

BioCAM DupleX





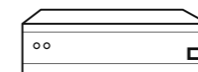
BioCAM DupleX

4096 electrodes for sensing and actuation in 2D and 3D in vitro brain models

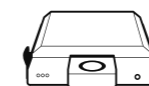
BioCAM DupleX is the result of more than 15 years of 3Brain's experience in developing CMOS high-resolution multielectrode arrays platform.

The system integrating all the latest technological advances will provide the researcher a simple, fully informative experience in all experimental contexts requiring a bidirectional interaction with in vitro brain models.

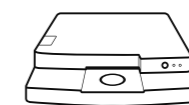
Sensing and actuating from thousands of cells will be easy and immediate, large dataset will be stored and analyzed in a fast and simple way thanks to BrainWave, the most powerful software to handle electrophysiological data ever developed.



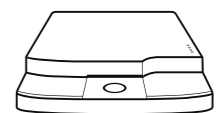
BioCAM Idea
2004



BioCAM 4096
2012



BioCAM X
2015

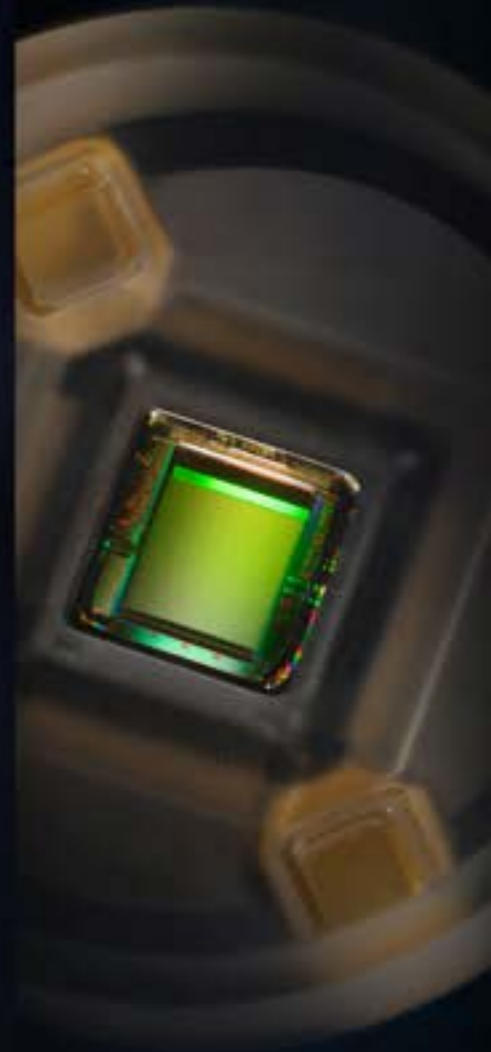
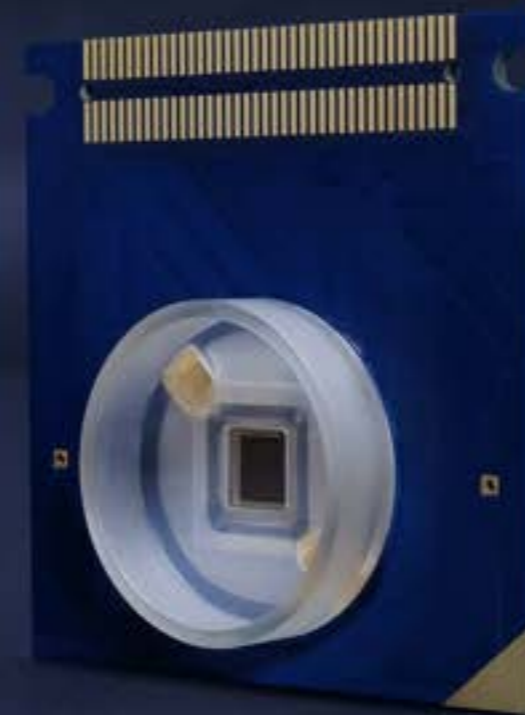


BioCAM DupleX
2019

4096 x 20kHz x Stim

BioCAM DupleX is empowered by Accura, the latest chip of the Khíron Asics family, allowing it to select any of the thousands of recording electrodes to release an electrical stimulation thus combining a high-resolution sensing with a micrometer precise stimulation.

