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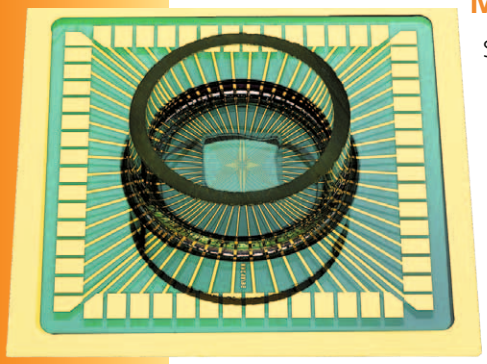
Innovations in Electrophysiology

MEA-System

Extracellular recording with microelectrode arrays for all applications

- Well-established technology
- Recording from up to 256 channels
- Microelectrode arrays with various layouts
- Broad range of accessories

Overview MEA-System



Microelectrode Array: A well-established technology

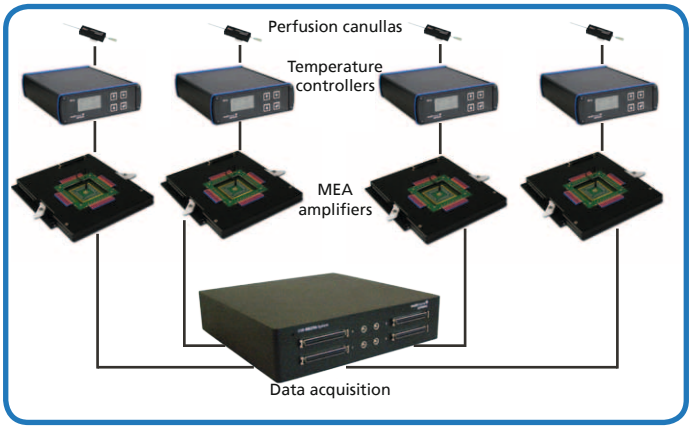
Since its introduction 30 years ago, the technology and the related culture methods for electrophysiological cell and tissue assays have been continually improved and have found their way into many academic and industrial laboratories. MEA technology has attracted increased interest because of a growing need to screen selected compounds against ion channel targets in their native environment at organic, cellular, and sub-cellular level.

The Microelectrode Array (MEA)-System is a compact and innovative tool for *in vitro* experiments. You can place cell and tissue preparations from heart, brain, and muscle on the MEA and record the electrophysiological signals with the MEA amplifier. The signals are then analyzed with the included software. The modular principle offers various possibilities for a set-up extension with perfusion and stimulation devices.The MEA-technology is an easy and straightforward approach to apply electrophysiological techniques for drug screening and basic research. Over 600 publications in scientific journals prove its versatility and reliability.

Classical MEA-Systems with 60, 120 or 240 channels

The classical MEA-System consists of a data acquisition computer, one to four MEA amplifiers, MEAs, and a temperature controller.

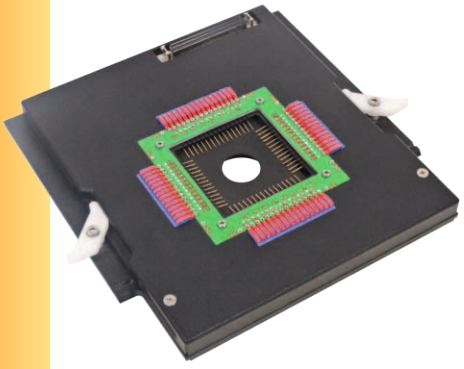
The core element is the MEA amplifier with 60 channels. Depending on your experimental need, you can decide whether to build a setup with one, two or four amplifiers, resulting in a system with 60, 120 or 240 channels respectively. You can run completely independent experiments on each of the amplifiers.



MEA amplifiers are available in two different versions, designed specifically for upright and inverted microscopes.

For data acquisition, you can choose either the PCI-bus data acquisition card, which is preinstalled in a computer or a USB data acquisition, which can easily be connected via USB 2.0 High Speed to any PC or laptop.

No matter which option you choose, flexibility, the possibility for setup expansions, and our recording and analysis software MC_Rack are always included.



Benefits of the MEA-Systems from MCS

- Suitable for upright and inverted microscopes.
- Widest range of MEAs available on the market.
- Unlimited and free software upgrades: flexible data acquisition and analysis software MC_Rack.
- Easy adaption to our stimulus generators.
- Stimulus artifact suppression.
- Expandable to multiple amplifier system.
- Software selection of stimulation electrodes.
- Real-time spike detection and feedback generation.

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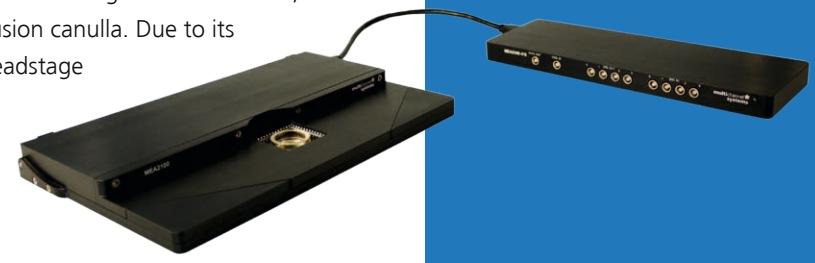
MEA-Systems with integrated stimulation: MEA2100-System

The MEA2100-System is composed of a data acquisition computer with software, an interface board, one or two MEA-headstages with integrated stimulation, MEAs, as well as temperature control and perfusion canulla. Due to its small-sized design you can position the MEA-headstage on any inverted or upright microscope. It is connected via only one MCS High Speed cable to the interface board, which offers various digital and analog in-/outputs for synchronization with other instruments.



The main advantage of the MEA2100-System is its flexibility.
Multi Channel Systems offers various contact units for the MEA-headstage. You can decide whether to work with one 60-electrode MEA, one 120-electrode MEA, or even two 60-electrode MEAs.

Moreover, it has a digital signal processor for real-time signal detection and feedback.

The flexibility of the MEA-2100-System is also shown in the possibility to connect two MEA-headstages to the interface board. This way, you can record from up to 240 channels. By e.g. using two headstages with two 60-electrode MEAs each, you have a four-fold system and increased throughput. The headstages are controlled completely independently by opening the data acquisition software MC_Rack multiple times.

All-in-one solution for 256 channels

The USB-MEA256-System is a stand-alone plug- and-play data acquisition system based on signal processing technology.

All necessary components are combined in one device:

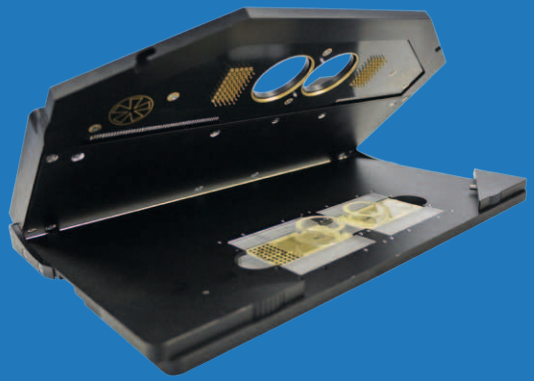
- Integrated amplifier for 252+4 channels: 252 channels from the microelectrode array plus 4 additional channels for simultaneous patch clamp recordings or any other analog signals such as temperature, pH, etc.
- Integrated analog/digital board for converting analog signals to digital data streams at 16 bit resolution and a sampling rate of 40 kHz/channel.
- Integrated temperature control.
- Easy adaption to our stimulus generators for current and voltage driven stimulation. Each electrode can be used for stimulation.

