



## CorTec research

### Product Catalogue



As precious  
as your research



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# Welcome!



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This latest edition of our catalogue gives you an update on our portfolio of neural interfaces for preclinical research.

Our silicone-based °AirRay research electrodes have overcome the current limitations of neural electrodes. They are made using high-precision laser manufacturing and offer unprecedented combination of flexibility, softness, stretchability, thinness, and density of contacts.

They are available in planar structures as well as in cuff electrode designs to be wrapped around peripheral nerves, and also in other 3D designs. Further adaptations also combine °AirRay research ECoG grid electrodes with metallic depth electrodes.

Upon request we can also provide a range of polyimide-based electrodes suitable for application in the central and peripheral nervous system.

Check out our fully implantable device Brain Interchange that allows a wide range of research applications in the field of closed-loop therapy.

All products are suited for recording and stimulation in acute or chronic use. They are biocompatible and are manufactured according to highest quality standards. Beyond the products you will find on the following pages we are offering customized designs to meet your specific needs.

Contact us to learn more!

CorTec is a young neurotechnology company located in Freiburg, Germany.

Thinking ahead, we are providing the technology of tomorrow already today.

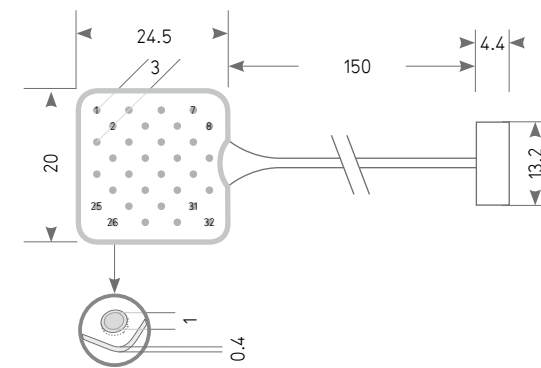


# °AirRay research Silicone-Based Electrodes



## Micro 4 x 8 Square 45°

°AirRay research in the classical square electrode format with micro-contacts in various arrangements.  
Please contact us for other electrode configurations or designs!



### General Information:

- Drawing shows product in the following connectivity option: Omnetics – with round cable.
- Learn more about our materials on page 29.
- For more Information about connectivity options (cables, connectors etc.) see page 24ff.

Product Configuration		Catalogue No.	Connection System
Micro 4x8 Square 45°	Platinum Iridium	1031.2004	For this product we recommend the following connectivity option: • Omnetics – with round cable Please see page 24ff. for further information!

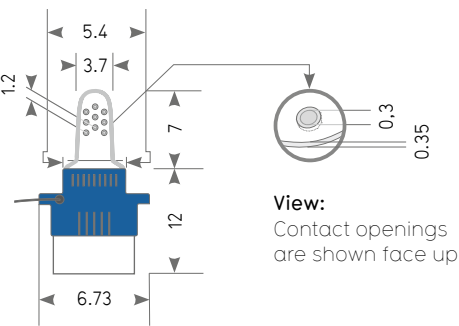
Copyright on all information and drawings is held by CorTec GmbH | Drawings represent the product in an abstract way and are not necessarily to scale | All dimensions in mm | For pricing please request a quotation.



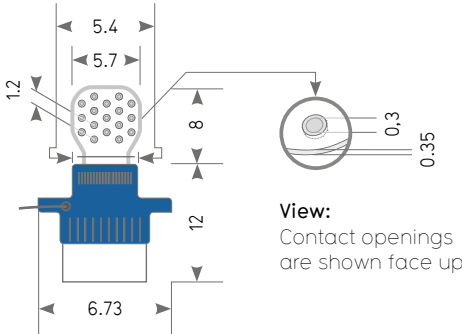
# Micro 8 Hexagonal | Micro 16 Hexagonal

°AirRay research smallest Micro ECoG grids in our standard portfolio. Please contact us for other electrode configurations or designs!

Micro 8 Hexagonal



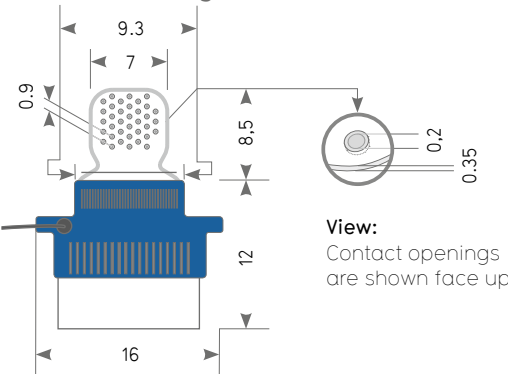
Micro 16 Hexagonal



# Micro 32 Hexagonal

°AirRay research smallest Micro ECoG grids in our standard portfolio. Please contact us for other electrode configurations or designs!

Micro 32 Hexagonal



General Information:

- Drawings show products in the following connectivity option: Omnetics - on PCB board.
- Learn more about our materials on page 29.
- For more information about connectivity options (cables, connectors etc.) see page 24ff.

General Information:

- Drawing shows product in the following connectivity option: Omnetics - on PCB board.
- Learn more about our materials on page 29.
- For more information about connectivity options (cables, connectors etc.) see page 24ff.

