multichannel ✳
systems

Innovations in Electrophysiology

Product Overview

- *Xenopus* Oocyte Research
- Patch-Clamp
- *In vitro* Electrophysiology
- *In vivo* Electrophysiology
- Stimulus Generators
- Data Acquisition and Analysis Software
- Microelectrode Arrays
- Electrophysiological Laboratory Equipment

New Generation of Wireless *in vivo* Systems: W2100-System

More information on page 15

- 4, 8, 16 or 32 channels
- Options for electrical and optical stimulation
- Highest sampling rate (32 channels @ 20 kHz simultaneously)

Multi-Well-MEA-System

More information on page 9

- 24 and 96 wellplate format
- Total of 288 channels
- Up to 50 kHz sampling rate on all channels
- Integrated 6-channel stimulator
- Fully climate controlled recording chamber
- Different well-plate variants

Contents

Xenopus Oocyte Research

- **Automated injection**
  Injection goes automatic: Roboinject

- **Automated electrophysiology**
  Classical usage of compounds: Roboocyte2

- **Automated electrophysiology**
  Non-destructive usage of compounds: HiClamp

Injection goes automatic

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Application

Injection of nanoliter volumes of compounds (e.g. DNA or mRNA) into *Xenopus laevis* oocytes or other cells of similar size.

rob✳inject

Automated injection

Product Features

- Fully automated injection using industry standard 96, 384, and custom well plates
- Sequential injection without user intervention
- Injection of up to 4 different samples per well and up to 8 different samples per plate
- Injection freely adjustable from 1 to 100 nl
- Variable injection depth and sample uptake speed
- Automated sample uptake (e.g. RNA or DNA)

Technical Data

Usable well plates	Disposable standard 96, 384, and custom well plates
Positioning accuracy	20 µm in x/y and z-direction
x/y movement speed	80 mm/s
z-axis speed	40 mm/s
Injection volume	1 - 100 nl
Average time needed for 96 injections	5 min
Movement time from well to well	2 s

Introduction

Until now, injection of nanoliter volumes into cells or embryos has been time-consuming and required highly qualified personnel in order to get satisfactory and reproducible results.

Multi Channel Systems is proud to present the Roboinject, the first and only commercially available fully-automated robot for compound injection into oocytes, eggs, and embryos using industry standard 96, 384, and custom well plates.

The automation of cell injection not only saves time and money, but also greatly enhances reproducibility of injection and survival of cells. It allows your highly qualified personnel to do away with routine work and concentrate on science.

Xenopus Oocyte Research

Classical compound usage

Application

Screening of ion channels and electrogenic transporters.

robo✱cyte2

Automated electrophysiology

Introduction

Oocytes of the toad Xenopus laevis are widely used as an expression system for ion channels, transporters, and receptors in drug development. Xenopus oocytes are big, robust cells (about 1 – 1.2 mm in diameter), can be obtained in large numbers, and are easy to handle.

Nevertheless, the low throughput of manually performed electrophysiology prevents its use for secondary functional screening of drug targets.

More than ten years ago, Multi Channel Systems (MCS) presented the first commercially available fully-automated system for Xenopus oocyte screening, the Roboocyte. In 2011, it was time for the Roboocyte2.

The Roboocyte2 is a fully-automated all-in-one solution for medium-throughput screenings of ligand-gated and voltage-gated ion channels, as well as electrogenic transporters based on the well-established Xenopus oocyte expression system. All necessary tasks are accomplished by a single robot.

Product Features

- Recording of 96 oocytes without supervision
- TEVC recording of voltage-gated and ligand-gated ion channels and electrogenic transporters
- Flexible design of automated recording sequences
- Automated cell wash
- Automated compound application

Technical Data

Amplifier ClampAmpC:	
Sampling rate	1 Hz - 20 kHz
Data resolution	16 bit
Proportional gain	0 - 6700 nA/mV
Integrator gain	0 - 8000 1/s
Typical rise time	<1 ms
Performance and Throughput	
Usable well-plates	Standard 96-well plates
Positioning accuracy	20 µm in x/y and z-direction

Non-destructive compound usage

Application

Screening of ion channels and electrogenic transporters.

HiClamp*

Automated electrophysiology

Product Features

- Fast drug application
- Minimal compound usage
- Non-destructive usage of compounds
- Works with 200 µl sample volume
- Fully-automated system

Introduction

The HiClamp is built around an entirely new concept: Instead of applying solutions to the oocytes, the HiClamp carries each cell from one compound to the next. Oocytes are transferred automatically one after the other from a 96-well plate into a silver wire basket serving as reference electrode. After automatic impalement of the intracellular glass microelectrodes, the basket is moved together with the oocyte from one compound-containing well to the next. Programmable washing steps effectively prevent cross-contamination between different compounds. The built-in digital amplifier guarantees a stable and accurate voltage-clamp resulting in precise and reproducible current recordings.

Technical Data

Amplifier	
Max. sampling rate	20 kHz
Data resolution	16 bit
Current electrode output	
Output range	-105 µA to +105 µA
Current resolution	1 nA
Voltage range	-100 V to +100 V
Voltage electrode input	
Typical rise time	<1 ms
Voltage electrode input	-500 mV to +500 mV
Voltage resolution	0.015 mV

Patch-Clamp

- **Automated Patch-Clamp**
  Pipette-based automatic Patch-Clamp System: PatchServer

multichannel * systems

Pipette-based automatic Patch-Clamp System

Application

Makes Patch-Clamp simpler and more efficient.

- Ultra fast compound application to ligand gated ion channels (<1ms)
- Selection of cells from inhomogeneous preparations, based on visual criteria (e.g. size, fluorescence)
- Works with all cell types that can be patched manually (CHO, HEK, cardiomyocytes, stem cells, primary neurons, …)

PatchServer

Automated Patch-Clamp

Product Features

- Fully automated Patch-Clamp procedure with standard glass pipettes
- Simultaneous, individual 4-channel recordings
- Low operating costs
- Cells can be visually identified & selected
- Piezo-driven Ultra-Fast Application with <1ms exchange rate (optional)

Technical Data

Number of recording channels	1 or 4
Seal quality	>GΩ*
Seal rate	~90%*
Whole cell rate	~80%*
Time to establish recording configuration	3 min per channel
Included MCS hardware	Pressure controller for each channel, „CatchAmp" for automated Cell handling and pipette positioning
Supported Patch-Clamp amplifiers	HEKA EPC 10 (Single or Quadro) Multiclamp 700B
Supported Patch-Clamp manipulators	Scientifica Patchstar

* Depends on cell type and preparation – typically same results as in manual patch clamp are achieved

Introduction

The PatchServer is world-wide the only automatic Patch-Clamp system directly based on the manual patch approach. It utilizes standard glass electrodes and emulates step-by-step the classical Patch-Clamp procedure.