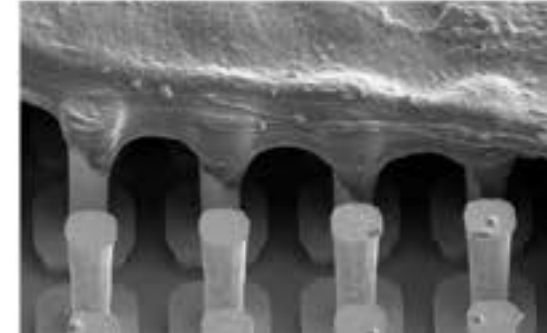
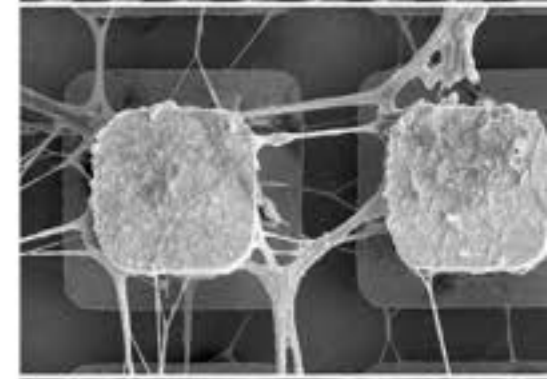
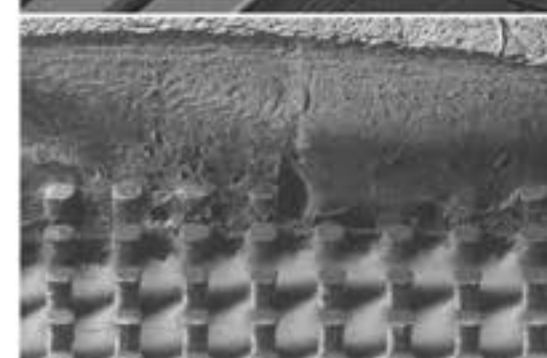
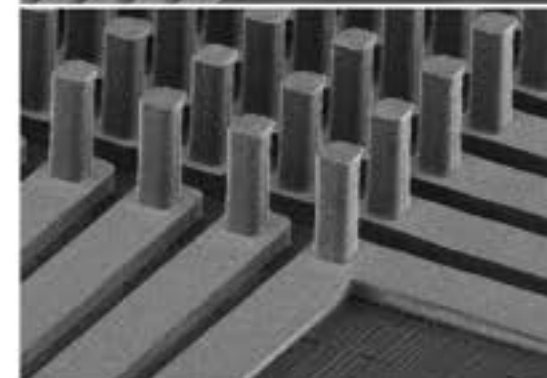
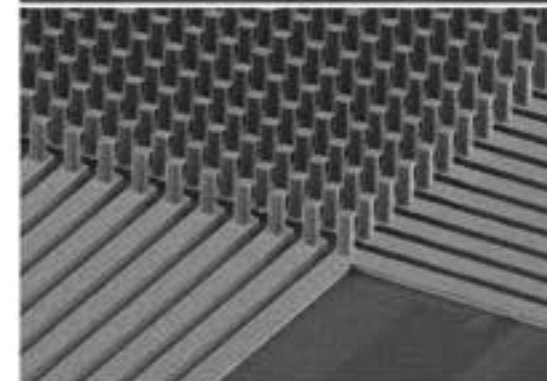
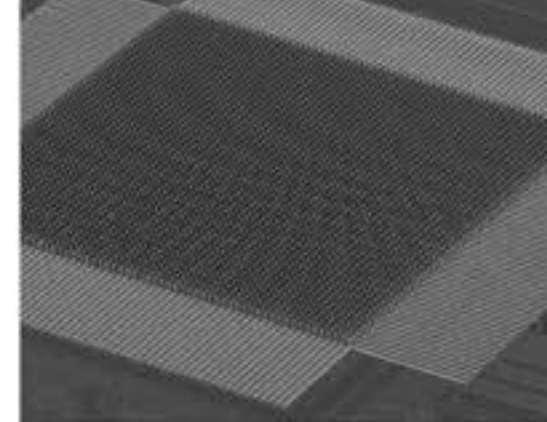
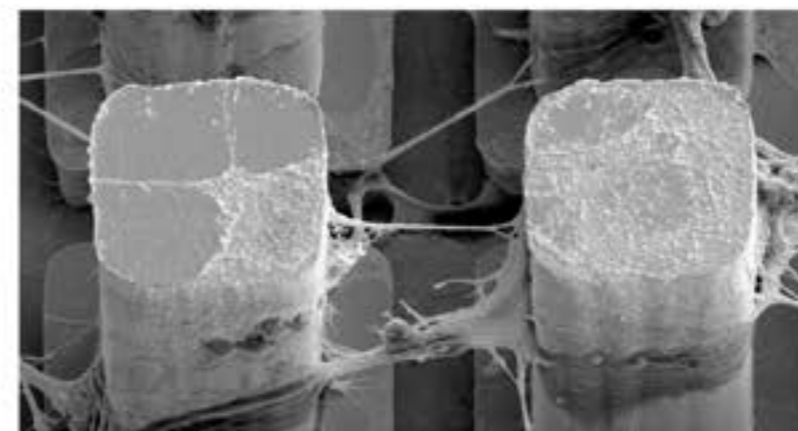
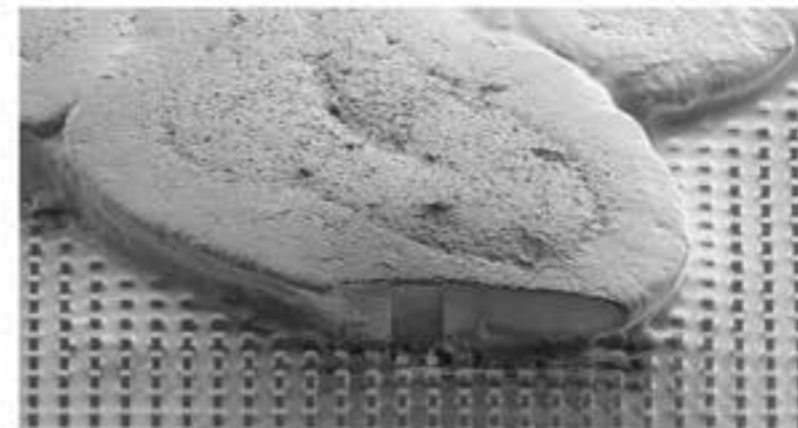
Accura chip is nowadays the most advanced chip on the market providing simultaneous recording of all the 4096 electrodes with the freedom to stimulate from any of them.



3D Brain tissue: the future of electrophysiology at your fingertips

BioCAM Duplex is the first achievement of 3Brain's project in providing electrophysiological tool to finely explore the in-vivo like activity generated by 3D in vitro models such as brain Organoids or Spheroids.

BioCAM Duplex is indeed the unique system able to acquire the signals recorded by the Accura 3D chip, the first CMOS-based MEA providing 4096 penetrating uNeedle electrodes. This revolutionary technology will enable the recording and stimulation from within a tissue, allowing the full exploitation of the use of 3D model in applications such as drug discovery, toxicology, personalized medicine etc...





All the power you need

BioCAM DupleX has a completely revised electronic and improved hardware computational power to pre-process your data. Real-time optimized algorithms allow to filter, denoise and compress signals before acquisition, which opens infinite potentiality in exploiting the high content data provided by the BioCAM DupleX.

