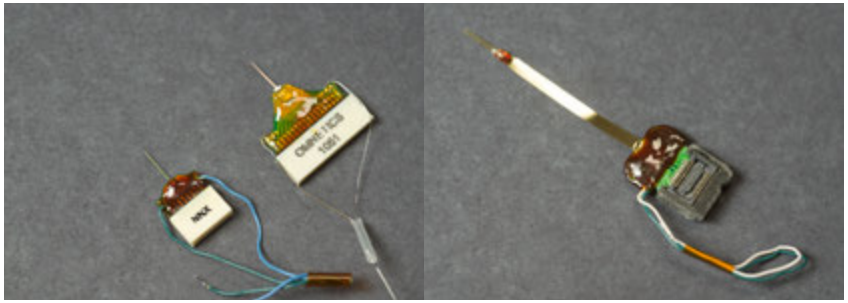
LEFT: A16 Package
RIGHT: A32 (left) and A64 (right) Packages

The A-Series package is suitable for acute experiments. The package is easy to handle and can be used with standard stereotactic frames.

Available acute packages:

- A16 / A32 / A64

CHRONIC



LEFT: CM16LP (left) and CM32 (right) Packages
RIGHT: HZ32 Package

Multiple packages can be specified for chronic experiments. The CM-Series is small and lightweight, permitting chronic implantation in mice. The H-Series packages include a robust, flexible cable, enabling microdrive use or floating implants. The Z-Series utilizes TDT's patented Zif Clip™ technology.

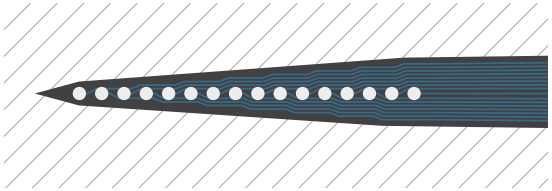
Available chronic packages:

- CM16LP / CM32
- H16 / HC16 / HZ16 / H32 / HC32 / HZ32 / H64 / H64LP / HC64 / HZ64
- Z16 / Z32 / Z64

A full description of all available connector packages can be found on page 28.

EXAMPLE CONFIGURATIONS

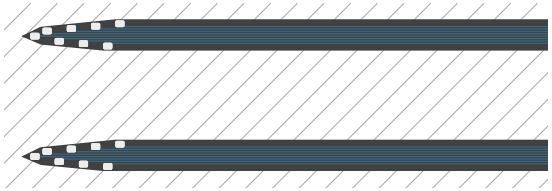
A1x16-5mm-25-177-A16

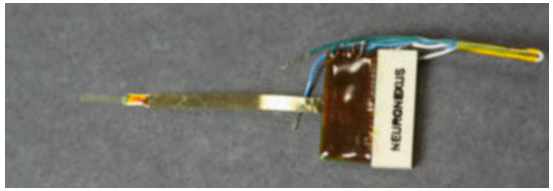


This example shows an A1x16-5mm-25-177 linear electrode array (left, page 90) configured with an A16 connector package (right, page 28). The electrode is 5mm long, and electrode site coverage spans 375 µm.

The A16 package utilizes Dual Inline Pin connections. Because of its size, this connector package is best suited for acute applications.

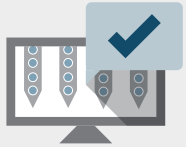
Buzsaki64-H64LP





This example shows a Buzsaki64 electrode array (left, page 122) configured with a H64LP connector package (right, page 31). The Buzsaki64 electrode array has a unique "octrode" electrode site layout which spans 140 µm vertically and 1400 µm horizontally.

The H64LP connector package utilizes two 32-channel Omnetics Nano connectors and includes a 30mm flex cable for connector standoff.



IMPROVE CHRONIC EXPERIMENTS

Combine an H-Series probe with the **dDrive** to improve the longevity of a chronic implant.

Turn to page 67 to learn more.

SmartProbe™

MINIATURIZED HIGH-CHANNEL COUNT PROBE WITH MODULAR ON-BOARD DIGITIZATION

SPECIFICATIONS

Channel Count	16, 32, 64, 128, 256
A/D Converter	16-bit ADC
Sampling Rate	Up to 30 kSamples/s
Signal Bandwidth	0.1-100 Hz 250 Hz -7.5 kHz

The SmartProbe™ combines reusable modular on-package electronics with NeuroNexus neural electrode arrays, enabling high channel count recording in an ultra-compact form factor.

The SmartProbe™ utilizes state-of-the-art on-board electronics to digitize neural signals at the implant site, minimizing both the overall implant size as well as noise from connectors and movement.

Miniaturization is achieved through the reduction of the output connector lead count, allowing a large number of channels (up to 256) to be multiplexed through a standard mini HDMI cable. Connection force is reduced, so daily connections take place more reliably.

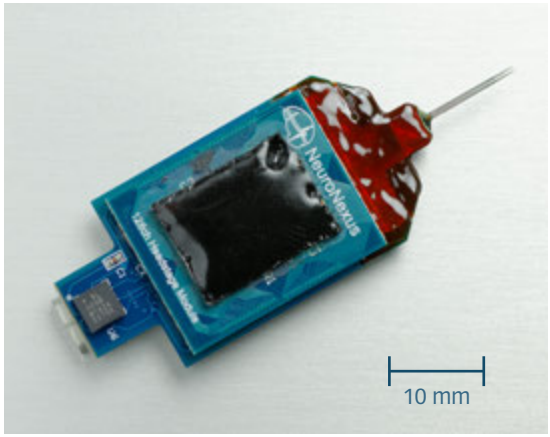
ARRAY DESIGNS

The SmartProbe™ can be configured from any Standard NeuroNexus electrode array. Turn to page 87 to see available designs.

DATA ACQUISITION AND CONTROL SYSTEMS

The SmartProbe™ requires a control and acquisition system such as the SmartBox™, or any Intan-compatible system. No headstage is required.

Alternatively, Standard NeuroNexus or other electrodes can be connected to the SmartBox™ with SmartLink headstages.



Above: 128 Channel SmartProbe with reusable on-package electronics
Below: SmartProbes can interface with any Intan system. NeuroNexus offers a cable for these applications.

SMARTBOX™

Do you need a portable, ready-to-go data acquisition solution?

Turn to page 63 to learn more.

Matrix Array™

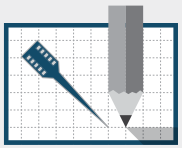
TRUE 3D NEURAL INTERFACE FOR LARGE AND SMALL ANIMALS

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. The Matrix Array™ concurrently spans cortical columns and layers, covering a volume of tissue and interfacing with large populations of neurons.

The support structure of the Matrix Array™ is a silicon platform where our industry-standard 2D silicon electrodes can be installed. Both the slot spacing and the 2D electrode arrays 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.

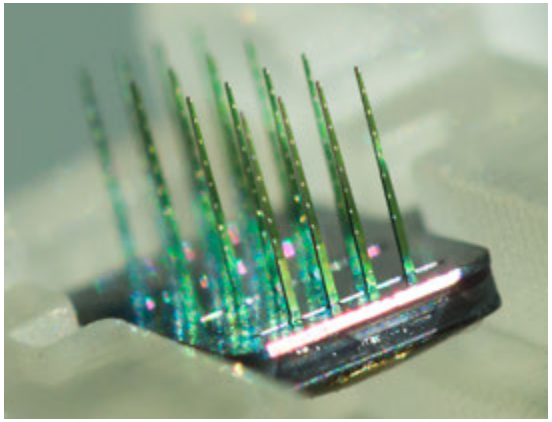
SPECIFICATIONS

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
Available Packages	Large Animal Chronic, Small Animal Chronic, Smart, MRI, Acute

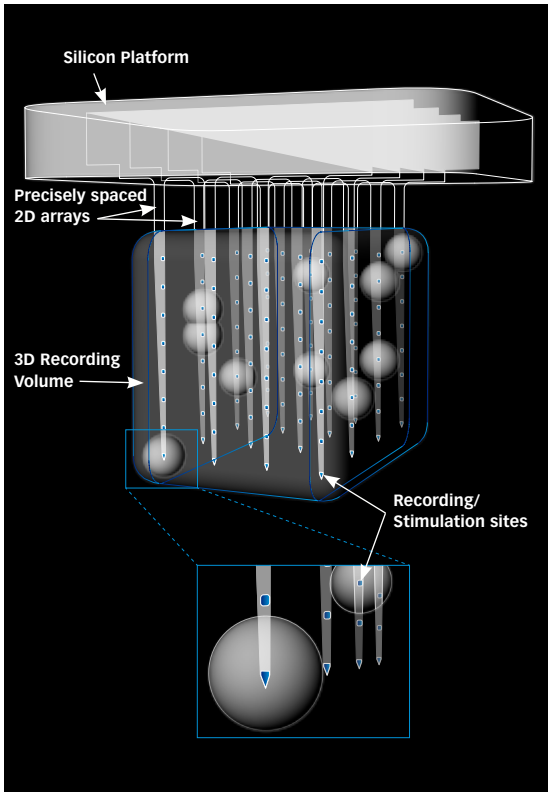


DESIGN YOUR OWN MATRIX ARRAY™

Up to 4 different electrode arrays can be specified for the available slots in the Matrix Array™ platform, and the platform itself can be customized to adjust the X-Y span of the probe.



Above: Close-up of the Matrix Array™.
Below: Matrix Array™ platform showing four 2D arrays installed, allowing electrode sites to record and stimulate in a three-dimensional space.

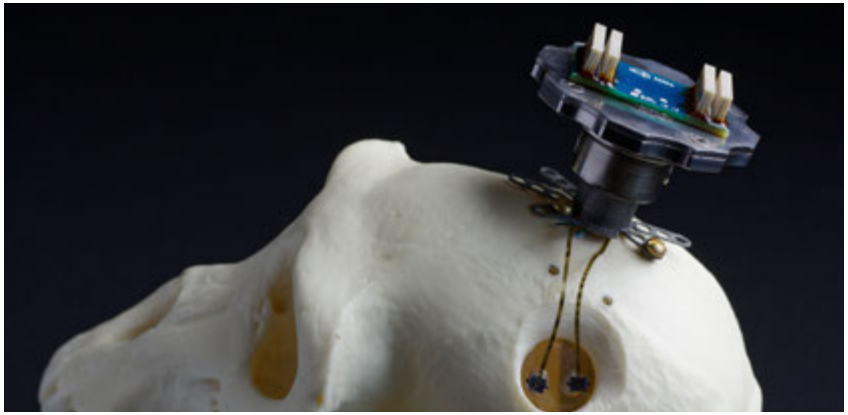


CONNECTOR PACKAGE AND HEADSTAGE INTERFACE

The Matrix Array is available in a wide variety of packaging options to suit almost any application:

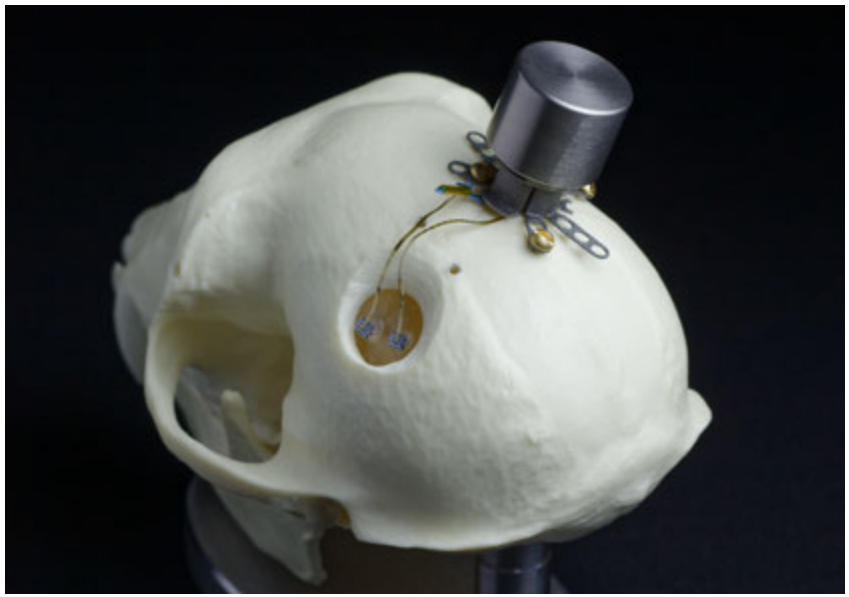
- **Large Animal Chronic (including Primate)**
- **Small Animal Chronic**
- **Acute**
- **MRI (with custom pedestal)**
- **Smart-enabled**

Additionally, the Matrix Array can be configured as a **single platform** (above left), **dual platform** (above middle, and "Large Animal Chronic" right), or as a **combined system** utilizing both penetrating arrays and a surface electrode (above, right).



Adaptors are available to connect the Matrix Array to any system. The Matrix HD package utilizes a self-aligning adaptor (above image) that connects simply and precisely with force applied via a torque wrench, reducing strain on the package and animal.

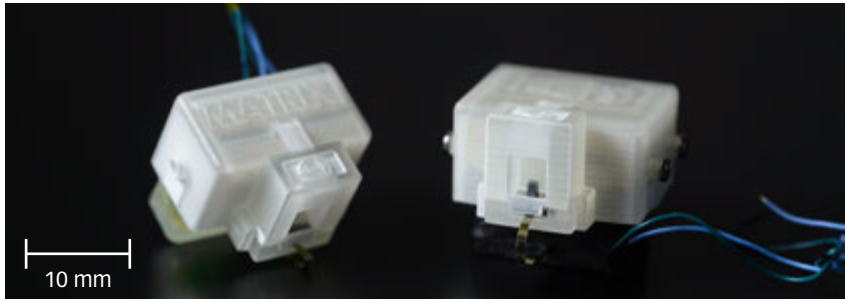
Large Animal Chronic



Dual Platform Matrix Array™ with Primate Pedestal

The updated **Matrix HD** package uses a durable high-density connector, allowing for a smaller overall package. A customizable titanium pedestal securely anchors the connector package to the skull. Self-aligning adaptors enable connection to existing systems.

Small Animal Chronic



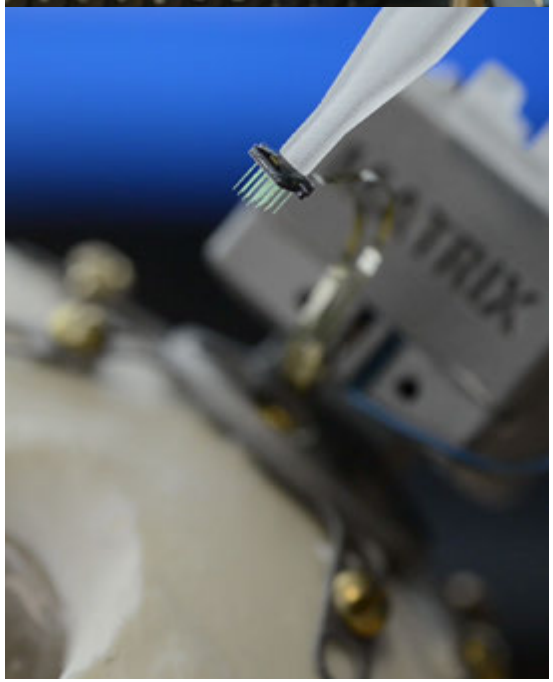
The **Small Animal Matrix Array** package comes in 64 and 128 channel variants, and connect to commonly available headstages and systems.

INSERTION TOOL (IST-MOTOR)

We have developed the IST-Motor insertion tool based on a computer-controlled, precision linear actuator to support surgical implantation of NeuroNexus arrays. Through our intuitive software application, arrays can be implanted to precise locations, at speeds most suitable for the application.

The IST-Motor can be mounted to standard stereotaxic manipulators. All IST (Insertion Tool) product lines are compatible with the IST-Motor, providing compatibility with all NeuroNexus probe packages.

The IST-Motor is ideal for insertion of our Matrix Arrays™. The carefully calibrated insertion minimizes damage from excessive insertion force. The specially designed IST-Matrix utilizes vacuum suction to hold the Matrix Array™ during insertion, allowing for a simple, vibration-free release after implant.



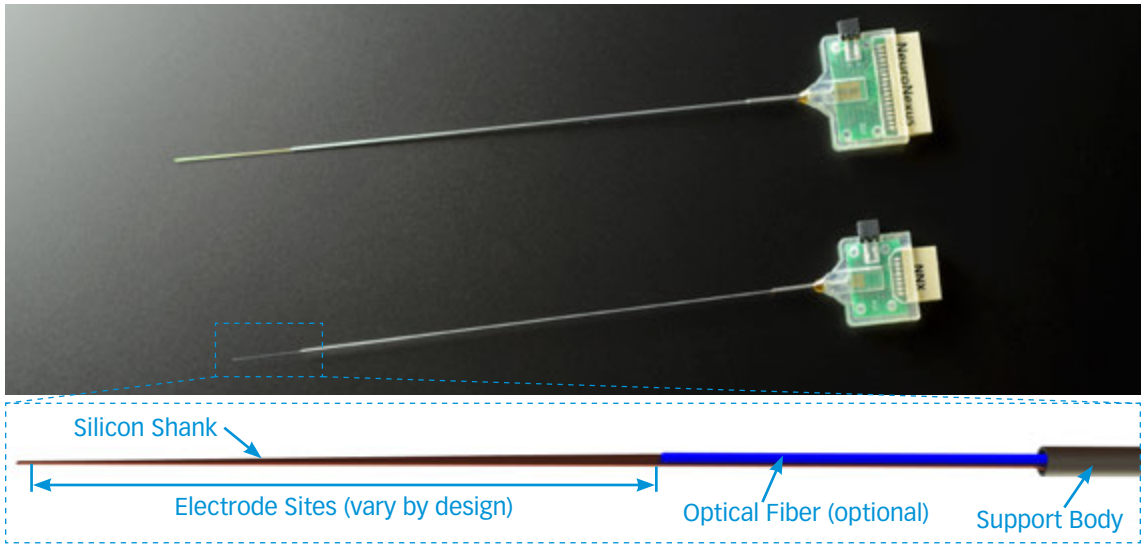
SPECIFICATIONS

Speed	0.22 µm/s - 8 mm/s (4.5 mm/s recommended)
Travel Range	0 - 50 mm
Accuracy	30 µm
Step Size	0.05 µm
Dimensions	150 mm (L) x 30 mm (W) x 20 mm (H)

Vector Array™

DEEP BRAIN
NEURAL INTERFACE

The Vector Array™ is optimized for large animal deep brain applications (e.g. non-human primate, porcine, etc). The probe design is completely overhauled to fully take advantage of our industry-leading silicon probe technology.



TOP: 32-channel (above) and 16-channel (below) Vector Arrays™
BOTTOM: Distal end of the Vector Array™, showing silicon electrode array with optional optical fiber augmentation.

The proximal body of the Vector Array™ is made of a rigid metal tube (Support Body), while the distal end interfacing with the target region is a customizable NeuroNexus silicon electrode array. This hybrid assembly combines a high-quality, proven neural interface at the critical region while providing the elongated probe system with a robust body.

SPECIFICATIONS

Implantable Length	70 mm
Silicon Electrode Length	10 mm
Site Layout	Edge or Poly2 (customizable)
Site Coverage	375 µm to 6300 µm, depending on design
Silicon Electrode Width	20 µm (min), ≈ 175 µm (max)
Channel Count	16, 32, 64
Support Body Diameter	315 µm OD (16-ch) 400 µm OD (32-ch, 64-ch)

ARRAY DESIGNS

See pages 153-158 for available Vector Array™ designs.

CONNECTOR PACKAGE AND HEADSTAGE INTERFACE

The Vector Array™ uses the H package. See page 30 for more detail.

Optogenetics

TURNKEY SOLUTIONS

SPECIFICATIONS

Fiber	Fused silica, 50 µm or 105 µm core, multi-mode
Outer Diameter	125 µm (standard) 62.5 µm (etched)
Weight (Coupler)	< 0.5 g
Transmission	> 75% (50 µm core to 105 µm core)
Numerical Aperture	0.22, 0.66
Durability	< 5% transmission variability after 40 connections
Rotation Test	< 2% variation over 1 rotation
Connection Strength	> 300 g before latch separation (typical)
Maximum Shear Force	900 g (applied to top of female coupler)
Length	Tolerance ± 500 µm
Fiber Tip Profile	Flat

NeuroNexus offers a wide range of products to support optogenetics research. Our optogenetics line includes **optoelectrodes, implantable fibers, light source systems (page 72),** and **accessories.** If you are new to the field of optogenetics, we also offer smartly bundled **optogenetics packages** with the equipment you need to get started.

OPTOELECTRODE ARRAY DESIGNS

Any Standard electrode array can be configured as an optoelectrode to enable concurrent optical stimulation and neural recording. An optical fiber (105 µm diameter) is placed on the top of the shank, and terminates 200 µm above the proximal site (distance can be customized on request). Multi-shank electrode arrays can be configured as optoelectrodes, but have limitations on fiber placement. Contact us for more information.

ABOVE: Illustration showing optical fiber mounted on an electrode array shank.

PROBE PACKAGE AND HEADSTAGE INTERFACE

NeuroNexus optoelectrodes use packages similar to our Standard probes. We recommend the OA series for acute experiments, and the OCM (Omnetics Nano) and OZ (Zif Clip™) series for chronic experiments. See pages 34-35 for more package information.

OPTOELECTRODE TECHNICAL NOTE

Visit neuronexus.com/products for an in-depth technical reference on optogenetics and probe configuration.

CHOOSING AN OPTICAL CONNECTION

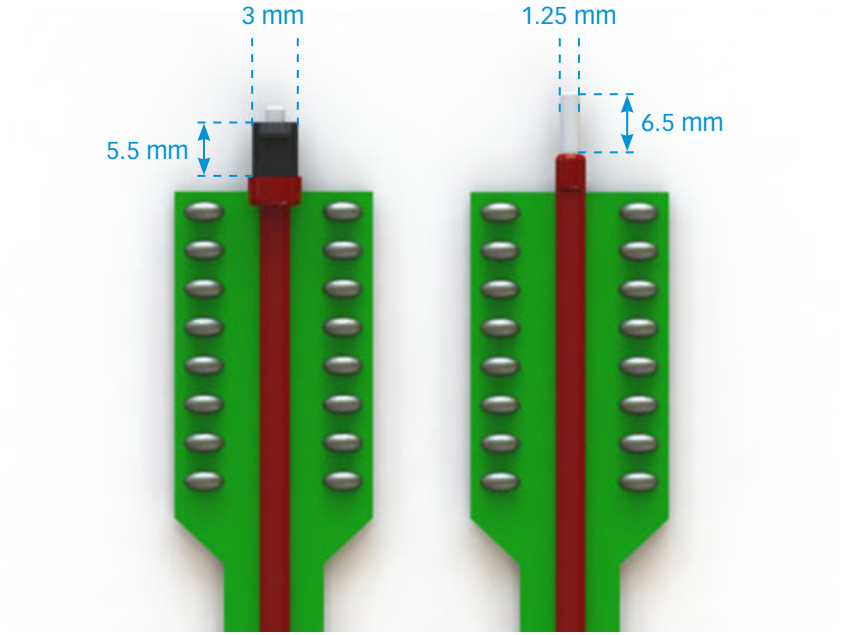
In addition to specifying an electrical connector, you should also specify an optical connector when configuring an optoelectrode. NeuroNexus offers two kinds of optical connection. LEFT: The Standard optoelectrode uses our locking NNc coupling mechanism. RIGHT: The Low Profile (LP) optoelectrode uses ferrule-to-ferrule coupling.

Standard (NNc coupling): OA, OCM, OZ

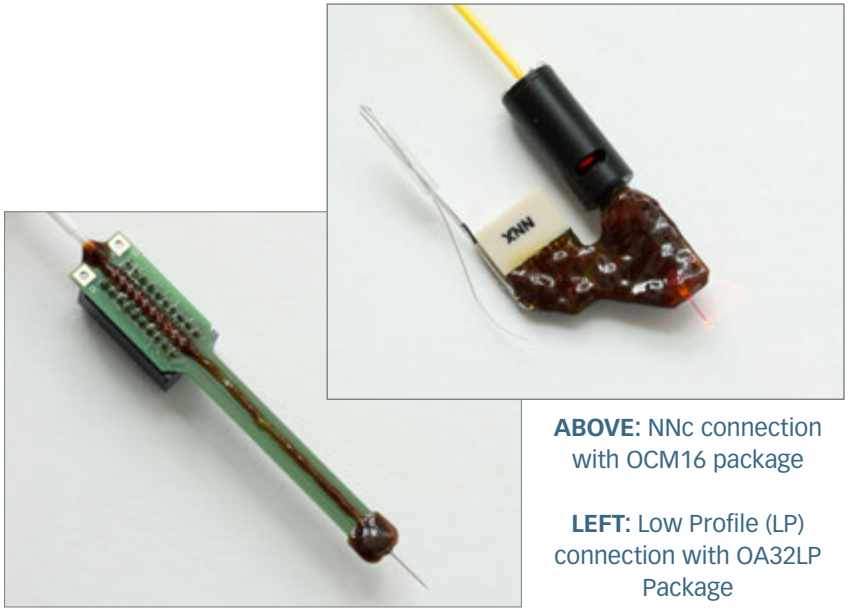
Our custom NNc coupling mechanism offers a robust optical connection that is best suited for behavioral studies. Due to its unique locking mechanism, NNc optoelectrodes offer the most consistent optical transmission for awake behaving animals. Typical transmission from a 50 µm core patch cord to a 105 µm core optoelectrode is >80%.

Low Profile (bare ferrule-to-ferrule coupling): OA LP, OCM LP, OZ LP

Bare ferrule-to-ferrule coupling is the most commonly used tool for optogenetics studies. It offers a simplified connection and smaller package size, but lacks the secure, robust connection the NNc coupling method provides. The LP packages also mate with TDT's Motorized Commutator. Typical transmission from a 50 µm core patch cord to a 105 µm core optoelectrode is >75%. LP packages use a 1.25 mm ceramic ferrule.



Left: Standard Connector
Right: Low Profile (LP) Connector



ABOVE: NNc connection with OCM16 package

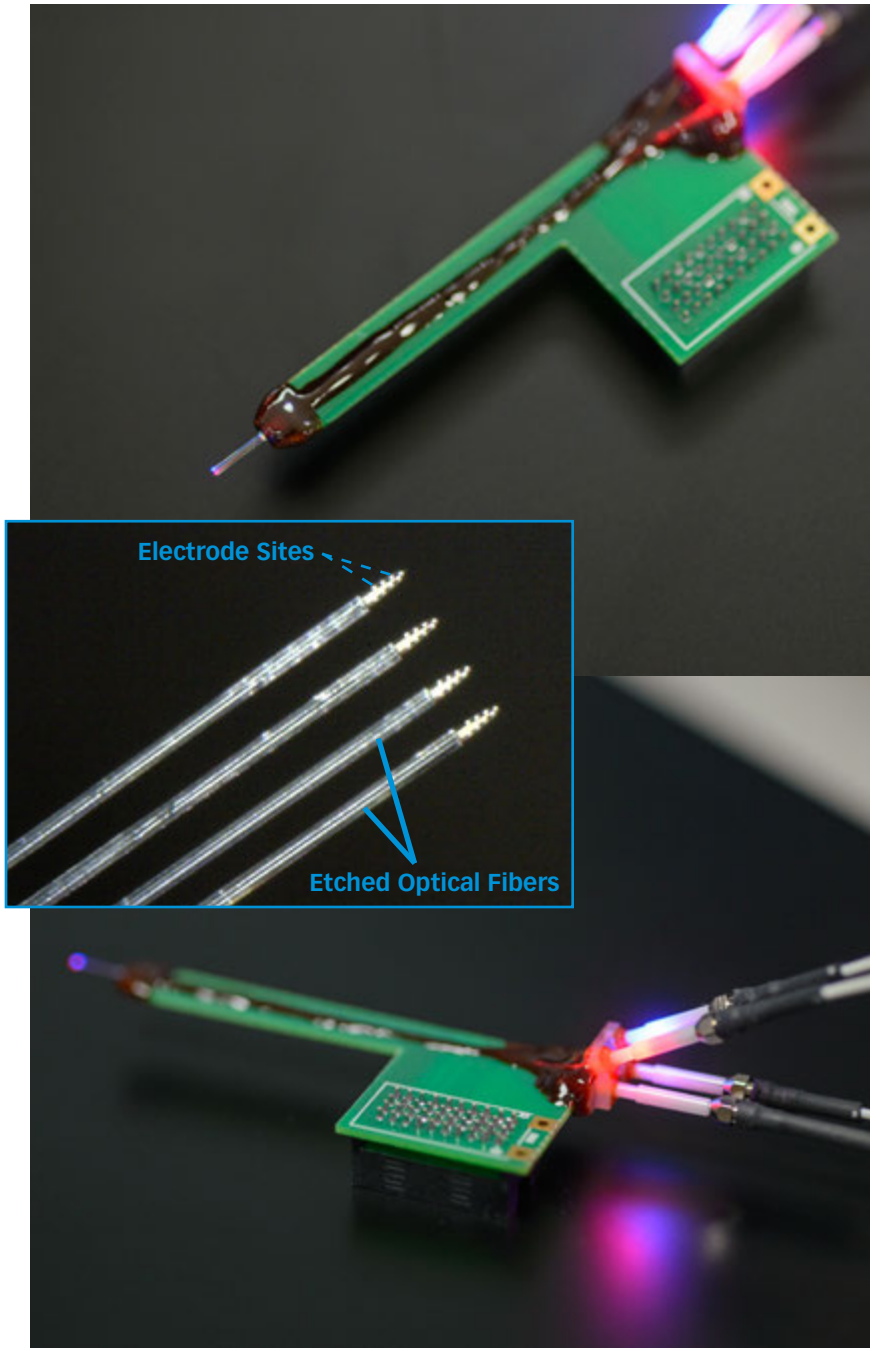
LEFT: Low Profile (LP) connection with OA32LP Package

MULTI-FIBER OPTOELECTRODES

NeuroNexus now offers multi-fiber optoelectrodes for expanded optogenetics applications in a compact, robust package.

Using acid etched optical fibers (65 µm), up to 8 fibers can be attached to each probe (one fiber per electrode array shank). Because of the physical limitations of optical fibers and NeuroNexus microelectrode arrays, there are some design constraints. Multi-fiber optoelectrodes are only available in LP (bare ferrule) packages.

RIGHT, TOP: Quad-optrode package showing lit fibers
RIGHT, BOTTOM: Compact ceramic ferrule attachment
INSET: Close-up image of a Buzsaki32 electrode array showing mounted fibers

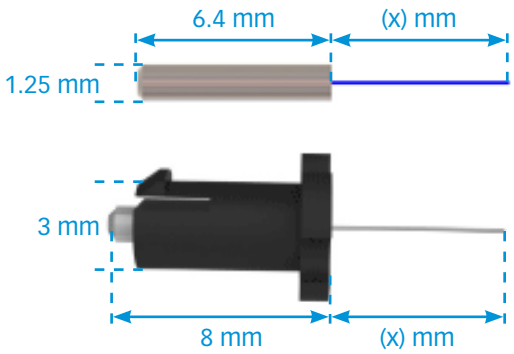


SPECIFICATIONS

Fiber	Fused silica, 50 µm (etched), 105 µm core (dual fiber only), multi-mode
Outer Diameter	65 µm (etched), 125 µm (105 µm core, dual fiber only)
Weight (Coupler)	< 0.5 g
Numerical Aperture	0.22
Durability	< 5% transmission variability after 40 connections
Rotation Test	< 2% variation over 1 rotation
Connection Strength	> 300 g before latch separation (typical)
Maximum Shear Force	900 g (applied to top of female coupler)
Length	Tolerance ± 500 µm
Fiber Tip Profile	Flat

IMPLANTABLE FIBERS

Implantable optical fibers are ideal for experiments requiring only optical stimulation without electrical recording from nearby neurons. The implantable fiber length can be customized between 2 - 10 mm, with a standard length of 2.5 mm. Note that the base of the NNc is designed to sit on the skull, so the skull thickness must be taken into account when determining the desired fiber length.



TOP: LP (Low Profile) Implantable fiber
BOTTOM: NNc Implantable fiber

LIGHT SOURCE INTERFACE

To interface with a variety of light source connectors, NeuroNexus offers patch cords with customized optical mating connectors. NeuroNexus currently offers patch cords to interface light sources with either a FC/PC, SMA, or LC connector. The standard length of a patch cord is 3 meters. Other lengths can be customized with a surcharge of $15/meter.

NeuroNexus currently offers patch cords with core diameter of 50 µm or 105 µm. Optical fibers can be optionally protected with plenum but will increase the patch cord diameter to 900 µm. A plenum patch cord is somewhat less flexible but offers additional protection against mechanical wear and tear.

It is optimal to use a patch cord with a core diameter that is equal to or larger than that of your light source. It is best to minimize core diameter mismatch. Be sure to check the core size of your light source before ordering the Optical Patch Cord.

When selecting a suitable light source, consider that single mode laser sources have core diameters less than 10 µm and provide excellent optical coupling efficiency. Alternatively, LED sources tend to have larger core diameters (e.g. 200 µm) and may result in lower efficiency.

OPTOGENETICS BUNDLES

NeuroNexus offers Optogenetics bundles with everything you need to get started. Visit neuronexus.com/products to learn more, or contact us directly.

LIGHT SOURCE SYSTEMS

NeuroNexus now offers light source systems. Contact us to tune one to your application.

Turn to page 72 to learn more.

REFERENCES:

Kravitz et al., Regulation of parkinsonian motor behaviours by optogenetic control of basal ganglia circuitry. Nature 2010

Royer et al., Multi-array silicon probes with integrated optical fibers: light-assisted perturbation and recording of local neural circuits in the behaving animal. Eur J Neurosci. 2010

Visit **neuronexus.com/science-update** for additional references.

Surface Probes

FLEXIBLE ARRAYS FOR µEEG RECORDING AND STIMULATION

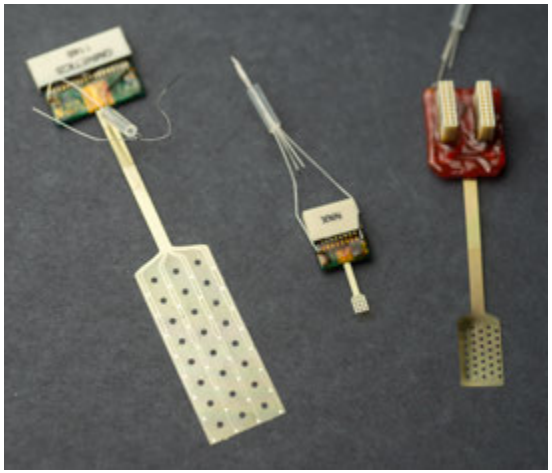
Surface electrode arrays are fabricated using our polymer MEMS technology, resulting in an ultra-flexible substrate designed to conform to the brain surface. These arrays are designed for surface electrocortigram (ECoG) recording, and can stimulate with appropriate electrode site optimization. They may be combined with Standard probes to establish concurrent surface and intracortical interfaces. Surface probes can also interface with a variety of nerves.

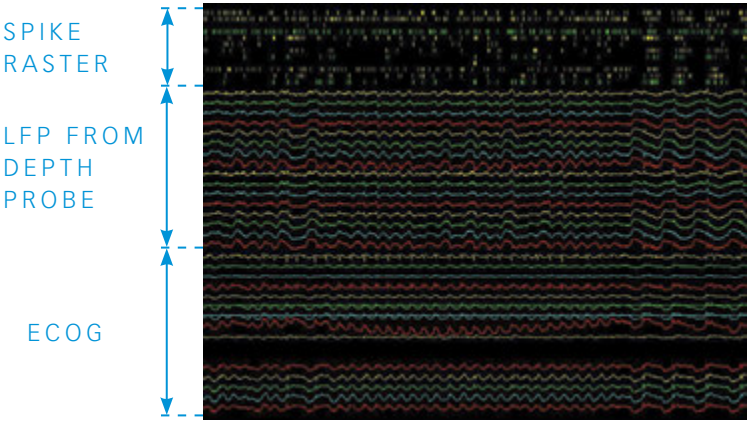
SPECIFICATIONS

Electrode Site Material	Platinum
Array Thickness	20 µm
Cable Length	5, 6, 10, 20, 30 mm (varies by design)
Channel Count	16, 32, 64 (varies by design)

ARRAY DESIGNS

NeuroNexus offers a variety of catalog designs suitable for use in species ranging from mice to non-human primates (see page 142-148). All Surface electrode arrays are integrated with a flexible cable. (Length varies by electrode design.)





ABOVE RIGHT: Surface probes. L-R: E32-3000-20-300-H32, E16-500-5-200-CM16, E32-1000-20-50/100-HC32

BELOW RIGHT: Actual simultaneous recordings of ECoGs from the brain surface using an E-Probe and spiking activity from the cortex using an A-Probe.

Nerve Cuffs

FLEXIBLE ARRAYS FOR NERVE STIMULATION

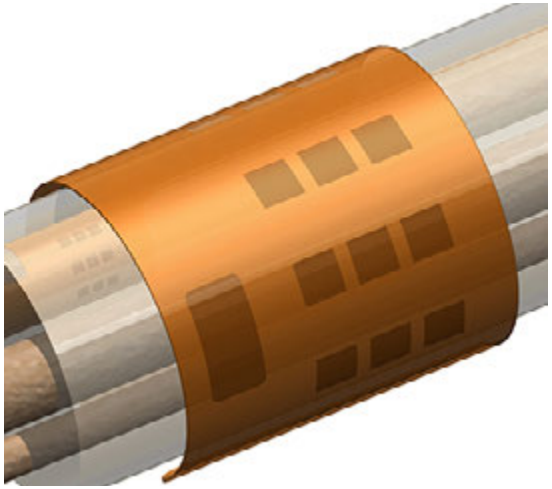
NeuroNexus Nerve Cuffs are ultra-flexible and durable polymer electrodes designed for stimulating and recording from peripheral nerves. Nerve Cuffs are fabricated with the same technology as our tried-and-tested Surface Electrodes.

SPECIFICATIONS

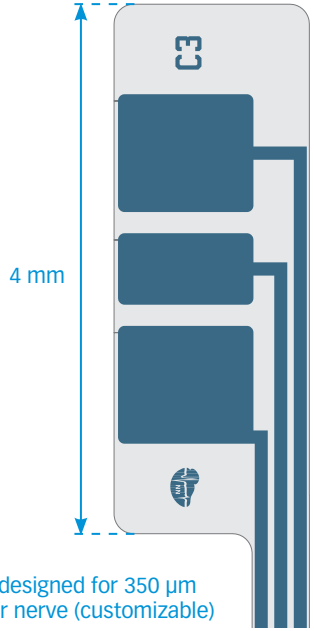
Electrode Site Material	Platinum
Array Thickness	20 µm

ARRAY DESIGNS

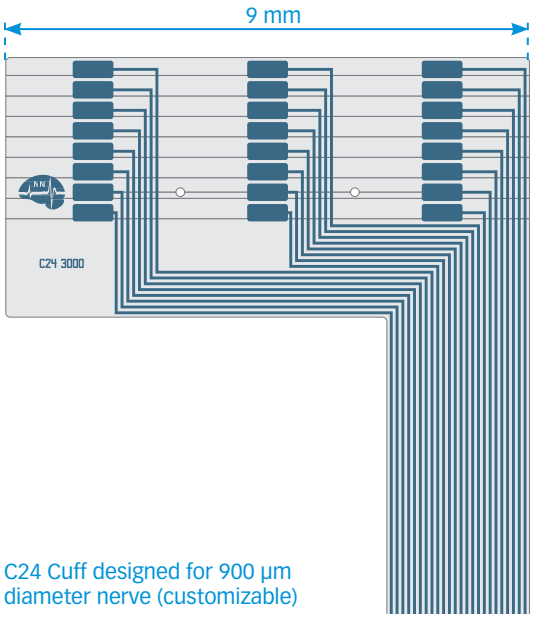
NeuroNexus offers a growing number of cuff designs (see page 139-140 for existing designs). All Nerve Cuff arrays are integrated with a flexible cable. (Length varies by electrode design.)



Above: Cuff electrodes wrapped around nerve bundle. Cuffs can be pre-curved to nerve diameter.



C3 Cuff designed for 350 µm diameter nerve (customizable)

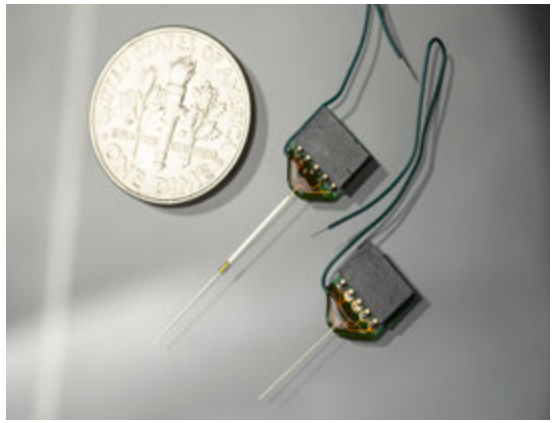


C24 Cuff designed for 900 µm diameter nerve (customizable)

Qtrode

4-CHANNEL PROBE

The **Qtrode** is a 4-channel probe ideal for acute and chronic experiments requiring lower channel counts, or for replacing wires. Qtrodes utilize the same technology as our Standard probes, and are stocked for fast delivery.



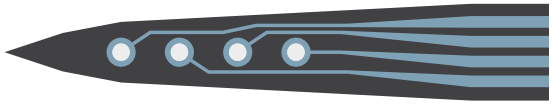
HQ4_21mm (top) and CQ4 (bottom) chronic packages

SPECIFICATIONS

Electrode Site Material	Iridium (standard)
Electrode Thickness	15 µm or 50 µm (varies by design)
Electrode Length	3, 5, 10 mm (varies by design)
Site Layout	Linear or Tetrode
Channel Count	4

ARRAY DESIGNS

The Qtrode has 2 available site layouts: Linear, and Tetrode. Qtrodes can reach structures as deep as 10 mm, and Linear site layouts can span depths of 150 µm, 300 µm, or 600 µm. (See pages 149-152 for complete array specifications.)



LINEAR

TETRODE

PROBE PACKAGE AND HEADSTAGE INTERFACE

Acute Qtrode packages use edge card technology, and chronic packages use 5 pin connectors. Adaptors are available to interface with other headstages (see page 73).

ABOVE: Q4 acute package

Specialty Applications

DRUG DELIVERY

SPECIFICATIONS

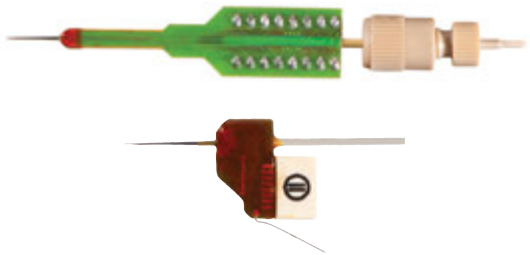
Electrode Site Material	Platinum
Total Probe Thickness	≈ 185 µm
Fluidic Port Tip Angle	90° (Standard) 45° (Custom)
Implantable Length	15-18 mm
Electrode Coverage	1.5 mm
Channel Count	16
Available Packages	D16, DM16

The E16-20mm-100-177 electrode array (page 124) can be mounted on a fluidic tube to combine drug delivery and electrophysiological recording. The fluidic tube is mounted on the lower side of the microelectrode array, and the delivery port is at the distal end of the fluidic tube.

The fluidic interface is compatible with standard HPLC adaptors for interfacing with external injection pumps. Typically, a pressure-based delivery mechanism is used.

As with many of our products, the fluidic probe can be customized. Contact us for your customization needs.

INTERFACE OPTIONS



Top: D16 probe. **Bottom:** DM16 probe.

Illustration of a fluidic tube mounted on the underside of an electrode array

REFERENCES:

Harris et al., Does neural input or processing play a greater role in the magnitude of neuroimaging signals? Front Neuroenergetics 2010

Maier et al., Cannabinoids disrupt hippocampal sharp wave-ripples via inhibition of glutamate release. Hippocampus 2011

Mangubat et al., On-demand pulsatile intracerebral delivery of carisbamate with closed-loop direct neurostimulation in an electrically induced focal-onset epilepsy rat model. J Neurosurgery (in press)

The D16 and DM16 packages are designed for drug delivery applications. The D16 is intended for acute use, and has the same general specifications as the A16 package. The DM16 is intended for chronic experiments of less than 1 week, and is similar to the CM16LP package.

Specialty Applications

MR COMPATIBLE & CHEMICAL SENSING

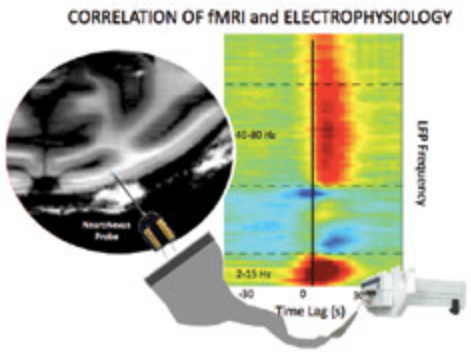
SPECIFICATIONS (MR COMPATIBLE)

Available Packages	MR_A16, MR_CM16, MR_CM32, MR_HC16, MR_HC32, MR_HC64

SPECIFICATIONS (CHEMICAL SENSING)

Electrode Site Material	Platinum (custom)
Electrode Thickness	15 µm or 50 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)

MR COMPATIBLE



When configured with the MR-Series Package, NeuroNexus probes include only trace amounts of ferromagnetic material and cause minimal or no distortion during typical MR imaging. In addition to the packages listed to the left, most of our Omnetics connector-based packages can be made MR compatible. Please contact us for details.

REFERENCES:

Kahn et al., Characterization of the Functional MRI Response Temporal Linearity via Optical Control of Neocortical Pyramidal Neurons. J Neurosci 2011

Young et al., Functional MRI response and correlated electro-physiological changes during posterior hypothalamic nucleus deep brain stimulation. Neuroimage 2011

MR A16 Probe. All MR-Compatible probes use special Omnetics Nano connectors marked "NI FR."

CHEMICAL SENSING

NeuroNexus probes can be tuned to detect neurochemical and electrophysiological signals. Chemical detection can be achieved by analyzing the *in vivo* cyclic voltammograms from electrode sites coated with ion selective membranes. NeuroNexus does not provide coatings, but can provide design suggestions and references that describe coating methods.

REFERENCES:

Johnson et al., Spatiotemporal pH dynamics following insertion of neural microelectrode arrays. J Neurosci Method. 2006

Johnson et al., Implantable microelectrode arrays for simulta-neous electrophysiological and neurochemical recordings. J Neurosci Method. 2008

Specialty Applications

rDBSA (DEEP BRAIN STIMULATION)

SPECIFICATIONS (rDBSA)

Electrode Site Material	Platinum
Substrate Material	Polyamide
Lead Diameter	0.75 mm
Penetration Length	up to 45 mm
Electrode Contact Shape	Elliptical
Channel Count	32

The rDBSA is a high-resolution multichannel probe for use in DBS research in animal models, developed from our innovative clinical DBS technology.

The rDBSA's novel design enables more precise, selective, and tunable microstimulation of deep brain structures. This establishes a significantly enhanced neural interface that enables more flexibility in electrode positioning, more precise current delivery, and more selective stimulation programming.

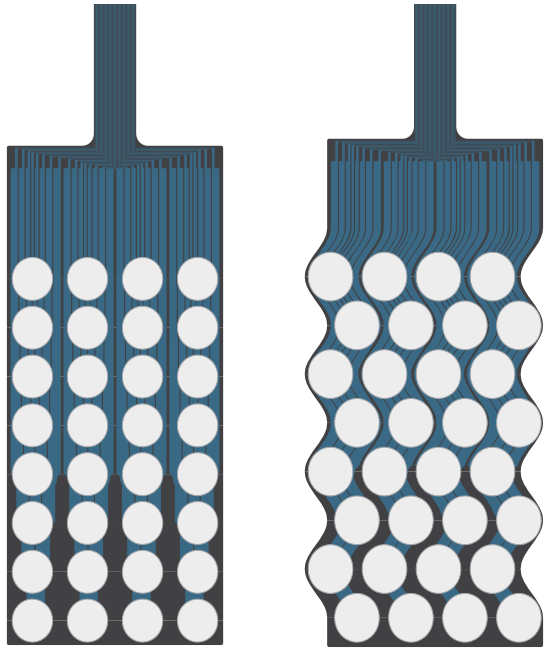
ARRAY DESIGNS

There are two rDBSA designs currently available. Type 1 features linear columns of electrode sites, and Type 2 utilizes offset sites.

PROBE PACKAGE

The rDBSA uses an Omnetics Nano 36-pin headstage connection.

An rDBSA probe tip, showing the wrapped array.



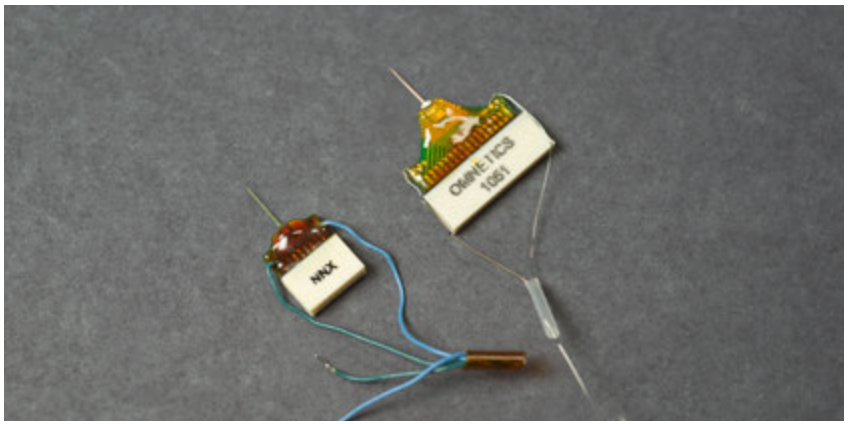
ABOVE: The Type 1 (left) and Type 2 (right) rDBSA arrays, unwrapped. The large sites are optimized for stimulation.

Headstage Interface

NeuroNexus probes interface with most commercially available headstages via the **connector package.** We also provide the SmartLink headstage for use with the SmartBox.

To configure a package for your headstage, you will first need to know what type of connector your headstage uses. Then, find the compatible packages that match up to your headstage.

OMNETICS NANO CONNECTORS



Omnetics Nano connectors are widely available. NeuroNexus offers a large range of packages that connect to headstages with Omnetics Nano connectors:

16 channel: CM16LP, H16, HC16, OCM16, DM16, MR_CM16
32 channel: CM32, H32, HC32, OCM32, MR_CM32
64 channel: H64, H64LP, HC64

DUAL INLINE PIN (DIP)

Dual Inline Pin connectors offer a versatile, reliable connection for acute applications.

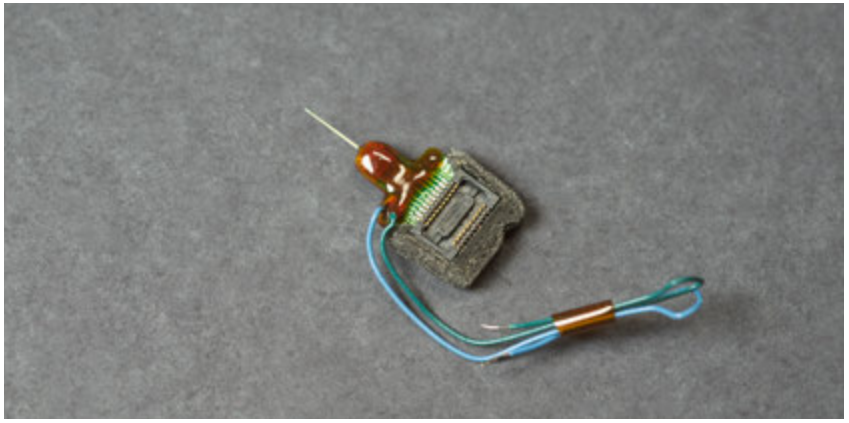
16 channel: A16

Headstage Interface

If you have a headstage that does not connect directly to any of our packages, you might need an adaptor. A complete list of adaptors can be found at neuronexus.com/products/accessories.

If you cannot find an adaptor that meets your setup needs, contact us for a custom adaptor or cable.

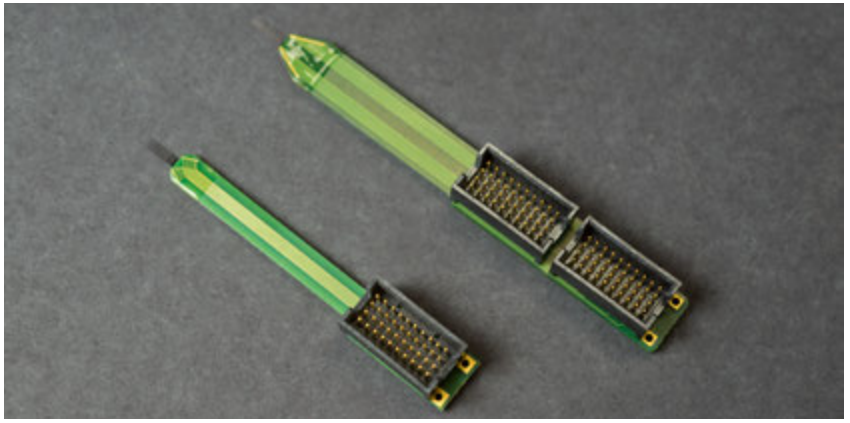
TDT ZIF-CLIP™



TDT Zif-Clip™ headstages utilize miniature, low insertion force connectors. Because of their small size, we recommend Zif-Clip™ headstages and packages for chronic use.

16 channel: Z16, HZ16
32 channel: Z32, HZ32
64 channel: Z64, HZ64

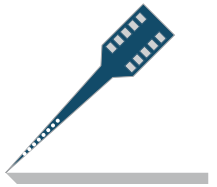
SAMTEC



SAMTEC connectors are reliable, stable, high-density connectors standard in acute applications.

32 channel: A32
64 channel: A64

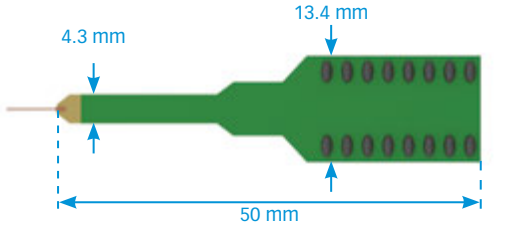
Connector Package Specifications



A-SERIES (ACUTE - PAGE 8)

A16

The A16 package is ideal for acute experiments using 16 channel electrode arrays.

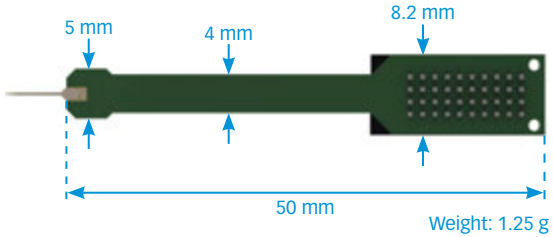


Weight: 1.25 g

CONNECTOR TYPE: Dual Inline Pin (DIP); pin length 5.5 mm, spacing 2.5 mm
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

A32

The A32 package is ideal for acute experiments using 32 channel electrode arrays.

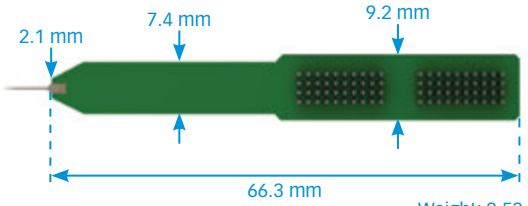


Weight: 1.25 g

CONNECTOR TYPE: SAMTEC MOLC-110-01-S-Q
MATING CONNECTOR: SAMTEC FOLC
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

A64

The A64 package is ideal for acute experiments using 64 channel electrode arrays.



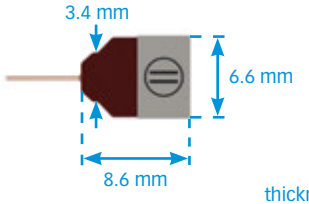
Weight: 2.53 g

CONNECTOR TYPE: (2x) SAMTEC MOLC-110-01-S-Q
MATING CONNECTOR: (2x) SAMTEC FOLC
COMPATIBLE ELECTRODES: Any 64 channel Standard (A-type) electrode array

CM-SERIES (CHRONIC - PAGE 8)

CM16LP

The compact CM16LP package is ideal for chronic experiments using 16 channel electrode arrays.

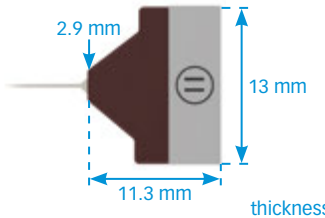


thickness: 1.73 mm
weight: 0.17 g

CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

CM32

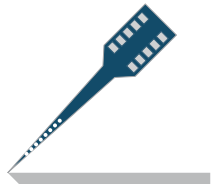
The compact CM32 package is ideal for chronic experiments using 32 channel electrode arrays.



thickness: 1.78 mm
weight: 0.32 g

CONNECTOR TYPE: Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

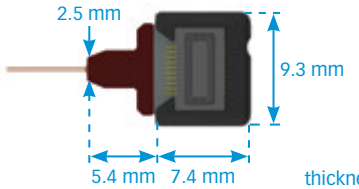
Connector Package Specifications



Z-SERIES (CHRONIC - PAGE 8)

Z16

The Z16 package is ideal for chronic experiments using 16 channel electrode arrays. It connects directly to a TDT ZC16 or ZC32 headstage.

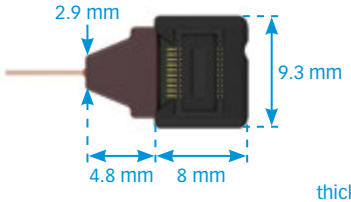


thickness: 2 mm
weight: 0.25 g

MATING CONNECTOR: TDT ZC16/ZC32 headstage
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

Z32

The Z32 package is ideal for chronic experiments using 32 channel electrode arrays. It connects directly to a TDT ZC32 headstage.

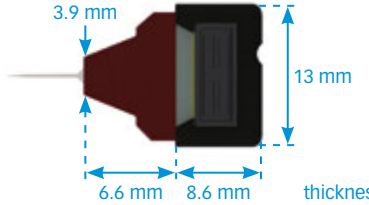


thickness: 2 mm
weight: 0.25 g

MATING CONNECTOR: TDT ZC32 headstage
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

Z64

The Z64 package is ideal for chronic experiments using 64 channel electrode arrays. It connects directly to a TDT ZC64 headstage.



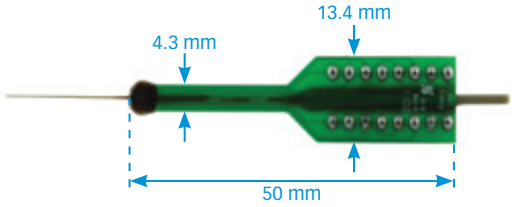
thickness: 2 mm
weight: 0.44 g

MATING CONNECTOR: TDT ZC64 headstage
COMPATIBLE ELECTRODES: Any 64 channel Standard (A-type) electrode array

D-SERIES (DRUG DELIVERY)

D16

The D16 package is ideal for acute fluidic or drug delivery experiments using the E16-20mm-100-177 electrode array. (See Drug Delivery, page 23)

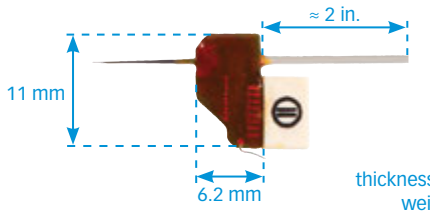


weight: 1.39 g

CONNECTOR TYPE: Dual Inline Pin (DIP); pin length 5.5 mm, spacing 2.5 mm
COMPATIBLE ELECTRODES: E16-20mm-100-177

DM16

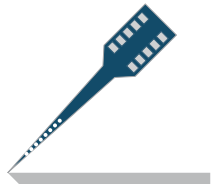
The DM16 package is ideal for chronic fluidic or drug delivery experiments using the E16-20mm-100-177 electrode array (page 124).



thickness: 1.78 mm
weight: 0.40 g

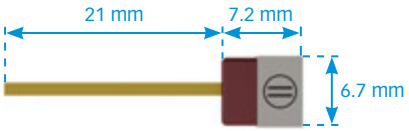
CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: E16-20mm-100-177

Connector Package Specifications



H16

The H16 package is ideal for chronic experiments requiring connector standoff.

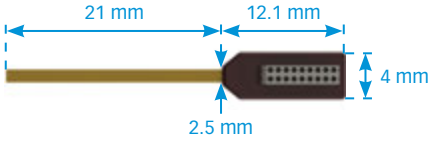


thickness: 1.78 mm
weight: 0.18 g

CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

HC16

The HC16 package is ideal for chronic experiments requiring connector standoff.

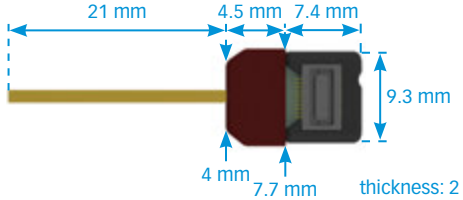


thickness: 5.4 mm
weight: 0.19 g

CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

HZ16

The HZ16 package is ideal for chronic experiments requiring connector standoff. It connects directly to a TDT ZC16 or ZC32 headstage.

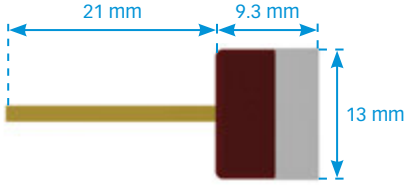


thickness: 2 mm
weight: 0.26 g

MATING CONNECTOR: TDT ZC16/ZC32 headstage
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

H32

The H32 package is ideal for chronic experiments requiring connector standoff.

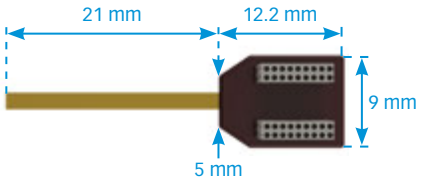


thickness: 1.78 mm
weight: 0.38 g

CONNECTOR TYPE: Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

HC32

The HC32 package is ideal for chronic experiments requiring connector standoff.

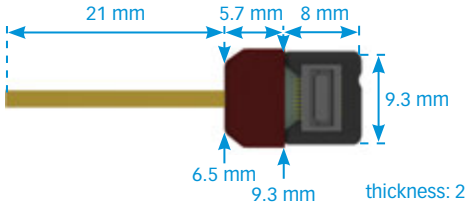


thickness: 5.4 mm
weight: 0.52 g

CONNECTOR TYPE: (2x) Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: (2x) Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

HZ32

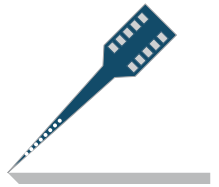
The HZ32 package is ideal for chronic experiments requiring connector standoff. It connects directly to a TDT ZC32 headstage.



thickness: 2 mm
weight: 0.26 g

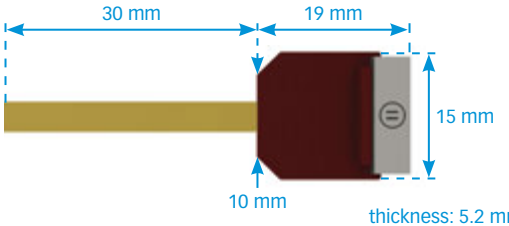
MATING CONNECTOR: TDT ZC32 headstage
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

Connector Package Specifications



H64

The H64 package is ideal for chronic experiments requiring connector standoff.

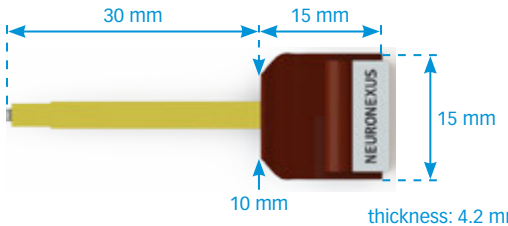


thickness: 5.2 mm
weight: 1.07 g

CONNECTOR TYPE: (2x) Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: (2x) Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 64 channel Standard (A-type) electrode array

H64LP

The H64LP package is similar to the H64 package (left), but more compact.

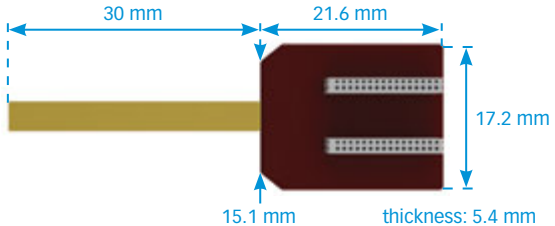


thickness: 4.2 mm
weight: 1.05 g

CONNECTOR TYPE: (2x) Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: (2x) Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 64 channel Standard (A-type) electrode array

HC64

The HC64 package is ideal for chronic experiments requiring connector standoff.

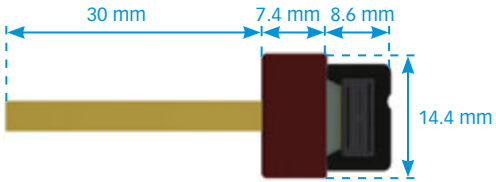


thickness: 5.4 mm
weight: 1.4 g

CONNECTOR TYPE: (2x) Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: (2x) Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 64 channel Standard (A-type) electrode array

HZ64

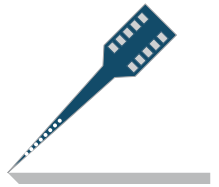
The HZ64 package is ideal for chronic experiments requiring connector standoff. It connects directly to a TDT ZC64 headstage.



thickness: 2 mm
weight: 0.54 g

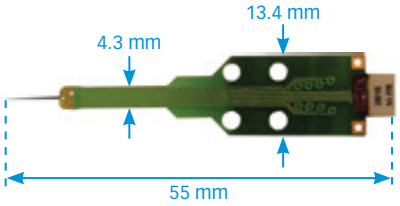
MATING CONNECTOR: TDT ZC64 headstage
COMPATIBLE ELECTRODES: Any 64 channel Standard (A-type) electrode array

Connector Package Specifications



MR_A16

The MR_A16 package is ideal for acute MRI applications.

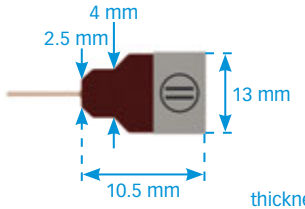


weight: 1.3 g

CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

MR_CM16

The compact MR_CM16 package is ideal for chronic MRI applications.

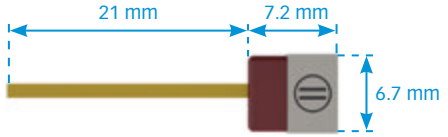


thickness: 1.78 mm
weight: 0.18 g

CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

MR_H16

The MR_H16 package is ideal for chronic MRI experiments requiring connector standoff.

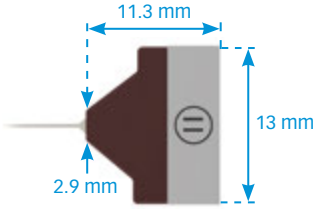


thickness: 1.78 mm
weight: 0.19 g

CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

MR_CM32

The MR_CM32 package is ideal for chronic MRI applications.

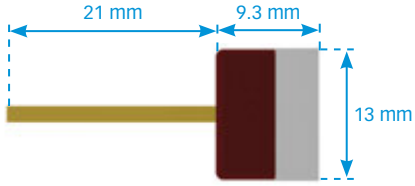


thickness: 1.78 mm
weight: 0.32 g

CONNECTOR TYPE: Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

MR_H32

The MR_H32 package is ideal for chronic MRI experiments requiring connector standoff.

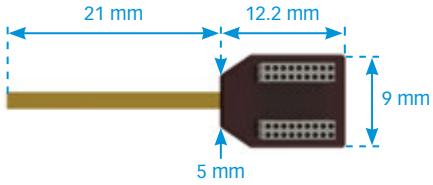


thickness: 5.4 mm
weight: 0.38 g

CONNECTOR TYPE: Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

MR_HC32

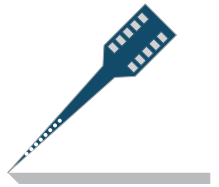
The MR_HC32 package is ideal for chronic MRI experiments requiring connector standoff.



thickness: 5.4 mm
weight: 0.52 g

CONNECTOR TYPE: (2x) Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: (2x) Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

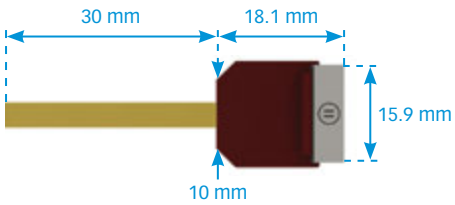
Connector Package Specifications



MR-SERIES (MRI COMPATIBLE)

MR_H64

The MR_H64 package is ideal for chronic MRI experiments requiring connector standoff.

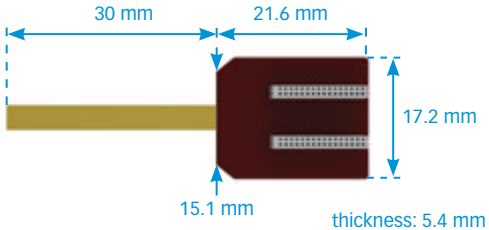


thickness: 5.2 mm
weight: 1.07 g

CONNECTOR TYPE: (2x) Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: (2x) Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 64 channel Standard (A-type) electrode array

MR_HC64

The MR_HC64 package is ideal for chronic MRI experiments requiring connector standoff.



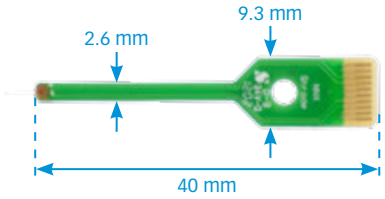
thickness: 5.4 mm
weight: 1.4 g

CONNECTOR TYPE: (2x) Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: (2x) Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 64 channel Standard (A-type) electrode array

Q-SERIES (4 CHANNEL)

Q4

The Q4 package is ideal for acute experiments with the 4-channel Qtrode.

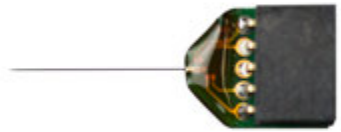


thickness: 2 mm
weight: 0.78 g

CONNECTOR TYPE: Edge connector
MATING CONNECTOR: Edge socket
COMPATIBLE ELECTRODES: Any 4-channel electrode array (Qtrode)

CQ4

The CQ4 package is ideal for chronic experiments with the 4-channel Qtrode.



thickness: 3.1 mm
weight: 0.31 g

CONNECTOR TYPE: Edge connector
MATING CONNECTOR: Edge socket
COMPATIBLE ELECTRODES: Any 4-channel electrode array (Qtrode)

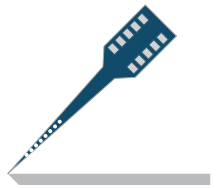
HQ4

The HQ4 package is ideal for chronic experiments with the 4-channel Qtrode, or experiments using a microdrive (see dDrive, page 67).

thickness: 3.1 mm
weight: 0.31 g

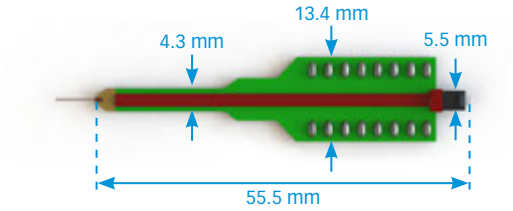
CONNECTOR TYPE: Edge connector
MATING CONNECTOR: Edge socket
COMPATIBLE ELECTRODES: Any 4-channel electrode array (Qtrode)

Connector Package Specifications



OA16

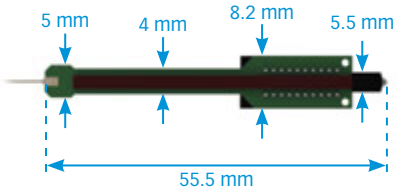
The OA16 package uses the NNc locking fiber coupler, and is ideal for acute optogenetics experiments with awake, behaving animals.



CONNECTOR TYPE: Dual Inline Pin (DIP); pin length 5.5 mm, spacing 2.5 mm
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

OA32

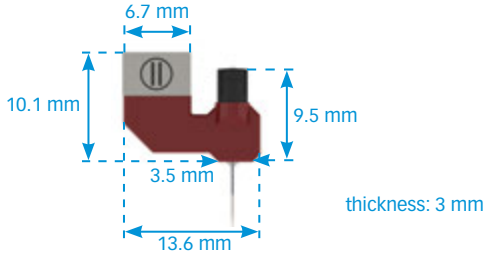
The OA32 package uses the NNc locking fiber coupler, and is ideal for optogenetics experiments with awake, behaving animals.



CONNECTOR TYPE: SAMTEC MOLC-110-01-S-Q
MATING CONNECTOR: SAMTEC FOLC
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

OCM16

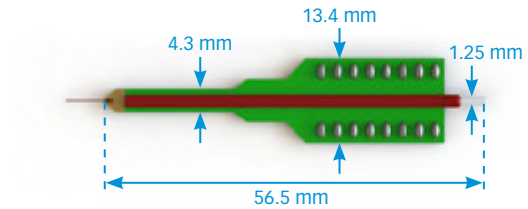
The OCM16 package uses the NNc locking fiber coupler, and is ideal for chronic optogenetics experiments with awake, behaving animals.



CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

OA16LP

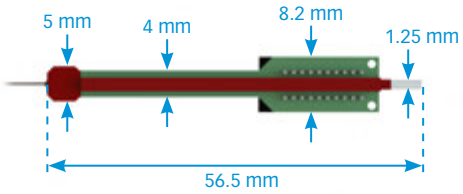
The OA16LP uses a bare ferrule fiber connection, and is suited for acute optogenetics experiments.



CONNECTOR TYPE: Dual Inline Pin (DIP); pin length 5.5 mm, spacing 2.5 mm
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

OA32LP

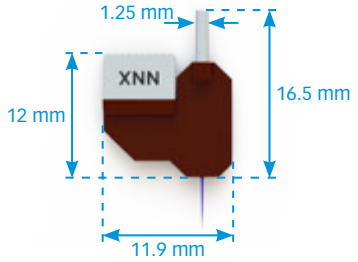
The OA32LP uses a bare ferrule fiber connection, and is suited for acute optogenetics experiments.



CONNECTOR TYPE: SAMTEC MOLC-110-01-S-Q
MATING CONNECTOR: SAMTEC FOLC
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

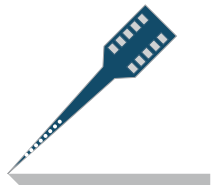
OCM16LP

The OCM16LP uses a bare ferrule fiber connection, and is suited for chronic optogenetics experiments.



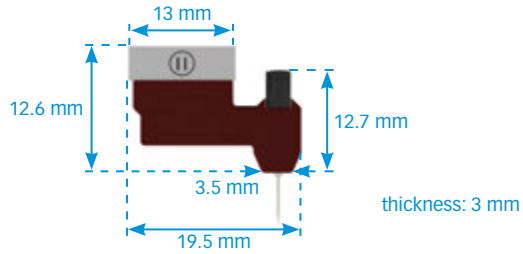
CONNECTOR TYPE: Omnetics NSD18 (2 guideposts)
MATING CONNECTOR: Omnetics NPD18 (2 guideposts)
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

Connector Package Specifications



OCM32

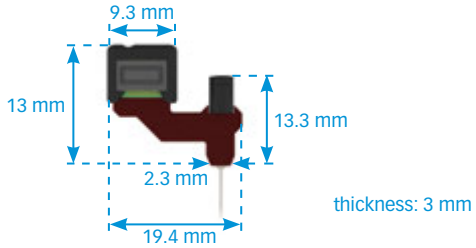
The OCM32 package uses the NNc locking fiber coupler, and is ideal for chronic optogenetics experiments with awake, behaving animals.



CONNECTOR TYPE: Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

OZ16

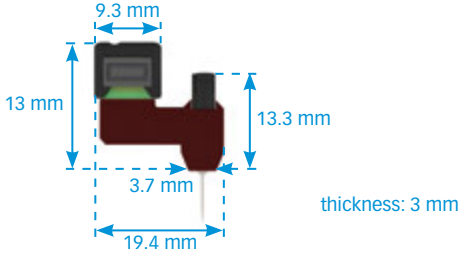
The OZ16 package uses the NNc locking fiber coupler, and is ideal for chronic optogenetics experiments with awake, behaving animals.



MATING CONNECTOR: TDT ZC16/ZC32 headstage
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

OZ32

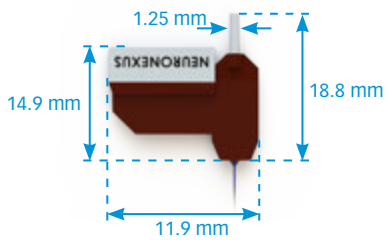
The OZ32 package uses the NNc locking fiber coupler, and is ideal for chronic optogenetics experiments with awake, behaving animals.



MATING CONNECTOR: TDT ZC32 headstage
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

OCM32LP

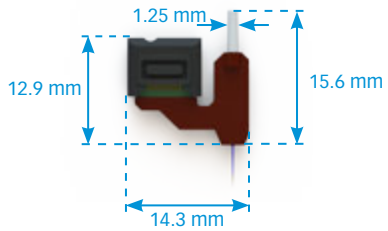
The OCM32LP uses a bare ferrule fiber connection, and is suited for chronic optogenetics experiments.



CONNECTOR TYPE: Omnetics NSD36 (4 guideposts)
MATING CONNECTOR: Omnetics NPD36 (4 guideposts)
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

OZ16LP

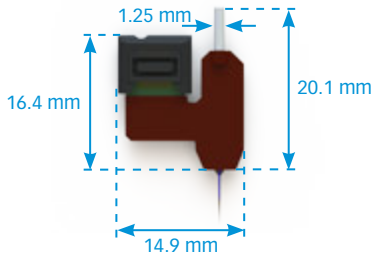
The OZ16LP uses a bare ferrule fiber connection, and is suited for chronic optogenetics experiments.



MATING CONNECTOR: TDT ZC16/ZC32 headstage
COMPATIBLE ELECTRODES: Any 16 channel Standard (A-type) electrode array

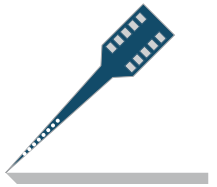
OZ32LP

The OZ32LP uses a bare ferrule fiber connection, and is suited for chronic optogenetics experiments.



MATING CONNECTOR: TDT ZC32 headstage
COMPATIBLE ELECTRODES: Any 32 channel Standard (A-type) electrode array

How to Configure a Neural Probe



A complete NeuroNexus neural probe assembly consists of two parts: an electrode array, and a package. Both must be configured.

Step 1:

Browse our Electrode Array Design section to find an electrode array that meets your needs.

Step 2:

Determine the connector on your headstage, and find a package that will connect to it. The following pages detail available packages.

EXAMPLE 1:

A user specifies an A1x32-6mm-50-177 (page 101) electrode array. The lab uses a Plexon HST/16V-G20 headstage, which has an 18-pin Omnetics Nano strip connector. The user can specify either a CM16LP (page 28) or an H16 (page 30) package, both of which have 18-pin Omnetics Nano strip connectors. The user desires connector standoff from the implant site, so the H16 package is selected. Because the A1x32-6mm-50-177 electrode comes in two thicknesses, that must be specified as well.

This is the resulting part number for this probe:

A1x32-6mm-50-177-H16-50
Electrode Array — Package — Thickness

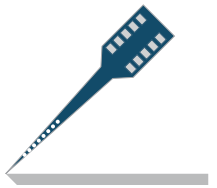
EXAMPLE 2:

A user wants to combine optical stimulation with neuronal recording using an A4x4-3mm-100-125-703 electrode array (page 96). The lab uses a TDT recording system with a 16 channel Zif Clip™ headstage. Because the user wants to specify an optoelectrode, the OZ16 package (page 35) is selected. Because the electrode array has multiple shanks, the user must co-ordinate fiber placement with the sales co-ordinator. Because the A4x4-3mm-100-125-703 electrode only comes in one thickness, that value can be omitted from the part number.

This is the resulting part number for this probe:

A4x4-3mm-125-703-OZ16
Electrode Array — Package

Model Numbers Explained



A2x2-tet-3mm-150-150-121-H16-50

ELECTRODE TYPE
A - Standard
E - Surface
M - Matrix
Q - 4-channel
V - Vector (Primate)

NUMBER OF SHANKS

SITES PER SHANK

SITE LAYOUT
Some electrodes have non-linear site layouts. This section specifies the site layout.

SHANK LENGTH

SITE SPACING (µm)

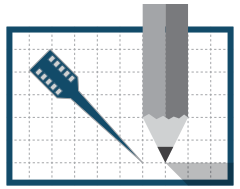
SHANK SPACING
Only necessary if the electrode has more than one shank.

SITE AREA (μm^2)

PACKAGE

THICKNESS
Some electrodes come in two thicknesses. If this is the case, this number specifies the desired electrode thickness.

DESIGNING YOUR OWN PROBE

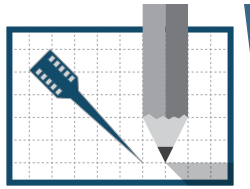


NeuroNexus offers a custom probe design service that provides unique access to a virtually unlimited design space. Almost any feature of a probe can be tailored to suit your application - and all it takes to get started is a sketch.

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

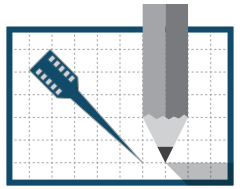
CUSTOM DESIGN SERVICES



There are three main time-consuming elements in the Custom Design process: time to get into the design queue, time for fabrication, and time for assembly. The first element is usually the rate-limiting step in the process since there is not always room to put a new design onto an upcoming mask set. Since we run new mask sets only once every few months, getting a priority position on an upcoming mask can make months-worth of difference in delivery time. We have therefore restructured our Custom Design Services to include three tiers to give our customers more options for access to leading edge silicon microelectrode technology, and at lower price points.

	PREMIUM	ADVANCED	STANDARD
MINIMUM ORDER	$20,000	$12,000	$7,500
DEVICE PACKAGE	Matrix Array™ OR probes with > 64 channels	64 channel probes	16-32 channel probes
ESTIMATED COST PER PROBE	Dependent on design	Similar to Catalog	Similar to Catalog
BENEFITS	20% extra B-Stock Faster delivery	10% extra B-Stock	Lowest minimum order

CUSTOM DESIGN SERVICES



PREMIUM

Premium custom orders are given a priority over other orders, so they go on the next outgoing mask and can even influence how soon the next mask is run. Expected delivery time for a premium custom order is 6 – 8 weeks. Premium orders require a minimum order size of $20,000, at a price that is dependent upon the design. Additional probes will be available for a reduced cost that is comparable to the cost of our catalog probes.

Premium custom orders come with one year of exclusive rights to the design. During the exclusive year, if your custom designed probe is requested by other customers, you can receive up to $8,000 credit for future orders if you allow others (approved by you) to purchase the custom probe. Each approved customer will be asked to pay a one-time $2,000 NRE charge in addition to the retail price of the probe, which will be applied toward your credit.

Premium orders receive 20% extra B-stock probes. So if the order consists of 20 probes, you will receive an additional 4 B-stock probes at no extra charge. Also, premium custom orders may utilize small features upon request. This allows for smaller traces, down to 2 µm pitch.

ADVANCED

Advanced custom orders are also given some priority on outgoing masks, which allows for an expected delivery time of 8 – 12 weeks. Advanced orders require a minimum order size of $12,000, with a per-probe price similar to comparable catalog probes. Advanced orders also receive 10% extra B-stock probes. Only standard spec probes (3 µm pitch) are allowed for Advanced custom orders, meaning no small features are available.

The Advanced custom option is a compromise between the cost benefits of the Standard custom option and the faster delivery time of the Premium option.

STANDARD

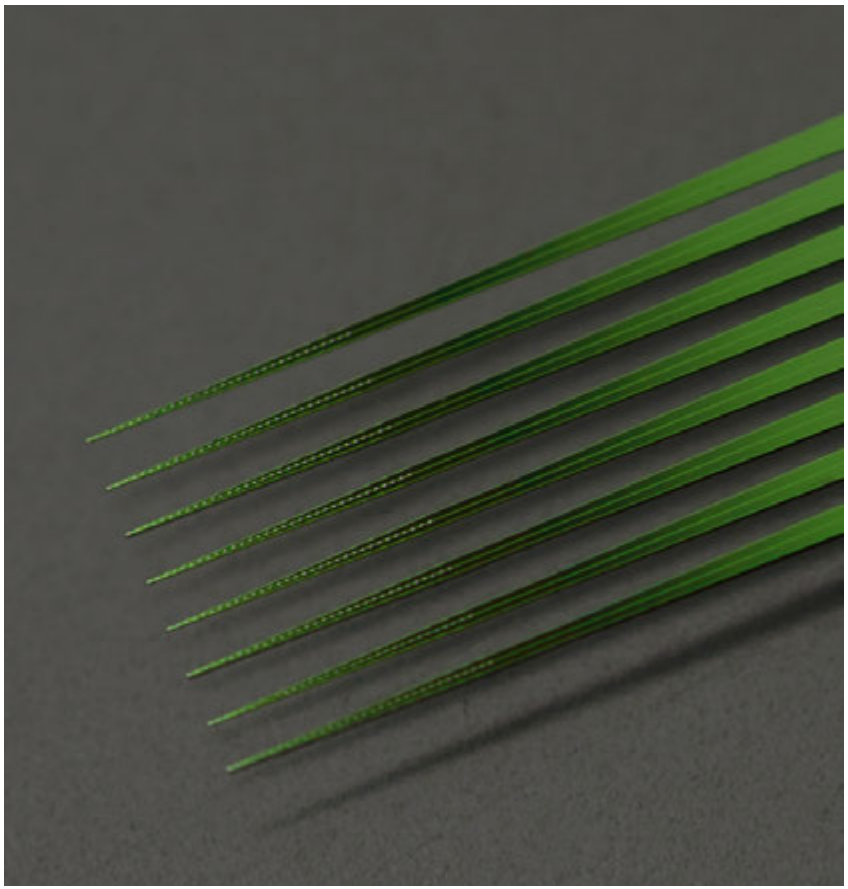
Standard custom orders will be fit into future mask sets as possible, which allows us to offer custom designed probes at such a small minimum order size. Expected delivery time is 4 – 6 months. Standard custom orders require a minimum order size of $7,500, with a per-probe price similar to comparable catalog probes. Only standard specification probes are allowed for Standard custom orders, meaning no small features are available.

CUSTOM DESIGN PROCESS

NeuroNexus probes are manufactured using state-of-the-art design, microfabrication and packaging techniques. Design is accomplished using a semiconductor computer-aided design (CAD) tool that results in a multi-layer mask set. These photolithographic masks are used in the fabrication process to transfer patterns of the probe features onto thin-films that have been deposited on a silicon wafer.

Thin-film fabrication is a batch process that permits us to fabricate a variety of probe designs simultaneously on a silicon wafer. NeuroNexus offers a Custom Design Service where customer-submitted designs can be fabricated on the same wafer as our standard catalog designs, and then packaged for use per the customer's specs.

RIGHT: Buz256 probe



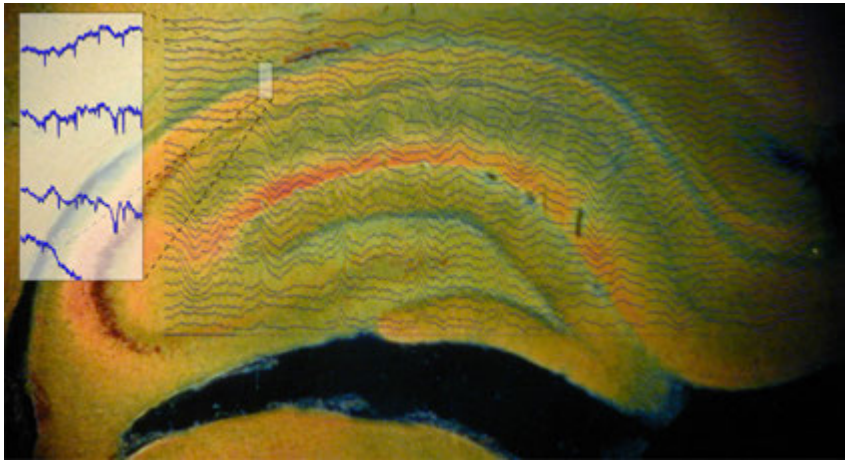
Dr. Gyorgy Buzsaki

RUTGERS UNIVERSITY, USA

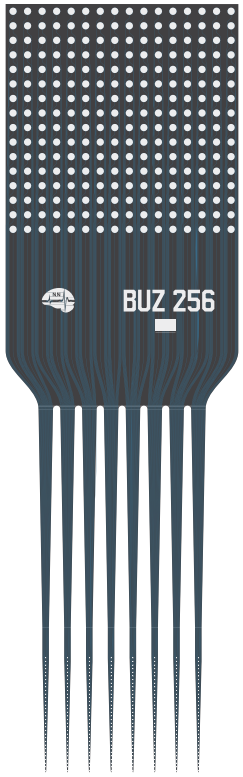
"Since NeuroNexus began fabricating probes with high reliability and reasonable costs, we virtually stopped using wire electrodes and monitor electrical activity with silicon probes. It is a one-way process: once one begins to record with silicon probes, he/she never goes back to wires."

Dr. Buzsaki

Dr. Buzsaki's group records large numbers of neurons simultaneously in the hippocampus and various cortical and subcortical structures for understanding how information is transferred across networks. He has designed seven custom probes through NeuroNexus that he uses to determine the geometrical distribution of extracellular currents, so that spiking activity can be related to the global behavior of the circuits.



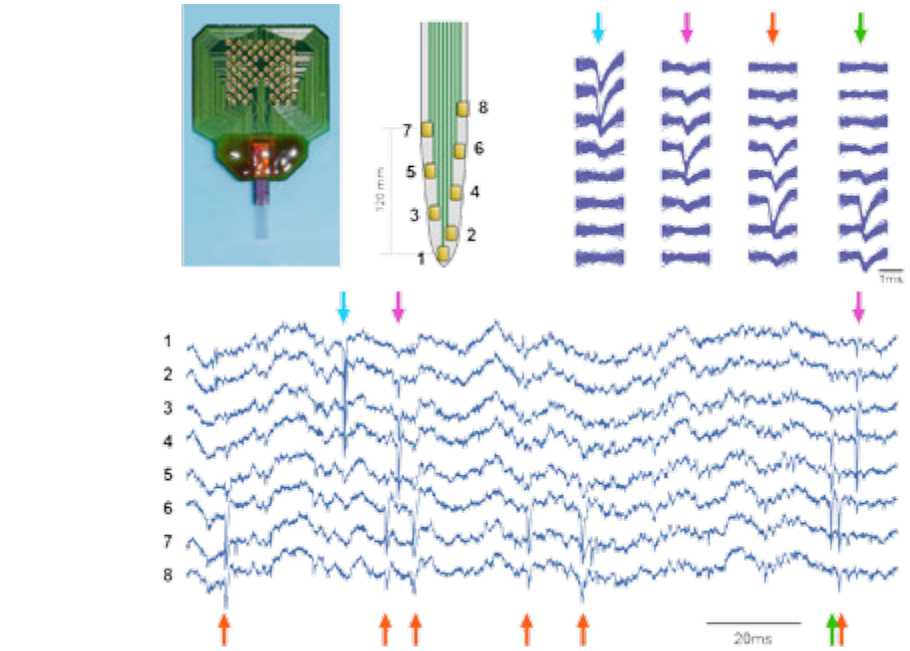
Snapshot of a 256 channel recording (32 sites x 8 shanks), superimposed on the histological image reflecting the signal locations. Image courtesy of A Berenyi and G Buzsaki.

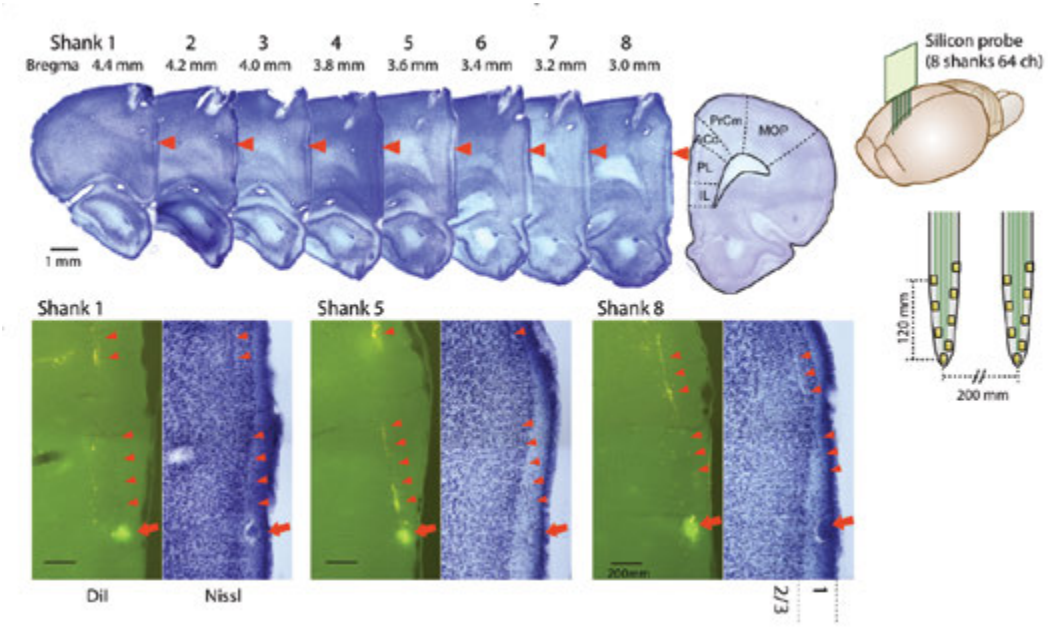


Buzsaki256 probe
(see page 174)

The **Buzsaki32** (page 119) and **Buzsaki64** (page 122) designs have become Dr. Buzsaki's workhorse probes. They were designed to record and segregate neurons in areas of packed cell densities as in the hippocampus and various neocortical layers. The inter-shank intervals allow for high-density sampling yet neighboring shanks record from independent populations. These custom designs allow for recording from representative samples of neurons in local circuits and monitoring of neuronal interactions with high temporal precision.

Many of Dr. Buzsaki's probes have become popular catalog designs. He continues to push the envelope of the NeuroNexus design space as evidenced by his most recent design, a 256-channel probe which incorporates minimum feature sizes.





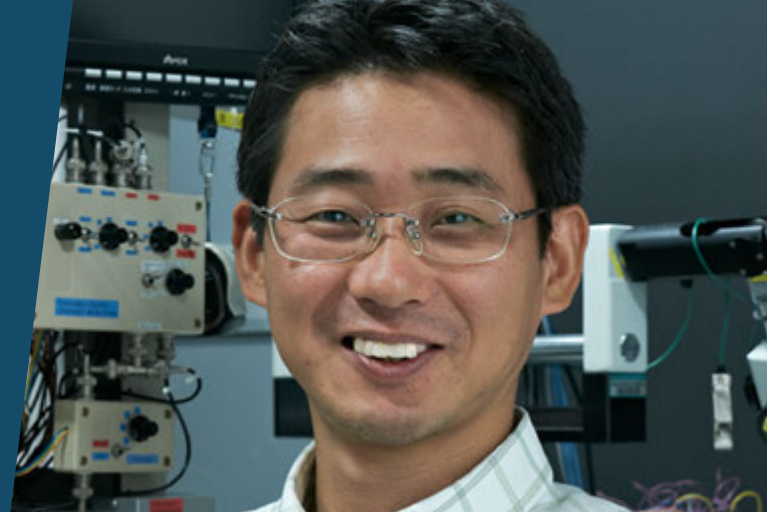
IMAGES

Right, Top: Wideband recording from a Buzsaki64 probe. Lower plot shows 8 channels of recordings from one shank.

Right, Bottom: Histology data from an 8-shank Buzsaki64 probe.

Dr. Yoshikazu Isomura

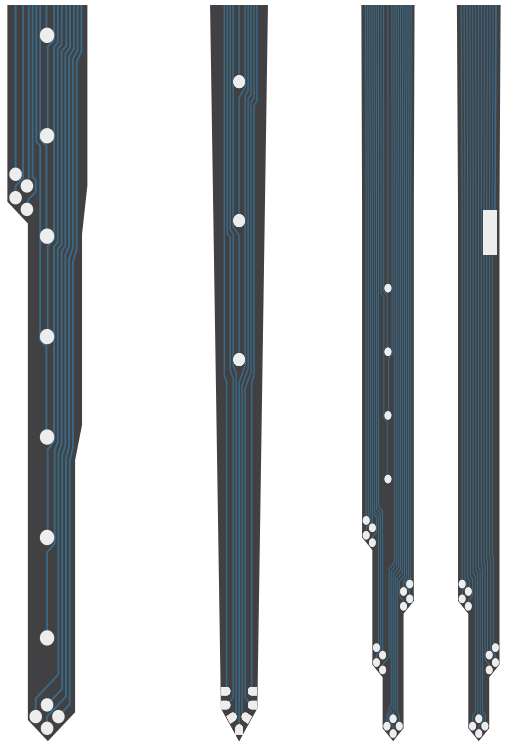
TAMAGAWA UNIVERSITY, JAPAN



"I feel truly grateful for being introduced to NeuroNexus probes and multi-neuron recording techniques in Dr. Gyorgy Buzsaki's lab. The probe I designed allows simultaneous comparison of cell-firing activity between different layers of cortex from rats or mice, in one experimental session. Moreover, it's suitable for CSD analysis of LFPs. I would recommend this for your first recording from cortex."

Dr. Isomura

Dr. Isomura investigates the microcircuitry and mechanisms in behaving rat primary motor cortex underlying preparation, initiation, and expression of voluntary movements. His 16-channel custom probe permits him to simultaneously record local field potentials (LFPs) and spike activity from multiple single neurons across cortical layers. His probe includes nine recording sites for LFPs (0 to 1,200 µm deep at 150 µm intervals) and two tetrode configurations (400 and 1,200 µm deep) for recording spike activity at superficial and deep layers. The two tetrode configurations are placed on leading edges of the array for interfacing with healthy tissue. This probe provides valuable information on functional processing in superficial and deep layers through simultaneous single-cell and population recordings.



LFP8-TetrodeSD, Isomura2, and Isomura32

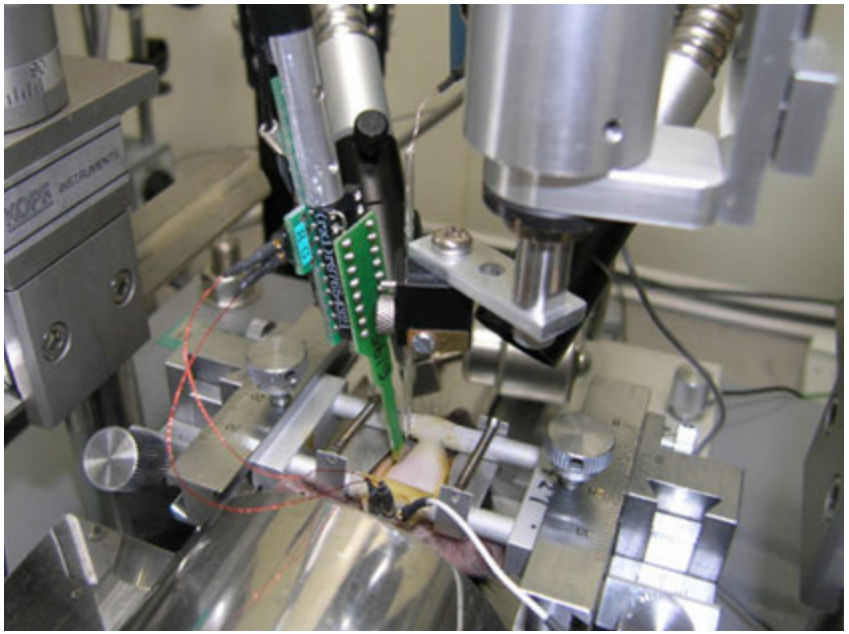
Close-up views of Dr. Isomura's Custom Designs. (Not to scale.) Left: LFP8-Tetrode SD (page 161). Middle: Isomura2 (page 161). Right: Isomura32 (page 166)

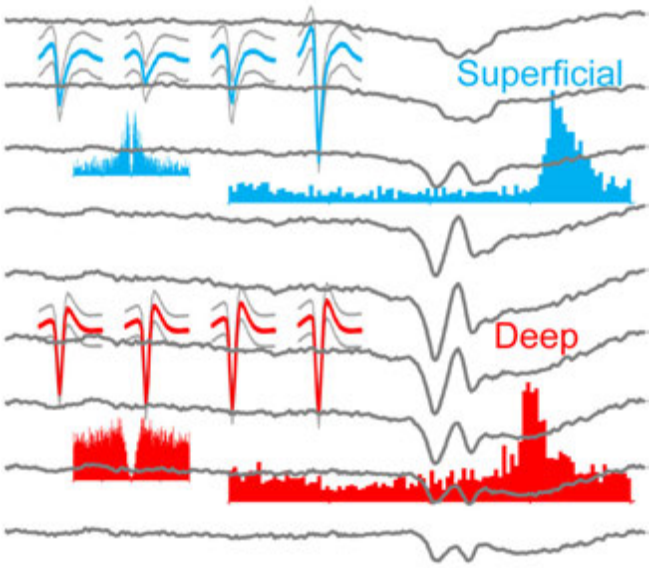
RESULT

Dr. Isomura and his colleagues performed multi-neuron and LFP recordings from various layers of the motor cortex during forelimb movements. They showed different motor-related functions of pyramidal cells and interneurons across the cortical layers (Nat. Neurosci., 12: 1586-1593, 2009). More recently, they have found that spiking activity of motor cortex neurons was often phase-locked to slow and fast gamma oscillations in the LFP activity, which might be functionally associated with motor preparation and motor expression, respectively.

PROBE STATUS

The electrode design is available in the catalog as a special order. (See page 161 for more information, or contact us for more detail.) Dr. Isomura appreciates maintaining contact with users of his custom design and learning about other applications and results.





IMAGES

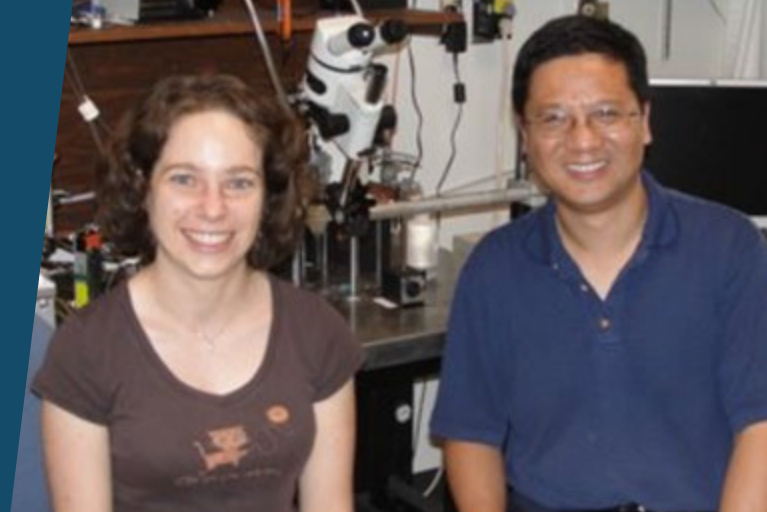
LEFT: Dr. Isomura's lab setup
RIGHT: Recordings from the LFP8-TetrodeSD probe.
Data and images courtesy of Isomura lab. Used with permission.

SCIENCE UPDATE

Isomura, Yoshikazu et al. "Reward-Modulated Motor Information in Identified Striatum Neurons." J Neurosci 2013

Drs. Hong Lei & Cecile Faucher

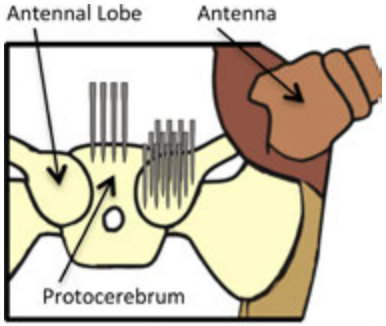
UNIVERSITY OF ARIZONA, USA

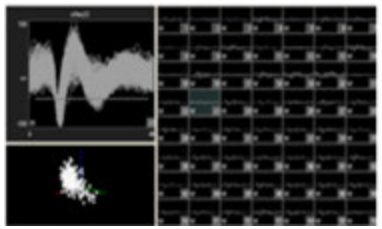


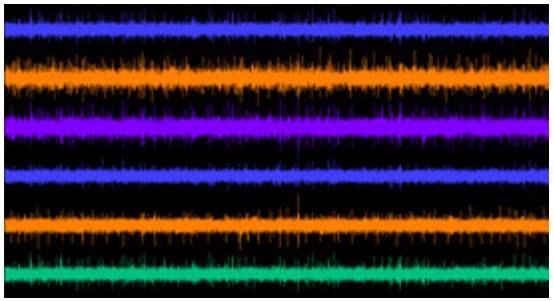
"Having such a high number of recording sites in two locations will significantly increase the chance to detect synchronous activity in one region of the moth brain and observe correlated responses in the target region."

Drs. Hong Lei and Faucher

The University of Arizona group is interested in how olfactory information is processed in insect brains, more particularly how synchronous activity in the antennal lobes is detected by downstream protocerebral neurons. They therefore needed to record simultaneously from two different locations in the small moth brain. NeuroNexus was tasked to design a high density probe to allow access to such a small brain region without excessive damage. A 64-channel array was designed that was comprised of a 3D stack of three 16-channel A-Probes and a single 16-channel A-Probe with flexible cable attached. The two units were integrated to one single connector, allowing access to two brain regions while minimizing the bulk of the probe assembly.





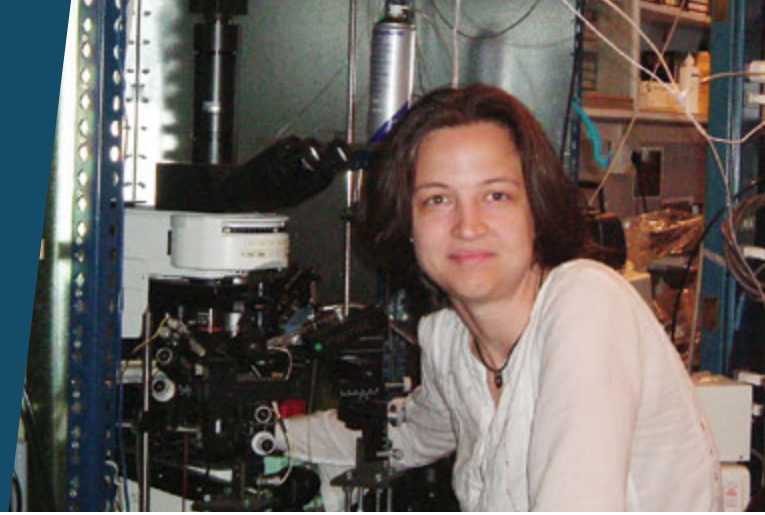


PROBE DETAIL

The Matrix Array™ (page 12) concurrently spans cortical columns and layers, interfacing with a volume of tissue. Specify different 2D arrays (pages 132-148) for a customized 3D neural interface.

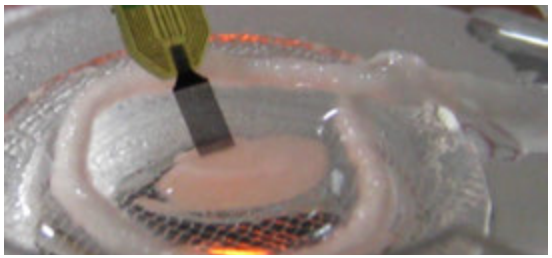
Dr. Liset Menendez de la Prida

INSTITUTO CAJAL CSIC, MADRID, SPAIN



"Both single cell activity and field potential population events can be easily recorded. The linear array allows for propagation studies both in vitro and in vivo and it can be used for current source density analysis in slices."

Dr. Menendez de la Prida



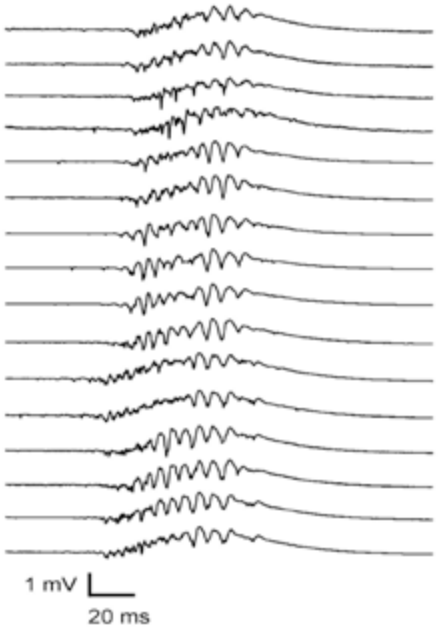
Dr. Menendez de la Prida is interested in performing linear array recordings to understand the generating mechanisms of brain oscillations. She designed a 16-channel comb silicon probe that can be used for both *in vitro* and *in vivo* applications. It allows current source density analysis of field potential events in slices, but is also used to record activity from different orientations. *In vivo,* it can be used for propagation studies or topographic localization of sensory responses.

RESULT

Dr. Menendez de la Prida has mostly used her design for *in vitro* studies. Use of the probe has revealed extremely useful information. Both single-cell and local field potential activity can be simultaneously recorded. The probe easily penetrates the slice and it can be repositioned several times over the course of a single experiment.

PROBE DETAIL

The A16x1 electrode array features 1 electrode site at the tip of each of its 16 shanks. See page 98 for more information.



IMAGES

EXTREME LEFT: The A16x1 probe inserted in an *in vitro* slice.

ABOVE: Propagation studies of one type of population activity record from rat hippocampal slices

Dr. Hubert Lim & Mrs. Malgorzata Straka

UNIVERSITY OF MINNESOTA, USA

"I have been a user of these probes for over ten years and have not found any other available technology that can allow me to reliably stimulate and record from similar populations of neurons across numerous brain regions simultaneously. The enormous amount of neural data that can be collected from each probe makes animal experiments more efficient and consistent."

Dr. Lim

Dr. Lim's group uses the new probe design to study the auditory pathway through multichannel stimulation and simultaneous recording of small populations of neurons. The power of these probes lies with the ability to stimulate as well as record from neurons using the same probe by electrochemically activating the sites to form iridium-oxide. Dr. Lim's group is able to record neural activity across numerous sites during placement to identify areas of interest, even within deep structures (e.g., inferior colliculus Fig. 1) without aspirating the cortical structures above it by using long shanks. Then those same sites can be electrically stimulated to activate the desired brain regions. In addition, the flexibility in the probe design allows Dr. Lim's group to record and stimulate different yet specific populations of neurons to better understand network coding within the auditory system.

RESULT

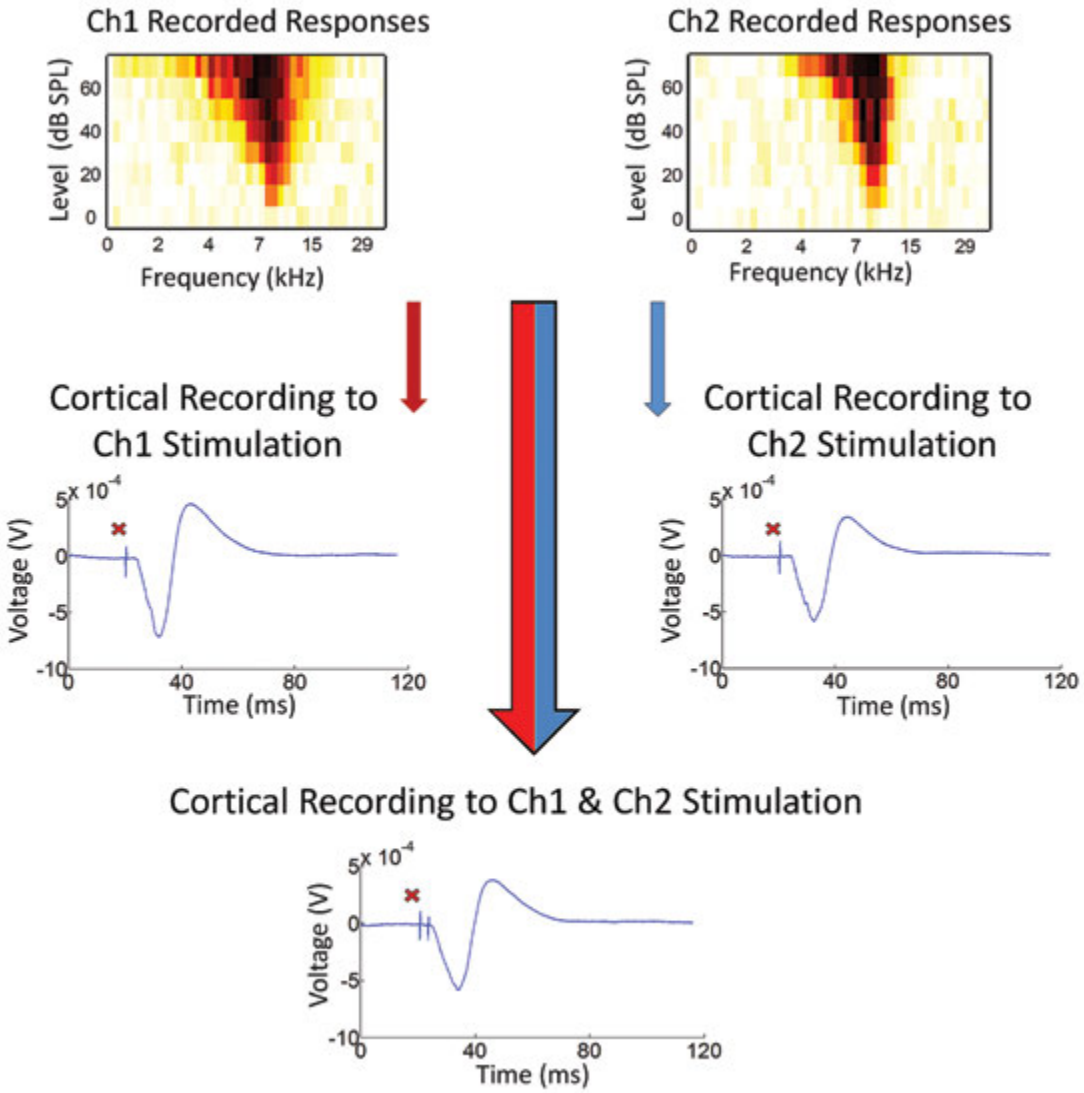
Dr. Lim's group has been able to position sites (e.g., Ch1 and Ch2 in Fig. 2) within the same frequency region of the inferior colliculus. They then stimulated these sites individually or collectively to elicit varying activation within the auditory cortex (local field potentials and spiking activity) with a separate NeuroNexus probe. Understanding how higher cortical structures respond to precisely delivered electrical stimulation allows Dr. Lim's group to not only better understand the auditory pathways but also improve stimulation techniques for new types of central auditory neuroprostheses.

PROBE DETAIL

The A4x8-8mm-100-500-703 electrode array is available as a special order. See page 166 for more detail.

ABOVE (FIG.1):
A three-dimensional rendering of the guinea pig inferior colliculus with an inserted probe.

RIGHT (FIG. 2):
Top: Examples of responses within the inferior colliculus on two separate recording sites (Ch1 and Ch2) selected for their similar activation patterns. Tones were played at different levels and frequencies, and the total spikes to each stimulus is displayed in separate bins (stimuli eliciting more activity appears darker). Both sites correspond to neurons responding best to 8 kHz tones. Bottom: Auditory cortical field potentials in response to stimulation of Ch1 or Ch2 individually or collectively with a specific delay. The electrical artifact to each electrical pulse is included (red cross).



Dr. Daniel Moran & Mr. Matthew MacEwan

WASHINGTON UNIVERSITY, USA

"I am very pleased with the outcome of this project. It would have taken a considerable amount of funds and, more importantly, time if I were to pursue this on my own or with an academic partner."

Dr. Moran

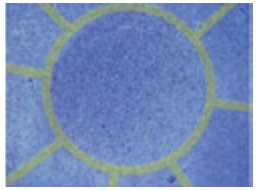
Dr. Moran's group approached NeuroNexus with a need for a dual-layer macro sieve electrode capable of recruiting distal musculature through selective stimulation of regenerated motor axons integrated into the device. NeuroNexus turned the novel design specifications/concept into a packaged system including a polymer based array and a custom printed circuit board.

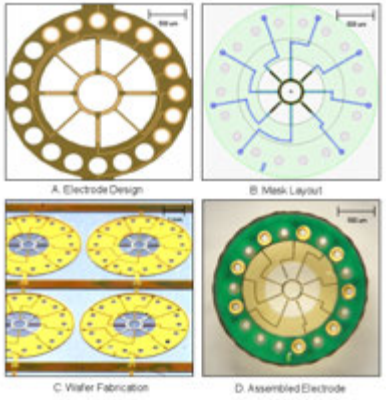
RESULT

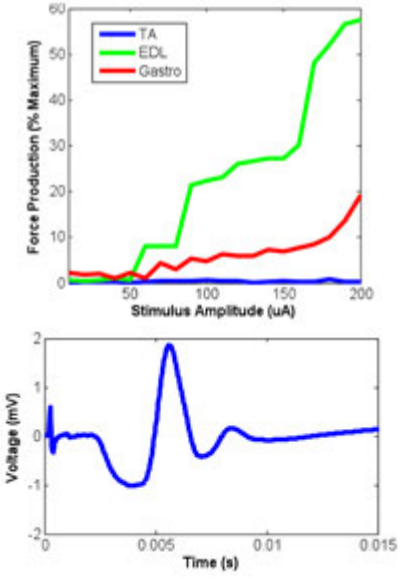
Dr. Moran's group was able to successfully demonstrate selective activation of multiple muscles within the lower leg of a rat through electrical activation of independent metalized sites with the device. Additional studies are currently underway to further investigate the functional resolution and functional capabilities of this unique 8-channel array.

PROBE DETAIL

Dr. Moran's nerve probe is a custom designed Surface array. Turn to page 20 for more information.







IMAGES

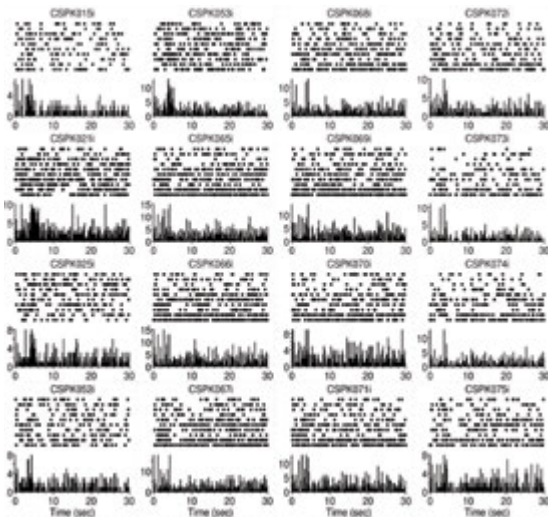
LEFT: Peripheral nerve regeneration through the implanted macro sieve electrode
MIDDLE: Designing the macro sieve electrode
RIGHT, TOP: Selective recruitment of distal musculature via bipolar stimulation
RIGHT, BOTTOM: Successful recruitment of regenerated nerve tissue via implanted electrode

Dr. Antonio Paolini

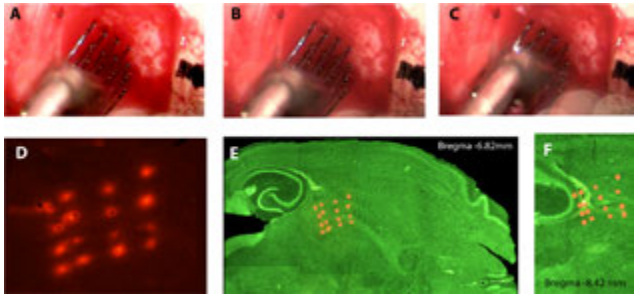
LA TROBE UNIVERSITY, VICTORIA, AUSTRALIA

"The 3D probe enables un-paralleled ability to map neural responses across an entire structure."

Dr. Paolini



Dr. Paolini's focus is currently directed toward understanding how auditory and olfactory information is processed through the amygdala. The presentation of olfactory stimuli can be laborious, and since cells adapt relatively quickly to the stimuli generating enough trials to ascertain the neural profile to a smell can be difficult. The 3-D probe allows Dr. Paolini to simultaneously map a large portion of the structure of interest and obtain a profile of the neural responses across 128 channels. The custom NeuroNexus 3D structure allowed the electrode shanks and sites to be configured to maximize sampling efficiency. A strong feature of the array is that it robust enough to allow deep brain recording from predictable trajectories.



RESULT

One of the most significant advantages of this custom design is that it allows electrodes to be inserted deep within the brain with little deviation from the 3-D configuration of the array. The figure to the right shows the ease of insertion of the 16 electrode prongs arranged in a 4 X 4 grid (A-C). The electrodes have been dipped in DiI allowing histological verification of recording positions (D-F). Electrodes remained in their 4x4 configuration deep within the brain indicated by dots (showing DiI locations) superimposed onto Fluorescent Nissl stained sections (E,F). The figure to the left shows the response of 16 of the 128 sites responding to an odor stimulus.

PROBE DETAIL

The Matrix Array™ (page 12) concurrently spans cortical columns and layers, interfacing with a volume of tissue. Specify different 2D arrays (pages 132-148) for a customized 3D neural interface.

Data and images courtesy of Paolini lab, used with permission.

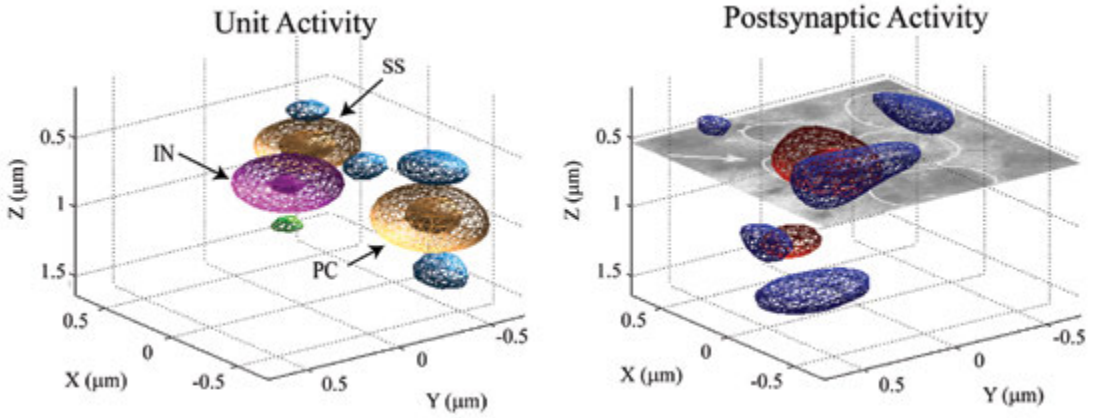
Dr. Jorge Riera

TOHOKU UNIVERSITY, JAPAN
FLORIDA INTERNATIONAL UNIVERSITY, USA

"Electrophysiology, before and again: In the era of the colored revolution in neuroscience through fluorescent imaging techniques, the extracellular electric recording technique is recapitulating its role thanks to the rapid development of the silicon-based microelectrode arrays (MEA)."

Dr. Riera

Dr. Jorge Riera is interested in elucidating volumetric aspects of the neuronal coding in the neocortex of rodents, as well as in determining how these aspects are reflected in the slow- components of the extracellular electric potentials at either the small (LFP) or the large (EEG) scale. For that end, multi-laminar extracellular recordings obtained from extended portions of the cortical sheet are desirable. For about three years, Dr. Riera's group in Tohoku University has been working together with NeuroNexus in customizing a three-dimensional "3D" probe to achieve this goal in particular for the somatosensory barrel cortex.

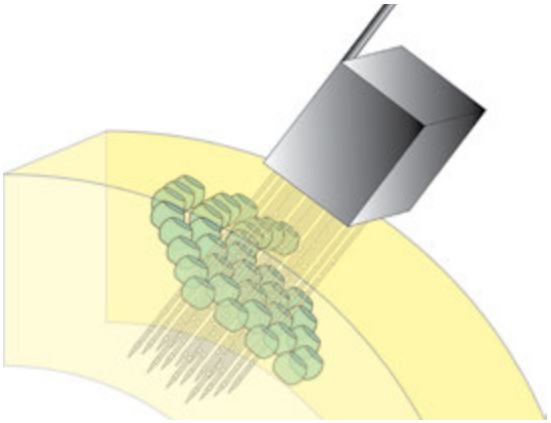


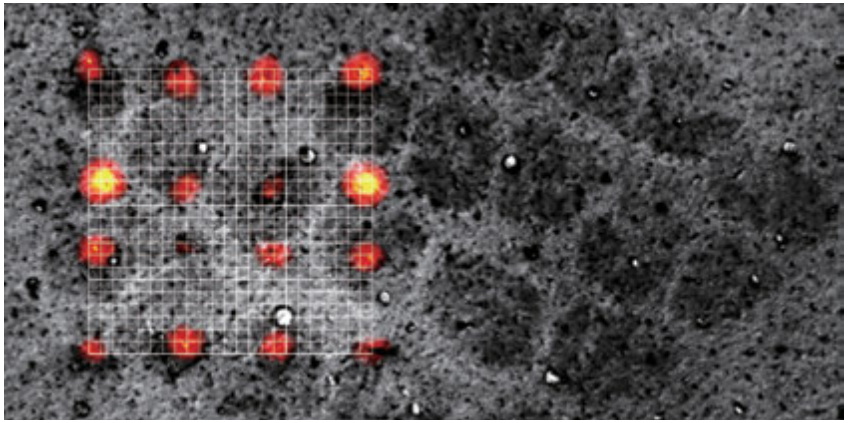
RESULT

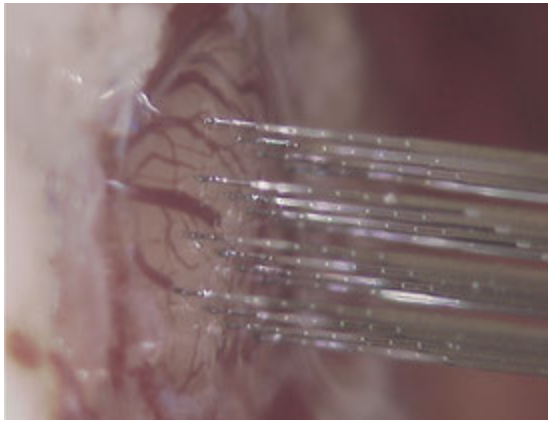
Dr. Takakuni Goto, a postdoc in Dr. Riera's group, has recently developed a new method to obtain 3D reconstructions of the neuronal current sources for unit/postsynaptic activity, which is robust to both noise and electrode resolution. This methodology is based on previous results about the conductive properties of the barrel cortex of Wistar rats (Goto et al., J Neurophysiol 104(6): 3388-3412, 2010). The group, currently in residence at Florida International University in Miami FL, is now working on determining the spatial codifiers of the whisker's velocity and direction. Please contact NeuroNexus for more information.

PROBE DETAIL

The Matrix Array™ (page 12) concurrently spans cortical columns and layers, interfacing with a volume of tissue. Specify different 2D arrays (pages 132-148) for a customized 3D neural interface.







IMAGES

LEFT: Peripheral nerve regeneration through the implanted macro sieve electrode
MIDDLE: Designing the macro sieve electrode
RIGHT, TOP: Selective recruitment of distal musculature via bipolar stimulation
RIGHT, BOTTOM: Successful recruitment of regenerated nerve tissue via implanted electrode

SCIENCE UPDATE

Jorge Riera et al. "Pitfalls in the dipolar model for the neocortical EEG sources." J Neurophysiol 2012.

Dr. Mesut Sahin

NEW JERSEY INSTITUTE OF TECHNOLOGY, USA

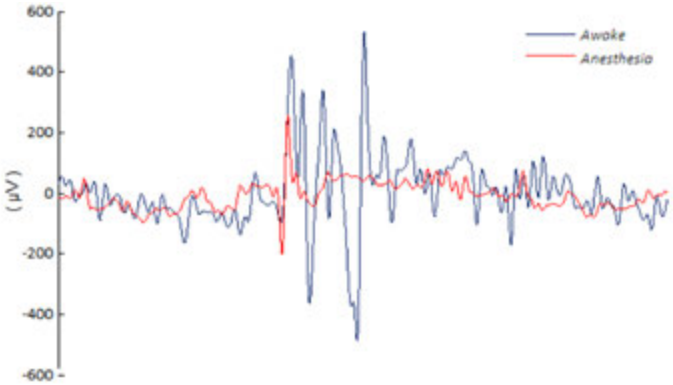
"(The) Chronic version of the Micro-ECoG electrodes from NeuroNexus made our implant procedure on the cerebellum much easier and more reliable. Electrode breakage is no longer a problem."

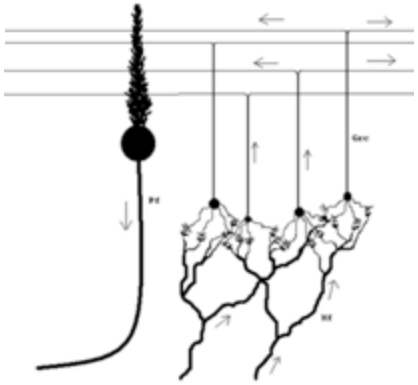
Dr. Sahin

SCIENCE UPDATE

Ordek, Gokhan et al. "Differential Effects of Ketamine/Xylazine Anesthesia on the Cerebral and Cerebellar Cortical Activities in the Rat." J Neurophysiol 2012

Rat cerebellar cortex is a very delicate structure. In addition, the cerebellum experiences large displacements towards and away from the back of the skull with the flexions/extensions of the neck in a behaving animal. All of this makes it very challenging to record cerebellar activity in awake animals. Highly flexible NeuroNexus EcoG arrays are well suited for this application. They are durable enough to be handled with surgical instruments and yet sufficiently flexible not to cause tension on the neural tissue after implantation.





ABOVE: Effect of anesthesia on peripherally evoked cerebellar cortex potentials by an air puff on the face.
RIGHT, TOP: Electrode implant location on the paramedian lobule of the rat cerebellum (picture shows right anterior cerebellum).
RIGHT, BOTTOM: Neural connections in the cerebellar cortex. Pc: Purkinje cell; Pf: Parallel fiber; Mf: Mossy fiber; Grc: Granular cell. Drawing by Jonathan Groth, PhD student at NJIT.

PROBE DETAIL

Dr. Sahin's E32-80s-15-15 Surface array is available as a special order. Turn to page 159 for more information.

Mr. Ingmar Schneider

LAURENT LAB, MPI FOR BRAIN RESEARCH
FRANKFURT AM MAIN, GERMANY

"Until I used the custom µECoG array, I never knew the precise extent of visually evoked activity, especially with this spatial and temporal resolution."

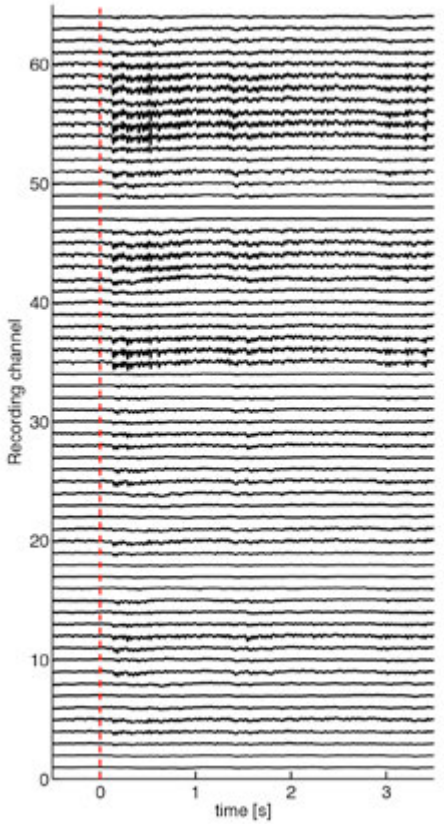
Mr. Schneider

The Laurent lab is interested in the behavior, dynamics and emergent properties of neural systems. Their efforts are focused on the cerebral cortex of turtles to facilitate the identification, mechanistic characterization and computational description of cortical functional principles. The aim of Ingmar's work is to functionally characterize visually responsive areas in turtle dorsal cortex and to analyze their spatiotemporal dynamics in response to naturalistic visual stimulation.

The size and flexible cabling of the µECoG array have been designed specifically to perform chronic recordings from the entire extent of dorsal cortex. Electrode density and package size have been carefully balanced to (i) achieve high electrode density (64 channels, pitch 500µm) and (ii) ensure connector compactness for chronic implantation, without restricting the animals' natural behavior. These µECoG electrodes allow routine recording of spatiotemporal patterns of both stimulus-evoked and spontaneous oscillatory activity in chronically implanted turtles.

PROBE DETAIL

Dr. Schneider's E64-500-20-60 can be viewed in detail on page 131.



Evoked activity in response to video stimulation. Video onset marked by the dashed red line.

Dr. Anton Sirota

UNIVERSITY OF TUEBINGEN, GERMANY

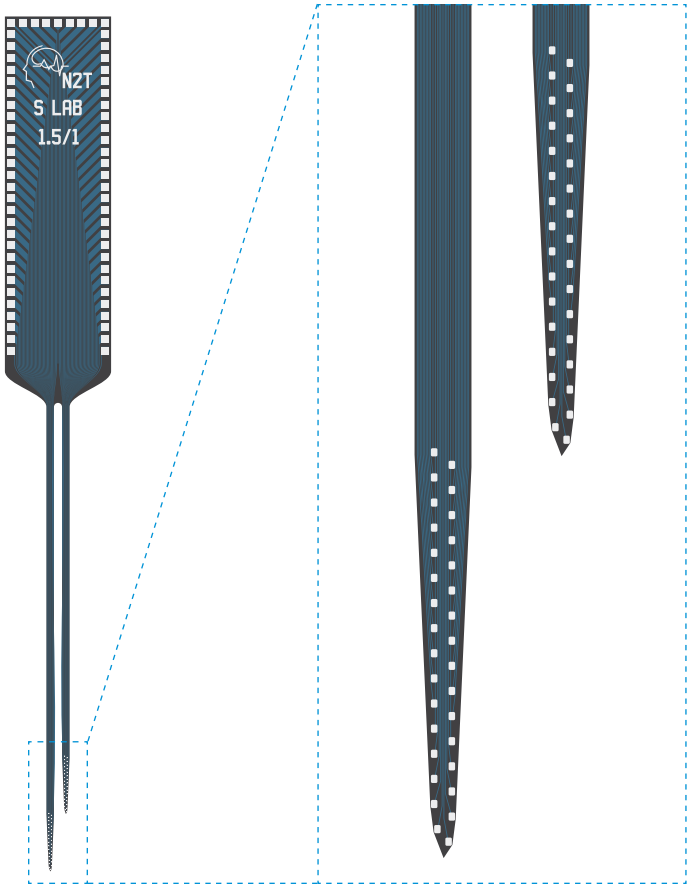
Extracellular recording of the local field potential (LFP) and spiking activity provide complementary information about the neural activity in freely moving animals.

Dr. Sirota has been using various types of catalog NeuroNexus probes to analyze multiple single neurons in a small volume, or LFPs across multiple layers/columns: close-spaced (15 µm) recording sites (Buzsaki32/64) or wide-spaced (100 µm) recording sites (A1x16-5mm-100-177).

Dr. Sirota's custom probe design is a high channel count, small feature probe that combines the advantages of both catalog designs while keeping shank width to a minimum. This custom probe is allowing Dr. Sirota to overcome existing recording limitations and analyze activity of neuronal populations across all layers of one cortical column in freely behaving rodents.

PROBE DETAIL

Dr. Sirota has two Custom Designs: the A1x64-Poly2-6mm-23s-160 and the A2x32-6mm-235-200-160. These are available as Special Order probes. See pages 169-170 for more detail.



IMAGE

Dr. Sirota's custom A2x32-6mm-235-200-160 probe and a close-up view of the tip.

Dr. Susumu Takahashi

DOSHISHA UNIVERSITY, JAPAN

"The outstanding engineers at NeuroNexus realized my ideal probe design. The silicon probes with high density contacts made my experiments much finer and (more) convincing."

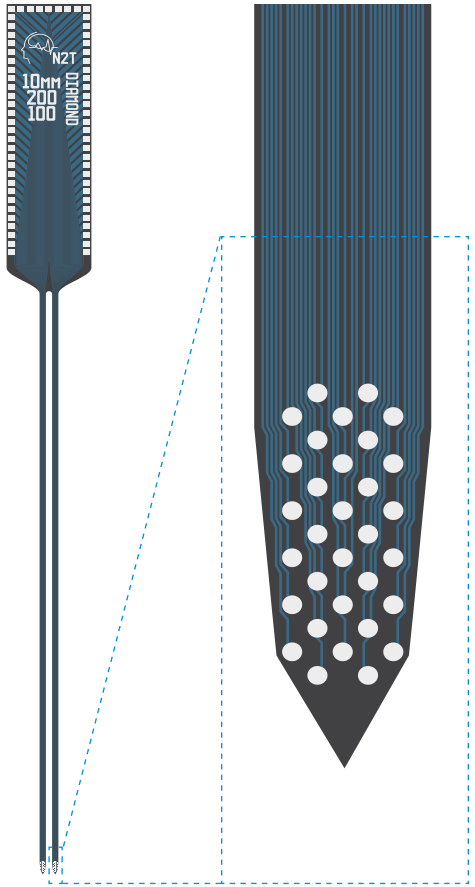
Dr. Takahashi

For several years, Dr. Takahashi has focused on the detailed information on action potentials in extracellular recordings using custom-made microwire electrode ('Dodecatrode,' Takahashi & Sakurai, Neurosci. 2005; Eur. J. Neurosci. 2007; Front. Neural Circuits. 2009). The major limitation of the microwire is that the arrangement of contacts in the brain is largely unknown. To overcome this limitation, Dr. Takahashi worked with NeuroNexus to realize a custom probe that has exceptionally high contact density to fully cover a pyramidal cell layer of the hippocampal CA1. This custom probe in conjunction with customized software will enable Dr. Takahashi to examine the details of extracellular activity originating from soma, dendrites, and axons in freely behaving animals.

PROBE DETAIL

Dr. Takahashi's A2x32-Poly5-10mm-200-100 electrode array features 5 columns of closely-spaced electrode sites on each of its 2 shanks. It is available as a special order. See page 171 for more detail.

IMAGE



Dr. Takahashi's custom A2x32-Poly5-10mm-200-100 probe and a close-up view of the tip.

Dr. Doug Weber

UNIVERSITY OF PITTSBURGH, USA

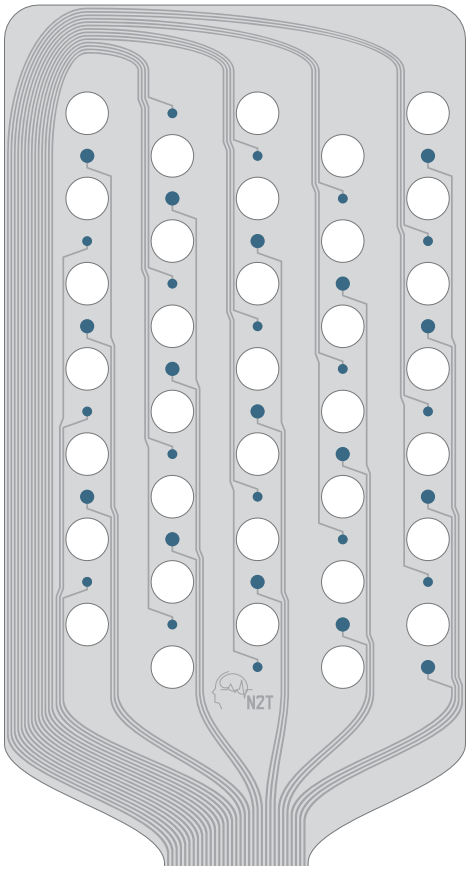
"The experienced team of engineers at NeuroNexus was very helpful in designing an electrode to meet our requirements. It would have been impossible for us to fabricate an electrode of this quality in-house."

Dr. Weber

Based on the excellent results obtained with existing E-Probes, and his experimental requirements for recording and stimulation, Dr. Weber designed a custom array. This customized array was designed to provide interleaved sites for neural recording and stimulation in spinal nerves. NeuroNexus E-Probe arrays are extremely flexible and conform well to the surface of the nerves, whose diameter require a high radius of curvature.

PROBE DETAIL

Dr. Weber's E32-1000-20-50/100 Custom Design is available in the catalog as a special order. See page 176 for more detail.



IMAGE

A close-up view of Dr. Weber's custom E32-1000-20-50/100 ECoG electrode.

Dr. Cristopher Niell

UNIVERSITY OF OREGON, USA

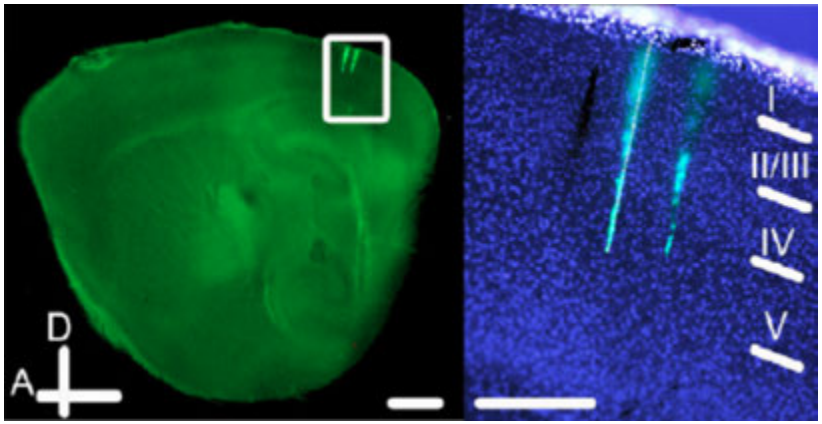
Dr. Niell has used a range of NeuroNexus probes for recordings in the mouse visual system. (Niell & Stryker, J Neurosci 2008; Niell & Stryker, Neuron 2010; Piscopo et al, J Neurosci 2013.) However, previous probes were not optimal for the mouse LGN and visual cortex, which are small structures and susceptible to damage. Therefore, Dr. Niell designed a probe to maximize the number of recording sites that could be placed in the small brain region, while decreasing the total tissue displacement that causes poor recording quality. These electrodes facilitate high-throughput recording and characterization of visual receptive fields in awake mice.

RESULT

This custom design has greatly increased the yield of isolated units in recordings from the LGN and visual cortex of awake mice. Ongoing experiments are studying the function and development of neural circuits in the visual system from eye-opening to adulthood.

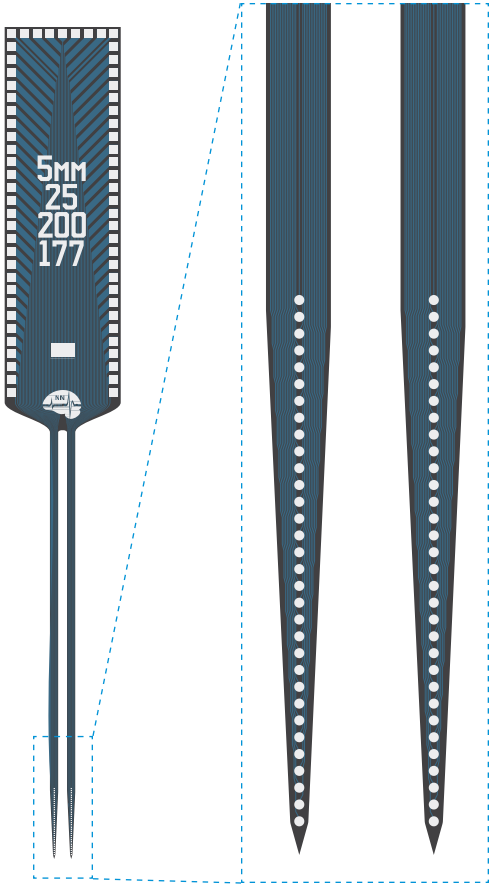
PROBE DETAIL

Dr. Niell's A2x32-5mm-25-200-177 electrode array features closely spaced sites, and is available in the catalog as a special order. See page 170 for more detail.



LEFT: Electrode tracks from mouse visual cortex, showing two shanks spanning multiple layers of cortex, reconstructed by coating the electrode with lipophilic dye. (Courtesy Dr. Jennifer Hoy)

RIGHT: Dr. Niell's custom A2x32-5mm-25-200-177.



Dr. Rune W. Berg

UNIVERSITY OF COPENHAGEN, DENMARK

"A neuron should always be studied in context of a neuronal network. NeuroNexus helps provide the tools."

Dr. Berg

Dr. Berg's design is a modification of the Buzsaki probe with the electrode distance being larger to match the size and distance of neurons in the spinal cord as opposed to in the hippocampus. Having the contacts on the edges allows sampling from a larger volume of tissue, and sampling with multiple recording sites greatly improves spike sorting quality. Now, Dr. Berg and his lab can start unraveling the mystery of motor pattern generation in the spinal cord.

RESULT

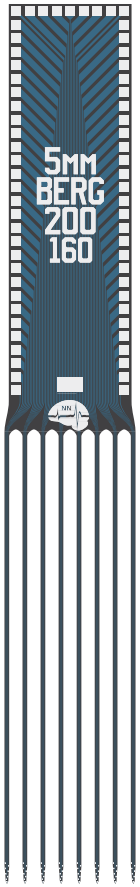
Electrophysiology from the spinal cord has revealed an intense communication among interneurons. How this interaction produces motor patterns and delicate coordination of muscles remains a mystery.