Suspended cells are provided by a cell delivery system, caught by a "Catch pipette" and held in position until being picked up by the recording pipettes.

The precise and fast automated pipette positioning is accomplished by our unique, patented guidance system.

Thus, the PatchServer makes it easy to generate high-quality electrophysiological data by automating the classical Patch Clamp technique.
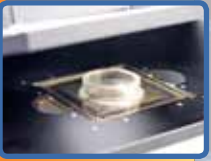
In collaboration with:

NMI
achieving results

In vitro Electrophysiology

- **Amplifying, recording, analyzing, and stimulating**
  High throughput electrophysiology: Multi-well MEA-System

- **Amplifying, recording, analyzing, and stimulating**
  Versatile MEA-System with integrated stimulation

- **Amplifying, recording, analyzing, and stimulating**
  Acute hippocampal slice recording system

- **Amplifying, recording, and analyzing**
  Integrated system with 256 channels

High throughput electrophysiology

Application

Non-invasive extracellular multisite recording with microelectrode arrays from neuronal and cardiac cultures, including stem cells and cell lines.

The ideal solution for drug screening and discovery as well as safety pharmacology in the field of cardiac and neuronal research.

Multi-well-MEA-System

Amplifying, recording, analyzing, and stimulating

Product Features

- 24 and 96 wellplate format
- Total of 288 channels
- Up to 50 kHz sampling rate simultaneous on all channels
- Integrated 6-channel stimulator
- Fully climate controlled recording chamber
- Different well-plate variants

Introduction

Multi Channel Systems is proud to present the brand new Multi-Well-MEA-System. Featuring 24- and 96-wellplates, it is the perfect tool for medium and high throughput electrophysiology. Being based on the MEA2100-technology, it includes high-quality, low-noise amplifiers, freely-programmable stimulators, and a digital signal processor for individual analyses.

Integrated heating as well as a connection to CO_2 supply enable full climate control of the recording chamber.

One big advantage of the Multi-Well-MEA-System is the high sampling rate. Your data is sampled at up to 50 kHz per channel (simultaneously on all channels). Thus, the accuracy of your data is guaranteed, whether you record from cardiac or neuronal samples.

Technical Data

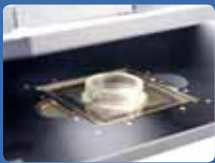| Amplifier	
Data resolution	16 bit
Number of recording channels	288
Stimulus Generator	
Number of stimulation signals	6
Current mode	± 1 mA
Voltage mode	± 10 V
Data converter and USB interface	
Sampling rate per channel	up to 50 kHz

In vitro Electrophysiology

Versatile MEA-System with integrated stimulation

Application

Non-invasive extracellular multisite recording with microelectrode arrays from neuronal and cardiac slice preparations or cultures, including stem cells and cell lines.

The ideal solution for drug screening and discovery as well as for safety pharmacology in the field of cardiac and neuronal research.

MEA2100-System

**Amplifying, recording, analyzing, and stimulating**

Introduction

The MEA2100-System is a versatile *in vitro* recording system with integrated stimulation and follows the tradition of high-quality, low-noise amplifiers.

It is the complete setup for extracellular recordings from microelectrode arrays (MEAs), including everything you need for your experiment: data acquisition computer with software; interface board; MEA-headstage with integrated stimulation; MEAs; as well as temperature controller and perfusion heating. Thanks to its compact design you can position the MEA-headstage on any inverted or upright microscope. It is connected via a single SATA cable to the interface board, which offers various analog inputs and digital in-/outputs for synchronization with other instruments.

Flexibility

The main advantage of the MEA2100-System is its flexibility. Multi Channel Systems offers various contact units for the MEA-headstage. Variants for one 60-electrode MEA, one 120-electrode MEA, or even two 60-electrode MEAs are available. Moreover, there are versions for 32-electrode MEAs for acute slice recordings (see next page). The contact unit of the MEA-headstage can be changed according to your experimental needs. The rest of the setup is not affected, so changing the contact unit is simple, quick, and cost-effective.

The flexibility of the MEA-2100-System allows you to connect two MEA-headstages to one interface board. This way, you can record from up to 240 channels. By using two headstages with two 60-electrode MEAs each, you have a four-fold system and increased throughput. Multi-well MEAs raise the throughput even more. The headstages are controlled independently by opening multiple instances of the data acquisition software.
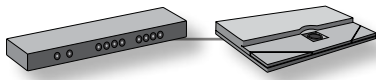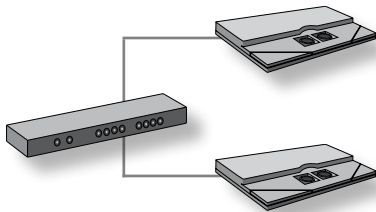
- 32 channels
- 60 channels
- 120 channels
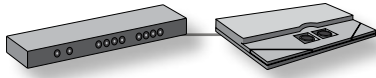
- 2 x 32 channels
- 2 x 60 channels
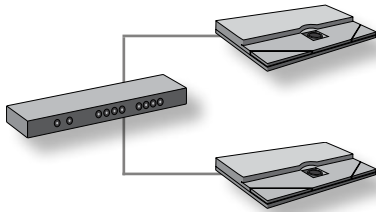
- 32 + 32 channels
- 60 + 60 channels
- 120 + 120 channels

- 2 x 32 + 2 x 32 channels
- 2 x 60 + 2 x 60 channels

Product Features

- Integrated stimulation
- Adjustable gain and bandwidth via software
- Variable contact unit
- Expandable to multiple amplifier system
- Unlimited and free: flexible data acquisition and analysis software MC_Rack

multichannel systems

MEA2100-System

Amplifying, recording, analyzing, and stimulating

Real-time signal detection and feedback

The real-time signal detection/feedback is essential if you need fast and predictable reactions related to recorded analog signals without time delay. Normally, the signal must be analyzed by the computer, which leads to an unpredictable time delay of the stimulus of at least 100 ms. By moving the analysis from the PC to the DSP (Digital Signal Processor) integrated in the interface board of the MEA2100-System, the detour is obsolete and the time delay reduced well below 1 ms. Simply define the condition for the feedback and download it to the interface board (1). During recording (2), the DSP filters the data and detects spikes (3), checking whether your condition is fulfilled. When a designated event is detected, the integrated stimulus generator generates the stimulus pulse (4).

