MaxOne

High-Density Microelectrode Array System

Versatility to Empower Your Research

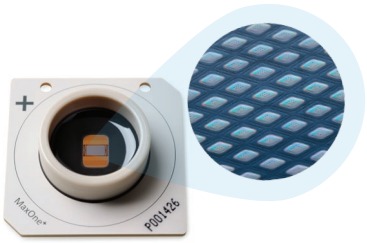
Every Cell Has a Story to Tell

Powerful single-well high-density microelectrode array system
for recording and stimulating your cells.

High-Density Microelectrode Array (HD-MEA)

MaxOne

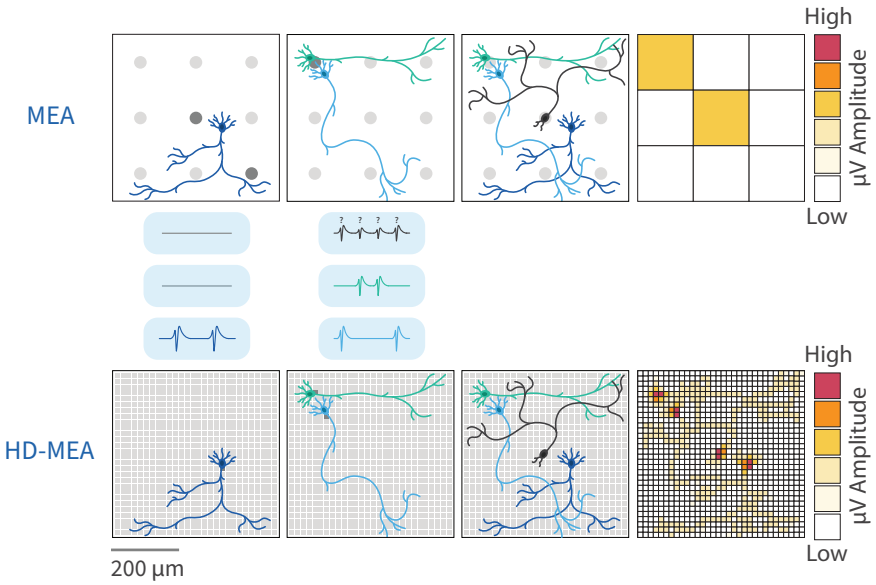
Capturing the intricate dynamics of cellular activity is key for phenotype characterization, disease modeling, and drug discovery. There is an increasing demand for real-time and label-free methods to simultaneously study the function, maturation, connectivity and morphology of cells within the same sample. High-density microelectrode arrays (HD-MEAs) serve as an unparalleled tool for conducting non-invasive in-vitro functional assays.



26'400 Pt-Electrodes Per Well
3'265 Electrodes/mm²
Low-Noise Readouts
Flexible Electrical Stimulation
Pt-Black coating (MaxOne Chips)
PEDOT coating (MaxOne+ Chips)

Readout at different scales
Network level
Cell level
Subcellular level

MaxOne HD-MEAs represent the next-generation electrophysiology platform, featuring densely packed microelectrodes capable of capturing the electrical signature of electrogenic cells with unprecedented precision.



Traditional MEAs feature large electrodes spaced far apart, allowing users to detect a subsample of the neuronal network. This provides an averaged view of the electrical activity of multiple cells and the network dynamics. With MaxOne HD-MEAs' high resolution and low noise, spikes generated by any active neuron on the array can be picked up by many tightly spaced electrodes, including the propagation of such signals along axonal arbors. MaxOne HD-MEAs thus provide exceptional data quality, enabling the capture of intricate whole network dynamics and identifying single cell function.

Key Features

Versatility

Use the compactly build MaxOne Recording Unit in various environments, including humidified incubators and accessories for both cultured and acute samples.

High-Quality Data

Obtain high-resolution and high-quality electrophysiological data while tracking dynamic functional changes at cellular, subcellular, and network levels.

Reproducibility

Exploit optimized recording strategies to analyze the entire culture at individual neuronal levels, thus enhancing the data reproducibility and statistical power.

Sensitivity

Capture the smallest signals (µV) thanks to our low-noise recording channels and the high electrode density, ensuring an electrode in close vicinity to even the weakest signals.