(R.W. Berg, M.-T. Chen, H.-C. Huang, M.-C. Hsiao, H. Cheng "A method for unit recording in the lumbar spinal cord during locomotion of the conscious adult rat", **J Neurosci Meth,** 182, 49-54, 2009)

(R.W. Berg, A. Alaburda and J. Hounsgaard "Balanced inhibition and excitation drives spike activity in spinal half-centers", **Science,** vol. 315(5810) 390-393, 2007)

PROBE STATUS

Dr. Berg's A8x8-5mm-200-160 Custom Design is available in the catalog as a special order. See page 171 for more detail.



RIGHT: Dr. Berg's 64-channel custom design.

Dr. Heiko Luhmann

UNIVERSITY MEDICAL CENTER
MAINZ, GERMANY

"For our in vitro and in vivo studies on large-scale network activity we needed reliable and high-quality electrode arrays with a special design. We only found them at NeuroNexus."

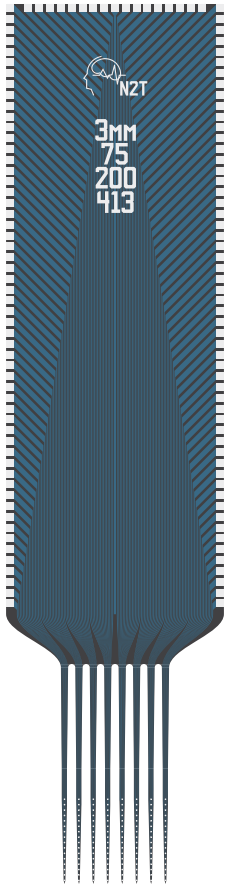
Dr. Luhmann

Dr. Luhmann's experimental studies with multi-electrodes arrays go back to the year 2006 (Nature 439: 79-83), when at that time electrodes were provided from the Michigan University Center for Neural Communication Technology (CNCT). Over the years our demands for special electrodes arrays (with up to 128 electrodes) became more complex and only NeuroNexus could provide these electrodes. Now Dr. Luhmann's lab is using various types of NeuroNexus electrodes on a daily basis to record field potentials (J. Neuroscience 2009, 2012, 2014; Cerebral Cortex 2013) and multi-unit activity (Cerebral Cortex 2014) in very young and adult rodent cortex. These technques are now combined with optogenetics.

PROBE DETAIL

Dr. Luhmann's A8x16-3mm-75-200-413 electrode array was designed for in vivo recordings in the barrel cortex of rodents. It features 128 channels, with 16 electrode sites on each of its 8 shanks.

The A8x16-3mm-75-200-413 electrode array is available in the catalog as a special order. See page 173 for more detail.



RIGHT: Dr. Luhmann's A8x16-3mm-75-200-413 custom design.

Figures

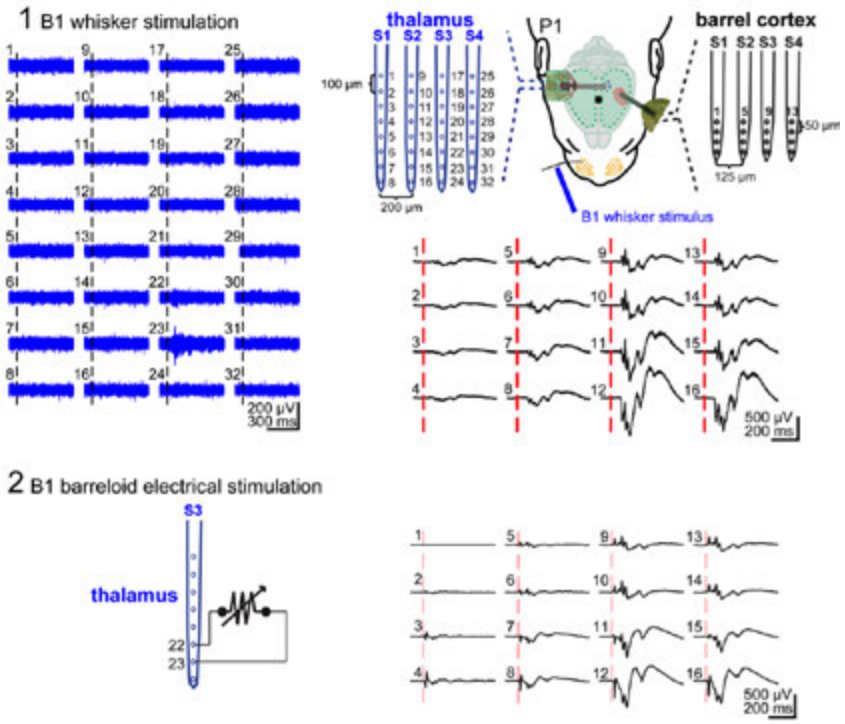


FIGURE 1: Simultaneous recordings with a 32-channel electrode in the somatosensory thalamus and with a 16-channel electrode in the barrel cortex of a 1 day old rat (from: Cerebral Cortex 23: 1299, 2013).

(1) Mechanical stimulation of whisker B1 elicits reponse at thalamic electrode #23 and at cortical electrodes 9-16.

(2) Local bipolar electrical stimulation at the thalamic electrode s #22 and #23 evokes a cortical response resembling the response to whisker stimulation.

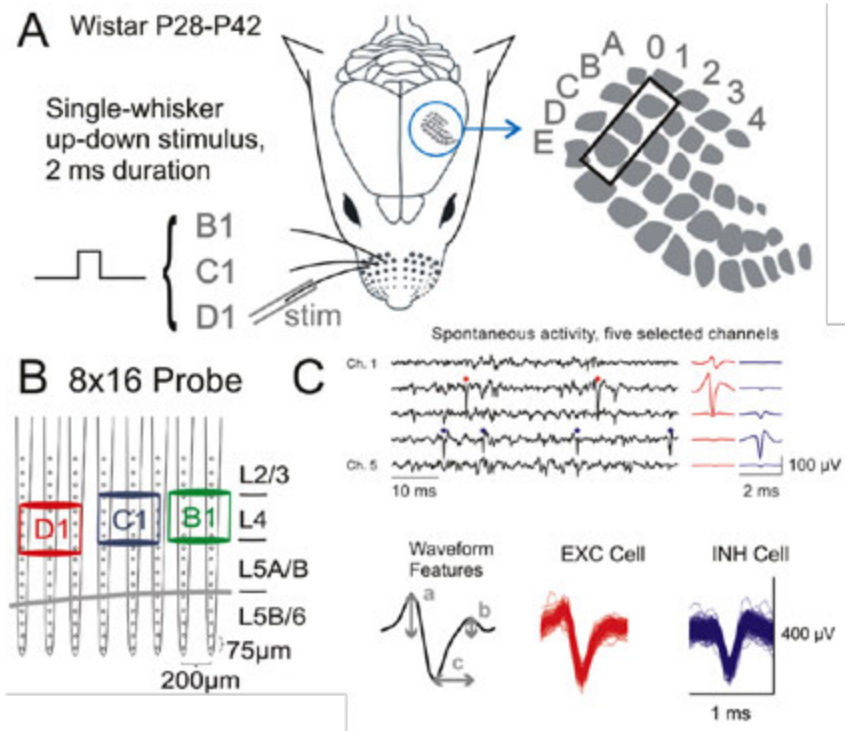


FIGURE 2: Recordings with 128-channel electrodes (8 shanks, 16 electrodes each) in three barrel-realted columns (B1, C1 and D1) adult rat. (A) Experimental setup with barrel field in somatosensory cortex (right). (B) Electrode design. (C) Recordings and identification of presumably excitatory (red) and inhibitory (blue) neurons based on spike waveform. From: Reyes-Puerta et al., Cerebral Cortex 2014, doi:10.1093/cercor/bhu007

SmartBox™

PORTABLE CONTROL + DATA STREAMING SYSTEM

The NeuroNexus SmartBox™ is a portable control and data streaming system designed to interface with all NeuroNexus probes.

The SmartBox™ arrives ready to go, with minimal setup required. Take it with you and record from anywhere: up to 256 channels simultaneously, from up to 4 independent experiments. A real-time display shows the experiment in progress, and a Spike Scope allows detailed viewing of individual channels. Speakers can be connected for auditory monitoring.

The included software intuitively displays up to 32 channels on one screen. Recorded data is streamed to file and can be loaded in MATLAB for analysis, or exported to other programs like NeuroExplorer or Offline Sorter.

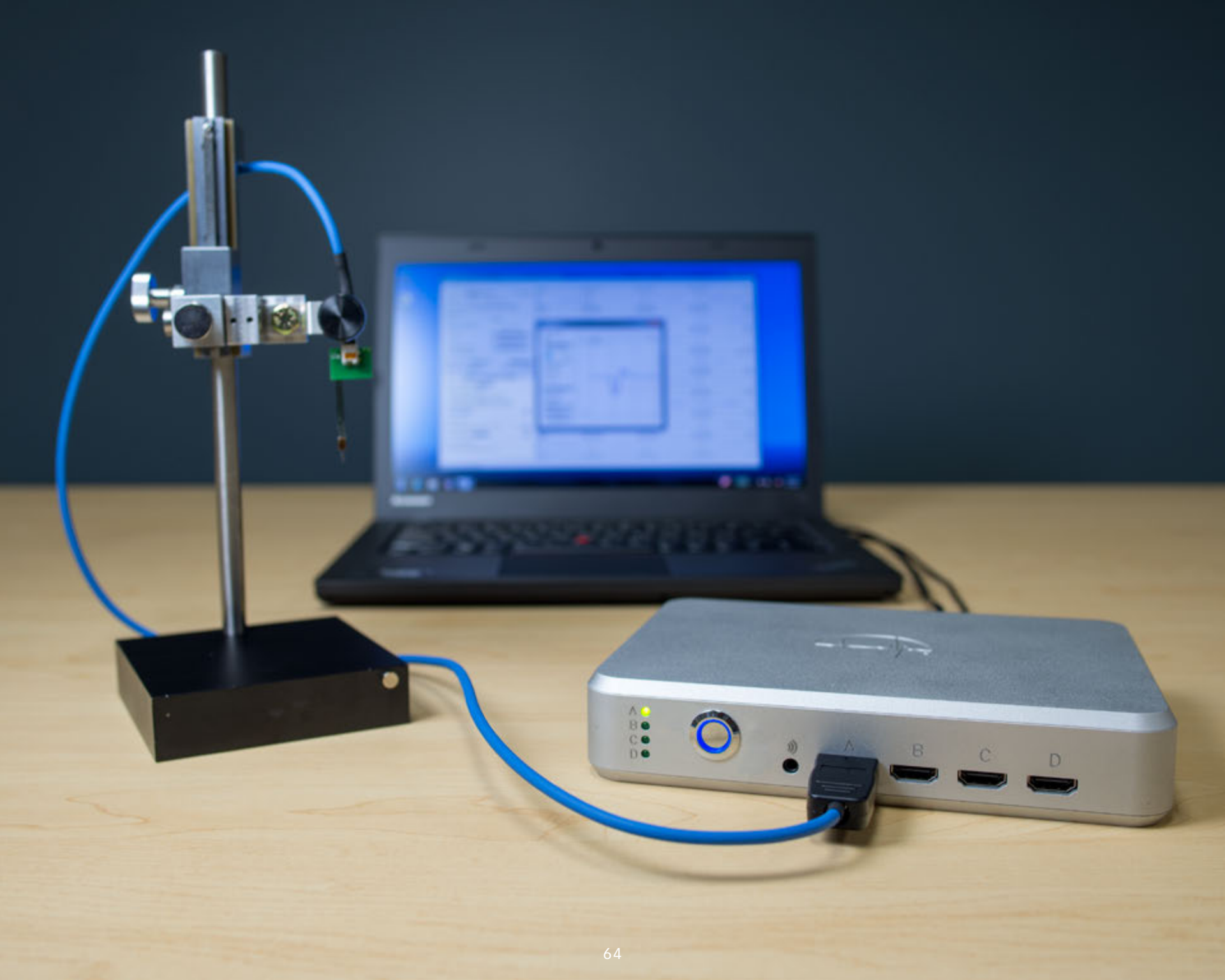
The SmartBox™ is capable of acquiring EMG, ECG, ECoG, EEG, neuron action potentials, and local field potentials.

SPECIFICATIONS

Acquisition Channel Count	16, 32, 64, 128, 256
A/D Bit Rates	16-bit
Analog I/O	4 BNC, 0-5 V TTL
Digital I/O	4 BNC, 0-5 V
Data Bandwidth	0.1 Hz - 20 kHz
Audio Monitoring	1 stereo Line Out jack, user selectable
Expansion I/O (via DB50 port)	14 digital in 14 digital out 6 ADC in 6 DAC out
PC Requirement	PC, Windows 7, USB 2.0

NO TRADEOFFS ON PERFORMANCE

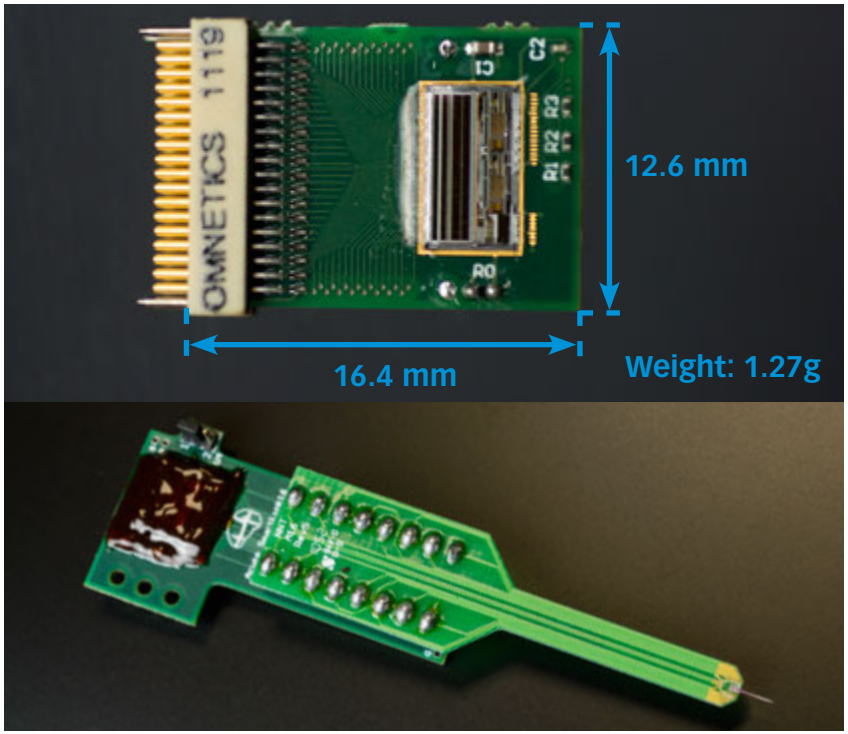
The SmartBox™ is powered by cutting-edge technology, leveraging an ASIC chip with onboard digitization and a powerful FPGA used by the electronics and telecommunications industries.


A
B
C
D

SMARTLINK HEADSTAGES

SmartLink headstages connect conventional probes to the SmartBox™ system. Contact us for connector options.

All SmartLink headstages use on-board electronics to digitize neural signals at the implant site. This improves signal fidelity and reduces noise from cable and animal movement. SmartLink headstages connect to the SmartBox™ with a custom HDMI cable. (NOTE: Regular HDMI cables **will not work** with the SmartBox™ family.)

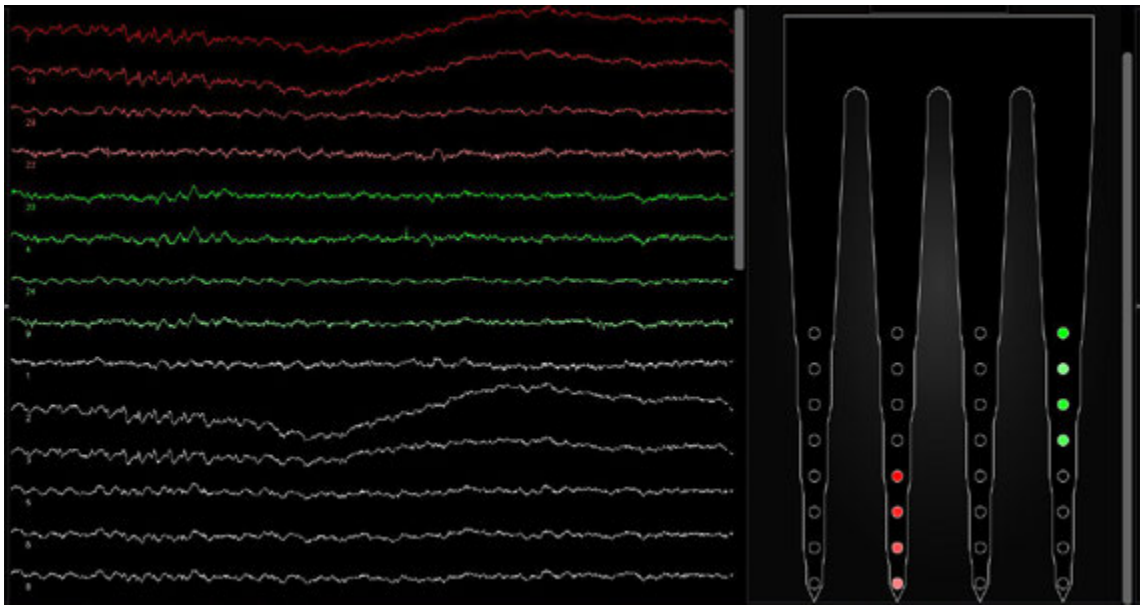


TOP: Chronic SmartLink64 headstage / **BOTTOM:** A16 probe on Acute Smartlink16 headstage

SMARTLINK HEADSTAGES	
Chronic SmartLink16	Connect a 16 channel conventional probe to the SmartBox™, using an 18-pin Omnetics connector (see CM16LP, page 28, and H16, page 30)
Acute SmartLink16	Connect a 16 channel conventional probe to the SmartBox™, using dual inline pins (see A16, page 28)
Chronic SmartLink32	Connect a 32 channel conventional probe to the SmartBox™, using a 36-pin Omnetics connector (see CM32, page 28, and H32, page 30)
Acute SmartLink32	Connect a 32 channel conventional probe to the SmartBox™ using a SAMTEC connector (see A32, page 28)
Chronic SmartLink64	Connect a 64 channel conventional probe to the SmartBox™ using 2 36-pin Omnetics connectors (see H64LP, page 31)
Acute SmartLink64	Connect a 64 channel conventional probe to the SmartBox™, using 2 SAMTEC connectors (see A64, page 28)

SMARTLINK SPECIFICATIONS			
A/D RESOLUTION	16-bit	LOW INPUT-REFERRED NOISE	2.4 μV_{rms} typical
SAMPLING RATES	1 kS/s - 30 kS/s	INPUT RANGE	± 5 mV
CUTOFF FREQUENCY	Adjustable; Lower: 0.1 - 500 Hz Upper: 100 Hz to 20 kHz	SMALLEST DETECTABLE SIGNAL	≈ 15 µV

GRAPHICAL USER INTERFACE



The new SmartBox GUI integrates mapping with real-time spatial estimates of spike locations. While the SmartBox can be used with any conventional high-impedance probe, the new control software comes with preloaded mapping for all current NeuroNexus probes, as well as support for future designs.

- **Color-coded channels:** Recording sites on the probe can be highlighted, and their corresponding spike trains move to the top of the screen. Conversely, spike trains of interested can be selected, highlighting their corresponding recording sites.
- **Customizable interface:** The new interface can display map and spike trains simultaneously, or switched to full-screen spike train viewing. All neural recording channels can be viewed simultaneously in one window by adjusting the channel amplitude and space between channels.

COMMUTATOR

Designed to seamlessly integrate with the SmartBox system, the NeuroNexus Commutator allows for uninterrupted recording and/or stimulation during awake and behaving experimental situations. Signals pass through the commutator while the cable freely swivels and rotates. A counterbalance arm maintains variable tension on the cable to prevent coiling as the animal moves throughout the cage.

The commutator system can be easily customized for uniquely sized cages and varying experimental needs.

Right: NeuroNexus Commutator
Far Right: Closeup of mini-HDMI port enabling connection to the SmartBox or any Intan system

COMPLETE SMARTBOX SPECIFICATIONS	
ACQUISITION CHANNEL COUNT	16, 32, 64, 128, 256
A/D RESOLUTION	16-bit
SAMPLING RATES	1 kS/s - 30 kS/s
PERIPHERAL OUTPUT	2 Analog*, BNC (± 3.3 V) 2 Digital*, BNC (0 - 5 V)
PERIPHERAL INPUT	2 Analog*, BNC (0 - 3.3 V) 2 Digital*, BNC (0 - 5 V)
AUDIO MONITORING	1 stereo line out (3.5 mm), user selectable
CUTOFF FREQUENCY	Adjustable; Lower: 0.1 - 500 Hz Upper: 100 Hz to 20 kHz
LOW INPUT-REFERRED NOISE	2.4 μV_{rms} typical
INPUT RANGE	± 5 mV
SMALLEST DETECTABLE SIGNAL	≈ 15 µV
PC REQUIREMENT	PC, Windows 7, USB 2.0

*Additional Input/Output available via
the DB50 expansion port: 14 digital in, 14 digital out
6 ADC in, 6 DAC out

REAL PORTABILITY

With an optional battery (shown above), the SmartBox™ can be operated from anywhere.

The battery is part of a SmartBox™ kit, or can be ordered separately. Visit neuronexus.com for more information.

dDrive

WEARABLE MICRODRIVE

The **dDrive** is NeuroNexus' solution for cost-effective chronic recording experiments. It features similar capabilities as the reusable nDrive, but is designed to be used for just one implantation, simplifying your prep.

The entire dDrive assembly (with probe) can be sterilized, and it arrives assembled and ready for your surgery. The simplicity of the dDrive makes it ideal for both beginners and experienced users recording with NeuroNexus' chronic probes.

The dDrive-m has a drive range of 2.5 mm, while the dDrive-xL (Extended Length) features a range of 7 mm. The 2016 dDrive utilizes a screw drive with even finer resolution than before, making a depth alteration of 150 µm with one complete turn. Also included with the dDrive are an easy to use connector holder and an adaptor that interfaces to your stereotaxic system.

Visit neuronexus.com to learn more about our implantation procedure.

ABOVE: dDrive-m on a mouse skull

SPECIFICATIONS

	dDrive-m	dDrive-xL
Dimensions (w/ cap) W x L x H	10 x 8 x 10 (mm)	10 x 8 x 15.5 (mm)
Dimensions (w/o cap) Dia. x H	3.5 x 7.65 (mm)	3.5 x 12.65 (mm)
Weight* (w/ cap)	0.47 g	0.75 g
Weight* (w/o cap)	0.12 g	0.16 g
Drive Range	2.5 mm	7 mm
Drive Resolution	150 µm/turn	150 µm/turn
Drive Mechanism	Screw base	Screw base

**Weights shown without probe. Turn to p.30-31 to see probe weights.*

ABOVE: Opto-dDrive with fiber attached, prepared for implantation

Opto-dDrive

NeuroNexus now offers a microdrive-compatible chronic Optoelectrode solution by combining some popular product lines: H-style probes, dDrives, and Optoelectrodes. With the addition of the **Opto-dDrive,** it is now possible to increase the effectiveness and longevity of your chronic Optoelectrode recordings.

Both the dDrive-m and dDrive-xL can be configured with an optical fiber. The following fibers are available:

- 105 µm diameter core / 125 µm diameter cladding / 0.22 NA
- 105 µm diameter core / 125 µm diameter cladding / 0.66 NA
- 50 µm diameter core / 62.5 µm diameter cladding / 0.22 NA

IMPLANTATION STRATEGY

The NeuroNexus YouTube channel provides detailed demonstrations of implantation strategies for various products, including the dDrive.

youtube.com/TheNeuroNexus

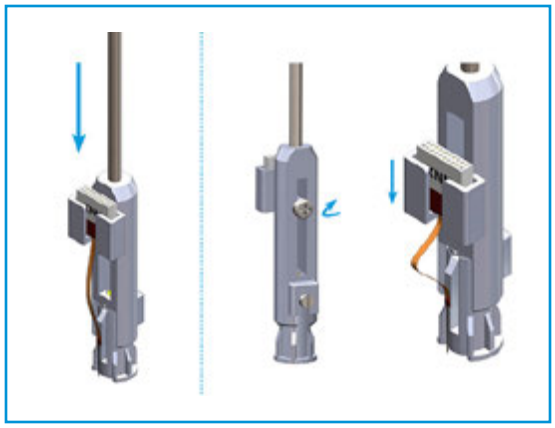
Multi-Drive

The **Multi-Drive** is a customizable solution for applications requiring more than one microdrive, or for applications requiring multiple probes with individually adjustable depth.

Contact us for more information.

ABOVE: Multi-Drive on Rat skull

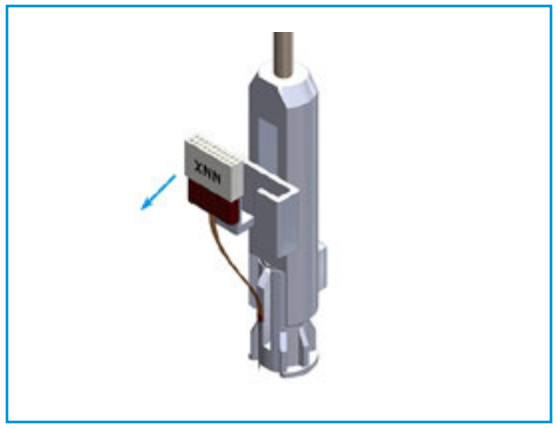
Basic Implantation Strategy



Step 1

Position the dDrive at the implant location. Lower until the base of the dDrive is level with the bone surface, and cement the base of the dDrive to the skull.

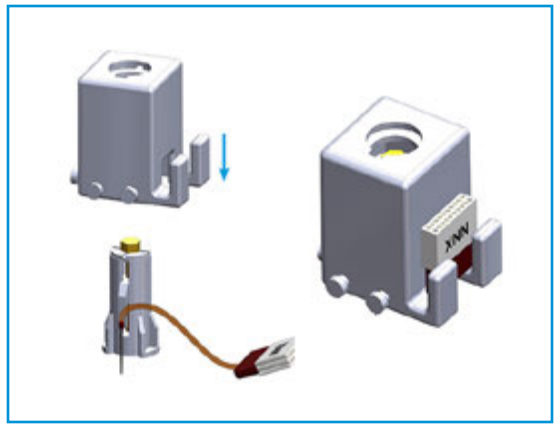
Loosen the connector holder and lower the connector, creating slack in the probe's flex cable, as shown.



Step 2

Disengage the connector from the drive and place on the skull. Hold the connector with a separate manipulator, leaving slack in the flex cable.

Loosen the dDrive securing screw and pull the insertion component away from the cemented drive.



Step 3

Drive the probe 1-2 mm into tissue. (Turn the screwhead counter-clockwise for downward motion.) This is to confirm successful insertion prior to securing the dDrive cap.

Place the cap over the dDrive such that the cap opening is concentric to the dDrive. Cement the cap in place. Position the connector in the connector slot and cement securely to the cap. Do not overstress the interconnect.

nDrive & nDrive-xL

WEARABLE MICRODRIVE

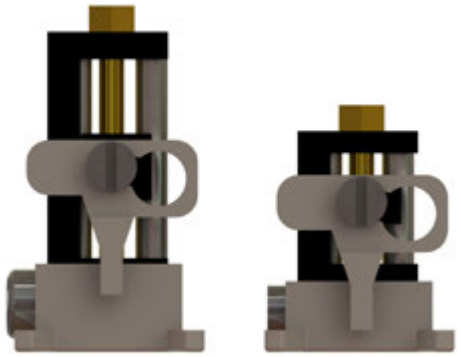
The **nDrive** is a bi-directional manually controlled microdrive for use with H-series Probes. The compact drive allows a probe to be moved over the course of a chronic experiment, providing an effective strategy to overcome brain movement or tissue encapsulation around the probe, greatly improving the success rate of your experiments.

SPECIFICATIONS

	nDrive	nDrive-xL
Dimensions (w/ lid) W x L x H	9 x 11 x 12 (mm)	9 x 11 x 16.5 (mm)
Dimensions (w/o lid) W x L x H	6.65 x 3.65 x 11 (mm)	6.65 x 3.65 x 15.5 (mm)
Drive Range	3 mm	6 mm
Drive Resolution	282 µm/turn	282 µm/turn
Drive Mechanism	Screw base	Screw base

The standard nDrive has a drive range of 3mm, while the nDrive-xL (Extended Length) has a range of 6mm. Each full turn of the drive screw alters implant depth by 282 µm. The recommended protocol is to implant the Probe/nDrive during the mounting step.

The nDrive can be re-used and replenishment and training kits are available. Copper Mesh is available as an alternative close-up option: grounding the Mesh serves as a Faraday cage and further shields the Probe from noise.

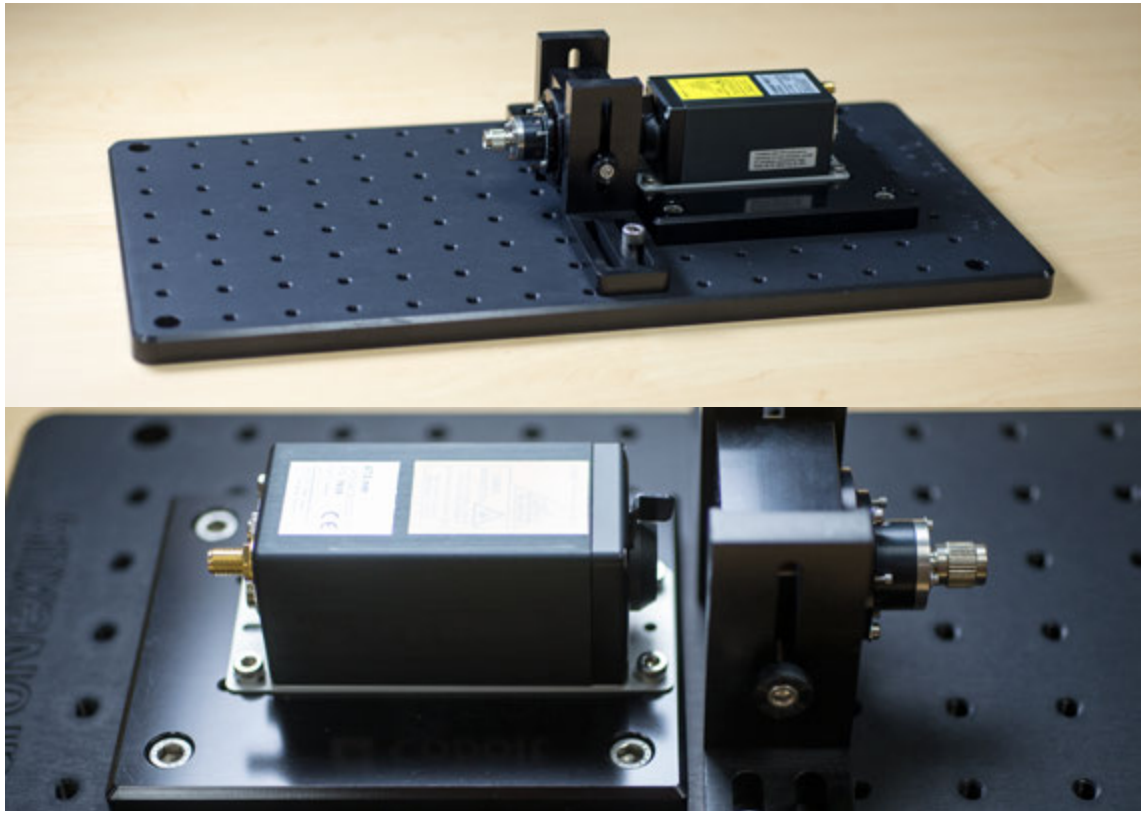


LEFT: nDrive-xL **RIGHT:** nDrive

For more information on implanting probes with the nDrive, visit Dr. Liset de la Prida's online guide: *http://hippo-circuitlab.com/2013/04/microdrive-implanting-procedures-2/*

Light Source Systems

NeuroNexus offers turnkey laser light source systems to illuminate our Optoelectrode line. Diode lasers and Diode-Pumped Solid-State (DPSS) lasers are ideal for Optogenetics applications, offering long-term output stability and extended operating lifetimes.

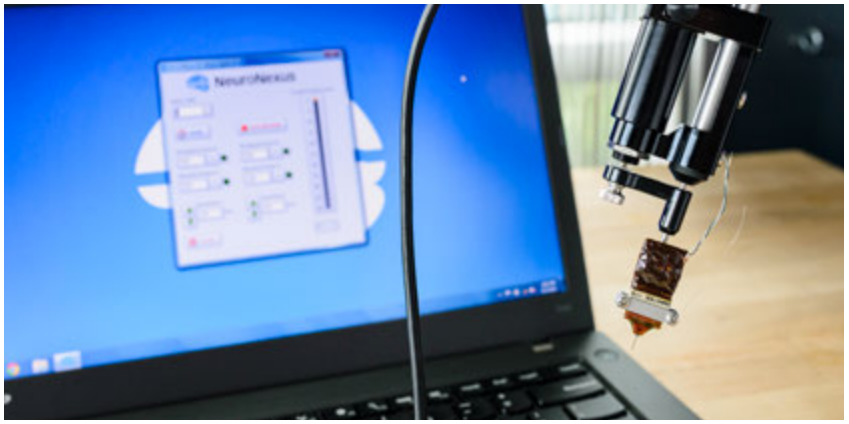


Contact us for more information on light source systems, related accessories, and setting up a system for your experiments. Laser systems purchased through NeuroNexus are calibrated in our lab to your applications.

FEATURES

- Available in popular output power ratings: 50 mW - 100 mW
- Low noise laser modules
- Tested to ensure power output requirement at the fiber tip is met
- Analog, digital & TTL modulation (Diode lasers)
- Extremely short rise/fall times for short pulses (Diode lasers)
- Low acoustic optical shutter modulation (DPSS lasers)
- Laser monitoring software to change power, operation, and other settings
- Includes fiber coupler to NeuroNexus and standard industry patch-cords

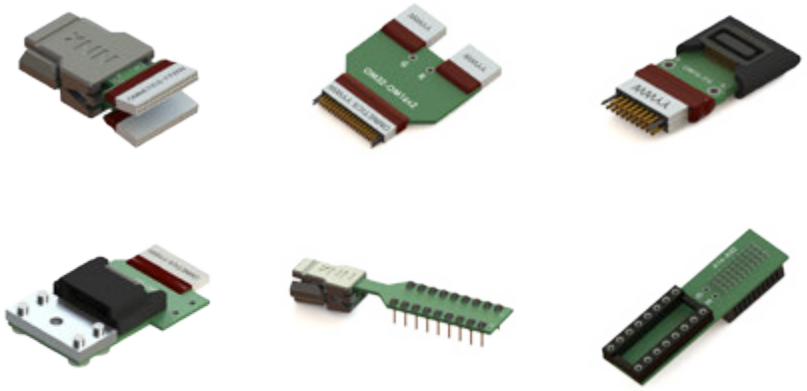
Insertion Tools



Insertion tools attach to the probe package and terminate with a 2 mm rod. To attach the 2 mm rod to a standard Kopf 7.9 mm stereotactic frame, you will need an adaptor (IST-ADPT). Custom rods with diameter less than 8 mm are also available.

Go to **neuronexus.com/products/accessories** for a full list of Insertion tools and prices.

Headstage Adaptors



If you have a headstage that does not connect directly to one of our probe packages, you might need a headstage adaptor. NeuroNexus offers a range of adaptors, listed at **neuronexus.com/products/accessories.** If you cannot find an adaptor to meet your needs, custom adaptors can be fabricated.

NOTE: When mapping electrode sites to the headstage with an adaptor, the adaptor map must be taken into consideration. Adaptor maps describe the channel routing through the adaptor. Mapping documents can be found at **neuronexus.com/support.**

Training Kit

Mock probe assemblies are available for training purposes. These assemblies are designed for insertion practice or mock surgeries, and are not functional. The mock probe assemblies do not include actual PCBs or connectors.

New users looking to move up from training kits may consider trying B-Stock probes (see page 83), which are irregular probes and are offered at discounted prices.

Probe Connector Cover

Connector covers offer protection for connectors used in chronic implants. The following connector covers are available:

CATALOG #	DESCRIPTION
CVR-OM16	Cover for packages using 16-channel Omnetics connector
CVR-OM32	Cover for packages using 32-channel Omnetics connector
CVR-Z16/32	Cover for packages using 16/32-channel Zif Clip™ connector
CVR-Z64	Cover for packages using 64-channel Zif Clip™ connector

Wire Strippers

Some probe packages come with insulated wires for grounding and reference channel customization. NeuroNexus recommends cutting or stripping these wires with a wire stripper optimized for small conductor cross sections.

MR Accessories

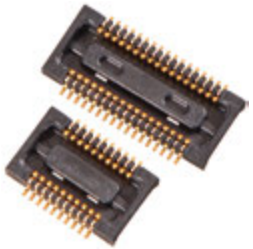
MR Accessories utilize trace to no amounts of ferromagnetic material to minimize MRI interference.

CATALOG #	DESCRIPTION
MR-Brainamp-Jumper	Jumper cable between adaptor and BrainAmp. Length can be customized. **NOTE:** Contains nickel-plated material.
MR-BrainAmp-Omnetics16x2	BrainAmp adaptor (32-channel)
MR-Omnetics16-Wire	Mate to Omnetics connector on the probe. Nickel-free material. Cable length ≈ 10" (254 mm)
MR-Omnetics16-Jumper	Jumper cable between adaptor and NeuroNexus probe. Nickel-free material.

Electrodes and Connectors

Electrodes

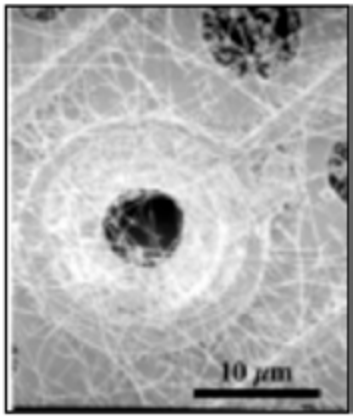
Unpackaged electrodes are available for purchase. These electrodes have the same mechanical properties as normal electrodes, but do not have functional electrode sites. Typical uses for these unpackaged electrodes are material and coating studies.



Connectors

Interface connectors are available for purchase. Contact us for more information.

Electrode Site Impedance Conditioning



The iridium activation service is available to achieve iridium oxide sites. Iridium oxide reduces impedance and improves charge transfer capability of an iridium based electrode and is recommended for experiments involving stimulation. **NOTE: The effects of iridium activation wear off over time, so the probe should be activated immediately before use.**

CATALOG #	DESCRIPTION
ACTIVATION16	16-channel activation
ACTIVATION32	32-channel activation

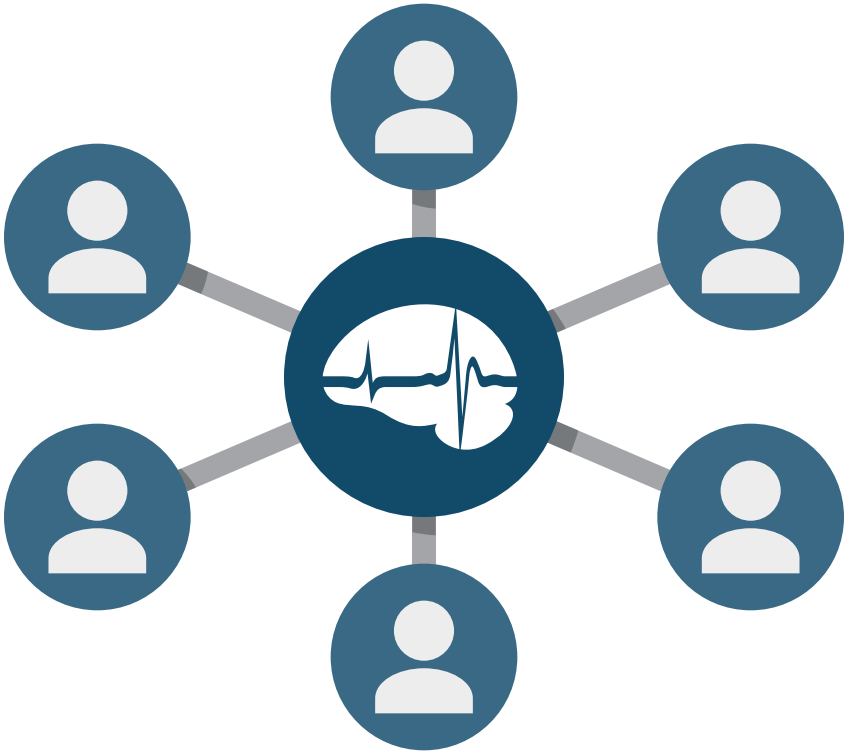
Surgery/Implant Consulting

Adapting to new technology and techniques can be difficult. NeuroNexus staff engineers and scientists have decades of combined experience, and we can help you reduce your ramp-up time so you can focus on the research.

We will collaborate with you to plan the experiment and devise strategies to minimize known issues. Surgical techniques often have significant impact on the outcome of a chronic experiment. We can help train your group and get you up and running quickly.

NEURONEXUS CAN:

- Perform surgery and implant electrodes for you on-site
- Assist with experiment paradigm design and pre-surgery planning
- Train new users on surgical techniques and electrode technology
- Assist with data analysis



COMMUNITY

SCIENCE UPDATE

The NeuroNexus Science Update provides a forum for users to communicate, collaborate, and share their published work. It also provides a valuable database for researchers looking for work similar to their own.

Upload your published papers, or search for other papers. Each paper is tagged in deep detail to help you find what you are looking for.

COMMUNITY-POWERED SUPPORT

Visit our community-powered site for answers to frequently asked questions or participate to help fellow researchers. NeuroNexus staff actively monitors and answers questions, and will update topics periodically. If you have a specific question, please send us an email directly.

We encourage our community of users to participate and share their expertise.

HOW TO ORDER

YOUR FIRST ORDER

Welcome to the NeuroNexus community!

Before you place your first order, you will need to fill out our Information Form, which you can find on our website (http://neuronexus.com/support/ordering). This helps us match orders to the appropriate lab and users.

After placing your order, you will receive a quote. Please include your quote with your purchase order(s), and identify the technical contact or user for each order or order co-ordination.

If you are starting a new lab and are interested in our electrode technology, contact us for a discount!

HOW IT WORKS

Because NeuroNexus offers such a wide variety of electrodes and neural probes, most NeuroNexus probes are built to order. If we do not have fully assembled probes in stock, typical delivery times will take between **4-6 weeks.**

If you have a specific experimental deadline to meet, please advise your sales co-ordinator at the time of your order. We will do our best to accomodate deadlines, but we strongly encourage you to order early if you can.

IN A HURRY?

There are several ways to speed up the delivery schedule:

Allow partial deliveries. If your order consists of a large number of probes and/or multiple designs, chances are some of the probes will become available before the others. Advise your sales co-ordinator to ship probes as they become available. Please note that additional shipping charges or customs fees may apply.

Rush your order. We may be able to deliver your order in 7-10 business days. A 25% premium will be included, but you must confirm a rushed order with your sales co-ordinator.

Provide alternative designs. If the electrode design you need is not available, chances are there is at least one with close enough design parameters to meet your needs. Browse through the **Electrode Array Design** section (page 87) to find alternatives, or give us a call!

Consider B-Stock probes. B-Stock probes have electrodes with very few irregular sites, but are otherwise perfectly functional. Most designs and configurations have B-Stock probes available for fast shipping. Check our webstore **(shopping.neuronexus.com)** to browse available probes.

HOW TO ORDER

BULK DISCOUNT

Receive a 10% discount for bulk orders of standard catalog probe designs totalling over $7,500.

WHAT ARE B-STOCK PROBES?

All NeuroNexus probes undergo extensive electrical and mechanical testing and inspection for all electrode channels before leaving our lab. At times, select probes exhibit a few channels with electrical shorts or open sites (out of 16/32/64 available), but are otherwise perfectly functional. These probes therefore do not pass our normal quality checks, and become B-Stock probes.

We typically have B-Stock probes in a variety of electrode and package combinations. All B-Stock probes are fully assembled, can be shipped immediately, and are discounted based on the number of irregular channels. Irregular channels are identified in the delivery documentation shipped with every order.

TERMS AND CONDITIONS

NOT FOR HUMAN USE

The products in this catalog are not FDA approved for human use. Their use is limited to investigational use only.

Please inspect your package for damage upon its arrival. If there are any damaged items, please report them to us within 7 days upon receipt of your package.

All sales are final. No exceptions.

Unused items may be exchanged with permission from NeuroNexus within 14 days of the receipt of the package.

NeuroNexus is not responsible for any customs fees for international orders. If you have any tax or customs-free IDs, please provide them at check-out along with instructions.

Please add a $25 fee for international orders (including Canada).

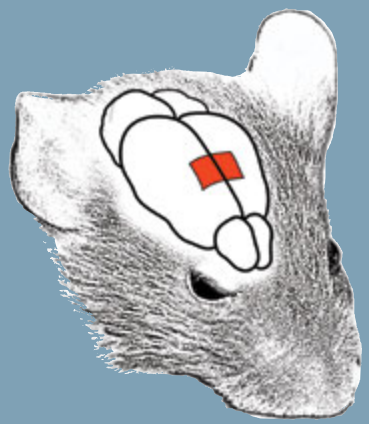
PROBE USE

1

PREPARE PROBE

- When handling probe, only touch PCB board
- Sterilize probe for chronic experiments
- Impedance check
- Perform Activation for stimulation applications (optional)

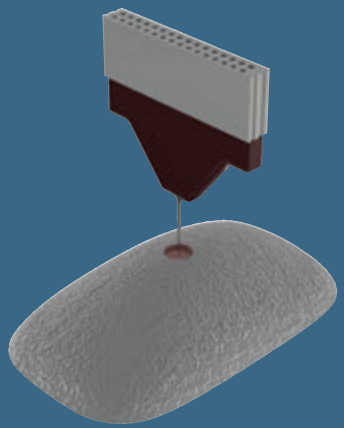
2



PREPARE ANIMAL

- Remove dura

3



IMPLANT PROBE

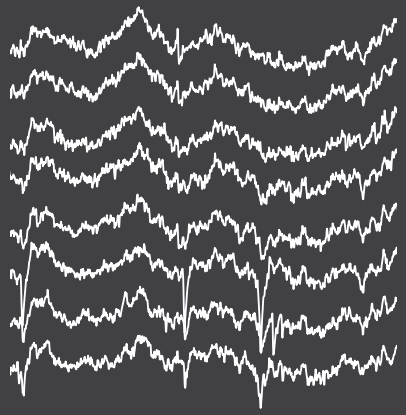
- First, connect the probe to the headstage or microdrive. This ensures better accuracy and minimizes post-implant movement.
- If buckling occurs, do not force insertion. Wait and let the probe work its way into the tissue. (This may take up to 15 minutes.)

4

CONNEC TO HEADSTAGE AND/OR MICRODRIVE

- The dDrive / nDrive (right image) can help improve the success rate of a chronic experiment. See pages 67-70.
- If your headstage does not connect directly to your probe, NeuroNexus can provide adaptors

5



ACQUISITION

6

COLLECT DATA

RECOMMENDATIONS FOR NEW USERS

Use Practice Kits & B-Stock Probes

New users sometimes break probes due to lack of handling/insertion experience. Training Kits (see page 74) are designed for insertion practices or mock surgeries. B-Stock probes are also recommended for novice users because of the immediate availability and reduced cost. B-Stock also offers the opportunity to sample various probe parameters, such as site area and shank strength.

Start with Acute

Acute probes are easier to handle because of the size of the PCB package. Acute experiments are often more managable and usually more predictable. NeuroNexus offers several different packaging options while the actual implanted probe design remains the same. When getting into chronic experiments, consider using a microdrive setup such as the dDrive (page 67) to prolong the duration of a chronic experiment.

Start with Catalog Probe Designs

NeuroNexus offers custom design services (see page 38) for users with specific or extraordinary requirements. However, there is a significant financial commitment for custom design probes. Prior experience with our technology and probes will ensure a successful custom design outcome.

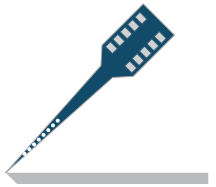
Use the right equipment

Using proper headstage amplifiers will eliminate/reduce noise. It is recommended that you use commercial amplifier systems with NeuroNexus probes. If you are using a Smart-enabled device (see page 11), we recommend the SmartBox data streaming system (page 63).

Plan Ahead

Most NeuroNexus probes are built to order. Order probes ahead of time with backup to ensure your experiment will go smoothly.

USING STANDARD PROBES



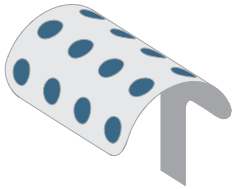
Basic Implantation Strategy

1. Measure impedances to verify the sites are functional.
2. For chronic experiments, sterilize the probe using Ethylene oxide (soaking the probes in alcohol may also work).
3. Prep the animal and open the craniotomy using your approved protocol, remove dura.
4. Using the stereotactic frame and the manipulator, implant the probe to the target region. If the probe buckles, DO NOT force insertion; wait 5-10 minutes. Typically the probe will slowly work its way into tissue.
5. For chronic experiments, apply the first layer of barrier using agar. Build up a "dam" using gelfoam and completely fill and protect any unimplanted shank with silicone (such as Kwikseal from WPI©). close up the craniotomy using dental acrylic. Check impedance and compare with impedance data from step 1 to ensure that the probe was not damaged or broken during the implantation.

Care for your Standard Probes

- Store probes in their shipping box. Keep the record that came with the probes. This will help you identify the probe designs in the future.
- For Standard Probes, withdraw probe from tissue afer the experiment and rinse with DI-water immediately. Soak probe (only the silicon shank and avoid the silicone coating) in a protein dissolving detergent/enzyme (such as contact lenses solution or diluted surgical instrument detergent). The process may take a few hours. Alcohol rinse is not recommended as it may dehydrate any residual tissue, causing protein to stick to the electrode site.
- Use connector covers (page 75) to protect the exposed connectors of the chronic packages.

USING SURFACE PROBES



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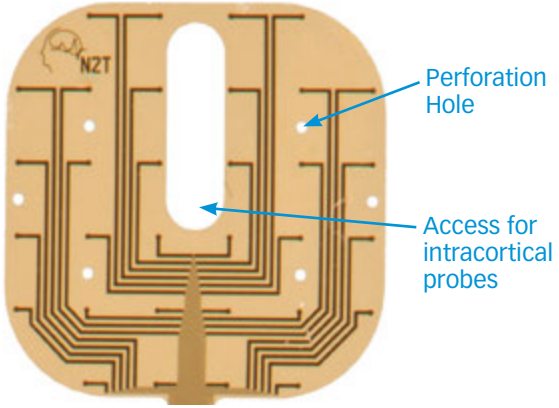
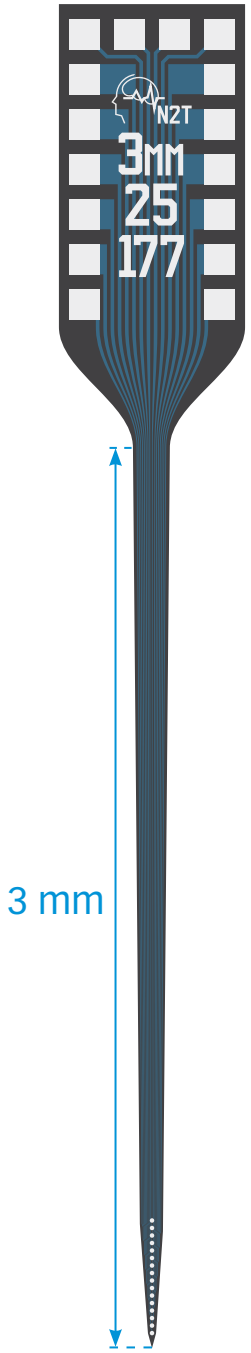
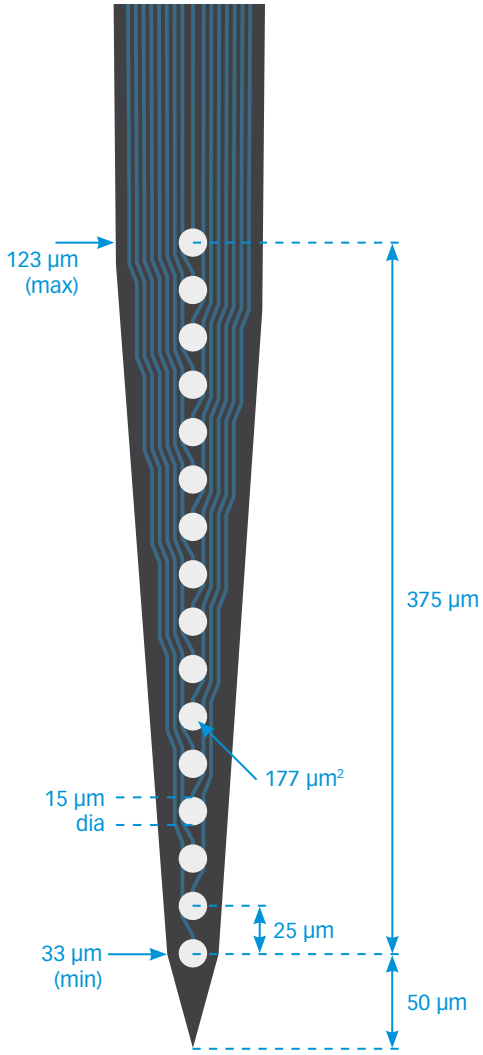
ABOVE: Simultaneous recording with a Surface and Standard Electrode.
BELOW: A Surface Array showing perforation and access for intracortical probes



A1x16-3mm-25-177



TIP DETAIL



available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

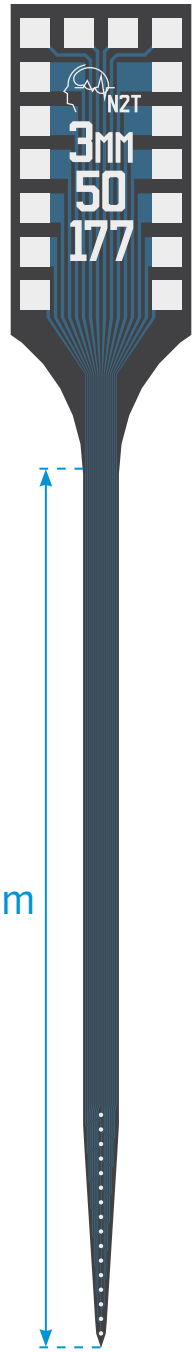
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

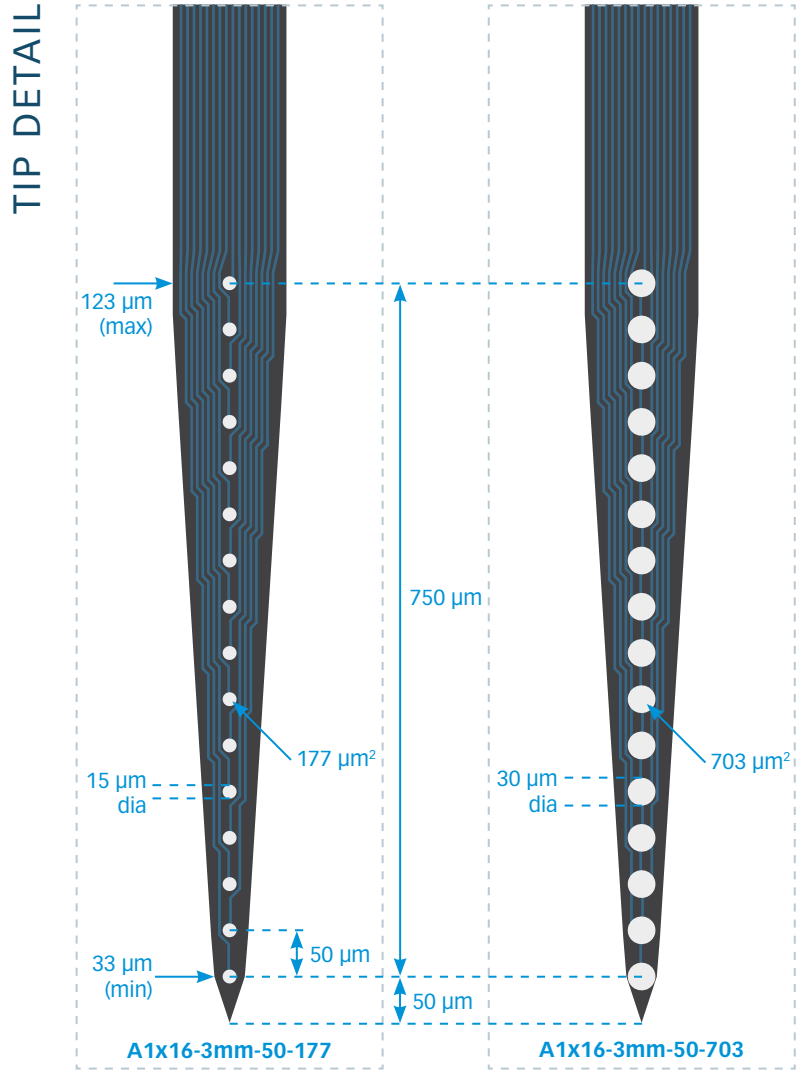
MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

thickness

15 µm

A1x16-3mm-50-177
A1x16-3mm-50-703





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A1x16-3mm-100-177
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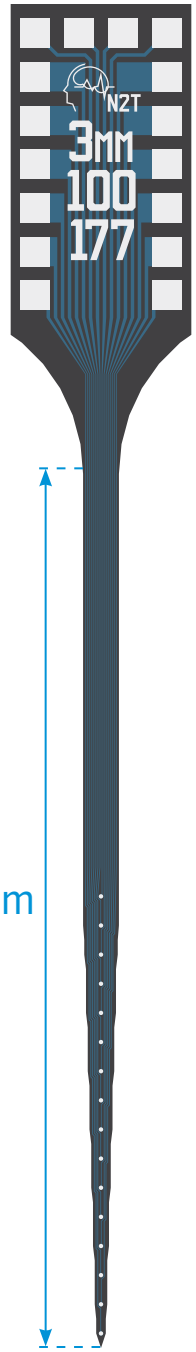

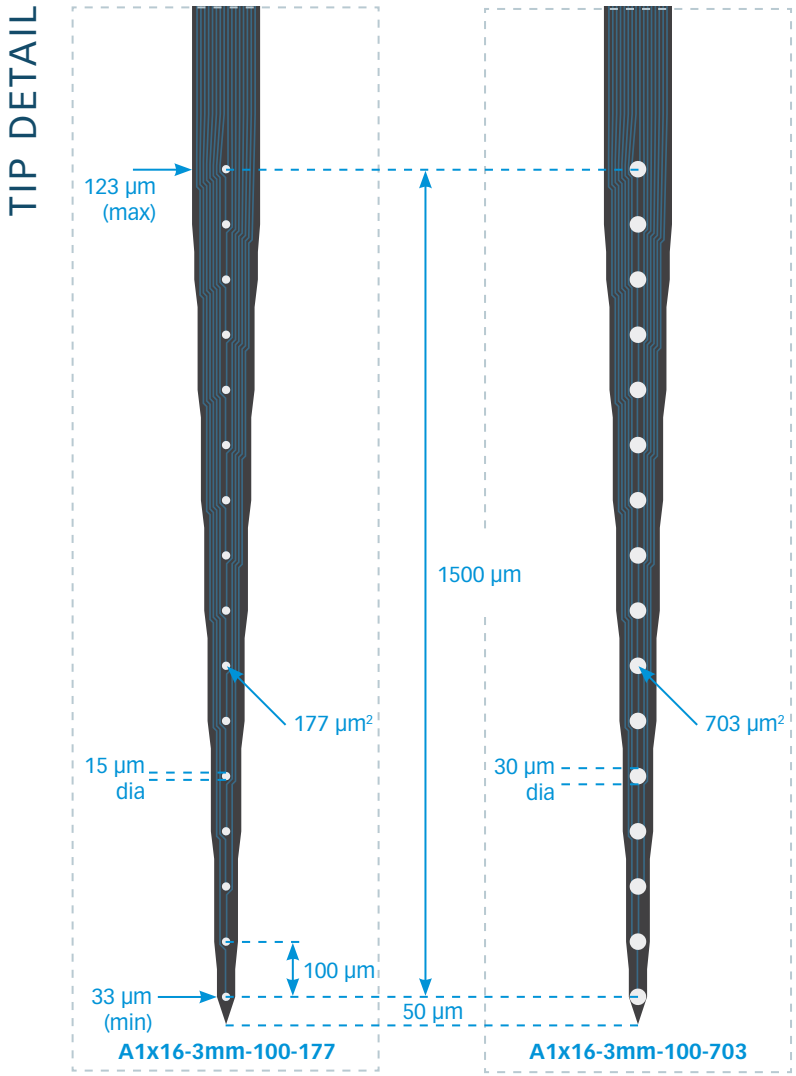

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OA16LP
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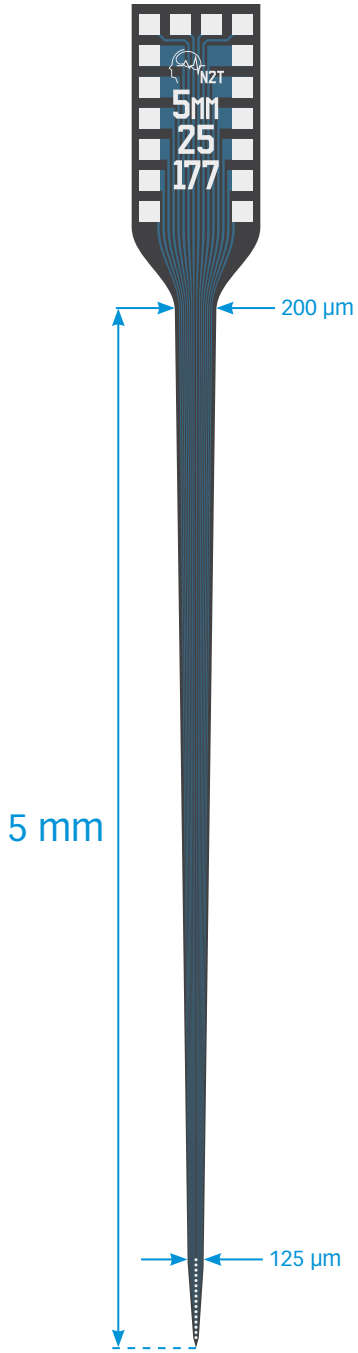
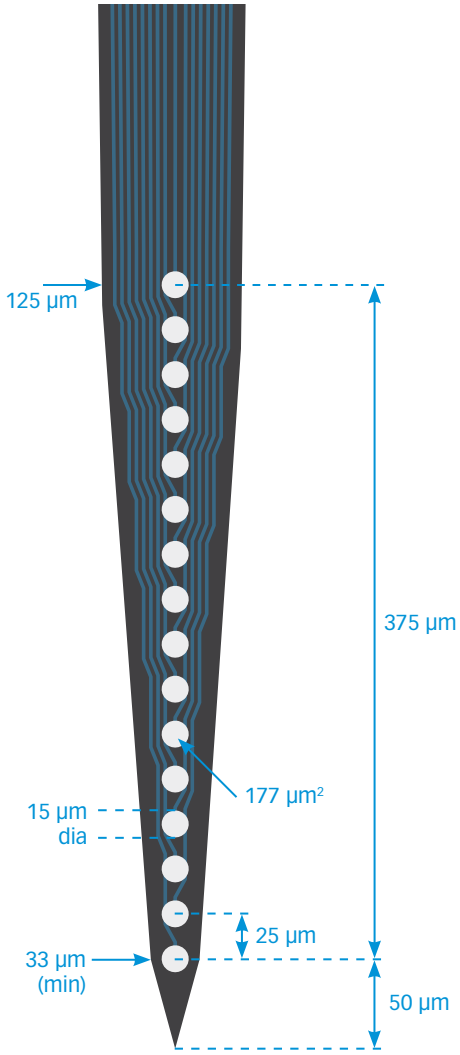
A1x16-5mm-25-177



TIP DETAIL



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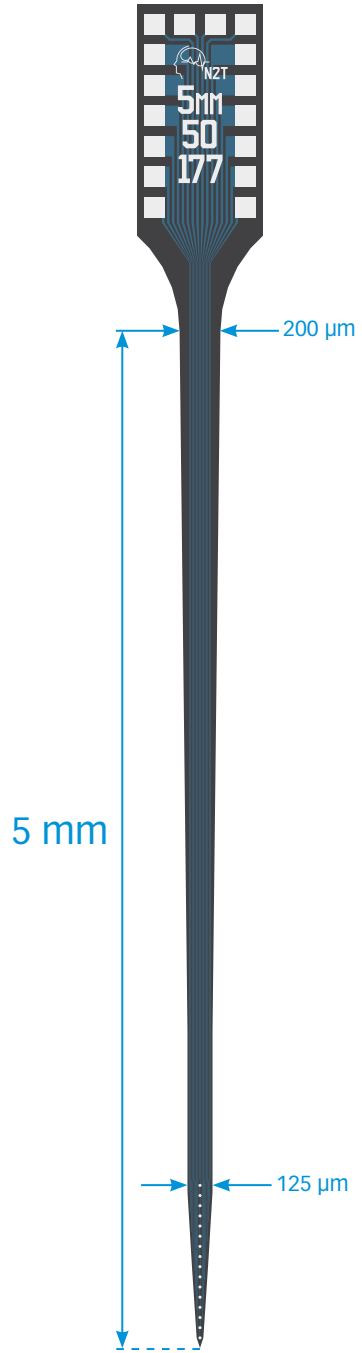
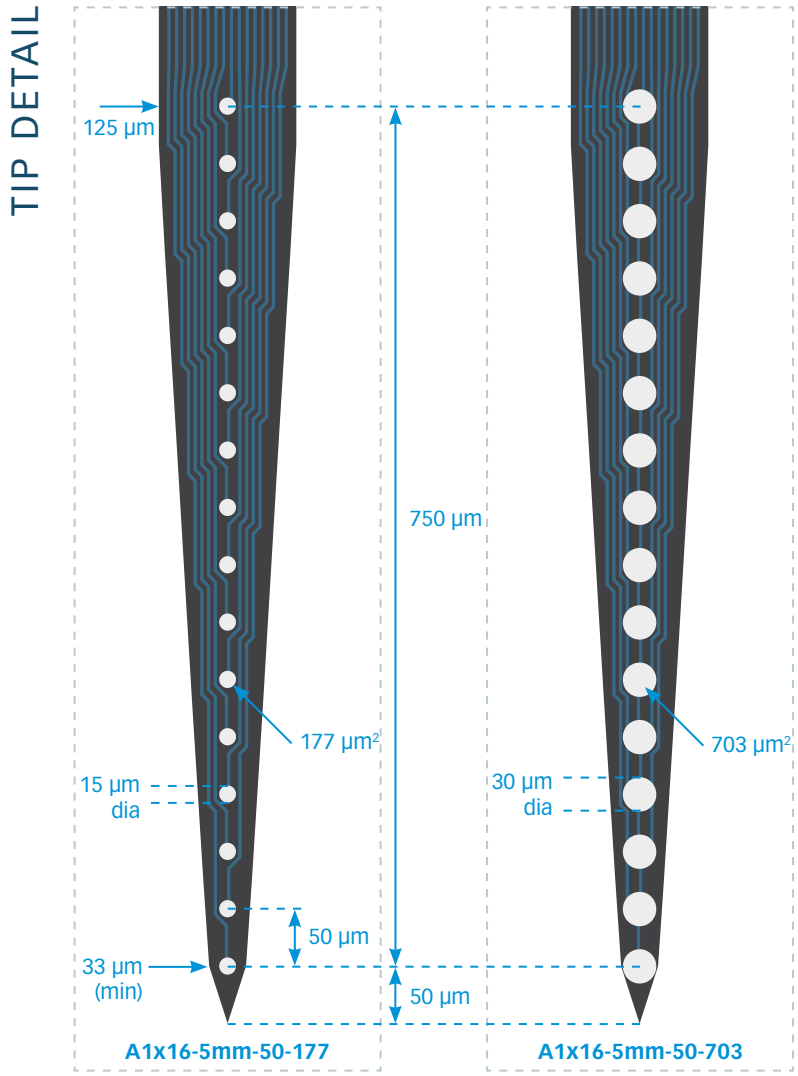
A1x16-5mm-50-177
A1x16-5mm-50-703





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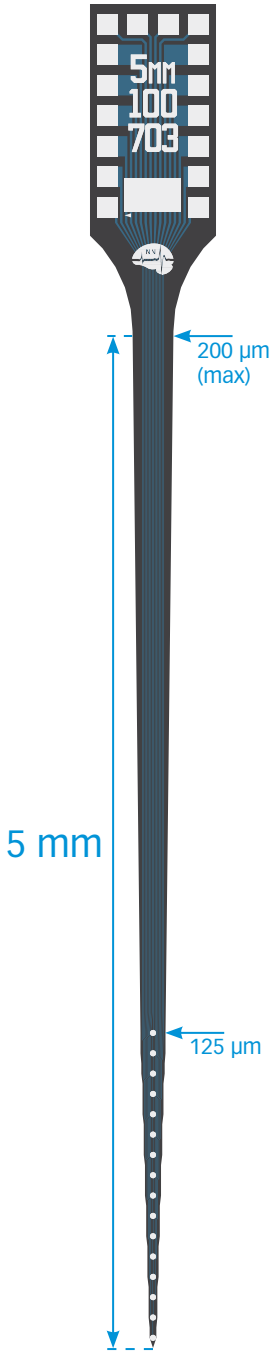
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

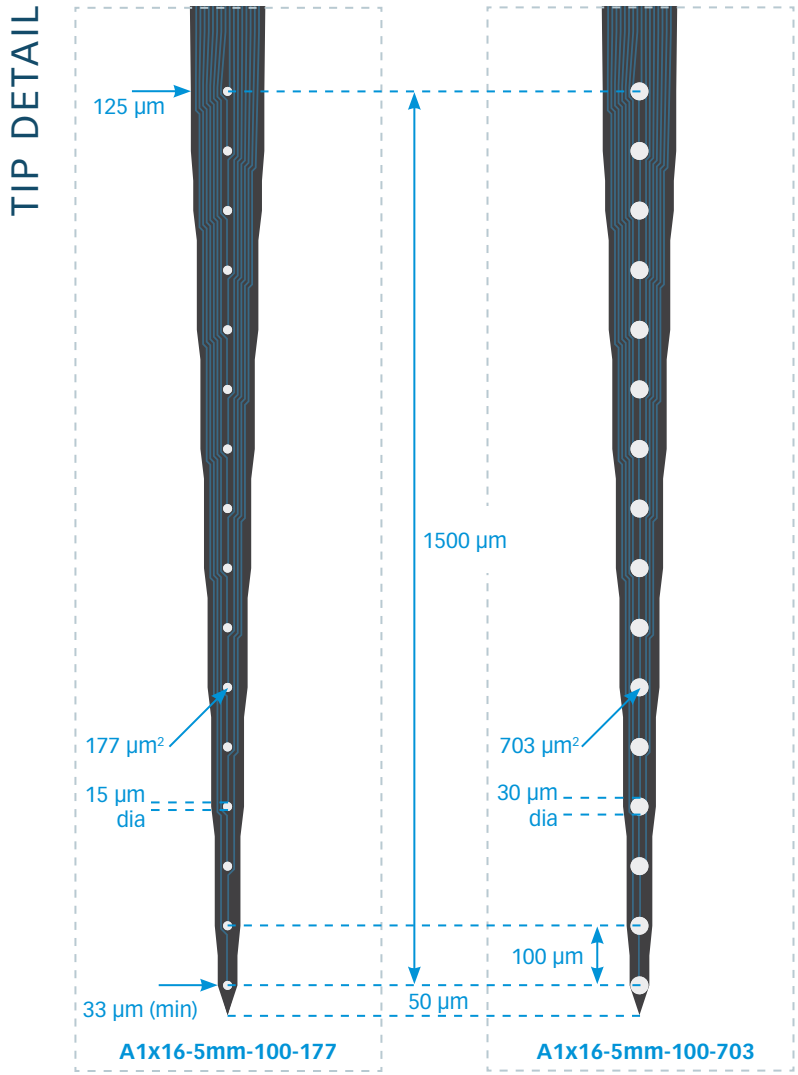
MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

thickness

15 µm
50 µm

A1x16-5mm-100-177
A1x16-5mm-100-703





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MR_CM16
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thickness

