in vivo Solutions for Extracellular Recording

- Up to 256 channels
- Real-time signal detection and feedback
- Adapters to all commercially available probes
- Wireless system
Wireless recording system

The Wireless-Systems from Multi Channel Systems are the all-in-one solution for amplifying, recording, and analyzing in vivo data from 4, 8, 16 or 32 channels. The amplifier bandwidth is 1 Hz to 5 kHz, sampled at 20 kHz per channel (up to 32 channels simultaneously, higher at less channels). With a resolution of 16 bit, the accuracy of your data is guaranteed.

The systems include everything you need: Small-sized headstage with integrated A/D converter and LED lights for video tracking, digitized transmission, powerful receiver, interface board, and data acquisition software package. With its excellent signal-to-noise ratio, it is the ideal solution for spikes, LFP, EEG, ECG, EMG, and ECoG. Additional inputs to the interface board allow the synchronization of the data with external devices.

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.

Portable in vivo systems with 16 or 32 channels

For a multitude of applications we offer a small and compact solution. The Portable-ME-Systems are complete plug-and-play data acquisition systems based on signal processing technology. They include all components you need to start your experiment immediately, so you can acquire data from either 16 or 32 channels.

The systems include headstages with eight, 16 or 32 channels and a compatible device with integrated filter amplifier and data acquisition, sampling your data at 50 kHz/channel. A standard USB-cable establishes the connection to your PC or notebook. The systems are portable and can travel with you.

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.

Stationary in vivo systems with up to 256 channels

The USB-ME-PGA/FAi-Systems are complete system solutions for in vivo recordings with microelectrode arrays. They include light-weight 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 the USB data acquisition to run your experiment on any desktop PC or notebook. You data is sampled at up to 50 kHz on 64 or 128 channels simultaneously (40 kHz on 256 channels).

The main advantage of this setup is its flexibility. Having the data acquisition box, you can decide to connect any MCS amplifier, be it for in vivo or in vitro experiments. So even if your experimental needs change in the future, the USB-ME-PGA/FAi-System can be adjusted and will fit your new needs too.
Data acquisition with USB High Speed

The USB-ME-System is a complete plug-and-play data acquisition system based on signal processing technology. It is included with all stationary in vivo systems and is available in 64-, 128-, and 256-channel versions. Depending on the number of channels, you can connect one, two or four filter amplifiers at the same time running different experiments on each of them. Open the data acquisition and analysis software MC_Rack up to four times at once and control your amplifiers independently. The USB-ME-System has an integrated DSP (Digital Signal Processor) which makes a real-time signal detection/feedback possible.

Light-weight and small-sized headstages

Multi Channel Systems offers miniature and micro preamplifiers (MPA or µPA) with 2, 8, 16, and 32 channels, which provide tenfold amplification. They are included in every portable and stationary in vivo system. Just connect the preamplifier to any standard microelectrode array, such as a NeuroNexus probe for acute and chronic implantations, and start your in vivo experiment. All preamplifiers have additional common ground and reference electrode inputs. The metal cases provide electrical shielding. Stable long-term recordings are ensured by the high input impedance.

Flexible microelectrode arrays

The Natural and Medical Sciences Institute (NMI) in Reutlingen, Germany (www.nmi.de) is a research institute which produces high-quality MEAs using utmost biocompatible materials. The NMI and Multi Channel Systems have collaborated on many projects and over many years. Together, we have developed flexible microelectrode arrays. The electrodes of FlexMEAs are imbedded in a thin and very flexible polyimide foil. This flexibility allows the attachment of the MEAs tightly to the surface of brain or heart preparations. FlexMEAs are available with 24, 36 or 72 electrodes of gold or titanium nitride (TiN) on polyimide foil and are the perfect solution for recordings from several species, in both acute and long-term chronic experiments.
Impedance testing device nanoZ

Multichannel microelectrode arrays for neuronal recording require testing of electrode site impedances to identify faulty sites, and conditioning of sites for effective microstimulation. Manual methods are labor intensive. The nanoZ was specifically designed for testing multichannel electrodes, and has several electropolating modes for automated impedance matching, site activation, and site re-juvenation. It can accurately measure the impedance of a 64-channel electrode in under a 15 seconds.