Personal Computer/Laptop
1
Download settings before experiment

Filtering/Signal detection
3

2 Recording

4

Sending out stimulus

Technical Data

Amplifier	
Data resolution	16 bit
Number of recording channels	60, 120 or 240
Stimulus Generator	
Number of stimulation signals	3 per MEA
Current mode	± 1 mA
Voltage mode	± 10 V
Data converter and USB interface	
Sampling rate per channel	up to 50 kHz

In vitro Electrophysiology

Acute hippocampal slice recording system

Application

Non-invasive extracellular multisite recording with perforated microelectrode arrays from acute hippocampal slices, including stimulation for standard LTP and LTD experiments.

MEA2100-32-System

Amplifying, recording, analyzing, and stimulating

Introduction

The acute hippocampal slice recording system, MEA2100-32-System, is a standalone 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 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 option to apply suction through the pMEAs are also included. The only feature that is not transferred from other MEA2100-Systems is the real-time signal detection and feedback option.

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.

Product Features

- Integrated perfusion ground plate
- Unlimited and free: flexible data acquisition and analysis software MC_Rack
- Optional software package for LTP and LTD experiments
- Expandable to multiple systems with four microelectrode arrays
- MEA layouts optimized for brain slice recordings with 32 recording and 12 stimulation electrodes

Technical Data

Amplifier	
Data resolution	16 bit
Number of recording channels	32 or 64
Stimulus Generator	
Number of stimulation signals	3 per MEA
Current mode	± 1 mA
Voltage mode	± 10 V
Data converter and USB interface	
Sampling rate per channel	up to 50 kHz

Integrated system with 256 channels

multichannel systems

Application

Non-invasive extracellular 256 channel recording with microelectrode arrays from neuronal and cardiac slice preparations or cultures, including stem cells and cell lines.

The ideal solution for drug screening and discovery, as well as for safety pharmacology in the field of cardiac and neuronal research.

USB-MEA256-System

Amplifying, recording, and analyzing

Product Features

- One version for upright and inverted microscopes
- Multiwell-MEAs available
- Unlimited and free: flexible data acquisition and analysis software MC_Rack
- 256 channels for recording and stimulation
- Easily adaptable to our stimulus generators

Technical Data

Electrode channels	252
Additional analog channels	4
Input voltage	± 4 V
Digital input channels	16
Digital output channels	16
Sampling frequency	up to 40 kHz/channel
Data resolution	16 bit
Possible bandwidth	1 Hz - 3 kHz
Gain	1100

Introduction

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

All the necessary components are combined in one device. You can record from 252+4 channels, i.e. 252 channels from the microelectrode array plus 4 additional channels that can be used for simultaneous patch clamp recordings or any other analog signals such as temperature, pH, etc.

The high number of electrodes confers two major benefits. First, you can cover a large area to record from different spots on your preparation. Second, the higher density of electrodes provides a better spatial resolution of the signal propagation. Furthermore, when using our multiwell-MEAs, you can run up to 9 experiments simultaneously on one system. The integrated heating system makes this a ready-to-go-setup. Adapting to our stimulus generators for current and voltage driven stimulation is quick and easy. Each electrode can be selected for stimulation.

In vivo Electrophysiology

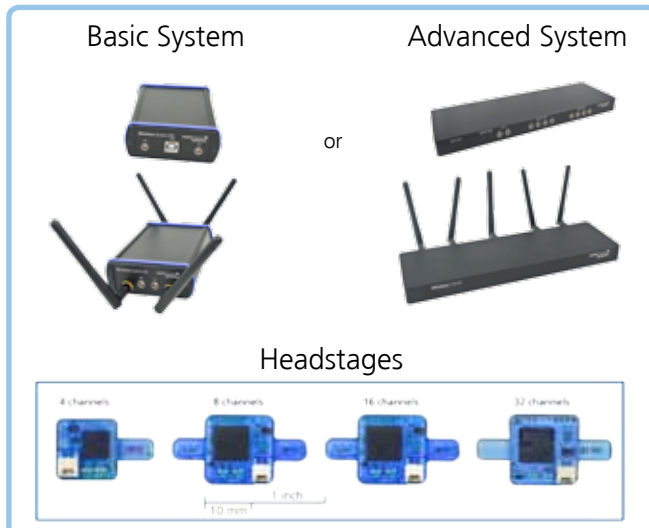- **Amplifying, recording, and analyzing**
  Wireless *in vivo* System

- **Amplifying, recording, and analyzing**
  Portable-ME-System

- **Amplifying, recording, and analyzing**
  Stationary-ME-System

Wireless *in vivo* System

Application

Recording of neuronal activity in freely moving animals.

Basic System   Advanced System

or

Headstages

Wireless-System

Amplifying, recording and analyzing

Product Features

• 4, 8, 16 or 32 channels

• 16-bit resolution

• Lightweight headstage

• Wide effective range (5 m)

• Excellent signal-to-noise ratio

• Options for electrical and optical stimulation (only advanced W2100-System)

Technical Data

Recording channels	4, 8 , 16 or 32		
Dimension of headstage (w/o antenna and battery)	4 ch: 13 x 13 x 5 mm 8 ch: 16 x 16 x 5 mm 16 ch: 16 x 16 x 6.5 mm 32 ch: 16 x 16 x 7.5 mm		
Weight of headstage (w/o battery)		Basic System	Advanced System
	4 ch	2.2 g	2.5 g
	8 ch	2.9 g	3.2 g
	16 ch	3.6 g	3.9 g
	32 ch	3.7 g	4.0 g
Battery life (8 ch @ 20 kHz, 100 mAh)	aprox. 2 hours (recording) aprox. 80 days (stand-by)		
Sampling frequency		Basic System	Advanced System
	4 ch	20 kHz/ch	25 kHz/ch
	8 ch	20 kHz/ch	25 kHz/ch
	16 ch	10 kHz/ch	25 kHz/ch
	32 ch	5 kHz/ch	20 kHz/ch

Introduction

The wireless *in vivo* systems are the all-in-one solution for amplifying, recording, and analyzing *in vivo* data from up to 32 channels.

