# ADVANCING
# NEUROSCIENCE
# RESEARCH

## Recording and Stimulation
Multi-channel data acquisition and neural stimulation, for free moving and restrained subjects

## Motorized Commutator
Slip ring commutator compatible with Alpha Omega and Intan Data Acquisition Systems

## Micro-manipulation Systems
Specially designed micro-positioners for single and multi electrode placement

## Disposable Electrodes
Specially designed acute and chronic electrodes

ALPHA oMega
Defining Neuroscience Technology

**ALPHA OMEGA**
Defining Neuroscience Technology

# Contents

# A Letter from the president

**Imad Younis**
**President & Founder**

Since its inception in 1993, Alpha Omega has played a leading role in fostering innovation and development in three main areas - functional neurosurgery, clinical research and neuroscience research. Over more than two decades, we have pioneered cutting-edge technology in both fields and humbly received international recognition from numerous global experts.

One of the key factors in our success is the unique and personal relationships we have maintained with our customers. This two-way collaboration allows us to constantly launch new products and versions tailored to our clients' evolving needs. Our Innovative technology is there for supporting and advancing your research, making it easier, faster, and more accurate.

# AlphaRS

A modular, scalable, multichannel neural data acquisition system

The alphaRS data acquisition system is a complete platform for conducting multichannel electrophysiology experiments. The system is modular and scalable with options to add on extra features and channels.
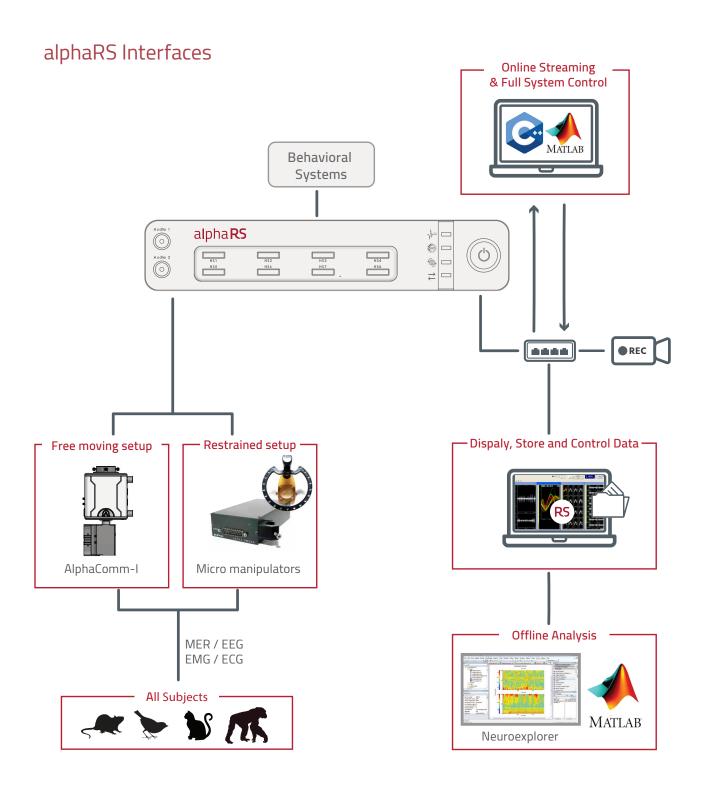
## System Overview

- **Expandability**. Up to 128 channel configurations
- **Plug and play** System
- **Online statistics**. Spike raster, firing rate, PSTH and evoked potential
- **Digitized Headstages**. Ultra-small and lightweight headstage suitable for all types of setups and subjects
- **Integrated Recording and Stimulation** in one system. Using one software to control all channel's modes and enabling closed-loop actions with short latency timing
- **Advanced stimulation capabilities**. Allowing a variety of stimulation options, patterns, and amplitudes, allowing manual or automatic control over all channel's modes
- **Online Recording and Stimulation** algorithm. An adaptive algorithm for fast recovery from stimulation artifact, the artifact deducted during stimulation enables online spike segmentation and sorting
- **Simultaneous data streaming** of Raw, Spike & LFP
- **Powerful DSPs**. State-of-the-art Octa core DSPs
- **SDK tool**. Two-ways communication using MATLAB or C++ for streaming all data and controlling system functionality
- **Optogenetics.** Built-in GUI for controlling various optogenetics systems

