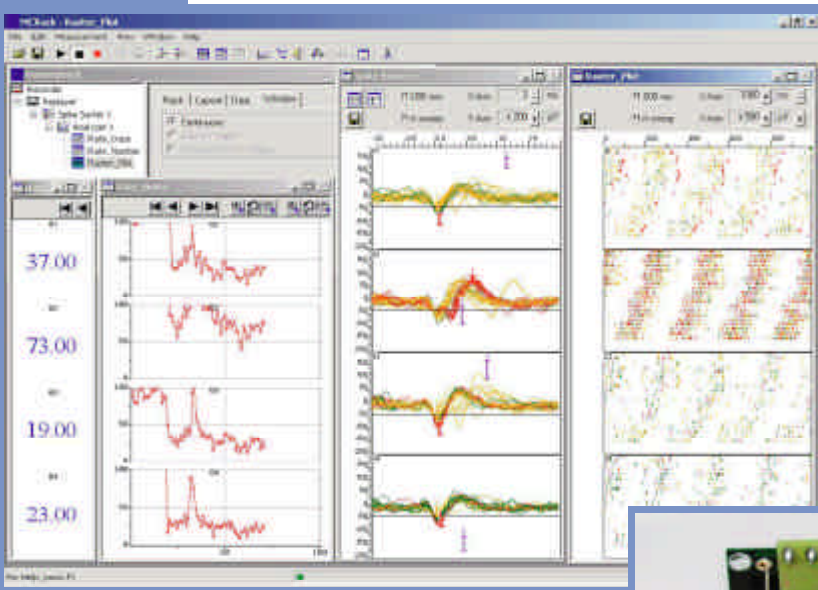


ME*

System

Extracellular Recording with Microelectrode Arrays



Michigan Probe mounted on a MCS 16 Channel Miniature Pre-amplifier

Advantages

* Compact, functional, and flexible system

- 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 Michigan probes or 8-Trodes available
- System performance fully exploits computer performance and new technical developments

* Perfect for a wide variety of applications

- Simultaneous spike and local field potential recording
- Multi-unit and single-unit recording from awake behaving animals
- Supports multitrode analysis for improved spike sorting
- Compatible with standard equipment and custom setups

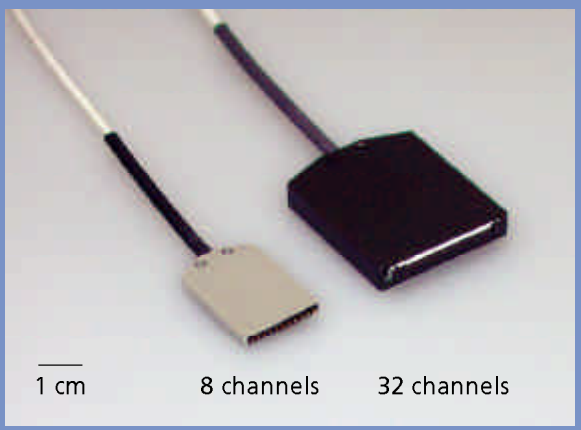
* High end amplifier and data acquisition technologies

- Up to 128 channels of simultaneous amplification and continuous data acquisition
- Blanking technology for superior stimulus artifact suppression
- Programmable gain (10-5000) and input voltage range (+/- 400 mV to +/- 4V)
- Signal-triggered TTL output for online feedback studies
- Wide range of multichannel (8, 16, 32, 48, 64) amplifiers with custom bandwidth available
- Differential amplification with respect to a common or to individual reference signals
- Superior common-mode noise rejection
- Power supply for standard amplifiers integrated into the data acquisition computer
- World-wide distribution network; fast, friendly and qualified support

* Powerful software for data acquisition, processing, 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
- 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 upgrades