Acute hippocampal slice recording system

The acute hippocampal slice recording system, MEA2100-32-System, is a stand-alone solution for extracellular recording and stimulation using perforated microelectrode arrays (pMEAs). It is designed specifically for experiments with acute hippocampal slices, but can be used for all acute slice preparations.

Based on the MEA2100 technology, the system consists of a headstage and an interface board. Headstages are available for one or two microelectrode arrays (32 recording, 12 stimulation electrodes) and contain a 32- or 64-channel amplifier and data acquisition, as well as an integrated three-channel stimulator per MEA. Perfusion, heating, and the possibility to apply suction through the pMEAs are also included.

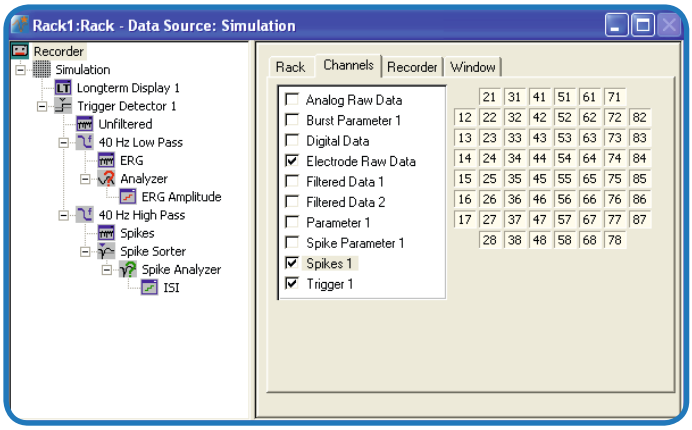
The system is compact and can be used on a standard lab bench. As two headstages can be connected to one interface board, you can record from four microelectrode arrays simultaneously.



Software

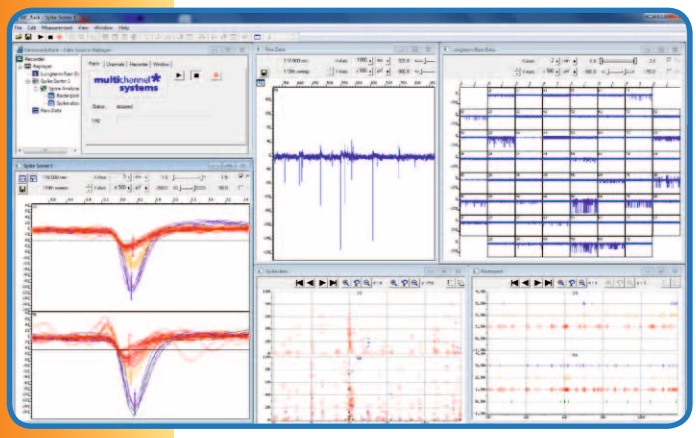
Flexible and easy-to-use software

The data acquisition and analysis program MC_Rack is highly adaptable with unlimited possibilities. It is included with all MEA- and ME-Systems.



For routine lab work, the program is set up like an instrument rack on a workbench:

- Combine virtual instruments (e.g. oscilloscope, filter, spike sorter, and much more).
- Virtual instrument rack: Use task-oriented template racks or design your own.
- Select any permutation of data streams for displaying, analyzing, exporting, etc.
- Extract parameters like spike rates for online or offline analysis.
- Apply several digital filters with different cutoff frequencies e.g. to separate spike activity from local field potentials.

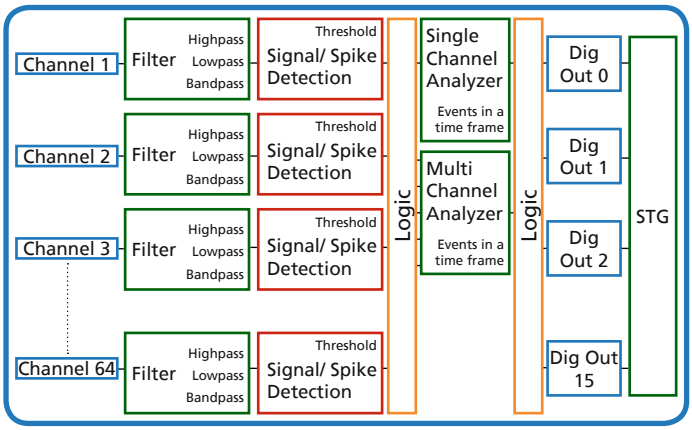


Online and offline analysis features of MC_Rack

Online filtering, spike sorting, local field potential (LFP) extraction, and triggering allow you to monitor parameters during the experiment and save offline analysis time. For ultimate experimental control, you can integrate the program controls (DLL) into your own custom software.

After the experiment you can review the raw data and extract additional parameters offline. Adjust spike detection or analyzer settings and re-run your experiment any number of times. Take the computer performance to the limit and extract multiple parameters in parallel. For example, you can use signal rate, peak-peak amplitude, slope 10/90 % and more; or separate different signal frequencies by digital filters and analyze them separately.

Real-time signal detection and feedback



Synaptic communication between neurons and wave propagation in cardiac tissue happen on a millisecond timescale. Many applications require stimulating at defined locations within a neuronal network as a response to activity on one or more specific electrodes. The real-time signal detection and feedback allows sending out trigger pulses within less than 100 µs and trigger a stimulus with less than 1 ms delay. In order to achieve this extraordinary performance the signal detection, analysis, and feedback logic happens on a special signal processor unit within the USB data acquisition. This bypasses the PC altogether to speed up the process. With real-time signal detection and feedback, it is possible to enable communication between devices accepting TTL pulses as a trigger without delay.