## Complete MATLAB Control & Data Access

- **Data streaming**. All data collected by the AlphaRS can be accessed online in MATLAB.
- **Full system control** allowing manual or automatic control over all channel's modes within MATLAB. Commands can be sent to adjust almost all system parameters or trigger unique stimulation paradigms.
- **Closed-loop functionality**. Data can be analyzed online, and results can directly trigger digital outputs or stimulation
- **Easy programming**. Specially designed MATLAB toolbox and instructions make accessing data right from within the software simple and straightforward.
- **Endless possibilities**. Online access to data means each user can code paradigms specifically for their unique needs.

# alphaRS Interfaces

Behavioral Systems

Online Streaming & Full System Control

alpha**RS**

Audio 1
Audio 2

HS1  HS2  HS3  HS4
HS5  HS6  HS7  HS8

● REC

**Free moving setup**

AlphaComm-I

**Restrained setup**

Micro manipulators

**Dispaly, Store and Control Data**

RS

MER / EEG
EMG / ECG

**All Subjects**

**Offline Analysis**

Neuroexplorer

MATLAB

# Digitized Headstages

- alphaRS can support up to 8 headstages
- Flexible cable length depending on the set up – minimum 30 cm -  maximum 8 m ( 2-8 m range is dependent on environmental noise)
- Supporting variety of signals: MER/EMG/EEG/ECOG/EKG

## 16CH
1cm

Recording

Recording + **Stimulation**

Recording + Accelerometer

**EMG** Recording

**EMG** Recording + Accelerometer

## 32CH
1cm

Recording

Recording + **Stimulation**

Recording + Accelerometer

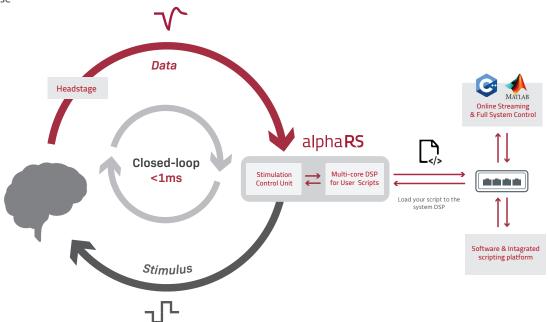## 64CH
1cm

Recording

Recording + Accelerometer

# Closed-loop functionality

Real-time closed loop. DSP programming allowing fast response

Data

Headstage

Closed-loop
**<1ms**

Stimulus

alpha**RS**

Stimulation Control Unit

Multi-core DSP for User Scripts

Online Streaming & Full System Control

Load your script to the system DSP

Software & Intagrated scripting platform

# alphaRS System Specifications

| Features | Specifications and Options |
|----------|---------------------------|
| Filtering | 4 Selectable software digital filtering per channel (0.02Hz to 10KHz) |
| Referencing | Digital selected channel referencing |
| Spike sorting | Up to 4 spike templates per channel using 8-point template matching, an SSQ algorithm, and optional window discriminators |
| Compatibility | MATLAB, C++, NeuroExplorer® online link |
| Audio | 2 stereo outputs |
| General purpose digital outputs | 8 outputs single-bit digital outputs, Synchronization TTL output |
| General purpose analog outputs | 4 outputs ± 5.0 V, 16-bit analog outputs |
| General purpose digital Inputs | 4 digital input channels (TTLs) , 16-bit digital input port |
| General purpose analog Input | 4 differential analog input channels with 16 bit-resolution and dynamic range of ±5V |
| PC interface | 1 Gbit Ethernet |
| Power supply | 4-pin DC power connector (100-240 VAC, 50-60 Hz) |
| HeadStage connectivity | Up to 8 HeadStages with micro HDMI connector |
| LED Indicators | Indicating general system's state |
| System size | 27 x 21 x 5 cm |
| **Stimulation Specifications** | |
| Amplitude | 1µA – 2.50mA |
| Pulse width | 0.03ms - DC |
| Voltage compliance | ± 9V |
| Stimulation Control | User interface / DSP Scripting / SDK – MATLAB/C++ |
| Stimulation frequency | DC – 1Khz |

