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Heart on a chip: Microelec trode Array (MEA)-Systems
- Complete, compact, and versatile system solution for in vitro recordings from MEAs
- Primary cardiomyocytes, stem cell and iPS cell derived cardiomyocytes, and cardiac slices
- Excellent for long-term recordings
- All systems can be connected to any computer (USB connection)
- One system for a variety of applications (MEA2100-System)
- Can operate 1, 2 or 4 microelectrode arrays
- Microelectrode arrays with 60, 120 or 252 electrodes (wide variety of layouts)
- Integrated stimulator (blanking circuit for simultaneous stimulation and recording without stimulus artifacts)
- Multiwell-MEA-System for higher throughput (Multiwell-MEA System)
- Recording system for 24- or 96-well plates with 288 channels with up to 1152 electrodes
- Integrated stimulator
- Ambient controlled chamber: Temperature, humidity, and CO2

Chip on a heart: Epicardial mapping systems
- Complete recording system for in vivo and in vitro applications
- Portable-ME-Systems: 16 or 32 channels available
- Stationary-ME-Systems: 64, 128 or 256 channels available
- Separate devices for data acquisition, filter amplifier and signal collector
- Different adapters for multielectrode arrays and headstages are available
- High spatial and temporal resolution
- Flexible electrode grids
- Customized arrays for large animals
- Easy handling with convenient analysis software

Cardiac applications
- Whole heart in vitro & in vivo
- Primary cardiomyocytes
- Stem cells and iPS cells
- Cardiac slice recordings

Primary cardiomyocytes
Primary cardiomyocytes are a highly predictive high-content assay system for drug testing. Many drugs prolong the QT interval in the ECG. On a cellular level this corresponds to a prolonged ventricular action potential. Usually, just one pacemaker triggers the syncytium of cardiomyocytes linked by gap junctions. The mapping allows monitoring important indicators of arrhythmogenic potential of a drug:
- Drawing isochronous lines
- Measuring conduction velocity

Stem cells and iPS cells
The electrodes of the MEA-chip record the field potential of stem cell clusters. Electrophysiological characterization opens up various opportunities:
- Classification of cells as atrial or ventricular phenotype.
- Pharmacological characterization.
- Utilization of validated stem cell derived cardiomyocytes for drug screening.
Multi Channel Systems offers multiwell solutions for high throughput experiments with high impact cardiac data using 24- or 96-well plates with integrated electrodes.

Cardiac slice recordings
Due to the intact structure of the tissue it is possible to map the excitation from the point of stimulation:
- Obtain field potential parameters from multiple electrodes.
- Detect differences between epicardial, intramural, and endocardial cells.
- Detect transmural dispersion of drug induced ventricular field potential prolongation early and in vitro.

Whole heart in vitro & in vivo
The electrophysiological mapping of the cardiac surface is an important tool in understanding mechanisms of supraventricular and ventricular arrhythmias.
- Record ALS offer recording of electrical activity with highest spatial and temporal resolution.
- Record either field potentials or monophasic action potentials.
- Data acquisition handles up to 256 channels in real-time.

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The advantages of MEA technology in cardiac research are:
- High spatial resolution
- All components of action potential reflected
- Shape comparable to ECG

Amplifiers, stimulators & data acquisition

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- QTZ 2, 8-channel stimulus generator for current and voltage-driven stimulation of cardiomyocytes.

Software

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Field potential duration, slope, and amplitude

Drug screening and pharmacological research can be done using MEA technology and stem cell derived or primary cardiomyocytes or even cardiac slices and whole hearts.

The graph on the left shows that a Ca2+ blocking will prolong the duration of the field potential (c430). The graph on the right shows that a L Type calcium channel blocker will shorten the field potential (c430). Calcium channel blockers will reduce slope and amplitude of the depolarization peak. These effects can either be used to validate the cells on the MEA or to do drug testing with well-characterized cardiomyocytes.

Excitation patterns

On the left-hand side a typical excitation pattern is displayed. A characteristic local activation time (c5) is illustrated. The days are an easy way of detecting reentry in the atrioventricular pathway. Another parameter monitored is the conduction velocity. Our MC_Rack and Cardio2D software can help you to get those results fast and reliable in a short time.

These tools are especially useful to detect reentry, ongoing excitations of infarcted infarcted myocardium and conduction velocity by plots after lesions or in co-cultures.

Heart rate & proarrhythmic events

Spontaneous beating and pacing preparations can be monitored by viewing heart rate in real-time. The multiwell-electrodes allow detecting multiple parallel preparations and analyzing them separately. Depending on the arrhythmogenic mechanisms drug induced arrhythmias can be studied in vitro.

- Plot heart rate / RR interval vs. time
- Detect Early Afterdepolarizations
- Perform beat-to-beat variability analysis
- Detect tachyarrhythmia and bradyarrhythmia

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- Map transmembrane signal propagation
- Investigate repolarization disturbances
- Bridge the gap between cells and organs

Cardiomyocytes

Primary cardiomyocytes can be isolated from neonatal rodents as well as embryonic chicken by simple enzyme digestion. These cells can be cultured and recorded on a variety of microelectrode arrays (MEA).

- Drug testing
- Excitation patterns
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- Safety pharmacology

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Cardiac field potentials
The recording electrodes are located in close proximity to the beating cardiac cells or tissue. The signal detected is an extracellular field potential. This signal consists of a rapid depolarization (sodium), a plateau phase (calcium) and a repolarization (potassium). Due to the similarity it shares with an ECG, the depolarization is compared to QRS complex, whereas the repolarization is referred to as T wave. The field potential is the first negative derivative of the action potential.

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- STG-2, 6, or 8-channel stimulus generator for current and voltage driven stimulation of cardiomyocytes.