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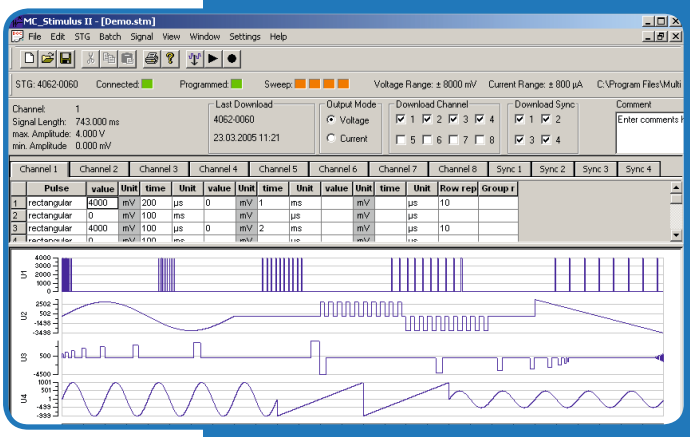
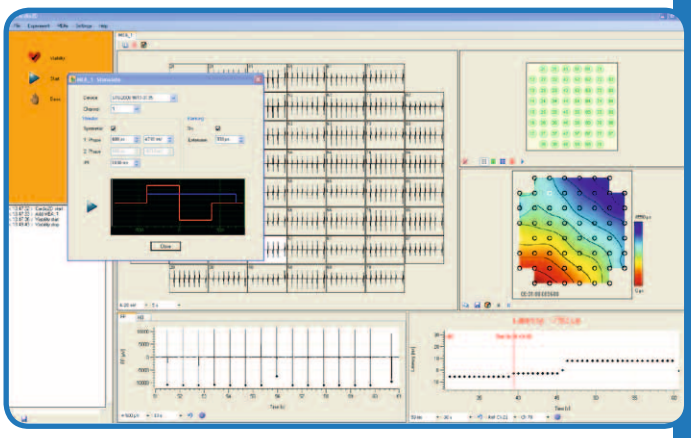
Stimulation software: MC_Stimulus

MC_Stimulus is a flexible software solution to control the STG series stimulus generators. One can program current and voltage pulses and download the stimulation patterns into the stimulus generator. Pulse patterns can be as simple as rectangular pulses or as complex as biological signal shapes or even white noise.

For simple protocols seperate software STG-Lite provides a simple adjustment of the frequency and the amplitude of stimulus signals by virtual knobs, whereas MC_Stimulus allows free signal programming and ASCII import.





For cardiac applications: Cardio2D

Cardio2D is a software package to record cardiac data and analyze this data for spatial properties of cardiac signal propagation.

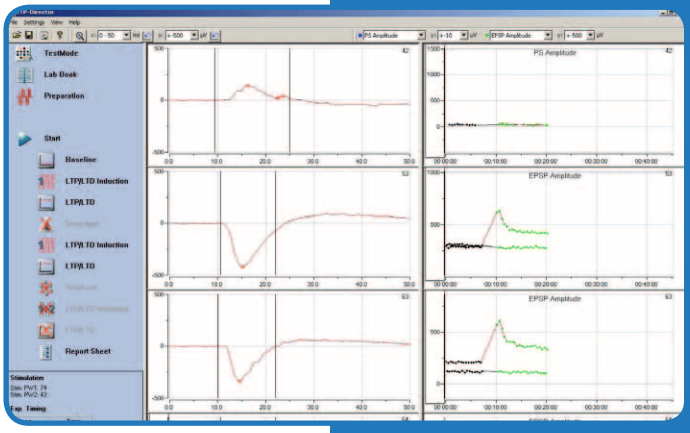
It is now possible to perform epicardial mapping recordings or map signal propagation in cardiac slices.

Cardio2D obtains false color coded maps with isochronous lines for local activation times. Conduction velocity is calculated automatically. Moreover, the software integrates the control of the stimulus generator.

For LTP/LTD experiments: LTP-Director

The software package LTP Director and LTP Analyzer is designed to run standard LTP/LTD experiments in acute hippocampal slices. It includes the control of recording, stimulation, and electrode selection, as well as an integrated documentation of the experiment in one program. Furthermore, it is possible to control an automatic perfusion system. The course of the experiment can be designed up front and then run automatically.

LTP Director is used for recording and LTP Analyzer is used for offline analysis of the data. Results can be normalized to baseline values and exported as relative ASCII values to a database.



Accessories

Stimulus generators

The stimulus generators of the 4000 series operate in voltage or current mode. The respective mode is selected by the included software. You can decide in favor of 2, 4 or even 8 completely independent stimulus outputs. Every single output is optically isolated and has the ability to provide any arbitrary analog waveform as stimulation signal. Every STG comes with MC_Stimulus software.

Furthermore, for every single stimulus output there is one TTL in- and output, so you can synchronize your data acquisition or trigger other devices. You can dynamically change the output signal and downstream pulses during stimulation.

Stimulation isolation units (one per output channel) are already included in the stimulus generator. You do not need any other device - just plug in your stimulator and start your experiment!

Temperature controller

The general purpose temperature controller (TC) is included with each MEA-System. Depending on the set-up, the TC has one or two output channels.

The Pt100 sensor guarantees a stable and precise temperature control over a wide temperature range. You can adjust the temperature accurately from ambient temperature up to 105 °C using either the buttons on the device itself or the included TCX_Control software. This software also tracks the temperature and saves the data, so you can review it anytime.

Peristaltic perfusion system

The peristaltic perfusion system is the perfect addition to all microelectrode array recording systems. The peristaltic pump PPS2 has one inlet and one outlet pump.

The main advantage of the PPS2 is its low pulsation. A low-pulsation contruction, a brushless motor with constant rotation speed and low electromagnetic emission, and droplet isolation chambers all contribute to an overall low pulsation level.

The flow rate of both pumps can be adjusted in the following ways:

- Software (included, connection via USB 2.0)
- Touch screen on the pump itself
- Additional analog input

The peristaltic perfusion pump is included with all MEA-Systems with perfusion cannula. In combination with the also included magnetic perfusion holders, you have all that is needed to start perfusion right away.

MEA-Introduction

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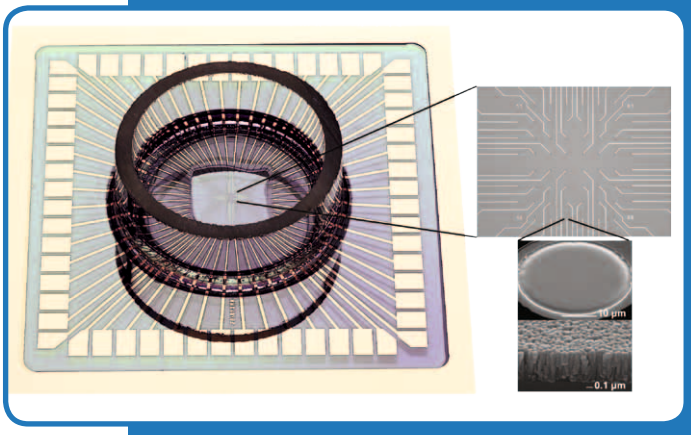
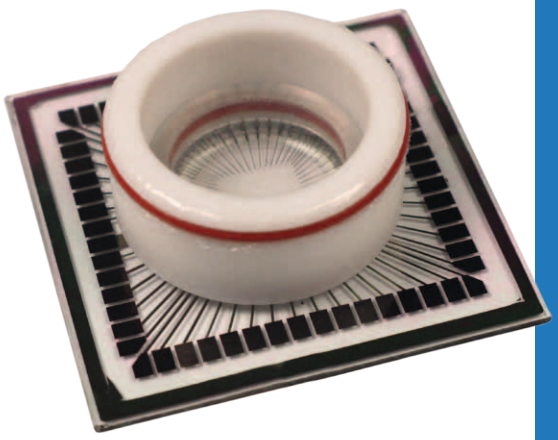
Extracellular recording with Microelectrode Arrays

A microelectrode array (MEA) is an arrangement of typically 60 electrodes allowing the targeting of several sites in parallel for extracellular recording and stimulation.