# alphaRS Headstage Specifications

| Features | Specifications and Options |
|----------|---------------------------|
| Dynamic Range | ± 5.0 mV |
| A/D input conversion | 16-bit resolution |
| Sampling Rate | 30kHz per neural channel |
| Amplifier Inputs | Single ended with one reference or differential per channel |
| Noise | 2.4µV RMS |
| Hardware Filters | HPF: 20mHz – 1KHz, LPF: 10Hz – 20KHz |
| HeadStage Configurations | 16, 32, 64 or 128 |
| HeadStage integrated Sensors | 3 axis accelerometers |
| Impedance check | Up to 5MΩ @ 1KHz, ±1nA |
| Size & Weight | 16 CH 23 mm x 13 mm x 2.6mm and 0.79gram<br>32 CH 24 mm x 15 mm x 2.6mm and 0.94gram<br>64 CH 21mm x 14mmx 4.7mm and 1.3gram |
| HeadStage integrated Stimulation | Flexible stimulation configuration to all channels // Up to ± 2.55mA current<br>Up to ± 9 voltage compliance |
| Cable length | 0.3-8 m (2-8 m range is dependent on environmental noise) |

# AlphaLab SnR™

Multi-channel workstation with complete data acquisition and
neural stimulation capabilities



AlphaLab SnR utilizes integrated, advanced stimulation sources to give users the power to deliver complex, unique stimulation patterns to all user-specified channels simultaneously.
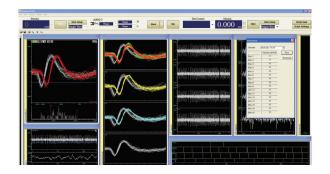A high saturation point and advanced hardware components give users the ability to stimulate and record on all channels. Additional tools, include current return path controls, current monitors, and immediate stimulation logging.
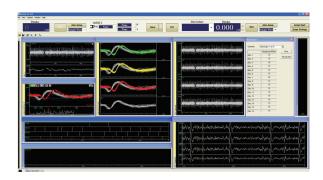
## Key qualities

- **Expandability high channel.** Each system may have between 16 to 128 channels.
- **Data streaming.** All data collected by the SnR can be cloned and streamed to multiple computers.
- **Multi-user support.** Workload may be optionally divided among multiple computers, allowing multiple users to simultaneously access, analyze, and manipulate the data.
- **Impedance check.** One-click impedance check.
- **Digitizing HeadStage.** The SnR utilizes a compact, lightweight digitizing HeadStage that samples each channel at up to 44kHz with a 16 bit A/D resolution.
- **Low noise.** less than 5µV @ 500kΩ electrode and less than 3µV @ ground.
- **Differential inputs.** The HeadStage uses differential inputs, which enables acquiring different signal types i.e. EMG, EEG, etc.

- **Powerful DSPs.** The SnR is equipped with advanced, powerful DSPs. All processing is done on the SnR itself, not on the PC.
- **Open file format.** Files are easily converted to other file formats, including .txt, .mat, .plx, .smr directly imported by common off-line data analysis software.
- **Experimental events log.** User-defined events can be created within the software, allowing the researcher to mark the data file with a user-defined variable making offline analysis easier.
- **Controllable digital filtering.** The user can select the LP and HP for both spike and LFP recordings.
- **Online sorting.** The SnR allows 4 spike templates to be set per channel. 8-point template matching, a SSQ algorithm, and optional window discriminators are utilized to make spike sorting as easy and accurate as possible.
- Online statistics. Spike raster, firing rate, PSTH and evoked potential
- Video tracking synchronization. Alpha Omega has partnered with Noldus (Ethovisia*) to provide synchronization between the SnR and Noldus video tracking systems, making the SnR the ideal choice for labs with video tracking needs.
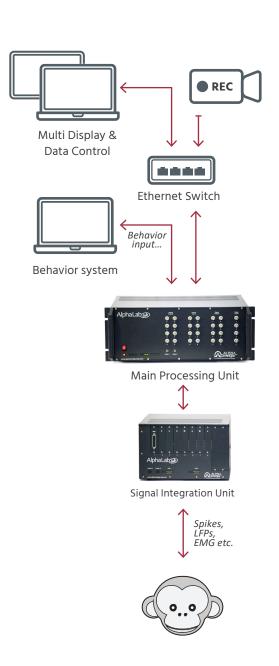
* Our software supports Ethovision V9.0 and 11.5

# Unique Stimulation Capabilities

- **Stimulate and record.** A high amplifier input range allows non-stimulating channels to record throughout stimulation. All channels can be capable of stimulating and recording.