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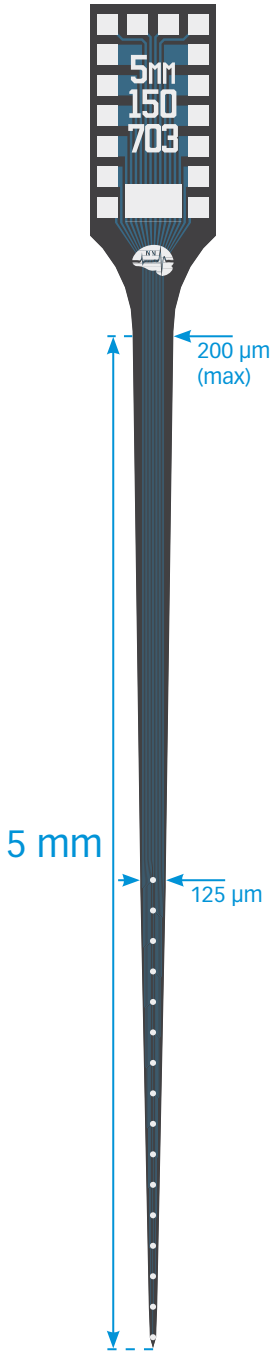
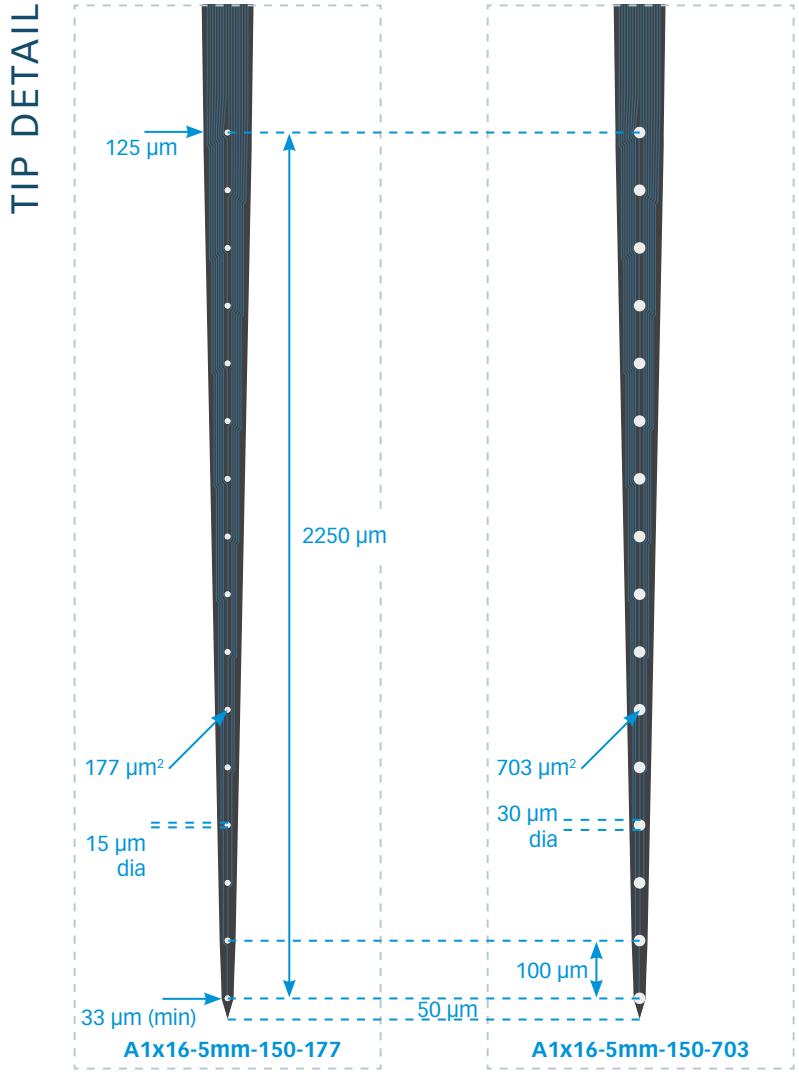
A1x16-5mm-150-177
A1x16-5mm-150-703





available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

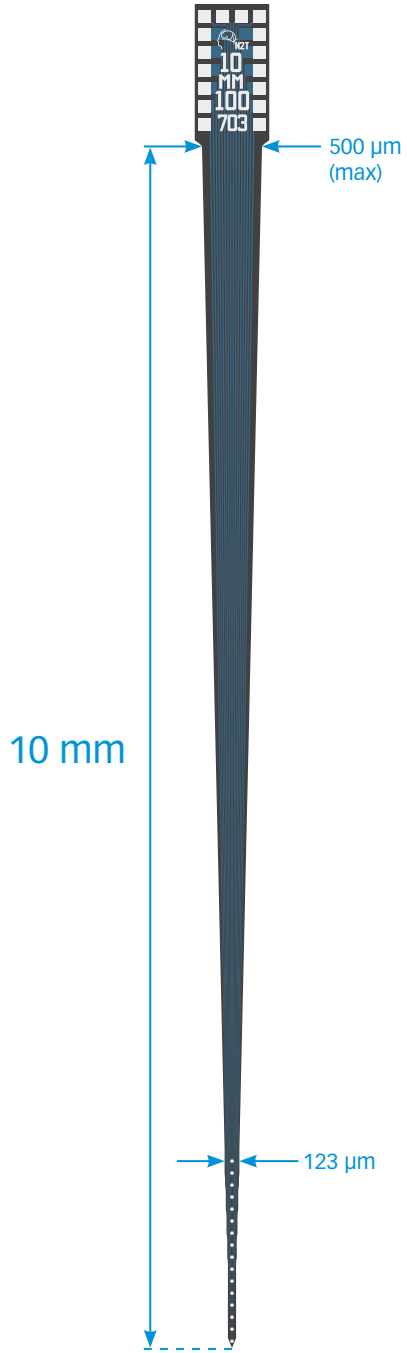
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

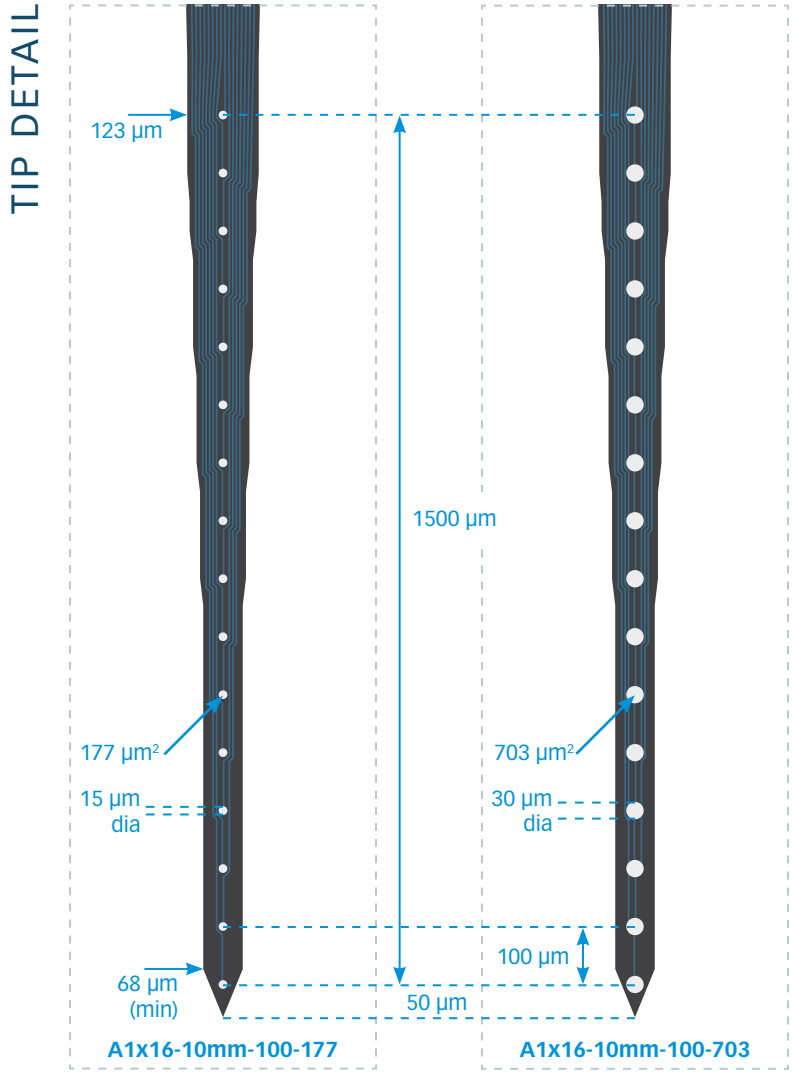
MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

thickness

15 µm

A1x16-10mm-100-177
A1x16-10mm-100-703





available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

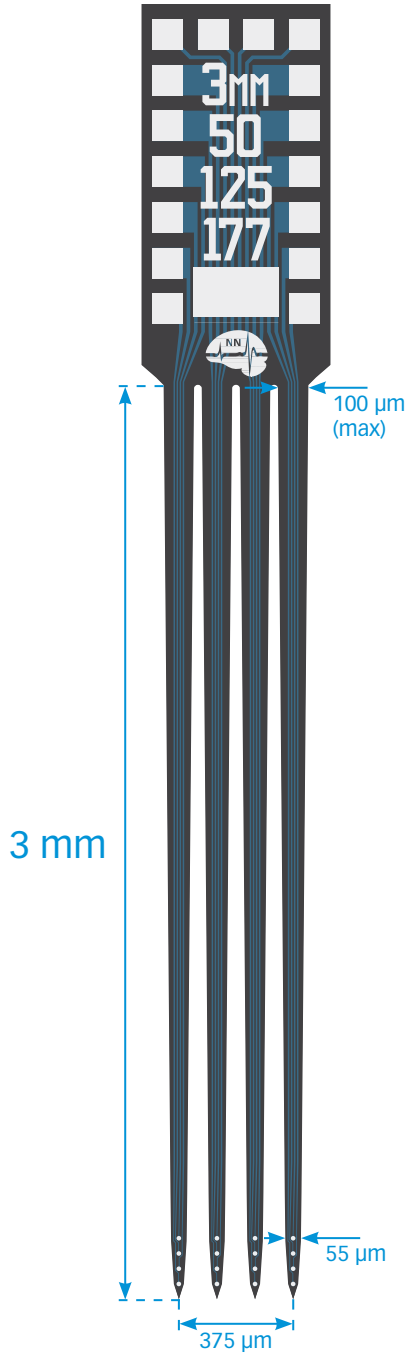
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

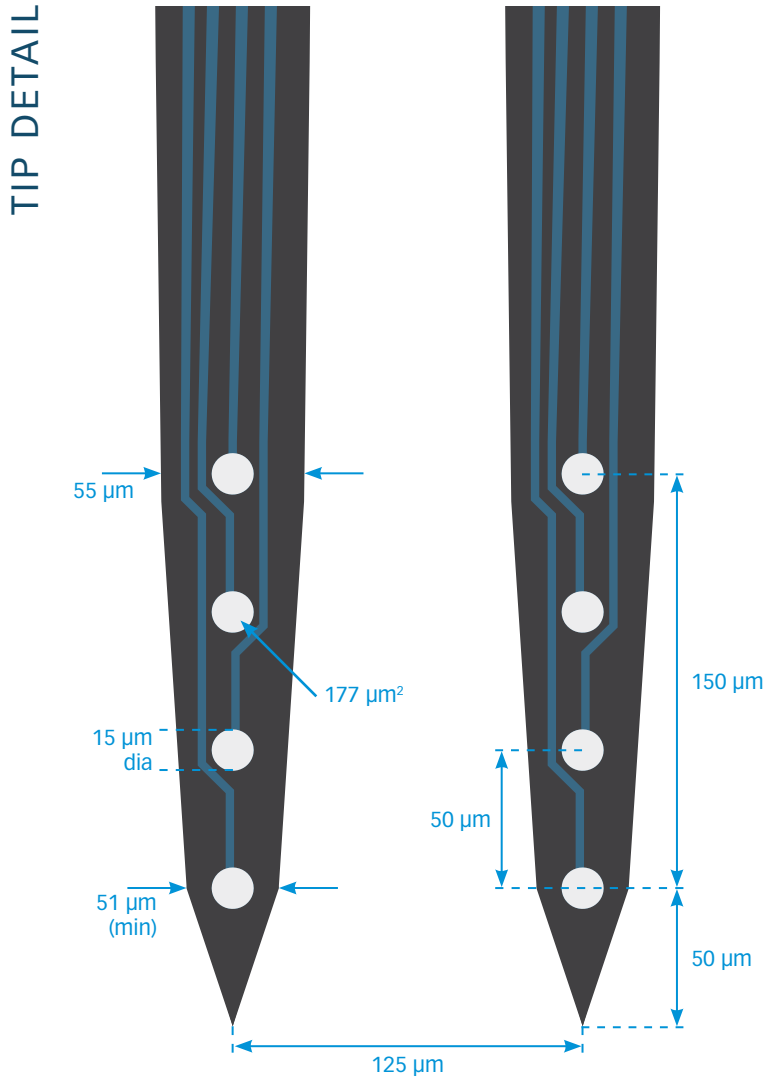
MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

thickness

50 µm

A4x4-3mm-50-125-177





available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

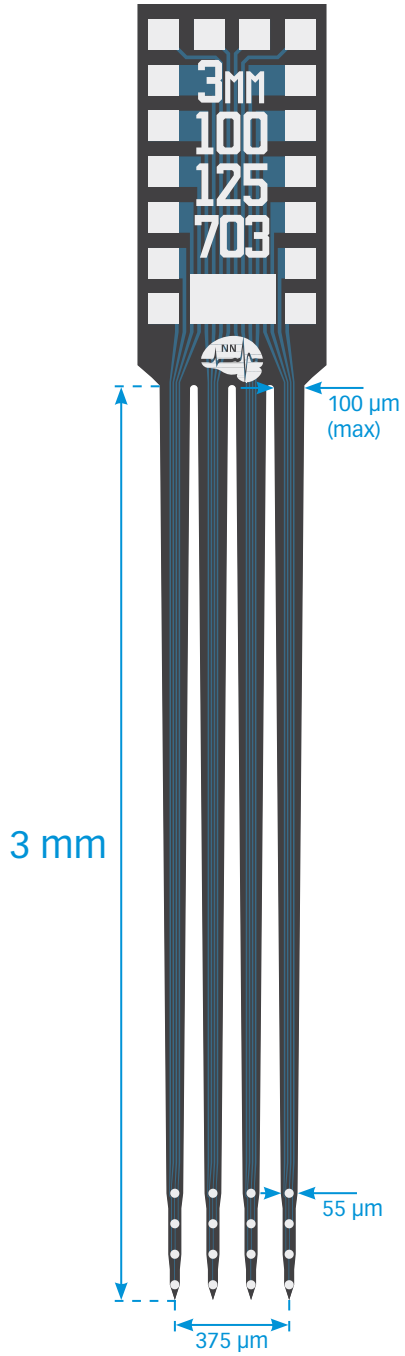
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

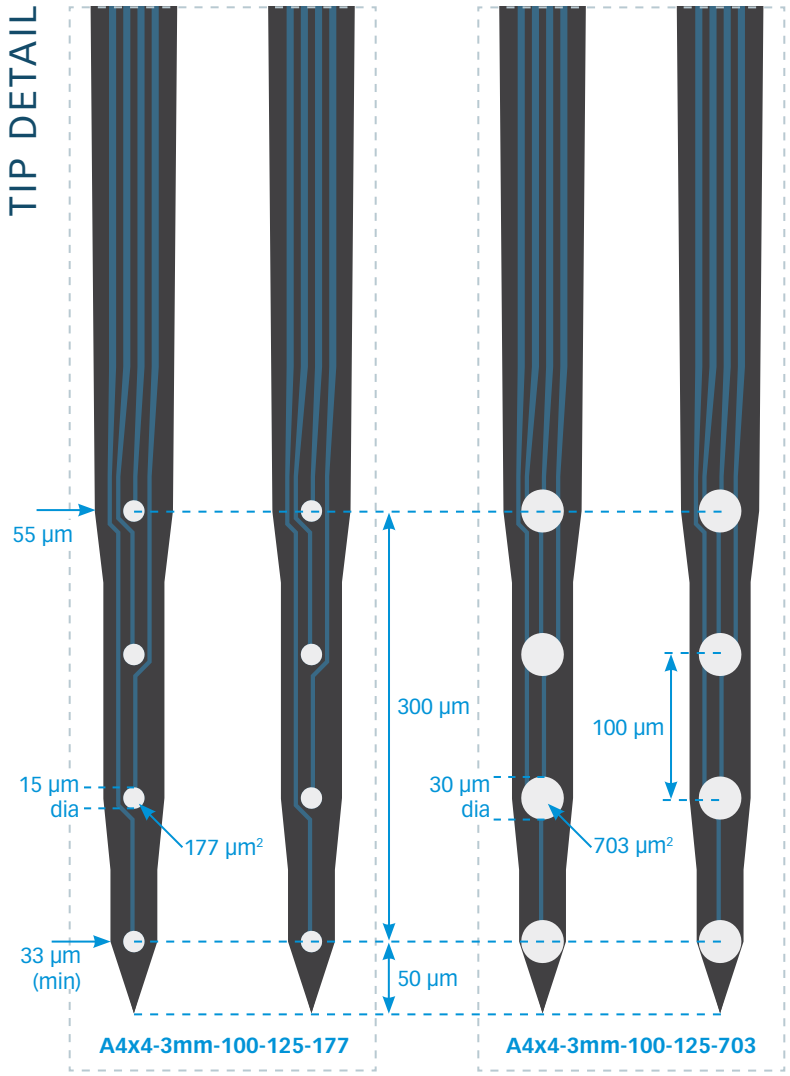
MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

thickness

15 µm

A4x4-3mm-100-125-177
A4x4-3mm-100-125-703





available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

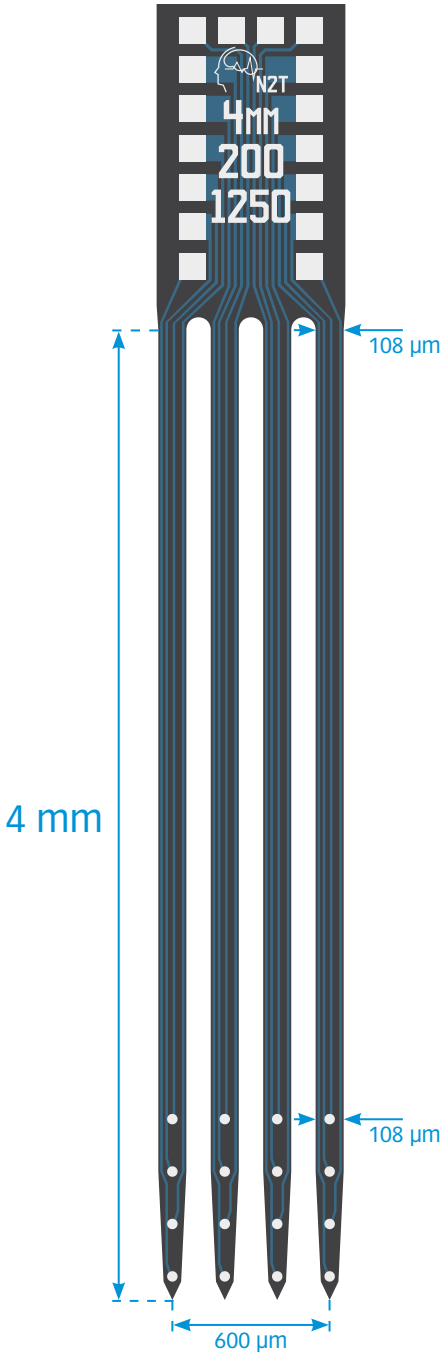
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

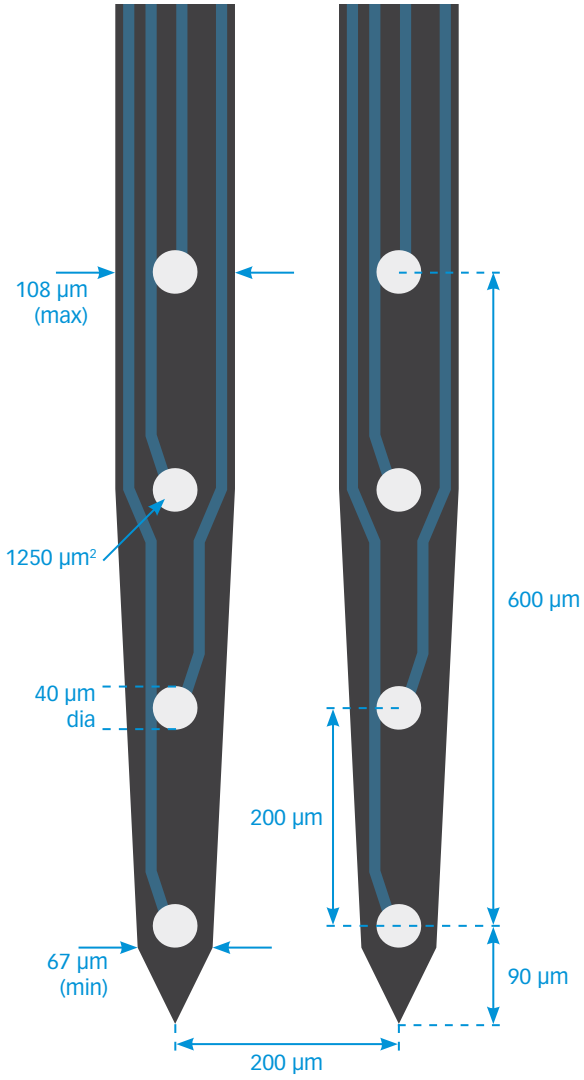
thickness

15 µm

A4x4-4mm-200-200-1250



TIP DETAIL



available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

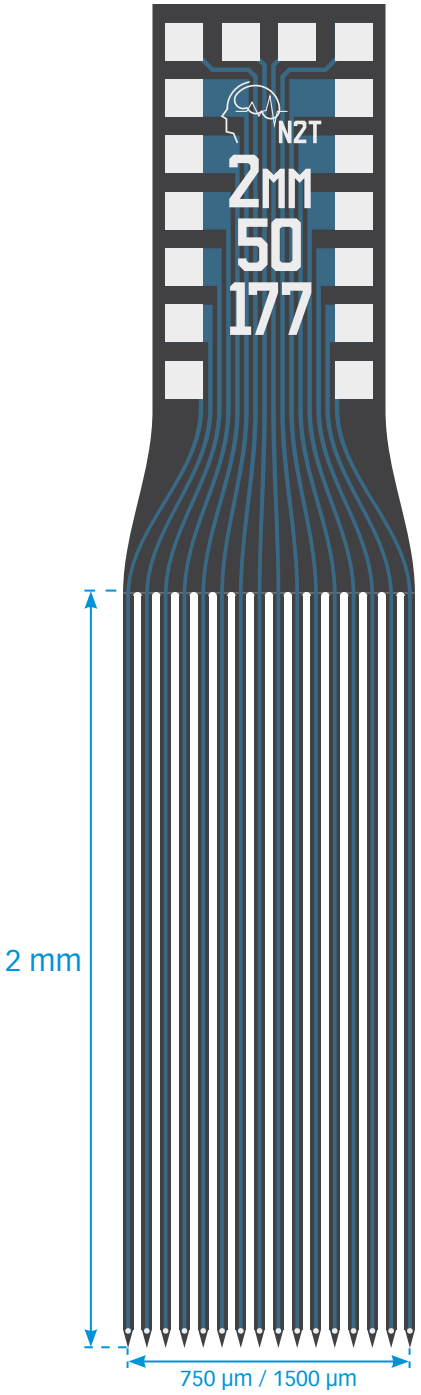
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

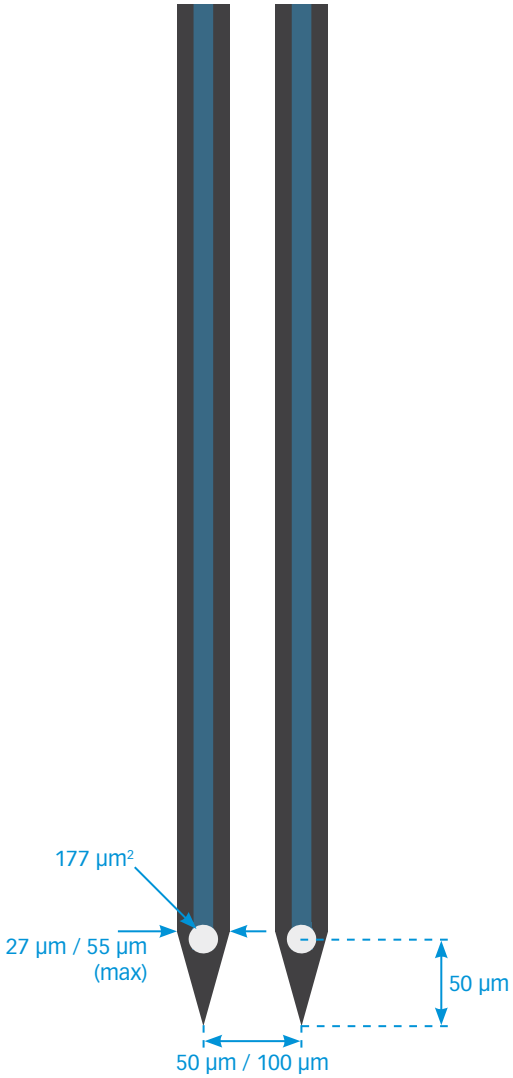
thickness

15 µm

A16x1-2mm-50-177
A16x1-2mm-100-177



TIP DETAIL



available packages

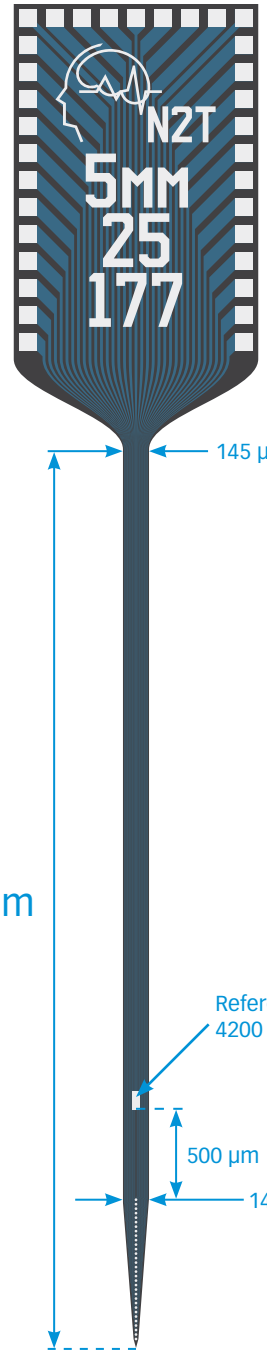
ACUTE
A16

CHRONIC
CM16LP
H16_21mm

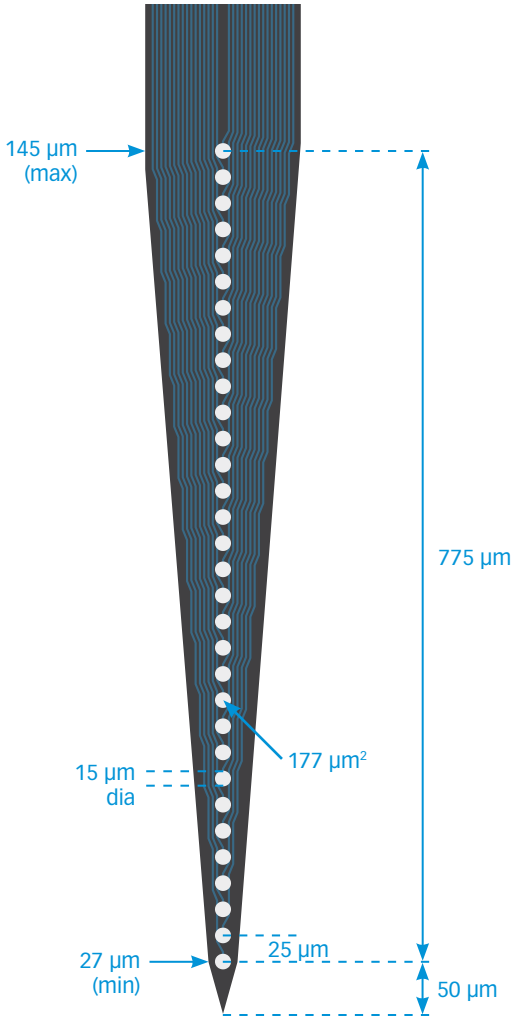
thickness

15 µm

A1x32-5mm-25-177



TIP DETAIL



available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

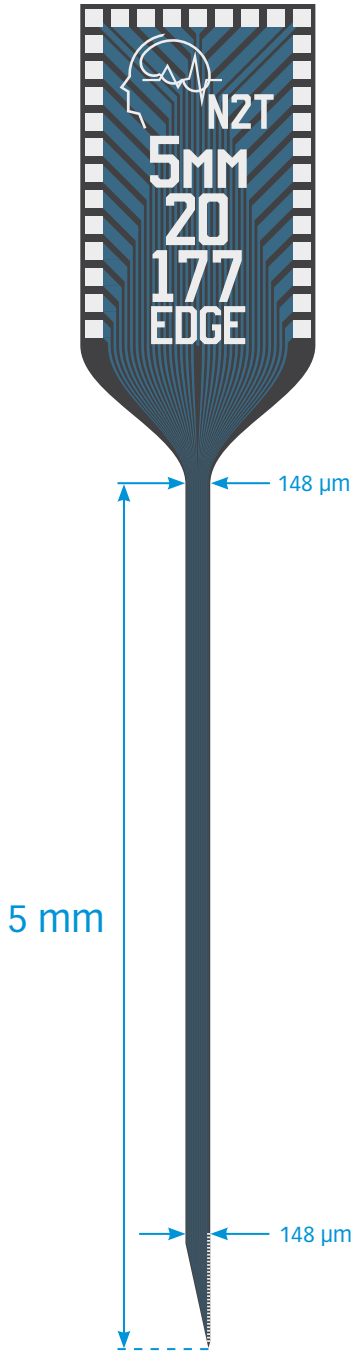
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

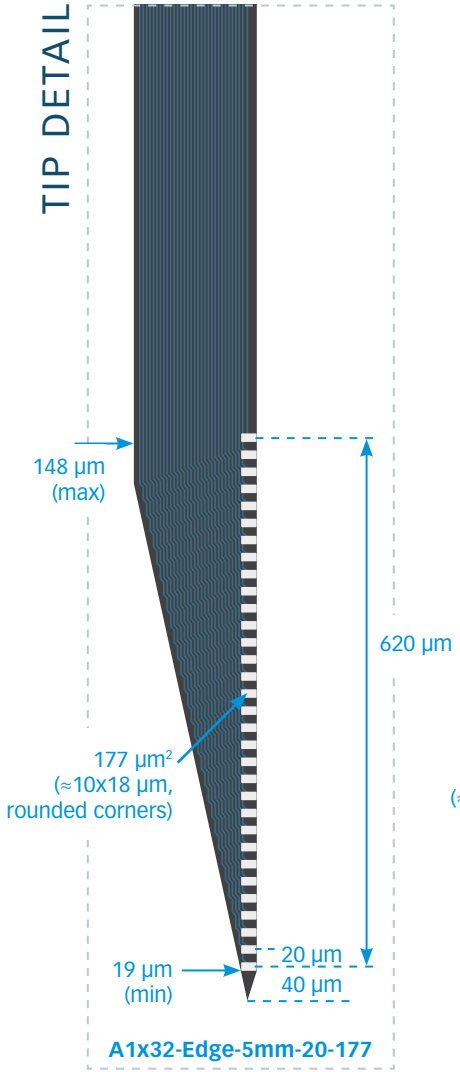
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

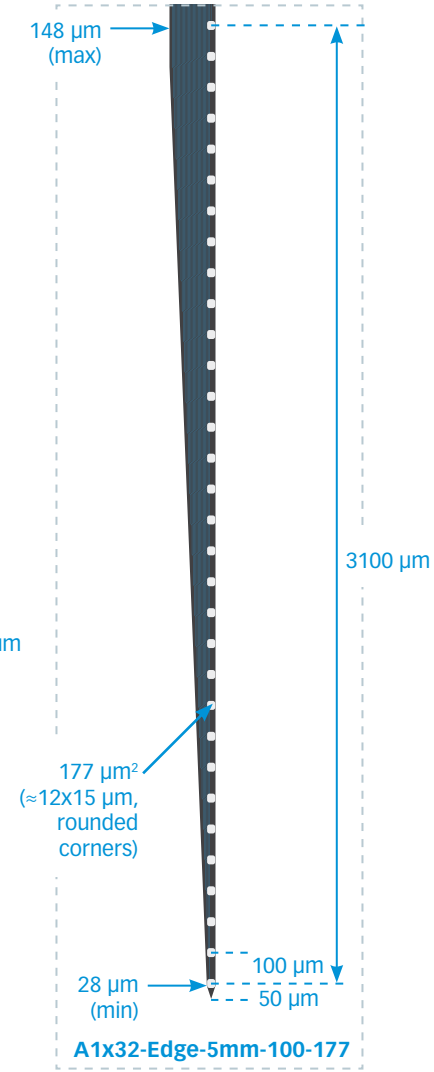
thickness

15 µm

A1x32-Edge-5mm-20-177
A1x32-Edge-5mm-100-177







available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

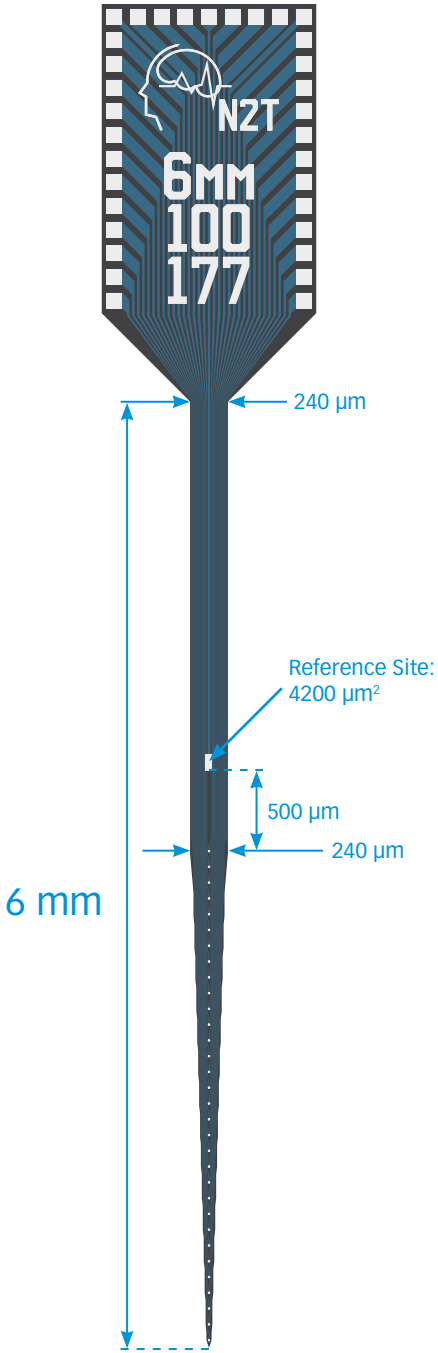
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

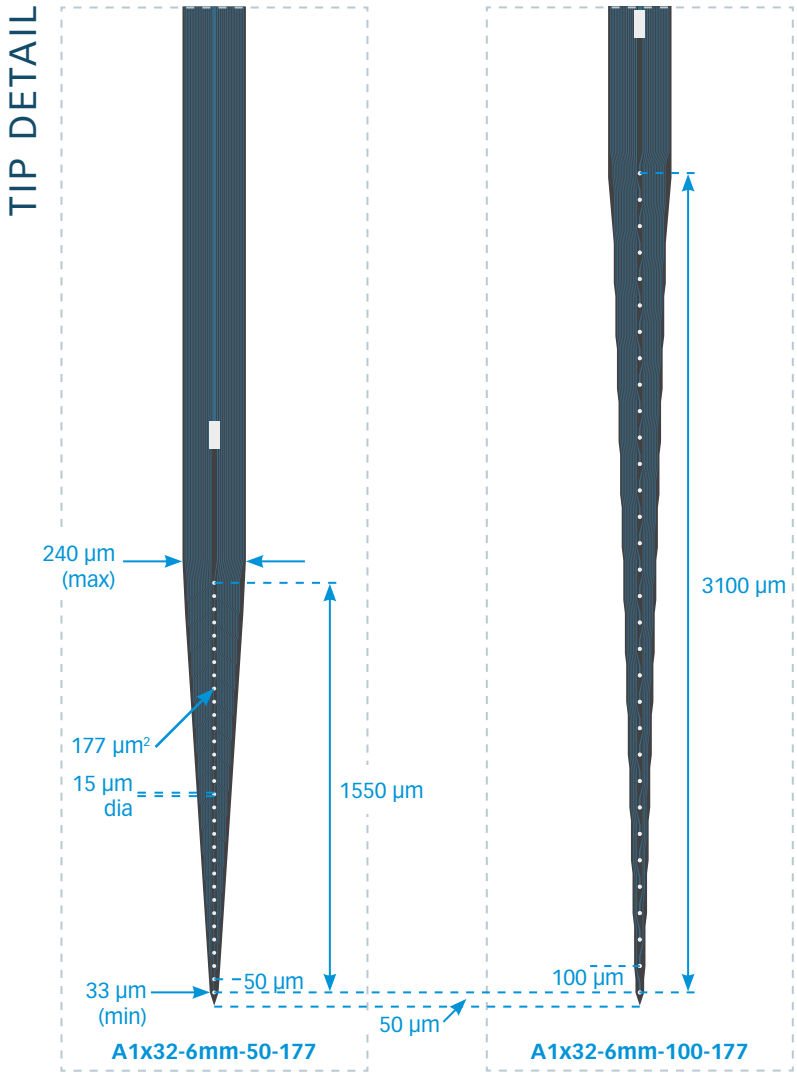
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

15 µm

A1x32-6mm-50-177
A1x32-6mm-100-177





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

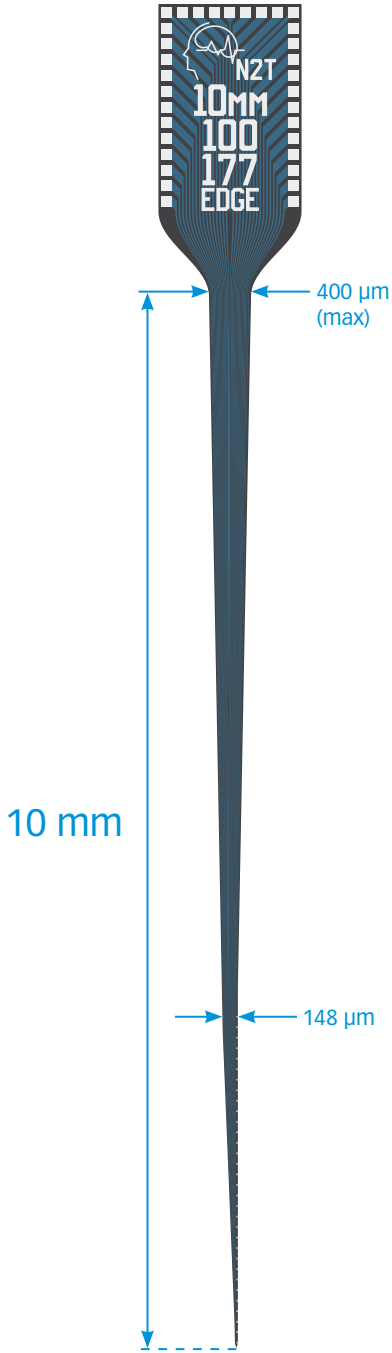
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

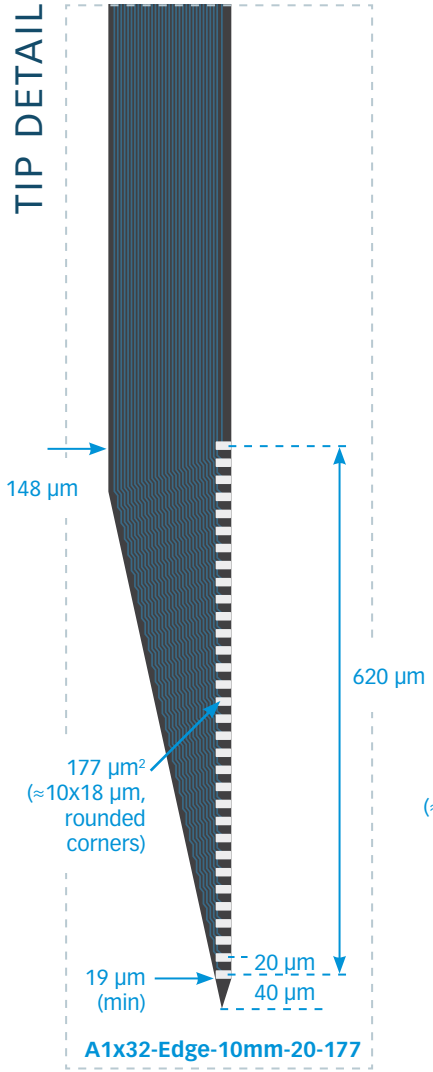
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

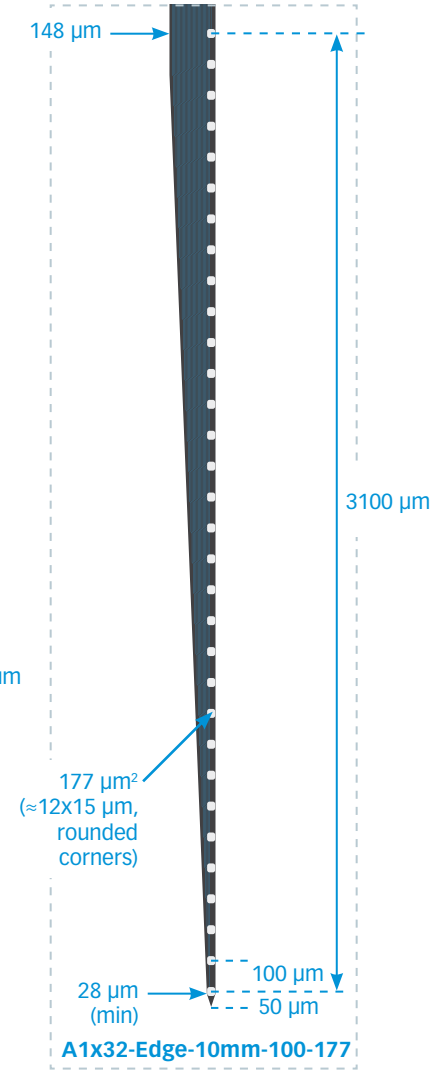
thickness

15 µm
50 µm

A1x32-Edge-10mm-20-177
A1x32-Edge-10mm-100-177







available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

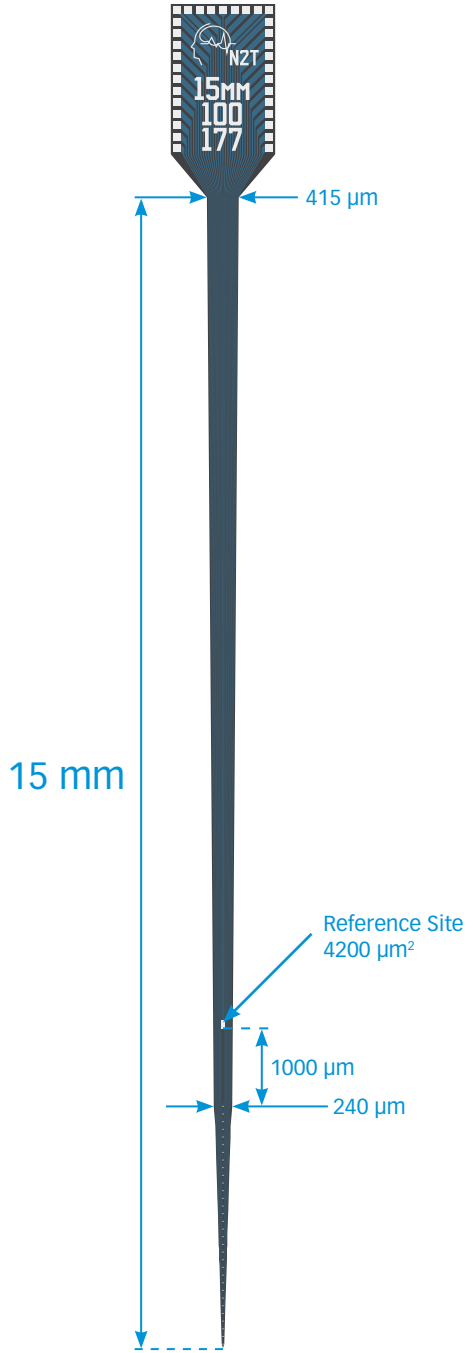
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

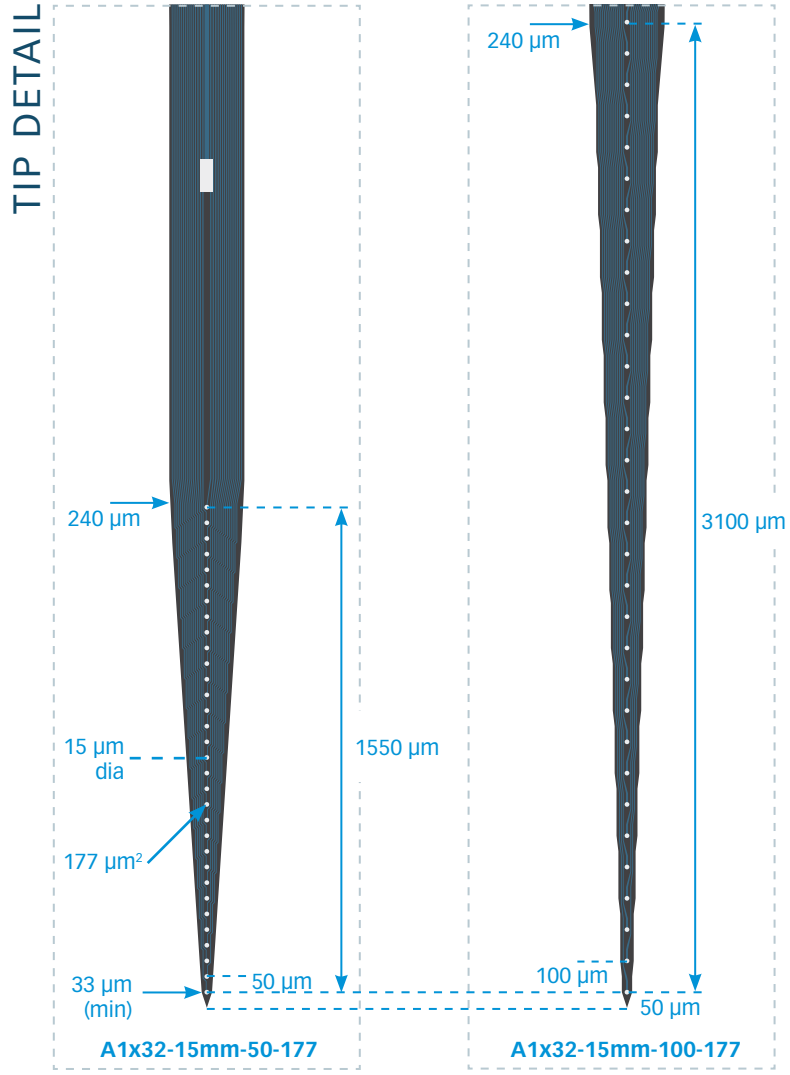
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

50 µm

A1x32-15mm-50-177
A1x32-15mm-100-177





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

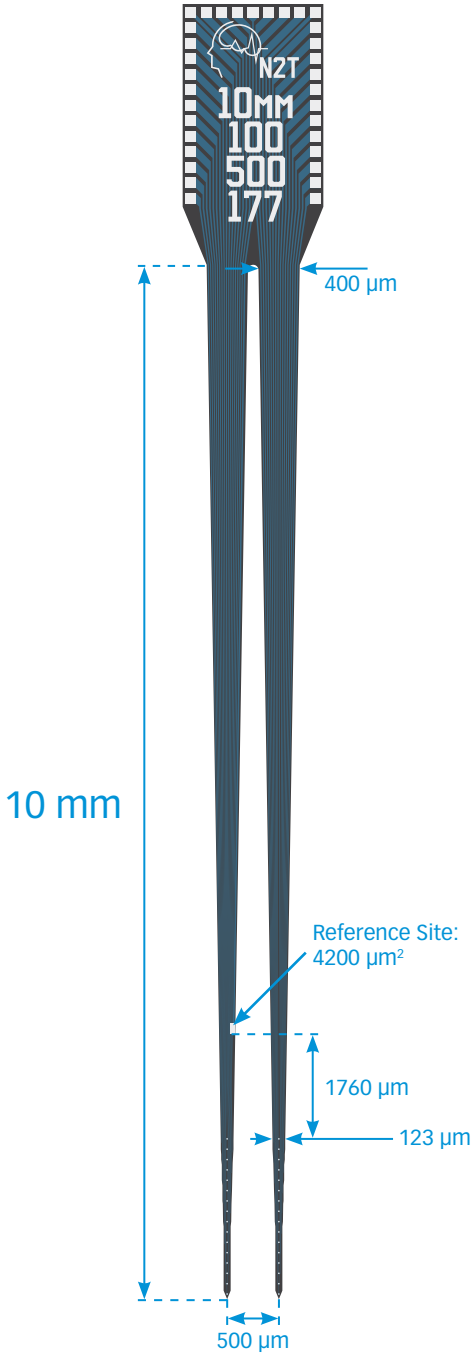
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

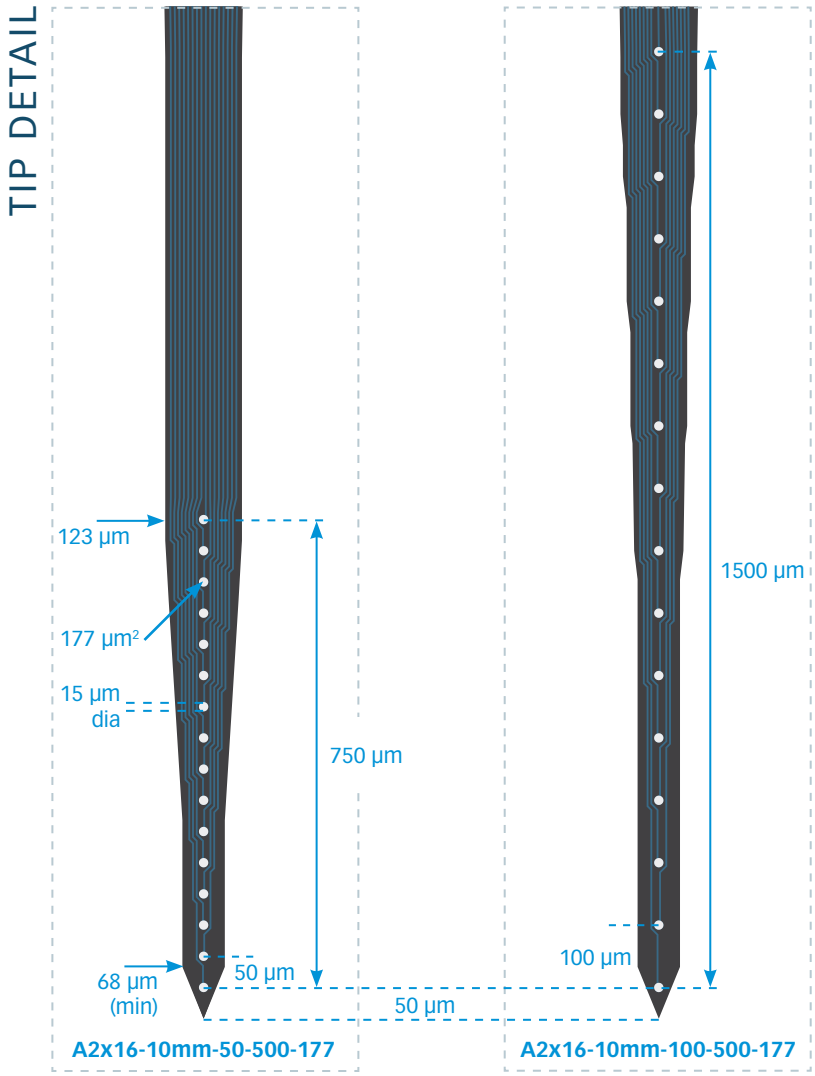
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

50 µm

A2x16-10mm-50-500-177
A2x16-10mm-100-500-177





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

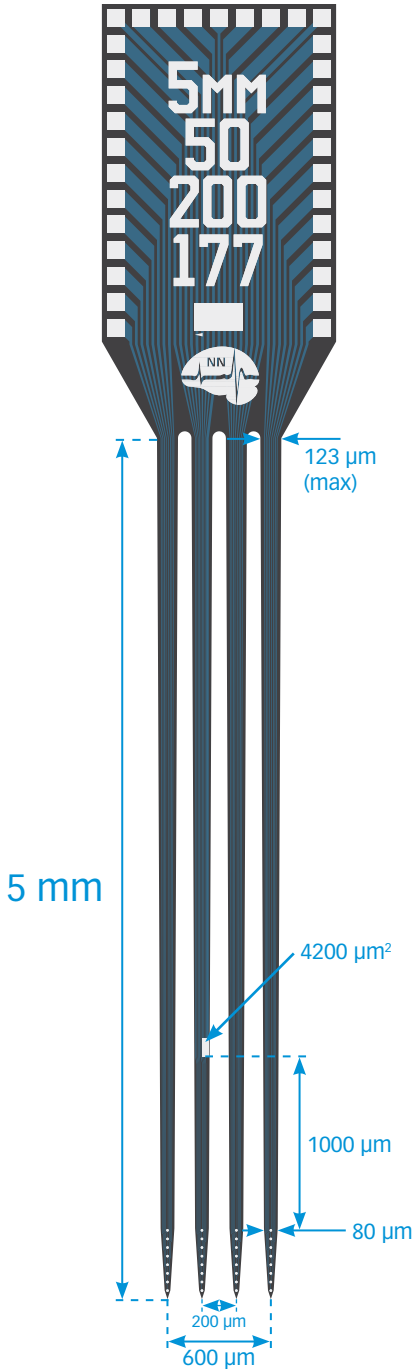
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

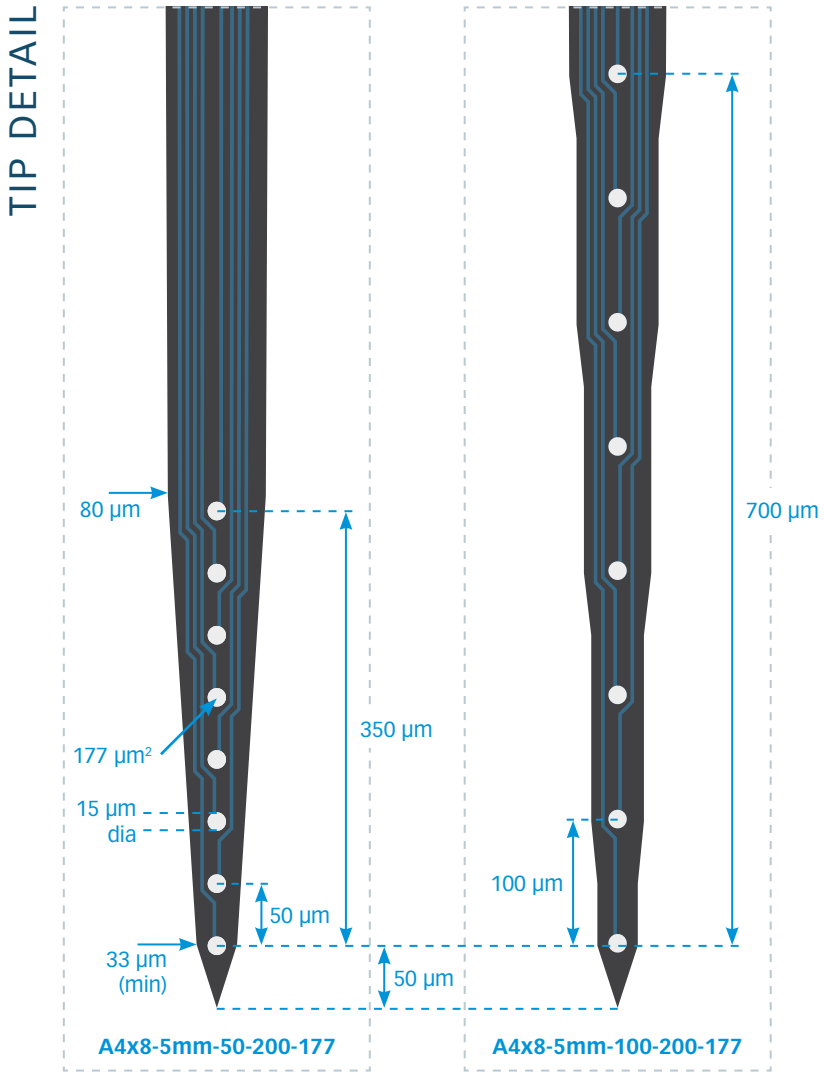
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

50 µm

A4x8-5mm-50-200-177
A4x8-5mm-100-200-177





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

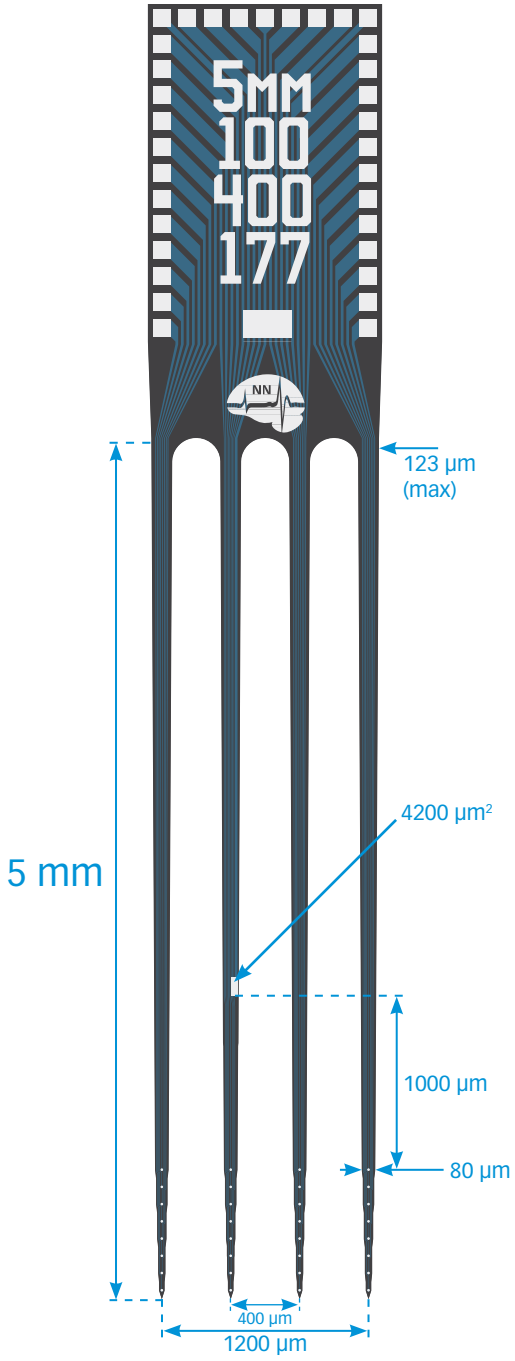
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

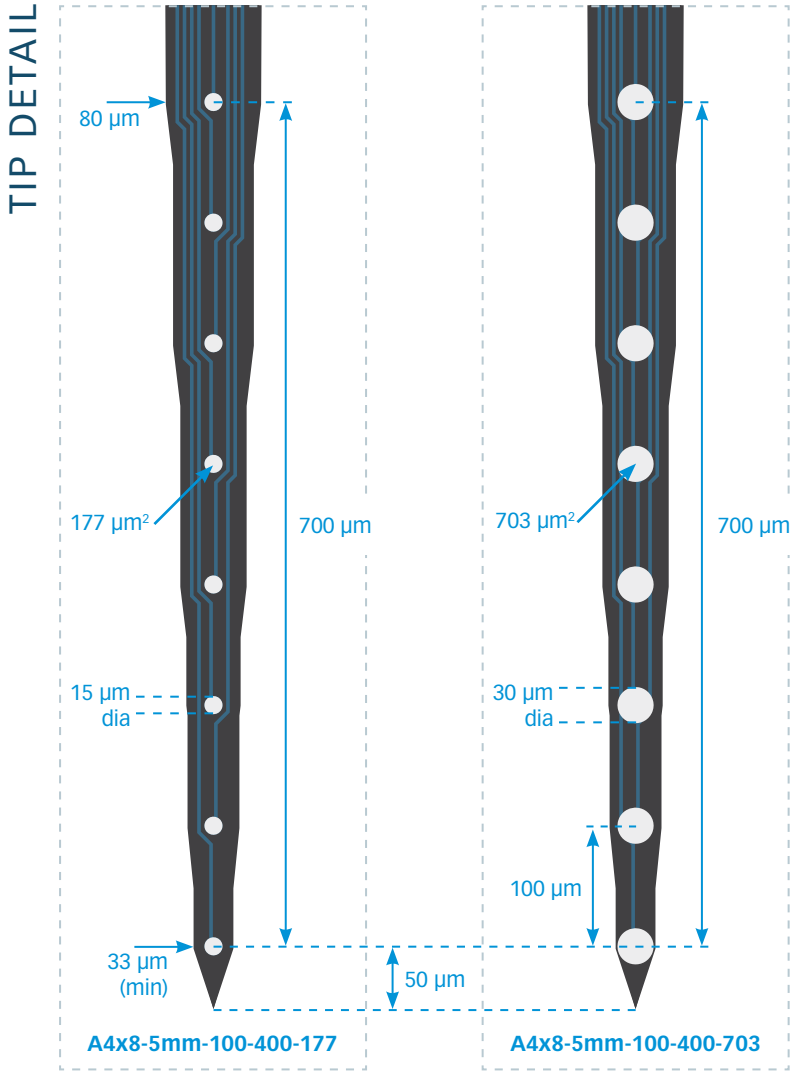
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

15 µm

A4x8-5mm-100-400-177
A4x8-5mm-100-400-703





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

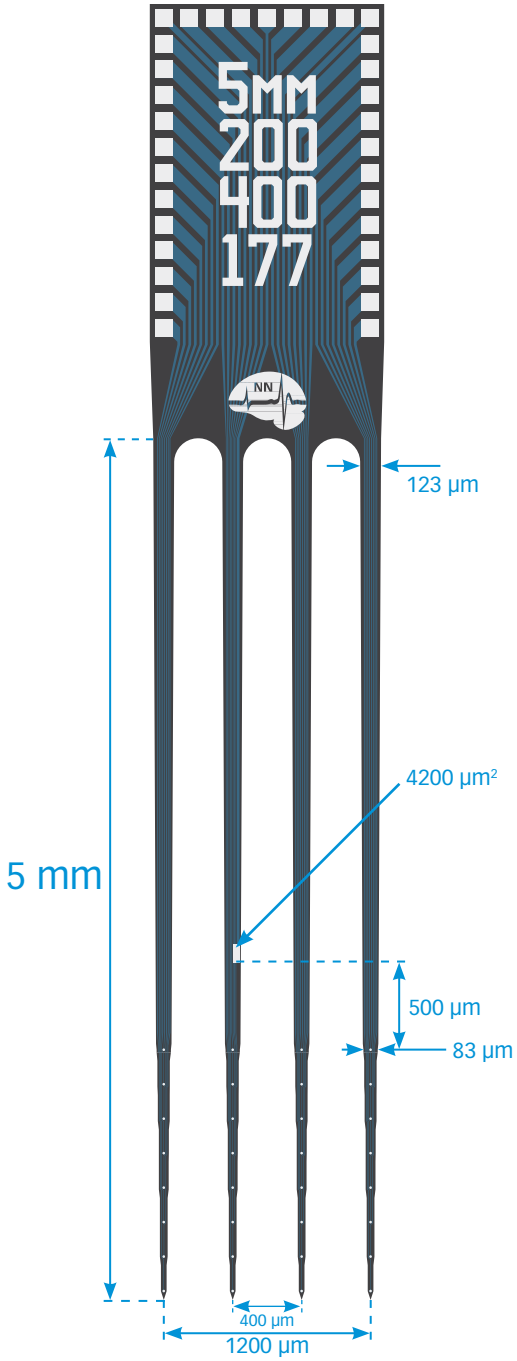
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

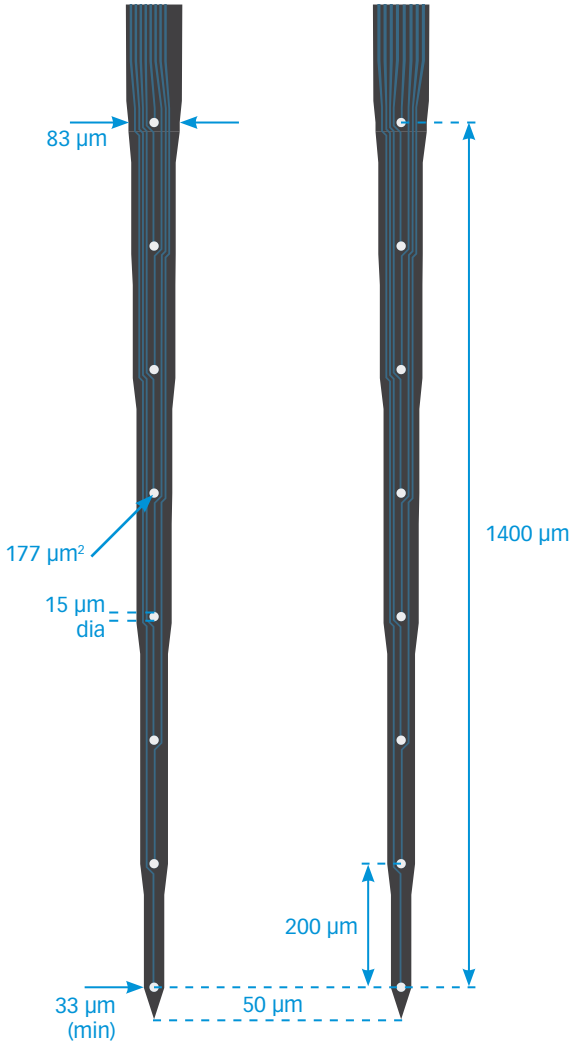
thickness

15 µm

A4x8-5mm-200-400-177



TIP DETAIL



available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

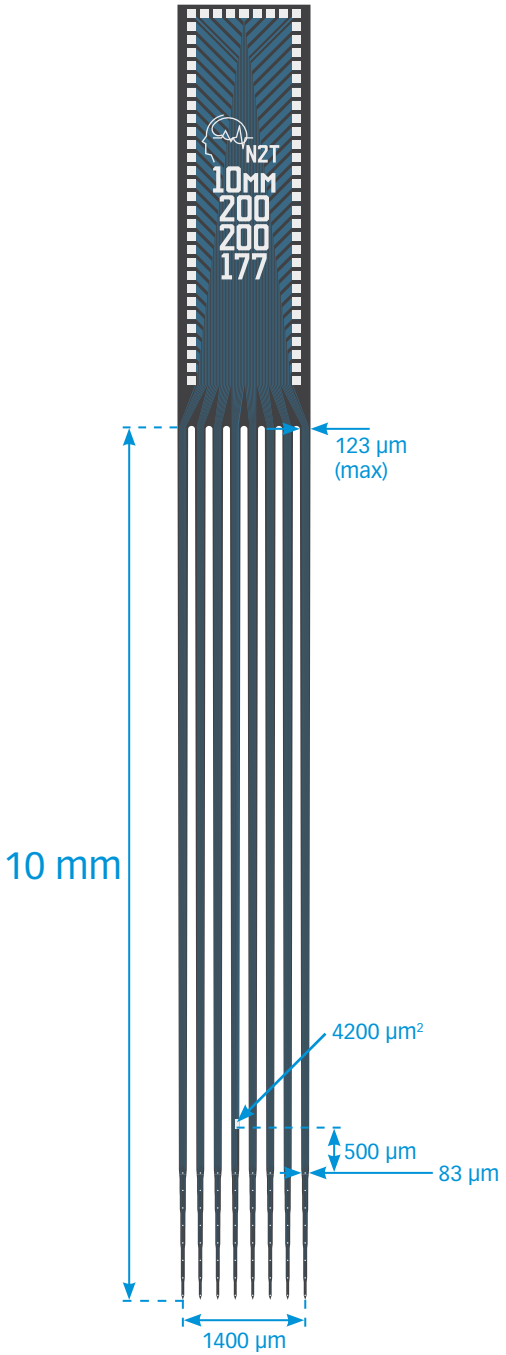
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

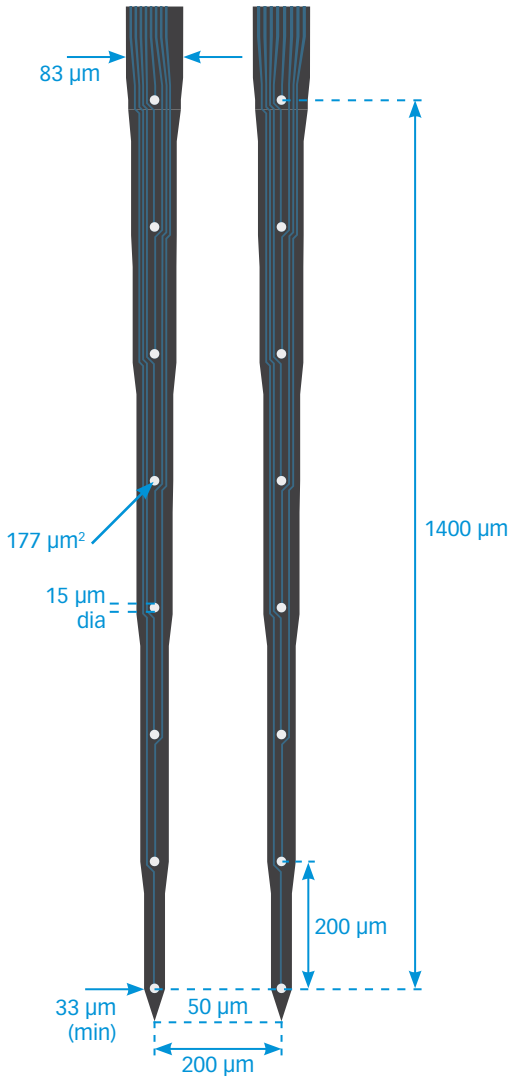
thickness

15 µm

A8x8-10mm-200-200-177



TIP DETAIL



available packages

ACUTE
A64

CHRONIC
H64_30mm
H64LP_30mm
HC64_30mm
HZ64_30mm
Z64

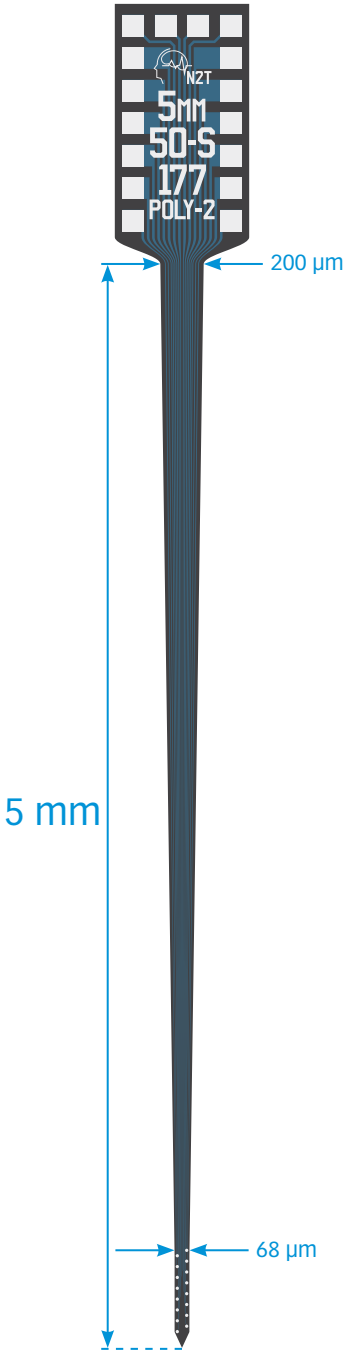
OPTOGENETICS
OA64
OA64LP

MR-COMPATIBLE
MR_H64_30mm
MR_HC64_30mm

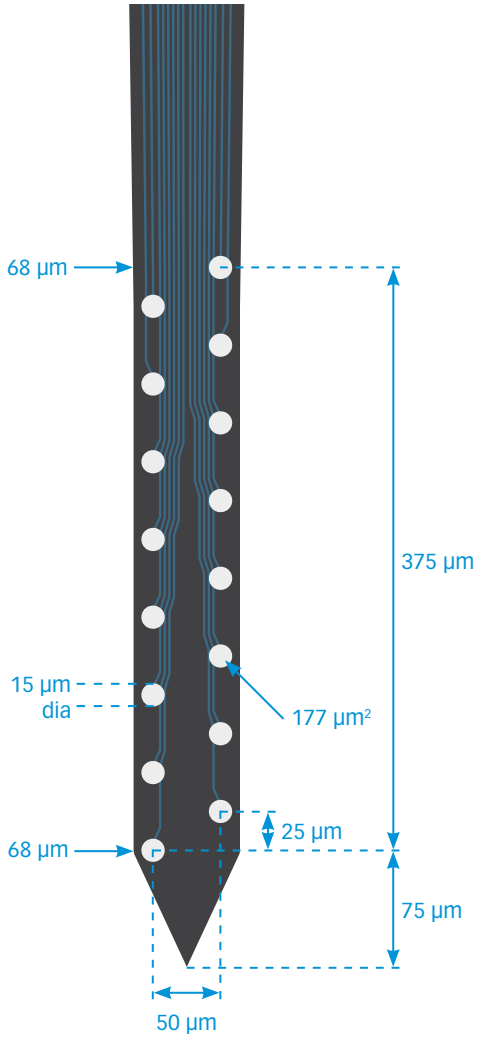
thickness

50 µm

A1x16-Poly2-5mm-50s-177



TIP DETAIL



available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

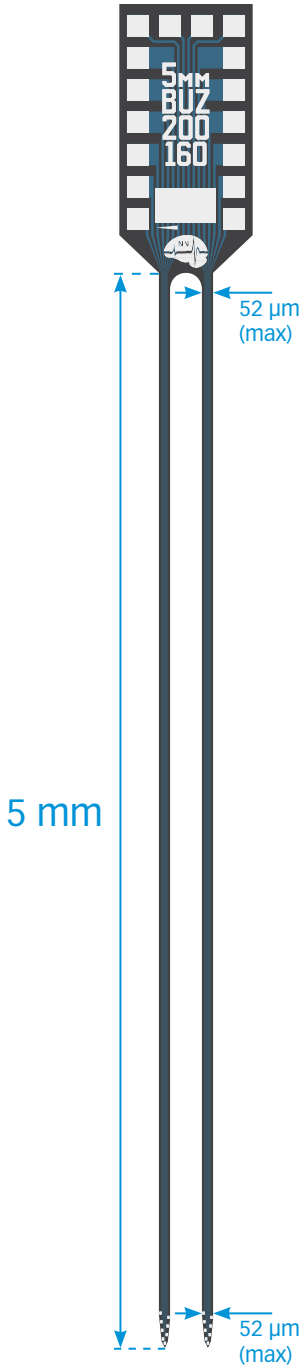
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