Cell lines or primary cell preparations are cultivated directly on the MEA. Freshly prepared slices can be used for acute recordings, or can be cultivated as organotypic cultures (OTC) on the MEA.

Several MEA geometries are provided for a wide variety of applications. Almost all excitable or electrogenic cells and tissues can be used for extracellular recording *in vitro*, for example, central or peripheral neurons, cardiac myocytes, whole-heart preparations, or retina.





Widest and best choice for all applications

The broad range of applications is reflected by the variety of MEAs with different geometries that have been developed to cover as many applications as possible.

The biological sample can be positioned directly on the recording area; the MEA serves as a culture and perfusion chamber. A temperature controller controls the temperature in the culture chamber. Various culture chambers are available, for example, ones with leak proof lids or with semipermeable seals. An incubator is not necessarily required, long-term recordings in the MEA culture chamber are possible over several weeks or even months.

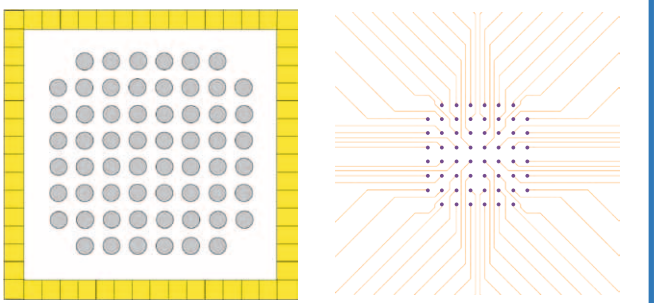
Production at highest quality standards

The Natural and Medical Sciences Institute (NMI) in Reutlingen, Germany (www.nmi.de), produces MEAs from very pure, fine quality and highly biocompatible materials. The NMI is a research institute, with which Multi Channel Systems has collaborated on many projects and over many years.

Quality controls and production processes have been improved over the last years so that MEAs are always of an excellent and consistent quality.

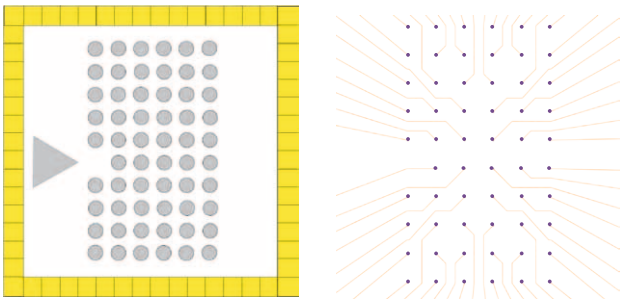
MEA-Layouts

Standard 8x8 layout



The configuration of 8 by 8 electrodes is the most versatile configuration. Applications range from neuronal networks to brain slices and from stem cell derived cardiomyocytes to cardiac tissue preparations. The spacing of the electrodes is available at 100 µm and 200 µm. This represents a square shaped recording area of 700 µm or 1.4 mm respectively. The electrodes are available with diameters of 10 µm and 30 µm. The advantage of 30 µm diameter electrodes is their low impedance and low noise level. 10 µm electrodes enable recording from single neurons or single cardiomyocytes.

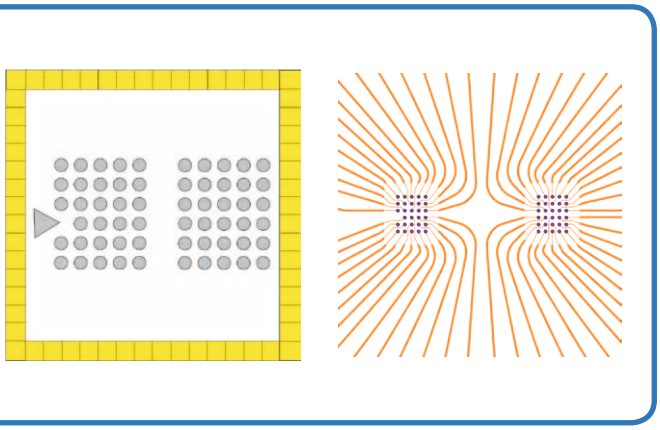
Some MEAs feature internal reference electrodes. Due to the integrated reference the culture can be kept sterile during recording to enable repeated recordings of long-term cultures.



6x10 layout

The 6 by 10 layout features an interelectrode distance of 500 µm. This creates a recording field of 4.5 mm by 2.5 mm. With these dimensions larger tissue samples can be recorded on one array. Each of the electrodes can be used for stimulation as well. All MEAs with the 6x10 layout also feature internal reference electrodes. Each of the electrodes can be selected as a stimulation electrode as well. The electrode material is TiN. The micro-column structure of each electrode minimizes impedance and allows low-noise recordings. The extremely durable material allow as much as 50 re-use cycles with acute experiments.

HighDense MEAs



A 30 µm electrode spacing is the ultimate in spatial resolution. This is possible by arranging 60 electrodes in two recording areas of 30 electrodes each. These two areas are spaced at 500 µm. The configuration within the two distinct recording areas is 5 by 6 electrodes. This translates into two distinct recording fields of 120 µm x 150 µm. The gap between the recording areas is used to guide the connecting lanes to the contact pads.

The main application of this MEA type is high resolution recording of individual neurons in neuronal networks. The electrode diameter is 10 µm. A low noise level is guaranteed by the use of TiN as electrode material.

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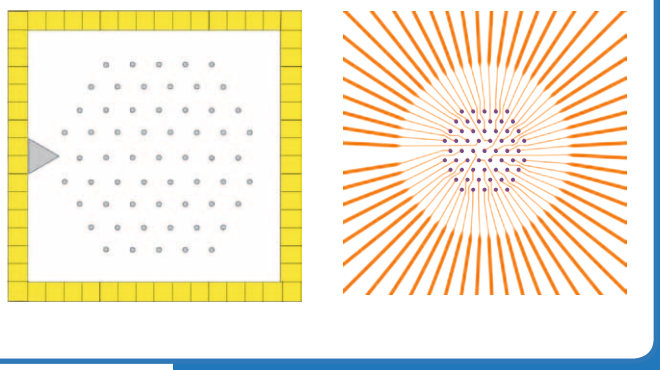
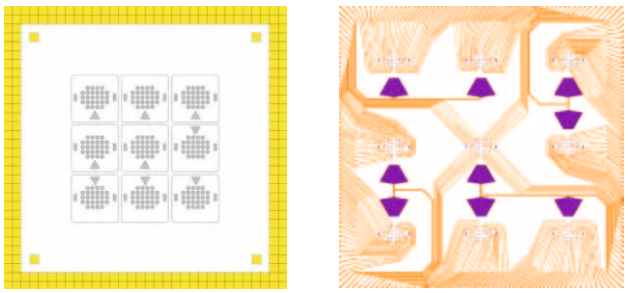
HexaMEAs

The 60 electrodes of HexaMEAs are available in two geometries. Either, the electrodes are aligned in equal distances (40 µm) with one electrode diameter (10 µm) as shown on the left or in a special configuration with varying electrode diameters (10, 20, 30 µm) and interelectrode distances.