Compact - Easy - Fully accessorized

Like its predecessor BioCAM X, the BioCAM DupleX is a complete system comprising a stimulus generator, a temperature control and a magnetic plate to attach perfusion holders integrated into a fashion compact aluminum case.

In addition, BioCAM DupleX implements an on chip integrated reference, thus simplifying experimental procedures and providing more freedom in using the system combined with other instrumentations as a microscope or a patch system.

Perfect alignment, perfect experiment

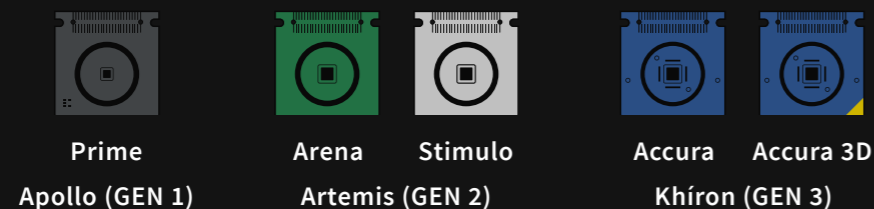
3Brain is always attentive to every detail in designing its products. The locking mechanism of the BioCAM DupleX has been equipped with a motorized system activated by the simple press of a button that will guarantee an always perfect contact alignment with the chip.

A set of LEDs will show the status of the system indicating if it is powered, a chip is locked, or if a recording is running.

One platform for all the chips

BioCAM DupleX is compatible with all the 3Brain's MEA probe series, comprising the 1st and 2nd generation (Prime, Arena and Stimulo chips) and the latest family Khíron with the fully-bidirectional Accura and Accura 3D probes.

COMPATIBLE WITH ALL MEA PROBE SERIES



HIGHLIGHTS

Unbounded performance

3D electrodes

for 3D in vitro models

4096

simultaneous recording electrodes

20 kHz/electrode

or up to 64kHz for electrode subsets

4096

stimulation sites

13 Gbps

Intel®'s Arria® 10 FPGA

2 GB

DDR4

USB-C[™]

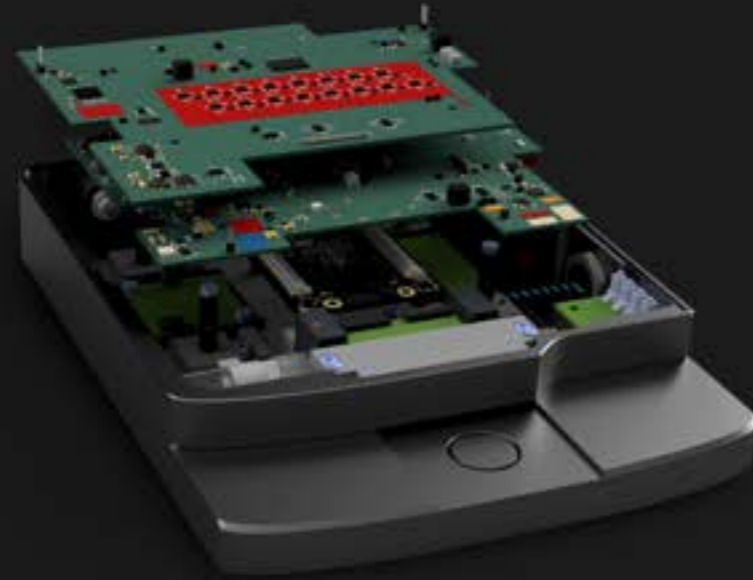
data interface

V.2

anti-spill barrier



UNDER THE CASE



REAL-TIME PROCESSING

Advanced FPGA control to denoise, filter and compress high-density data.

MAGNETIC SURFACES

All the surfaces around the MEA chip are magnetic for easy setup with other equipment, such as perfusion holders.

TEMPERATURE CONTROL

Integrated heating and cooling system.

INTEGRATED STIMULATOR

2 independently programmable stimulator channels (1 voltage and 1 current).

FAST LOCKING SYSTEM

A motorized solution to reliably lock and unlock your microelectrode array (MEA) chips.

ROBUST EXTERNAL CASE

Crafted from aluminum to shield from electromagnetic and mechanical noise.

MAIN CONTROLLER

computational core	Intel®'s Arria® 10 FPGA 13Gbps, 2GB DDR4, and ARM® dual-core Cortex™-A9 1.5 GHz
data resolution	12 bit
number of simultaneous recording channels	4096
sampling frequency (full-array)	20 kHz/electrode
region-of-interest	1 - 4 independent subsets of electrodes (up to 64 kHz sampling frequency)
temperature control	active heating and cooling system
data interface	USB 3.1 Type-C
ground reference	on-chip integrated
HD-MEA compatibility	Prime, Arena, Stimulo, Accura
3D HD-MEA compatibility	Accura 3D (firmware upgrade required)
control software compatibility	BrainWave 4 or higher
inputs	two analog inputs (-3.3 V to 3.3 V) or triggers (LV-TTL)

STIMULATION MODULE

integrated current stimulator	✓
real-time stimulation controller	✓
number of independent channels	3 (2 int. and 1 ext.)
internal (on-chip) stimulation sites	4096 (only with HD-MEA Accura)
external stimulation sites	2 (accessible with optional connector box)
maximum amplitude	+/- 1 mA
amplitude resolution	10 µA
time resolution	10 µs