Product Configuration		Catalogue No.	Connectivity Options
Micro 8 Hexagonal	Platinum-Iridium	1031.2006	For these products we recommend the following connectivity option: • Omnetics - on PCB board Please see page 24ff. for further information! Connectable to MCS Wireless Headstages. See page 25 for more details.
Micro 16 Hexagonal	Platinum-Iridium	1031.2008	

Product Configuration		Catalogue No.	Connectivity Options
Micro 32 Hexagonal	Platinum-Iridium	1031.2028	For this product we recommend the following connectivity option: • Omnetics - on PCB board Please see page 24ff. for further information! Connectable to MCS Wireless Headstages. See page 25 for more details.

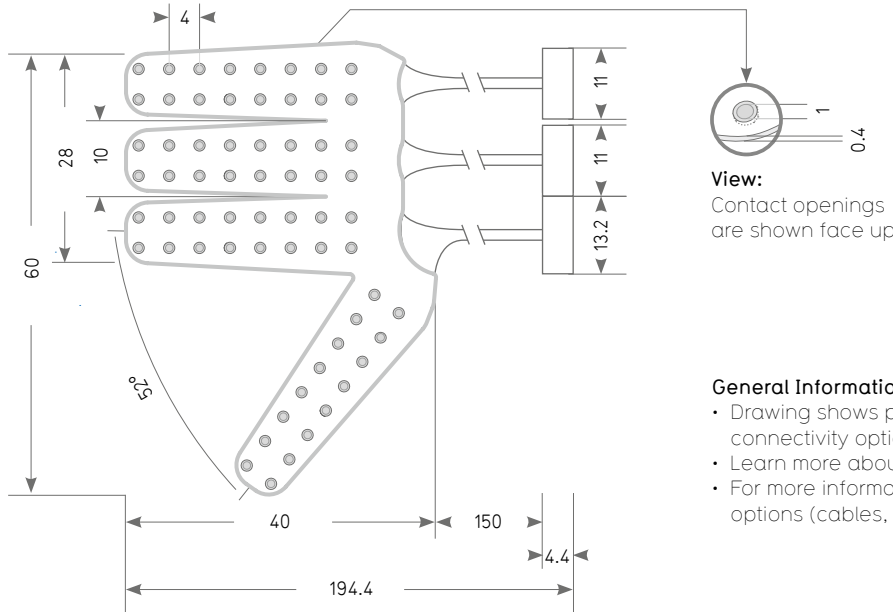
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# 4 x 16 Finger

Sectional distribution with equal contact spacing and slit contours to ideally adapt to the convex shape of the brain. Please contact us for other electrode configurations or designs!



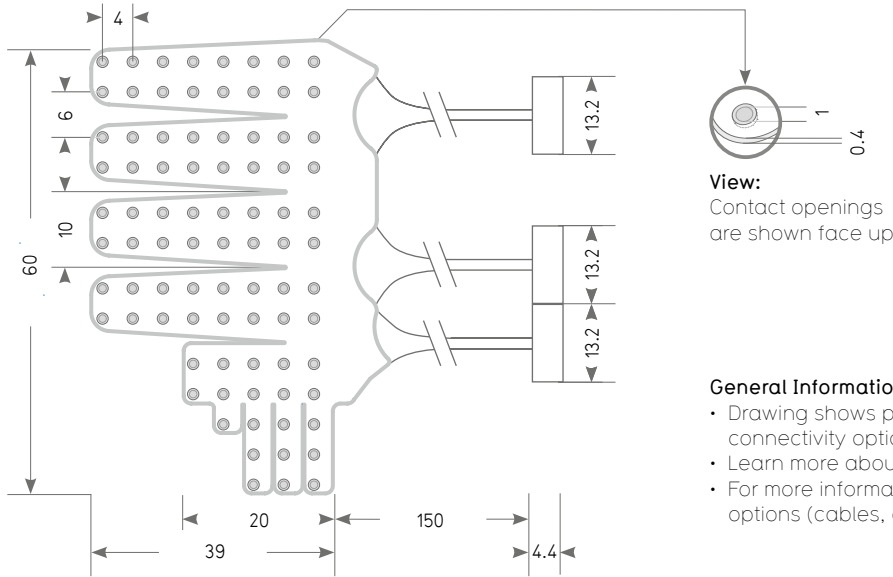
**View:**  
Contact openings  
are shown face up

- General Information:**
- Drawing shows product in the following connectivity option: Omnetics – with round cable.
  - Learn more about our materials on page 29.
  - For more information about connectivity options (cables, connectors etc.) see page 24ff.



# 5 x 16 Finger Subsectional

Sectional distribution with equal contact spacing and slit contours to ideally adapt to the convex shape of the brain. Please contact us for other electrode configurations or designs!



**View:**  
Contact openings  
are shown face up

- General Information:**
- Drawing shows product in the following connectivity option: Omnetics – with round cable.
  - Learn more about our materials on page 29.
  - For more information about connectivity options (cables, connectors etc.) see page 24ff.

Product Configuration	Catalogue No.	Connectivity Options
4 x 16 Finger	Platinum-Iridium 1031.2018	For this product we recommend the following connectivity option: <ul style="list-style-type: none"><li>• Omnetics – with round cable</li></ul> Please see page 24ff. for further information!