The specific layout with varying diameters and distances ideally resembles the regularity of the retina's architecture. The density of neurons is more important in the center than in the peripheral. This is matched by the density of electrodes on the MEA, which is also higher in the center than in the peripheral.





Multi-well MEAs

To increase the throughput in drug testing and screening applications we offer MEAs with multiple wells. These allow operation of up to nine independent experiments on one MEA. They can be used to run a number of replicates in parallel or to obtain a complete dose response curve within one recording. The 256MEA technology has 28 electrodes and internal reference in each well of a 9-well MEA chip.

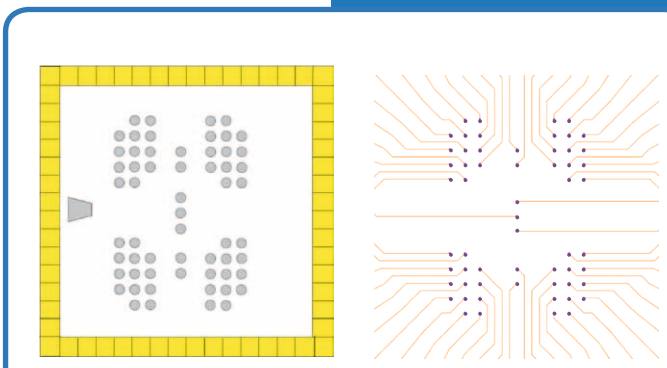
Applications include toxicology, neurobiology, stem cell research, and safety pharmacology. The data streams from the different wells can be analyzed individually.

Currently MCS offers 6-well MEAs with 60 electrodes and 9-well MEAs with 252 electrodes.

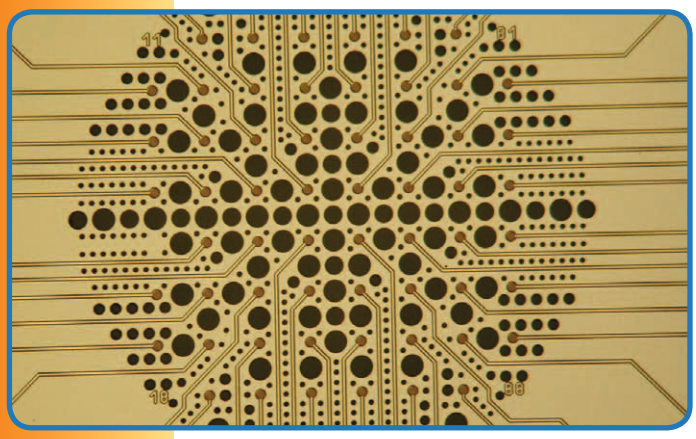
Special layouts

Different applications do have special requirements regarding electrode configuration, materials, and special features. Multi Channel Systems puts customer needs as the top priority. In collaboration with some of our customers we have developed a wide range of special electrode layouts. Some typical modifications include the addition of specially shaped stimulation electrodes or set-up layouts with four quadrants of high density recording areas.

The material used for special layout MEAs is very variable. Electrodes can be made from Gold, TiN, ITO or even Iridium. It is possible to integrate microfluidics and perforation. The basic material can be glass, printed circuit boards or a polyimide foil.



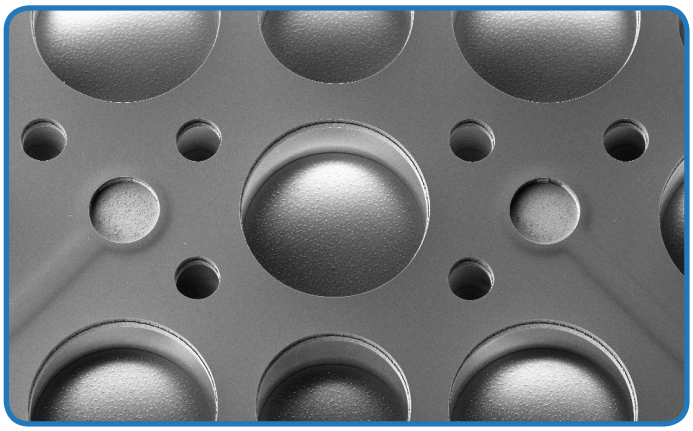
MEA-Types



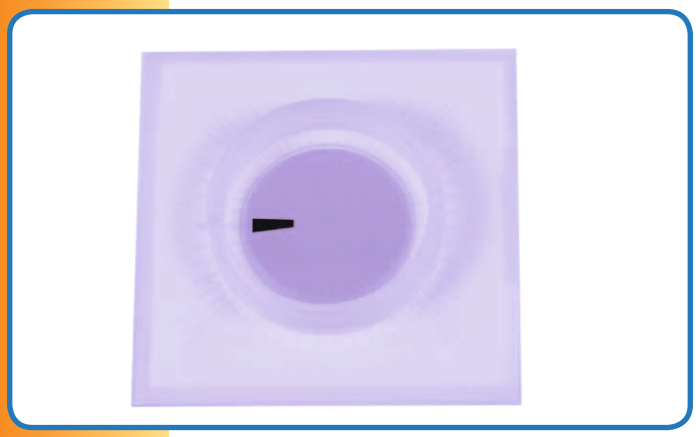
Perforated microelectrode arrays

Perforated MEAs (pMEAs) are manufactured on a thin polyimide foil instead of a glass substrate. The foil is fixed on a glass carrier for physical stability. Around the electrode field, there is a circular area where the foil is perforated by holes of variable diameters (see image, dark spots). In combination with a perfusion ground plate (PGP), these perforations make it possible to perfuse your tissue preparation from the bottom while you record from it on the MEA. All that is needed to work with pMEAs is available as an upgrade to the regular MEA-System. Perforated MEAs are available with 32, 60 or 120 recording electrodes.

pMEAs and perfusion



Perforated MEAs were designed to enable perfusion of the tissue on the array from the bottom. When recording from an acute slice preparation with MEA electrodes, signals are detected from cells at the bottom of the slice. These cells are probably less healthy then the ones on the top, because they get less oxygen and nutrients from the perfusion solution. Perfusion from the bottom solves this problem and enables better signals and improved long-term survival of your acute slices. In addition, slices can be held in stable contact with the MEA surface by applying a negative pressure, thereby sucking the tissue down to the electrodes. A slice anchor (weight) is no longer necessary.



ThinMEAs

ThinMEAs are as thin as a coverslip glass (180 µm). This makes them ideal whenever high resolution imaging is combined with MEA technology.

There are two key advantages of ThinMEAs: Firstly, low working distance objectives with high magnification can be used to view subcellular structures while recording electrical activity. Second is that UV transmission which allows combining Calcium imaging (e.g. with FURA2) and MEA recording.