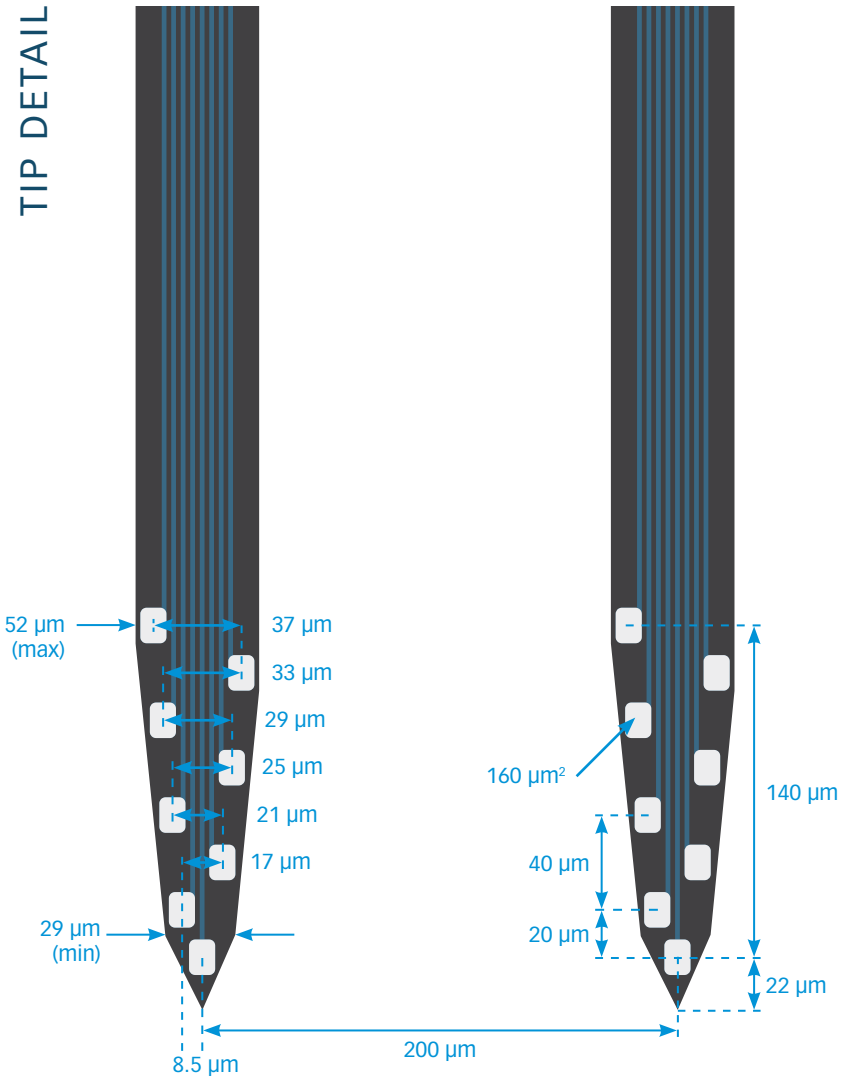
MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

thickness

15 µm

Buzsaki16





available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

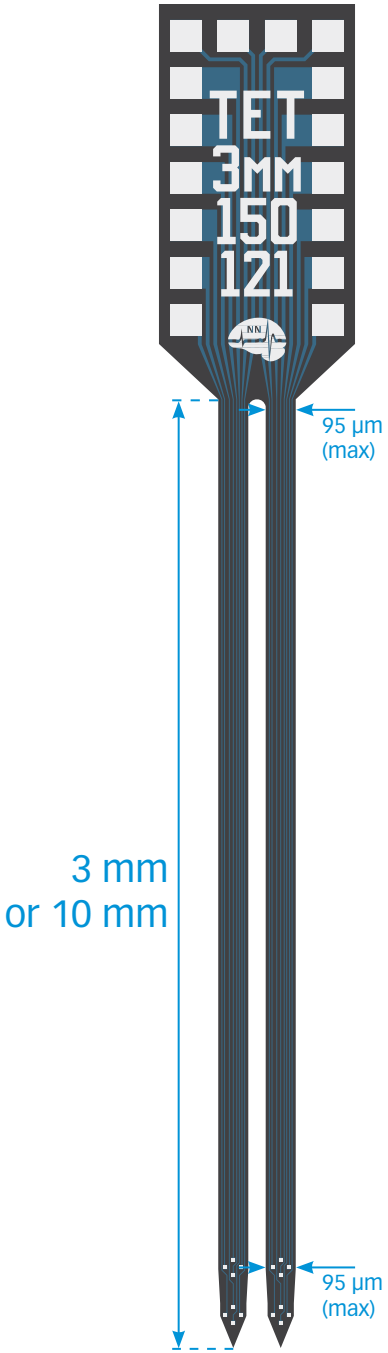
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

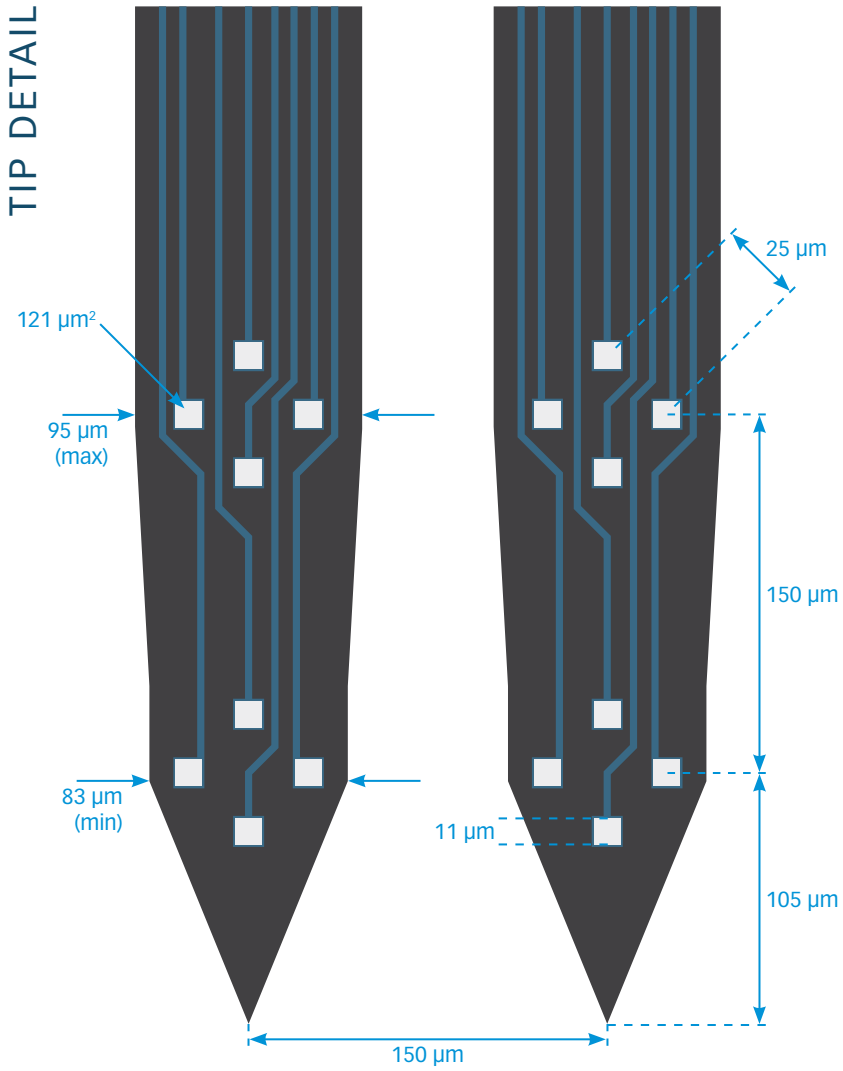
MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

thickness

15 µm

A2x2-tet-3mm-150-150-121
A2x2-tet-10mm-150-150-121





available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

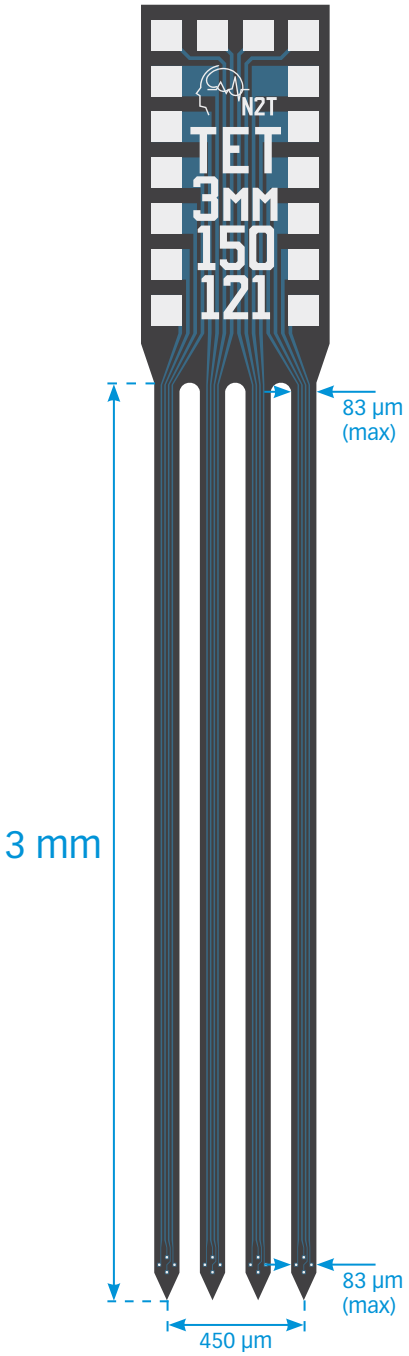
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

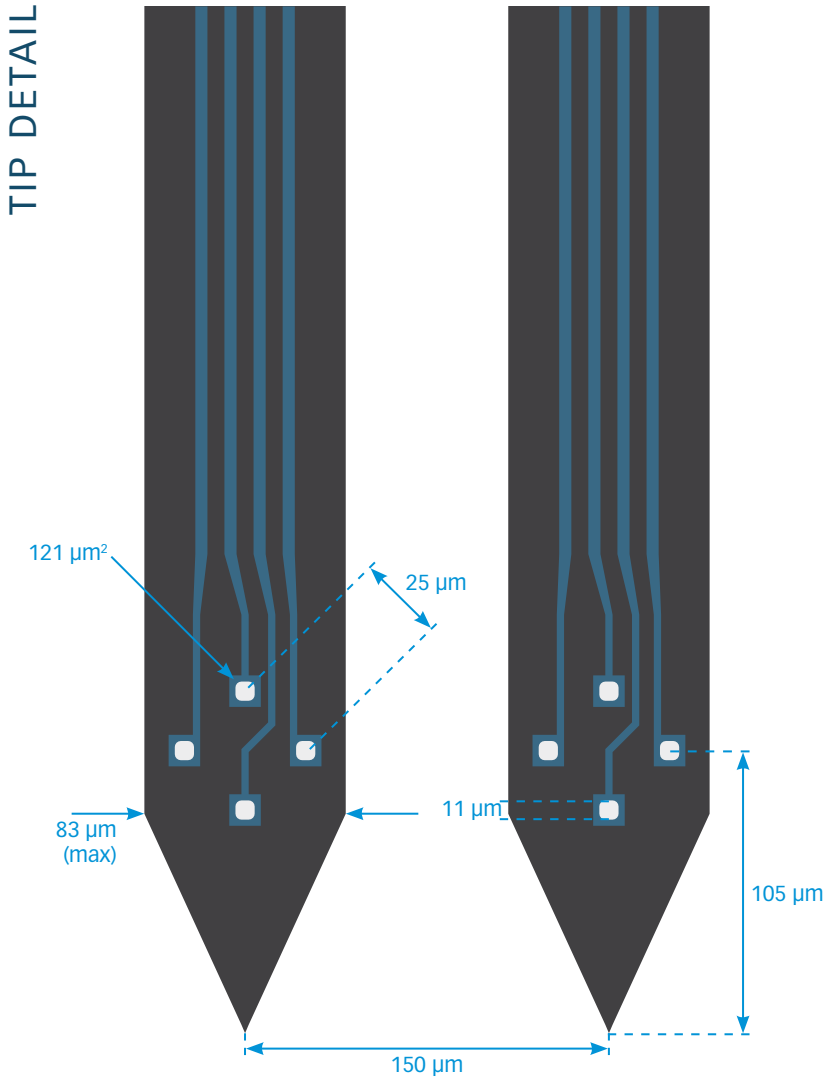
MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

thickness

15 µm (3 mm only)
50 µm (10 mm only)

A4x1-tet-3mm-150-121





available packages

ACUTE
A16

CHRONIC
CM16LP
H16_21mm
HC16_21mm
HZ16_21mm
Z16

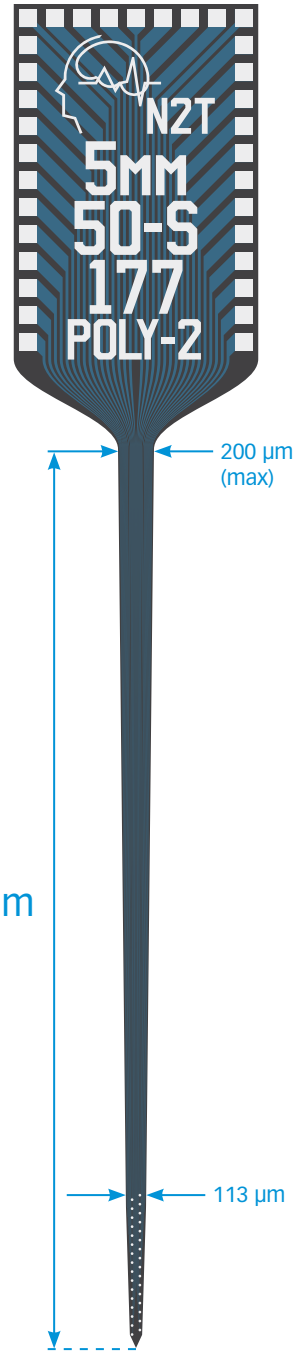
OPTOGENETICS
OA16
OA16LP
OCM16
OCM16LP
OZ16
OZ16LP

MR-COMPATIBLE
MR_CM16
MR_H16_21mm
MR_HC16_21mm

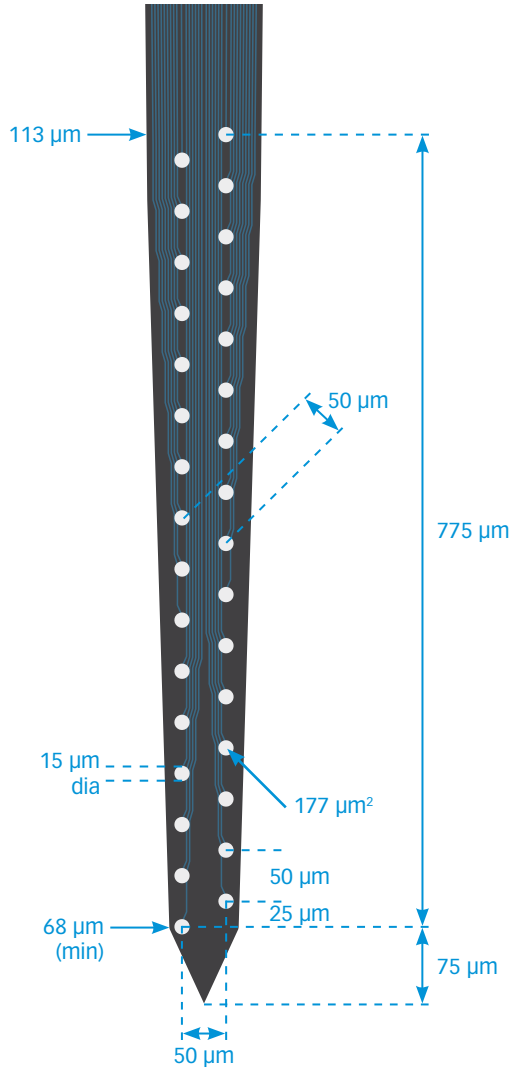
thickness

15 µm

A1x32-Poly2-5mm-50s-177



TIP DETAIL



available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

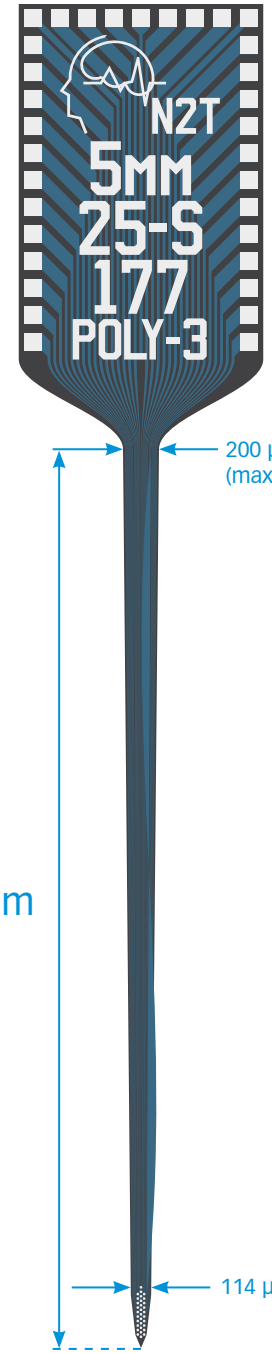
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

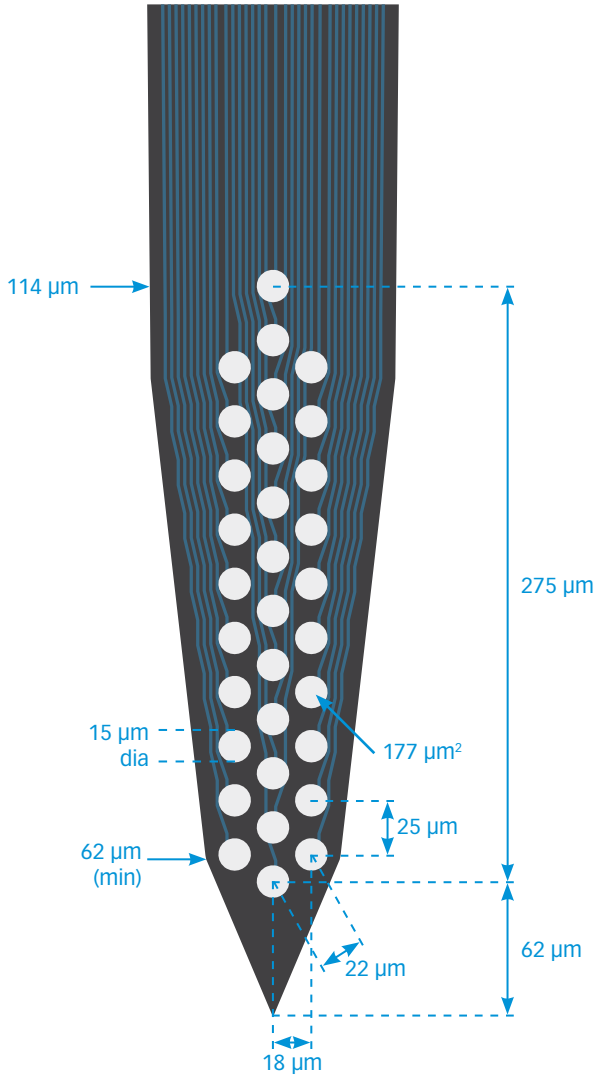
thickness

15 µm

A1x32-Poly3-5mm-25s-177



TIP DETAIL



available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

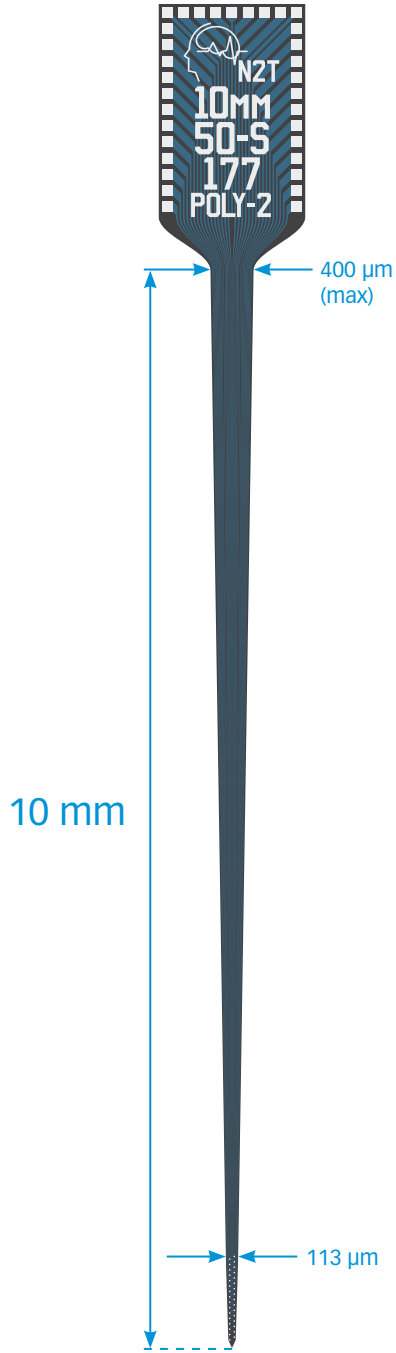
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

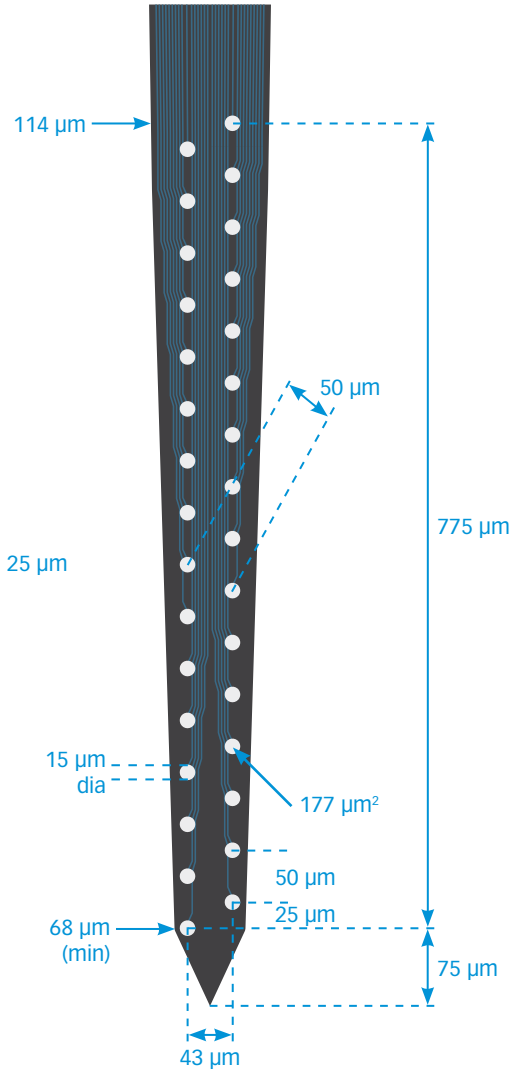
thickness

15 µm

A1x32-Poly2-10mm-50s-177



TIP DETAIL



available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

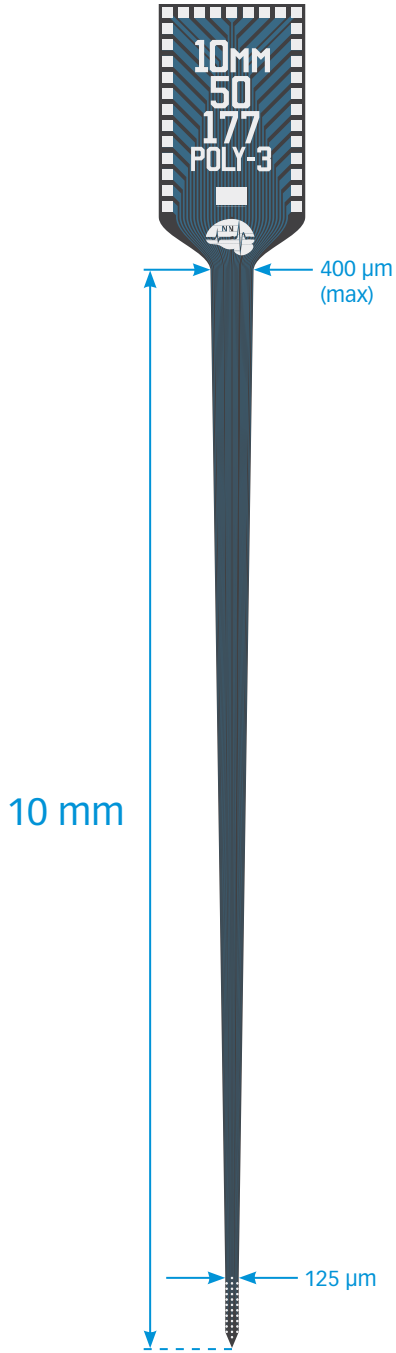
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

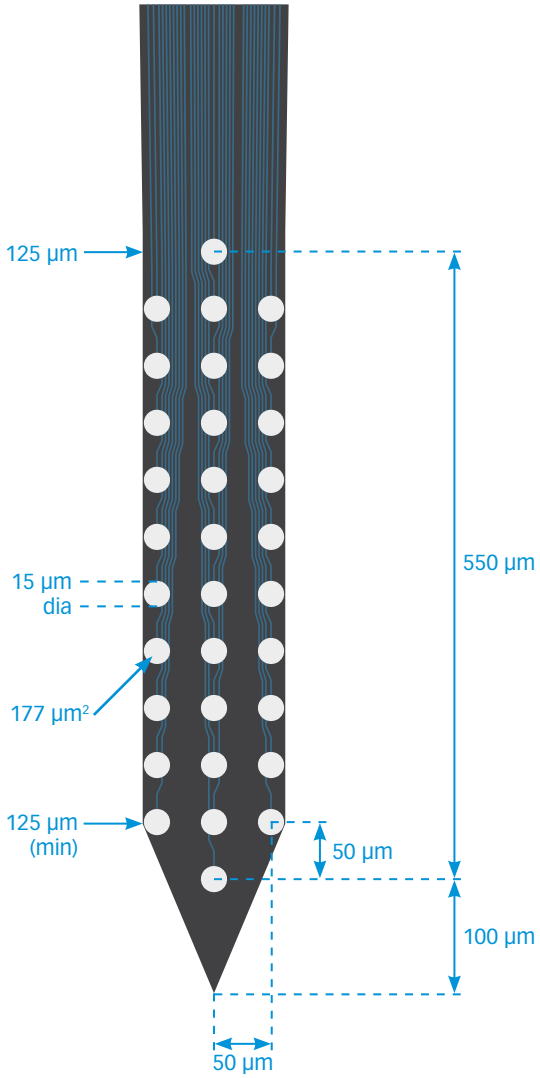
thickness

50 µm

A1x32-Poly3-10mm-50-177



TIP DETAIL



available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

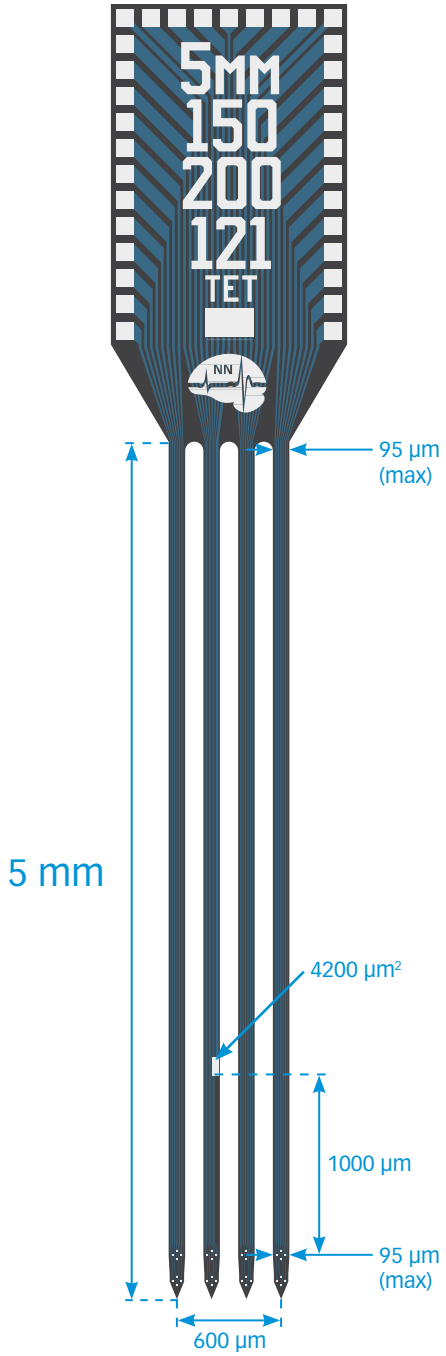
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

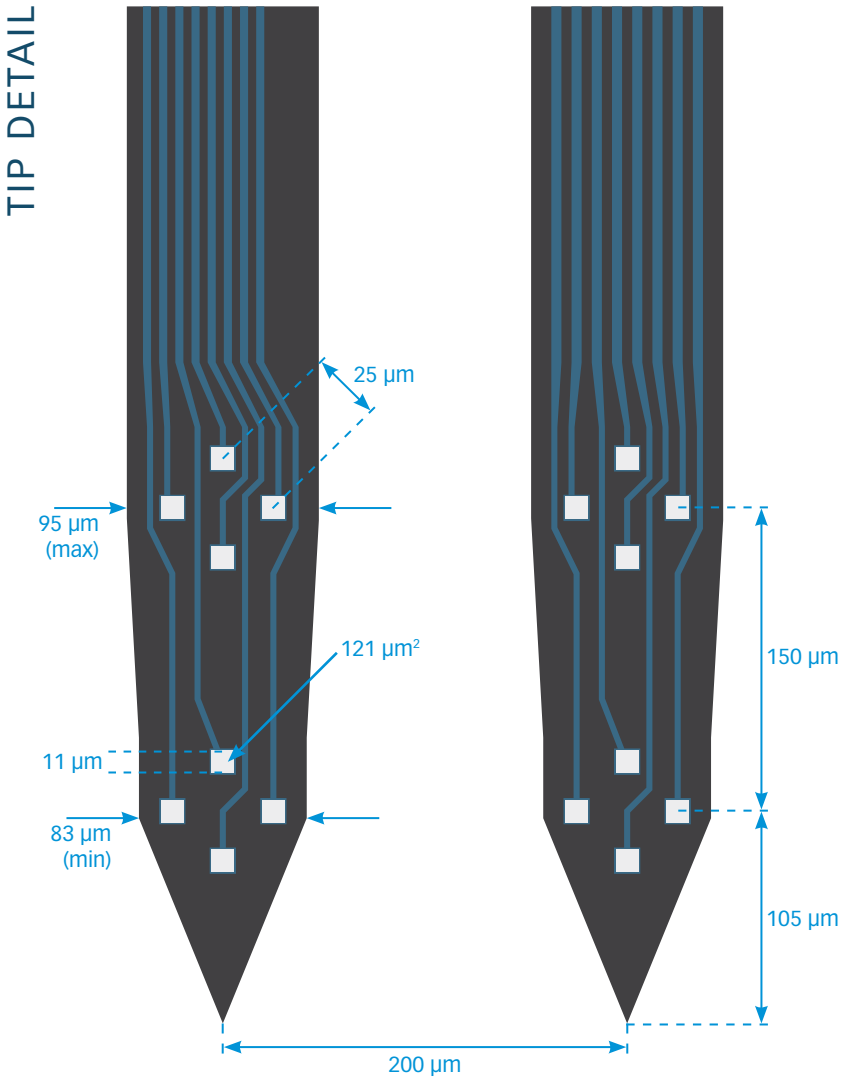
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

50 µm

A4x2-tet-5mm-150-200-121





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

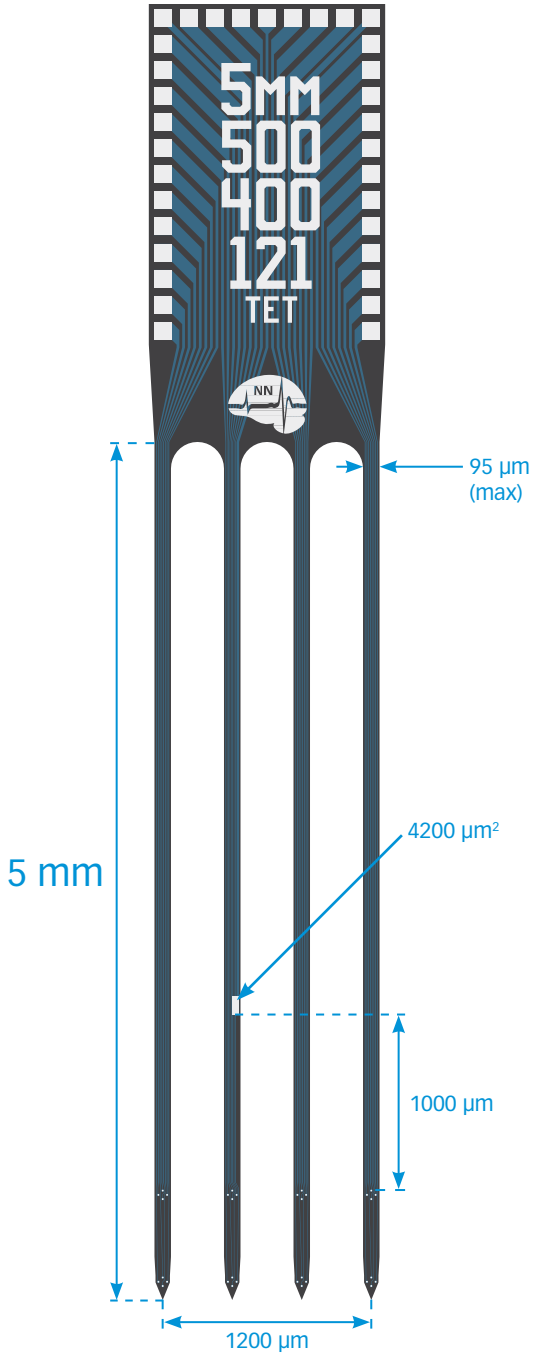
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

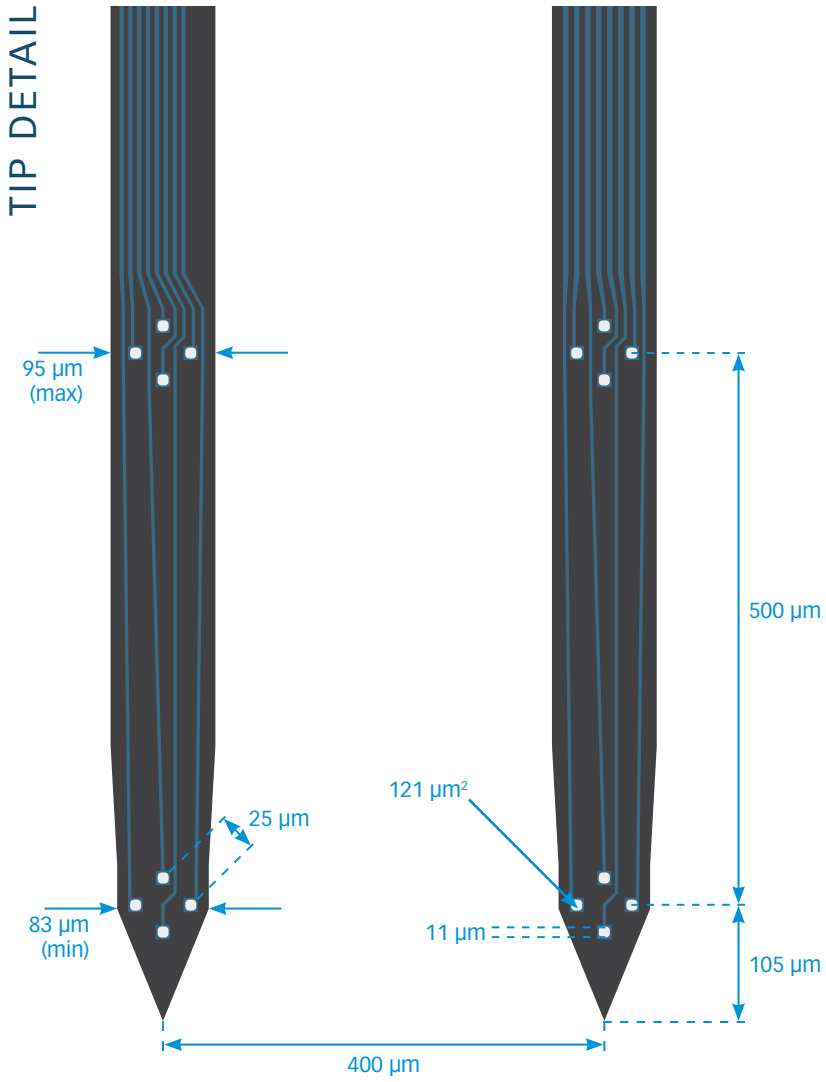
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

15 µm

A4x2-tet-5mm-500-400-121





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

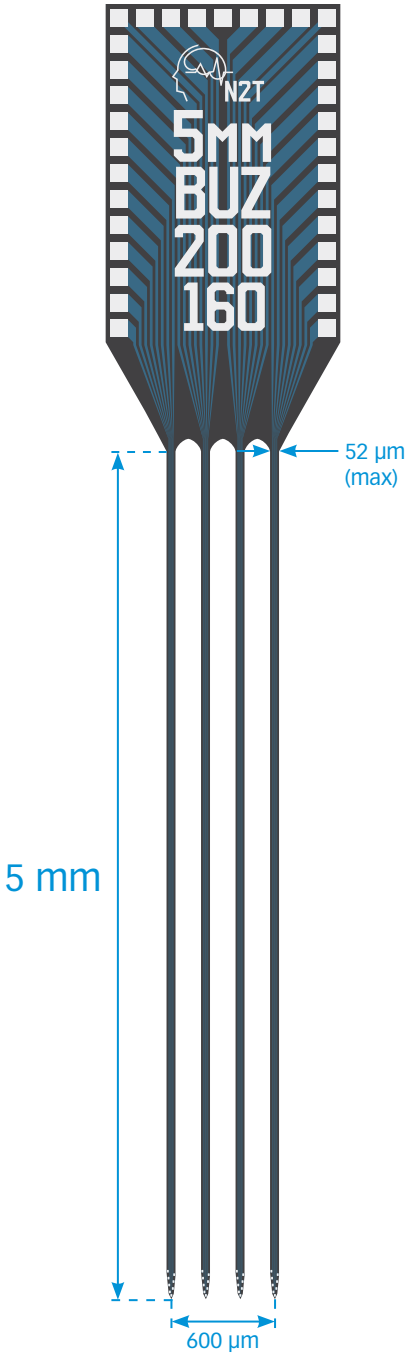
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

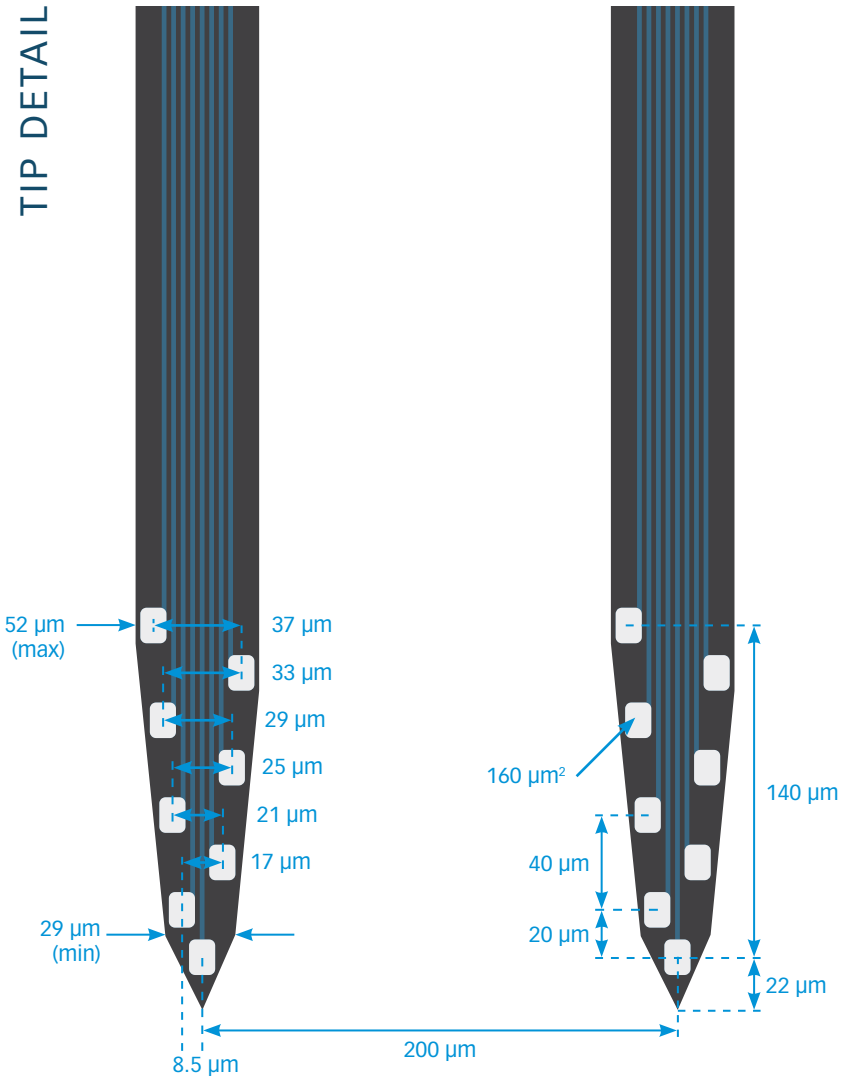
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

15 µm

Buzsaki32





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

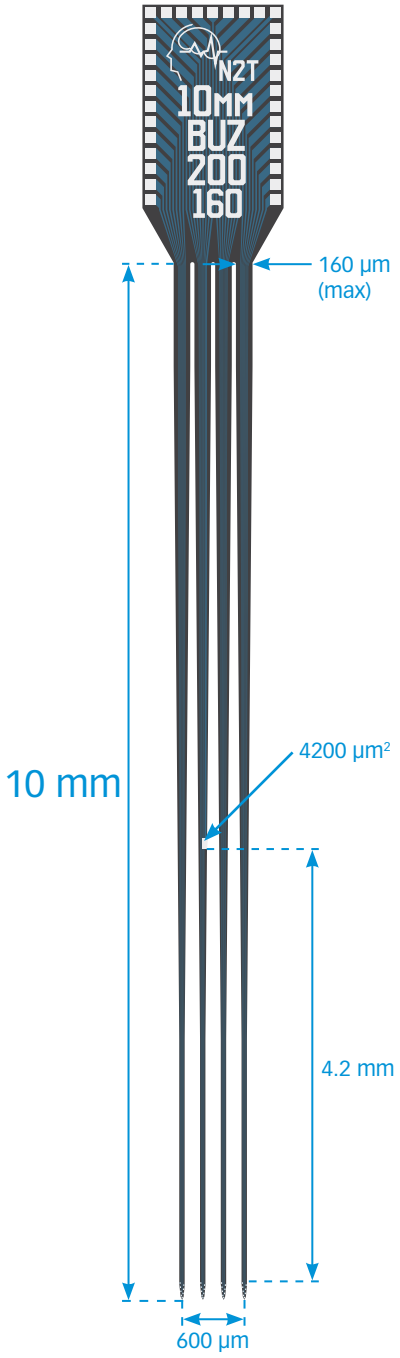
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

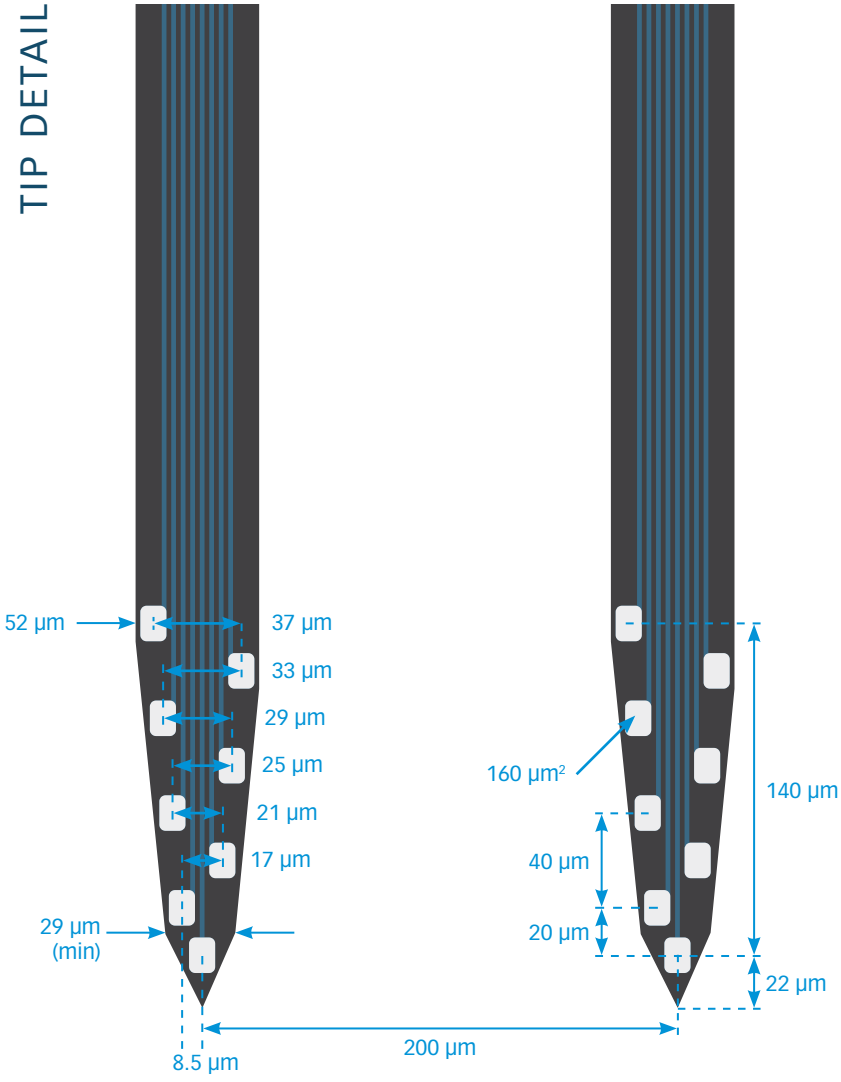
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

15 µm

Buzsaki32L





available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

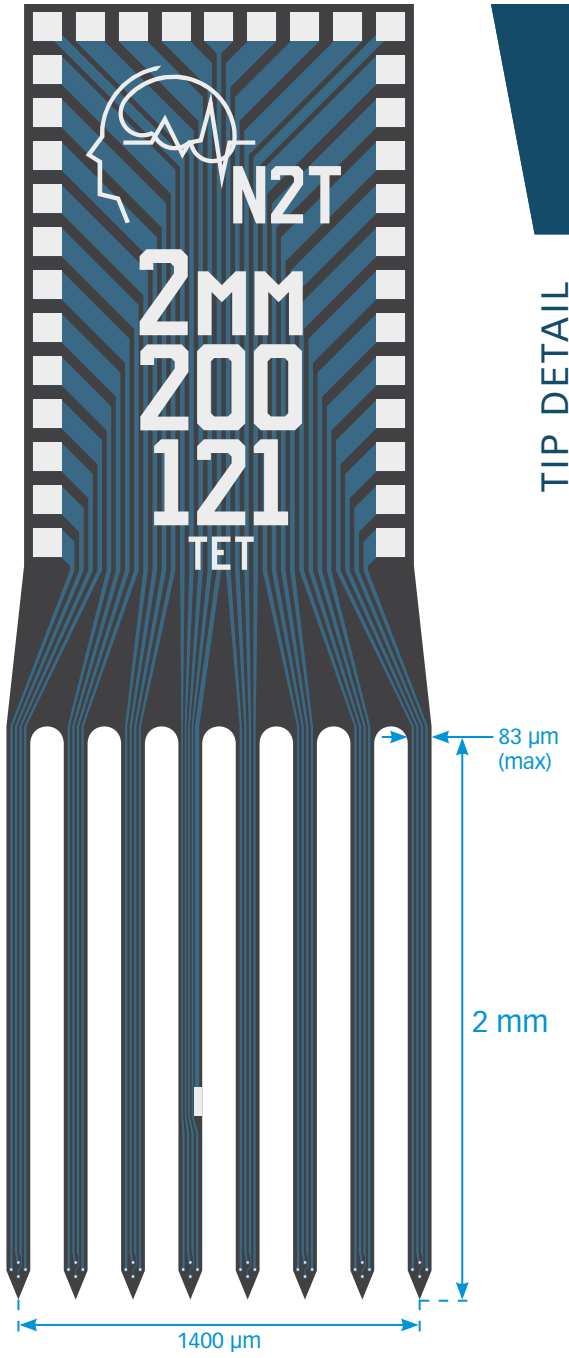
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

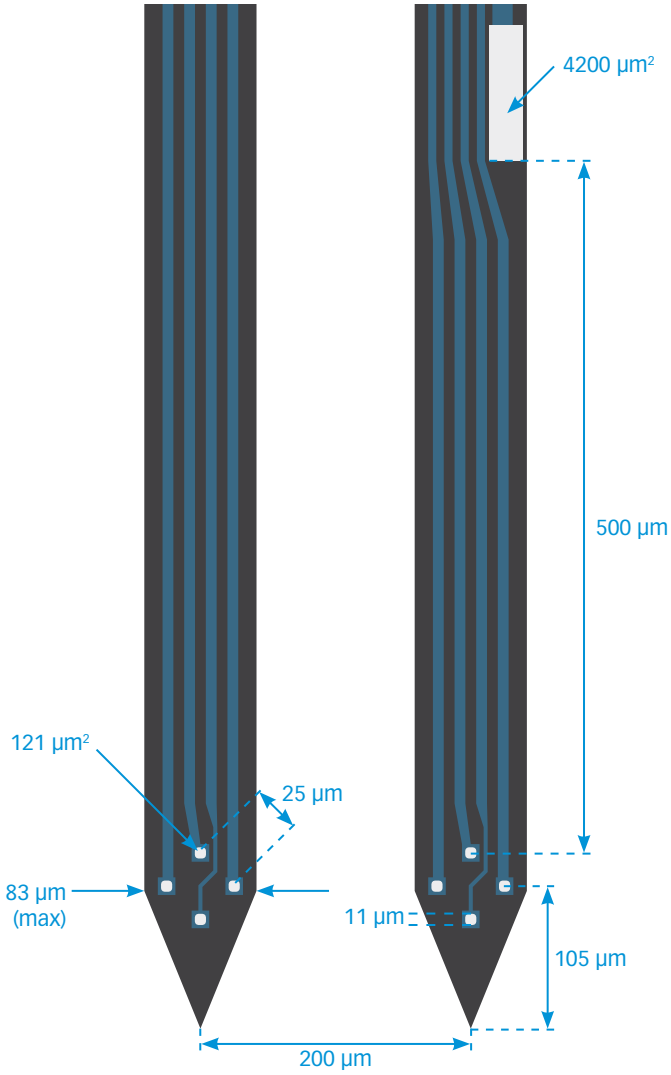
thickness

50 µm

A8x1-tet-2mm-200-121



TIP DETAIL



available packages

ACUTE
A32

CHRONIC
CM32
H32_21mm
HC32_21mm
HZ32_21mm
Z32

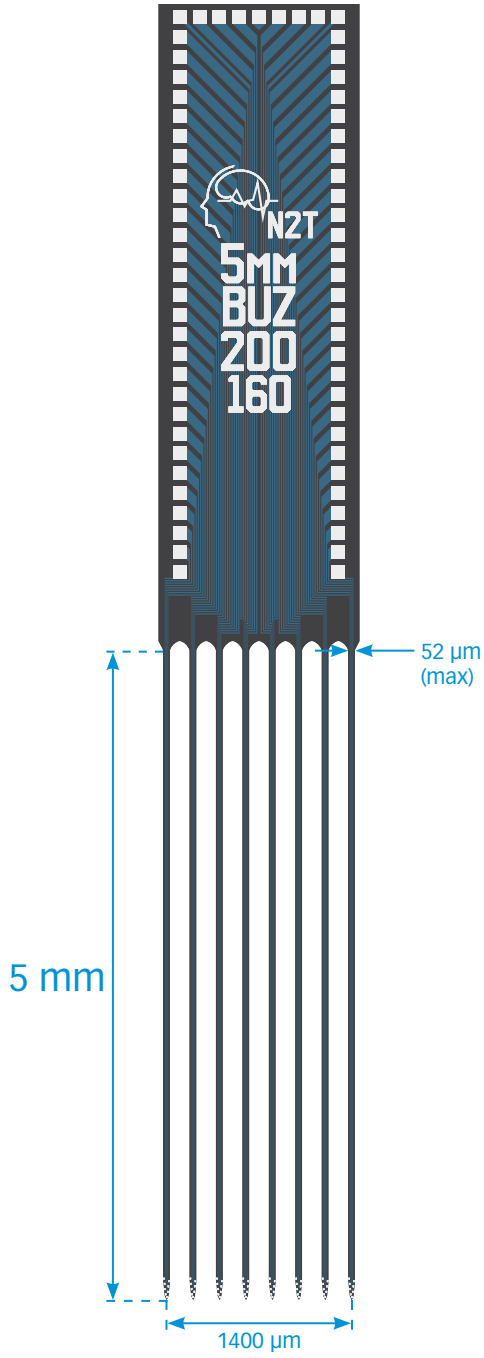
OPTOGENETICS
OA32
OA32LP
OCM32
OCM32LP
OZ32
OZ32LP

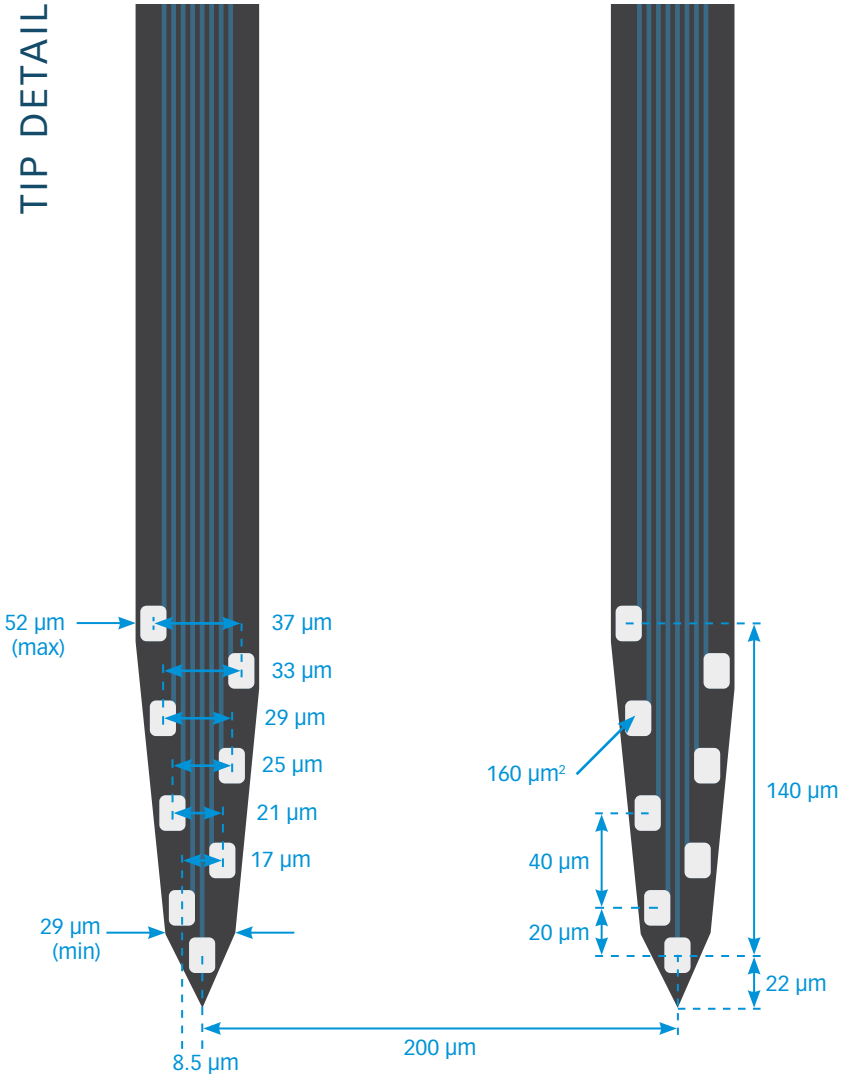
MR-COMPATIBLE
MR_CM32
MR_H32_21mm
MR_HC32_21mm