- **Integrated and scalable stimulation**. The SnR may include an embedded stimulation source for each individual channel, giving the researcher the ability to simultaneously stimulate on each channel with unique paradigms.

- **Advanced stimulation control**. Modify stimulation parameters with a few clicks, or utilize text based scripting to create complex stimulation waveforms.

- **Conditional stimulation**. Stimulation can be trigged by digital inputs, threshold crossings, or template matches.

- **Current return control.** Localize and direct injected currents by selecting any number of electrodes as stimulation return channels.

- **Accurate stimulation logging** by A stimulation markers logged within 1 sample of the beginning of a stimulation pulse.

- **Current monitor.** Online measuring and displaying of injected current

- **High current range**. Stimulation sources can output currents. between 2μA-4mA, with pulse width between 40μsec-1msec



Multi Display & Data Control

● REC

Ethernet Switch

Behavior system

*Behavior input…*

Main Processing Unit

Signal Integration Unit

*Spikes, LFPs, EMG etc.*

# SnR Technical Specifications



| | |
|---|---|
| Gain | 20 |
| Number of channels | 16 - 128 (Several 128 channel systems can be cascaded) |
| Dynamic Input Range** | ± 62.5mV |
| Amplifiers Input | Differential |
| Hardware high pass filter (HPF) | 0.075Hz OR 1Hz |
| Hardware low pass filter(LPF) | 10KHz |
| Sampling Rate | Maximum 44,000 Samples per Second for each channel |
| A/D Resolution | 16 bit |
| Bit Resolution | 1.9 µV |
| Input Referred Noise (RMS) | 5µV @ 500 KΩ electrode |
| Impedance check | Measure, calculate and report for all electrodes |
| Physiological Signal Types | Spikes, LFP, EEG, EMG and other |
| Stimulation | Optional, supports up to 128 current sources |
| No. of channels | Up to 128 channels (can be split into two HeadStages) |
| Audio Outputs | 2 stereo outputs |
| General purpose I/O pack | Optional - 16 analog inputs, 8 analog outpts, 4 digital inputs, 1 digital input port (16 bits), 8 digital outputs |
| Stimulation Sources | Up to 128 current sources |
| Stimulation Pulse Width | 50 µSec - 1 mSec |
| Stimulation Pulse Amplitude | Biphasic - 2 µA – 7 mA (up to ±50V) |
| Audio Outputs | 2 stereo outputs |
| Analog Inputs | 16 |
| Analog Outputs | 8 |
| Digital Inputs | 4 |
| Digital Port (16bit) + strobe and ready | 1 expandable to 9 |
| Digital Outputs | 8 |
| Power | 100 V – 240 V, 50Hz - 60Hz |
| Connection to PC | Standard 1 GB Ethernet |

## MOTORIZED COMMUTATOR

# AlphaComm

Motorized Commutator for Free Moving Animal Setup

## Features and benefits:

- Supports up to 256 channels
- High resolution sensing
- Ability to control velocity and sensitivity
- Compatible with optogenetics (up to 4 fibers) & liquid tubes
- Allows electrical stimulation
- Compatible with variety of arena sizes and shapes
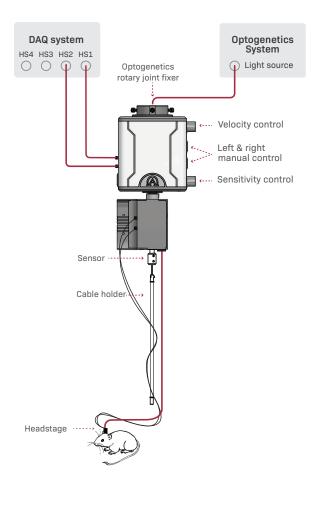- Flexible mounting option suitable for any electrophysiology setup

## Commutator is ideal for

- Free moving rodents
- Long session experiments
- Recording and stimulation (electrical/optical)
- advanced electrophysiology setups with external connections (liquid tubes/sensors)

**AlphaComm** is a motorized slip ring commutatorwith the ability to control the sensitivity and velocity of the motor, and to eliminate signal noises that are caused by undesired animal movements, all in a simple setup.