PHYSICAL SPECS

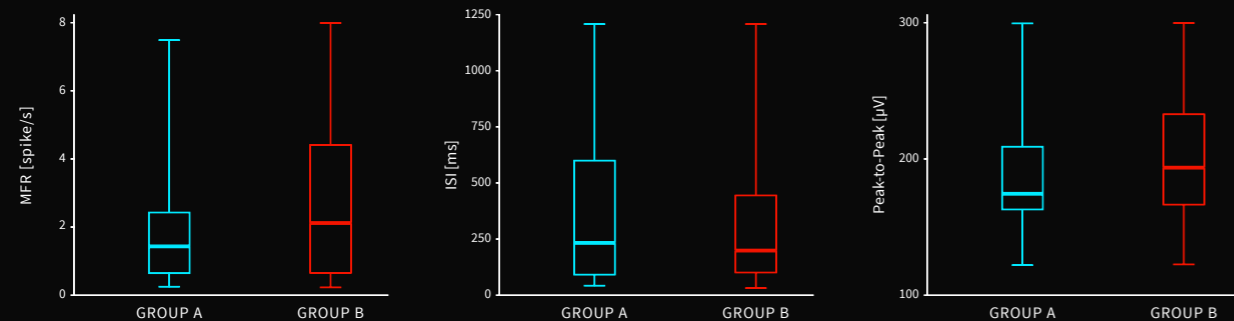
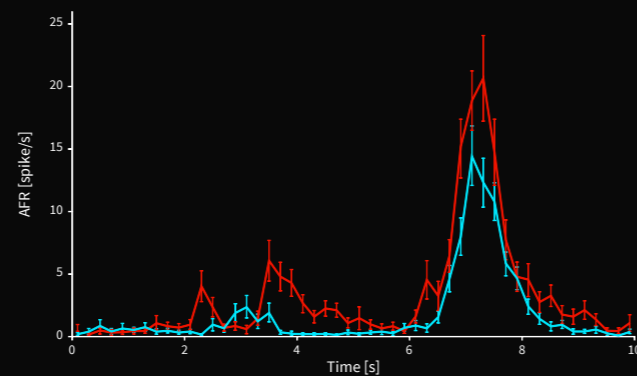
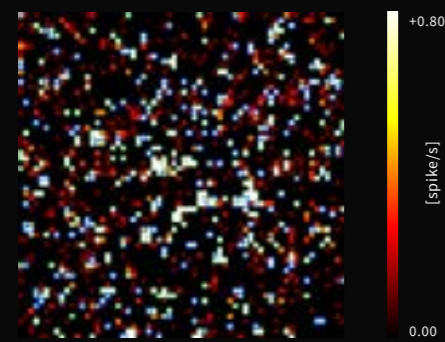
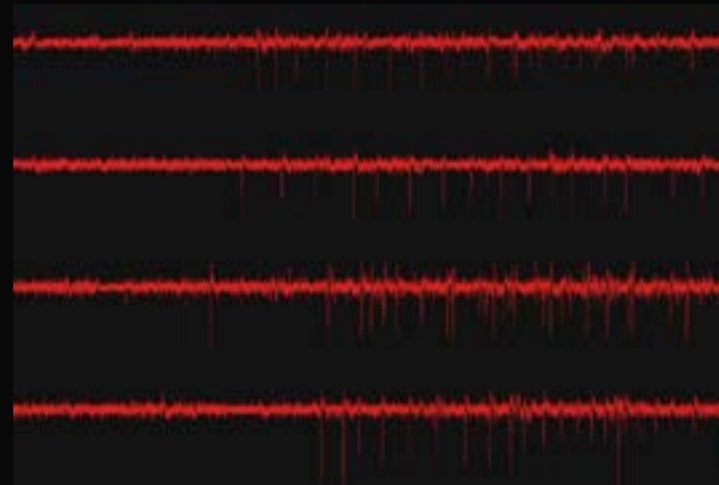
body material	anodized aluminum and stainless steel
locking mechanism	motorized
protection from liquid spill over	anti-spill barrier v. 2
dimensions (W x D x H)	180 x 230 x 42 mm 7.09 x 9.05 x 1.65 inches
weight	2 kg / 4.4 pounds

Chip generation	Apollo (GEN 1)	Artemis (GEN 2)	Khíron (GEN 3)	
HD-MEA model:	Prime	Arena	Stimulo	Accura
ELECTRICAL CHARACTERISTICS				
system bandwidth	1 Hz - 20 kHz	1 Hz - 20 kHz	1 Hz - 20 kHz	1 Hz - 20 kHz
noise	11 µV*	11 µV*	11 µV*	11 µV*
maximum input-referred signal amplitude	4 mV	4 mV	4 mV	40 mV
MAIN ARRAY				
mode of operation	recording	recording	recording	recording and stimulation (bidirectional)
# of electrodes	4096	4096	4096	4096
# of simultaneous recording electrodes	4096	4096	4096	4096
# of stimulating electrodes	-	-	-	4096
electrode size	21 µm x 21 µm	21 µm x 21 µm	21 µm x 21 µm	21 µm x 21 µm
electrode pitch	42 µm	42 µm	81 µm	60 µm
active area (area with electrodes)	2.67 mm x 2.67 mm	2.67 mm x 2.67 mm	5.06 mm x 5.06 mm	3.8 mm x 3.8 mm
SECONDARY ARRAY				
secondary Array	No	No	✓	No
mode of operation	-	-	stimulation	-
# of electrodes	-	-	16	-
electrode size	-	-	21 µm x 21 µm	-
electrode pitch	-	-	1.28 mm	-
electrodes area	-	-	3.86 mm x 3.86 mm	-
PHYSICAL SPECS				
flat area (around active area)	~3 mm x 3 mm	~6 mm x 6 mm	~6 mm x 6 mm	~6 mm x 6 mm
reservoir volume	~2.5 mL	~2.5 mL	~2.5 mL	~2.5 mL

* within 100 Hz - 10 kHz

Human-derived neuronal cultures

Human stem cell-derived neuronal networks represent the future gold-standard in in-vitro neuroscience. 3Brain's technology can fully exploit such a model by recording outstanding spiking activity from human-derived neuronal cultures as the example on the right. Furthermore, acquired data can be analyzed in a fast and easy way using the neurocomputational tools integrated in BrainWave as shown in figures below.