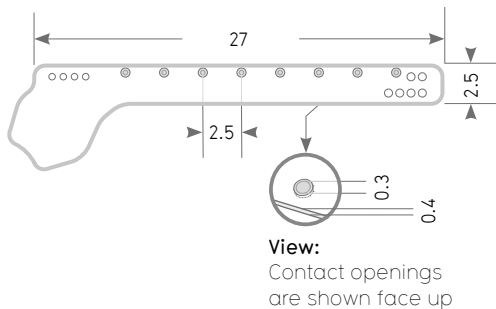
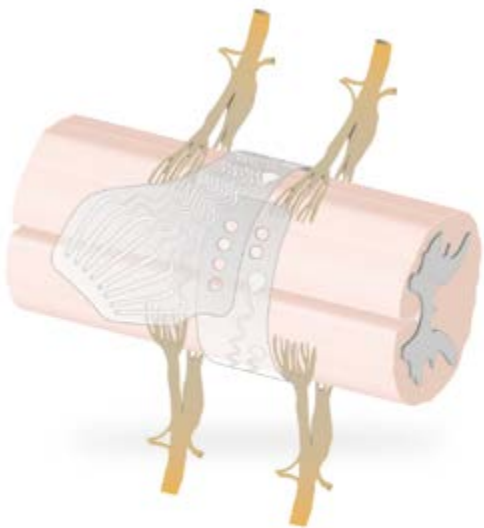
Product Configuration	Catalogue No.	Connectivity Options
5 x 16 Finger	Platinum-Iridium 1031.2022	For this product we recommend the following connectivity option: <ul style="list-style-type: none"><li>• Omnetics – with round cable</li></ul> Please see page 24ff. for further information!





# Fetz Spinal Cord 8

Strip electrode for recording from and stimulating of the spinal cord, developed in cooperation with Eberhard Fetz. Please contact us for other electrode configurations or designs!



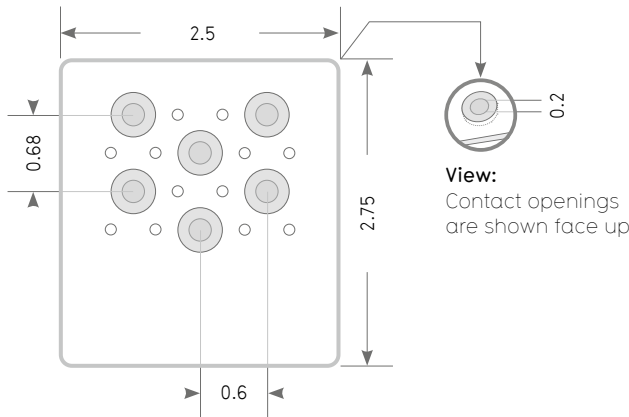
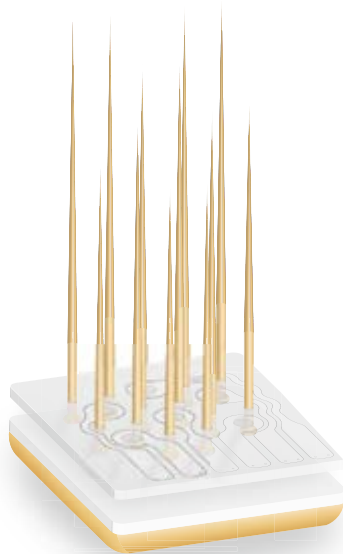
- General Information:**
- Openings at shaft and tip facilitate fixation.
  - Product is supplied with round cable incl. strain relief.
  - Learn more about our materials on page 29.
  - For more information about connectivity options (cables, connectors etc.) see page 24ff.
  - Product can be supplied sterile.

Product Configuration	Catalogue No.	Connectivity Options
Platinum-Iridium	1031.2024	Several connection systems available, e.g. <ul style="list-style-type: none"><li>• Omnetics,</li><li>• Touch-proof plugs,</li><li>• Open cable ends.</li></ul> Please see page 24ff. for further information!



# StingRay 12 + 6

StingRay combines our ECoG electrode with the Floating Micro-electrode Arrays (FMA) by MicroProbes, enabling access to both: surface as well as depth signals. The product will be supplied as a ready-to-use assembly of both components.



- General Information:**
- Length of individual needles can be adjusted.
  - Combination shown here is comprised of 12 needle and 6 surface electrode contacts.

Product Configuration	Catalogue No.	Connectivity Options
Platinum-Iridium/Platinum-Iridium Platinum-Iridium/Iridium	1051.2001.01 1051.2002.01	Both product components are connected to an Omnetics connector via one cable.

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# Micro Cuff Tunnel

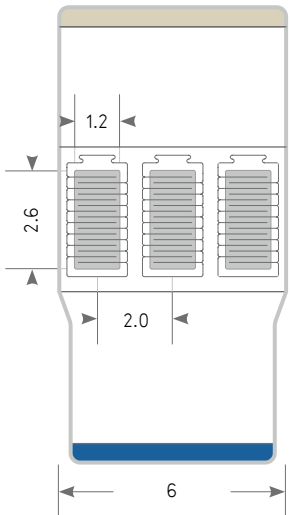
One of the major design innovations by CorTec: Cuff electrodes for recording from and stimulation of peripheral nerves with elastic modules. Micro Cuff Tunnel – the solution for easy handling.  
Please contact us for other electrode configurations or designs!