**AlphaComm** supports **both neural recording and stimulation** (optical and electrical) and seamlessly interfaces with variety of data acquisition systems. This motorized commutator ensures an ultra-quiet environment for recording due to superior electrical shielding.

# EPS Electrode Positioning System

Specially designed micropositioner with flexible shafts for multi-electrode placement in restrained subjects

- **Compatible with the Flex MT** and MultiDrive
- Optimize data collection with **accurate and independent multi-electrode placement**
- **Improve the quality of neural recordings** by recording clean and stable neural signals
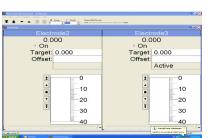- Maximize your research by **recording crucial data from all electrodes**



The Alpha Omega EPS is a state-of-the-art micropositioner designed for the accurate placement of microelectrodes in acute in vivo experiments. The system gives the user maximum flexibility, allowing control of each individual electrode during an experiment, with no noise interference. Moving the electrodes smoothly and independently enables the user to execute research with greater control and precision than ever before.

## Key Features and Benefits

- **Micron precision.** The EPS is exceptionally precise. Software controls the electrode movement with micron precision.
- **Electronic control**. An easy-to-use software interface ensures accurate, computer controlled electrode placement.
- **Flex MT and MultiDrive compatible**. The EPS easily connects to any AlphaOmega microdrive to provide precise control of every electrode.
- **Complete control**. Drive all electrodes simultaneously or position a single electrode at a time.
- **Quick and easy setup**. The EPS system is easy to setup and operate, reducing the time it takes to perform each experiment.
- **Speed control**. Select an entry speed between 5-400 microns/second for each electrode.
- **Expandability**. Choose between 1 to 4 motors per EPS box, and add up to 8 boxes to independently control 1 to 32 electrodes.

- **Remote control**. Control the electrode movement from inside the recording room through an easy-to-use joystick interface that allows complete control over each electrode.
- **Reliability**. Alpha Omega's EPS system is durable and reliable, with some customers using the system for over 10 years without the need for service and without loss of precision.
- **Motor separation**. The EPS was specially designed with flexible shafts to separate the motors from the microdrive, significantly reducing the chance of interference that occurs in comparable systems.
- **Independent or group control**. All electrodes can be positioned independently as needed, or controlled in user-defined groups for simultaneous control.
- **Less weight**. The motor box has been specifically designed to be mounted; electrodes are controlled through flexible shafts to minimize the weight on the chamber
- **Limitless layout options**. Flexible shafts allow a single motor box to connect to a variety of micropositioner layouts, making the connection to any Flex MT or MultiDrive easy. Additionally, it's simple to connect to more than 1 chamber at a time, or to use multiple terminals in one chamber.



User-interface

# FlexMT™

## Flexible microdrive designed with innovation in mind

- Record from any chamber
- Use any electrode or multi-contact electrode
- Set-up to record in only a few minutes

The Flex MT is a versatile electrode manipulator (microdrive) used to position one or more electrodes or electrode arrays during acute, restrained animal experiments. Its new and unique design allows for numerous benefits over comparable models and helps improve the efficiency of data collection while reducing setup times for each experiment.

A modular, adaptable design means the Flex MT can meet the goals of any researcher. The Flex MT can connect to any chamber, and the Mini Flex MT is optimized for stereotactic frame setups when smaller animals are utilized. Additionally, it is easy to position, align, or swap out electrode drive towers, and each tower can be selected or customized to drive a number of electrode types, including single electrodes, injectrodes, stereotrodes, linear microelectrode arrays, U-probes, or a custom design of the researcher's choosing. Combined with Alpha Omega's EPS (Electrode Positioning System), the researcher has complete and precise control over all aspects of electrode positioning.
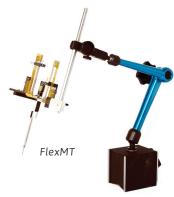
## Key Features and Benefits

- **Multi-contact probe compatibility.** In addition to single electrodes, the Flex MT can drive multi-contact probes, such as the linear microelectrode array or U-probe. Custom adapters are also available for other electrode types.