Longitudinal Experiments

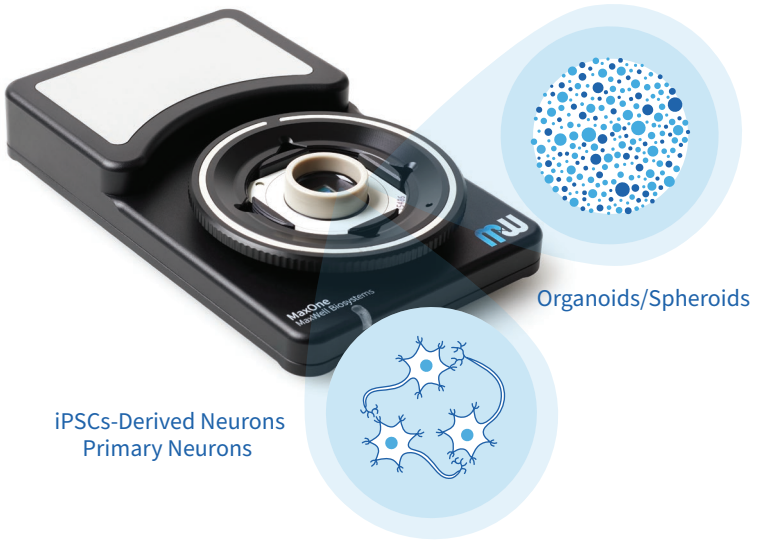
Assess cell development, maturation, or compound effects by performing longitudinal experiments over the course of days, weeks, and months.

Integrity

Conduct non-invasive and label-free recordings, eliminating any potential side effects associated with the use of dyes and prolonged exposure to light.

Applications

Exploring the electrophysiological properties of cells enables users to understand their functional traits and roles in different systems as well as disease models. Taking advantage of its advanced capabilities and versatility for customization, MaxOne users are equipped to customize their platform to explore the boundaries of neuroengineering and organ-on-a-chip.



Other Applications

Phenotyping

Solution for extended cell characterization and longitudinal developmental studies spanning weeks or months.

Disease Modeling

Versatile platform to study various cellular models of neurodevelopmental and neurodegenerative diseases.

Neuroengineering

Integrating biology with engineering, customized scripting enable users to explore the boundaries of neuroengineering and artificial intelligence.

Organ-on-a-Chip

Recipe for an advanced organ-on-a-chip platform: MaxOne HD-MEA, microfluidic devices, and cultured neurons - build your own now!

Assays

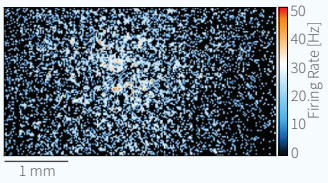
MaxLab Live Software is a comprehensive and user-friendly tool designed for visualizing, recording, and analyzing data recorded with MaxOne. Its assays guide the user through automated workflows to the extraction of key metrics at multiple levels, including network, single-cell, and subcellular details.

ActivityScan

Are the cells active? Where are they located?

Record whole sample activity through array scanning

Identify the firing activity and location of cells



Activity Metrics

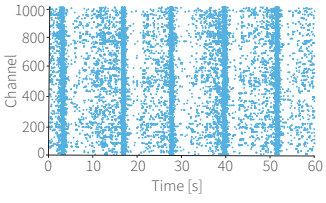
Firing Rate, Spike Amplitude, etc.

Network

Are the cells interconnected?

Record population activity through smart electrode selection

Identify network-level synchronized activity



Network Metrics

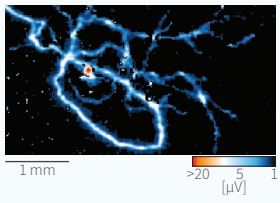
Burst Rate, Burst Duration, etc.

AxonTracking

Are the axons functional?

Record and automatically identify single neurons

Track axonal arbors and extract action potential conduction velocity



Axon Metrics

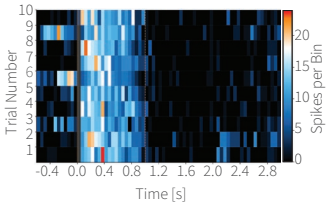
Conduction Velocity, Total Axonal Length, etc.