Cardiac slice recordings
After being used in brain research for a long time, slice technology is now used in cardiac research. Cardiac slices are placed on a MEA, from where you can record and analyze the signals from up to 252 electrodes.

- Map transmembrane signal propagation
- Investigate repolarization disturbances
- Bridge the gap between cells and organs

Software
Multi Channel Systems offers various software programs combining complex tasks with a user-friendly interface.

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- STEM: The universal software solution for data acquisition, analysis, and generation of 2D- and 3D-images.
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Heart rate & proarrhythmic events
Spontaneously beating cardiac preparations can be monitored by viewing heart rate in real-time. The multiwell-arrays allows detecting multiple parameters online and analyzing 40 cardiac cells simultaneously. Depending on the arrhythmogenic mechanisms drug-induced arrhythmia can be studied in vitro.

- Plot heart rate vs. time
- Detect Early Afterdepolarizations
- Perform beat-by-beat analysis
- Detect tachycardia and bradycardia

ES and iPSC cells
These cells are omnipotent or pluripotent and can be differentiated into various cell types.

- Characterization of the cells
- Drug testing
- Modeling systems for transplantation of the cells into native tissue
- Safety pharmacology

Whole heart in vitro & in vivo
With flexible microelectrode arrays, MEA-based technology is suitable for single cell activity from every area of a Langendorff heart or even recorded in vivo from beating hearts of small animals. Just position the array on your preparations.

- Discover subepicardial and subendocardial arrhythmias.
- Calculate conduction velocity
- Measure frequency patterns.

Excitation patterns
On the left-hand side a typical excitation pattern is displayed. On the right the signal is shown during a single period (cycle). The apex can be displayed in various morphologies and thereby provide the array on your preparations.

- Array configuration
- Electrode density
- Shape comparable to ECG

Field potential duration, slope, and amplitude
Drug screening and pharmacological research can be done using MEA technology and stem cell derived or primary cardiomyocytes – or even cardiac slices and whole hearts.

The graph on the left shows that a K+ channel blocker will prolong the duration of the field potential (F4031, Quinidine, Sotalol), whereas a L Type calcium channel blocker will shorten the field potential (Nifedipine). Sodium channel blockers will reduce slope and amplitude of the depolarization peak. These effects can either be used to validate the cells on the MEA or to do drug testing with well-characterized cardiomyocytes.
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- Map transmural signal propagation
- Investigate repolarization disturbances
- Bridge the gap between cells and organs

Cardio2D software

The graph on the left shows that a hERG blocker will prolong the field potential duration, slope, and amplitude of the depolarisation peak. These effects can either be used to validate the cells on the MEA or to do drug testing with well-characterized cardiomyocytes.

Fexaprost on Cor4U cardiomyocytes from Notocord-hem.

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Heart rate & proarrhythmic events

Spontaneously beating cardiac preparations can be monitored by viewing heart rate in real-time. The multiwell-MEA technology allows detecting multiple parameters simultaneously and analyzing them separately. Depending on the arrhythmogenic mechanisms drug induced arrhythmias can be studied in vitro.

- Heart rate / HR interval vs. time
- Detect Early Kferproarrhythmias
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Excitation patterns

On the left-hand side is a typical excitation pattern as displayed in a circular format. The area can be expanded as necessary by zooming on the spike graph. Pictures that allow an easy detection of arrhythmogenic excitation patterns. These tools are especially useful to detect reentry, circus excitations of in vitro or in vivo preparations. The experts have developed these tools in collaboration with biologists.

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- Measuring conduction velocity

Stem cells and iPS cells
The electrodes of the MEA chip record the field potential of stem cell clusters. Electrophysiological characterization opens up various opportunities:
- Classification of cells as atrial or ventricular phenotype.
- Pharmacological characterization.
- Utilization of validated stem cell derived cardiomyocytes for drug screening.

Cardiac slice recordings
Due to the intact structure of the tissue it is possible to map the excitation from the point of stimulation.
- Obtain field potentials from multiple electrodes.
- Detect differences between epicardial, intramyocardial, and endocardial cells.
- Detect transmural dispersion of drug induced ventricular field potential prolongation early and in vitro.

Heart on a chip: Microelectrode Array (MEA) Systems
- Complete, compact, and versatile system solution for in vitro recordings from MEAs.
- Primary cardiomyocytes, stem cell and iPS cell derived cardiomyocytes, and cardiac slices
- Perfect for long-term recordings
- All systems can be connected to any computer (USB connection)
- One system for a variety of applications (FlexMEA-System)
- Can operate 1, 2 or 4 microelectrode arrays
- Microelectrode arrays with 60, 120 or 252 electrodes (wide variety of layouts)
- Integrated stimulator (blanking circuit for simultaneous stimulation and recording without stimulus artifacts)
- Multiwell-MEA-System for higher throughput (Multiwell-MEA System)
- Recording system for 24- or 96-well plates with 288 channels with up to 1152 electrodes
- Integrated stimulator
- Ambient controlled chamber: Temperature, humidity, and CO2

Chip on a heart: Epicardial mapping systems
- Complete recording system for in vivo and in vitro applications
- Portable-ME-Systems: 16 or 32 channels available
- Filter amplifier and data acquisition integrated in one device
- Stationary-ME-Systems: 64, 128 or 256 channels available
- Separate devices for data acquisition, filter amplifier and signal collector
- Different adaptations for multielectrode arrays and headstages are available.
- High spatial and temporal resolution
- Flexible electrode grids
- Customized arrays for large animals
- Easy handling with convenient analysis software

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Cardiac applications
- Whole heart in vitro & in vivo
- Primary cardiomyocytes
- Stem cells and iPS cells
- Cardiac slice recordings