The innovation in **CorTec’s** split cylinder cuffs is their flexible structure: A unique closing mechanism with color-coded flaps enables easy handling. The contacts are designed as a flexible meandering structure, allowing the cuff to be stretched to a certain extent without exposing the contact to tensile forces.

During implantation the flaps work as an electrical seal. The electrode can be removed without affecting its functionality. Micro Cuff Tunnel electrodes are available in different diameters, starting from 200 µm, with varying numbers of contacts.

Please contact us fo custom design solutions!



Example of a Tri-polar Micro Cuff Tunnel with a diameter of 1000 µm and a cuff length of 6 mm:

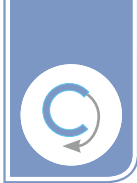
- General Information:**
- By default, cuffs are supplied with open cables (insulated wires with exposed ends). Please contact us, if you are interested in any other connectivity.
  - Learn more about our materials on page 29.
  - Product can be supplied sterile.

Available in various configurations with lateral cable entry in the following parameters:

		Inner Diameter	Length					Inner Diameter	Length	
			3	6	10				6	10
Bi-polar	0.2	x	–	–		Tri-polar	0.5	x	–	
	0.3	x	–	–			0.6	x	–	
	0.4	x	–	–			0.8	x	–	
	0.5	x	x	–			1.0	x	x	
	0.6	x	x	–			1.2	x	x	
	0.8	x	x	–			1.5	x	x	
	1.0	x	x	x			2.0	x	x	
	1.2	x	x	x			2.5	x	x	
	1.5	x	x	x			3.0	x	x	
	2.0	–	x	x						
	2.5	–	x	x						
	3.0	–	x	x						
Please contact us to receive our Order Form!										

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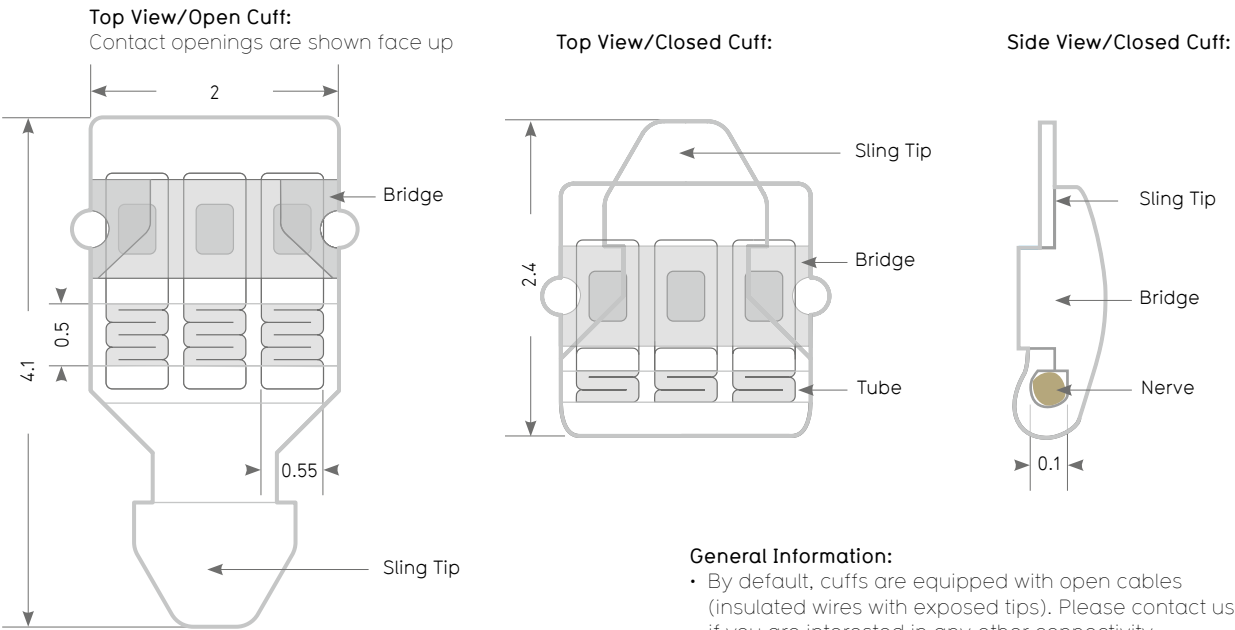


# Micro Cuff Sling

One of the major design innovations by CorTec: Cuff electrodes for recording from and stimulation of peripheral nerves with elastic modules. Micro Cuff Sling - the solution for smallest diameters. Please contact us for other electrode configurations or designs!



Example of a Tri-polar Micro Cuff Sling with a diameter of 100 µm and a cuff length of 2 mm:



- General Information:**
- By default, cuffs are equipped with open cables (insulated wires with exposed tips). Please contact us, if you are interested in any other connectivity.
  - Learn more about our materials on page 29.
  - Product can be supplied sterile.

Available in various configurations with the following parameters:

Bi-polar						Tri-polar					
	Inner Diameter	Cable entry lateral		Cable entry top			Inner Diameter	Cable entry lateral		Cable entry top	
		Length 2.0	Length 2.5	Length 2.0	Length 2.5			Length 2.0	Length 2.5		
Bi-polar	0.1	x	x	x	x	Tri-polar	0.1	x	x	x	x
	0.2	x	x	x	x		0.2	x	x	x	x
	0.3	x	x	x	x		0.3	x	x	x	x

Please contact us to receive our Order Form!