The systems include everything you need: compact headstage with integrated A/D converter, digitized transmission, powerful receiver, batteries, as well as the popular MC_Rack software package.

The most advantageous feature of the Wireless-Systems is the amplification and digitization of the data on the headstage itself. This way, only digital data is sent to the receiver, which ensures that your data is not diluted or distorted.

With its excellent signal-to-noise ratio, it is the ideal solution for spikes, LFP, EEG, ECG, and ECoG.

Multi Channel Systems offers two different Wireless-Systems: The basic W-System and the advanced W2100-System. Most features are the same for both systems; however, the advanced W2100-System offers more possibilities e.g. regarding stimulation and sampling rate.

In vivo Electrophysiology

Integrated systems with USB High Speed

Application

Non-invasive extracellular multisite recording with microelectrode arrays *in vivo*.

Amplifying, recording, and analyzing

Portable-ME-System

Introduction

For a multitude of applications we offer a small and compact solution. The USB-ME-FAI-System is a complete plug-and-play data acquisition system based on signal processing technology. It includes all components you need to start your experiment immediately, so you can acquire data from either 16 or 32 channels. The system includes headstages with 8, 16 or 32 channels and a compatible filter amplifier. A standard USB-cable establishes the connection to any PC or notebook.

The systems are portable and can travel with you. MC_Rack data acquisition software is included and provides the necessary flexibility for many types of experiments. This is a complete all-in-one solution for a variety of *in vivo* and some *in vitro* applications. The size, cost, and ease of use make it an ideal system for many different applications.

Product Features

- All-in-one solution
- Portable and flexible
- Real-time signal detection and feedback
- Lightweight miniature preamplifiers
- Adapters for almost all available acute and chronic probes

Technical Data

Headstage	
Input channels	8, 16 or 32
Bandwidth	DC to 50 kHz
Gain	10
Filter amplifier	
Input channels	16 or 32
Input voltage	± 4 V
Digital input channels	16
Digital output channels	16
Sampling frequency	up to 50 kHz/channel
Data resolution	16 bit
Bandwidth	1 Hz - 5 kHz
Gain	100

Component systems with USB High Speed

Application

Non-invasive extracellular multisite recording with microelectrode arrays *in vivo.*

Stationary ME-System

Amplifying, recording, and analyzing

Product Features

- Lightweight miniature preamplifiers
- Filter amplifiers with customizable bandwidth
- Advanced filter amplifiers with programmable gain
- Adapters for almost all available acute and chronic probes
- Expandable to multiple amplifier systems

Technical Data

Electrode channels	64, 128 or 256
Input voltage	± 4 V
Digital input channels	16
Digital output channels	16
Sampling frequency	up to 50 kHz/channel
Data resolution	16 bit

Introduction

The USB-ME-PGA/FAI-Systems are complete system solutions for *in vivo* recordings with microelectrode arrays. They include lightweight miniature headstage amplifiers, filter amplifiers with or without programmable gain, and a USB data acquisition box to record from 64 up to 256 channels in real-time. Just connect your amplifier to a USB-ME-System to run your experiment on any desktop PC or laptop. Listen to audible electrical activity in real-time. Moving the analysis from the PC to the DSP (Digital Signal Processor) integrated in the USB-ME-System hardware, allows for real-time signal detection/feedback. This provides fast and predictable reactions for recorded analog signals without time delay. These are the only systems in the world that enable you to run four completely independent experiments simultaneously.

Stimulus Generators

- **Current and voltage driven stimulation**
  Stimulus generators with integrated isolation units

Stimulus generators with integrated isolation units

Application

Neuronal networks:
- Long-term, feedback, and white noise stimulation
- Biological signals as stimulation patterns

Brain slices:
- Flexible LTP induction patterns
- Studies of synaptic plasticity

Skeletal muscle:
- Evoke isometric and isotonic contractions

Cardiac cells and tissues:
- Pace cardiac cell cultures, slices, purkinje fibers, or papillary muscle

Stem cells:
- Mimic cardiac or neuronal environment

STG4000-Series

Current and voltage driven stimulation

Product Features

- Current and voltage driven stimulation
- Completely software driven
- Integrated isolation units for each channel
- Each channel optically isolated
- Each channel has one TTL input and output
- Arbitrary analog waveforms

Technical Data

Analog output channels	2, 4 or 8
Voltage output	-8 V to +8 V @ ± 20 mA
Voltage output resolution	1 mV
Voltage output slope	> 4 V/µs
Current output options	-160 µA to +160 µA @ 120 V
	-1.6 mA to +1.6 mA @ 120 V
	-16 mA to +16 mA @ 120 V
Resolution	14 bit
Time resolution	20 µs

Introduction

The 4000 series stimulus generators operate in voltage or current mode, as selected via software. 2, 4 or 8 completely independent stimulus outputs are available. Every output is optically isolated and can provide any arbitrary analog waveform as a stimulation signal. Every STG comes with MC_Stimulus II software.

Furthermore, for every single stimulus output there is one TTL input 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.

The standard multi-file mode allows you to switch between different stimulus patterns on the same electrode. You can have as many files as your specific STG has output channels. The extended multi file mode for the STGs with 4 and 8 output channels allows even more: up to 256 stimulation patterns can be assigned to one or more outputs of the stimulus generator.

Software

- **Data acquisition and analysis**
  Flexible and powerful: MC_Rack

- **Data acquisition and analysis**
  Excitation patterns, conduction velocity studies, and QT-prolongation studies: Cardio2D

- **Data acquisition and analysis**
  Long-term potentiation and depression studies: LTP-Director

Flexible and powerful

Multi Channel Suite

Data acquisition and analysis

Application

Multi Channel Suite is a complete software solution for reliable acquisition and analysis of electrophysiological data.

Real-time recording, graphing, and analysis of extracellular activity of excitable cells for *in vivo* and *in vitro* applications.

Product Features

- Consists of three tools:
  - Experimenter for recording and online analysis
  - Analyzer for offline analysis
  - DataManager for exporting to other programs (Python, Matlab, Neuroexplorer etc)
- Free software updates from our website
- Free support via email or phone

Technical Data

Operating system	Microsoft Windows® 7, 8; English and German versions supported
Data file format compatible with	NeuroExplorer, Offline Sorter, FIND, Matlab, Python, R

Introduction

The data acquisition and analysis program Multi Channel Suite is highly adaptable with unlimited possibilities.