Stimulation

How does electrical stimulation affect cells?

Characterize the excitability of cells

Study effects of electrical stimulation on neuronal activity



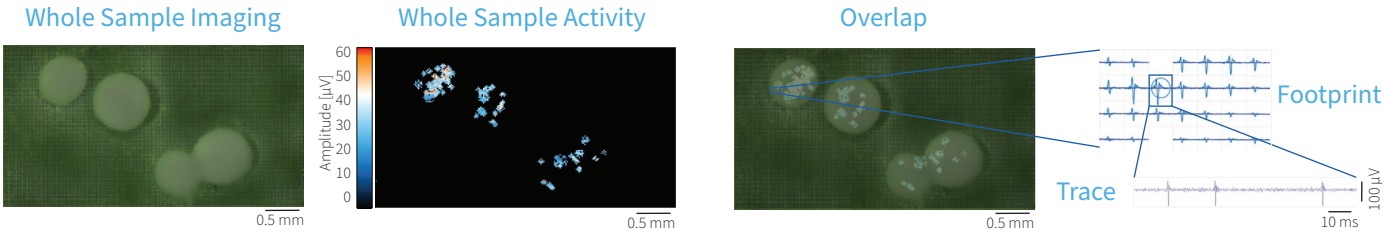
Stimulation Metrics

Evoked Total Spikes, Evoked Activity Peak, etc.

Application Highlight

MaxOne HD-MEA empowers users to capture high quality label-free electrophysiological recordings across a wide range of electrogenic samples - a representative collection of organoid samples are highlighted in this section.

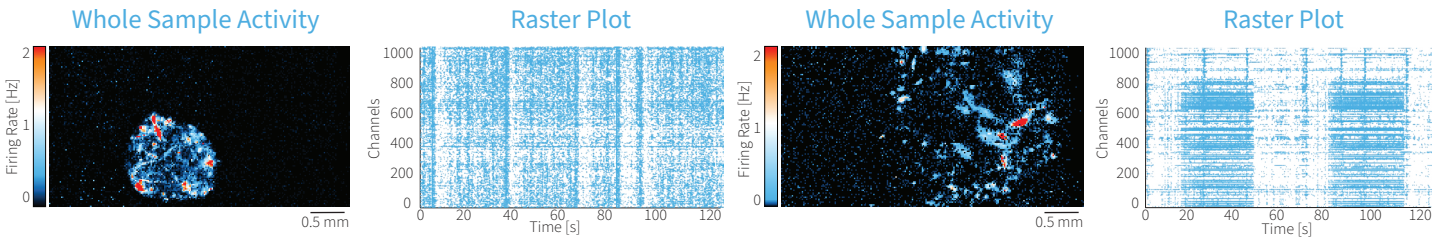
Cortical Organoids



The activity map of cortical organoids powered by the MaxOne HD-MEA matches its image. Example electrical footprint of a single cell and representative traces from a single electrode showcases the high-quality data.

Fused (Dorsal + Ventral) Forebrain Organoids

Hippocampal Organoids

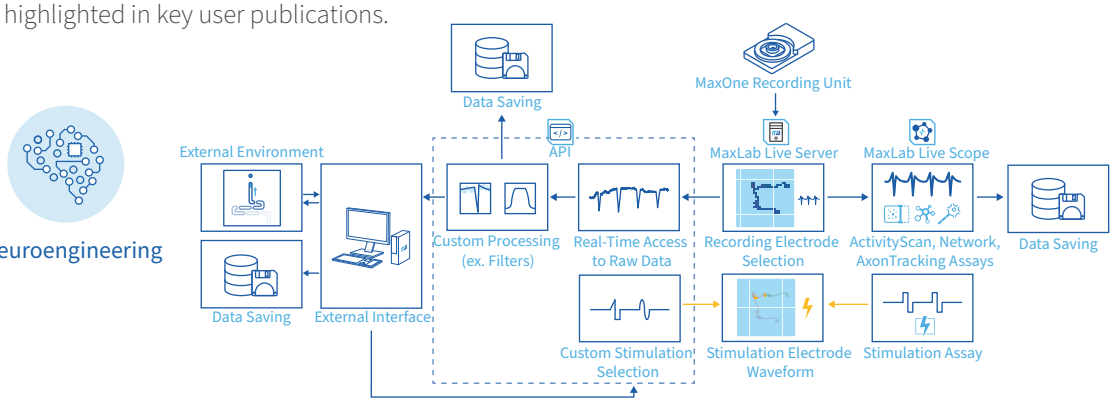


Whole sample activity map and raster plot of network dynamics of fused (dorsal + ventral) forebrain and hippocampal organoids are depicted above. Organoids differing in size are characterized on the MaxOne HD-MEA with ease.