Lightweight miniature head stage preamplifiers

- * Connected to the microelectrodes for providing the initial tenfold amplification stage
- * Additional common ground and reference electrode inputs: The reference electrode is ideally identical to the recording electrodes and placed into a comparable but inactive area or tissue. Background or noise signals that are picked up by both the reference electrode and the recording electrodes are removed.
- * Provided adapters ensure a close proximity to the probe to minimize signal loss and crosstalk
- * Metal case provides electrical shielding
- * High input impedance for stable long term recordings
- * Very low bias current to prevent electrode damage



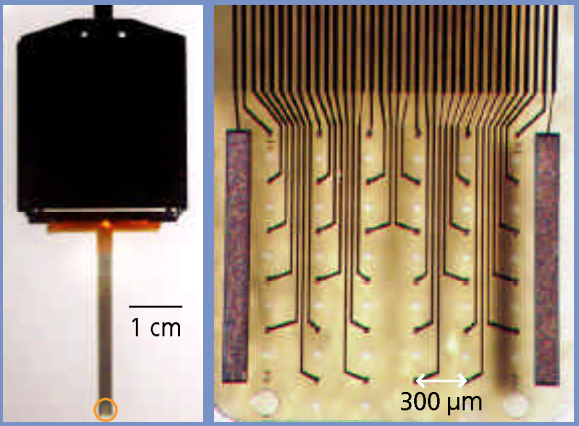
Multichannel filter amplifiers with customizable bandwidth

- * Amplification of signals from microelectrodes or from miniature preamplifiers
- * Three different types of compact amplifiers with 8, 16, 32, 48, and 64 input channels available
- * **S type** with single ended inputs: All signals are measured with respect to the amplifiers ground. Therefore, the signal source's ground and the amplifier's ground should have the same value for obtaining good results. Perfect for use with the miniature preamplifier that provides a common reference input.
- * **I type** with input for a common indifferent reference electrode: Same type as the miniature preamplifiers (see above). Most-sold standard type of amplifiers.
- * **D type** with separate differential inputs for each channel: For each recording electrode, a reference electrode is placed in an adjacent inactive area. Background noise is subtracted for each channel **separately**.
- * Gain and bandwidth can be configured for the user



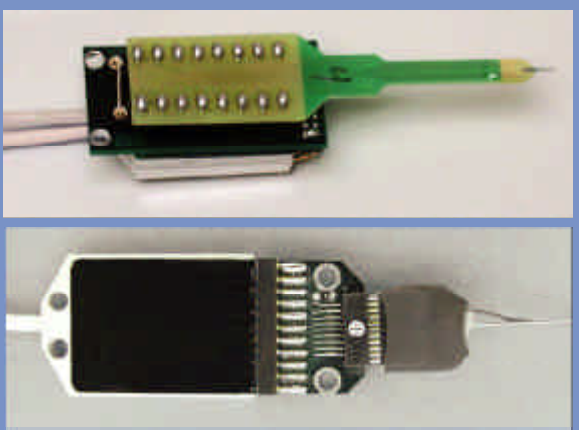
Advanced filter amplifiers with programmable gain

- * S type filter amplifiers for users who demand even more comfort and flexibility
- * Gain can be flexibly adjusted from 10 to 5000 for each channel separately with the user-friendly program FiltAmp: Simply pick the desired gain for each channel from the drop-down list. Download the settings onto the amplifier via the serial port and you are ready to go. You can print a report sheet and save the gain configuration for later use.
- * Standard versions with 16, 32, and 64 inputs available.
- * Special versions featuring two different pass bands for recording signals with different frequencies, for example for recording field potentials and spikes in parallel: Signals are split and the two pass bands are sent to two separate outputs. Available with 16 input and 32 output channels, or 32 input and 64 output channels.
- * As standard filter amplifiers, programmable gain amplifiers are available with customizable bandwidth configurations