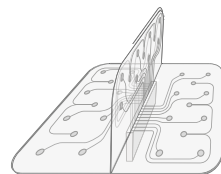
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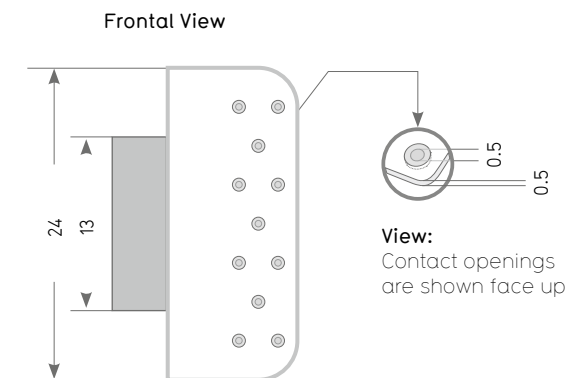
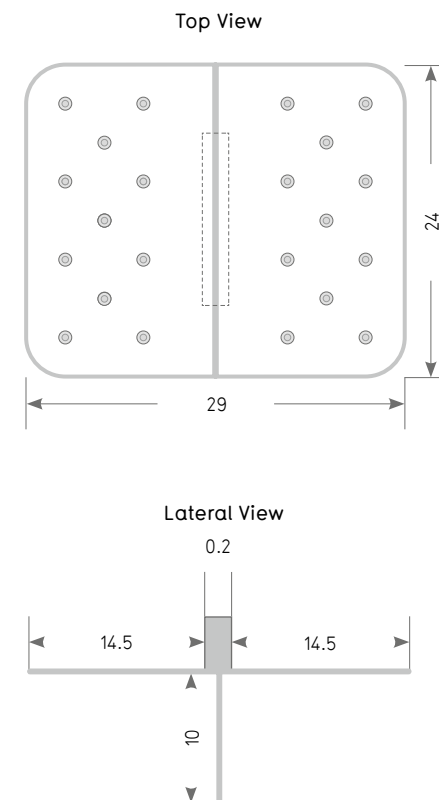


## 3D Designs

CorTec's innovation in 3D electrode design: °AirRay research for recording and stimulation in brain indentations. Please contact us for design requests in 3D!



Grid in real size



### General Information:

- Learn more about our materials on page 29.
- For more information about connectivity options (cables, connectors etc.) see page 24ff.

°AirRay research in 3D is a design inspiration for recording and stimulation from the surface of the brain as well as from indentations such as sulci or the midline. The 'keel' of the electrode has contacts on both sides, allowing access to both banks of the indentation.

The intrasulcal 3D electrode shown here is a design inspiration with 32 channels for recording and stimulation: 16 contacts on the surface of the brain plus, 8 contacts on each side of the 'keel'.

### Product Configuration

The product configuration shown on these pages is intended as a design inspiration.

Please contact us with your specific design request!

### Connectivity Options

Optimal connectivity for this product will be specified according to the individual layout and application.

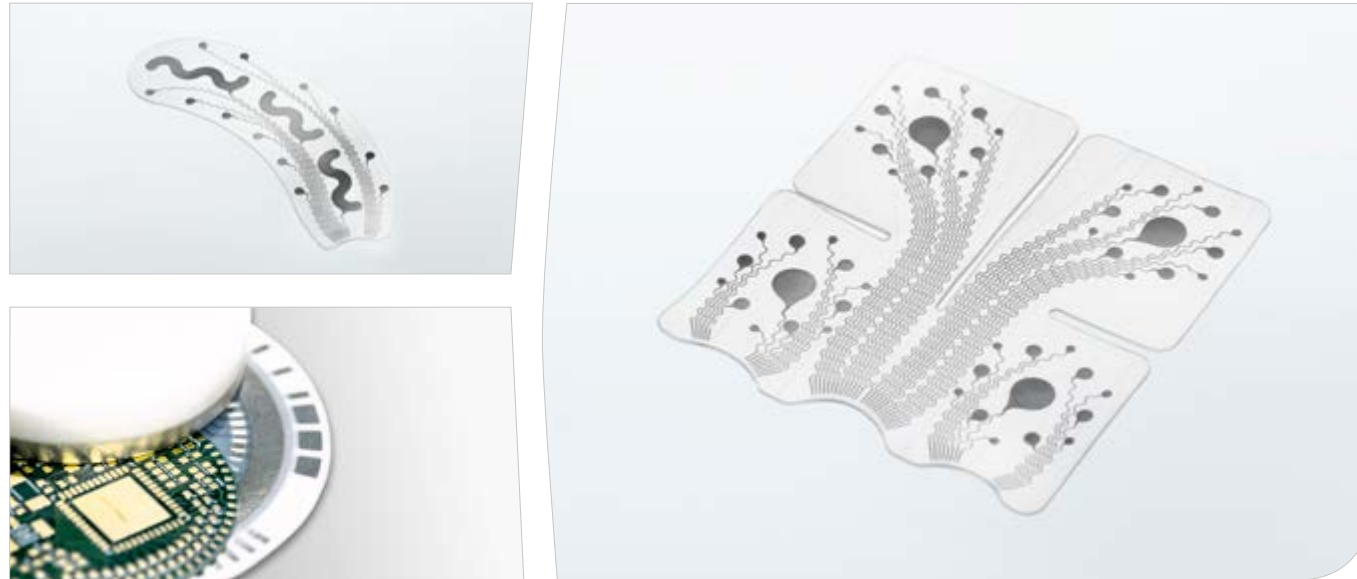
Please see page 24ff. for further information!