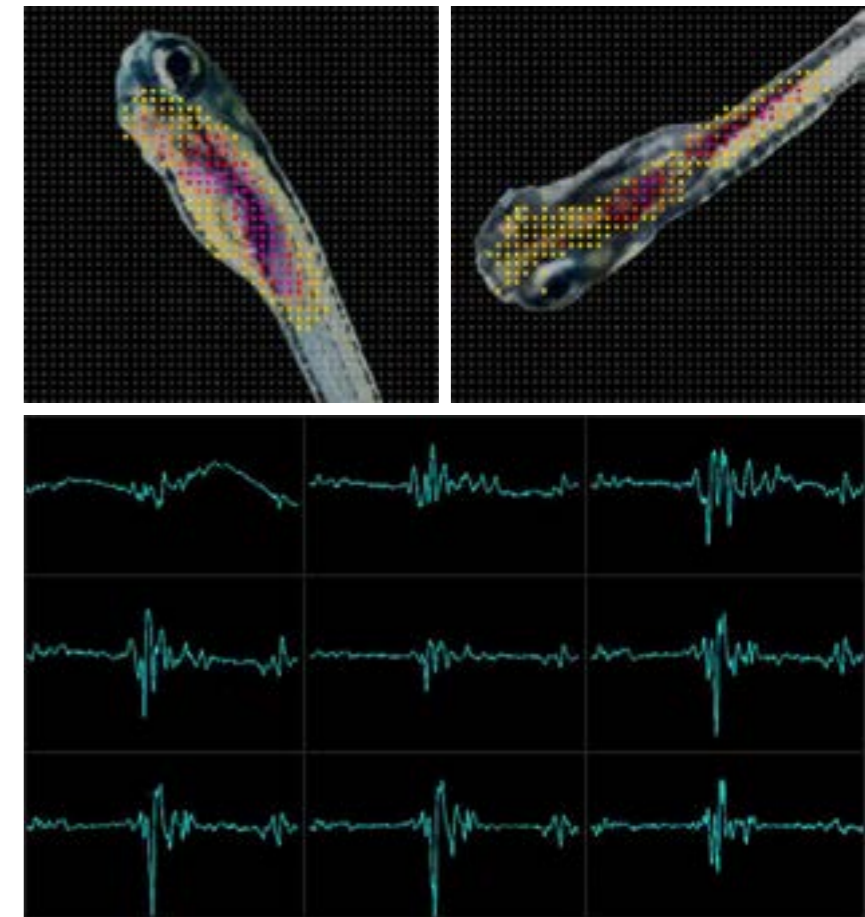


False color map (top left) of the spiking activity recorded from the 64x64 electrode array. Average Firing Rate (top right) and boxplots (bottom) of the Mean Firing Rate, Inter Spike Interval and Spike Amplitudes computed on two selected distinct groups of neurons. (Courtesy of Dr Ma'ayan Semo, Institute of Ophthalmology, University College London).

Zebrafish for toxicology and drug discovery

Zebrafish is emerging as a new important tool in studying brain disfunction with an increasing key role in toxicology and drug discovery applications due to its peculiarities as a genetic structure and major organs development similar to humans.

3Brain's high density MEA can easily record from the entire zebrafish providing a detailed map of the functional activity, thus representing a powerful tool to study this fascinating biological model.



Examples of whole zebrafish electrical activity recording by means of HD-MEAs. (Courtesy of Dr. Karen Mruk, School of Pharmacy, University of Wyoming).

MADE IN SWITZERLAND



3Brain AG

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HyperCAM Alpha



 3Brain



—ComPlato 550
37 °C • 5 % CO₂
90 % RH

Door CLOSED Plate LOCKED



HyperCAM Alpha

Alpha: the dawn of a new era in multiwell functional screening

3Brain revolutionizes functional screening assays with HyperCAM Alpha, the first multiwell system based on the Coreplate™, a radically new technology making use of processing microchips integrated in each well to transform standard cell culture plastic plates into intelligent devices.

With its thousands of sensing and actuating electrodes per-well, HyperCAM Alpha is the most advanced, precise, and reliable solution to monitor and stimulate several in vitro models: human iPSC-derived neurons, dissociated murine cultures, acute brain and cardiac tissues, complex 3D neuronal assemblies, spheroids or brain/cardiac organoids.

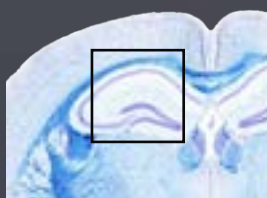
This is CorePlate™:

6 wells x 4096 sensors

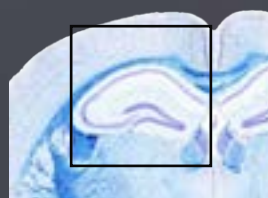
Thanks to the CorePlate™ technology, HyperCAM Alpha can record from up to 13824 sensors over 6 independent wells simultaneously (2304 electrodes/well).

Whether you need to focus on small areas or to monitor larger portions of your samples, Alpha provides you the maximum flexibility for your assay's needs with different spatial recording configurations selectable.

Large brain tissues, dense or sparse human derived neuronal networks, spheroids or organoids of any dimension always fit with the recording capabilities of Alpha.



