

°AirRay[®] Electrode Technology

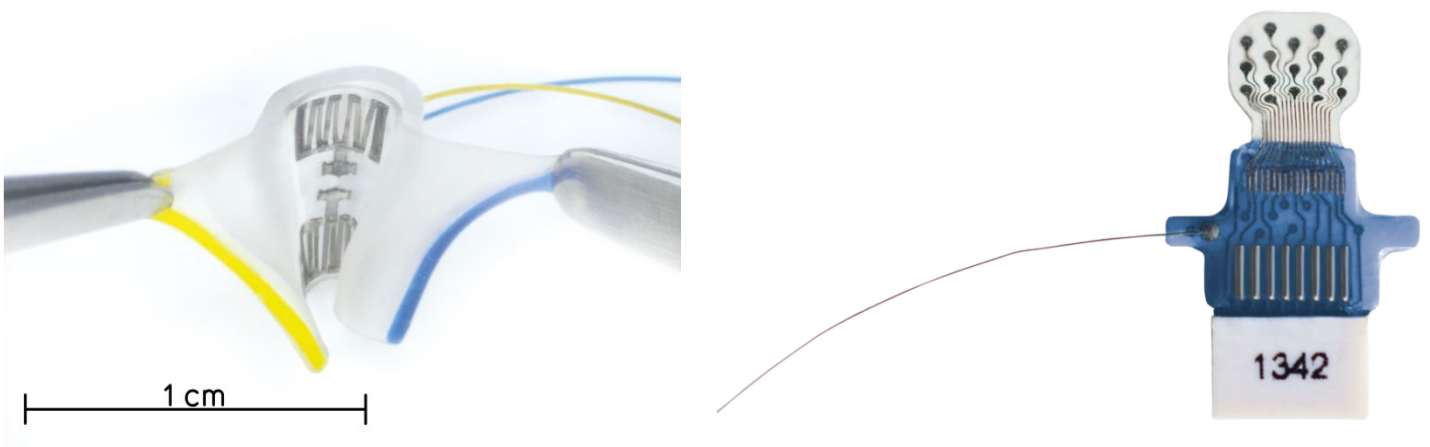
With the proprietary °AirRay[®] electrode technology we have overcome the current limitations for neural electrodes with outstanding mechanical properties and highest manufacturing precision. It also allows very small feature sizes of 25 µm and high integration densities of electrical contacts. The °AirRay[®] electrode can be designed with variations in thickness, contact size, contact spacing, contact shape and overall electrode size.

By using ultra-short-pulse laser micromachining this technology enables a very high reproducibility. In addition, prototyping of °AirRay[®] electrodes is very fast. First prototypes can be produced within a day, implantable electrodes require only one week to be manufactured.

The electrodes provide excellent electrochemical properties. By default, Platinum-Iridium is used as electrode material, optionally with high performance coatings for enhanced charge transfer to biological tissue. By varying the thickness of silicone rubber or parylene C reinforcement layers the mechanical properties can be adjusted to individual requirements. Electrodes can, thus, be very soft or hard enough to be pushed under the skin or into fascicular tissue.

The electrode can be modified for example to build three-dimensional assemblies as well as nerve cuff electrodes that wrap around peripheral nerves. Further adaptations cover the integration of microfluidic channels for drug delivery into electrode arrays. It is, furthermore, possible to fold planar °AirRay[®] electrodes or to establish combinations with other technologies.

°AirRay[®] Cortical Electrode (see following page) is cleared for clinical use by FDA.



°AirRay[®] Cortical Electrode

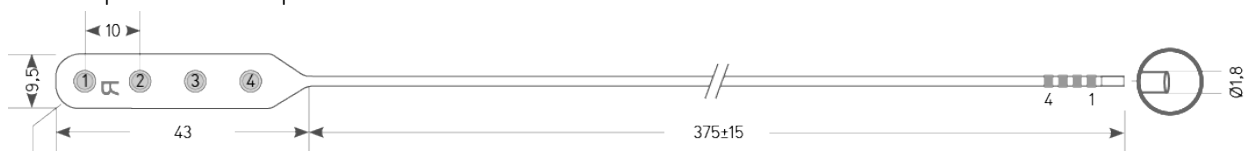


°AirRay[®] Cortical Electrode has received market clearance from the Food and Drug Administration (FDA) in the USA for invasive neuromonitoring in the central nervous system. The product portfolio includes all possible contact arrangements from 1x4 to 8x8 electrode contacts.