- **Record from any chamber.** The Flex MT easily connects to popular chamber designs. Researchers can also request a custom design, or use a stereotactic mount for small animal experiments.

- **Quick and easy setup.** Towers can easily be positioned and aligned on the ring, and customized grids give researchers an accurate coordinate system for electrode placement.



*Chambers in different sizes and shapes*

- **Record from any restrained animal.** The Flex MT can be head mounted onto a chamber, or mounted on a stereotactic frame for smaller animals.

- **Modular components.** The Flex MT was designed with flexibility in mind. Add or remove electrode drive towers simply and easily. Switch grids between experiments, or swap the chamber adapter with a stereotactic mount for different animal types. Customization is just 1 screwdriver away.



*FlexMT*



*FlexMT*

- **Experimental flexibility.** Need additional channels, or want to change trajectories?  It's quick and simple to modify the experiment to ensure the target is reached and the desired data is collected.
- **Injection capabilities.** Utilize Alpha Omega's injectrodes to easily add injection capabilities to each tower, making simultaneous fluid delivery and recording simple.
- **Complete chamber access.** With the Flex MT, it is easy to position and reposition the electrodes as needed to access any point within the chamber.
- **Micron precision.** The EPS's flexible shafts drive the Flex MT's towers, giving user software controlled, micron precision for all electrodes.
- **No motor noise.** The motors are isolated by flexible shafts, reducing mechanical noise and making recording during movement possible.
- **Tip integrity.** Electrodes are back-loaded into individual carriers, preventing damage to the electrode tip.
- **Drive any number of electrode types.**
- **Custom designs are available.**

*Electrode assembly*

# Product Specifications

**Application**
Acute, Restrained Animal

**Mounting options**
Head mountable (Flex MT)
Sstereotactic frame mountable (Mini Flex MT)
Record from any chamber (custom designs available)
Compatible with most Crist chambers

**Movement range**
Coarse – 30mm (customizable)
Electronic – 40mm
Alignment – 10mm

**Tower options**
Single Electrode Tower
Linear Microelectrode Array Tower
U-Probe Tower
Injectrode Tower
Stereotrode Tower
Custom Towers available upon request

**Grid options**
**Round (19mm diameter):**
0.65mm holes every 1mm (gauge 23 guide)
0.45mm holes every 0.8mm (gauge 26 guide)

**Square (25mm x 25mm):**
0.65mm holes every 1mm (gauge 23 guide)
1.65mm holes every 2mm (gauge 16 guide)
2.11mm holes every 2.5mm (gauge 14 guide)
3.05mm holes every 3.5mm (gauge 11 guide)

**Mini Flex MT:**
0.65mm holes every 1mm (gauge 23 guide)
0.45mm holes every 0.8mm (gauge 26 guide)

**Penetration guide options**
Beveled or Non-Beveled
7 hole spacer (3.05mm)
4 hole spacer (2.11mm)
4 electrode bundle (1.65mm)

**Size**
Ring diameter – 65mm
Tower height – 75mm

**Weight**
55g + 5g for each electrode assembly

**Ring options**
Full ring or half rings are available
Custom diameters available upon request

# MultiDrive Terminal

Precision microdrive for electrode manipulation with almost limitless possibilities

- Record from any chamber
- Choose a custom electrode layout
- Reduce setup times

The MultiDrive is an electrode manipulator (microdrive) used to position one or more electrodes during acute, restrained animal experiments.  The MultiDrive comes in various models and customizable layout options to meet the different experimental needs of each researcher.  The standard MultiDrive gives users independent control of between 4 and 32 electrodes.  The dual positioner MultiDrive gives researchers additional control over the trajectory angle, making more targets accessible from a single chamber. Combined with Alpha Omega's EPS (Electrode Positioning System), the researcher has complete and precise control over all aspects of electrode positioning.