1024 el.
60 μm pitch
1.9 x 1.9 mm^2 area



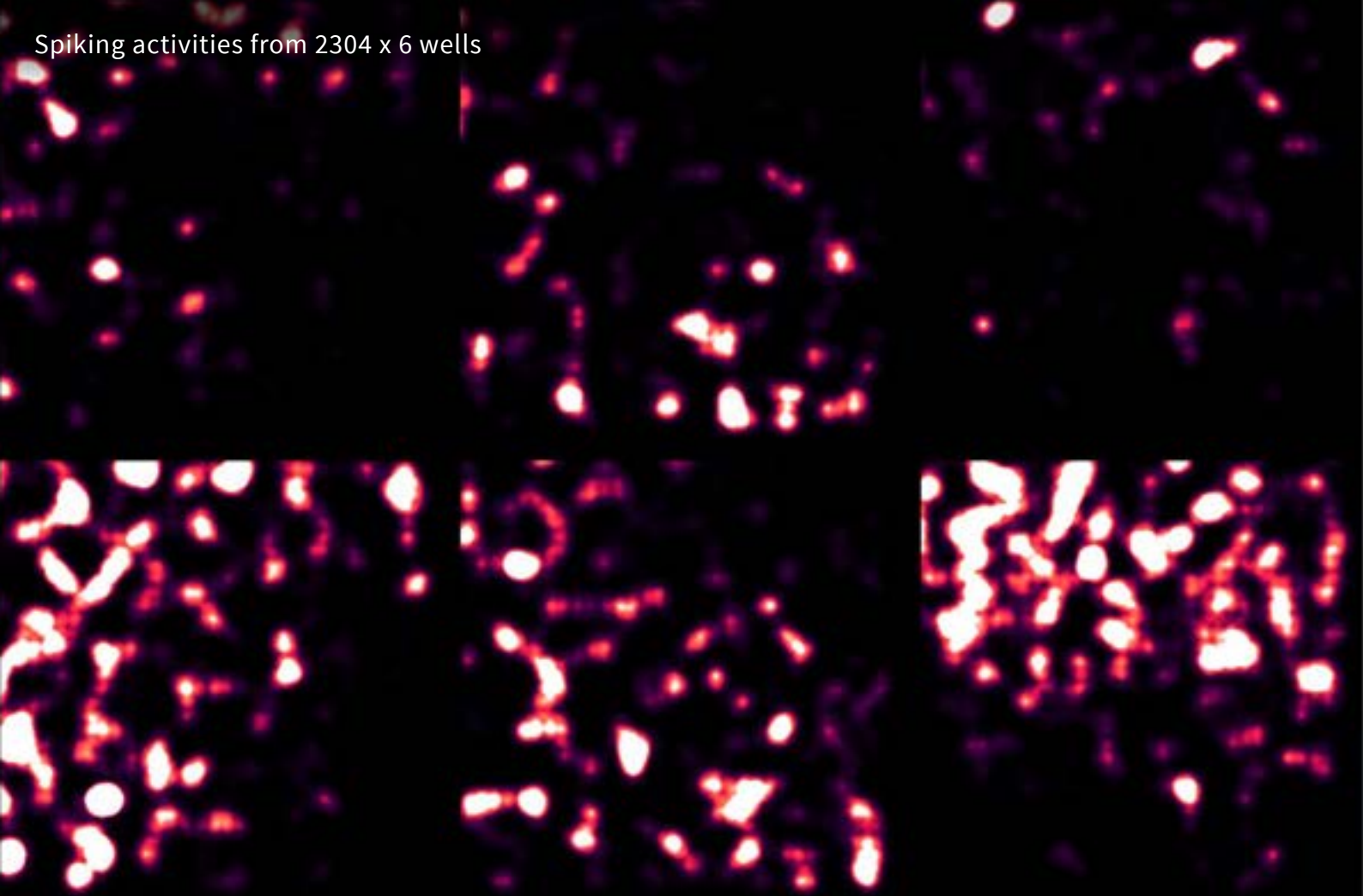
2304 el.
60 μm pitch
2.9 x 2.9 mm^2 area



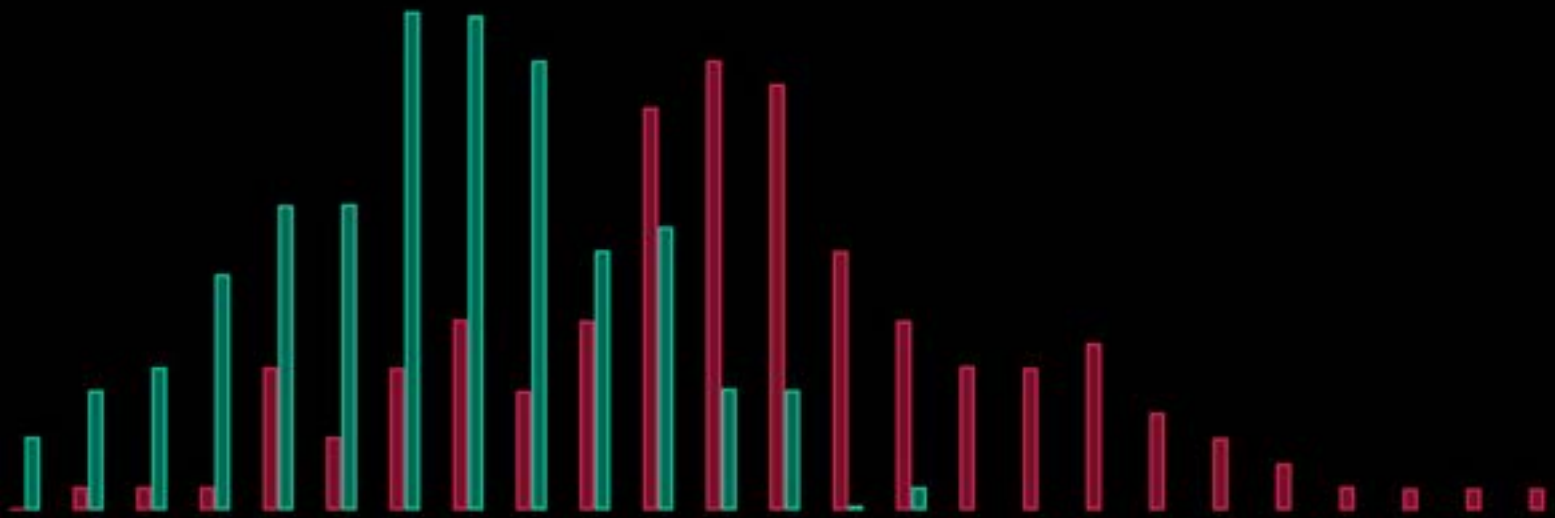
1024 el.
120 μm pitch
3.8 x 3.8 mm^2 area