FlexMEA - flexible microelectrode array

- * Two-dimensional array with 32 microelectrodes for recording or stimulation, 2 indifferent reference electrodes, and 2 large ground electrodes
- * Perfect for recordings from several species, in both acute and long term chronic experiments
- * Planar electrodes with only 30 μm diameter resulting in an impedance of about 50 $\text{k}\Omega$, arranged in a square 6 x 6 grid
- * Only 12 μm "thick" and with 6 x 6 perforating holes between the electrodes for a perfect contact with the tissue
- * Flexible and biocompatible polyimid as the base material supports the titanium nitride (TiN) electrodes and thin-film conductors made of pure gold
- * TiN allows the formation of electrodes as small as possible with an excellent signal to noise ratio and a long lifetime



Adapters for all standard microelectrodes

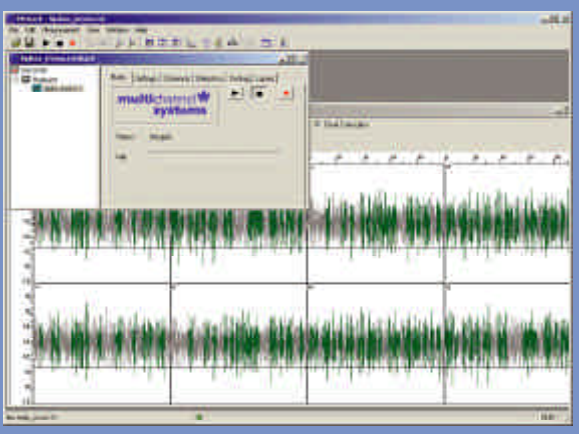
- * Complete setups for *in vivo* stimulation and recording can be combined with any standard microelectrode array such as Michigan probes (from the Center for Neural Communication Technology, University of Michigan, <http://www.neuronexustech.com>) or the 8-Trode (from ALA Scientific Instruments Inc., New York) for acute and chronic implantations.
- * A Michigan probe with 16 recording sites is connected to two 8-channel miniature preamplifiers (see top picture). The 8-Trode adapter allows a direct connection of the 8-Trode to an 8-channel miniature preamplifier (see bottom picture).
- * Other adapters according to your specifications are available on request. Please ask for an adapter that is compatible with your electrode array.



Accessories for a wide variety of applications

Multi Channel Systems provides a wide range of accessories that are perfect for use with other MCS products, but are easily adaptable to custom systems as well.

- * Freely programmable multichannel stimulus generators
- * Blanking circuit preventing stimulus artifacts: Voltage levels are held constant during a TTL pulse synchronized with the stimulation, thus preventing a saturation of the following filter amplifier.
- * Signal collectors for multiplexing channels from preamplifiers and delivering the signals to the following amplifier by a 68-pin MCS High Grade cable
- * Signal splitters for sending signals simultaneously to the data acquisition card and to an external instrument, for example an oscilloscope
- * Channel grounding units for silencing unused electrodes
- * Isolated power supply with 20 W output power for programmable gain amplifiers and custom setups

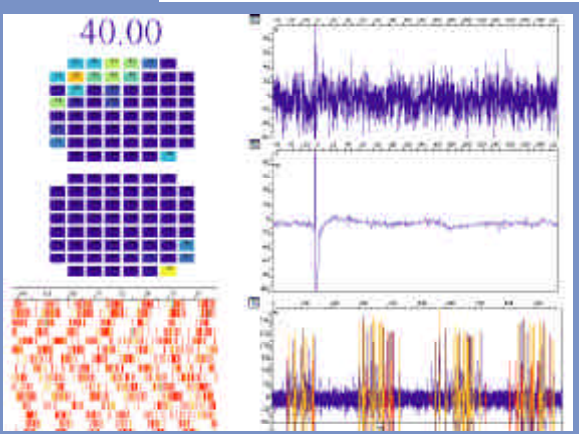


Flexible and easy to use software

The data acquisition and analysis program MC_Rack is not limited to standard applications. The software is highly adaptable with essentially **unlimited** possibilities.