thickness

15 µm

Buzsaki64





available packages

ACUTE
A64

CHRONIC
H64_30mm
H64LP_30mm
HC64_30mm
HZ64_30mm
S64
Z64

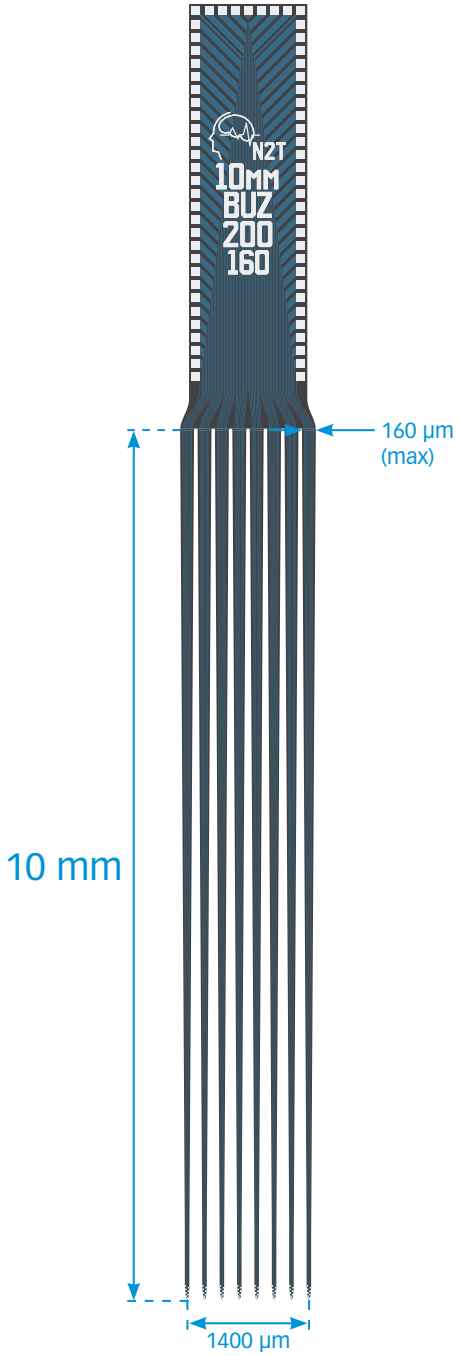
OPTOGENETICS
OA64
OA64LP

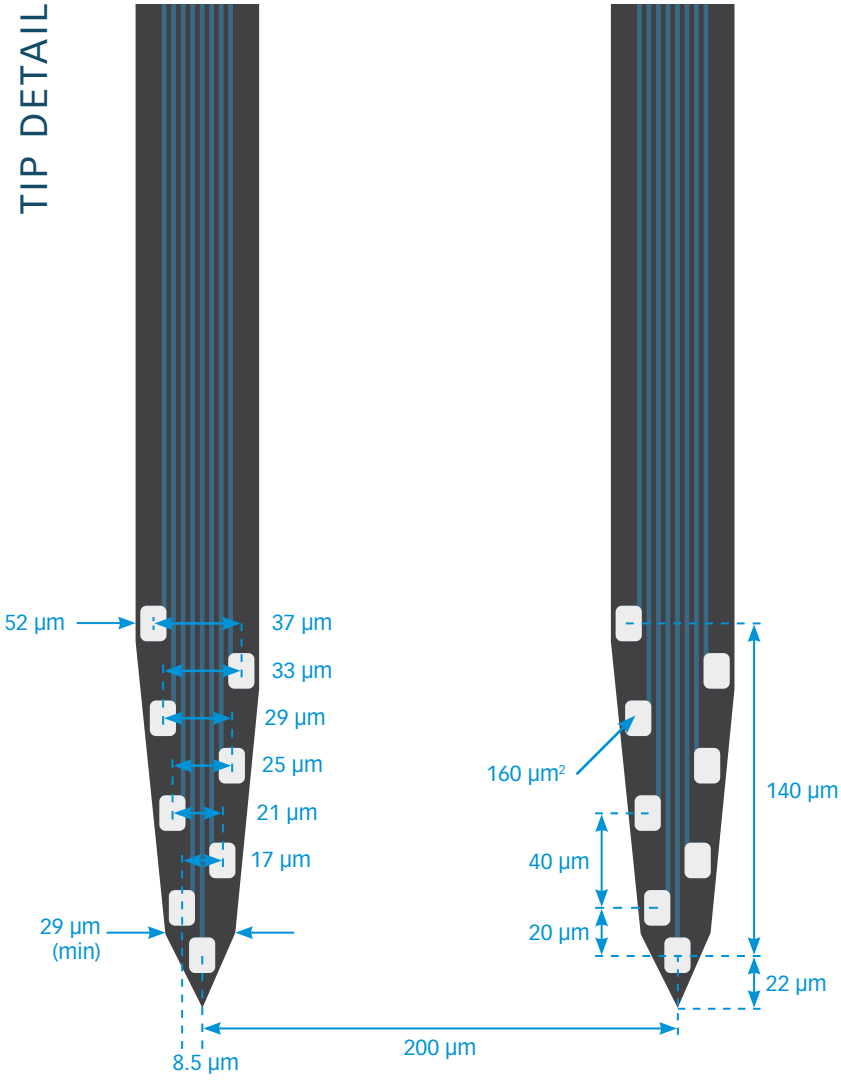
MR-COMPATIBLE
MR_H64_30mm
MR_HC64_30mm

thickness

15 µm

Buzsaki64L





available packages

ACUTE
A64

CHRONIC
H64_30mm
H64LP_30mm
HC64_30mm
HZ64_30mm
S64
Z64

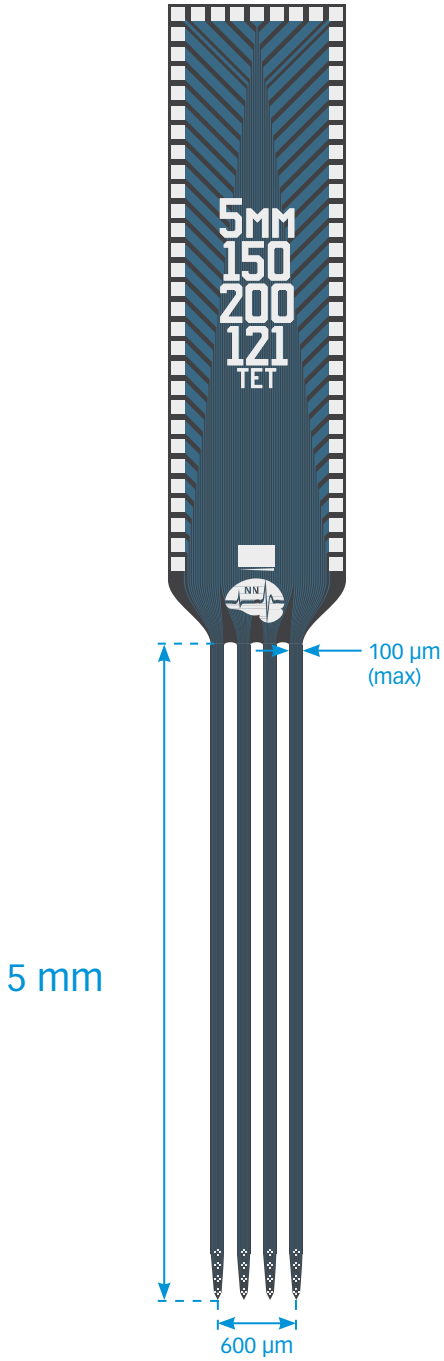
OPTOGENETICS
OA64
OA64LP

MR-COMPATIBLE
MR_H64_30mm
MR_HC64_30mm

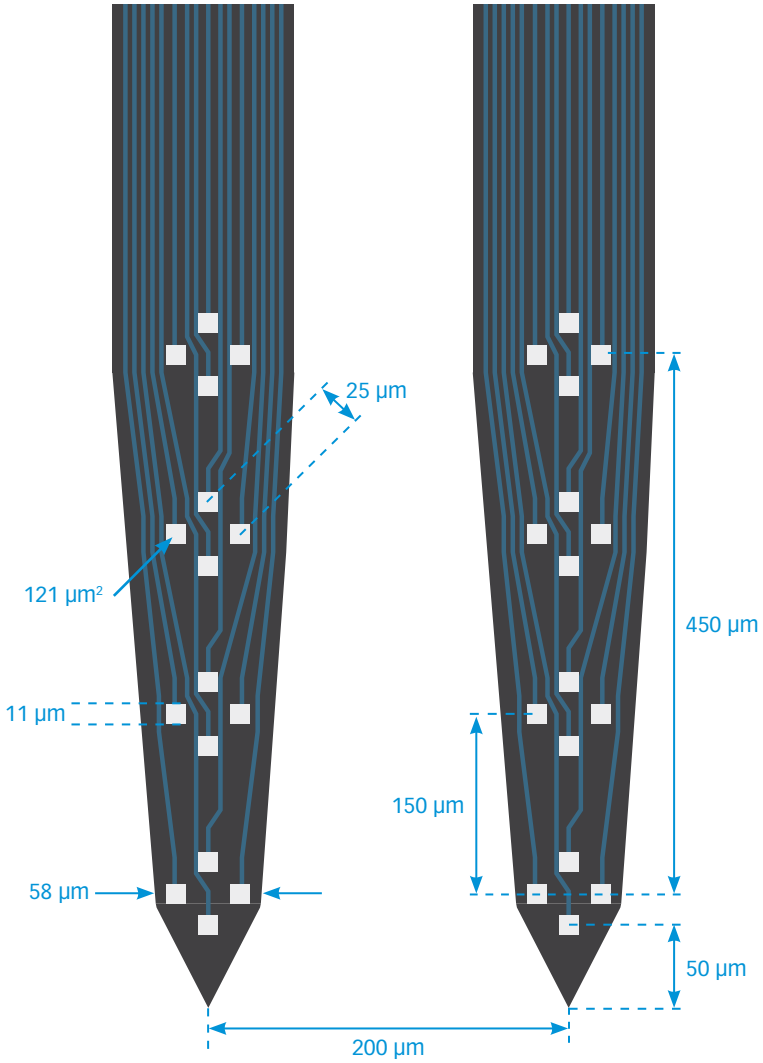
thickness

50 µm

A4x4-tet-5mm-150-200-121



TIP DETAIL



available packages

ACUTE
A64

CHRONIC
H64_30mm
H64LP_30mm
HC64_30mm
HZ64_30mm
Z64

SMART
S64

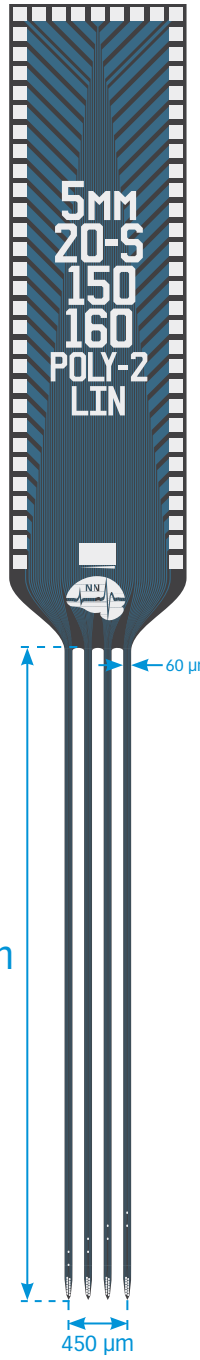
OPTOGENETICS
OA64
OA64LP

MR-COMPATIBLE
MR_H64_30mm
MR_HC64_30mm

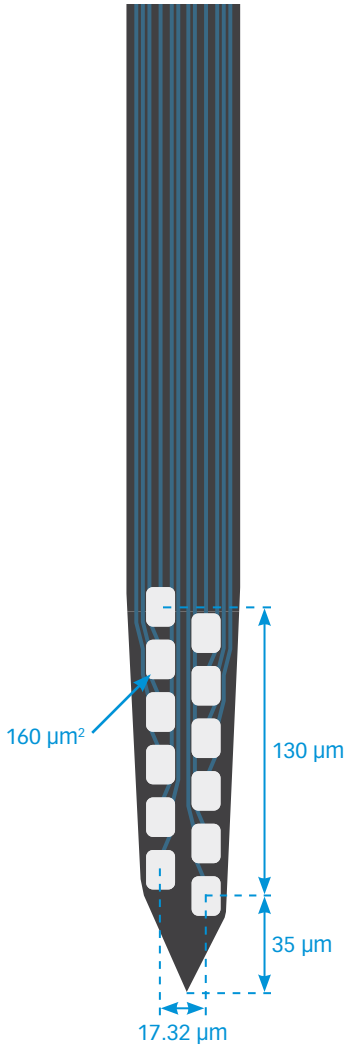
thickness

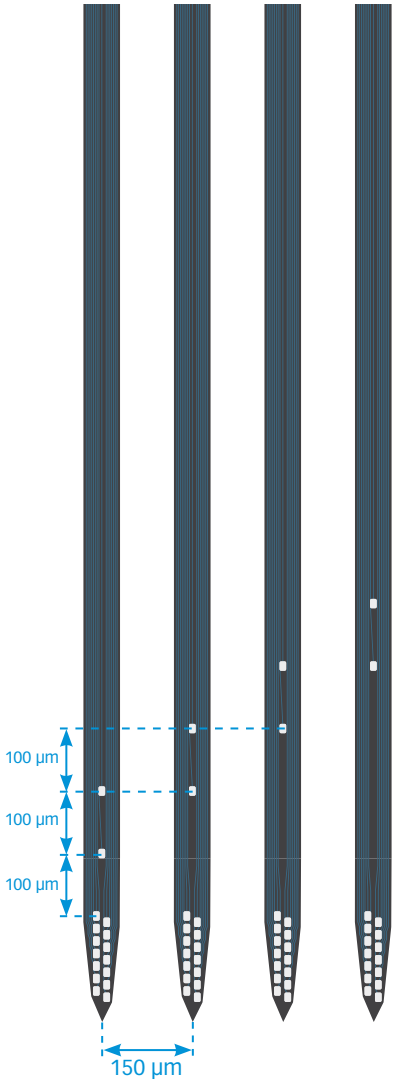
15 µm

A4x16-Poly2-5mm-20s-lin-160



TIP DETAIL





available packages

ACUTE
A64

CHRONIC
H64_30mm
H64LP_30mm
HC64_30mm
HZ64_30mm
Z64

SMART
S64

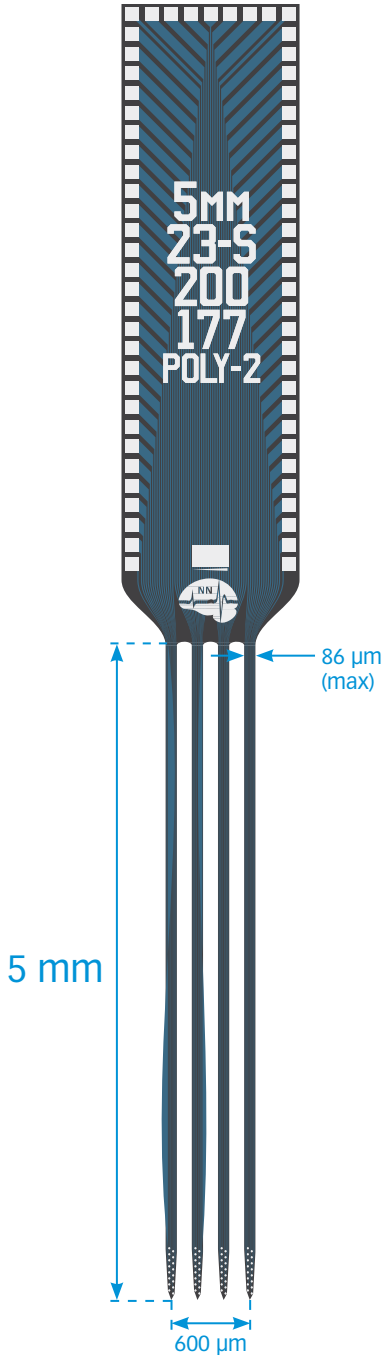
OPTOGENETICS
OA64
OA64LP

MR-COMPATIBLE
MR_H64_30mm
MR_HC64_30mm

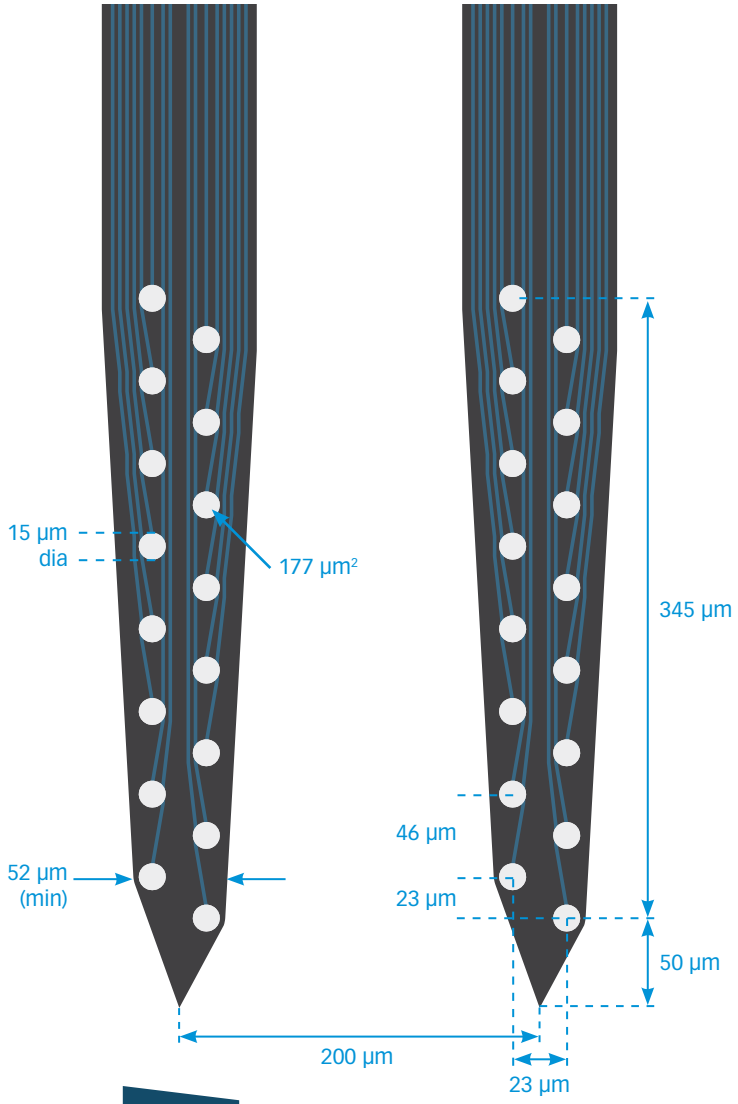
thickness

15 µm

A4x16-Poly2-5mm-23s-200-177



TIP DETAIL



available packages

ACUTE
A64

CHRONIC
H64_30mm
H64LP_30mm
HC64_30mm
HZ64_30mm
Z64

SMART
S64

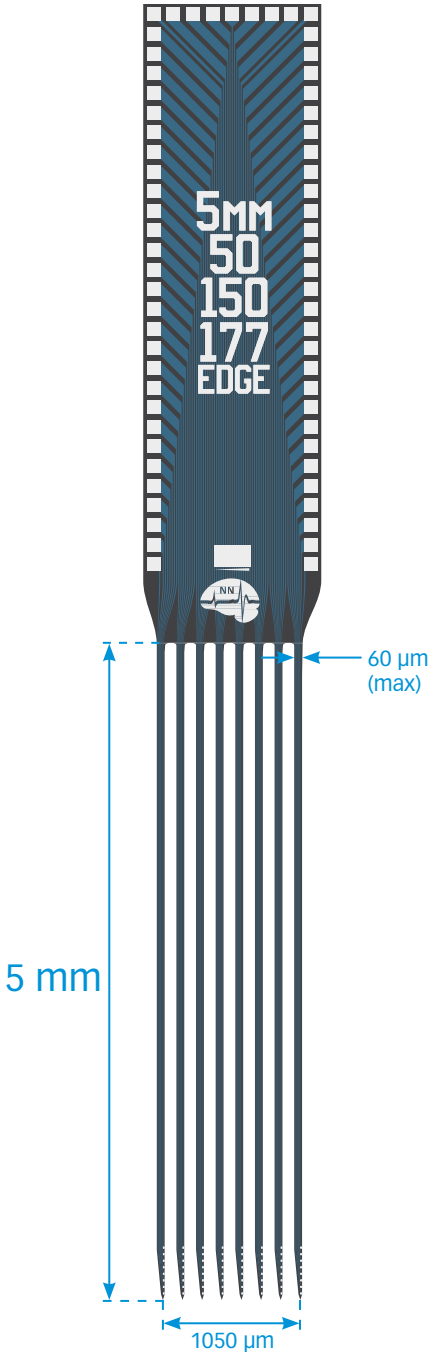
OPTOGENETICS
OA64
OA64LP

MR-COMPATIBLE
MR_H64_30mm
MR_HC64_30mm

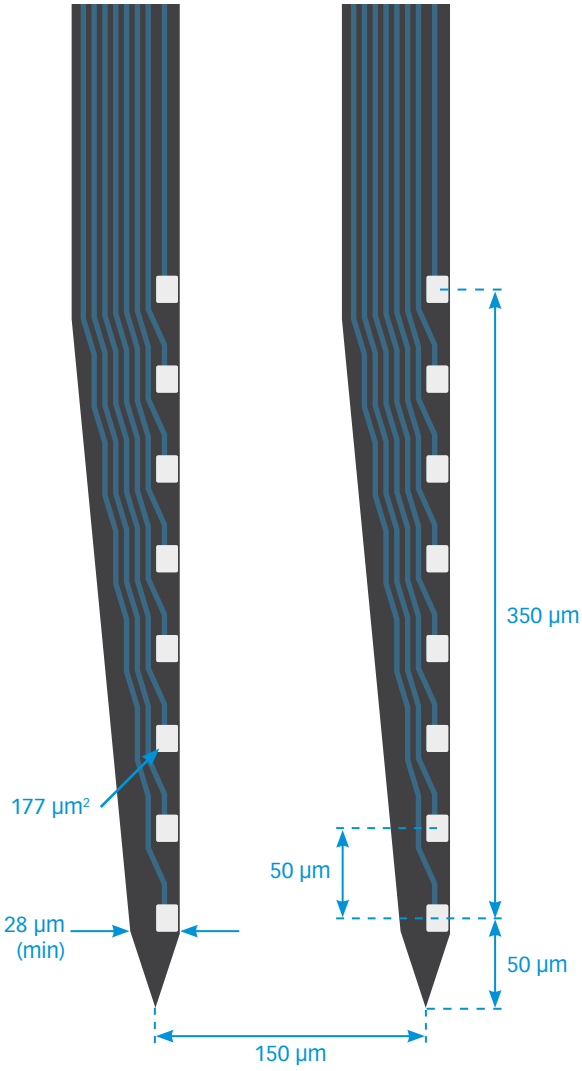
thickness

15 µm

A8x8-Edge-5mm-50-150-177



TIP DETAIL



available packages

ACUTE
A64

CHRONIC
H64_30mm
H64LP_30mm
HC64_30mm
HZ64_30mm
Z64

SMART
S64

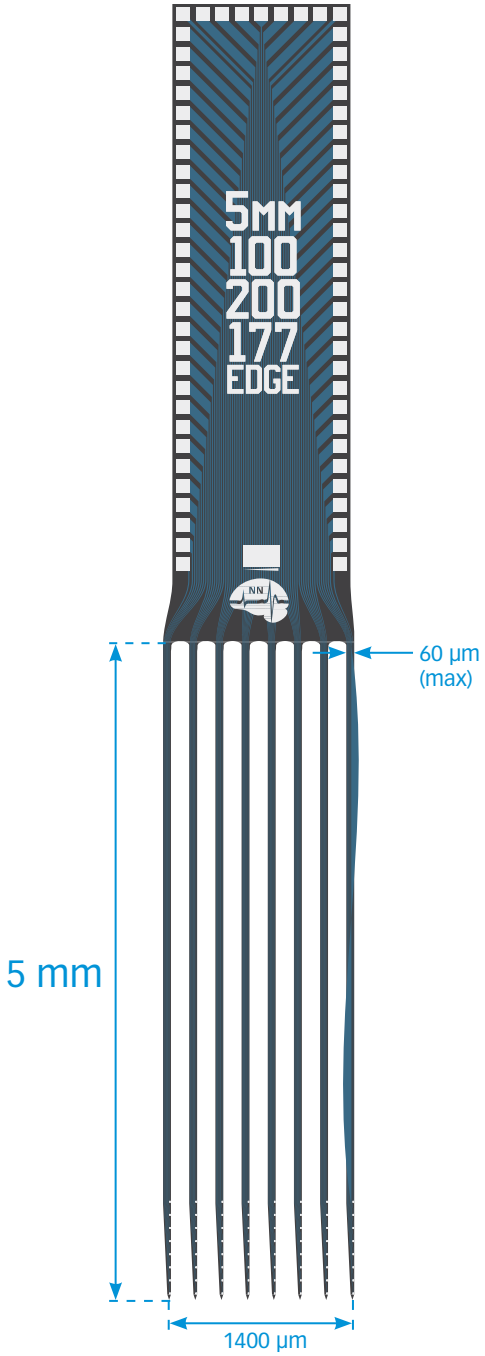
OPTOGENETICS
OA64
OA64LP

MR-COMPATIBLE
MR_H64_30mm
MR_HC64_30mm

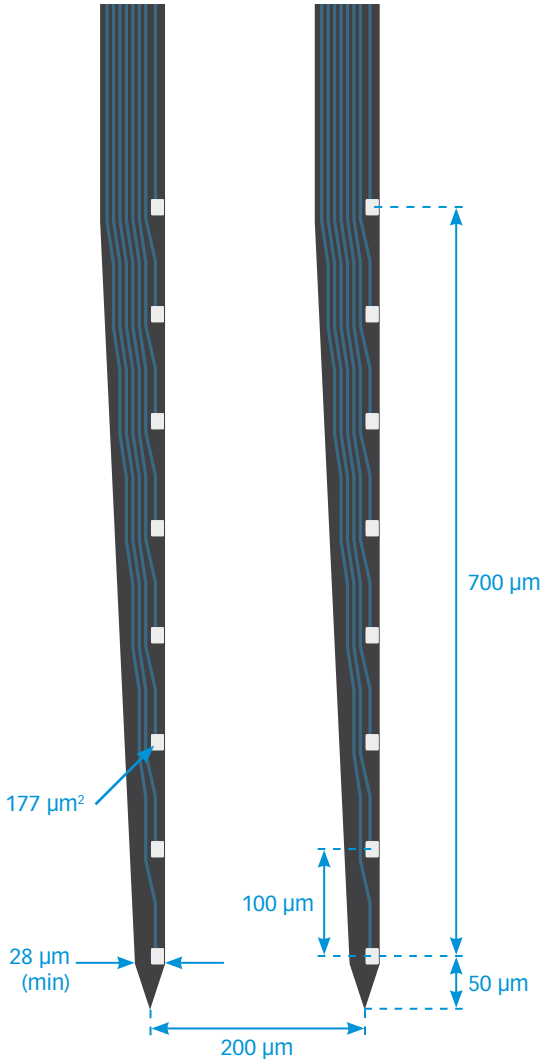
thickness

15 µm

A8x8-Edge-5mm-100-200-177



TIP DETAIL



available packages

ACUTE
A64

CHRONIC
H64_30mm
H64LP_30mm
HC64_30mm
HZ64_30mm
Z64

SMART
S64

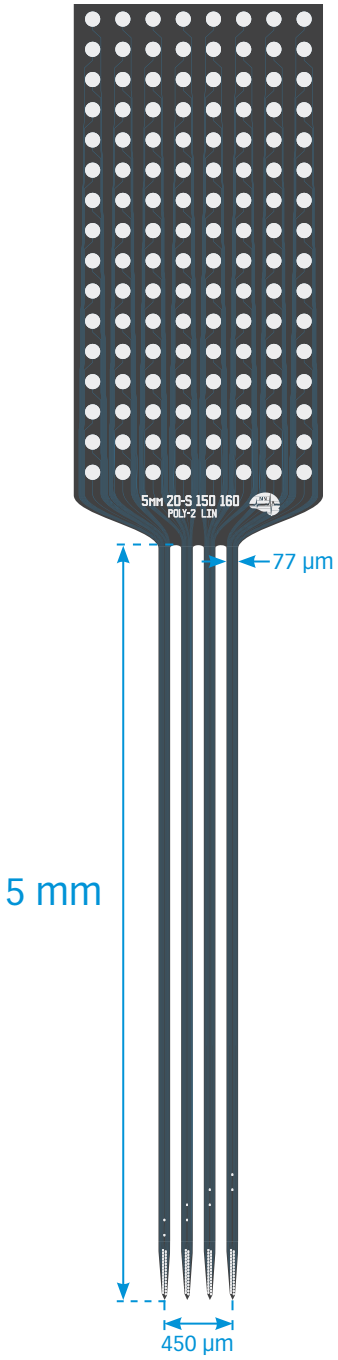
OPTOGENETICS
OA64
OA64LP

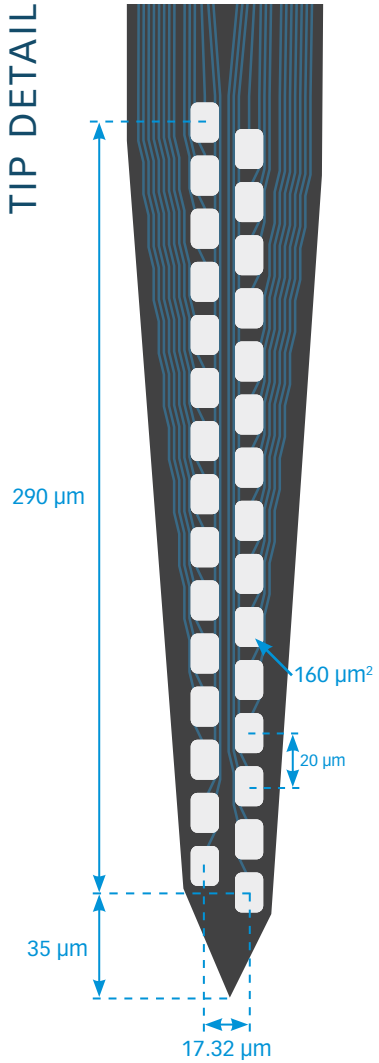
MR-COMPATIBLE
MR_H64_30mm
MR_HC64_30mm

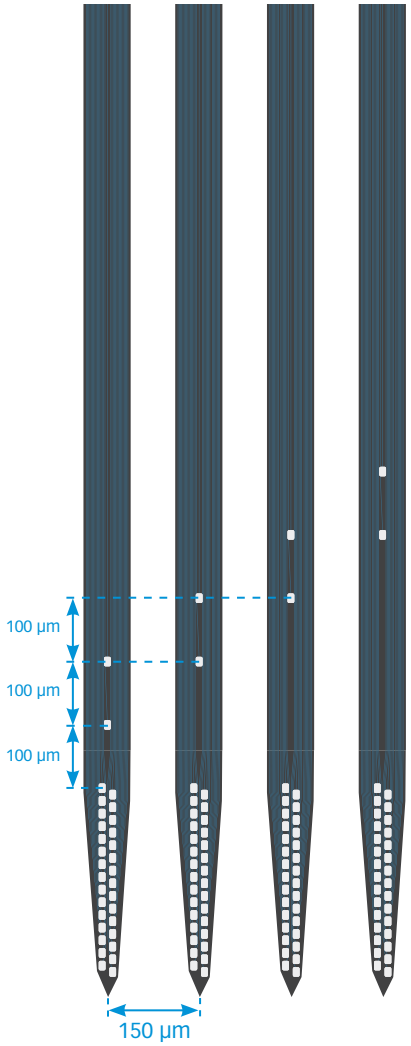
thickness

15 µm

A4x32-Poly2-5mm-20s-lin-160







available packages

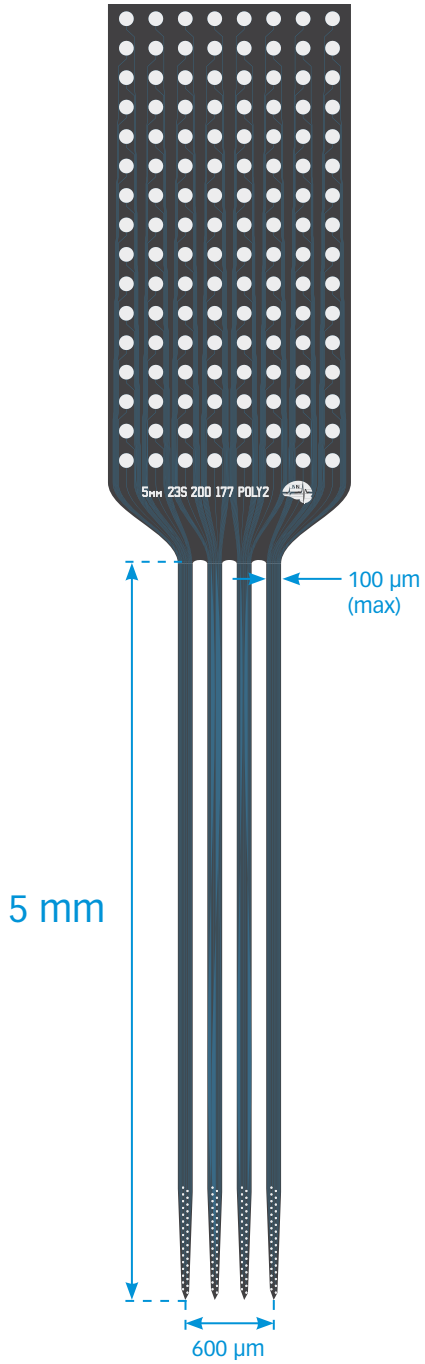
SMART
S128

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

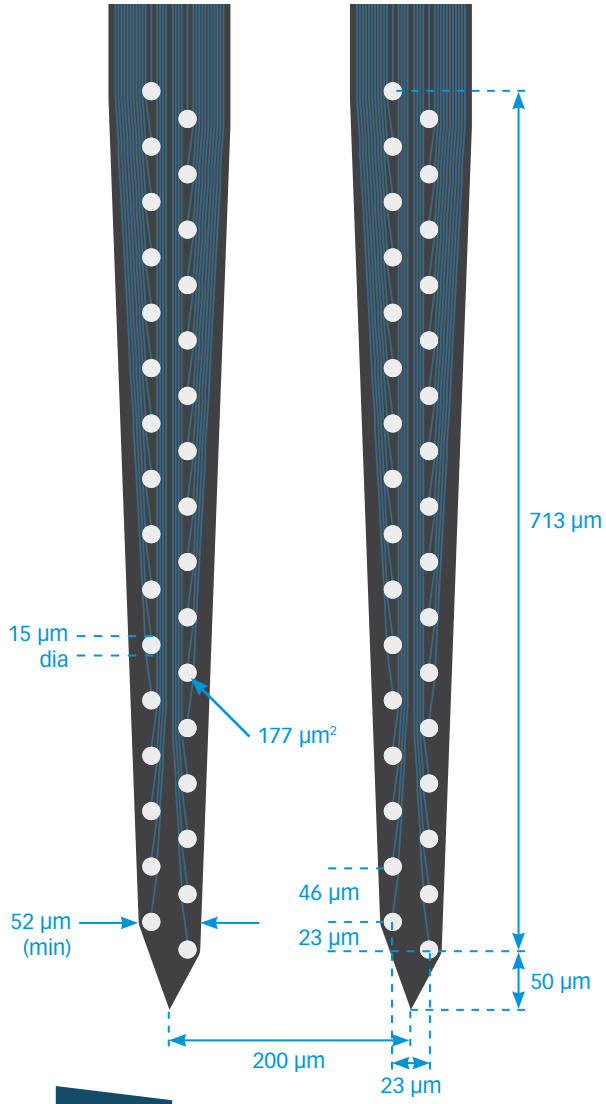
thickness

15 µm

A4x32-Poly2-5mm-23s-200-177



TIP DETAIL



available packages

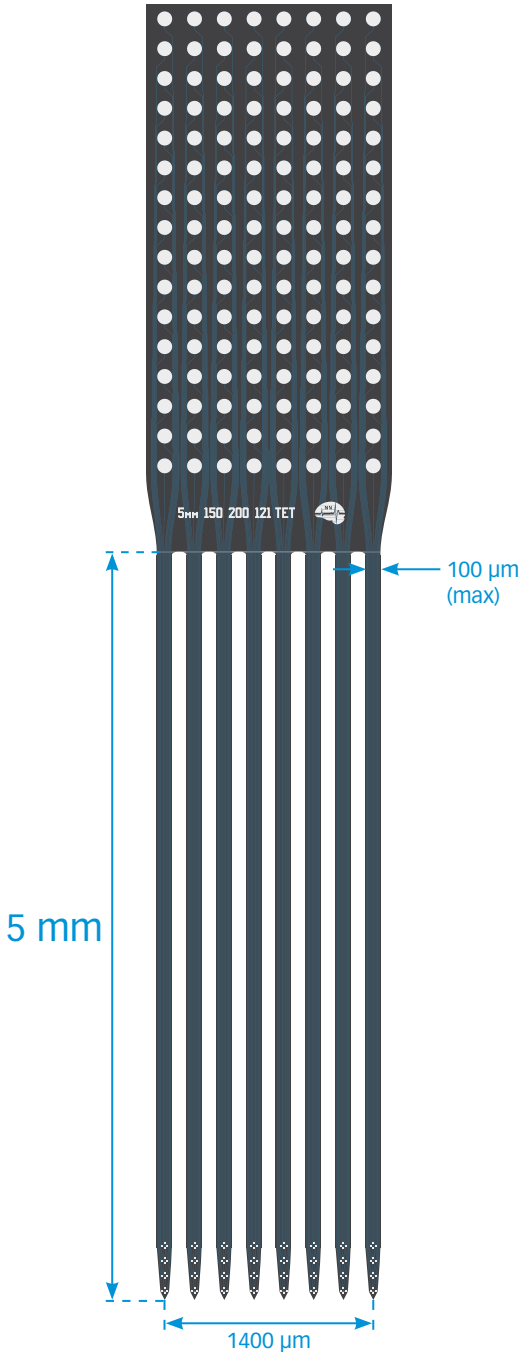
SMART
S128

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

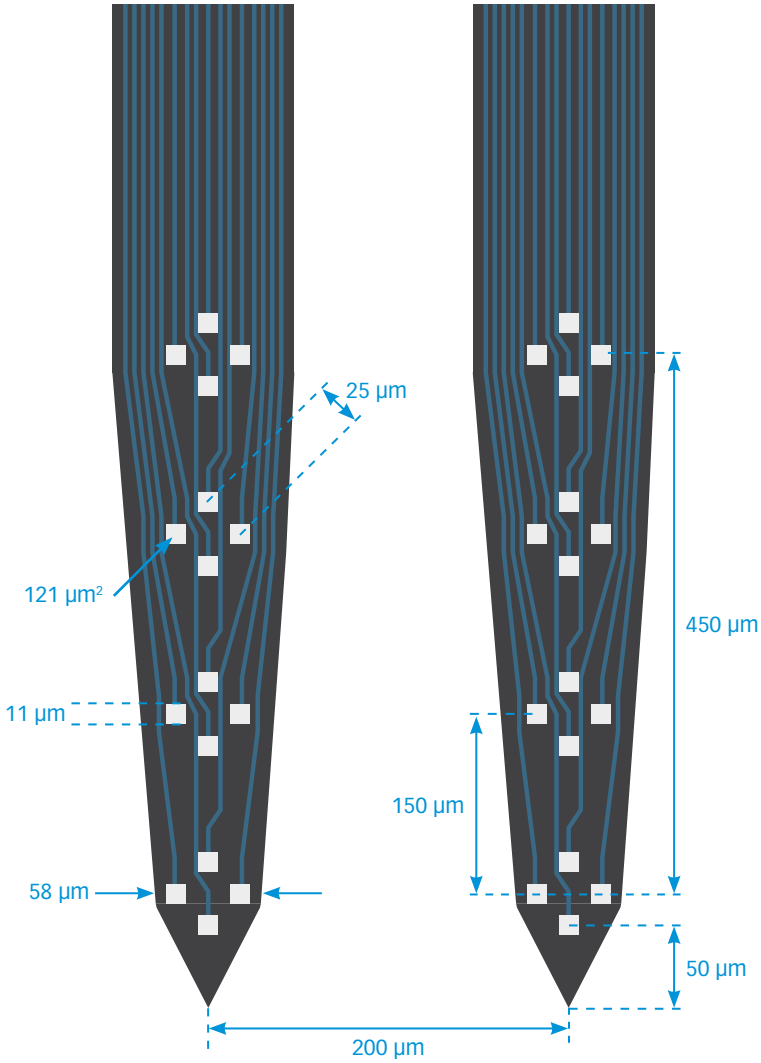
thickness

15 µm

A8x4-tet-5mm-150-200-121



TIP DETAIL



available packages

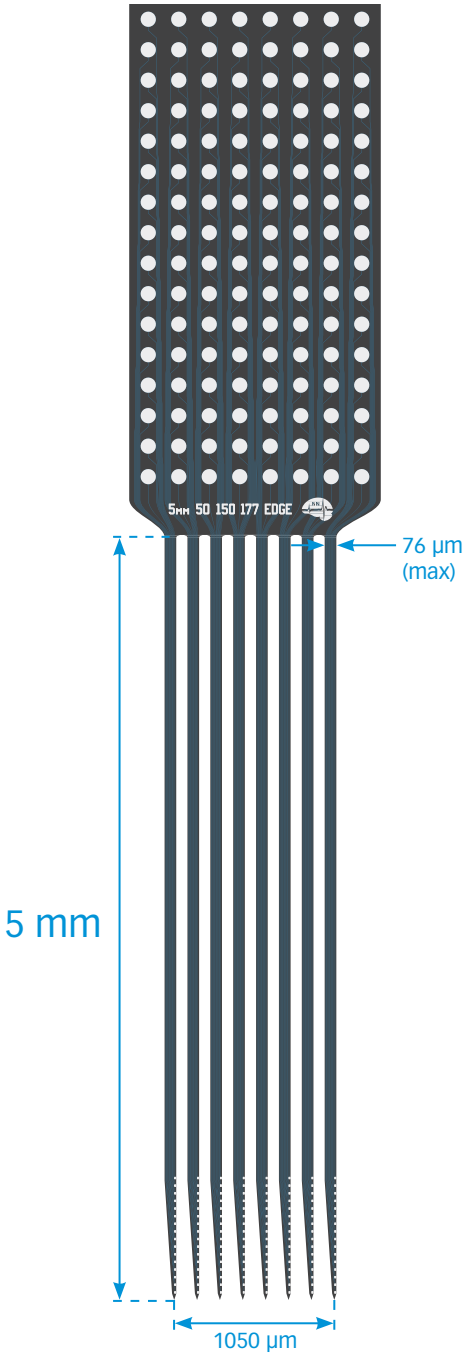
SMART
S128

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

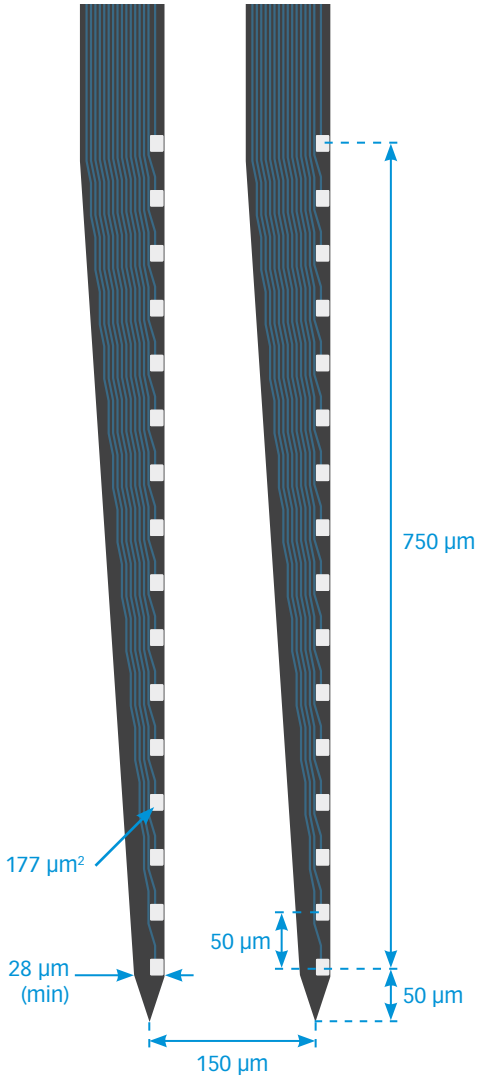
thickness

15 µm

A8x16-Edge-5mm-50-150-177



TIP DETAIL



available packages

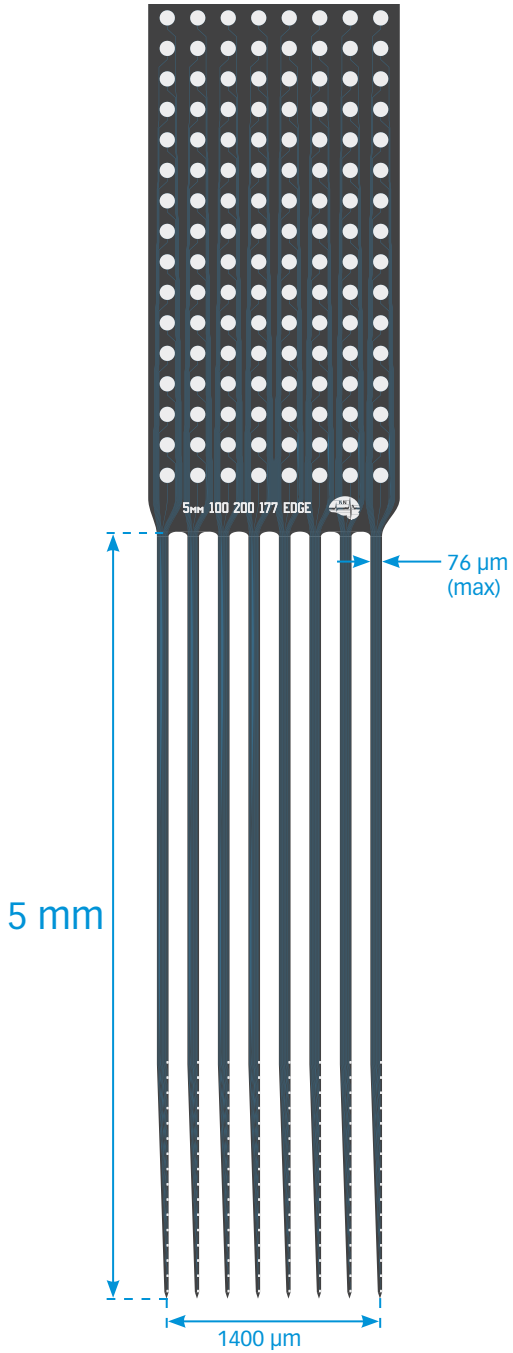
SMART
S128

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

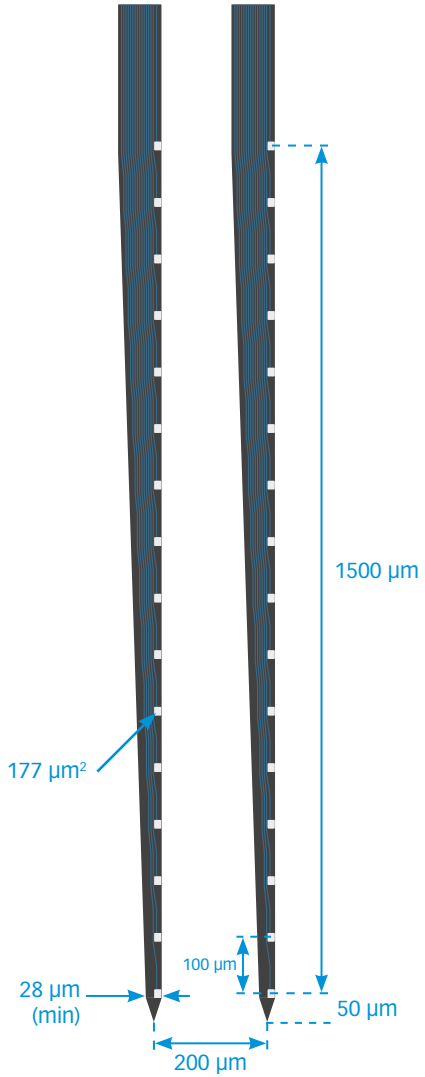
thickness

15 µm

A8x16-Edge-5mm-100-200-177



TIP DETAIL



available packages

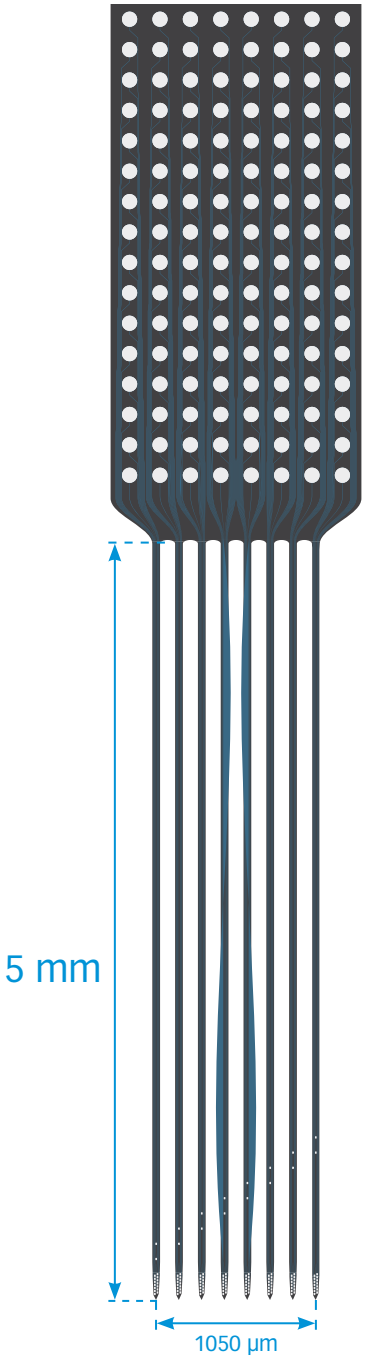
SMART
S128

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

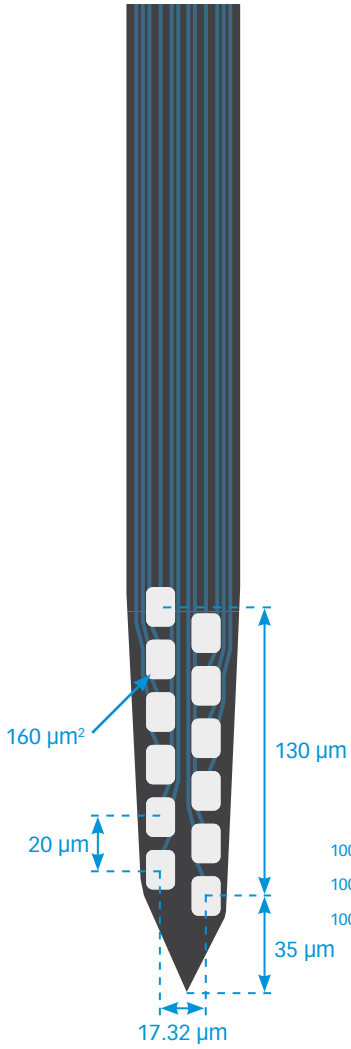
thickness

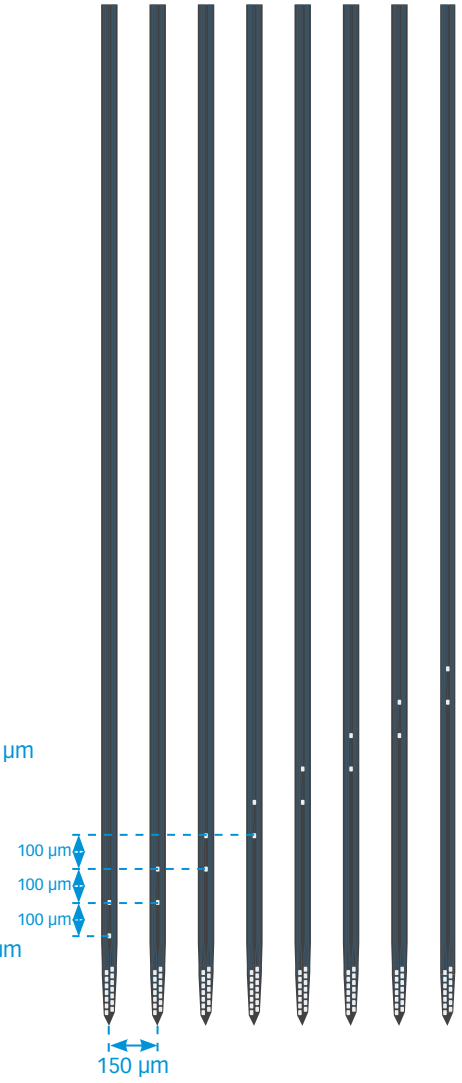
15 µm

A8x16-Poly2-5mm-20s-lin-160



TIP DETAIL





available packages

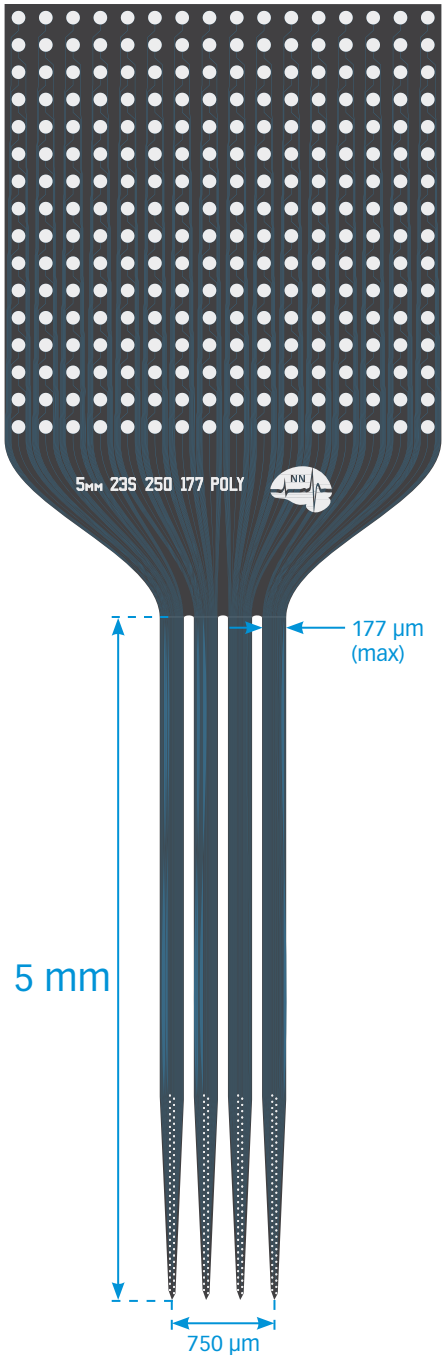
SMART
S128

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

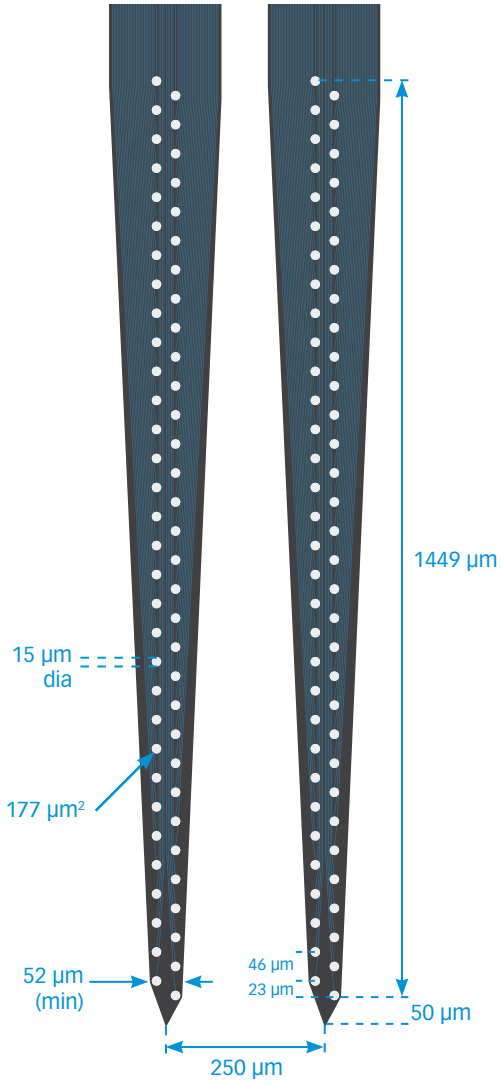
thickness

15 µm

A4x64-Poly2-5mm-23s-250-177



TIP DETAIL



available packages

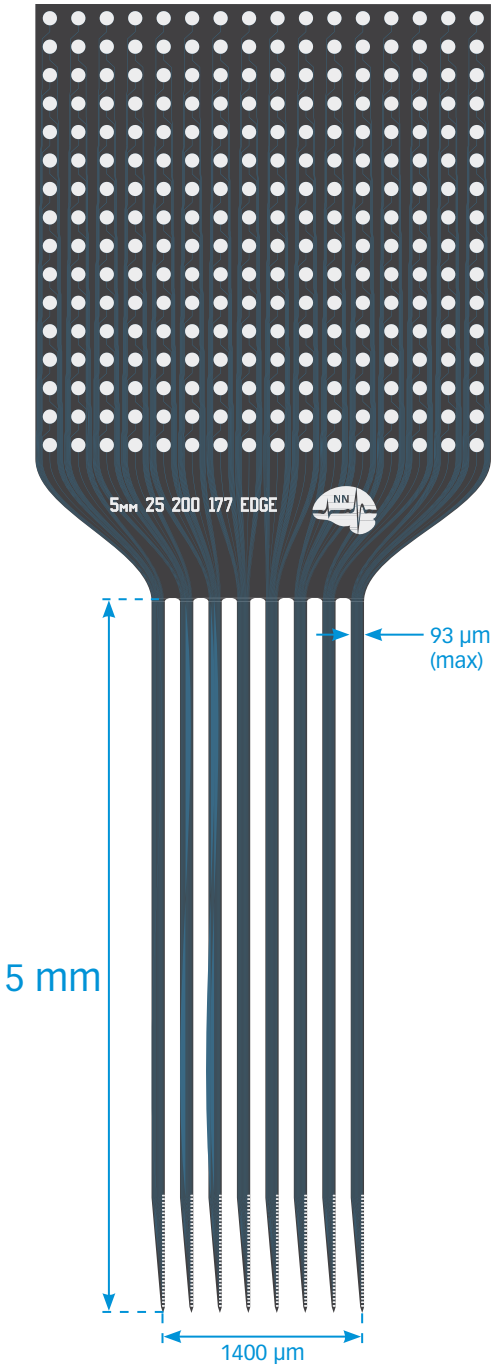
SMART
S256

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

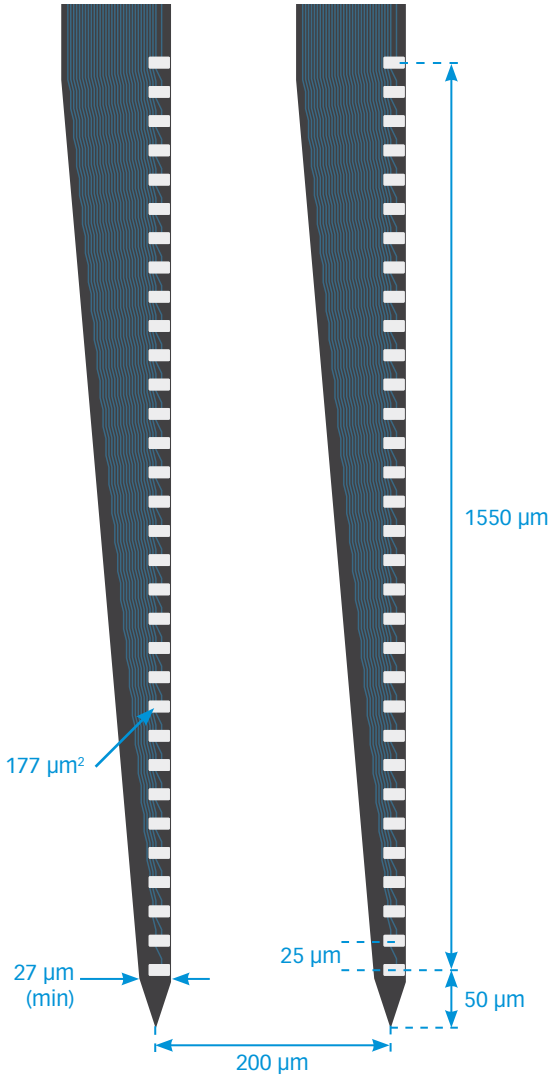
thickness

15 µm

A8x32-Edge-5mm-25-200-177



TIP DETAIL



available packages

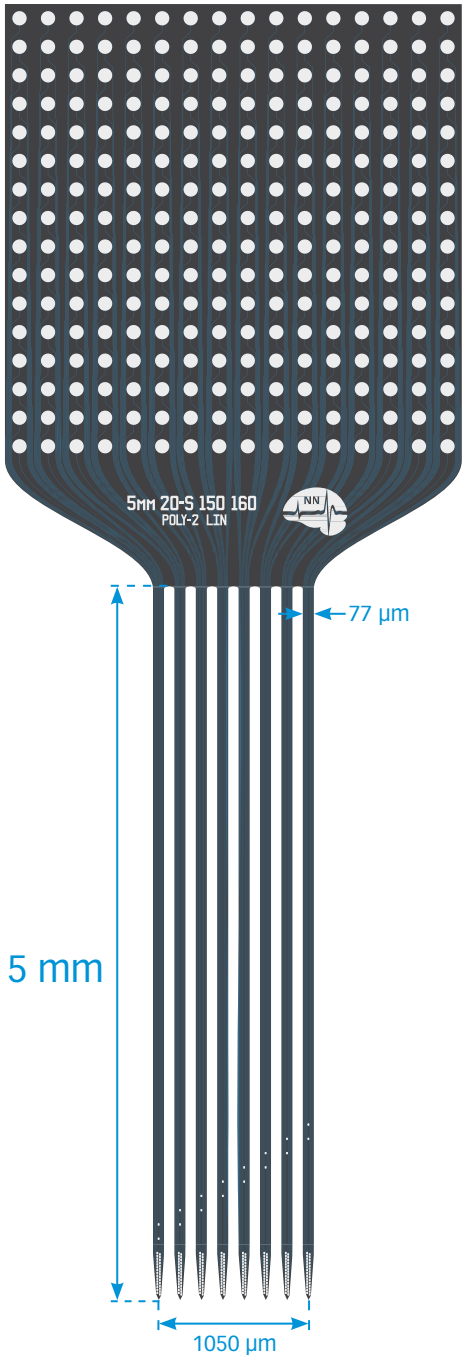
SMART
S256

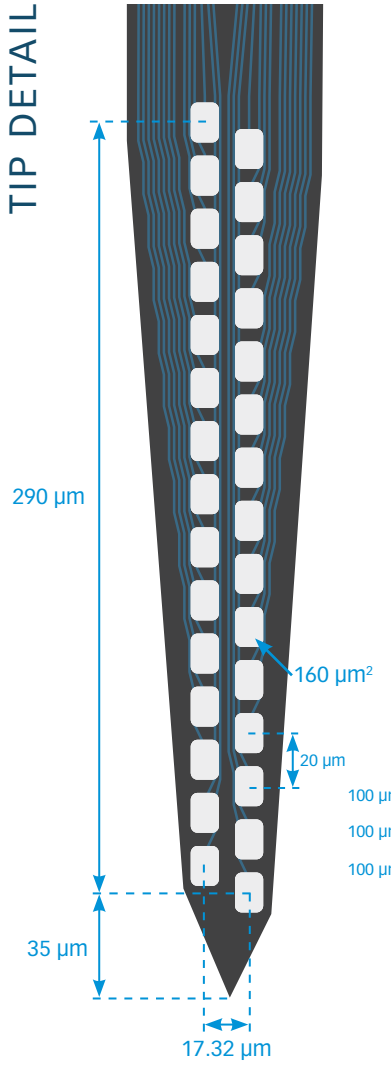
Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

thickness

15 µm

A8x32-Poly2-5mm-20s-lin-160





available packages

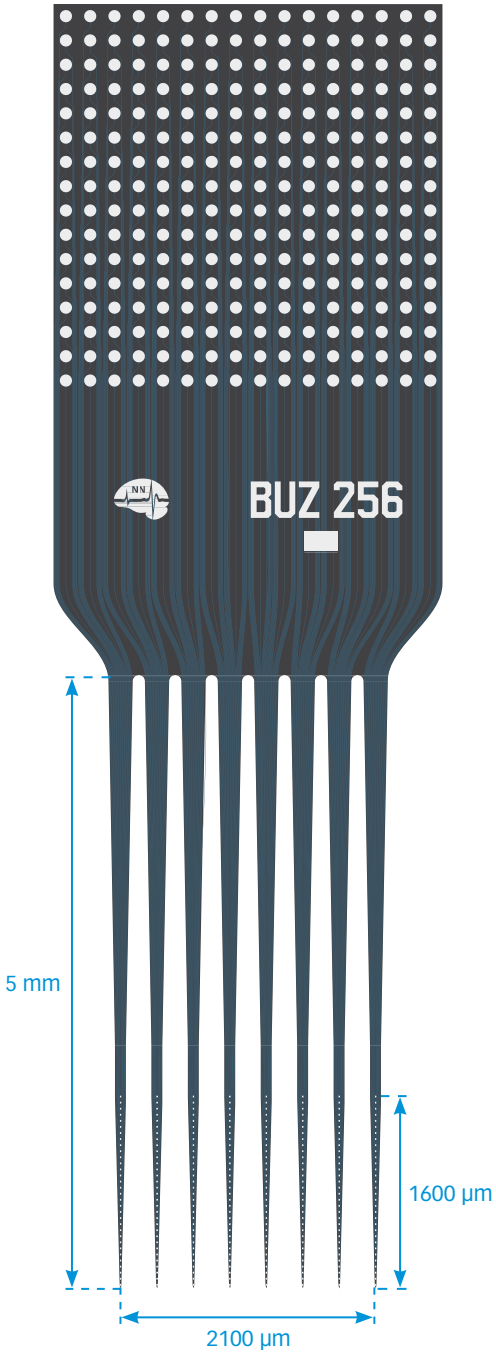
SMART
S256

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

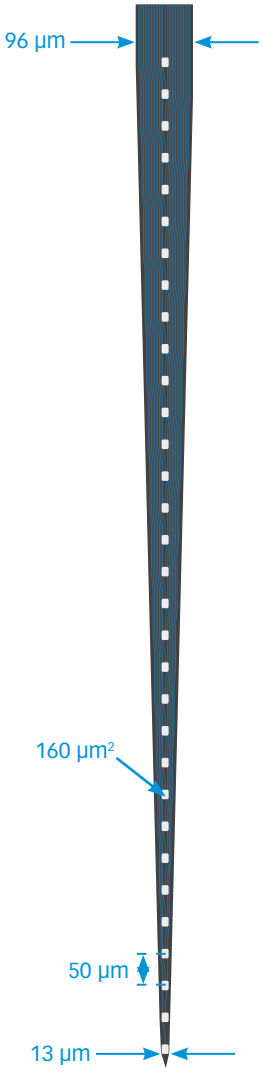
thickness

15 µm

Buzsaki256



TIP DETAIL



available packages

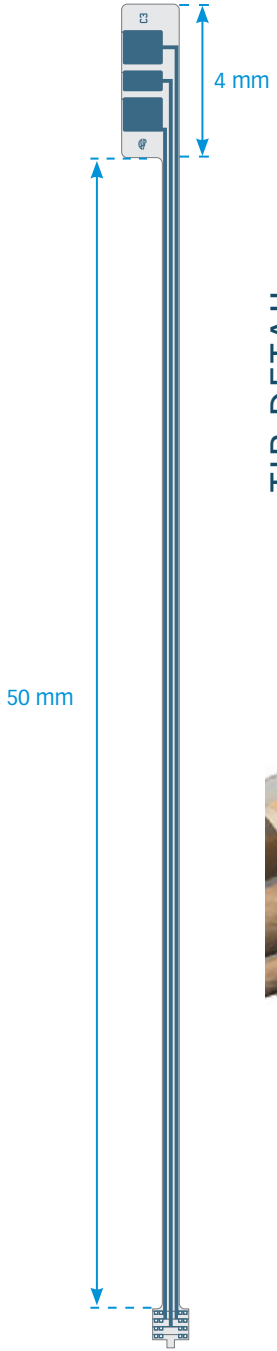
SMART
S256

Note: Given the high channel count of this design, there may be up to 15% irregular sites on the assembled device

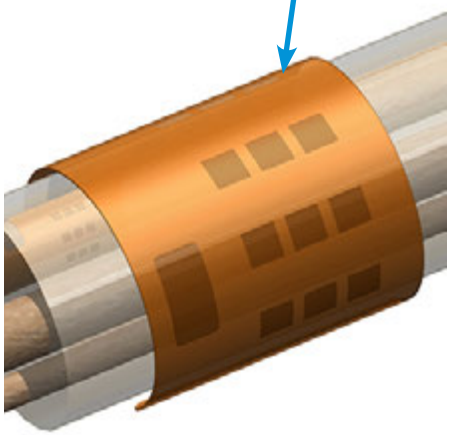
thickness

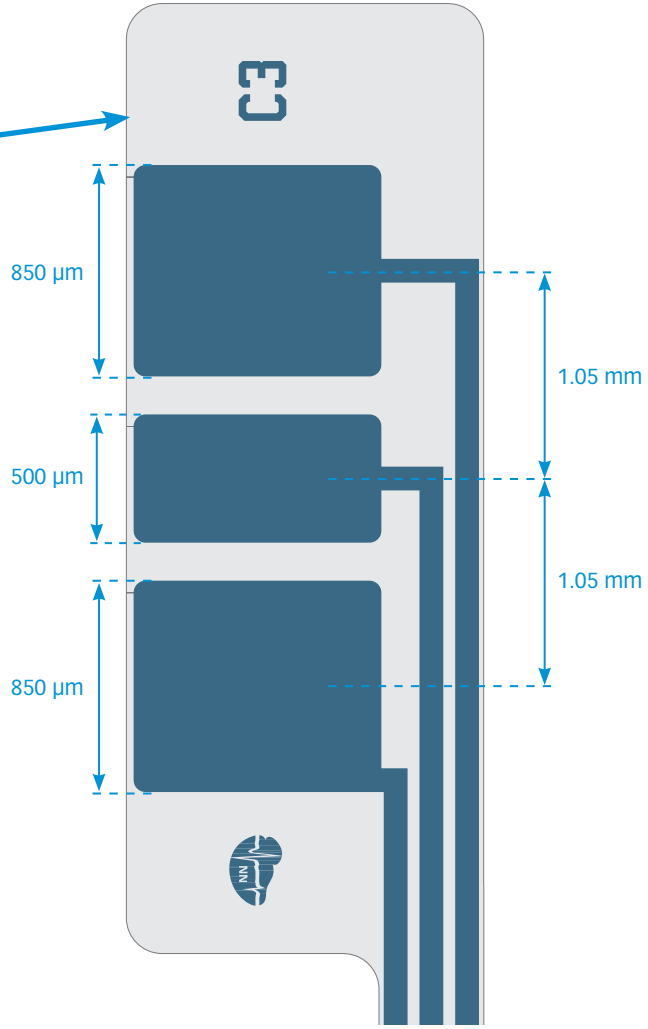
15 µm

C3



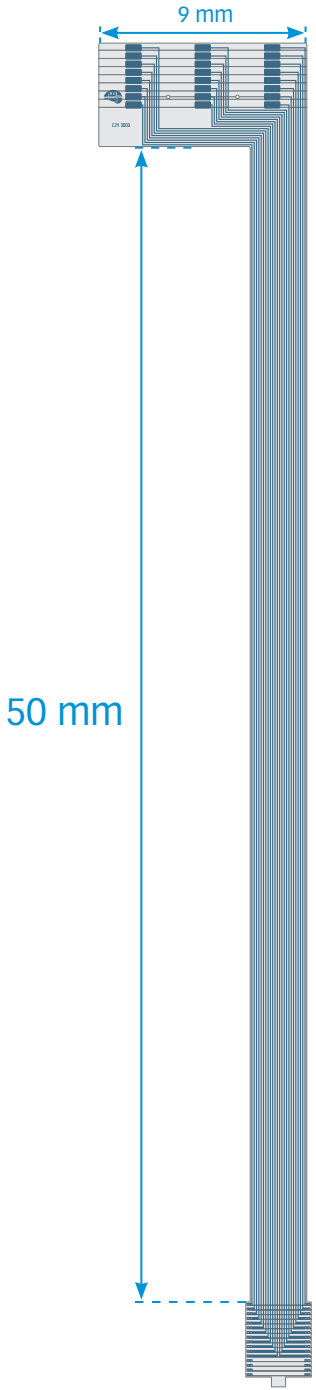
TIP DETAIL



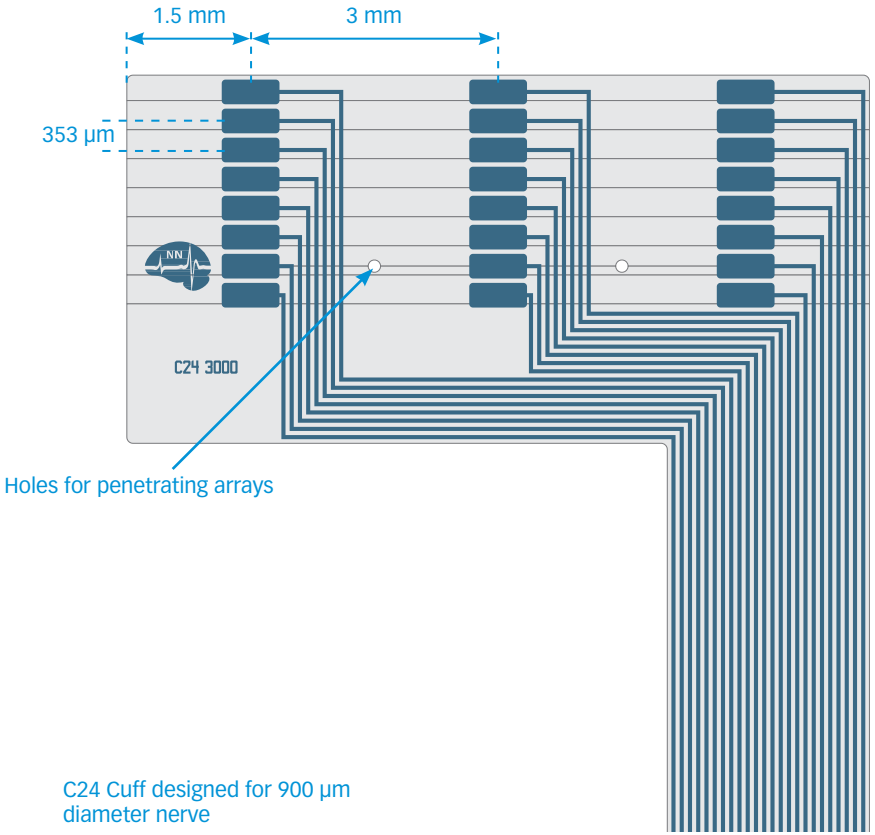


C3 Cuff designed for 350 µm
diameter nerve (customizable)

C24

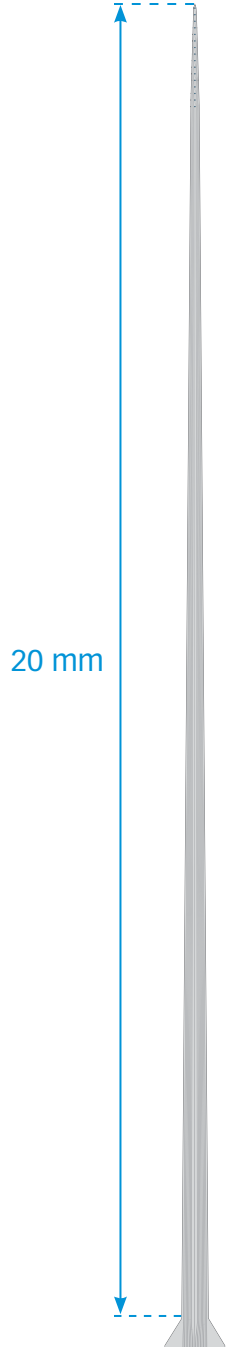


TIP DETAIL

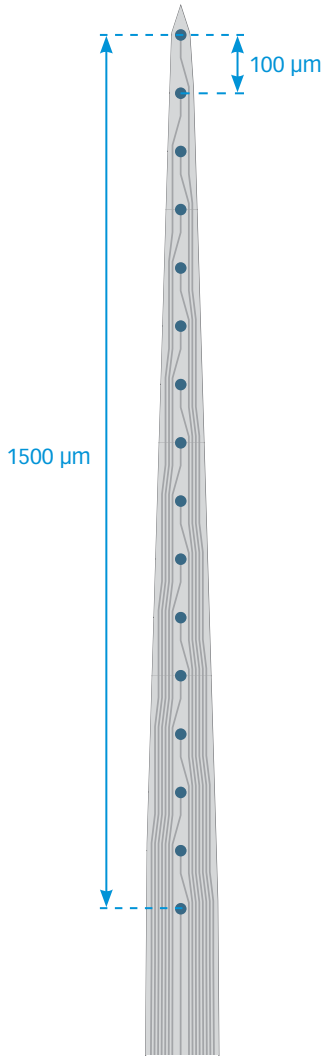


C24 Cuff designed for 900 µm diameter nerve

E16-20mm-100-177 (Drug Delivery Array)