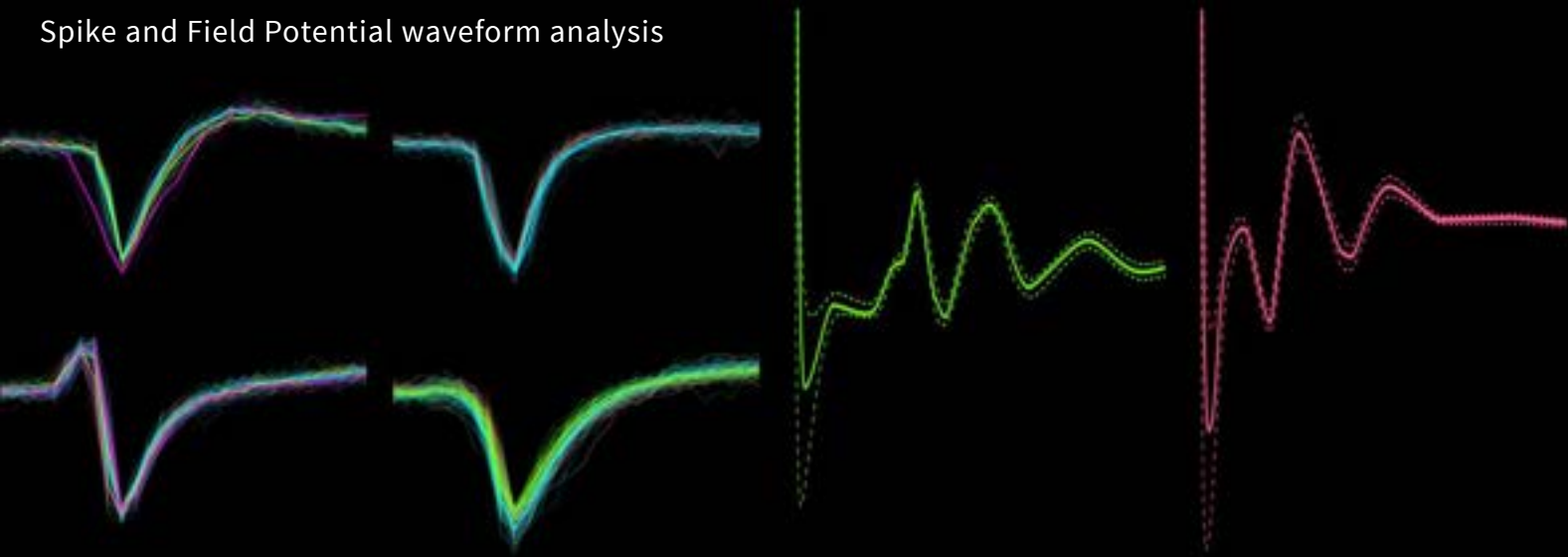
Spiking activities from 2304 x 6 wells



Firing distribution from two different cell populations



Spike and Field Potential waveform analysis





No compromise on data quality

Alpha's state-of-the-art hardware technology, combined with the latest generation of our BrainWave software, makes it easy to process the large amount of data generated in a few clicks. Information from wells and well groups can be combined, filtered, browsed and visualized in a variety of ways to get the most accurate picture of your cell preparation.

Furthermore, the high statistical quality of the data generated in each well reduces the overall need for replicates, simplifying experimental assays and reducing costs and time-to-results.

One system, multiple uses

The versatility of Alpha makes the system ideal for any kind of experiment. The environmental chamber housing the CorePlate™ multiwell can operate in the closed-lid configuration to provide a space where temperature and CO₂ saturation can be controlled and humidity monitored, ensuring ideal conditions for long-term kinetic assays on cell culture models.

The open-lid configuration allows for the integration of fluidic systems and acute tissue measurements. Besides, the incubation chamber is sealed to protect the instrument's electronics from accidental spill-out or experimental misuse.

Alpha has also stimulating capabilities: with its two independent channels, the system enables designing complex experimental paradigms such as Long Term Potentiation or Paired Pulse protocols.



HIGHLIGHTS

Unrivalled performances on a 6-well device

2304

max recording channels per well

4096

stimulation sites per well

20 kHz/electrode

@1024 electrodes per well

1.5 GHz

ARM® dual-core Cortex™

Temperature and CO₂

active control

Spill out protection

with water-proof chamber

Touch screen

for a quick access to the main controls

USB-C

data interface

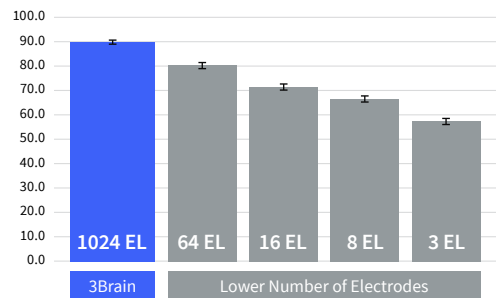


Get to your results 4 times faster!

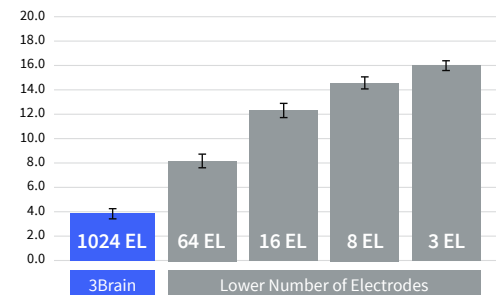
HyperCAM Alpha, with up to 2304 electrodes per well, provides experimental reliability and reproducibility that far exceed what can be achieved with standard multiwell MEA platforms, which use only a few electrodes per well.