In the following we list the designs that we offer as part of our standard catalogue. Please contact us for other configurations.

Strip-Electrodes

1x4 Strip Electrode | 4 Contacts



1x6 Strip Electrode | 6 Contacts

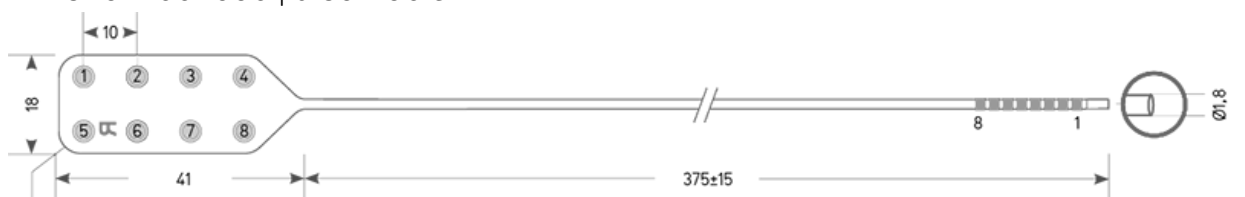


1x8 Strip Electrode | 8 Contacts



Grid-Electrodes

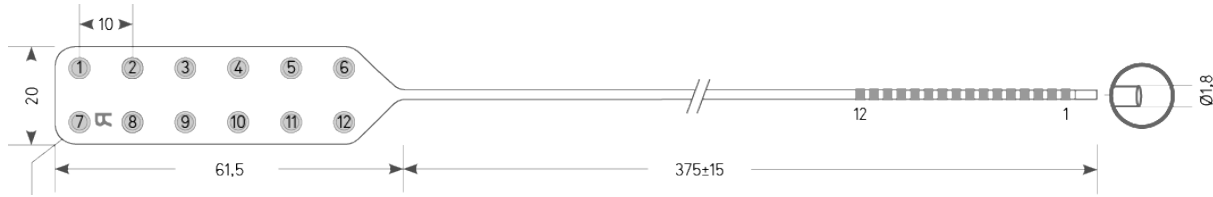
2x4 Grid Electrode | 8 Contacts



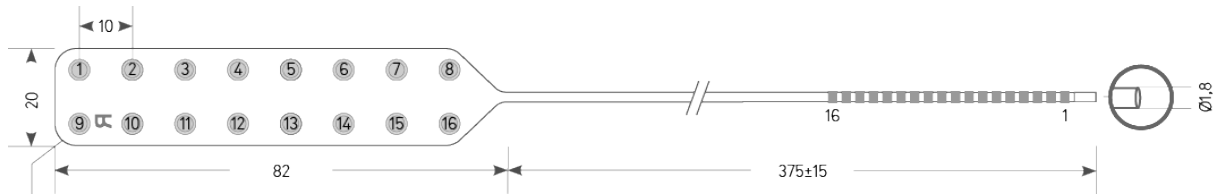
2x5 Grid Electrode | 10 Contacts



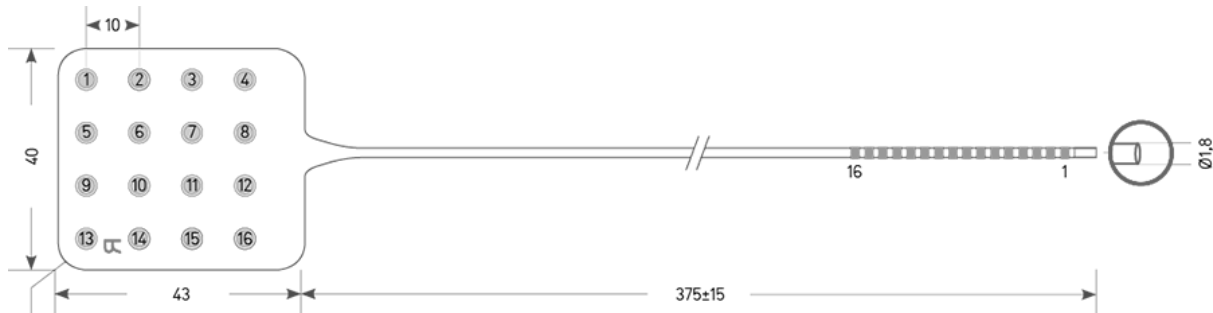
2x6 Grid Electrode | 12 Contacts



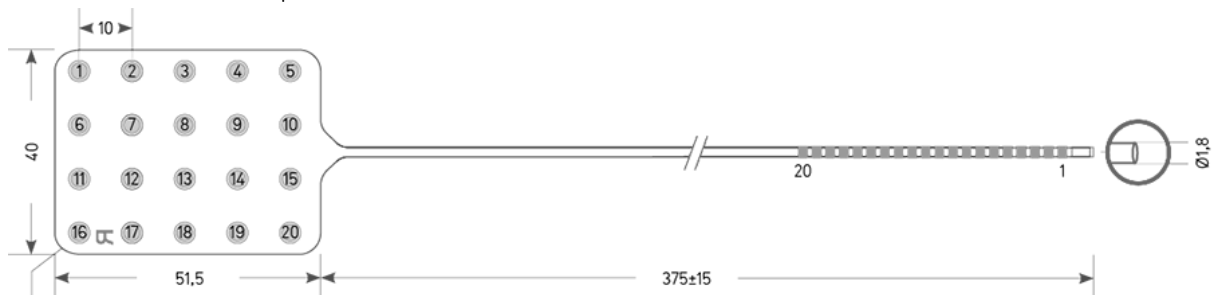
2x8 Grid Electrode | 16 Contacts



4x4 Grid Electrode | 16 Contacts

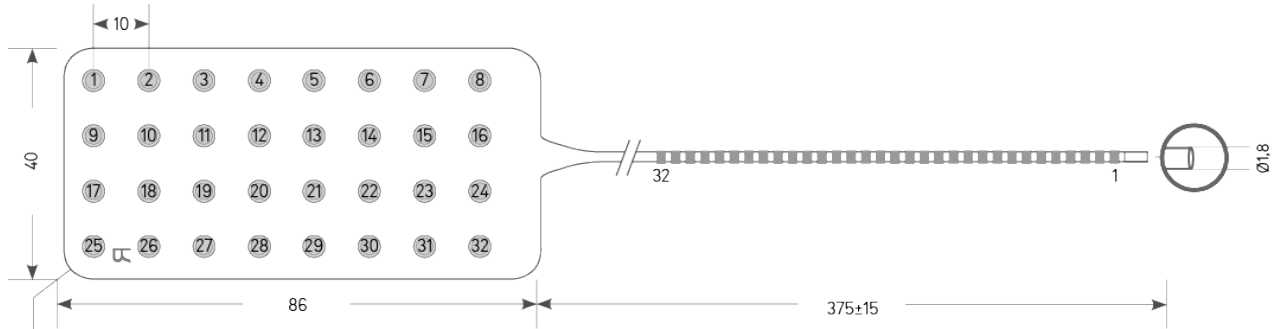


4x5 Grid Electrode | 20 Contacts

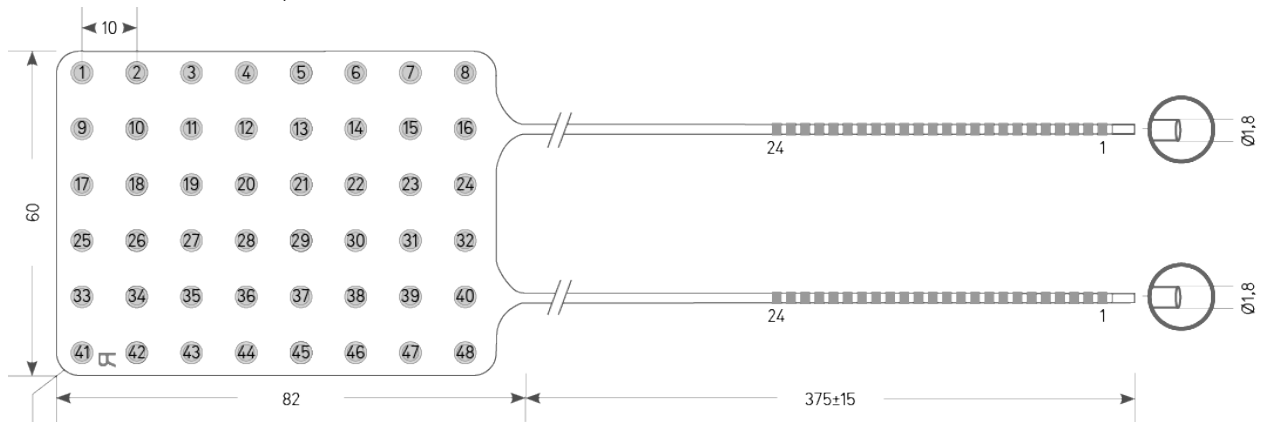




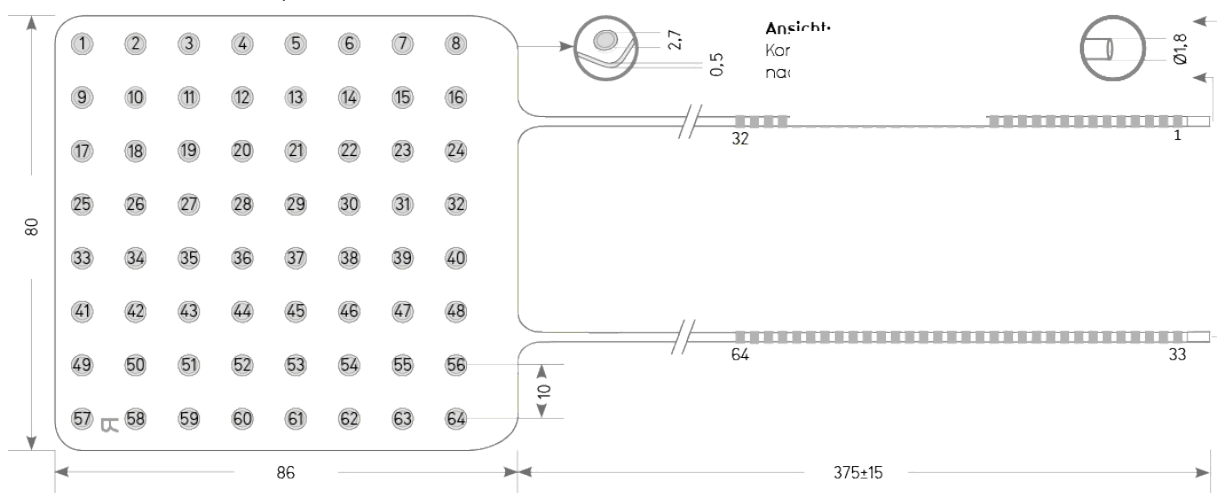
4x8 Grid Electrode | 32 Contacts



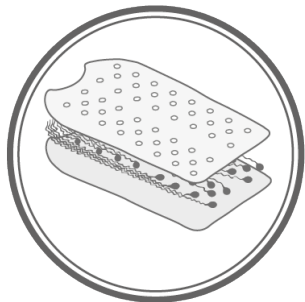
6x8 Grid Electrode | 48 Contacts



8x8 Grid Electrode | 64 Contacts

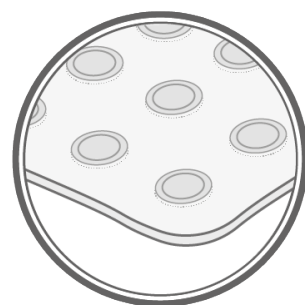


DESIGN OPTIONS



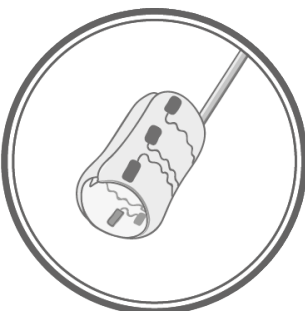
Multi-Layer Functionalization