TIP DETAIL

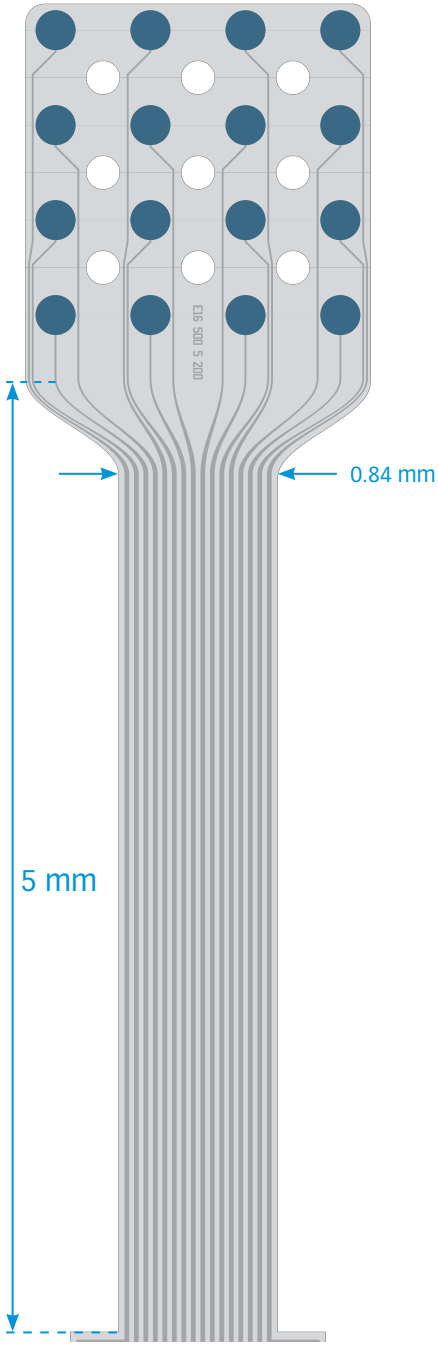


available packages

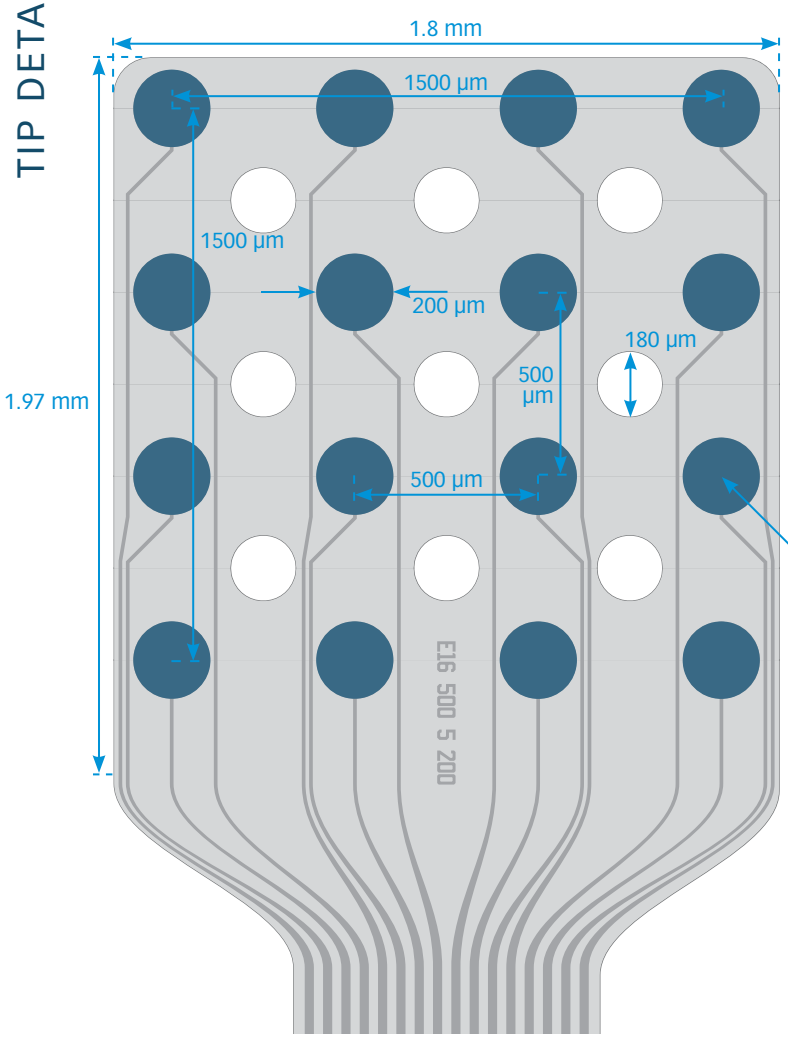
ACUTE
D16

CHRONIC
DM16

E16-500-5-200



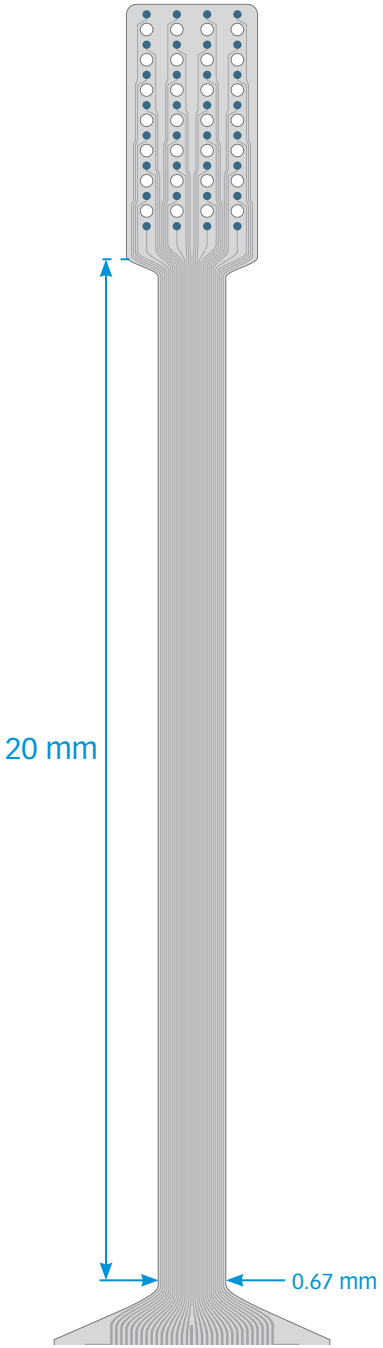
TIP DETAIL



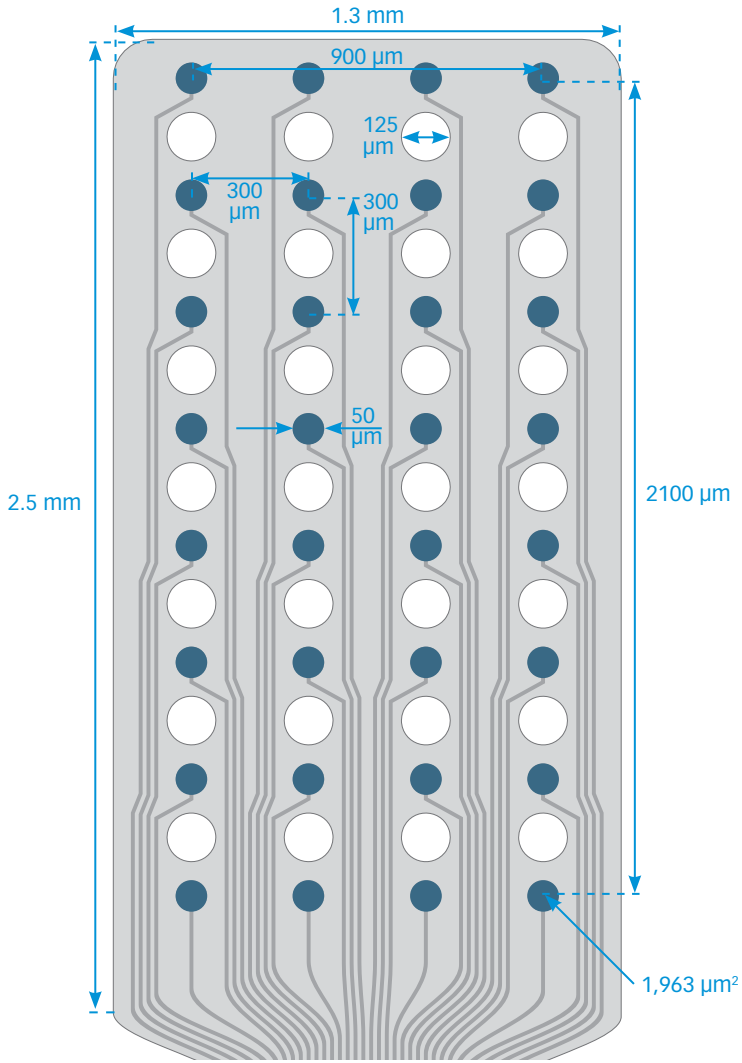
available packages

CHRONIC
H16
HC16
HZ16

E32-300-20-50



TIP DETAIL

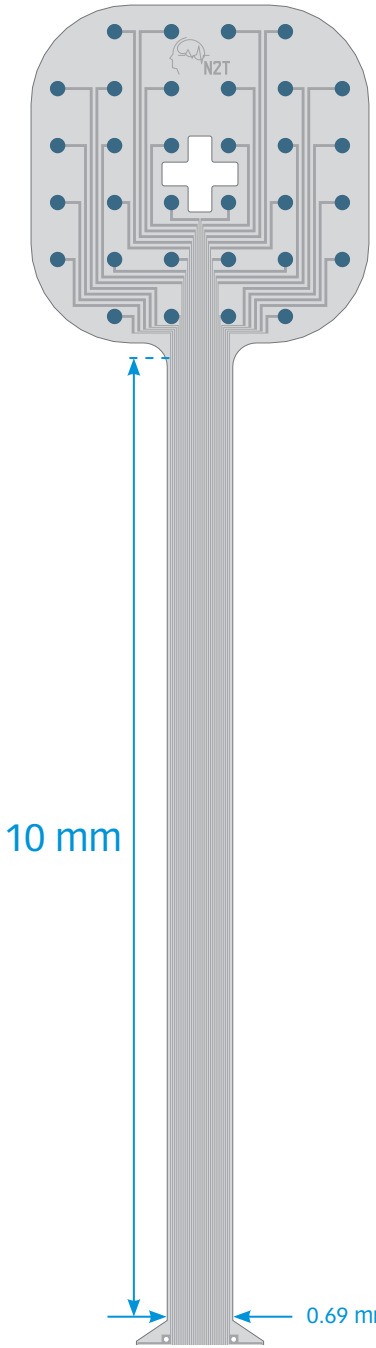


available packages

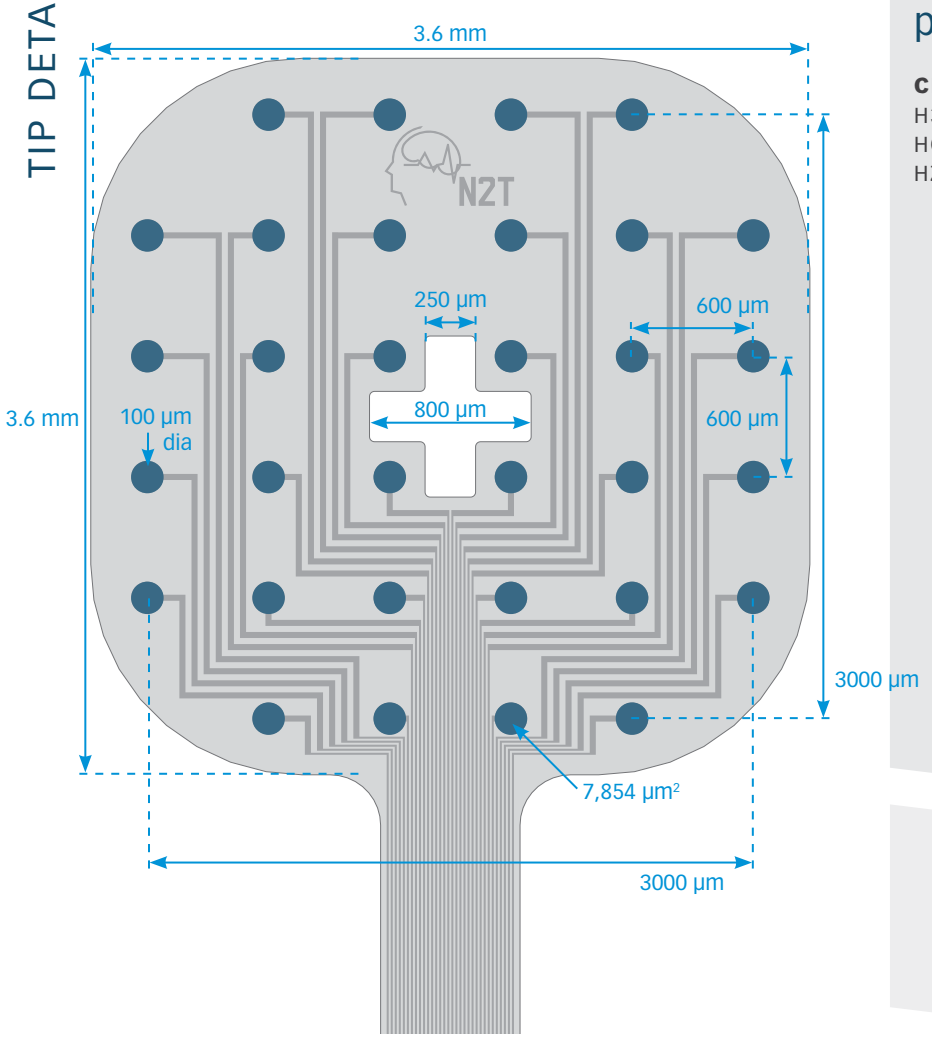
CHRONIC

H32
HC32
HZ32

E32-600-10-100



TIP DETAIL

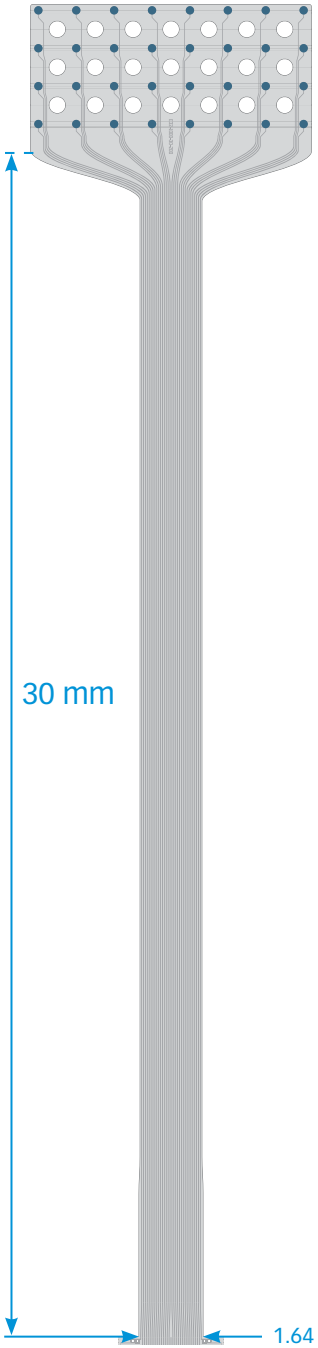


available packages

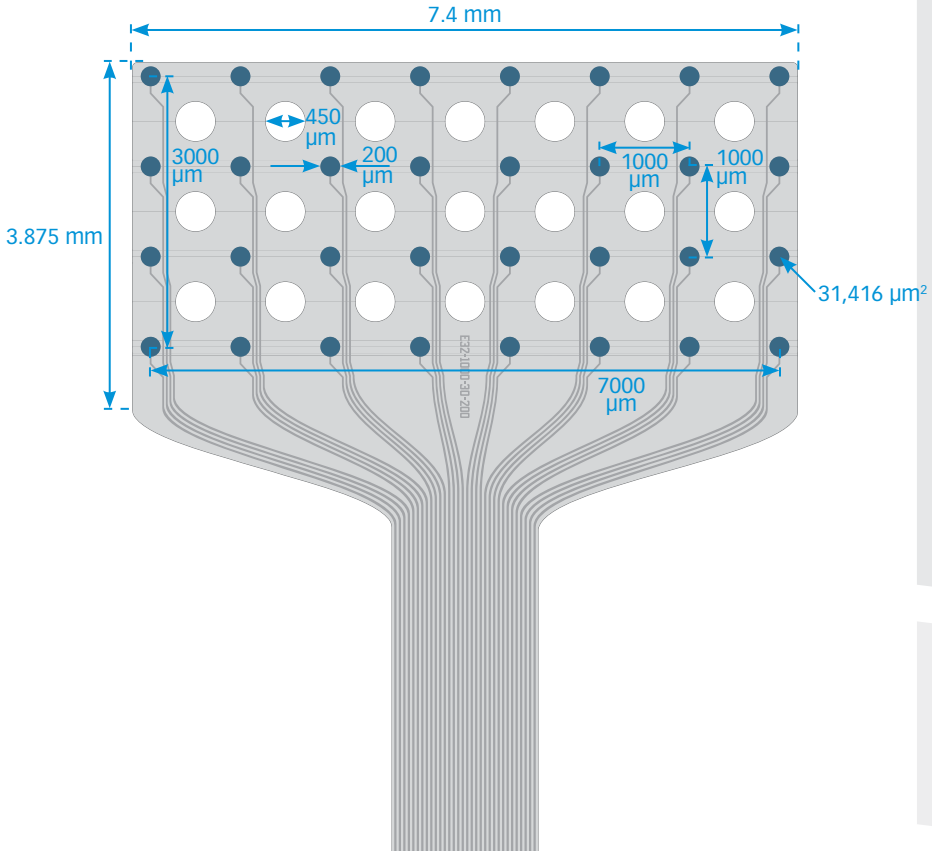
CHRONIC

H32
HC32
HZ32

E32-1000-30-200



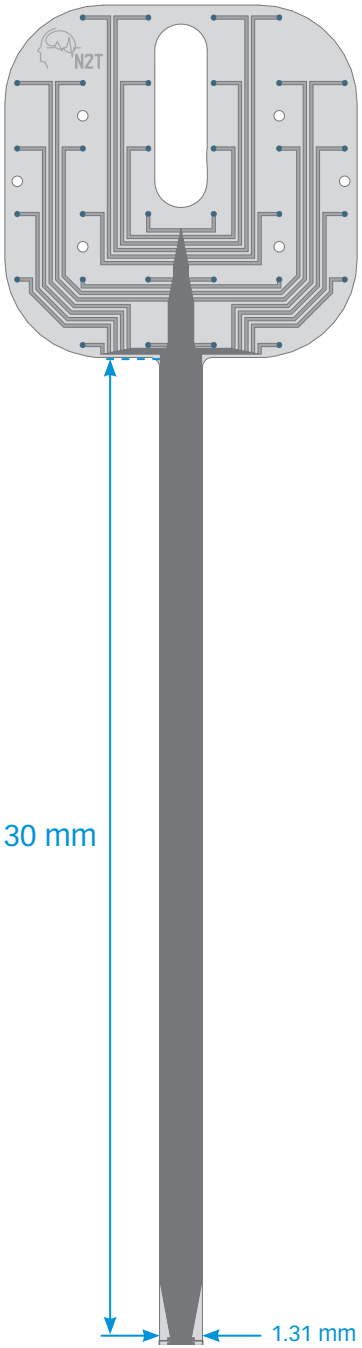
TIP DETAIL



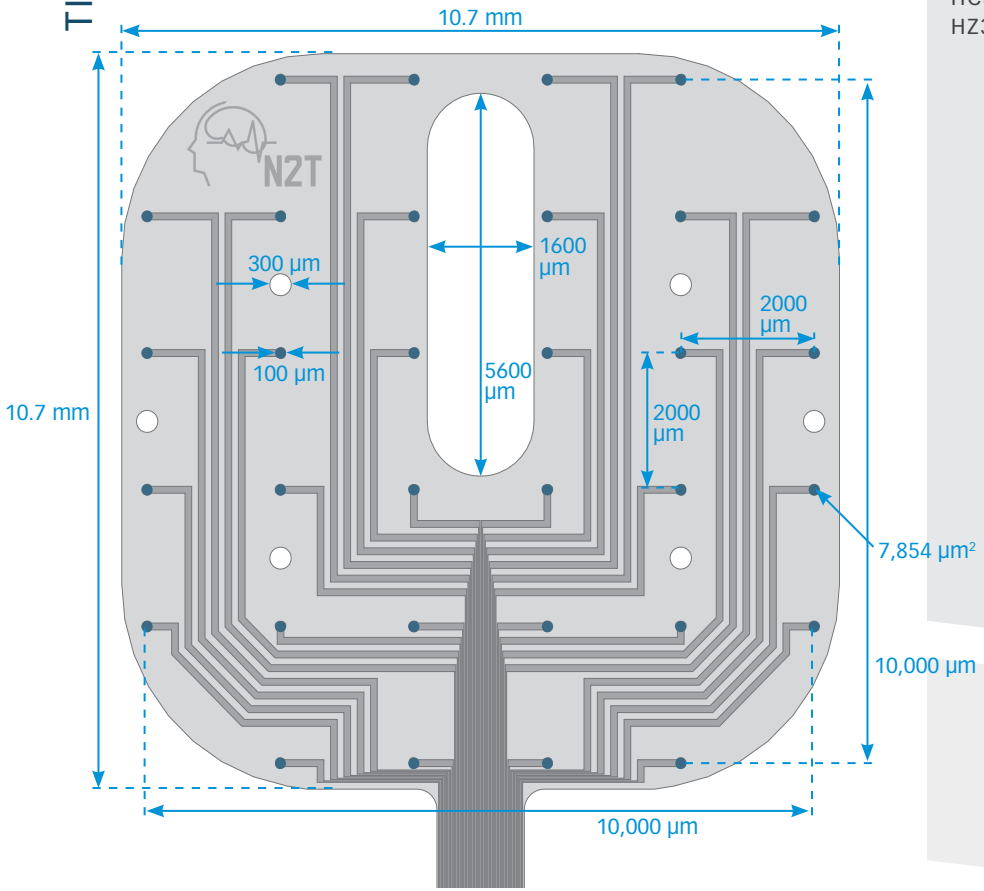
available packages

CHRONIC
H32
HC32
HZ32

E32-2000-30-100



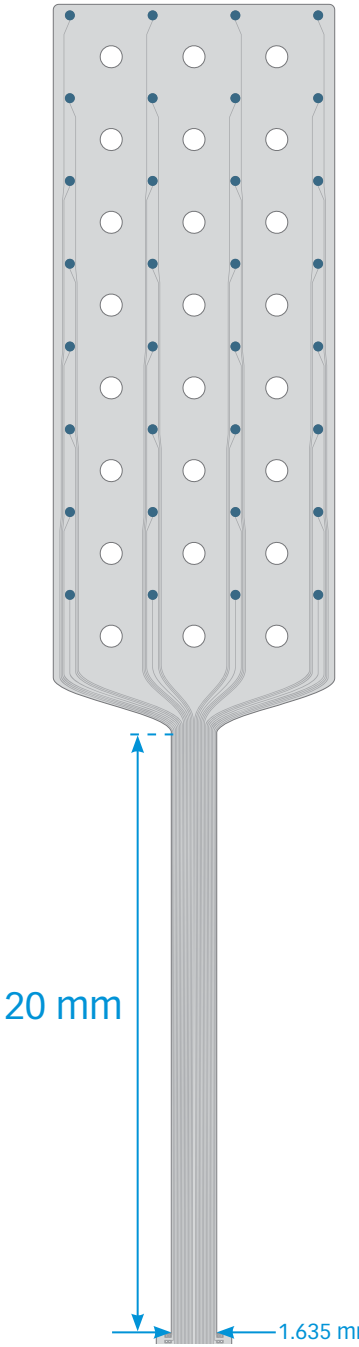
TIP DETAIL



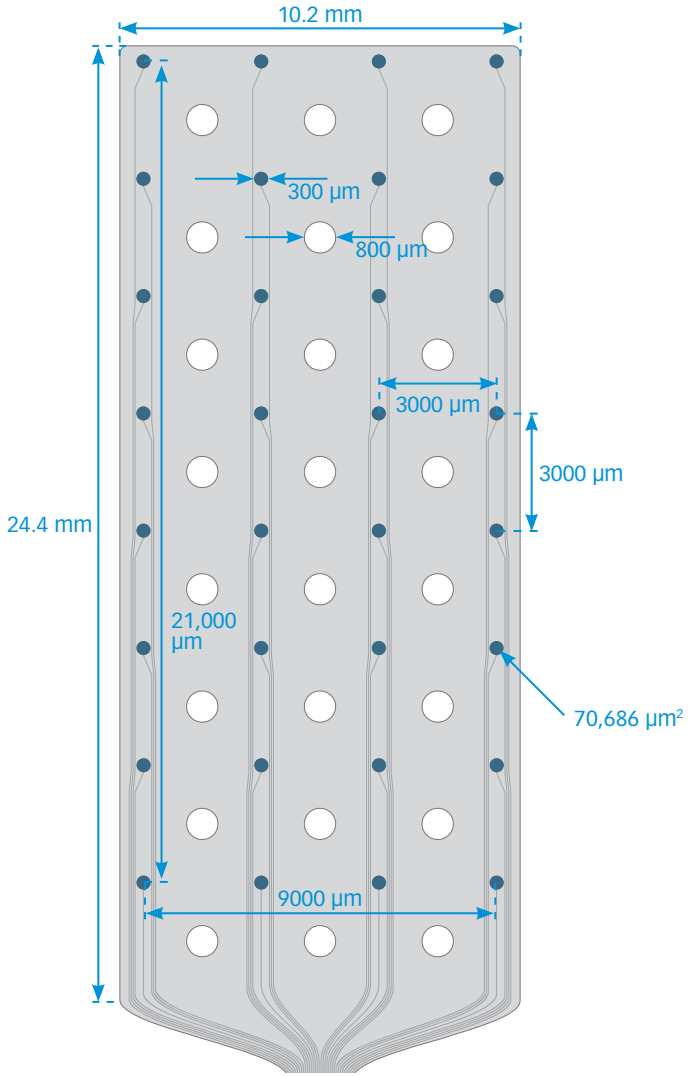
available packages

CHRONIC
H32
HC32
HZ32

E32-3000-20-300



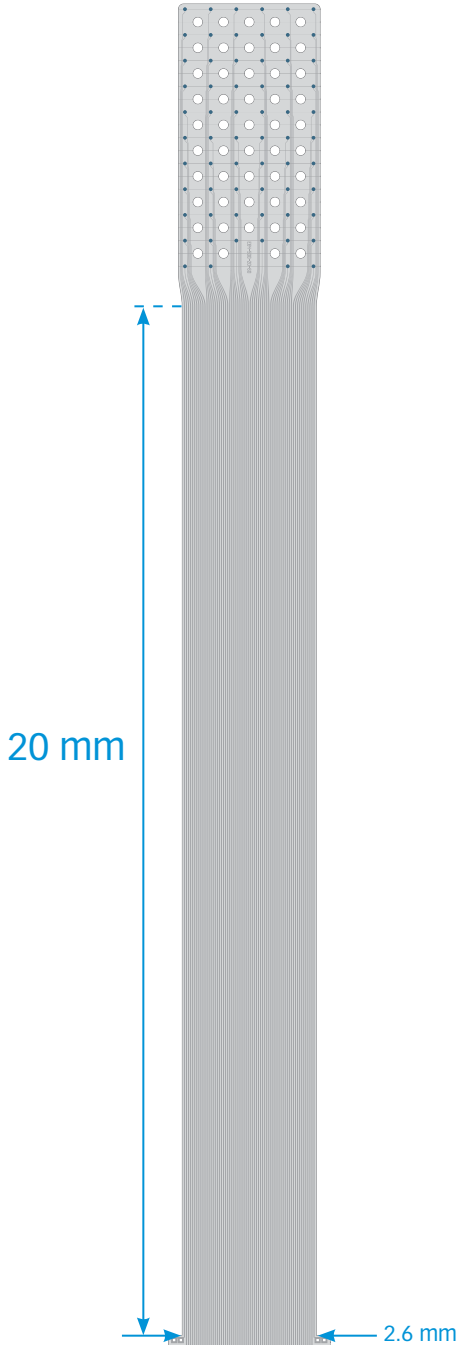
TIP DETAIL



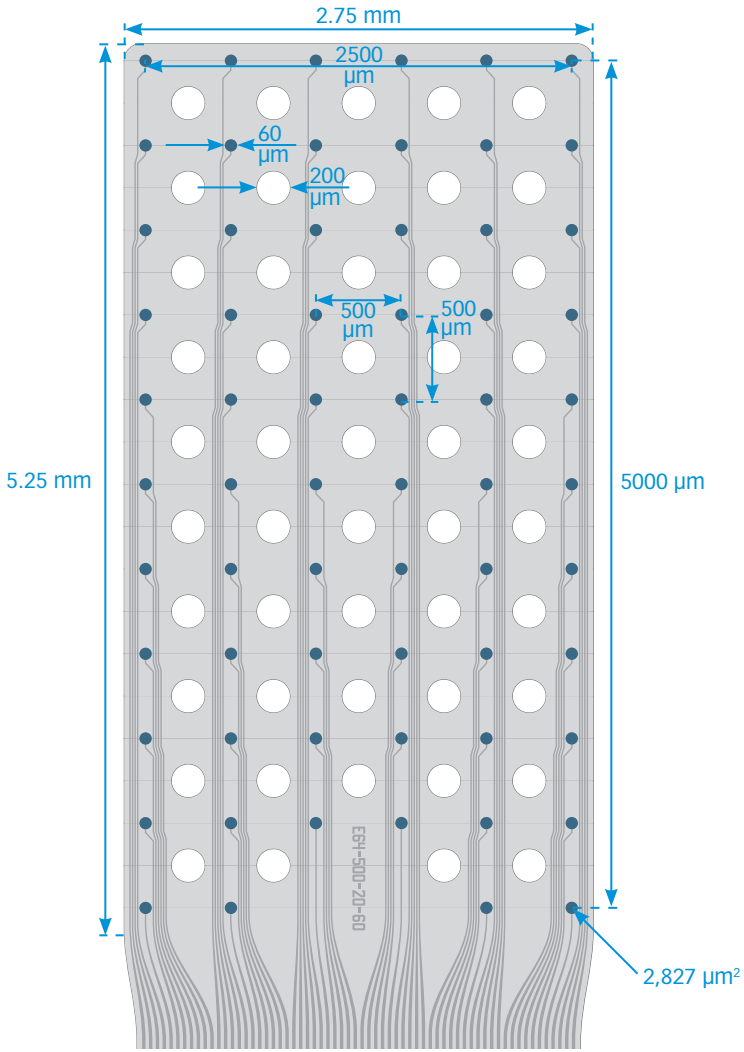
available packages

CHRONIC
H32
HC32
HZ32

E64-500-20-60



TIP DETAIL

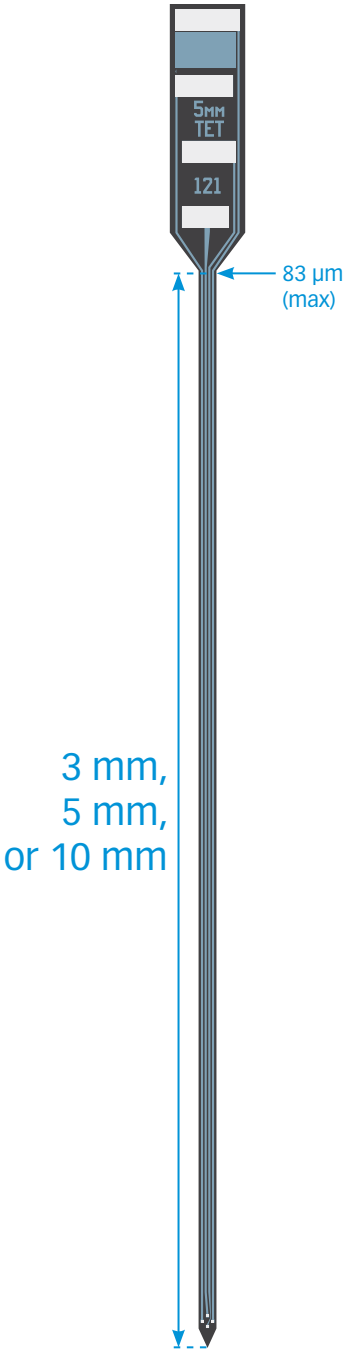


available packages

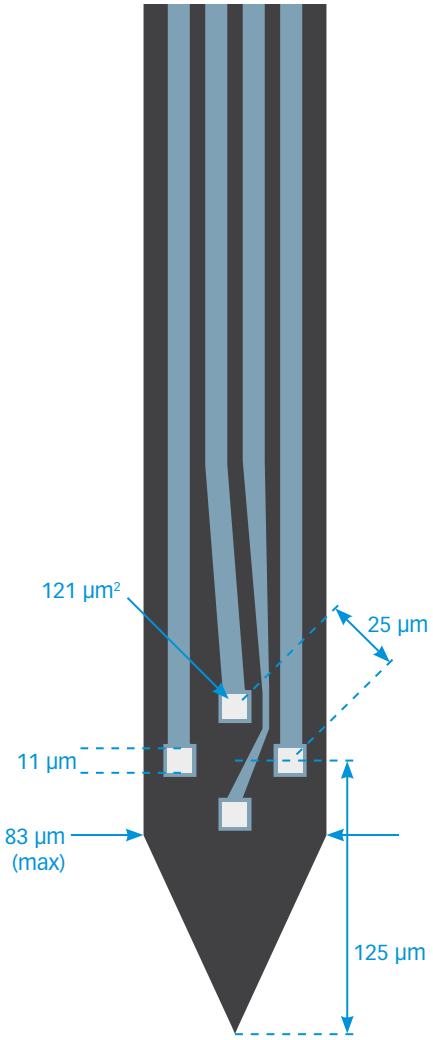
CHRONIC

H64
H64LP
HC64
HZ64

Q1x1-tet-3mm-121
Q1x1-tet-5mm-121
Q1x1-tet-10mm-121



TIP DETAIL



available packages

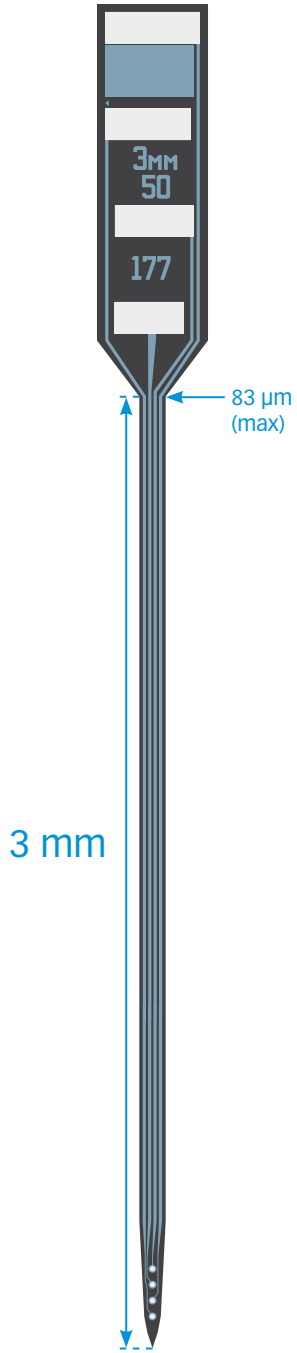
ACUTE
Q4

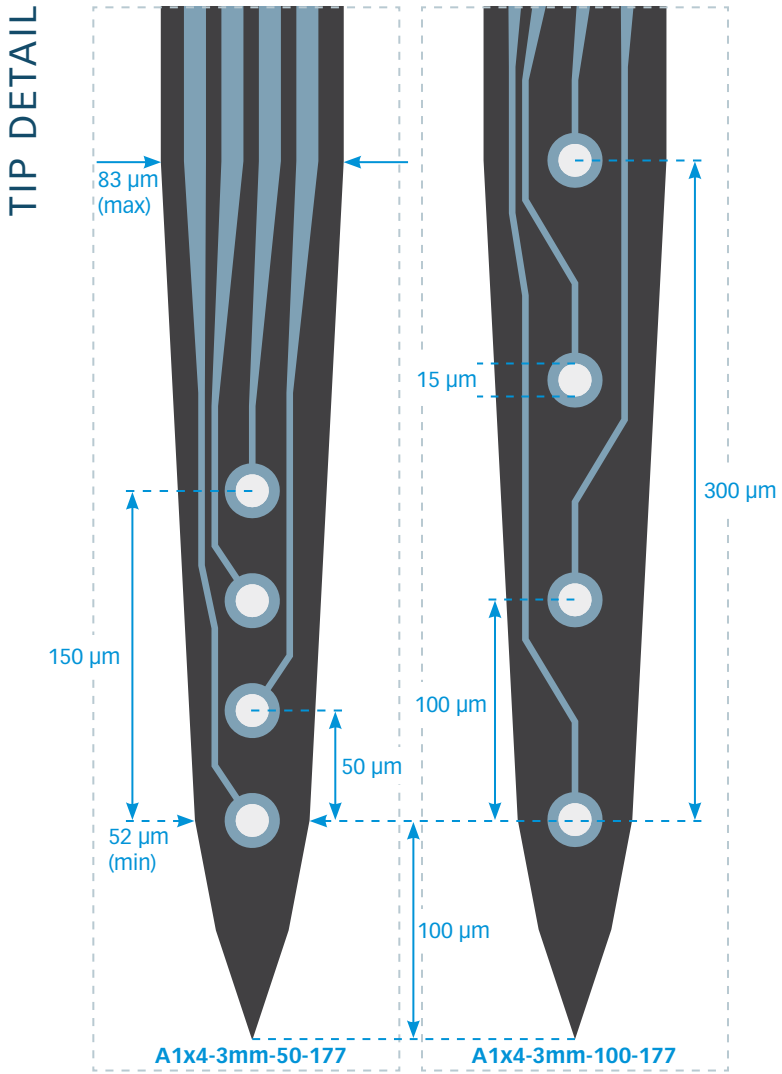
CHRONIC
CQ4
HQ4_21mm

thickness

15 µm (3 mm, 5 mm)
50 µm (3 mm, 5 mm, 10 mm)

Q1x4-3mm-50-177
Q1x4-3mm-100-177





available packages

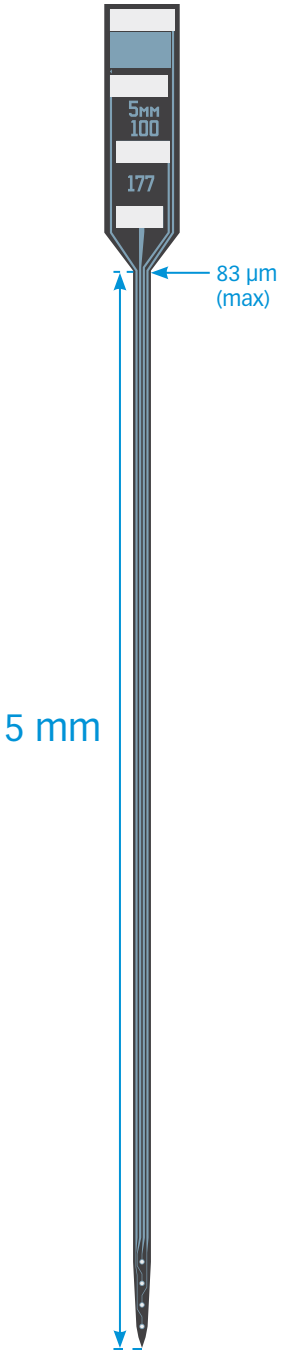
ACUTE
Q4

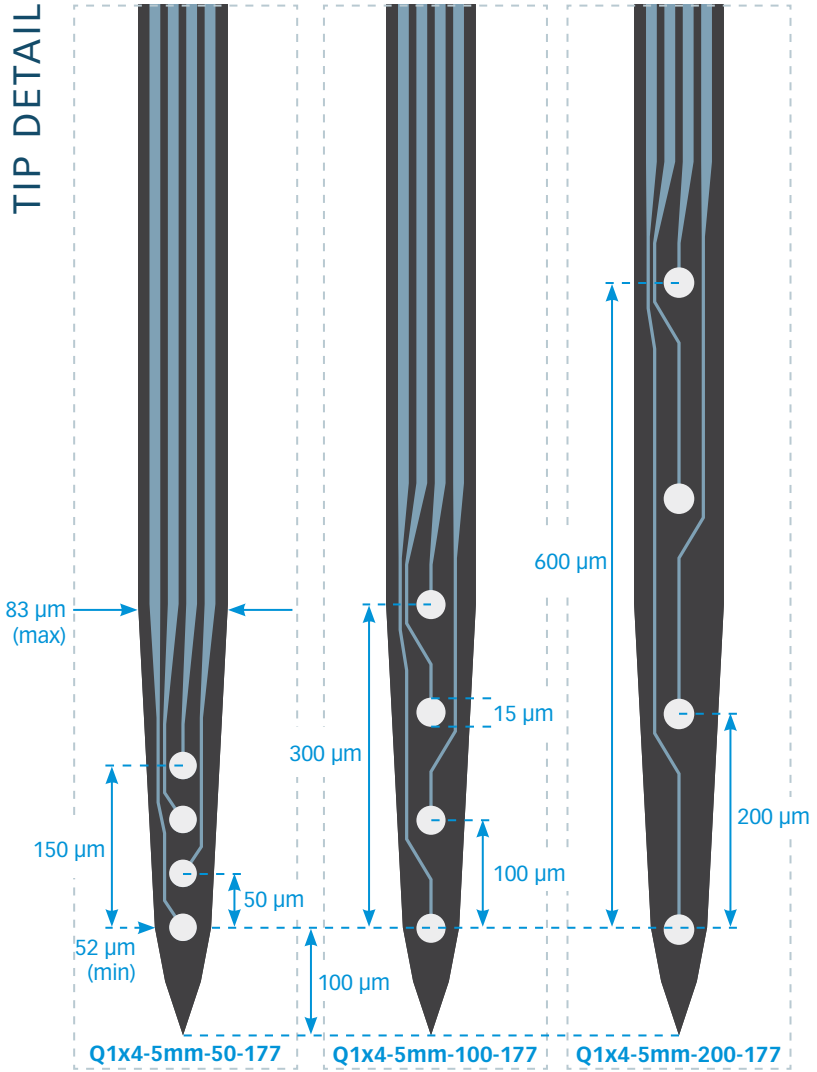
CHRONIC
CQ4
HQ4_21mm

thickness

15 µm
50 µm

Q1x4-5mm-50-177
Q1x4-5mm-100-177
Q1x4-5mm-200-177





available packages

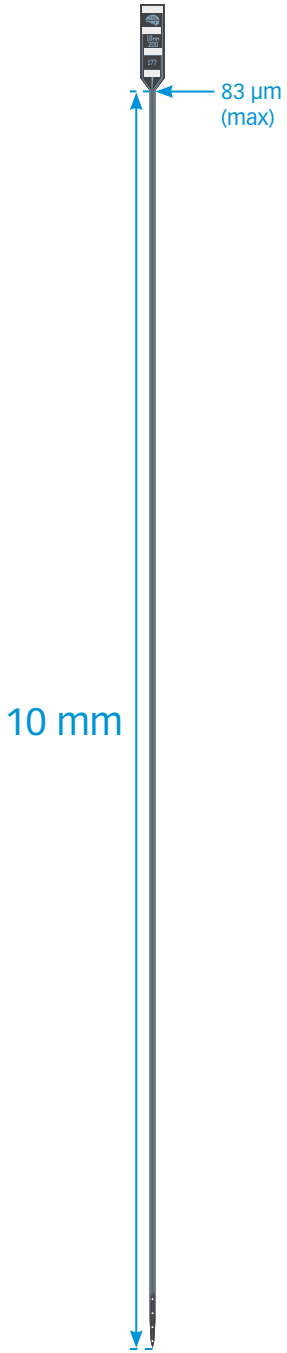
ACUTE
Q4

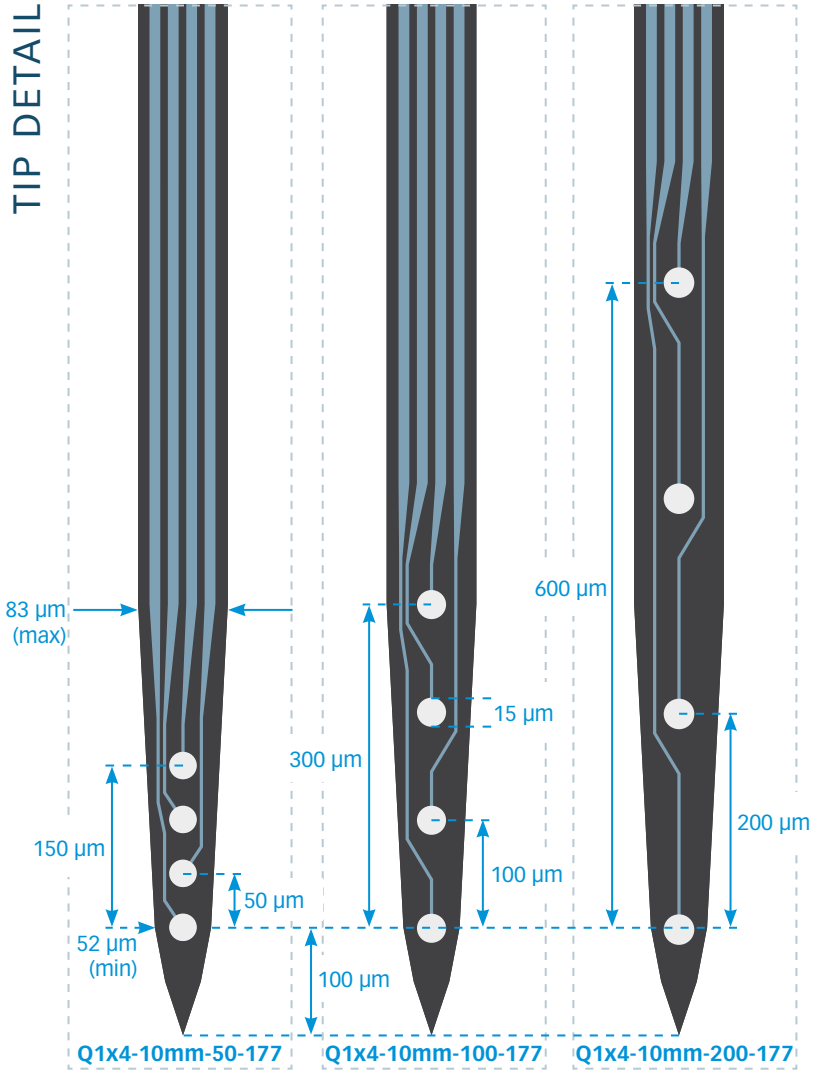
CHRONIC
CQ4
HQ4_21mm

thickness

15 µm
50 µm

Q1x4-10mm-50-177
Q1x4-10mm-100-177
Q1x4-10mm-200-177





available packages

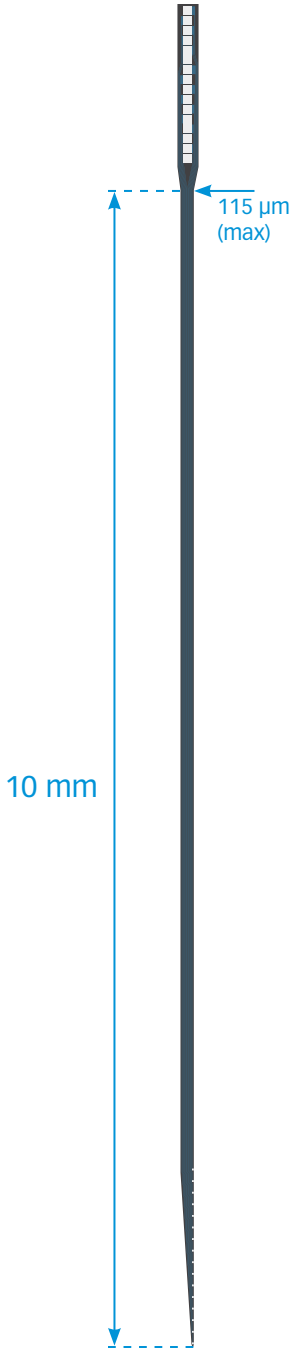
ACUTE
Q4

CHRONIC
CQ4
HQ4_21mm

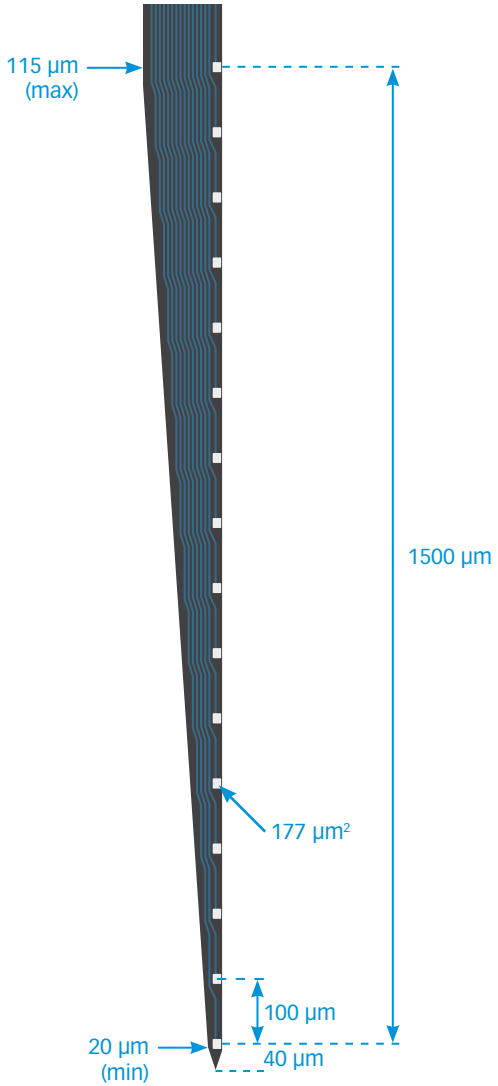
thickness

50 µm

V1x16-Edge-10mm-100-177



TIP DETAIL



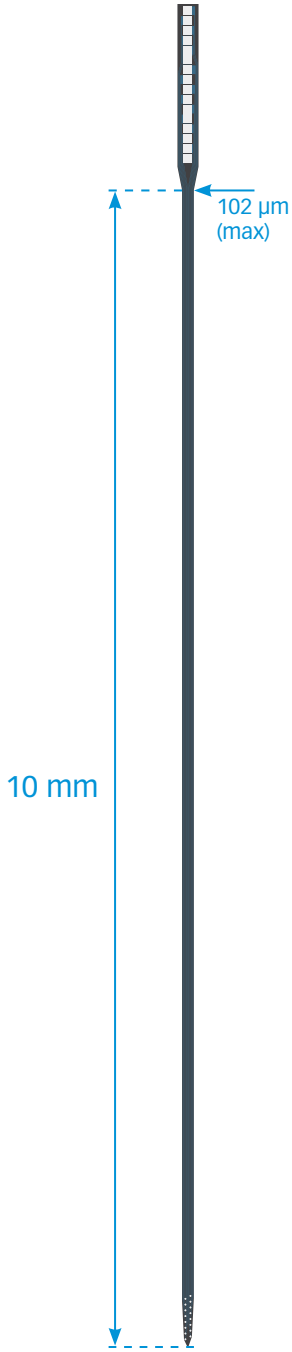
available packages

ACUTE
H16

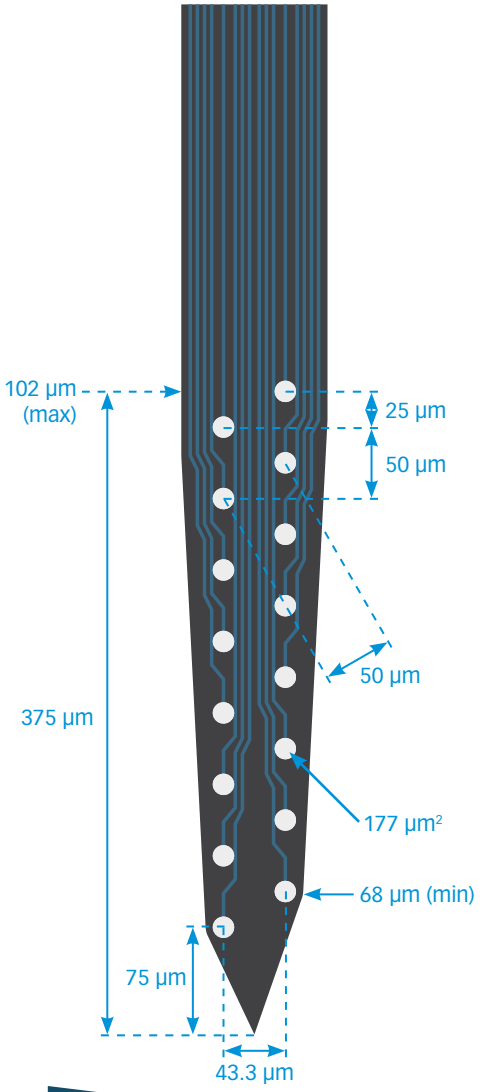
thickness

50 µm

V1x16-Poly2-10mm-50s-177



TIP DETAIL



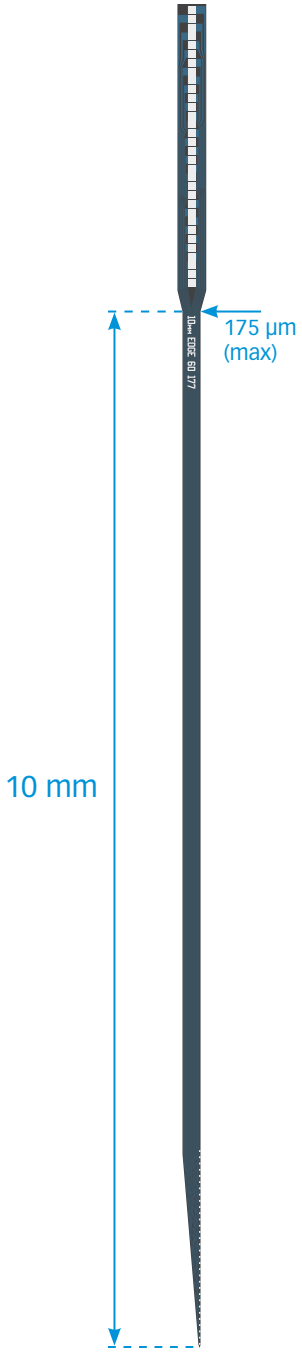
available packages

ACUTE
H16

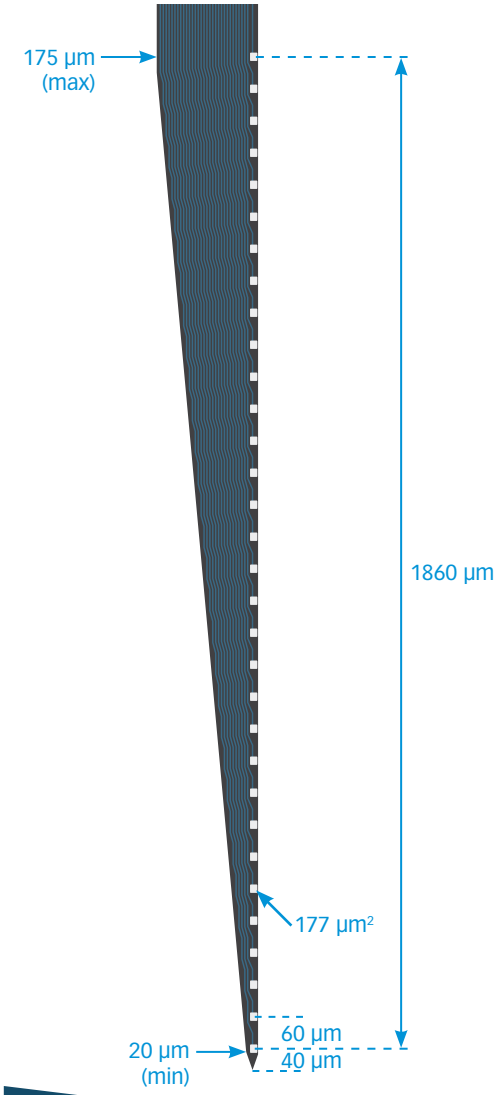
thickness

50 µm

V1x32-Edge-10mm-60-177



TIP DETAIL



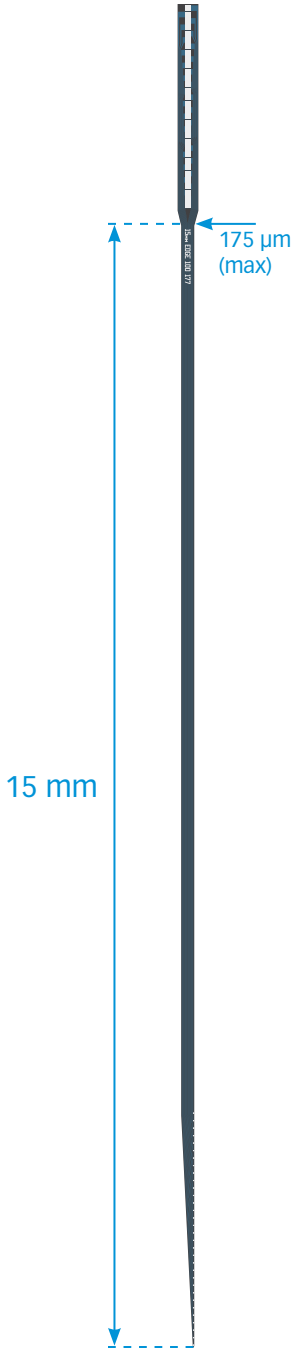
available packages

ACUTE
H32

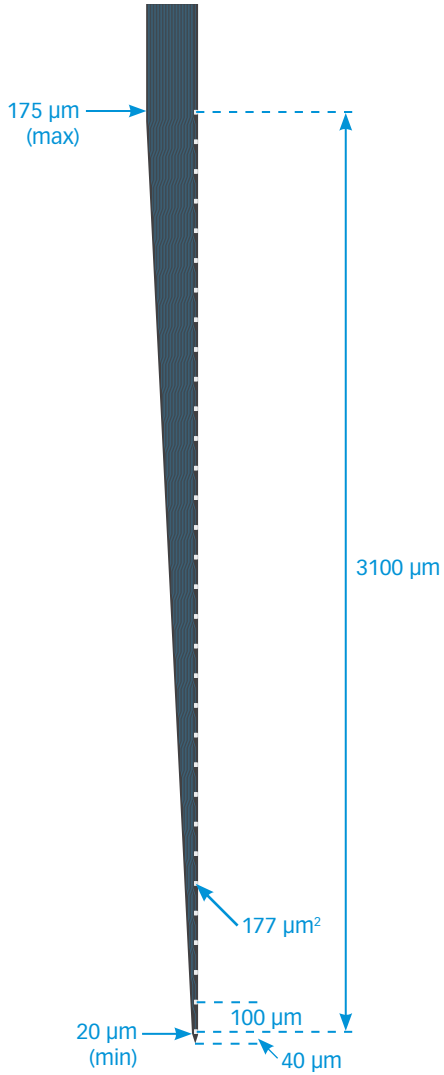
thickness

50 µm

V1x32-Edge-15mm-100-177



TIP DETAIL



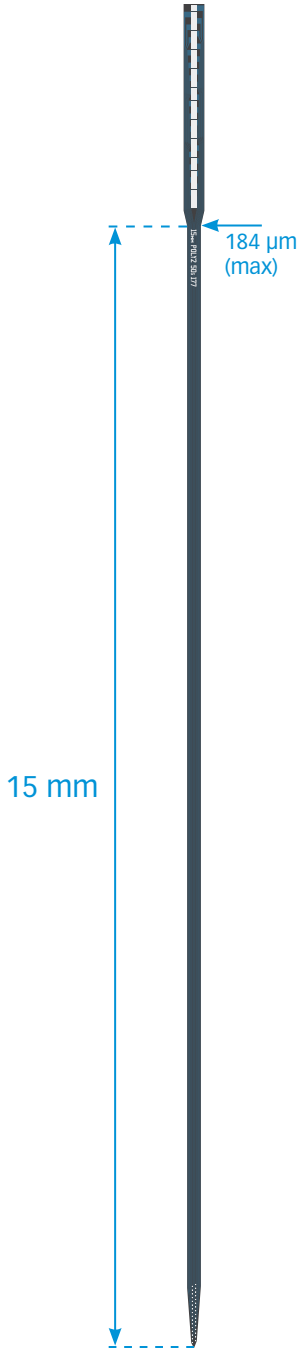
available packages

ACUTE
H32

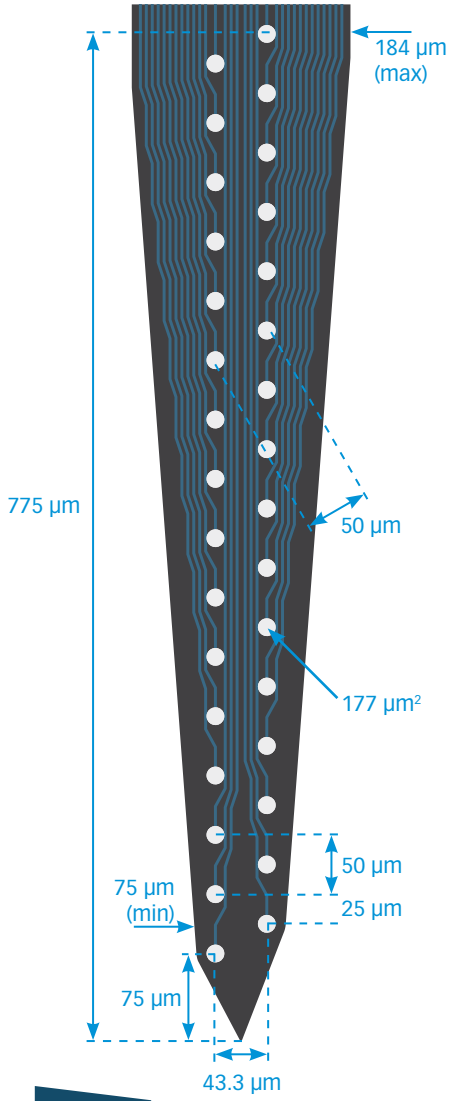
thickness

50 µm

V1x32-Poly2-15mm-50s-177



TIP DETAIL



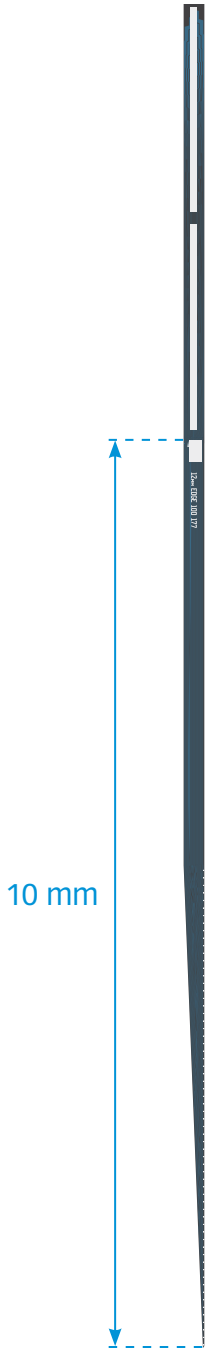
available packages

ACUTE
H32

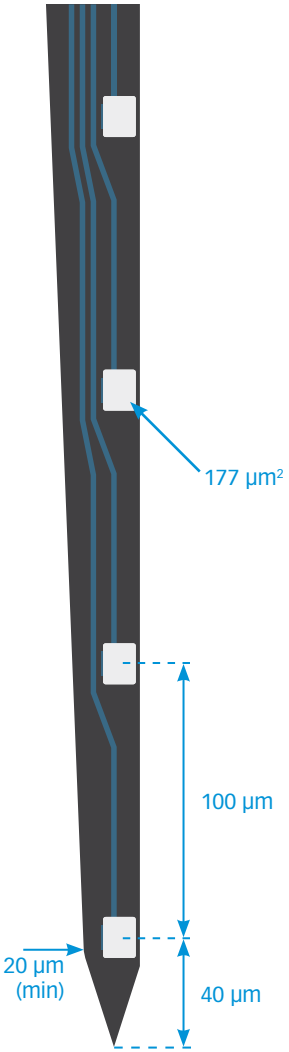
thickness

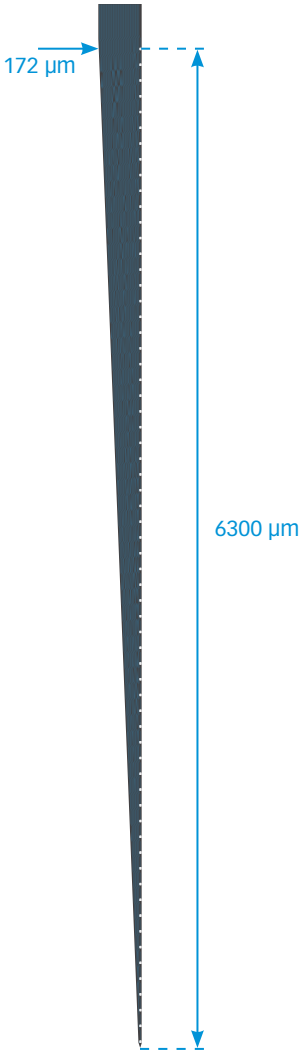
50 µm

V1x64-Edge-10mm-100-177



TIP DETAIL





available packages

ACUTE
H64

thickness

50 µm

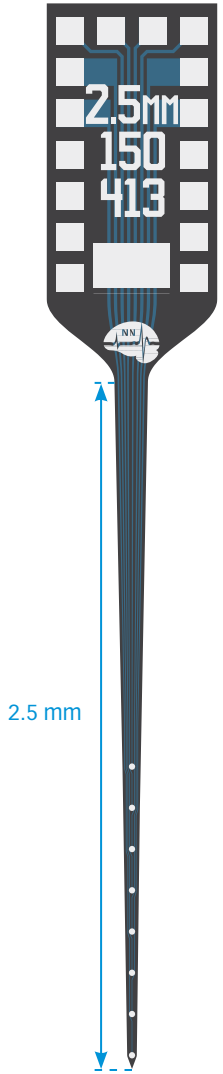
Special Order

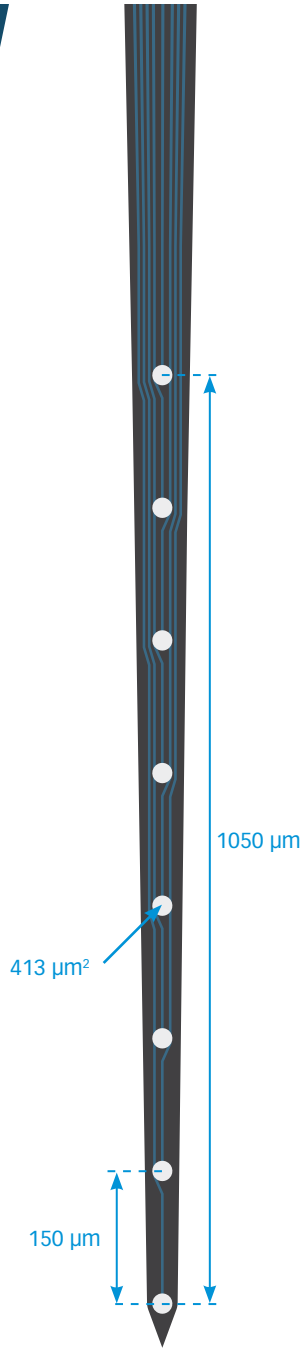
The list below is a library of unique designs that can be placed on special order. (Selected designs are detailed on the following pages.) Special orders are subject to availability and may require a minimum order quantity. Please be advised that out-of-stock designs may take a longer time for delivery. Standard designs with alternative site areas (such as 312, 413, and 703 μm^2) and thickness options may also be placed on special order.

For further details, contact a NeuroNexus sales representative.

- A1x4-tet-1.6mm-150-121
- A1x5-1.68mm-200-500-177
- A1x8-4mm-200-1250
- A1x16-3mm-100-413
- A1x16-3mm-50-413
- A1x16-5mm-100-413
- A1x16-5mm-150-413
- A1x16-5mm-50-413
- A1x16-Poly2-5mm-50-177
- A1x16-10mm-100-413
- A1x16-10mm-100-703-Pt
- A1x16-Poly2-10mm-100-625
- A16x1-2mm-50-413
- A16x1-2mm-50-703
- A16x1-2mm-100-413
- A16x1-2mm-100-703
- A1x32-Edge-5mm-100-413
- A1x32-Edge-5mm-100-703
- A1x32-6mm-100-413
- A1x32-6mm-100-703
- A1x32-6mm-50-413
- A1x32-6mm-50-703
- A1x32-6mm-50-95
- A1x32-7mm-100-1250
- A1x32-10mm-100-413
- A1x32-10mm-100-703
- A1x32-10mm-50-413
- A1x32-10mm-50-703
- A1x32-Edge-10mm-100-413
- A1x32-Edge-10mm-100-703
- A1x32-Poly3-10mm-25s-177
- A1x32-Poly3-10mm-50-413
- A1x32-12mm-dia-413
- A1x32-15mm-100-413
- A1x32-15mm-100-703
- A1x32-15mm-50-413
- A1x32-15mm-50-703
- A1x64-Poly2-6mm-235-160
- A2x2-tet-3mm-150-150-312
- A2x8-11mm-125-200-177
- A2x16-10mm-100-500-413
- A2x16-10mm-100-500-703
- A2x16-10mm-50-500-413
- A2x16-10mm-50-500-703
- A2x32-6mm-235-160
- A4x1-tet-3mm-150-312
- A2x32-Poly5-10mm-20s-200-100
- A4x2-tet-5mm-150-200-312
- A4x2-tet-5mm-500-400-312
- A4x2tet-7mm-500-400-312
- A4x2tet-9mm-1500-170-121
- A4x4-3mm-50-125-413
- A4x4-3mm-50-125-703
- A4x4-3mm-100-125-413
- A4x4-3mm-200-200-177
- A4x8-10mm-200-200-177
- A4x8-10mm-200-200-703
- A4x8-10mm-200-500-413
- A4x8-4mm-200-400-1250
- A4x8-5mm-100-200-413
- A4x8-5mm-100-200-703
- A4x8-5mm-100-400-413
- A4x8-5mm-200-200-177
- A4x8-5mm-200-200-413
- A4x8-5mm-200-200-703
- A4x8-5mm-200-400-413
- A4x8-5mm-200-400-703
- A4x8-5mm-50-200-413
- A4x8-5mm-50-200-703
- A4x8-5mm-50-400-177
- A4x8-5mm-50-400-413
- A4x8-5mm-50-400-703
- A4x8-8mm-100-500-177
- A4x8-8mm-100-500-703
- A4x8-10mm-200-200-413
- A4x8-10mm-50-200-VAR
- A4x16-3.6/3mm-50-430-177
- A4x16-5mm-50-500-703
- A8x1tet-2mm-200-312
- A8x4-2mm-100-200-177
- A8x4-2mm-100-200-413
- A8x4-2mm-100-200-703
- A8x4-2mm-200-200-177
- A8x4-2mm-200-200-413
- A8x4-2mm-200-200-703
- A8x4-2mm-50-200-177
- A8x4-2mm-50-200-413
- A8x4-2mm-50-200-703
- A8x8-10mm-200-200-413
- A8x8-10mm-200-200-703
- A8x8-2.5mm-200-200-177
- A8x8-2.5mm-200-200-413
- A8x8-2.5mm-200-200-703
- A8x8-5mm-200-200-177
- A8x8-5mm-200-200-413
- A8x8-5mm-200-200-703
- A8x16-3mm-75-200-177
- Buzsaki32sp
- Buzsaki64sp
- Buzsaki256
- E1x21-27.8mm-250-1800
- E16-500-10-VAR
- E16-barrel-6-100
- E32-80s-15-15
- E32-1000-20-50/100
- LFP8-TetrodeSD
- Isomura2
- Isomura32
- rDBSA

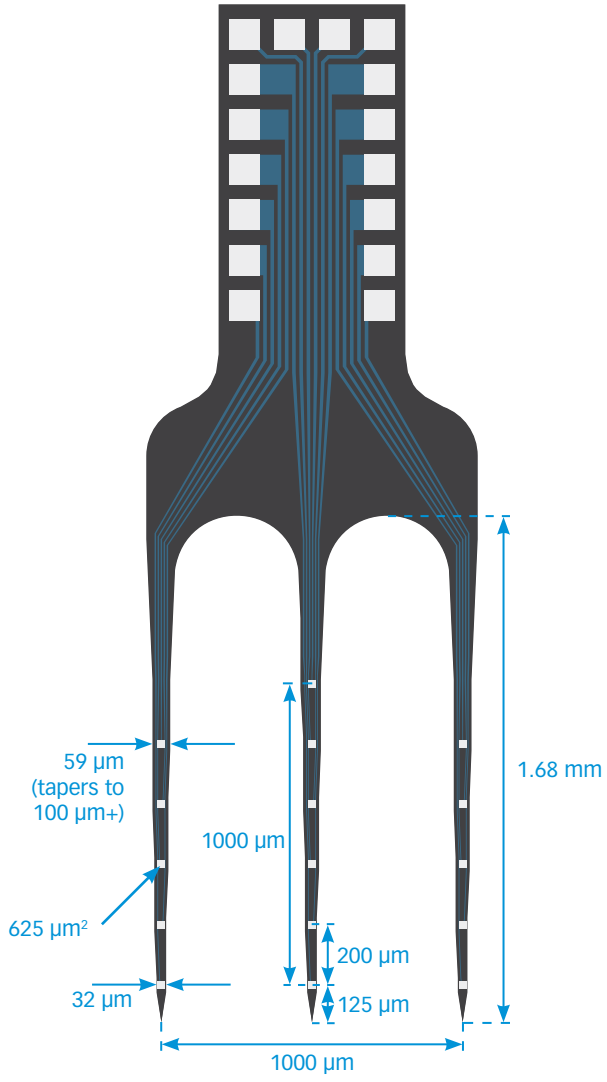
A1x8-2.5mm-150-413



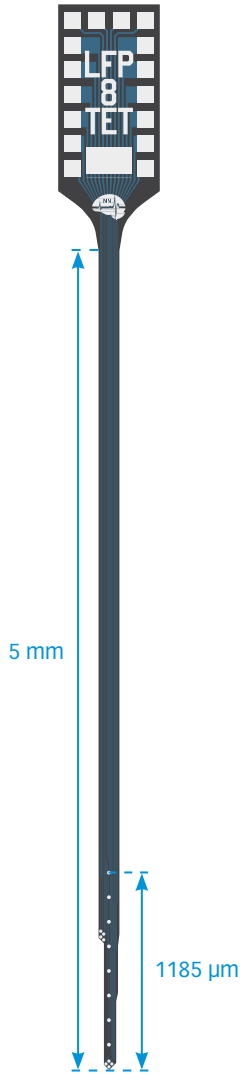


A3x5-1.68mm-200-500-177

NOTE: Sharp tip angle (18°)



LFP8-TetrodeSD

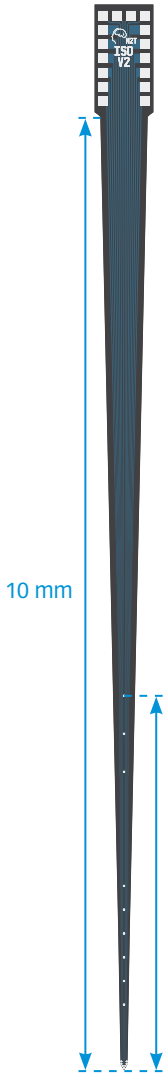


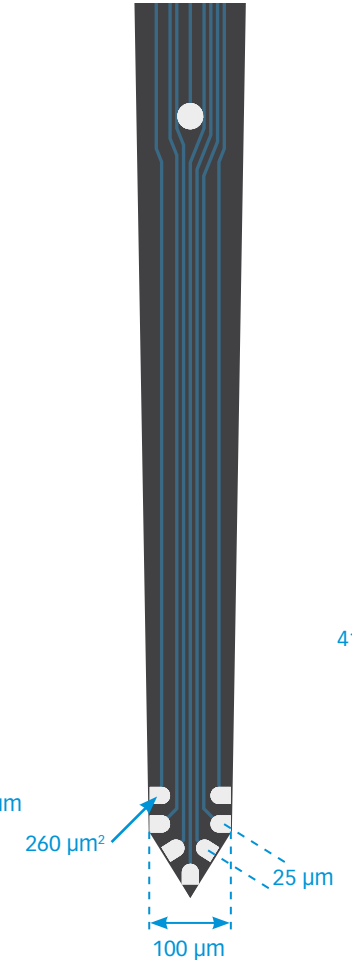
Tetrode Site Area:
312 µm²

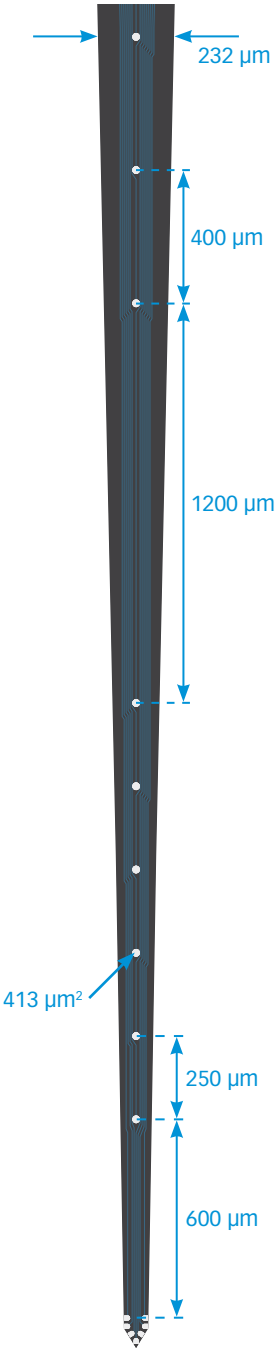
Tetrode Spacing:
25 µm

Other Site Area:
413 µm²

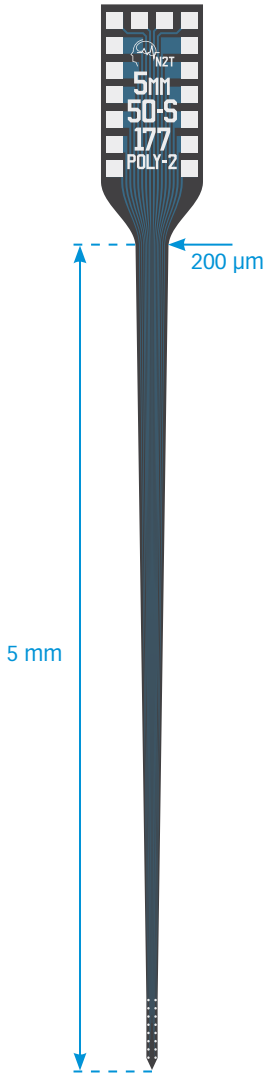
Isomura2

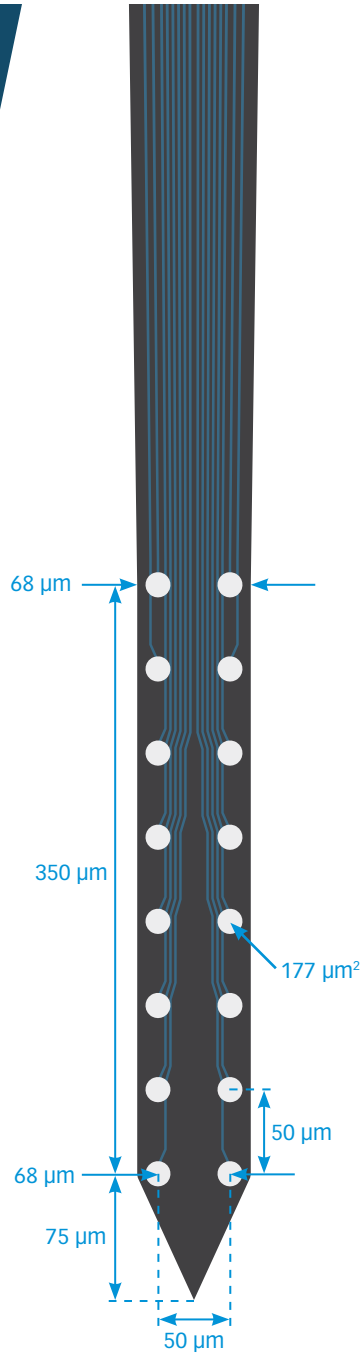






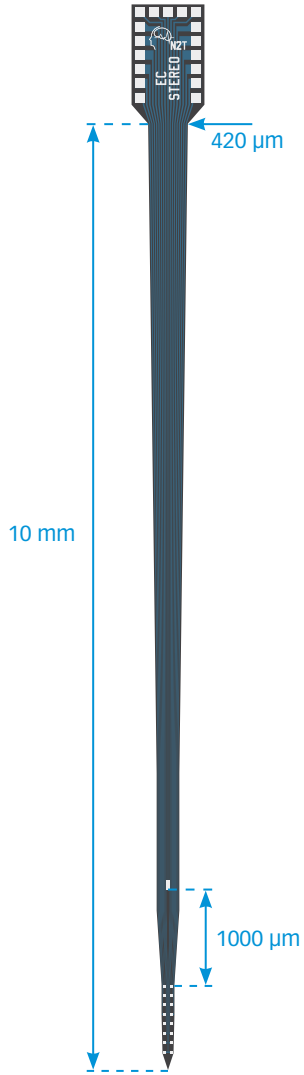
A1x16-Poly2-5mm-50-STD-177

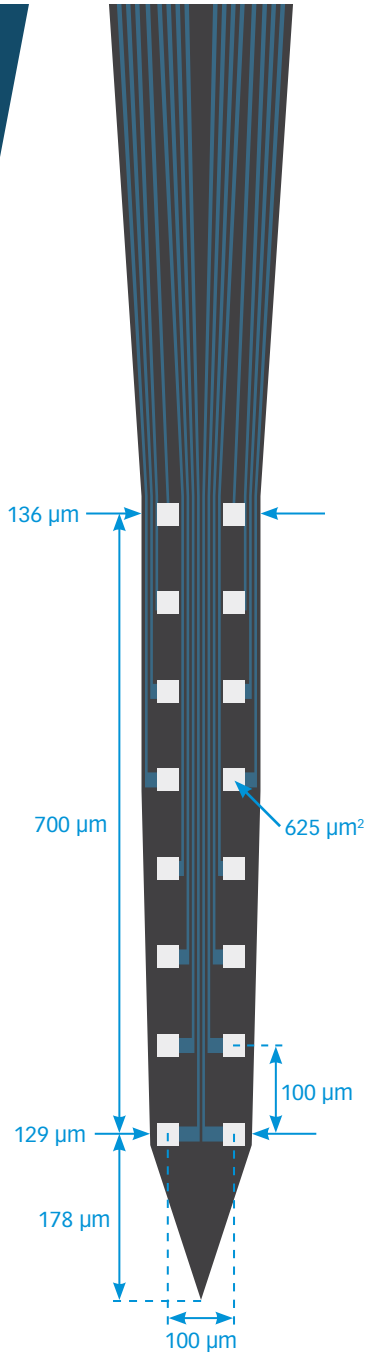




A1x16-Poly2-10mm-100-625

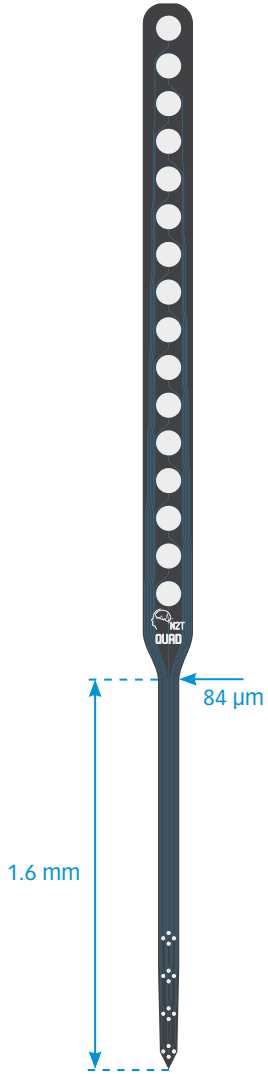
NOTE: Pt site configuration may be available for electrochemical studies

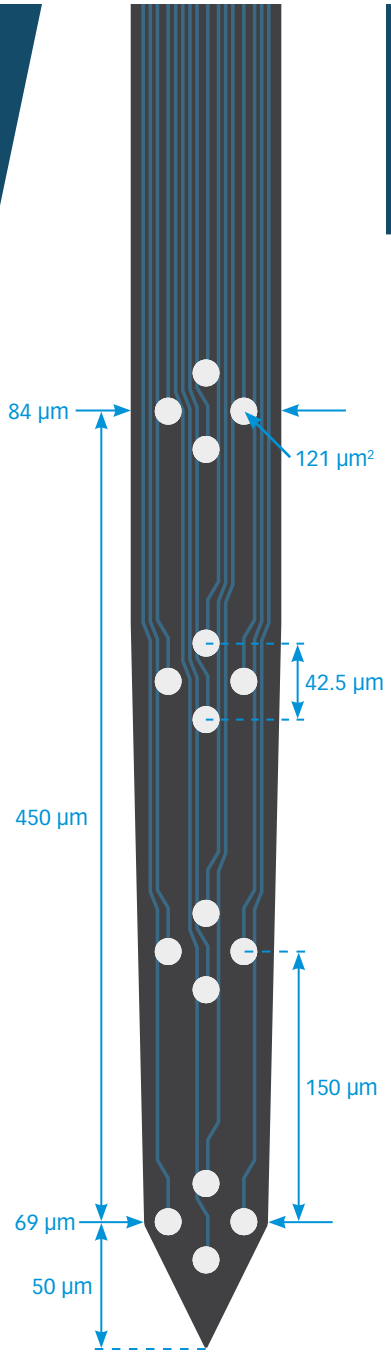




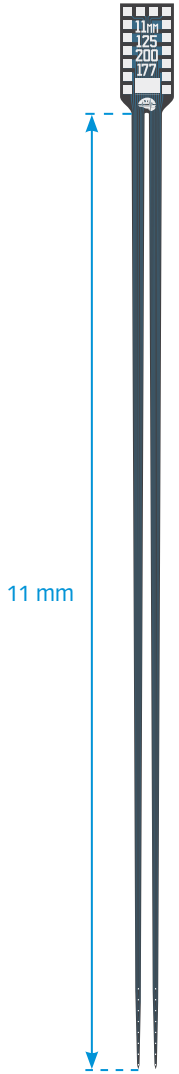
A1x4-tet-1.6mm-150-121

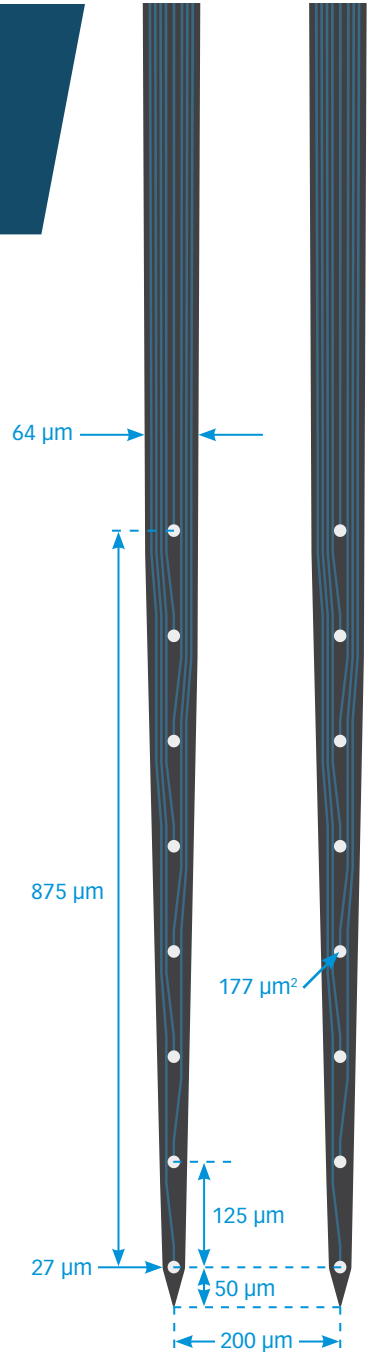
NOTE: Designed to interface with wire-based tetrode drives. Also available in a 3-tetrode configuration.