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## Design Inspirations

Individual solutions provide more flexibility. Our °AirRay technology allows us to produce grids with electrodes of any shape and spatial arrangement. Additionally we are offering packaging solutions in application-specific shapes and designs.



CorTec stands for cutting-edge technology for the next generation of implantable devices.

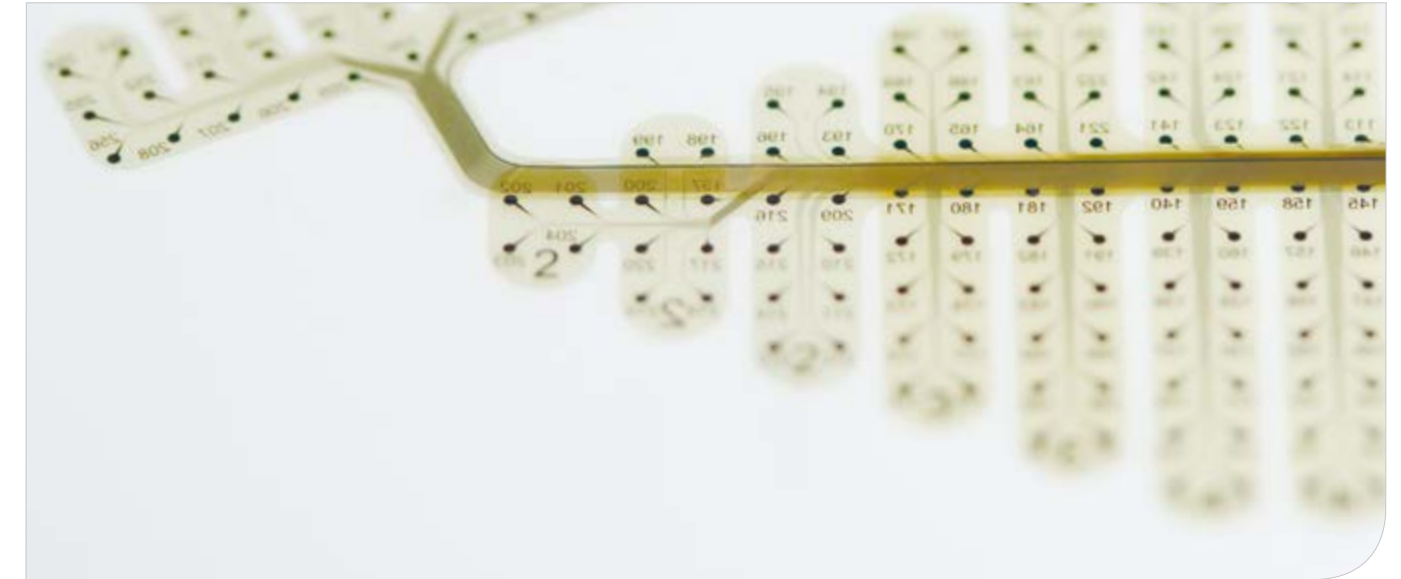
Thanks to our °AirRay electrode technology we can realize any shape of grid outlines – from the classical square shape to sectional, curved or circular designs. Contact layouts can vary from standard round contacts to elongated or curved designs. The smallest diameter that we are currently offering is 0.1 mm while the largest flat geometry possible is 90 x 90 mm. Learn more about possible electrode specifications on page 29.

Our ceramic encapsulation technology is the first packaging solution for implants with a very high channel count available on the market. Designed according to your requirements it ensures a protection of the implant electronics for decades.

Please contact us with your individual design requests!



## Polyimide-Based Electrodes



Apart from our broad range of silicone-based electrodes we can also deliver polyimide-based electrodes upon demand.

We can provide several designs suitable for interfacing with the central nervous system for surface or in-depth recording and stimulation. Interfaces to the peripheral nervous system are available in the form of cuff electrodes or penetrating shafts.

For a comparison of the material features of the two different substrates please see page 29.

Please contact us to learn more about our available designs!



## CorTec Brain Interchange

### Bi-directional Implant System



## CorTec Brain Interchange

### 3 Components

A fully implantable system for chronic open and closed loop interaction with the nervous system, consisting of:

An internal Electronics Unit to which implantable electrodes are connected.

A wireless External Unit that powers the implant, reads out the recorded data and transmits them to a PC. It also receives stimulation commands from the PC and instructs the implant to send electrical pulses to the electrodes.

A Software Package (C++ API) allowing you to program an experimental specific closed-loop algorithm according to your paradigm.

**CorTec** Brain Interchange currently features 32 channels, all of which can be used for recording and stimulation. No skin breach is involved due to its fully wireless functionality.

Please contact us with your order request!