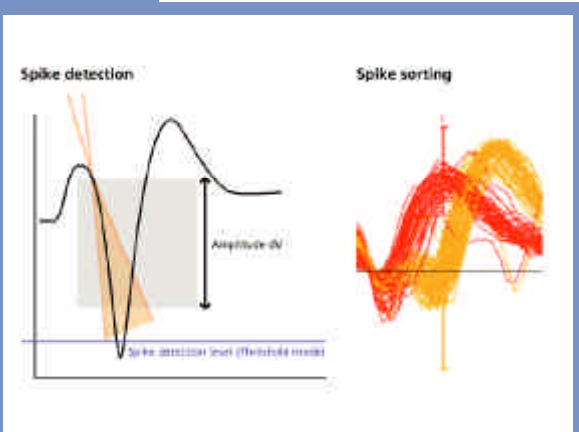
The daily work in a lab in mind, the program is set up like an instrument rack on a workbench:

- * Combine virtual instruments, for example an **oscilloscope**, a **filter**, an **event detector**, a **spike sorter**, a **sound** output, or a **signal-triggered TTL pulse**
- * Virtual instrument rack: Use task-oriented template racks or design your own according to your application
- * Select any permutation of data streams for displaying, analyzing, file saving, exporting, and much more
- * Extract parameters like spike rates and field potential amplitudes in **online** or **offline analysis**
- * **Average** data over time for signal enhancement



Graphing data

- * Select channels of interest and arrange them according to the geometry of the array or customize the layout
- * Display all data types: analog **raw data**, **spike cutouts**, **event time stamps**, **filtered data**, extracted **parameters**, and **digital TTL pulses**
- * Choose from several display types to find the best presentation of your data
- * **Overlay** spike cutouts and plot time stamps of spike detection events in a **raster plot** to visualize patterns
- * Use a **false color** plot to identify different areas of activity
- * Plot extracted **parameters** such as i/o curves or amplitude vs. time



Spike detection and sorting

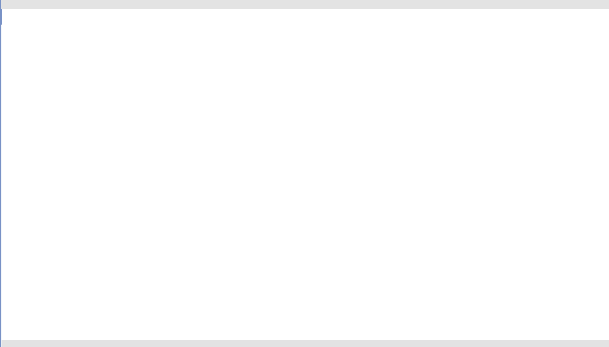
MC_Rack detects neural spike activity based on a **threshold** or on the **waveform**. Spike detection parameters can be set up separately for each channel.

The picture on the left illustrates both methods:

- a) You can drag and drop the **threshold** (blue line in the picture) in the data display, or use thresholds that are statistically determined by the program.
- b) The **waveform method** analyzes the slope (illustrated in orange in the picture) and amplitude (shown in gray) of signals. Spikes are detected reliably in underlying local field potentials even with increased noise.

The picture on the right shows how spikes can be **sorted** into up to **three** groups per electrode. In overlay mode, single unit activities are easily discriminated. Simply drag the unit markers (see red and yellow bars in the image) with your mouse on spike cutouts to tag the corresponding signal streams as single units.

Distributed by:



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ME Systems are complete with everything you need to start right away:

- 8, 16 or 32-channel miniature head stage preamplifier with adapters for all standard probes
- Compact filter amplifier or programmable gain amplifier with custom gain (from 10 to 5000) and band-width (from 0.1 Hz – to 10 kHz) for up to 128 channels
- Preinstalled data acquisition computer with TFT monitor
- 50 kHz sampling rate per channel, up to 128 channels, 12.8 MB/s total conversion rate
- Software-selected input range from +/- 400 mV to +/- 4 V
- Additional digital in- /output for synchronizing other instruments with the recording, and for recording additional information in parallel to the extracellular recording, for example signals from other amplifiers such as patch clamp amplifiers
- Easy to use MC_Rack program for displaying and recording data, with online and offline analysis tools
- More equipment available on request, for example for stimulation