All tracks of ThinMEAs are made from ITO – an electrically conducting, transparent material. This leaves just the electrodes opaque and allows perfect vision all over the array. ThinMEAs are available with 60 and 252 recording electrodes.

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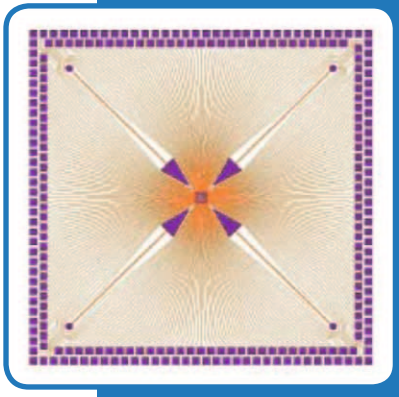
MEAs with 256 electrodes

With the introduction of the USB-MEA256-System MCS also introduced MEAs with 256 electrodes. There are three advantages with the increased number of electrodes:

- Higher spatial resolution
- Larger recording area
- Higher throughput

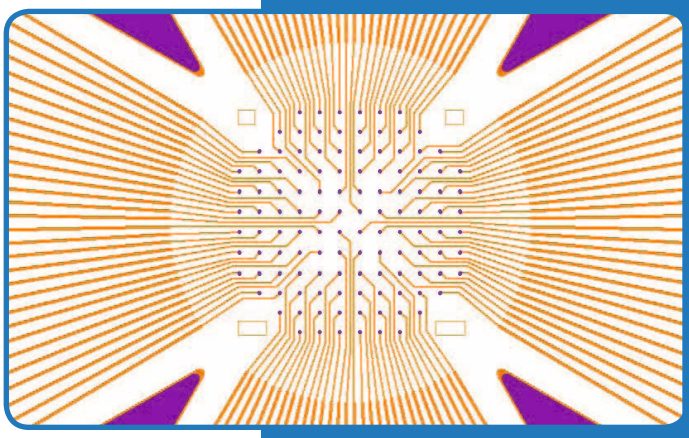


By reducing the electrode spacing it is possible to map a distinct area with a higher spatial resolution. In a 16 by 16 electrode array grid electrode spacing of 30, 60, 100, and 200 µm are available. The electrode diameter is 8, 10, and 30 µm. All 256MEA layouts have internal reference electrodes.

Apart from the 16x16 layout, Multi Channel Systems also offers a 9-well MEA for the USB-MEA256-System. It has 26 recording electrodes (30 µm diameter, TiN) and two large stimulation electrodes (200 µm by 50 µm) in every well. Each well has an internal reference electrode. Every recording electrode can be used for stimulation and even the stimulation electrodes can be used for recording.

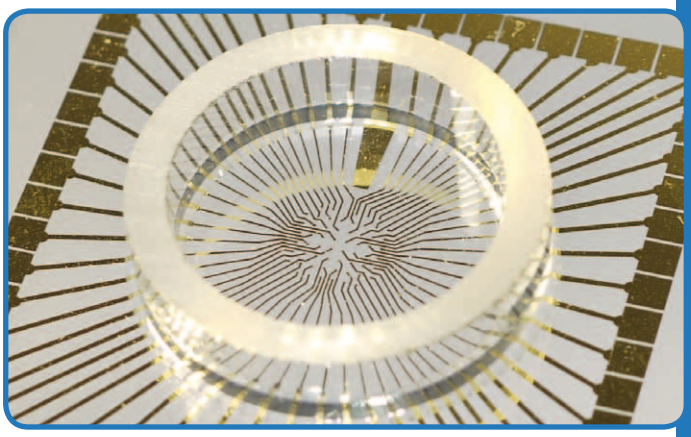
The researcher has all options to design the experimental setup that best suits them. Since analysis of such a large set of data recorded with 256 channels is tedious, MCS offers semi-automated analysis routines and easy export features into Matlab or other analysis programs.

MEAs with 120 electrodes for the MEA2100-System



One of the main advantages of the MEA2100-System is its flexibility. Because it is available with various contact units, you can choose to operate it with MEAs with 120 electrodes. They are arranged in a 12x12 grid, sparing 6 electrodes in each corner. Every single electrode is selectable for stimulation via the included software. Only click on the respective electrode and it will be used for stimulation.

Currently, 120MEAs are available with 100µm and 200 µm electrode spacing and 30 µm electrode diameter, as standard glass MEAs as well as perforated MEAs. Other configurations are under development. Please contact us if you need a custom layout.



EcoMEAs

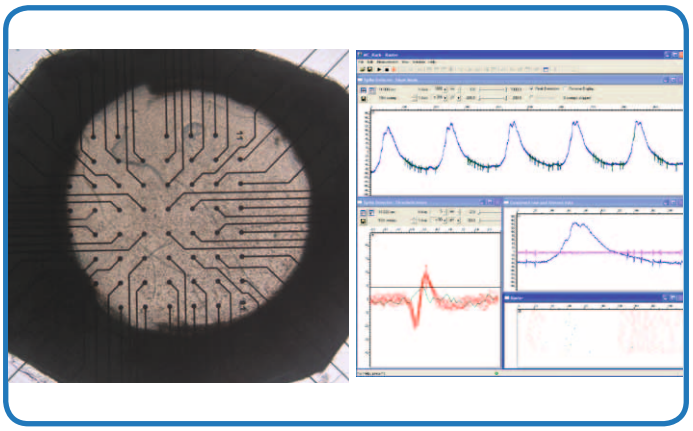
The EcoMEA is a low cost option for routine experiments, particularly in cardiac research. As the requirements to spatial resolution are not that challenging here MCS opted for a more economic manufacturing process. Electrodes are made from gold, have a diameter of 100 µm, and a spacing of 700 µm. We can either use float glass carrier or printed circuit board. The latter allows us to design special layouts at very reasonable costs. Both materials can be sterilized by autoclaving, radiation or ethanol. Gold electrodes are very robust and guarantee an extended number of re-use cycles.

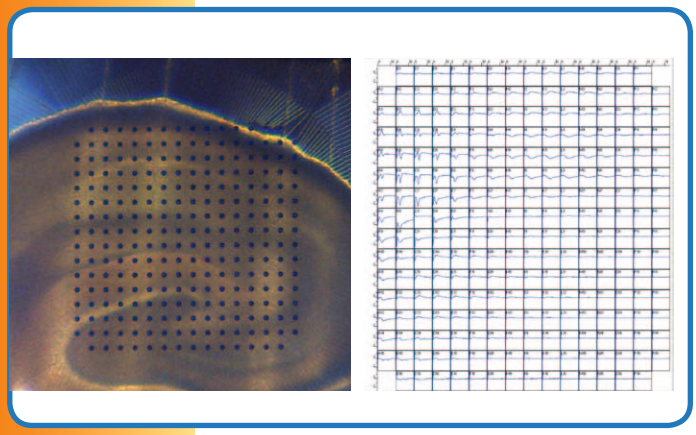
Applications

Retina

Retina whole mount preparations can be recorded on the MEA. Special MEA layouts are available that are adapted to the architecture of the retina. It is possible to stimulate the tissue either with light or with electrical stimuli with the MEA electrodes.