## Key Features and Benefits

- **Record from any chamber.** The MultiDrive easily connects to popular chamber designs.  Researchers can also request a custom design, or use a stereotactic mount for small animal experiments.
- **Customizable guides.** Design a custom layout for the MultiDrive to optimize electrode spacing and maximize the number of electrodes reaching the desired target.
- **Record from any restrained animal.** The MultiDrive can be head mounted onto a chamber, or mounted on a stereotactic frame for smaller animals.
- **Micron precision.** The EPS's flexible shafts connect to the MultiDrive, giving user software controlled, micron precision for all electrodes.
- **Independent electrode control.** Each electrode can be controlled independently or together in user-defined groups.
- **No motor noise.** The motors are isolated by flexible shafts, reducing mechanical noise and making recording during movement possible.

- **Control of all axes.** The standard MultiDrive gives X and Y control of all electrodes, and micron precision while driving the electrode in the Z plane.  Additionally, the dual positioner gives full control over the angle of entry.
- **Tip integrity.**  Electrodes are back-loaded into individual carriers, preventing damage to the electrode tip.

Dual Positioner

Microdriving Terminal

32 Channel Positioner     Chambers

## Product Specifications

**Application**
- Acute, Restrained Animal

**Mounting options**
- Head mountable (MultiDrive)
- Stereotactic frame mountable (miniature MultiDrive)
- Record from any chamber (custom designs available)
- Compatible with most Crist chambers

**Number of channels**
- MultiDrive – 4, 8, 16, or 32 channels
- Dual positioner MultiDrive – 8 or 16 channels
- Miniature MultiDrive – 4 or 8 channels

**DISPOSABLE ELECTRODES**

# Single Electrodes

A wide range of single electrodes

Alpha Omega has a complete line of single electrodes available to meet your research needs.  Our electrodes are consistently hailed by researchers as the most robust and durable electrodes available on the market.
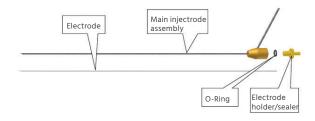
## Product Specifications

| | |
|---|---|
| **Application** | Acute Recording and Stimulation |
| **Electrode material** | Tungsten |
| **Insulation material** | Glass |
| **Shank diameter** | Glass insulated: 125, 150, or 200µm |
| **Total diameter** | Glass insulated: 250, 310, or 380µm |
| **Electrode Length** | Glass insulated: 30-130mm |
| **Impedance** | Glass insulated: 0.5-2.0 MΩ |
| **Tip Shape** | Glass insulated: 60 or 90˚ |
| **Pin** | Optional |

# Injectrodes

A versatile solution for simultaneous recording and fluid injection

The injectrode has been specially designed to allow researchers to record and inject fluid into the same target site.  A single electrode is held within a beveled needle to allow recording as the fluid is delivered.  The reusable main assembly is also easily driven by all Alpha Omega microdrives, making adding fluid delivery to experiments simple and cost-effective.  Additionally, the beveled needle is offered in a wide range of diameters and lengths, allowing researchers to use almost any electrode on the market.

**ALPHA oMega**
*Defining Neuroscience Technology*

In 1993, Alpha Omega was established as a small engineering firm in Nazareth, Israel, by Imad Younis, a specialist in biomedical engineering. From those humble beginnings, our organization has grown into a truly global company, offering a wide range of pioneering products for our clients - along with consistent innovation and uncompromising quality and service. We have done this with the help and close collaboration of world renowned experts and leading research institutions. More than 25 years later, our organization continues to lead the industry with the same mission and determination in mind - improving the quality of patient care in the field of functional neurosurgery, while helping advance neuroscience research.

Today, Alpha Omega has an extensive and established customer base worldwide, and our products can be found in the most advanced hospitals, universities, and research institutions across the globe. Our equipment has been repeatedly tested and used in hundreds of operating rooms and research labs by leading doctors and scientists.

Alpha Omega prides itself not only on innovative technology, but also an extraordinary level of service and personal attention that we dedicate to each and every one of our clients. Our professional sales and support team, located in the United States, Germany, Israel, and China along with a select group of international partners, cover the world to offer our clients a helping hand and expert advice whenever and wherever there is a need.

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