- Adjustment of thickness and flexibility by number and type of polymer or metal layers
- Adaptation of contact density and functionality by number and type of metal layers
- Integration of microfluidic channels and ports



General Dimensions

- Thickness:
 - Silicone electrodes: 0.15 mm – 1 mm
 - Hybrid silicone-parylene electrodes: 0.08 mm – 1 mm
- Contact size:
 - Silicone electrodes: down to 0.1 mm
 - Hybrid silicone-parylene electrodes: down to 0.05 mm
- Contact spacing:
 - Silicone electrodes: down to 0.3 mm center-to-center
 - Hybrid silicone-parylene electrodes: down to 0.06 mm center-to-center
 Depending on number of contacts
- Contact shape: round, rectangular or arbitrary
- Design geometry maximum: 90 mm x 90 mm
- Various designs for electrode outline incl. slit contours



Design Variation – Cuff Electrodes

- Inner diameter: starting from 0.1 mm
- Number of contacts: arbitrary
- Closing mechanisms:
 - Split cylinder
 - Buckle-and-belt
 - Self-spiraling
 - Piano hinge
- Further closing mechanisms for chronic implantation can be developed



Other Variations

- Folding planar AirRay[®] electrodes
- 3D assembly of multiple AirRay[®] electrodes
- Intrafascicular electrodes
- Combination with other technologies:
 - Depth electrodes
 - 3D metal parts
 - Functional components such as surgical mesh or suture material

MATERIALS

Polymers	Medical grade silicone rubber • Long-term (≥ 30 days) • Short-term (< 30 days)	Parylene-C	
Metals	Medical grade metal alloys: • Platinum-Iridium (90/10) • Platinum • MP35N	High-performance coatings: • Sputtered Iridium Oxide (SIROF) • Platinum Black	Physical surface modification permits additional adaptations to the individual application.

PERFORMANCE

	Charge Injection Capacity	Impedance (Diameter 1 mm)		Impedance (Diameter 2.7 mm)	
		10 Hz	1 KHz	10 Hz	1 KHz
MP35N	Max. 0.03 mC/cm ²	260 kΩ	5 kΩ	32 kΩ	0.6 kΩ
Platinum-Iridium (90/10)	0.09 mC/cm ²	47 kΩ	1 kΩ	8 kΩ	0.2 kΩ
Platinum	0.05 mC/cm ²	available on request		available on request	
Sputtered Iridium Oxide (SIROF)	≥ 1 mC/cm ²	available on request		available on request	
Platinum Black	0.25 mC/cm ²	available on request		available on request	

TESTING

- Impedance spectroscopy
- Pulse testing
- Corrosion testing
- Reliability testing



Company Support

VALIDATIONS

Our development and manufacturing comply with highest quality standards. We can offer a wide range of in-house validations or verifications as well as validations together with partners and test laboratories. The listed validations concern all of our products, their developing and manufacturing stages.

Process Validations (together with external partners and test laboratories)

- Cleaning process validation
- Packaging process validation
- Sterilization process validation (ETO)

Mechanical and Electrical Validations/Verifications

- Design and product specifications
- Bending load
- Tensile testing
- Micro IRHD testing (together with external partners)
- Impedance
- Dielectric strength
- Corrosion
- Layer pull strength
- Hermeticity
- Shear strength

GENERAL SERVICE

For all our °AirRay[®] Electrodes we offer the following services:

- Device design
- Tests/validations of new designs incl. technical documentation
- Sterilization
- Cleaning