With daily lab work in mind, the program is set up like an instrument rack on a workbench, allowing you to combine virtual instruments (e.g. recorder, filter, event detector, spike detector, stimulus generator or signal-triggered TTL pulse) in any way you want. The experimental set-up is very flexible and intuitive. All you have to do is choose the instruments by drag'n'drop and connect them, the way you want. Changes to the set-up are always possible.

Data is easily exported into HDF5 format, which is compatible with analysis tools like Matlab or Python. Or you can analyze the recorded data in the Multi Channel Analyzer. This tool also offer the import of video data, which can be connected to the recorded data by time stamps.

The Multi Channel Suite is a easy-to-use, flexible, yet powerful tool for online and offline data analysis.

Software

Excitation patterns and conduction velocity studies

Application

Cardio2D is used to acquire and analyze field potential data from cardiac cells, tissue and whole organs via microelectrode arrays (MEA) and flexible MEAs. The software has a mapping module for the analysis and visualization of cardiac signal propagation patterns and the measurement of conduction velocity. There is also a module that allows analysis of the field potential duration – a surrogate marker for the action potential duration and QT-Interval in the ECG.
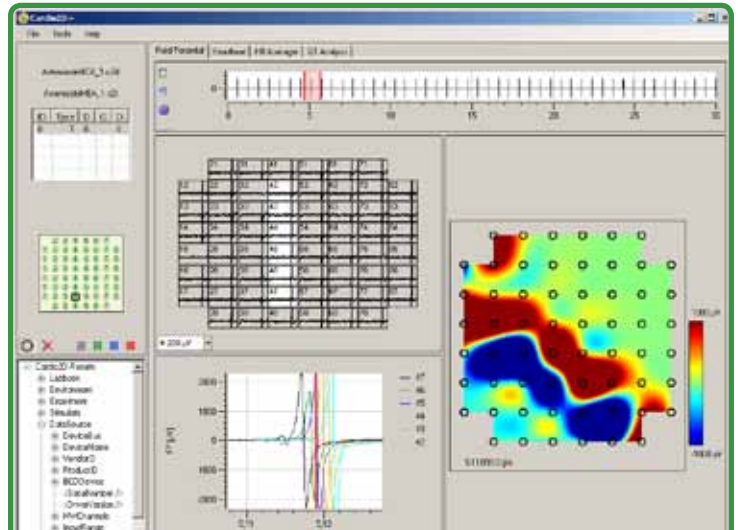
Cardio2D

Data acquisition and analysis

Introduction

Cardio2D has a data acquisition and an analysis module. It is used to analyze cardiac cell and tissue cultures for signal propagation properties and proarrhythmic events. This includes conduction velocity, local activation time maps, and signal propagation movies. The software can be used to map activation patterns on the surface of a heart, in a cardiac slice or in cardiac cell cultures.

Cardio2D allows monitoring for re-entry cycles – an important indicator in the generation of atrial fibrillation. It can also be used to evaluate the integration of stem cell derived cardiomyocytes into cardiac tissue *in vitro* and *in vivo*. It is suitable for drug testing on cultured cardiomyocytes and ES or iPS cell-derived cardiomyocytes. Cells cultured on multi-well microelectrode arrays can increase the throughput of the assay. The Cardio2D software will measure the field potential duration (corresponds to QT interval in ECG) and sodium peak, as well as analyze for proarrhythmic events. The software will also calculate dose response curves. Experiments can be supported in multi-well format up to 24 wells in parallel.

Product Features

- Map cardiac field potential propagation
- Create local activation time plots
- Measure conduction velocity
- Create false color plots
- Display cardiac waves as a movie
- Increase throughput via multi-well microelectrode arrays

Technical Data

Operating system	Microsoft Windows® 7, 8, Vista or XP with NTFS; English and German versions supported
Cardio2D	Data acquisition, online monitoring, and movie generation
Cardio2D+	Data analysis, display, and movie generation

Long-term potentiation and depression studies

multichannel systems

LTP-Director

Data acquisition and analysis
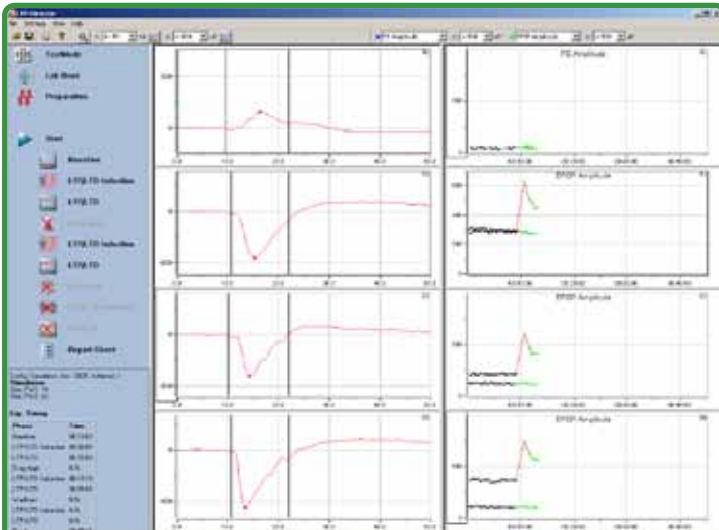
Application

LTP-Director is a specialized software solution to run standardized LTP (long-term potentiation) experiments in hippocampal slices. It features complete control of recording and stimulation, as well as automated perfusion, online data analysis, and documentation of the experiments.

Product Features

- User friendly
- Standardized experiments
- Control stimulation
- Control drug delivery and perfusion
- Automated report sheet generation

Technical Data

| Operating system	Microsoft Windows ® 7, 8, Vista or XP with NTFS; English and German versions supported
Data acquisition, stimulation, and online monitoring	LTP-Director
Data analysis, display, report sheet generation	LTP-Analyzer

Introduction

The LTP-Director/LTP-Analyzer software package is designed to run and analyze standardized LTP and LTD experiments in hippocampal slices. You can control the recording, stimulation, and perfusion equipment from a single program. It is possible to set up the complete experiment in advance and then run it automatically. All relevant experimental parameters are documented and saved together with the acquired data in one file.