The highly informative recordings obtained with HyperCAM Alpha allow you to fully exploit your biological model by increasing precision and accuracy. The number of replicates required to reach stable results (“hit the target”) is reduced by a factor of 4, with considerable time and cell/reagent savings.

ACCURACY



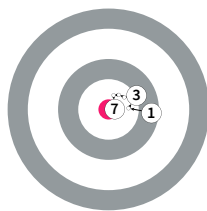
OF REPLICATES TO HIT THE TARGET



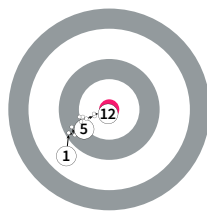
1024 ELECTRODES



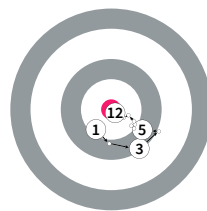
64 ELECTRODES



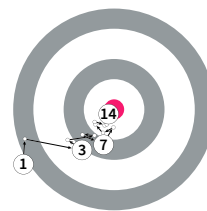
16 ELECTRODES



8 ELECTRODES

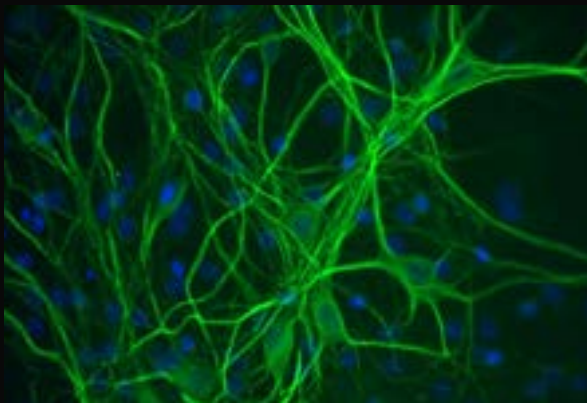


3 ELECTRODES



HyperCAM Alpha performances compared with lower electrode number configurations. Accuracy and number of replicates to reach stable results are extracted by averaging results from 12 different datasets. Accuracy in evaluating basic metrics (e.g. neuronal firing rate) improves significantly with 1024 el. and, at the same time, the number of replicates required to reach stable results is reduced by ~4 times. Target charts show an example of the number of required replicates for one experiment. Successive replicates are added to the pool of data to evaluate the metrics and the added number of replicates is indicated on the targets. Lower electrode density configurations require more replicates (e.g., 14 replicates for 3 el. config.) than higher density ones (2 replicates for 1024 el.; 2304 not shown).

Human derived and dissociated cell culture studies with unmatched details

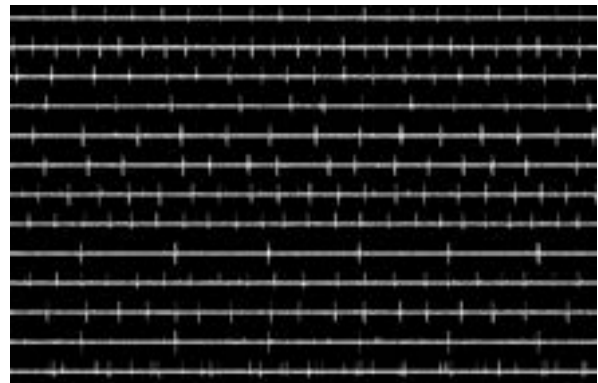
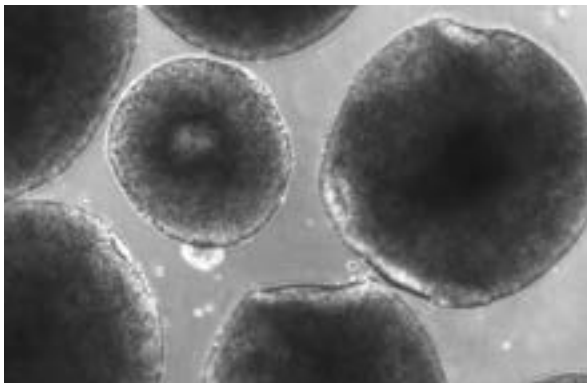


HyperCAM Alpha allows label-free functional monitoring of large neuronal networks with single-cell spiking activity resolution. This is the most advanced technology to study physiological and pathological neuronal conditions, to decode mechanisms of signal processing and to improve the quality and reliability of drug screenings or toxicological assays.



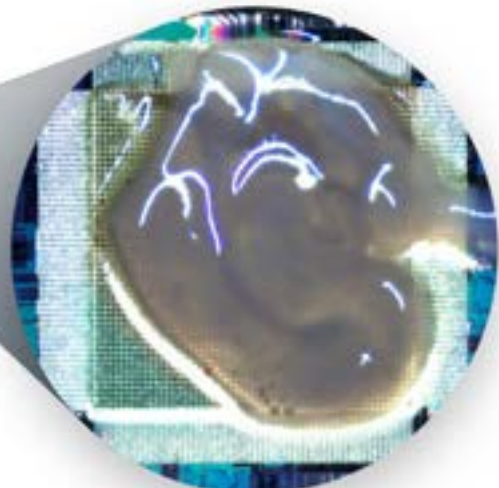
Deep investigation of brain spheroids and organoids

3D structures of almost any size and dimension can be easily positioned on the 6-well CorePlate™ sensors for long term activity monitoring and screening assays. No matter how complex your model is, you will not lose any detail of its spontaneous or electrically evoked activity.



Up to 6 brain slices in parallel

HyperCAM Alpha is the first multiwell system designed to work with acute brain slices requiring the use of a fluidic system. In the open-lid configuration, HyperCAM Alpha allows the parallel monitoring of up to 6 slices. LTP/LTD protocols are handled by an upgraded version of EVOS, a module of our BrainWave software specifically designed to automatize such studies.



MADE IN SWITZERLAND



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