Spikes and µERGs can be recorded at the same time and the signal components can be separated by adjustable online filters.





Acute slices

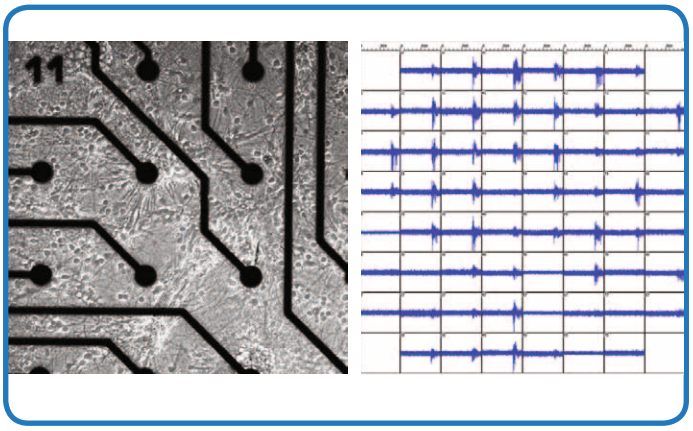
Acute slice preparations can be placed on the MEA, and all electrodes can be used for simultaneous recording or stimulation. The large number of electrodes makes it possible to acquire information from all areas of your preparation simultaneously.

When using a MEA-System with the blanking circuit technology , it is very easy and fast to scan for the best stimulation site, as the stimulation electrode can be selected by software.

Perforated MEAs were specifically designed to optimize recording conditions and survival of acute tissue slices on MEAs, thereby allowing stable long-term recordings. pMEAs are also available in layouts adapted to the hippocampal formation.

Neuronal cell cultures

It is possible to grow primary neuronal cells or cell lines directly on the MEA surface, and record continuously or repeatedly over extended periods of time (up to several months). The high number of electrodes and the large recording surface ensures that the activity from a wide part of the network is detected, and not only from a single spot. Neuronal cultures on MEA are a well established system that is used in many labs around the world.



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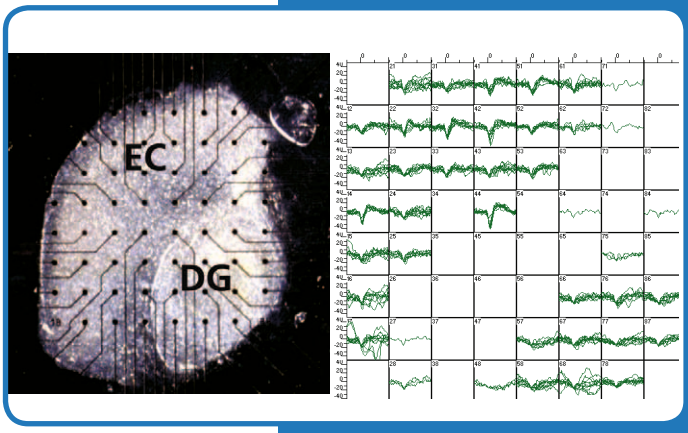
Organotypic cultures

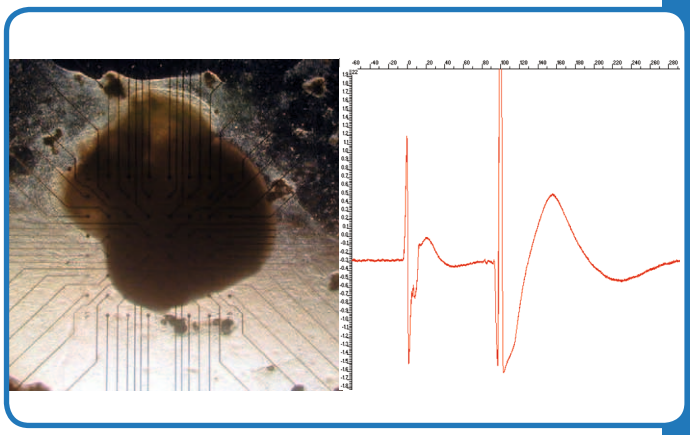
Organotypic cultures can be grown on filter membranes and then be recorded on MEAs the same way as acute tissue preparations. Alternatively, it is possible to grow the tissue cultures directly on the MEAs. This enables repeated recordings over an extended period of time, and makes it possible to follow long term processes like neuronal development or regeneration in one preparation.



Cardiac cell cultures

Cardiomyocytes, isolated from embryonic chicken, neonatal rat or mouse, or cardiac cell lines such as HL-1 cells can be cultured on the MEA dish. The cells couple by gap junctions and form a functional syncytium with one or multiple pacemakers. The cell culture can be paced by external or internal stimulation electrodes.

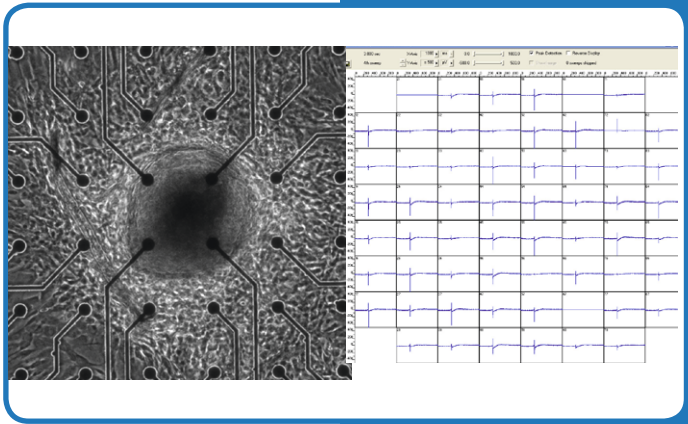
The cardiac cell culture on MEA is a valuable assay system in cardiac toxicity and safety pharmacology research. It can also be used as a model system for arrhythmia research. The multitude of electrodes allows measuring conduction velocity and plot local activation time maps.



Stem cells

Embryonic and adult stem cells from mouse, monkey, and man as well as induced pluripotent cells can be differentiated into neurons or cardiomyocytes. These cells can be cultured on the MEA and characterized by repeated measurements over extended time scales. It is possible to determine functional details of the differentiated cells by selected pharmacological tools (e.g. differentiate between ventricular and atrial cardiomyocytes).

Cardiomyocytes obtained from stem cells are a valuable screening tool in drug discovery as they fully reflect the properties of human cardiomyocytes.



Overview MEAs

Product name	Electrode grid	Total # of electrodes	Electrode spacing (µm)	Electrode diameter Ø (µm)	ITO tracks option	Culture chamber interface options*				
						w/o ring	glass ring 6 mm high**	plastic ring without thread 6 mm high**	plastic ring with thread 6 mm high**	macrolon ring
Standard MEAs: TiN electrodes, SiN isolator, opaque or transparent contact pads (TiN or ITO) and tracks (Ti or ITO)										
60MEA100/10	8x8	60	100	10	○	○	○	○	○	
60MEA200/10	8x8	60	200	10	○	○	○	○	○	
60MEA200/30	8x8	60	200	30	○	○	○	○	○	
60MEA500/10	6x10	60	500	10		○	○	○	○	
60MEA500/30	6x10	60	500	30		○	○	○	○	
SquareMEAs: TiN electrodes, SiN isolator, opaque or transparent contact pads (TiN or ITO) and tracks (Ti or ITO)										
60SquareMEA	8x8	60	200	50		○	○	○	○	
PedotMEAs: PEDOT-CNT electrodes, gold contact pads and tracks										
60PedotMEA200/30	8x8	60	200	30		○	○	○	○	
High Dense MEAs: TiN electrodes, SiN isolator, transparent (ITO) contact pads and tracks										
60HDMEA30/10	2x (5x6)	60	30	10	●	○	○	○	○	
HexaMEAs: hexagonal layout. TiN electrodes, SiN isolator, opaque or transparent contact pads (TiN or ITO) and tracks (Ti or ITO)										
60HexaMEA	hexagonal	60	30, 60, 90	10, 20, 30	○	○	○	○	○	
60HexaMEA40/10	hexagonal	60	40	10	●	○	○	○	○	
pMEAs: Polyimide foil with perforation on glass carrier, TiN electrodes, SiN isolator, opaque contact pads (TiN) and tracks (Ti)										
60pMEA100/30	6x10	60	100	30		○	○	○	○	
60pMEA200/30	8x8	60	200	30		○	○	○	○	
120pMEA100/30	12x12	120	100	30		○	○	○	○	
120pMEA200/30	12x12	120	200	30		○	○	○	○	
pMEAs for acute hippocampal slices for use with USB-MEA32-STIM4-System: Polyimide foil with perforation on glass carrier, TiN electrodes, SiN isolator, opaque contact pads (TiN) and tracks (Ti), four layouts L1 to L4										
pMEA32S12	10+12+ 10 or 4x8	32 (rec.) 12 (stim.)	90, 100, 125, 150	30 (rec.) 50 (stim.)		○	○			
StimMEAs: TiN electrodes (4 pairs of large stimulation electrodes with 70x250µm), SiN isolator, opaque contact pads (TiN) and tracks (Ti)										
60StimMEA200/30	8x8	60	200	30		○	○			
120MEAs: TiN electrodes, SiN isolator, opaque or transparent contact pads (TiN or ITO) and tracks (Ti or ITO)										
120MEA30/10	12x12	120	30	10	●	○	○	○	○	
120MEA100/30	12x12	120	100	30	●	○	○	○	○	
120MEA200/30	12x12	120	200	30		○	○	○	○	
256MEAs: TiN electrodes, SiN isolator, transparent (ITO) contact pads and tracks										
256MEA30/8	16x16	252	30	8	●	○	○	○	○	
256MEA60/10	16x16	252	60	10	●	○	○	○	○	
256MEA100/30	16x16	252	100	30	●	○	○	○	○	
256MEA200/30	16x16	252	200	30	●	○	○	○	○	
EcoMEAs: Polyimide or glass base, gold electrodes, contact pads, and tracks										
EcoMEA	8x8	60	700	100		○	○	○	○	
ThinMEAs: 180µm glass, TiN electrodes, SiN isolator, transparent (ITO) contact pads and tracks										
60ThinMEA30/10	2x(5x6)	60	30	10	●	○	○	○	○	
60ThinMEA100/10	8x8	60	100	30	●	○	○	○	○	
60ThinMEA200/30	8x8	60	200	30	●	○	○	○	○	
256ThinMEA	16x16	252	200	30	●	○	○	○	○	
6-wellMEAs: TiN electrodes, SiN isolator, opaque contact pads (TiN) and tracks (Ti)										
60-6wellMEA	6x(3x3)	54	200	30		○				○§
256-6wellMEA	9x(6x5)	234 (rec.) 18 (stim.)	300	30	●	○				○§
9-wellMEAs: TiN electrodes, SiN isolator, opaque contact pads (TiN) and tracks (Ti)										
256-9wellMEA	9x(6x5)	252	300	30		○				○$
4Q MEAs: 4 quadrands, TiN electrodes, SiN isolator, opaque contact pads (TiN) and tracks (Ti)										
4QMEA1000	4 quad-rands	60	200, 500, 1000	30		○	○	○	○	

● = fixed, ○ = optional, * Culture chambers/lids available for all rings, except plastic rings without thread. ** Other ring heights on request (glass ring: 12 mm, plastic ring without thread: 3 mm, plastic ring with thread: 15 mm). § 10 mm high. $ 9 mm high.

Materials:

SiN (Silicon nitride): very hard material, high strength over a broad temperature range, very high fracture toughness	Ti (Titanium): opaque tracks are visible and trace to contact pads for stimulation can be found easily
TiN (Titanium nitride): very stable material, long life, can be reused several times	ITO (Indium tin oxide): perfect view of the specimen under the microscope
Gold: low spatial resolution, useful for medium throughput screening, low cost	PEDOT-CNT (carbon nano tubes): ideal for stimulation and low noise recordings

Advantages

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Extracellular multisite recording

- Easy to set up and operate
- Simultaneous recording from many electrodes in a single experiment greatly increases information content
- Long-term studies of cell cultures or slices for several weeks or even months possible

Compact and functional hardware

- Complete plug and play system with light weight, compact, and functional components
- Combined MEA interface and amplifier – minimized noise
- Broad range of MEA layouts available – optimized for different applications
- Modular system, can easily be upgraded and combined with various custom instruments
- System performance advances with computer performance and new technologies

Flexible software – for all applications

- Variety of analysis options
- Event detector based on threshold or on waveform
- Digital filtering
- Multiple ways to display signals for the best presentation of your data
- Free and unlimited software upgrades
- Flexible data stream management saves disk space
- Data file format compatible with many analysis tools such as Matlab, NeuroExplorer, Origin

Most advanced technology on the market

- Amplifier with blanking technology for superior stimulus artifact suppression
- Stimulation and recording from electrodes selected in software
- Signal-triggered TTL pulses for online feedback studies
- Fourfold MEA-System for recording 240 channels from four MEAs with a single data acquisition computer
- Real-time signal detection and feedback

Market leader

- Proven technology with many satisfied customers
- World-wide distribution network; free, fast, friendly, and qualified support

Distributed by:

System version	MEA60-System	MEA2100-System	USB-MEA256-System	MEA2100-32-System
Raw data channels	60, 120 or 240	60, 120 or 240	252	32, 64
Gain	500 - 5000	software selectable	1100	software selectable
Bandwidth	1 Hz - 10kHz	software selectable	1 Hz - 5 kHz	software selectable
Data resolution	16 bit	16 bit	16 bit	16 bit
Sampling rate per channel	up to 50 kHz	up to 50 kHz	up to 40 kHz	up to 50 kHz
Integrated stimulation	no	yes (current and voltage)	no	yes (current and voltage)

multichannel systems
Innovations in Electrophysiology

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