Multiple parameters, for example EPSP slopes and population spike amplitudes, can be analyzed in parallel, on- or offline. Results can be normalized to control conditions directly within the software and exported to a database as ACSII data. The software's main advantages are user friendliness and reproducibility of experimental conditions. The LTP-Director/LTP-Analyzer software package is compatible with all MEA-Systems with blanking circuit and the MEA2100-System.

Microelectrode Arrays

- **Contacting**
  Where they come from: Material and Production
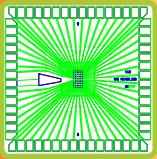
- **Contacting**
  Available for a variety of applications: MEA-Layouts
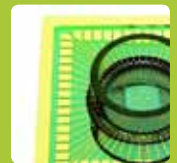
- **Contacting**
  Suit your needs: MEA-Types

Where they come from

Application

Extracellular recording *in vitro* from almost all excitable or electrogenic cells and tissues, e.g. central or peripheral neurons, cardiomyocytes, whole-heart preparations, retina or stem cells.

Material and Production

Contacting

Product Features

- Available with opaque (titanium) or transparent (indium tin oxide) tracks and contact pads
- Long life, can be reused many times
- Electrode layouts for all applications
- Electrodes with very low impedance
- Substrate-integrated reference electrode for almost all MEAs
- Electrodes as small as 8 µm in diameter

Technical Data

Dimensions	49 x 49 mm (49 x 25 mm for 32 electrodes)
Number of electrodes	32, 60, 120 or 256
Interelectrode distances (µm)	30, 60, 100, 200, 300, 500, 700
Electrode diameters (µm)	8, 10, 30, 100
Track options	Ti, ITO, Au
Electrode grids	8x8, 6x10, 12x12, 16x16, 2x(5x6), hexagonal, 6x(3x3), 9x(6x5), special layouts

Introduction

The Natural and Medical Sciences Institute (NMI) in Reutlingen, Germany (www.nmi.de) is a research institute which produces high-quality MEAs using the most biocompatible materials. The NMI and Multi Channel Systems have collaborated on multiple projects over many years.

State-of-the-art quality controls and production processes ensure that MEAs are always of excellent and consistent quality. The electrodes are coated with titanium nitride (TiN), a very stable material, which guarantees that the MEAs can be reused many times.

The majority of the MEAs have glass carriers, which facilitate the examination of the sample under any upright or inverted microscope. Tracks and contact pads are available in opaque and transparent versions and most MEAs have internal reference electrodes.

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Microelectrode Arrays

Available for a variety of applications

Introduction

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.
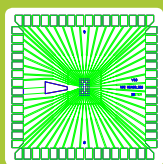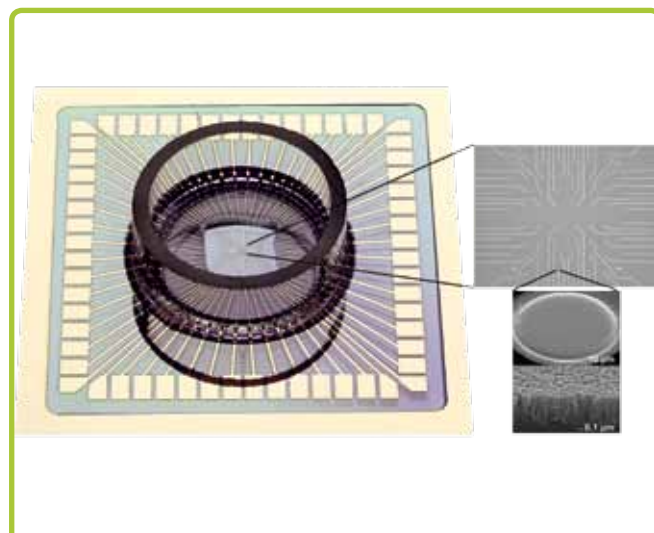
MEA-Layouts

Standard 8x8 layout

The 8 by 8 electrode configuration is the most versatile. Applications range from neuronal networks to brain slices and from stem cell derived cardiomyocytes to cardiac tissue preparations. Electrode spacings of 100 and 200 µm are available, providing a square-shaped recording area of 700 µm and 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.

Many MEAs feature internal reference electrodes. The integrated reference allows the culture to be kept sterile during recording to enable repeated recordings of long-term cultures. Stimulation of each electrode is also possible.
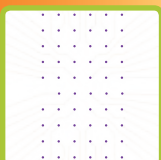
6x10 layout

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, allowing larger tissue samples to be be recorded on one array. Each electrodes can also be used for stimulation. All MEAs with the 6 by 10 layout also feature internal reference electrodes. The electrode material is TiN. The micro-column structure of each electrode minimizes impedance and allows low-noise recordings. The extremely durable material allows as many as 50 re-use cycles with acute experiments.
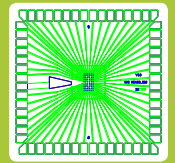
Hexagonal layout

- 60 electrodes
- Available with equal or varying electrode diameter and distance
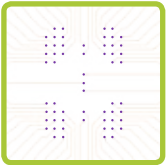- Layout perfect for retina recordings

High Dense layout

- 60 electrodes in two recording areas
- Interelectrode spacing of only 30 µm, electrode diameter of only 10 µm
- High resolution recording of individual neurons in neuronal networks

MEA-Layouts

Contacting

Special layouts

- Wide range of special electrode layouts developed together with customers
- Specially shaped stimulation electrodes or layout with four quadrants of high density recording areas
- Custom layouts on request

Multi-well layouts

- 60 electrodes divided into 6 wells
- 256 electrodes divided into 9 wells
- Increased throughput
- Ideal for toxicology, neurobiology, stem cell research, and safety pharmacology