Adapters for NeuroNexus probes, MEAs, and connectors from Millmax and Omnetics are available. Channel mapping for different adapters is handled transparently by the software.

Adapters for all standard microelectrodes

You want to combine the Multi Channel Systems in vivo setup with a standard microelectrode, such as a NeuroNexus probe? No problem. As a standard we can offer the following solutions for you:

- Adapters for many acute and chronic probes from NeuroNexus Technologies.
- Adapters for Matrix electrodes from FHC Inc.

Do we have the right adapter for you? If not, please do not hesitate to ask us. We will certainly find a solution that fits your needs, too.

Stimulus Generators

The 4000 series stimulus generators operate in voltage or current mode. The respective mode is software selected. Two, four or eight completely independent stimulus outputs are available. 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!
**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 in vivo-systems from Multi Channel 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.
- Apply several digital filters with different cutoff frequencies e.g. to separate spike activity from local field potentials.

**Real-time signal detection and feedback**

The real-time signal detection/feedback is an advantageous feature if you need fast and predictable reactions related to recorded analog signals without time delay. Before, the signal had to be analyzed by the computer, which led 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 USB-ME-System, the detour is obsolete and the time delay is now far below 1 ms. All you need to do is to define the condition for the feedback and download it to the USB-ME-System (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 stimulus generator generates the stimulus pulse (4).

**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.
**Surface mapping**

Flexible microelectrode arrays based on polyimide foil can be used to record from a large area at the surface of brain or heart in vivo or ex vivo. The flexibility of the array allows an optimal electrode-to-tissue contact on uneven surfaces. The image on the left shows signals recorded from a rat barrel cortex with a 32 channel FlexMEA. Signals are averaged and high pass filtered and the minimum of the first signal component is monitored online.

**Multi layer recordings**

Silicon based polytrodes can be used to record from multiple sites in all layers of the cortex simultaneously. The activity of hundreds of neurons can be monitored with exceptional single-unit isolation. The image shows a current-source density map of the primary visual cortex of a rat made with a 54 channel polytrode. Fluorescent staining confirms the depth of the polytrode in the cortical layers. The figure was kindly provided by Tim Blanche, Redwood Center for Theoretical Neuroscience, University of California, Berkeley.

**Acute and chronic recordings**

Recording systems from Multi Channel Systems are compatible with all kinds of in vivo electrode arrays on the market. Spike activity from acute or chronically implanted electrodes can be recorded with high resolution. It is possible to monitor any channel as an audio output in real-time, which helps positioning the electrode in the brain. All relevant parameters can be monitored online on all channels. The screenshot in the right shows data from an electrode array chronically implanted in a rat brain. Spikes are sorted online, overall spike rate and unit-specific ISI are monitored simultaneously.
Compact, functional, and flexible systems
- Complete plug and play data acquisition system with light-weight and functional components
- Modular system, can be easily upgraded and combined with other instrumentation
- Adapters for all standard microelectrode arrays such as NeuroNexus probes
- Plug-and-play systems

Perfect for a wide variety of applications
- Real-time signal detection and feedback
- Simultaneous spike and local field potential recording
- Multi-unit and single-unit recording from awake behaving animals
- Supports multitrode analysis for improved spike sorting
- Wireless systems available

High-end amplifier and data acquisition technologies
- Up to 256 channels of simultaneous amplification and continuous data acquisition
- Amplifier made according to your needs (gain and bandwidth)
- Programmable gain (10-5000), selectable via software (PGA only)
- Signal-triggered TTL output for online feedback studies
- Wide range of multichannel amplifiers with custom bandwidth available
- Differential amplification with respect to a common or to individual reference signals
- Superior common-mode noise rejection

Powerful software for data acquisition and analysis
- Flexible data stream management saving disk space
- Data file format compatible with many analysis tools such as Matlab, NeuroExplorer, Origin
- Numerous online analyses from simple data streaming and storage to online spike sorting and spike burst analysis
- Online digital filtering
- Online event detector based on threshold or on waveform
- Multiple ways to display signals for the best presentation of data
- User-friendly graphical interface
- Free and unlimited software updates

High-quality product from the market leader
- Developed, produced, and tested in-house in Germany
- Over 15 years of experience in the electrophysiology market
- World-wide distribution network
- Fast, friendly, and qualified support