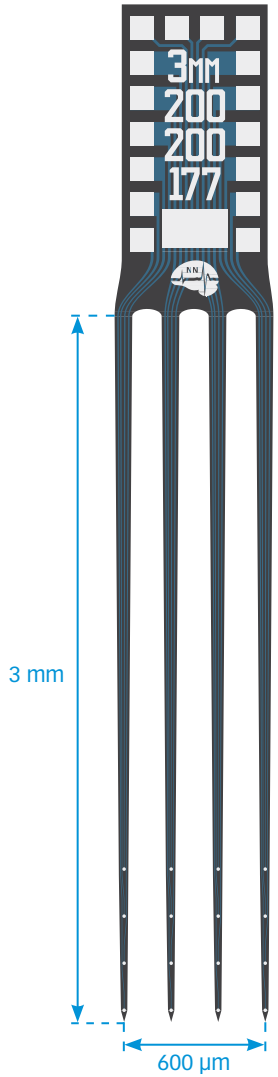


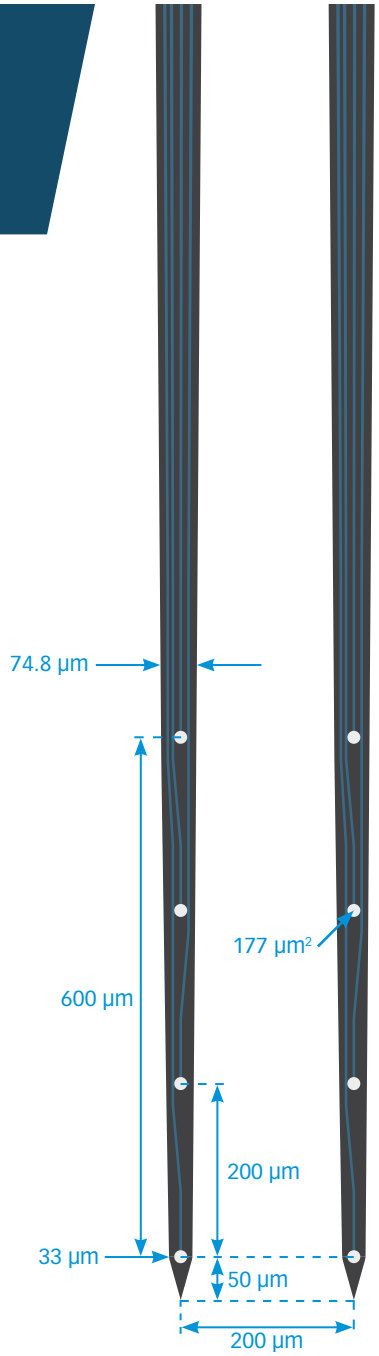
A2x8-11mm-125-200-177



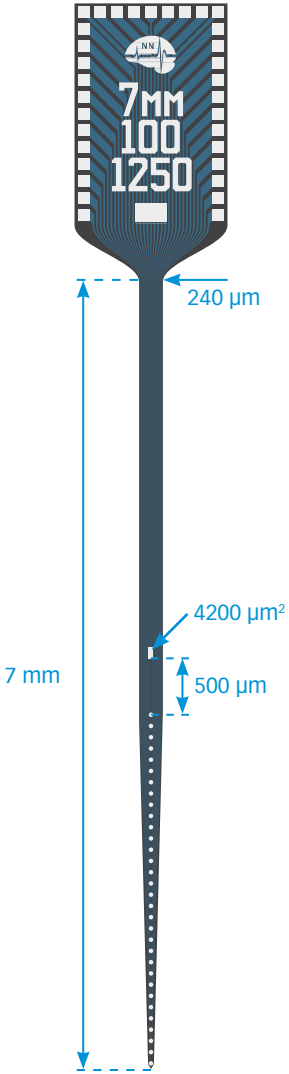


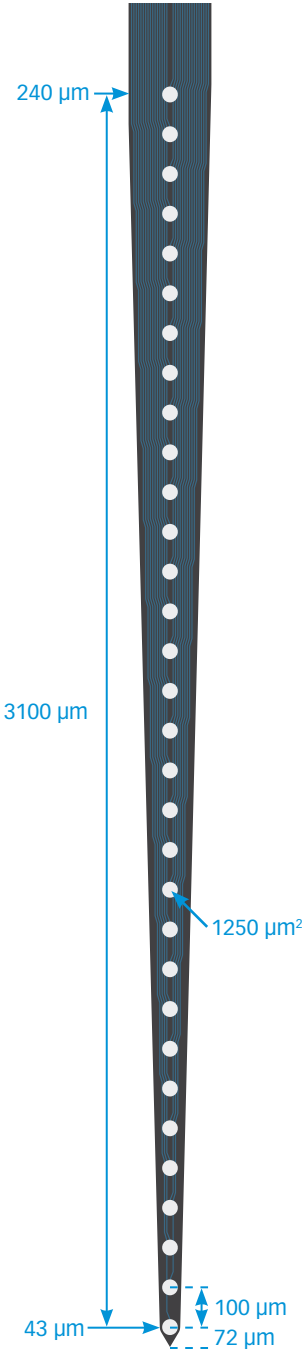
A4x4-3mm-200-200-177



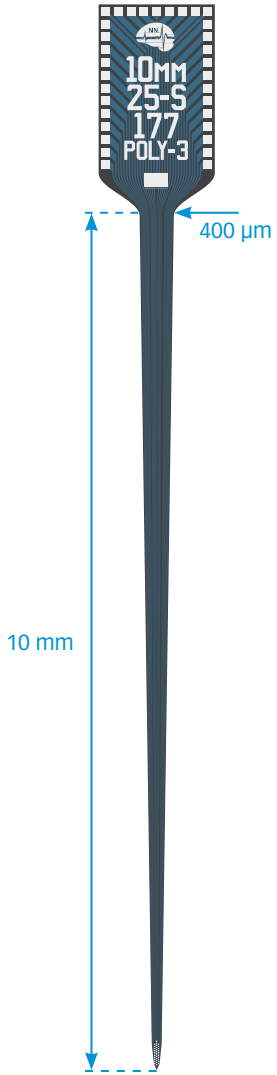


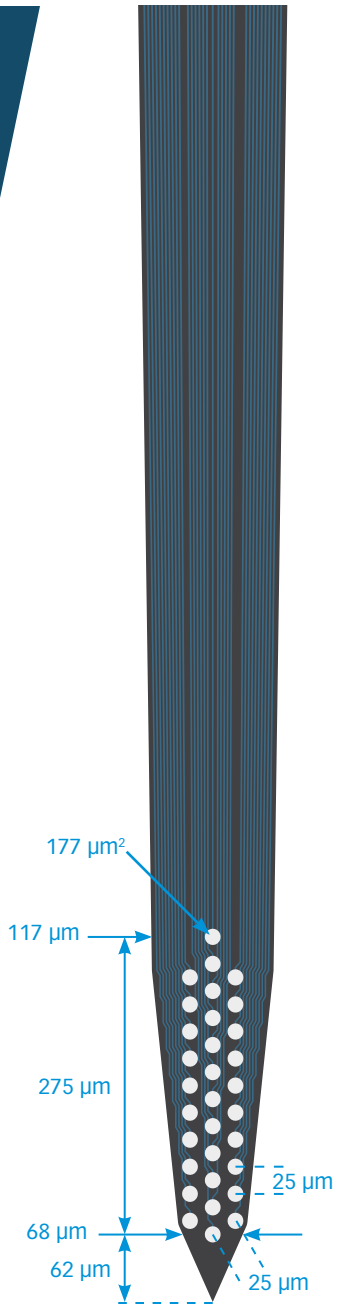
A1x32-7mm-100-1250



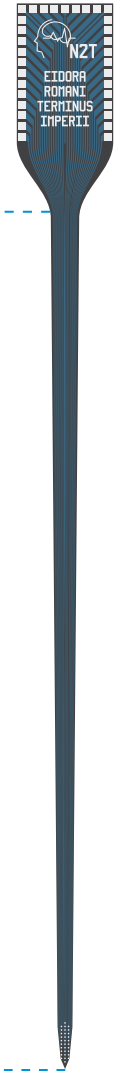


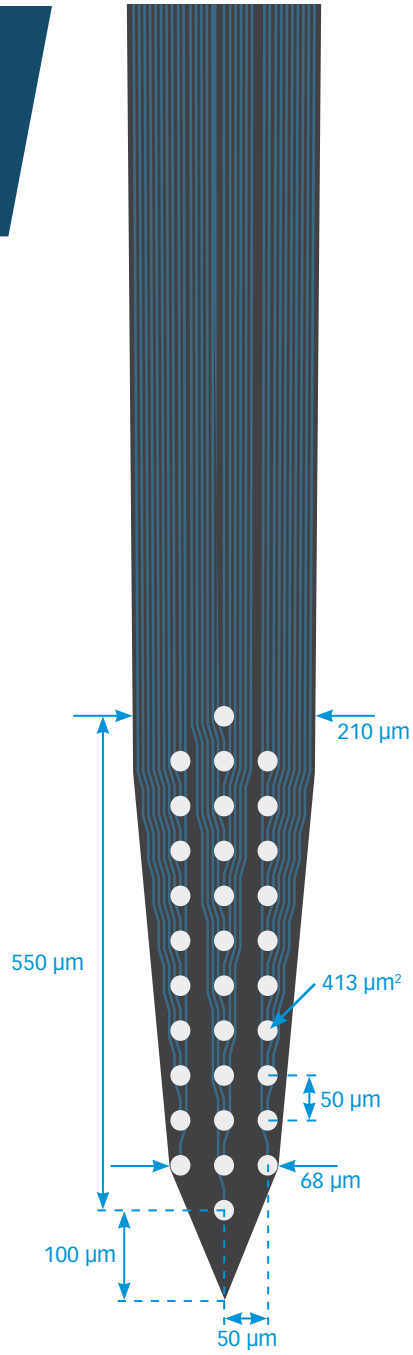
A1x32-Poly3-10mm-25s-177



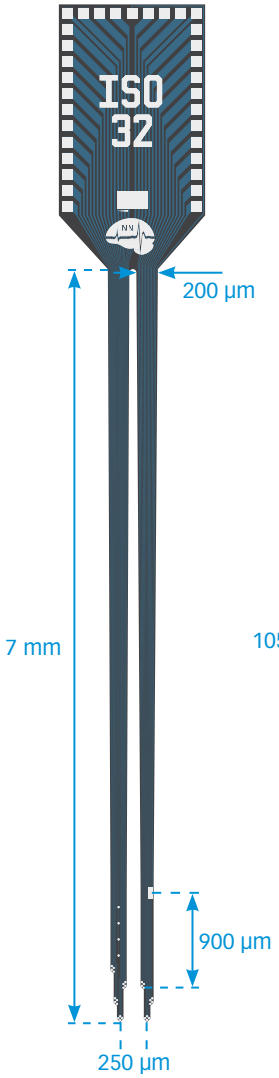


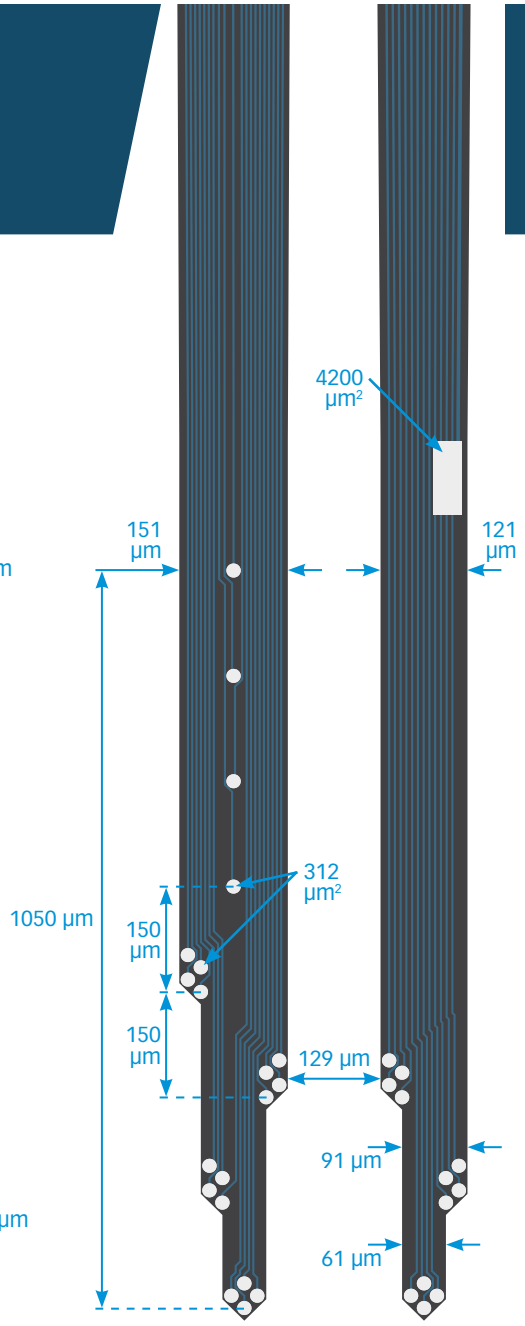
A1x32-12mm-dia-413



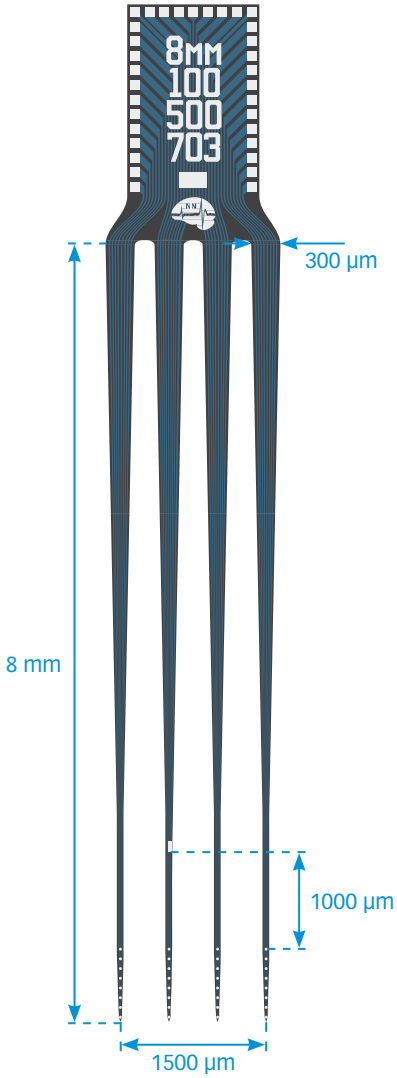


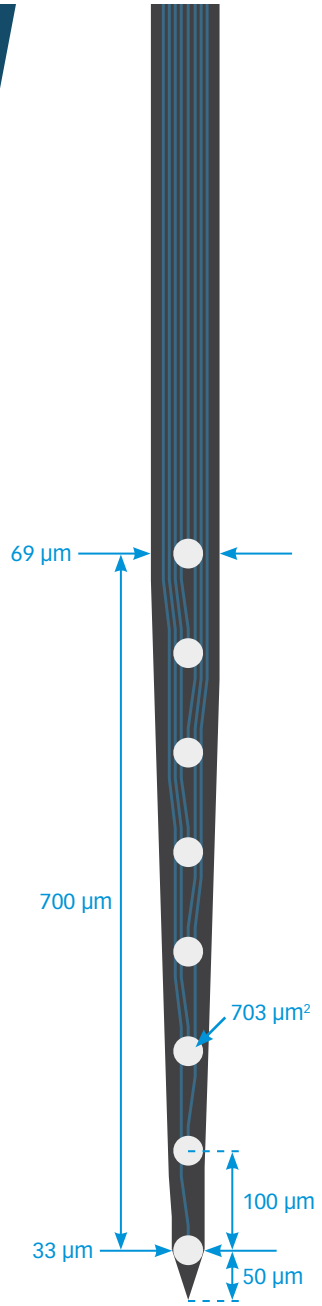
Isomura32



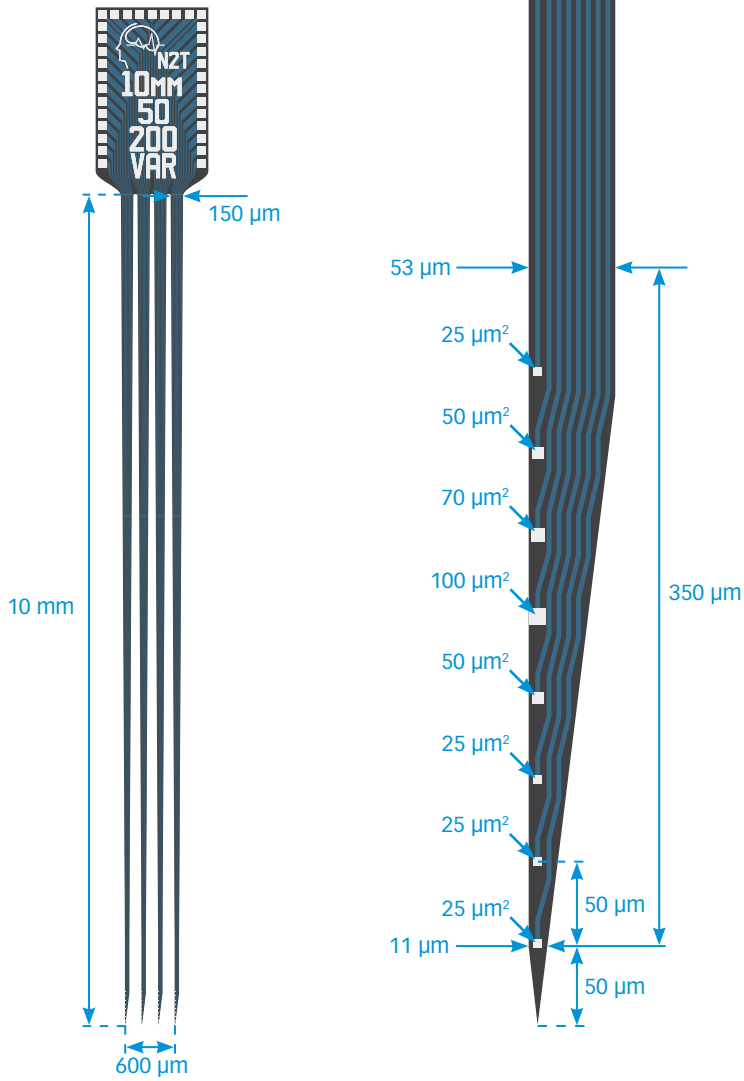


A4x8-8mm-100-500-703

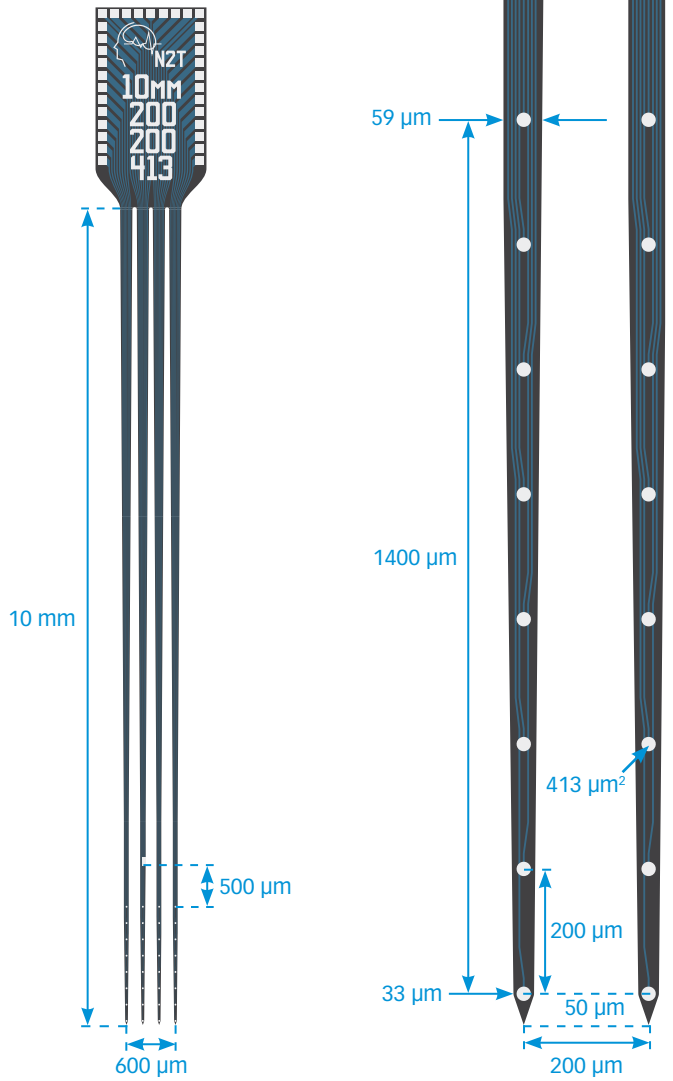




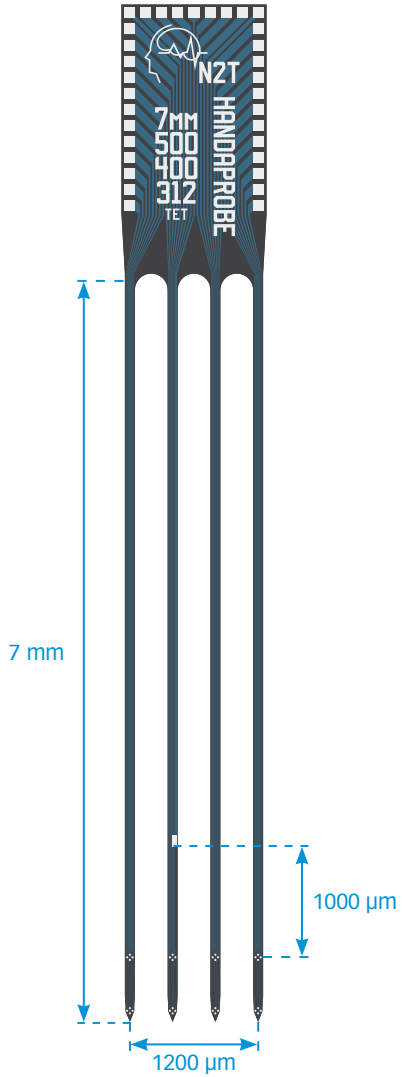
A4x8-10mm-50-200-VAR

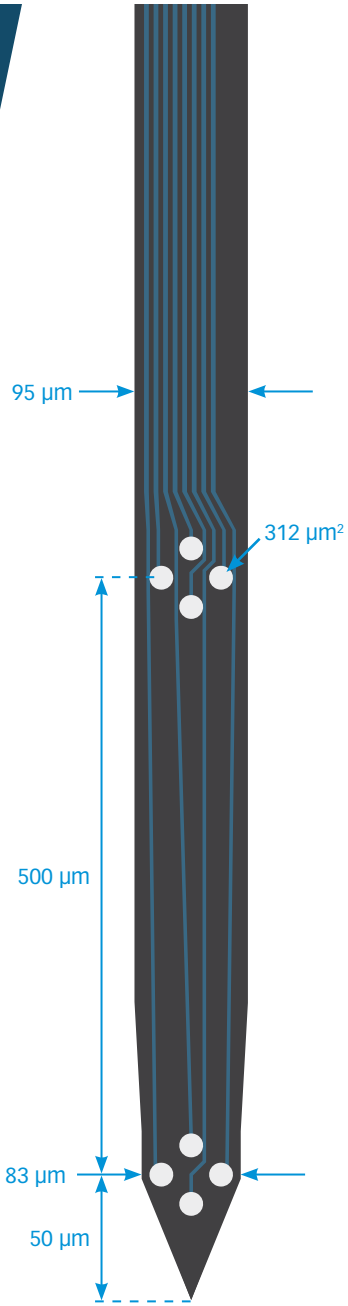


A4x8-10mm-200-200-413

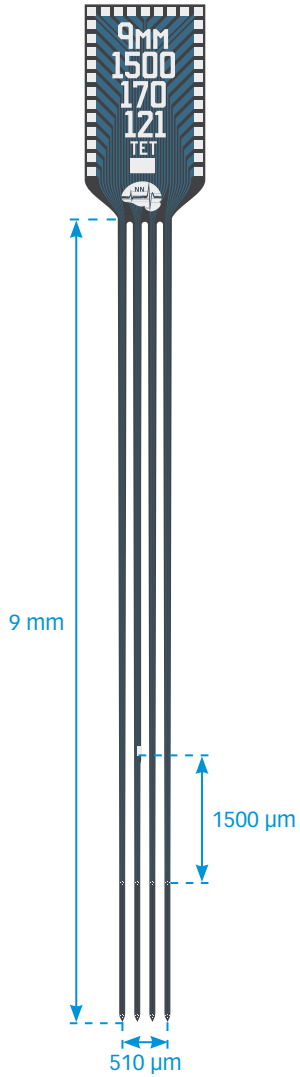


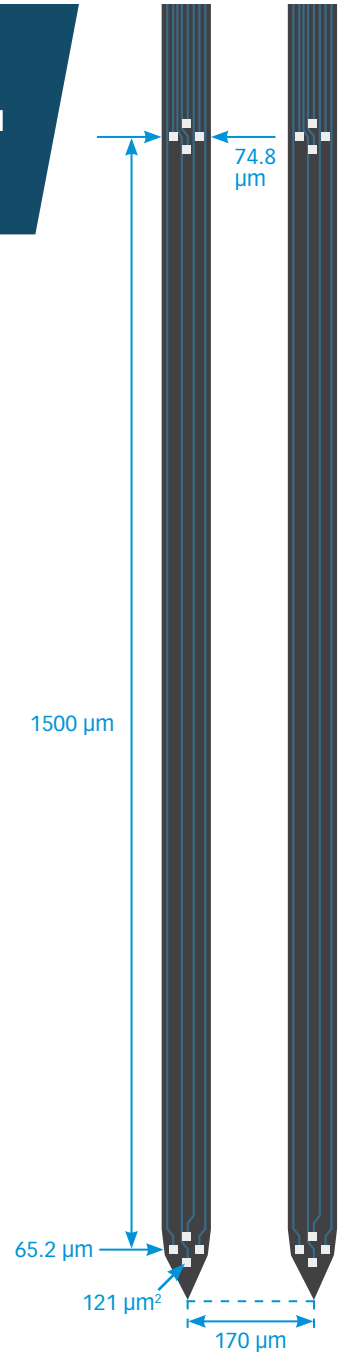
A4x2-tet-7mm-500-400-312



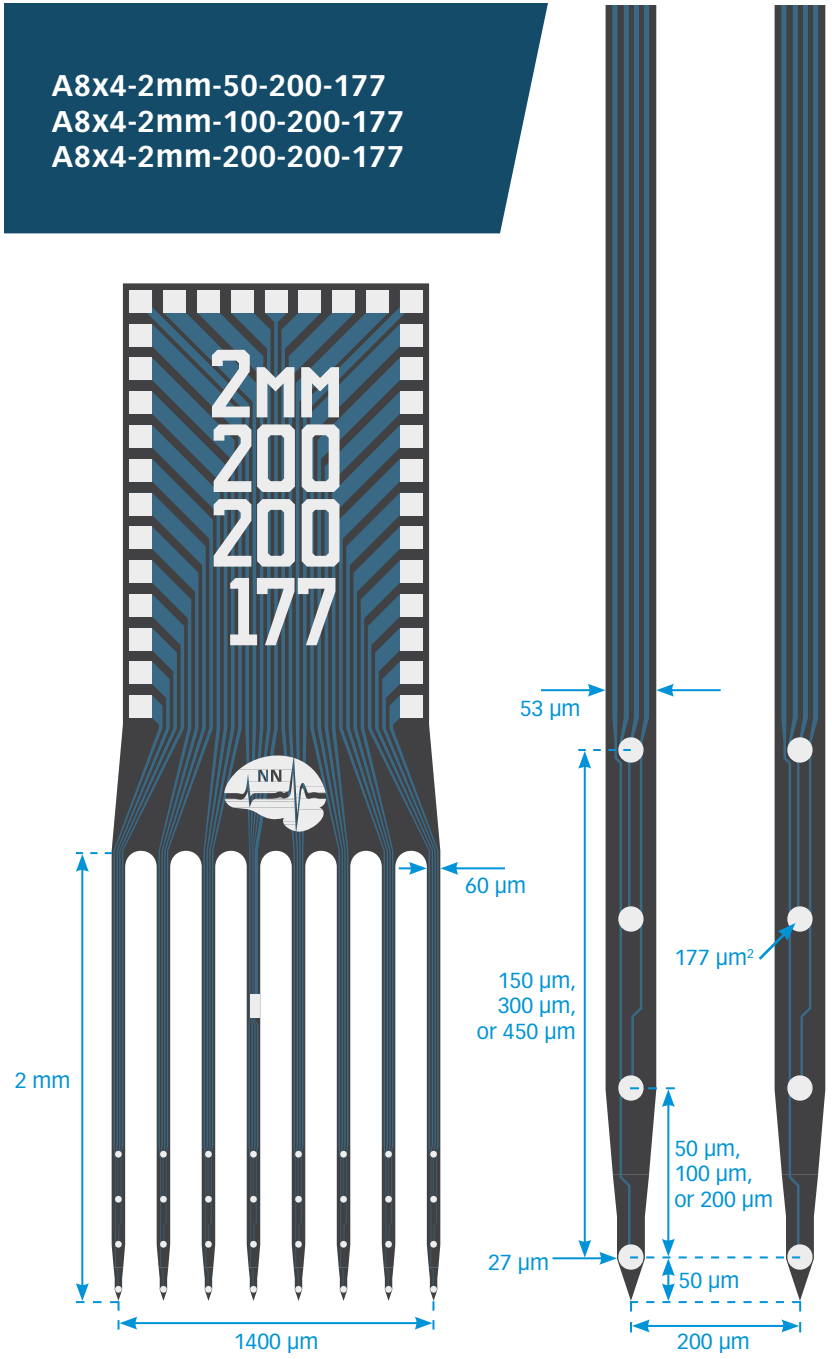


A4x2-tet-9mm-1500-170-121



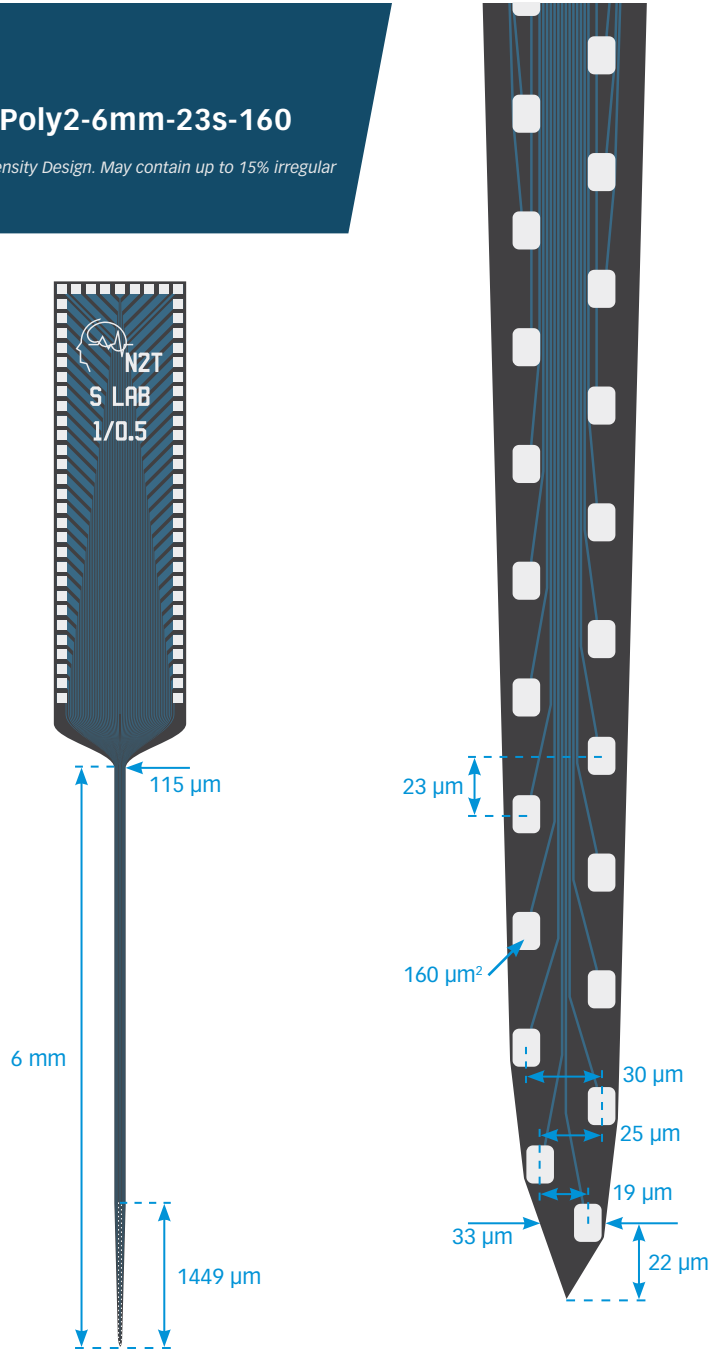


A8x4-2mm-50-200-177
A8x4-2mm-100-200-177
A8x4-2mm-200-200-177

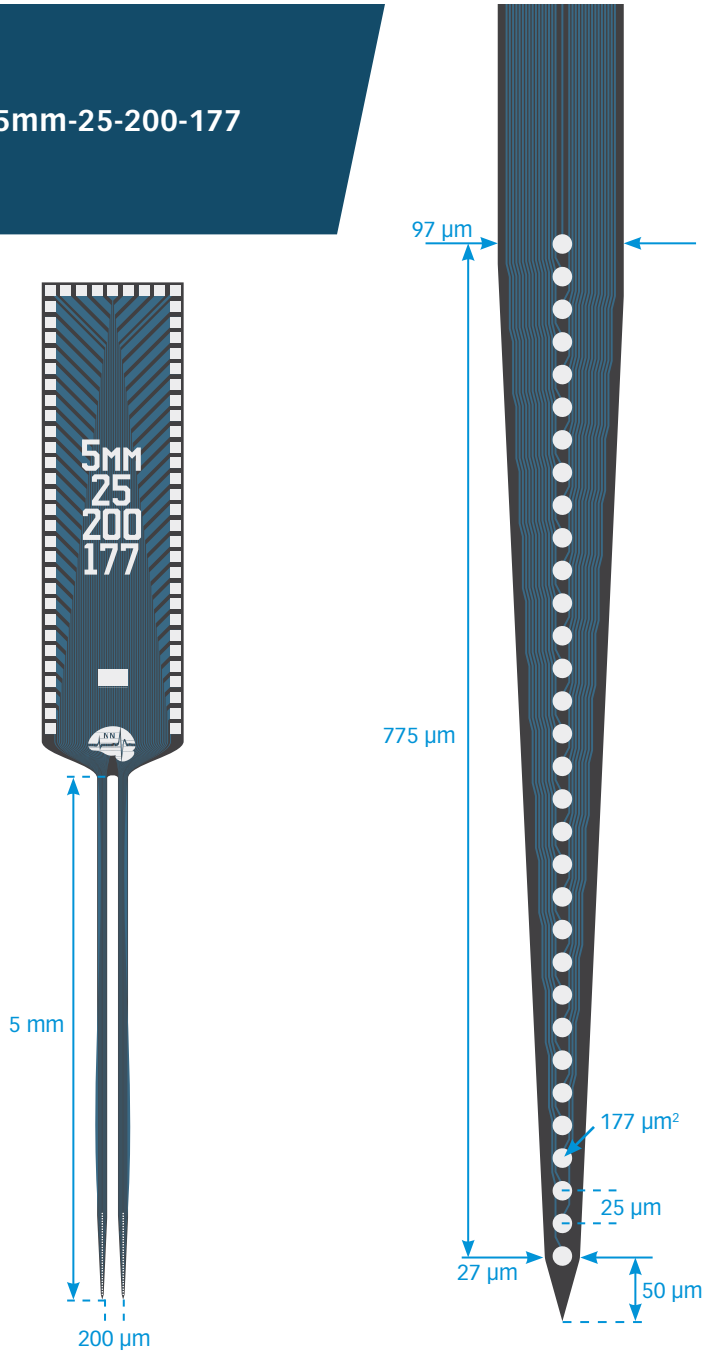


A1x64-Poly2-6mm-23s-160

NOTE: High Density Design. May contain up to 15% irregular sites.

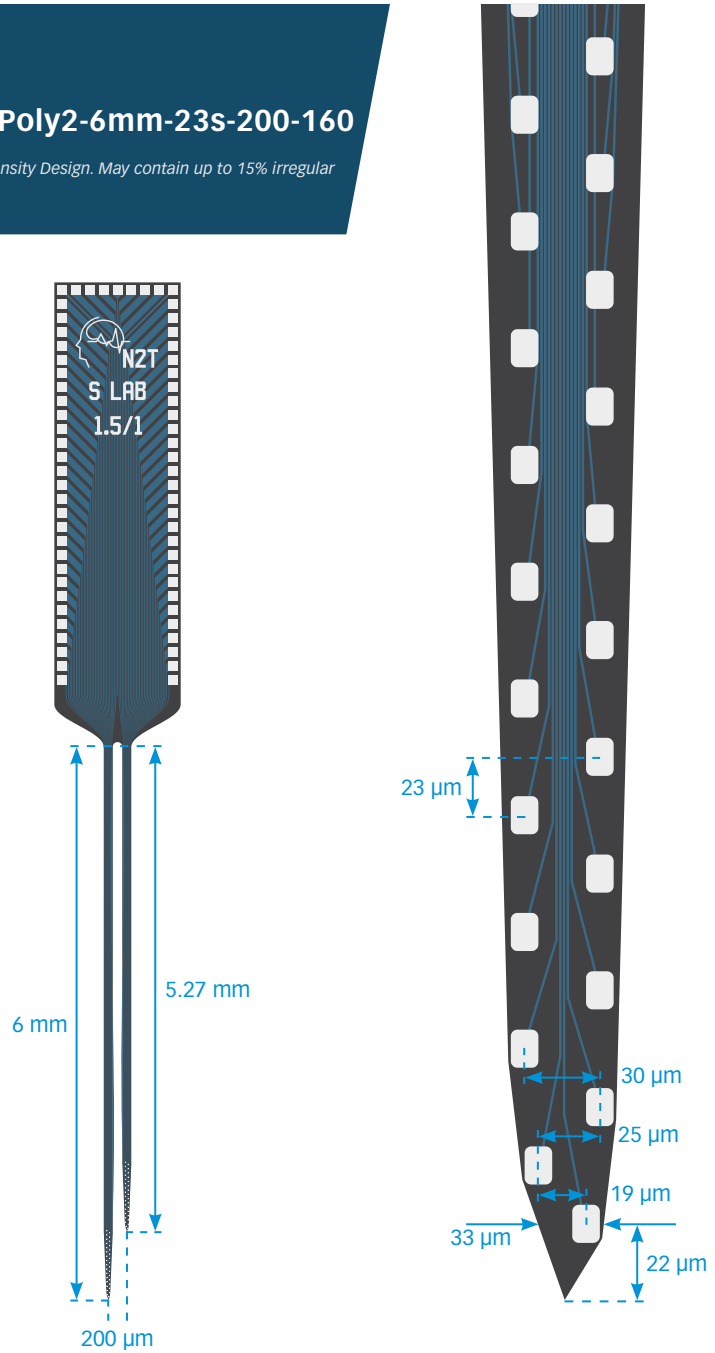


A2x32-5mm-25-200-177

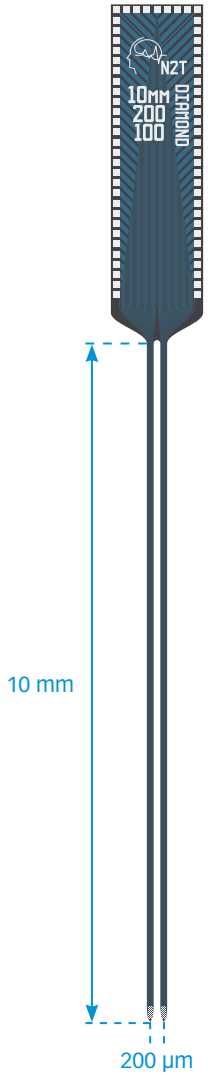


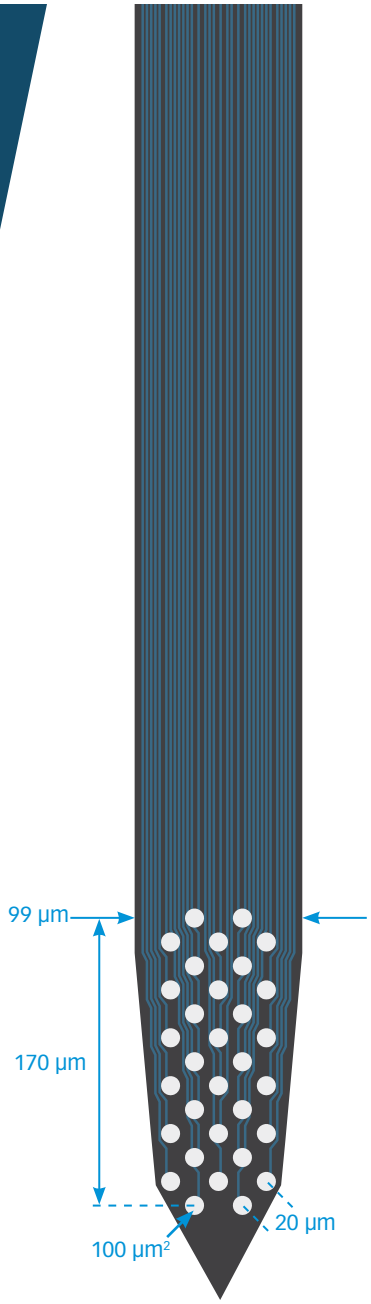
A2x32-Poly2-6mm-23s-200-160

NOTE: High Density Design. May contain up to 15% irregular sites.

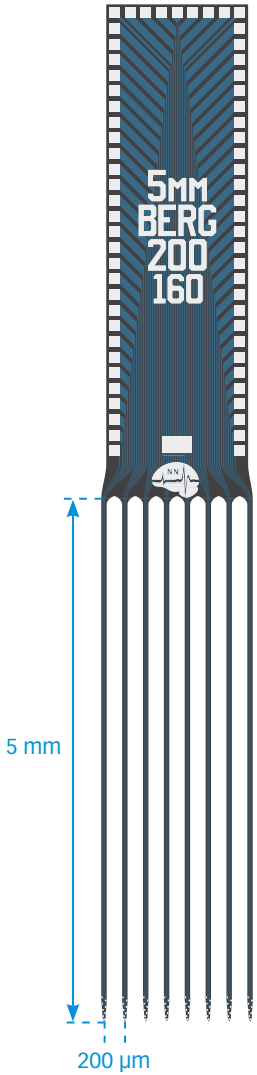


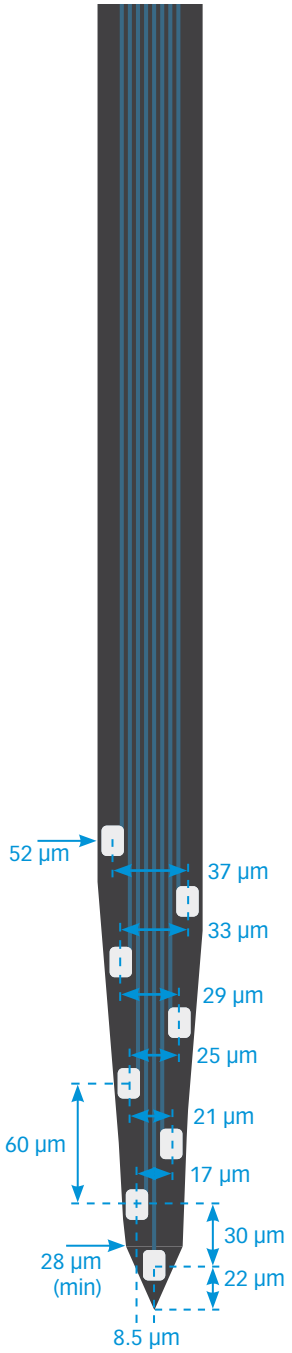
A2x32-Poly5-10mm-20s-200-100



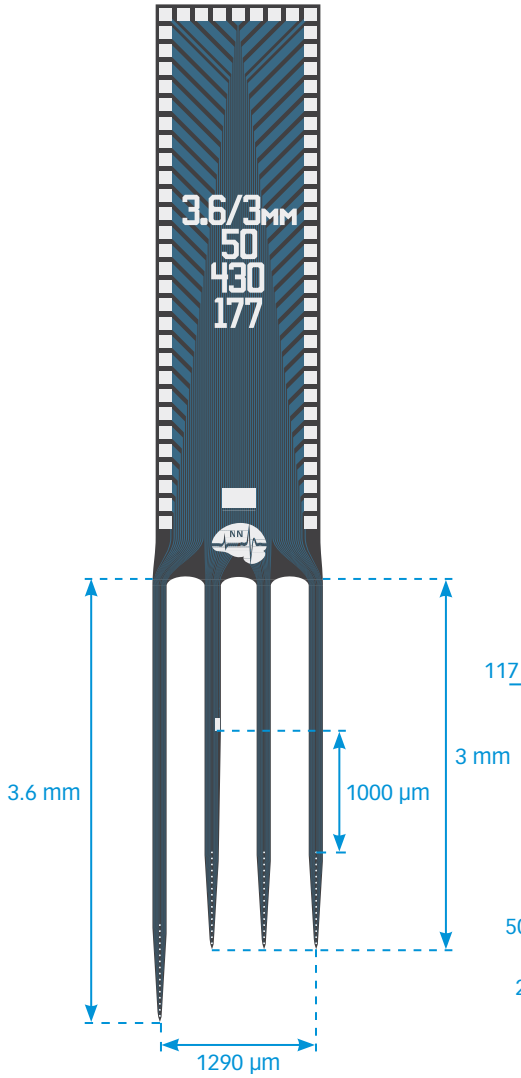


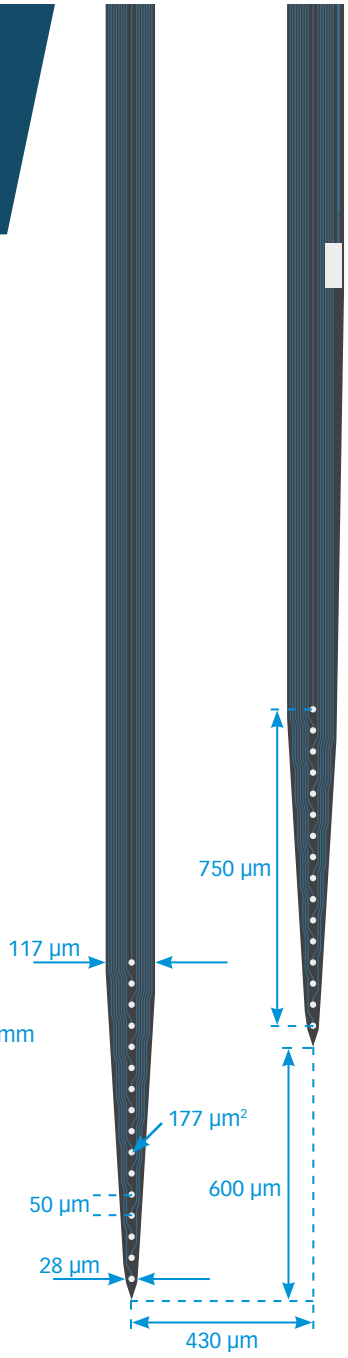
A8x8-5mm-200-160



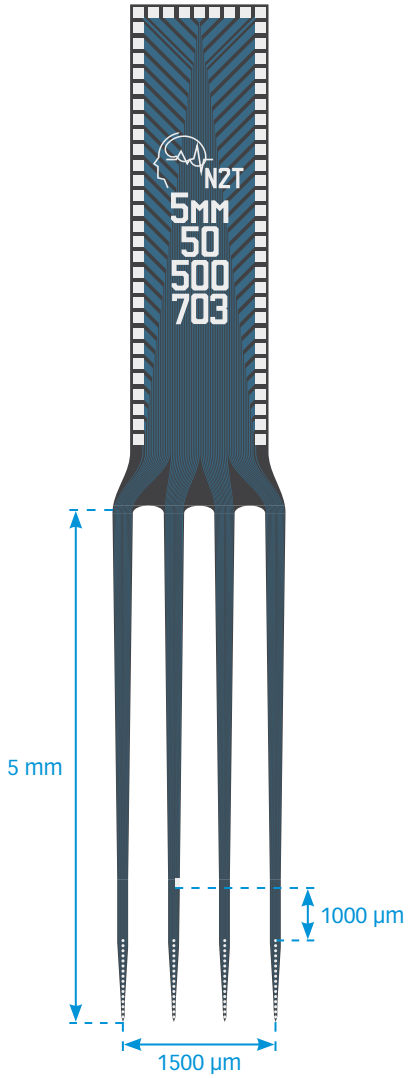


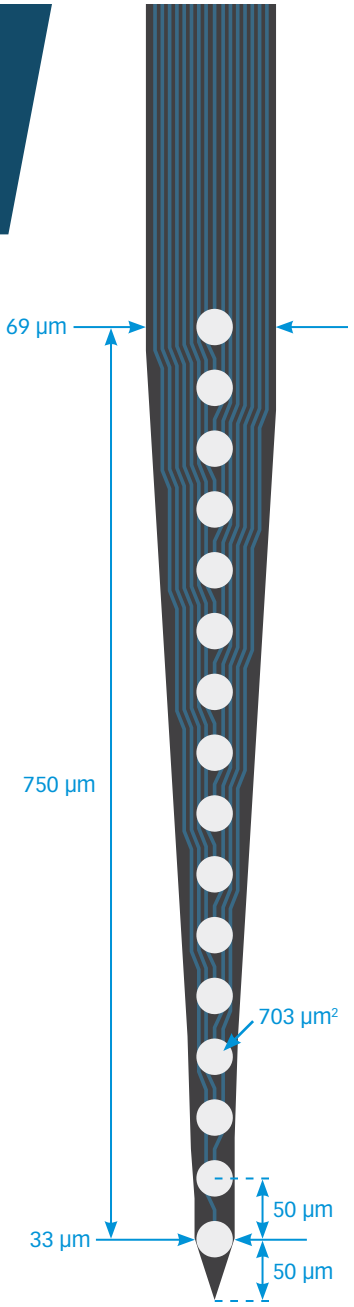
A4x16-3.6/3mm-50-430-177



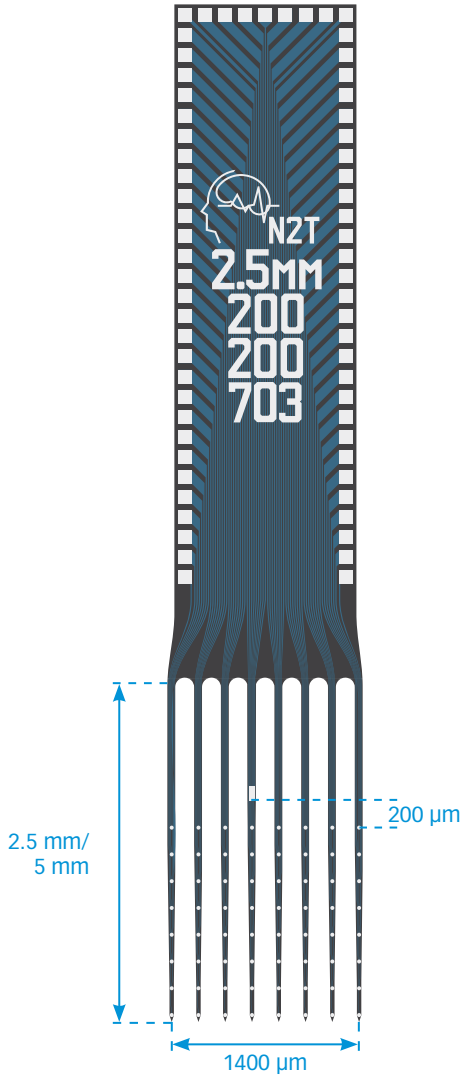


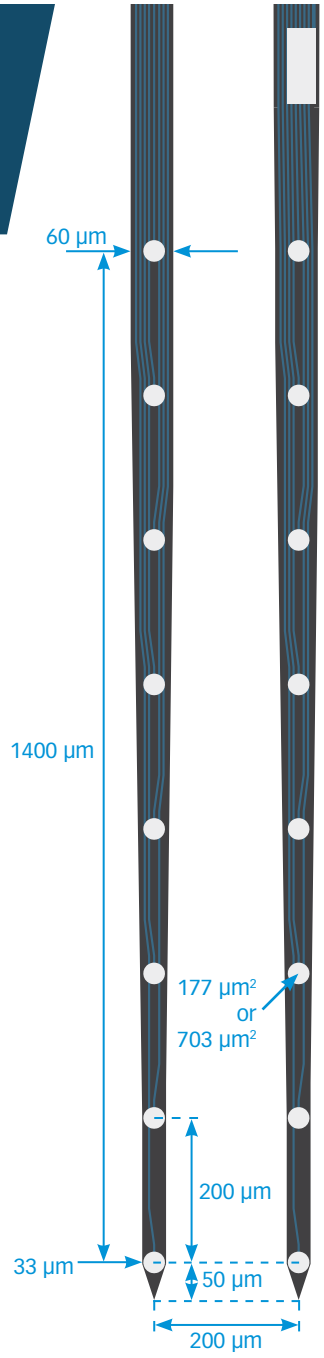
A4x16-5mm-50-500-703





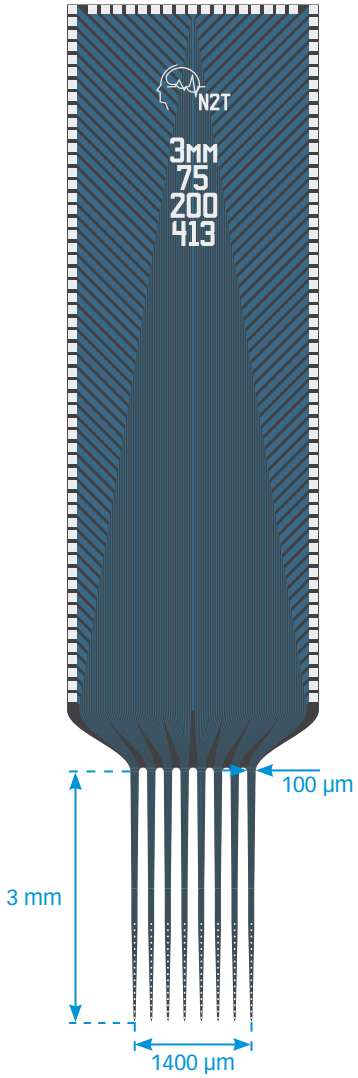
A8x8-2.5mm-200-200-177
A8x8-2.5mm-200-200-703
A8x8-5mm-200-200-177
A8x8-5mm-200-200-703

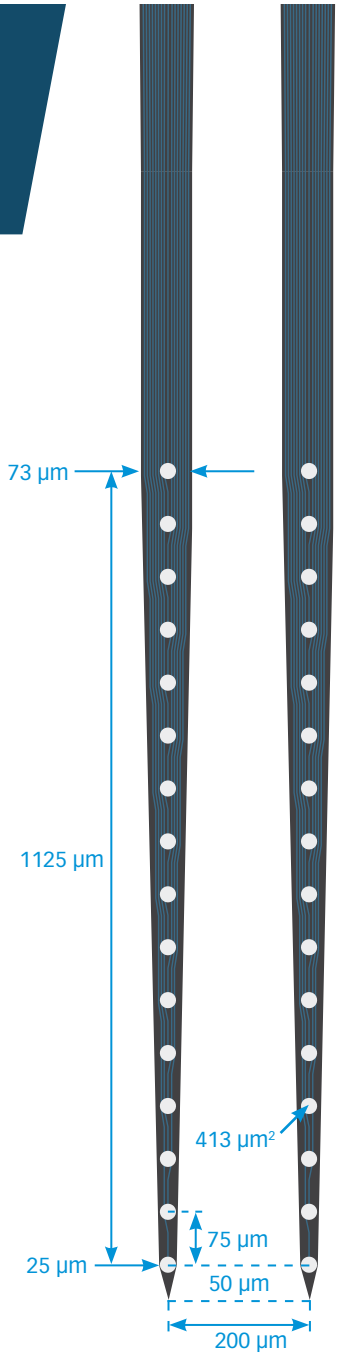




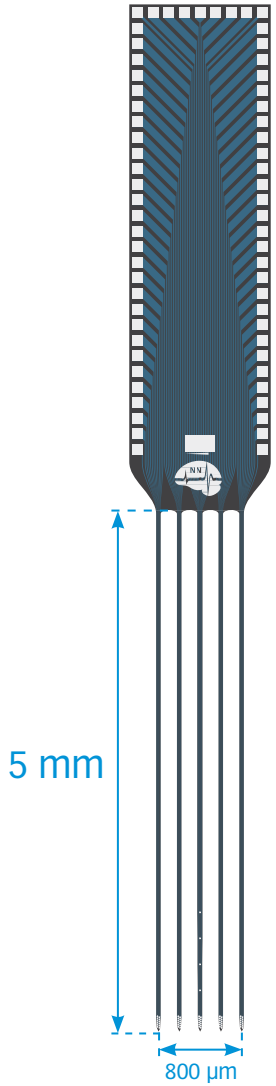
A8x16-3mm-75-200-413

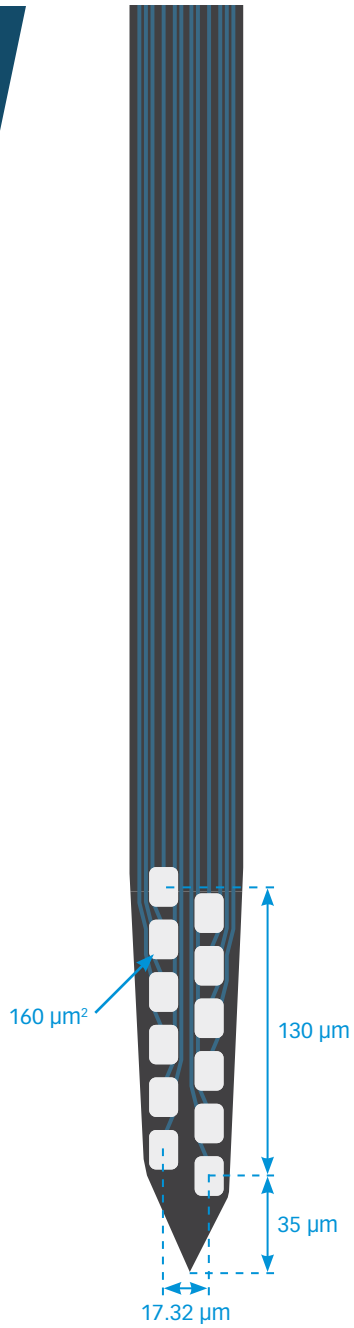
NOTE: High Density Design - mates to a custom A-style board. May contain up to 15% irregular sites.





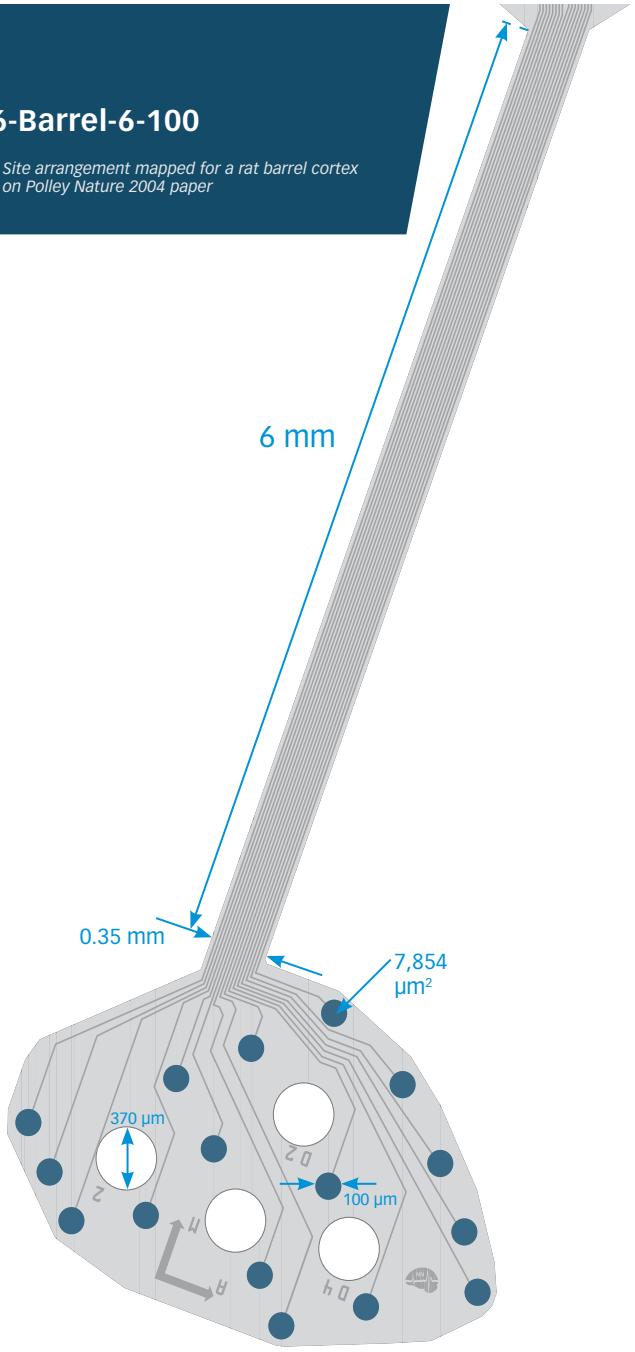
A5x12-Poly2-5mm-20s-lin-160





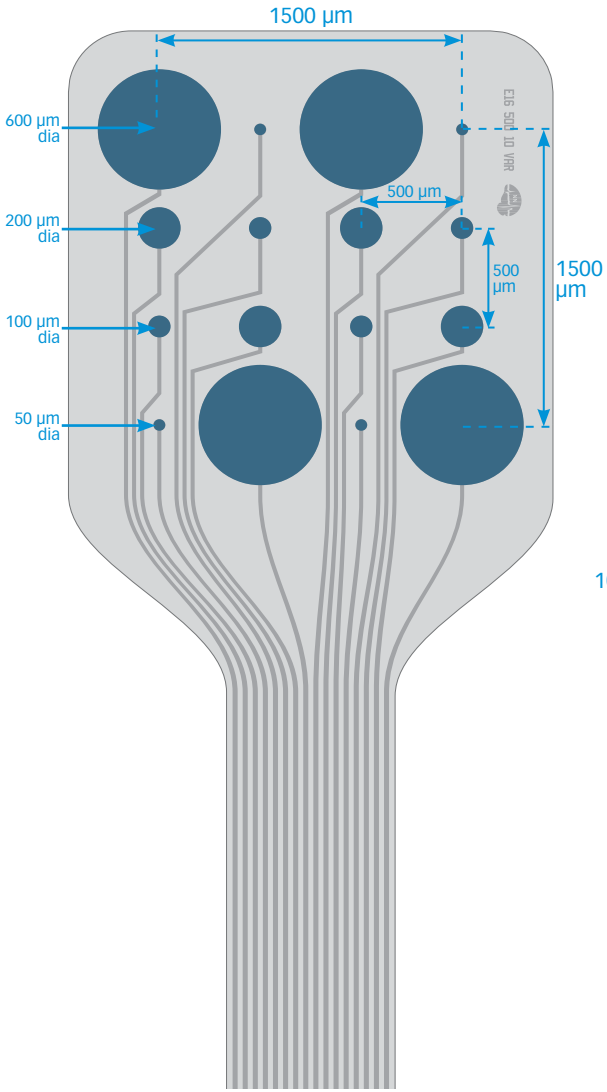
E16-Barrel-6-100

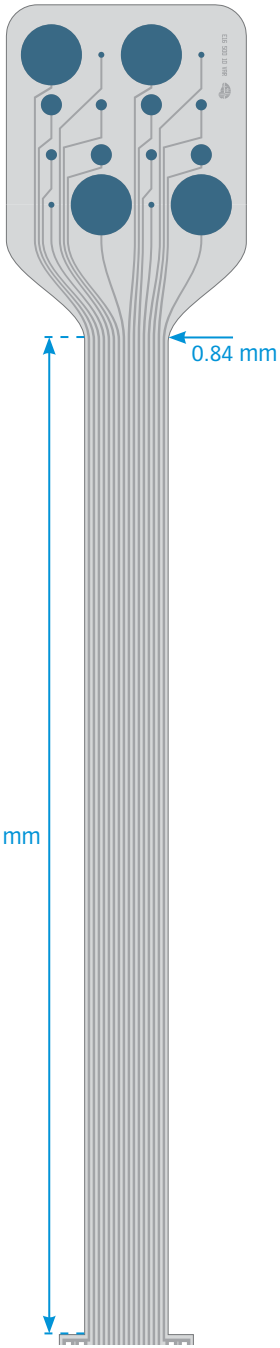
NOTE: Site arrangement mapped for a rat barrel cortex based on Polley Nature 2004 paper



E16-500-10-VAR

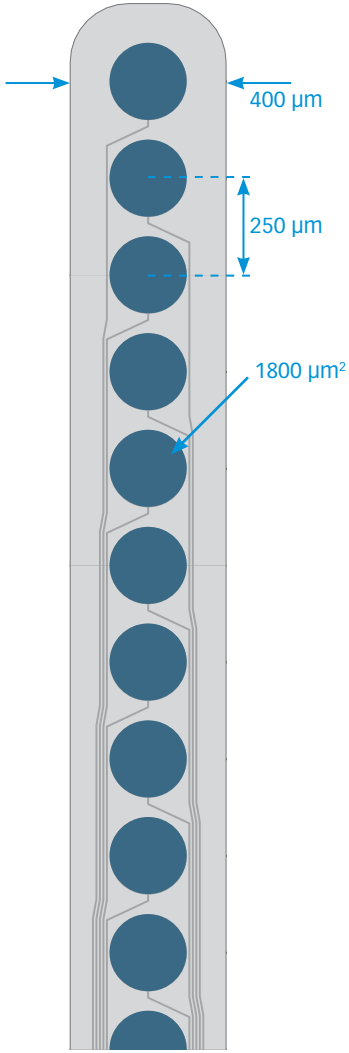
NOTE: Designed for investigating the relationship between site area and recorded ECoG

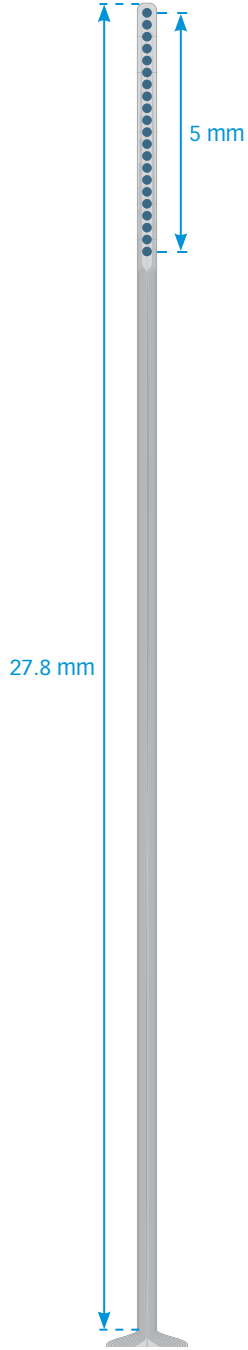




E1x27-27.8-250-1800

NOTE: Designed for cochlear use. The probe substrate is designed to be flexible to allow for integrating with a customized carrier to fit the user's specific application.





E32-1000-20-50/100

NOTE: Designed with alternating site arrangements for stimulation and recording