# CorTec Brain Interchange Technical Specifications



# Additional Services & Information

## Recording

Channels	32 channels + 1 reference + 1 ground (ground switchable between dedicated ground electrode and any other electrode contact)
Sampling Rate	1000 Hz
ADC Resolution	16 bit
Upper Cutoff Frequency	450 Hz
Lower Cutoff Frequency	0.5 Hz

## Stimulation

Channels	Each of the 32 channels (concurrent stimulation at 4 channels: 3 predetermined channels, 1 switchable to any of the 32 electrode contacts)
Type	Current controlled stimulation (against ground)
Current	Max. - 6 mA / +1.5 mA for max. 1.5 kΩ impedance
Shape	Biphasic, charge balanced
Pulse Width	Programmable (negative phase: 10 μs - 2,500 μs; positive phase: 4 times the duration of the negative phase, with 1/4 of the amplitude of the negative pulse)

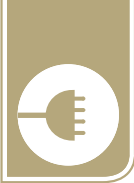
## Encapsulation

Dimensions	60 mm x 30 mm x 7 mm
Encapsulation Material	Ceramics
Coating	Medical grade silicone rubber Designed for long-term use

## Software

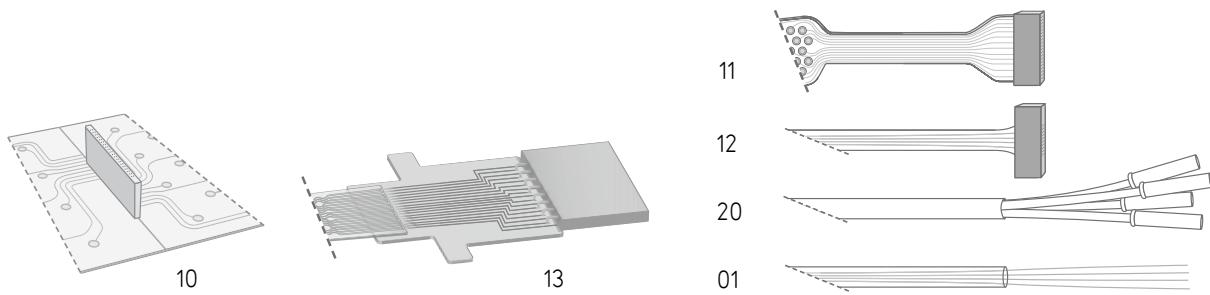
C++ Interface
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# Connectivity Options

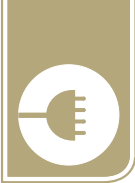
Flexible solutions for the connection of °AirRay research to external amplifiers and stimulators: wired variations.



Silicone-based designs offer various interfacing methods to external amplifier or stimulator systems. Omnetics connectors are most common to research applications. Several options are available: The connector can be placed on the grid, with a flat or round cable as an extension in between or on a printed circuit board (PCB).

Other connector types can be supplied upon request. For electrodes with a smaller number of contacts it can be convenient to establish a direct connection via touch-proof plugs for each channel. For optimal flexibility we also offer open cable ends (labeled by channel) for individual ways of establishing the connection.

Connectivity Option	Connection Code	Connectivity Option	Connection Code
Omnetics – direct to grid	10	Touch-proof plugs	20
Omnetics – flat cable	11	Open cable ends	01
Omnetics – round cable	12	Individual configuration	99
Omnetics – on PCB board	13		



# Connectivity Options | Wireless Headstages

Additional solution for the connection of °AirRay research Micro Grids equipped with Omnetics connectors: Wearable headstages for recording and stimulation offered by Multi Channel Systems.



Multi Channel Systems (MCS) offers a wireless system with 4, 8, 16, or 32 channels for amplification, recording, stimulation and analysis of in-vivo data. The corresponding headstages perfectly fit °AirRay research. Especially the Micro Grids shown on page 6 are specifically designed to fit the MCS wireless system.

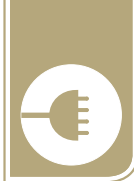
Individual designs are also available. By default, °AirRay research is connected to MCS wireless headstages via Omnetics connectors on PCB boards.

**For more information about the MCS wireless headstages please visit:**  
**[www.multichannelsystems.com/products/wireless-systems](http://www.multichannelsystems.com/products/wireless-systems).**

Upon request, we can supply the complete setup consisting of electrodes, wireless headstages and data acquisition system.

Please contact us for more information!





## Connectivity Options | Implantable System

A brand-new completely implantable solution: °AirRay research Micro Grids or Micro Cuffs can be attached to a small-sized completely implantable system developed by Triangle BioSystems International.

TBSI Implantable Wireless System with CorTec Micro Cuff electrode



We proudly present our new combo product in cooperation with Triangle BioSystems International (TBSI): Completely implantable miniature systems for recording or stimulation with either grid or cuff electrodes attached.

The TBSI Implantable Wireless System for recording is available with 5, 16 or 32 channels. It has a 50 kHz sampling rate and typical bandpass filtering between 0.8 Hz and 7 kHz per channel. It is compatible with electrodes of up to 1 MΩ impedance.

The TBSI Implantable Stimulation System is available with 2 channels that can be independently enabled and programmed. It drives electrodes with up to 20 kΩ resistance. The maximum output of the system is 1 mA.

Both systems have a package life of 90 days and are supplied with the required software.

Any electrode from our portfolio as well as individual designs with a matching number of channels can be attached.

For more information about the TBSI Implantable Wireless and Stimulation Systems please visit:  
[www.trianglebiosystems.com](http://www.trianglebiosystems.com)

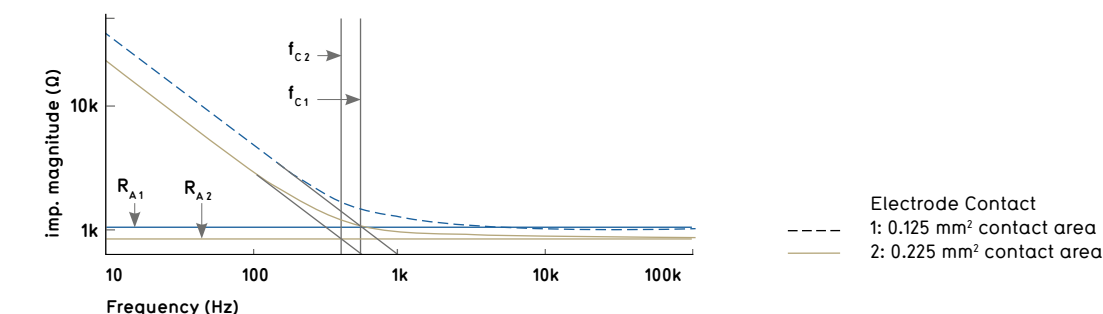
Choose your preferred system together with a matching electrode and we will supply the implant ready to use.

Please contact us for more information!



## Impedance Spectroscopy

As a special service we are offering impedance spectroscopy accompanying °AirRay research. The analysis is available either for selected contacts or for each contact of a design.



Impedance spectra show the electrochemical impedance of electrodes depending on signal frequency. Such detailed knowledge about electrode characteristics is especially important when dealing with small signals, as is typically the case in neural recordings.

Upon request we use the impedance spectra for extracting values for equivalent circuit models or determine key features such as access resistance  $R_A$  and cut-off frequency  $F_{\text{cut-off}}$ . This allows you to understand your setup better in order to get the best out of your experiments.

Impedance spectroscopy is available for all contact materials that we are offering. Our current portfolio includes:

- Platinum
- Platinum Black\*
- Platinum-Iridium
- Iridium Oxide

\* Nano-rough Platinum coating for improved stimulation performance





## Coating

To maximize the performance of our electrodes, i.e. signal to noise ratio for recording or maximum injectable charge in case of stimulation, we offer different types of coating.

High performance coatings have a positive influence on the signal to noise ratio in neural recording experiments. Their main strength is the increase of electrical charge injection capacity in electrical stimulation or blocking experiments.

The coating allows larger current amplitudes or stimulus pulse widths to be applied without risking electrode corrosion and neural tissue damage compared to a uncoated electrode.

The following charge injection capacities are achieved:

Pure Platinum-Iridium  
(no coating):

Standard contact material

90  $\mu\text{C}/\text{cm}^1$

Platinum Black Coating

Offered for any electrode design

250  $\mu\text{C}/\text{cm}^2$

Iridium Oxide Coating

Offered for selected electrode designs

700  $\mu\text{C}/\text{cm}^3$

<sup>1</sup> Cogan et al.: In Vitro Comparison of the Charge-Injection Limits of Activated Iridium Oxide (AIROF) and Platinum-Iridium Microelectrodes, 2005.

<sup>2</sup> Own investigations.

<sup>3</sup> Own investigations, matching Cogan et al.: Sputtered iridium oxide films (SIROFs) for low-impedance neural stimulation and recording electrodes, 2004.



## Technology Features | Silicone vs. Polyimide

Each of our electrode technologies has its own feature combination that renders it more suitable for some applications compared to others. The synopsis below gives an overview of the influences of the technological differences on the final product. Please contact us for further advice!

	Silicone-based Electrodes	Polyimide-based Electrodes
Minimum Thickness	100 $\mu\text{m}$	10 $\mu\text{m}$
Mechanical Properties	Soft, flexible & stretchable electrodes with various grades of stiffness	Flexible, not stretchable
Minimum Contact Spacing	100 $\mu\text{m}$	10 $\mu\text{m}$
Minimum Contact Size	100 $\mu\text{m}$	10 $\mu\text{m}$
Contact Shape	Any geometrical shape	Any geometrical shape
Contact & Lead Materials	Platinum, Platinum-Iridium, MP35N Others available upon request	Platinum, Others available upon request
Coating	Platinum Black, Iridium Oxide Others upon request	Platinum Black, Iridium Oxide Others upon request
Development Process	Fast & economical process from design to product; design modifications easily realizable	Timeline from design to product: 2 months; the same for design modifications (currently not available)
Manufacturing Process	Flexible CAD/CAM laser processing	MEMS batch processing
Connectivity	Easy & quick connection to many connectors & cables	Restricted connectivity options
Long-Term Implantability	Proven	Possible



You can order all products from this catalogue with reference to their item number. Please contact us, if you are interested in modified versions! All products are available with various connection systems (see page 24ff.).

Please make sure to indicate the connection system of your choice in your order! Simply attach the corresponding Connection Code to the Catalogue Number according to the following examples:

- **AirRay research** Micro 16 Hexagonal in Platinum Iridium with Omnetics connector on PCB board.
- Catalogue Number. **Connection Code**
- 1031.2008.13

Many research projects require individual solutions. Please contact us for special design requests!

We are happy to assist you!

Please contact us to request a quotation:

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