Microelectrode Arrays

Suit your needs

Application

Several MEA geometries and materials are provided for a wide variety of applications. Almost all excitable or electrogenic cells and tissues can be used for extracellular recording *in vitro*, e.g. central or peripheral neurons, cardiomyocytes, whole-heart preparations or retinas.
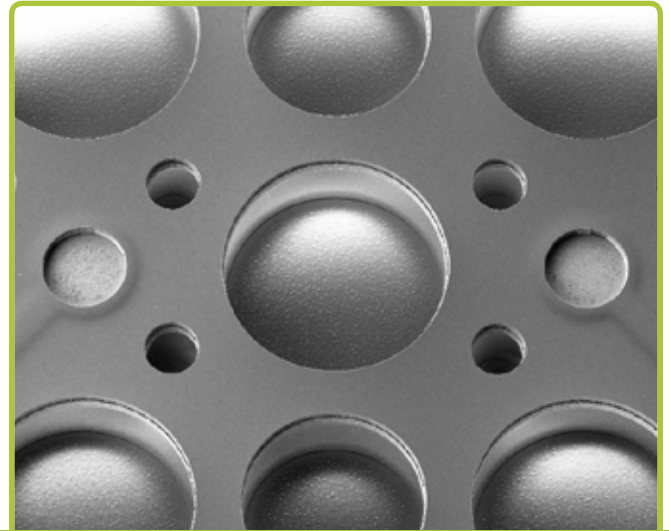
MEA-Types

Contacting

Perforated MEAs

Perforated MEAs (pMEAs) are manufactured on a thin polyimide foil, which is fixed on a glass carrier for physical stability. Surrounding the electrode field, is a circular area where the foil is perforated (see image, dark spots).

pMEAs 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 than 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 with the constant vacuum pump available from MCS.

If you wish to work with pMEAs, all you need to do is to equip your MEA-System with a perfusion ground plate (PGP) and start recording.

MEAs with 256 electrodes

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

- 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 spacings of 30, 60, 100, and 200 μm are available. For the 30 μm spacing, the electrode diameter is 8 μm, for the 60 μm spacing the electrode diameter is 10 μm. For 100 μm and 200 μm spacing 30 μm diameter electrodes are used. All 256MEA layouts have four internal reference electrodes.

ThinMEAs

- Recording area is as thin as a coverslip glass (180 µm)
- Facilitates use of low working distance objectives with high magnification
- UV transmission possible
- Transparent tracks, perfect vision
- Available with 60 or 256 electrodes

MEA with 120 electrodes

- For MEA2100-System
- 120 electrodes in a 12 by12 grid
- 4 internal reference electrodes
- Ideal for stimulation
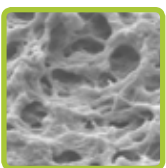- Available as standard glass MEAs and perforated MEAs

MEA-Types

Contacting

EcoMEAs

- Low cost option for routine experiments
- Gold electrodes (very robust, many re-use cycles)
- 100 µm diameter electrodes, 700 µm spacing
- Either float glass carrier or printed circuit board

Pedot-CNT-MEAs

- Electrodes with a composite of carbon nanotubes and PEDOT
- Reproducible low impedance
- High signal-to-noise ratio
- Excellent biocompatibility and cell adhesion
- Ideal for stimulation

Flexible MEAs

- Made of flexible polyimide foil (12 or 50 µm thick)
- Available with 24, 36 and 72 electrodes
- For *in vivo/ex vivo* experiments and specific *in vitro* applications
- Titanium nitride or gold electrodes
- Can easily be connected to MCS headstages

Electrophysiological Laboratory Equipment

- **Investigating and isolating**
  Everything you need in your lab

- **Pumping**
  Constant vaccum pump: CVP

- **Pumping**
  Accessories for fluidic devices

Everything you need in your lab

Application

Fundamental accessories for your setup in any electrophysiological experiment.

Laboratory Tables and Faraday Cages

Investigating and isolating

Introduction

When performing electrophysiological experiments, a crucial factor is the surroundings. The stability of the table, electric fields in the proximity of the sample, and the ability to fasten other instruments and accessories are vital.

Multi Channel Systems has more than 15 years of experience in the field of electrophysiology. We understand your needs, what details and product features to consider, and most importantly, we work with the best equipment suppliers.

We offer you a complete laboratory equipment setup, starting with vibration-free tables, Faraday cages, micromanipulators, Patch-Clamp-Setups, and any other required accessories.

You will receive your complete system in one shipment, from one supplier. You do not have to worry about obtaining quotations and invoices, or juggling the various shipping dates. Everything arrives together. We take care of everything and you receive the entire setup from one source.

Service only available in MCS sales area. Please contact your local distributor for details in your country.

Advantages

- Well-known manufacturers
- High quality products
- Convincing combination of compatible products
- Complete setup from one source

Constant vacuum pump

Application

Any experiment where negative pressure is needed.

Especially suited for use with perforated microelectrode arrays

CVP

Introduction

The constant vacuum pump (CVP) with pressure control is a vacuum pump with a precision pressure sensor and a waste bottle.

The differential sensor measures the pressure in the compartment attached to the waste bottle and compares it to the ambient pressure. The suction pump is then regulated to maintain the selected negative pressure in this compartment. It is now possible to precisely control the suction and to keep the negative pressure stable.

The constant vacuum pump is the perfect addition to your MEA-System if you want to work with perforated microelectrode arrays.

You can establish and most importantly control the suction so you get better electrode-to-tissue contact without the need of a weight and your slice is kept in place. Moreover, your experiments are more repeatable since you can reproduce the exact same suction again and again.

Product Features

- Simple integration to any setup
- Ideal for use with perforated MEAs
- User-friendly handling
- Precise control of suction

Technical Data

Operating temperature	10 °C - 40 °C
Maximum pressure	-200 mbar below atmospheric pressure
Resolution	0.1 mbar
Sensor accuracy	± 2.5 %
Capacity of pp-bottle	5 l

Accessories for fluidic devices

Peristaltic Pump and Perfusion Equipment

Pumping

Introduction

Many electrophysiological experiments require the use of liquids. In order to offer you an entirely complete setup, we collaborate with many manufacturers to provide you with any liquid handling devices you might need. Moreover, we have perfusion equipment as well as pumps in our own product portfolio, too. All you need to do is to let us know what you need and we will get it for you. Peristaltic pumps, valves, tubes, and perfusion tool holders are just some examples for our product range in fluidic.

The advantage for you is that you can get everything you need for your setup from one single source. We at Multi Channel Systems with our research experience and knowledge of the market, know what products you might need and what details to pay attention to, and most importantly, we know where to purchase those products or how to manufacture the best product ourselves.

Complete systems for electrophysiology from Multi Channel Systems live up to their promise: They truly include everything you might need!
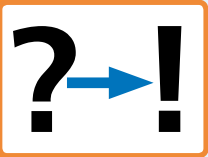
Product Features

- Own MCS products or from well-known manufacturers
- High quality products
- Convincing combination of compatible products
- Complete setup from one source

About Us

- **Presenting**
  Who we are: Multi Channel Systems

- **Supporting**
  Always there to assist you: Our support team

- **Exchanging**
  Modular design for *in vitro* and *in vivo* applications

Who we are

Multi Channel Systems MCS GmbH was founded in 1996 and is based in the Science and Technology Park in Reutlingen in Southwest Germany. MCS operates globally from this location.