Data courtesy of MaxWell Biosystems users including the laboratory of Prof. Lena Smirnova at John Hopkins University and the Stem Cell Engineering Research Group at Instituto Superior Tecnico.

Advanced MaxOne Capabilities

The **Application Programming Interface (API)** equips users to explore the boundaries of neuroengineering by maximizing all features of the MaxOne HD-MEA in a customized way. With real-time access to raw data streams (C++) and platform for customized processing and integration with external environments (Python), users can develop feedback systems for neurocomputing – a selection of which is highlighted in key user publications.



Enabled Applications

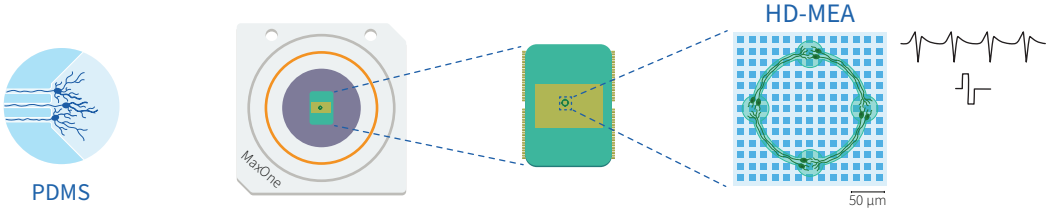
Open Loop

Cai et al., 2023
Nature Electronics

Closed Loop

Kagan et al., 2022
Neuron

Featuring the same high electrode resolution and low noise, the MaxOne+ chips ensures a smooth user experience for microfluidic device attachment and enables users to flexibly record and stimulate every cell across the whole device. Check out our key user publications below to have a glimpse for their engineered neuronal networks.



Enabled Applications

Duru et al., 2023
Biosensors & Bioelectronics

Sato et al., 2023
Frontiers in Neuroscience

MaxOne System

MaxOne System Features

Components	Recording Unit Hub
System status indicator	LED
Dimension (L x W x H)	Recording Unit: 150 x 95 x 25 mm^3 Hub: 185 x 280 x 90 mm^3
Incubator friendly	Yes, for the Recording Unit
Accessory compatibility	Perfusion System Tissue Holder DigiPins

PSM PLM PSM PLM

Chip Features

	MaxOne		MaxOne+	
Ring diameter	Inner: 19 mm Outer: 24 mm	Inner: 32 mm Outer: 35 mm	Inner: 19 mm Outer: 24 mm	Inner: 32 mm Outer: 35 mm
Typical applications	Cultured samples	Acute samples	Cultured samples Organ-on-a-Chip	Acute samples Organ-on-a-Chip
Ring height	8 mm		8 mm	
Active sensing area	3.85 x 2.10 mm^2		3.85 x 2.10 mm^2	
Total number of electrodes	26’400		26’400	
Nr. of recording/stimulation elc.	26’400		26’400	
Electrode density	3’265 electrodes/mm^2		3’265 electrodes/mm^2	
Electrode center-to-center distance	17.5 µm		17.5 µm	
Electrode size	8.8 x 12.0 $µm^2$		11.5 x 11.5 $µm^2$	
Electrode material	Pt-Black		PEDOT	
Surface topography	<2.0 µm		<0.6 µm	
Sampling rate	20 kHz/channel		20 kHz/channel	
Number of recording channels	1’020		1’020	
Adjustable gain	Yes		Yes	
Electrical stimulation	Yes		Yes	
Number of stimulation units	32		32	
Maximum voltage stimulation	± 1.0 V		± 1.0 V	
Electronic ID	No		Yes	
Sterilization Treatment	No		Yes	

Disclaimer

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