The main focus of our company is the development of precise scientific measuring instrumentation in the field of electrophysiology for research groups at universities and for the pharmaceutical industry. Our modular product principle approach allows us to adjust our products to your specific experimental needs. MCS products are flexible and are designed to fit into tight laboratory spaces. Our main goal is to develop products that are focused on our customers' specific needs and applications. Our team includes basic science researchers so we know what it is like to work in a lab environment.

Our constant dialog with scientists helps us to be at the cutting edge of technology. We are also involved in several national and international research projects that are pushing the limits of technology for science.
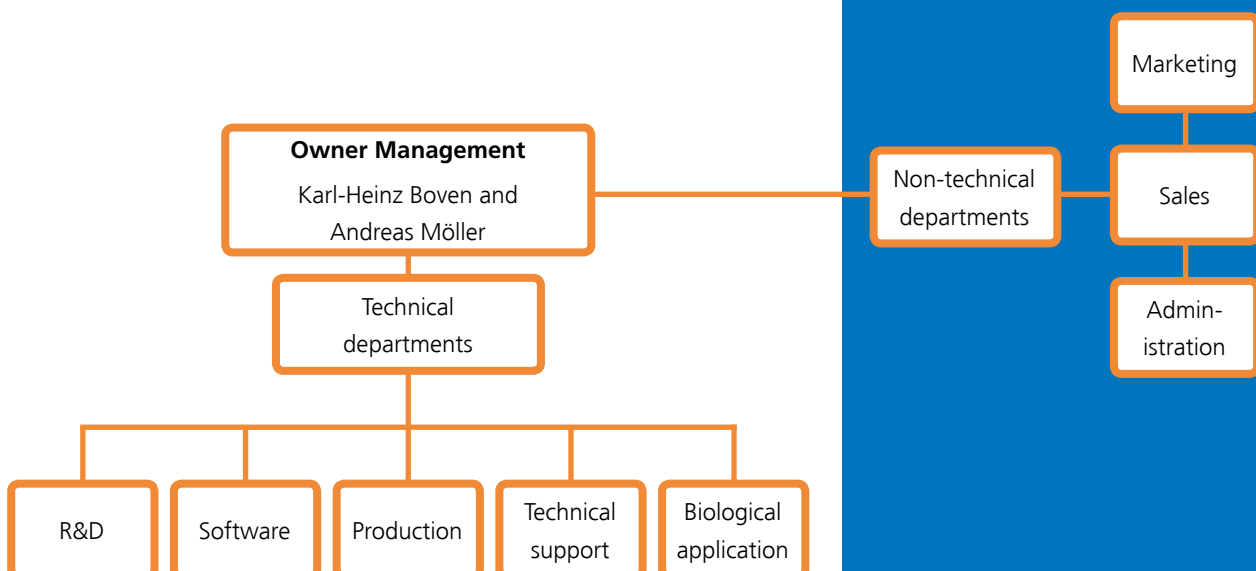
With more than 15 years of experience, a global distribution network, and over 600 satisfied customers worldwide, MCS is the global market leader in the field of non-clinical microelectrode array electrophysiology.
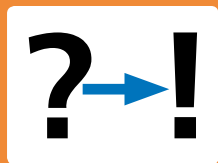
Multi Channel Systems

Presenting

Our goal is to provide you with products of the highest quality and performance and give you the best customer service. Since all departments are located in one building, our communication and interaction between different teams is smooth and efficient. Our manufacturing department gives feedback to the R&D team, logistics works closely with manufacturing, the support department collaborates with software and manufacturing, and so on. Our customers' needs and issues can be considered by all departments both before and after purchase. In this way, we can guarantee that you will receive the best product and the best support possible.

Owner Management
Karl-Heinz Boven and
Andreas Möller

Technical departments

R&D
Software
Production
Technical support
Biological application

Non-technical departments

Marketing
Sales
Admin-istration

Application

Neuronal, cardiac, and ion channel electrophysiology

Supporting

Our Support Team

Introduction

Our support team holds PhDs in biology, biophysics, and biochemistry. They have research experience in the fields of electrophysiology, cardiology, neuroscience, and ion channel studies. They understand your needs and have knowledge pertaining to your research. They will assist you with any experimental problems via e-mail, phone, or even come to your lab for training.

Our application-focused support team is assisted by their colleagues from the software and hardware departments. So whatever your question might be, we will do our best to help you. We strive to answer all your inquiries as quickly as possible, usually within 24 hours. In order to ensure that you receive the best answer as quickly as possible, we use the OTRS electronic ticket system.

In general, all support inquiries are free of charge. Free phone calls, e-mails, and forum discussions are part of our customer-service oriented attitude. For whole-day trainings in your lab, we are happy to send you a quotation.

Features

- Quick response (usually within 24 hours)
- E-mail, phone, and training
- OTRS ticket support data base
- Free of charge

Contact us

Phone	+49 - 7121 - 909 25 - 25
E-Mail	support@multichannelsystems.com
Contact form	www.multichannelsystems.com
User forum	www.multichannelsystems.com

Modular design

Application

In vitro and *in vivo* experiments

In vitro and *in vivo* Applications

Exchanging

Introduction

Do you want to perform *in vivo* as well as *in vitro* experiments? Or think that you might want to change your focus of research in the future? Then Multi Channel Systems' modular recording systems with the USB-ME-System data acquisition device is the right choice for you.

One big advantage of our data acquisition devices is that they are suitable for *in vivo* as well as *in vitro* applications. You can connect an MEA-amplifier for *in vitro* experiments or a filter amplifier and headstages for *in vivo* experiments.

Multi Channel Systems' data acquisition systems offer you the greatest flexibility you can get. You can either purchase the data acquisition system together with both amplifiers (*in vitro* and *in vivo*) straight away or you can add the second amplifier, when your experimental needs change. There is no need to acquire new software or a new data acquisition. Simply change the amplifier and you have a complete set-up for your new application.

One data acquisition system

- For *in vivo* amplifiers
- For *in vitro* amplifiers
- Modular setup
- One software program

Distributed by: