

# Halo-5 Halo-10-Mini Microdrive Users Manual

Microdrive used for manually driving tetrodes for  
electrophysiology recordings

© Neuralynx, Inc.  
105 Commercial Drive, Bozeman, MT 59715  
Phone 406.585.4542 • Fax 866.585.1743

[Neuralynx.com](http://Neuralynx.com)  
[support@Neuralynx.com](mailto:support@Neuralynx.com)

Revision 2.0  
2/9/2018

# Table of Contents

1	Document Overview .....	4
2	Halo-5 Microdrive Overview.....	4
2.1	Halo-5 Microdrive Components.....	5
2.1.1	Halo-5 Body.....	5
2.1.2	EIB .....	5
2.1.3	Exit Tip .....	5
2.1.4	Shuttle .....	5
2.1.5	Included Hardware.....	6
2.1.6	Recommended Supplies (not included) .....	6
2.2	Recommended Additional Products.....	6
2.2.1	Halo-5 Assembly Kit .....	6
2.2.2	Halo-5 Stereotaxic Mount.....	6
2.2.3	Halo Microdrive Turn Tool .....	7
2.2.4	Halo-5 Omnetics Protective Cap .....	7
2.2.5	Tetrode Assembly Station.....	7
3	Halo-10-Mini Microdrive Overview.....	8
3.1	Halo-10-Mini Microdrive Components .....	9
3.1.1	Halo-10-Mini Body.....	9
3.1.2	EIB's .....	9
3.1.3	Exit Tip .....	9
3.1.4	Shuttle .....	9
3.1.5	Included Hardware.....	10
3.1.6	Recommended Supplies (not included) .....	10
3.2	Recommended Additional Products.....	10
3.2.1	Halo-10-Mini Assembly Kit .....	10
3.2.2	Halo-10-Mini Stereotaxic Mount.....	10
3.2.3	Halo Microdrive Turn Tool .....	11
3.2.4	Halo-10-Mini Protective Cap.....	11
3.2.5	Tetrode Assembly Station.....	11
4	Assembling the Microdrive.....	12
4.1	Mounting Shuttles into the Drive Body .....	12
4.2	Mounting the Exit Tip.....	13
4.3	Alignment Considerations for Halo-5 .....	14
4.4	Alignment Considerations for Halo-10-Mini.....	14
4.5	Inserting Polymicro Tubing .....	15
4.6	Loading and Prepping Tetrodes .....	15
4.7	Pinning Tetrodes .....	17
5	Implanting the Microdrive .....	18
5.1	Stereotaxic Mount .....	18
5.2	Craniotomy.....	18
6	Protective Cap.....	19
7	Custom Exit Tip.....	19
8	Optogenetics .....	19
9	Glossary .....	20
10	Vendor List .....	20

## List of Figures and Tables

Figure 2.1 Halo-5 Microdrive Diagram ..... 4

Figure 2.2 Body ..... 5

Figure 2.3 Halo-5 EIB’s: EIB-16-QC, EIB-18MM, EIB-18 ..... 5

Figure 2.4 Exit Tip..... 5

Figure 2.5 Shuttle..... 5

Figure 2.6 Halo-5 Assembly Jig ..... 6

Figure 2.7 Halo-5 Stereotaxic Mount ..... 6

Figure 2.8 Halo Microdrive Turn tool ..... 7

Figure 2.9 Halo-5 Protective Cap ..... 7

Figure 2.10 Tetrode Assembly Station ..... 7

Figure 3.1 Halo-10-Mini Microdrive Diagram..... 8

Figure 3.2 Body ..... 9

Figure 3.3 EIB-36-Halo-10-Mini..... 9

Figure 3.4 Exit Tip..... 9

Figure 3.5 Shuttle..... 9

Figure 3.6 Halo-10-Mini Assembly Jig ..... 10

Figure 3.7 Halo-10-Mini Stereotaxic Mount ..... 10

Figure 3.8 Halo Microdrive Turn tool ..... 11

Figure 3.9 Halo-10-Mini Protective Cap ..... 11

Figure 3.10 Tetrode Assembly Station ..... 11

Figure 4.1 Shuttle Mounting ..... 12

Figure 4.2 Standard Exit Tip mounted on Halo-5 and Halo-10-Mini Microdrives ..... 13

Figure 4.3 Dimensioned (mm) Standard Halo-5 Exit Tip ..... 13

Figure 4.4 Dimensioned (mm) Standard Halo-10-Mini Exit Tip ..... 13

Figure 4.5 Mounting Exit Tip to Drive Body ..... 14

Figure 4.6 EIB connector reference locations Halo-5 ..... 14

Figure 4.7 EIB connector reference locations Halo-10-Mini ..... 15

Figure 4.8 Mounting Polymicro into the Halo-5 ..... 15

Figure 4.9 Tetrode Tip Separating ..... 16

Figure 4.10 Microdrive and EIB mounted in Assembly Jig ..... 16

Figure 4.11 Pinned and Fully Assembled Microdrive ..... 17

Figure 5.1 Stereotaxic Mount ..... 18

Figure 5.2 Craniotomy ..... 18

Figure 6.1 Halo-5 Microdrive Protective Cap ..... 19

# 1 Document Overview

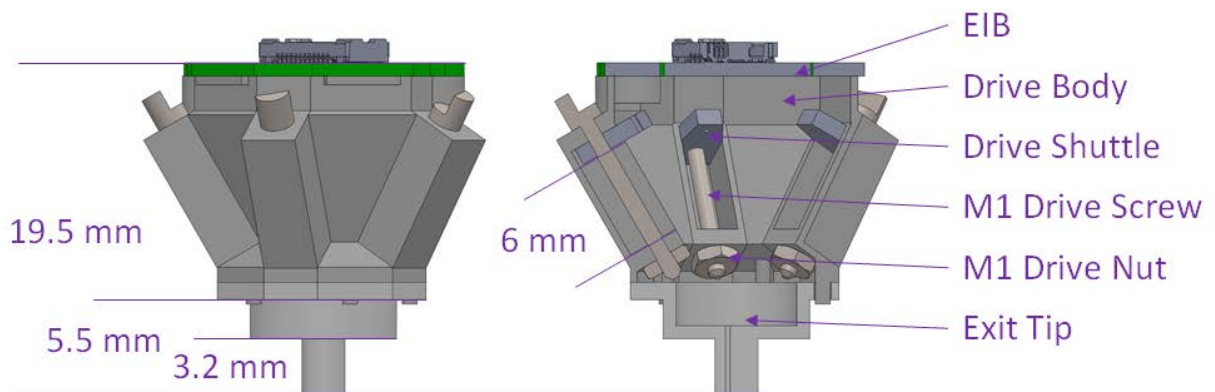
This document describes the specifications and features of the Halo-5 and Halo-10-Mini Microdrives. It also explains how to assemble the Microdrive, and use it during normal operation. Step-by-step assembly instructions are outlined and additional products are recommended to further facilitate this process. Most functions of components and use of accessories are shared between these two drives. There is a glossary at the end of the document.

## 2 Halo-5 Microdrive Overview

The Halo-5 Microdrive allows up to 4 tetrodes to be inserted into a freely moving animal. One additional insertion shuttle can be used to insert fiber optics or reference electrodes.

### Features:

- 5 independent drivable shuttles: 4 tetrode, 1 for fiber or reference
- 6 mm insertion depth
- Customizable exit pattern
- M1 x .250mm half-moon head drive screw.
- 1.8-2 grams



**Figure 2.1 Halo-5 Microdrive Diagram**

## 2.1 Halo-5 Microdrive Components

### 2.1.1 Halo-5 Body

- 5 shuttle paths
- 0.45 grams

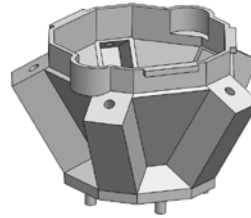


Figure 2.2 Body

### 2.1.2 EIB

- 3 available options: EIB-16-QC, EIB-18MM, EIB-18

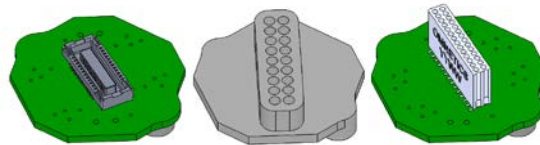


Figure 2.3 Halo-5 EIB's: EIB-16-QC, EIB-18MM, EIB-18

### 2.1.3 Exit Tip

- Precision machined Ultem
- Select from Neuralynx Exit Tip Configuration Guide
- Customizable Tips: Contact [sales@neuralynx.com](mailto:sales@neuralynx.com) to order
- Geometry for enhanced dental cement bonding
- 1 use life
- 0.21 grams

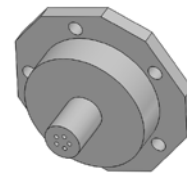


Figure 2.4 Exit Tip

### 2.1.4 Shuttle

- 0.02 grams
- Sleeves of 10

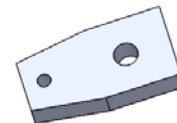


Figure 2.5 Shuttle

### 2.1.5 Included Hardware

- 6 X M1 Drive screw
- 6 X M1 Nut

### 2.1.6 Recommended Supplies (not included)

- Tetrodes
- 5 minute epoxy
- Loctite 242
- EIB pins
- Kwik-Cast / Kwik-seal
- Dental Cement
- X-ACTO blade
- Polymicro tubing

## 2.2 Recommended Additional Products

Neuralynx provides additional products to support the assembly and use of the Halo-5 Microdrive and enhance multichannel electrophysiological research.

### 2.2.1 Halo-5 Assembly Kit

- Assembly Jig
- 2.5mm Hex Driver
- Stereotaxic Mount (see 2.7.2)
- Halo Microdrive Turn Tool (see 2.7.3)

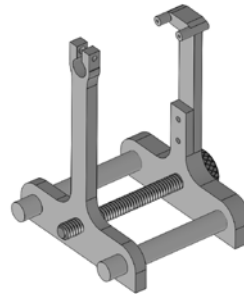


Figure 2.6 Halo-5 Assembly Jig

### 2.2.2 Halo-5 Stereotaxic Mount

- 0.310" Stereotaxic rod attachment

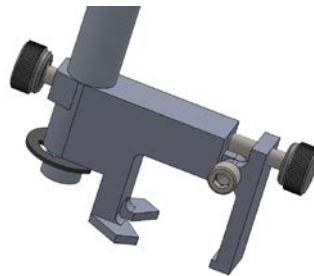


Figure 2.7 Halo-5 Stereotaxic Mount

### 2.2.3 Halo Microdrive Turn Tool

- Locks onto M1 Drive screw.
- 16 indexed increments



Figure 2.8 Halo Microdrive Turn tool

### 2.2.4 Halo-5 Omnetics Protective Cap

- Protects Omnetics connector or QuickClip® and EIB pins during animal storage.
- Magnetically aligns itself to EIB-18 and EIB-16-QC
- Retained in place with Clips

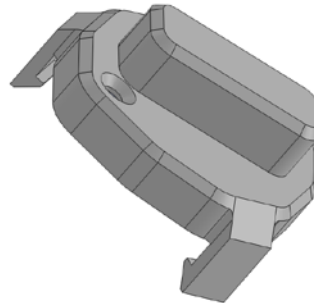


Figure 2.9 Halo-5 Protective Cap

### 2.2.5 Tetrode Assembly Station

- Simplifies construction of tetrodes



Figure 2.10 Tetrode Assembly Station

### 3 Halo-10-Mini Microdrive Overview

The Halo-10-Mini Microdrive allows up to 8 tetrodes to be inserted into a freely moving animal. Two additional insertion shuttles can be used to insert fiber optics or reference electrodes.

#### Features:

- 10 independent drivable shuttles: 8 tetrode, 2 for fiber or reference
- 6 mm insertion depth
- Customizable exit pattern
- M1 x .250mm half-moon head drive screw.
- 3.2-3.4 grams

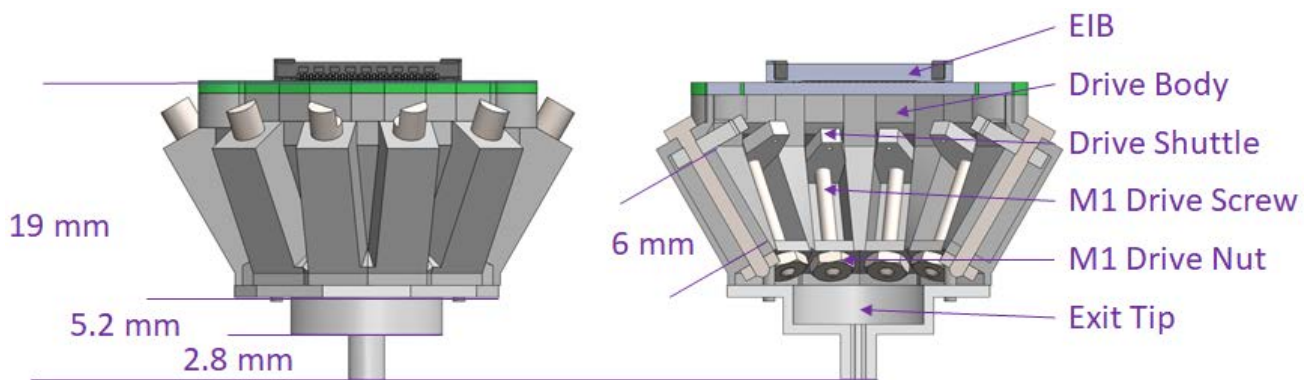


Figure 3.1 Halo-10-Mini Microdrive Diagram



## 3.1 Halo-10-Mini Microdrive Components

### 3.1.1 Halo-10-Mini Body

- 10 shuttle paths
- 4 ground wire pass through locations
- 0.45 grams

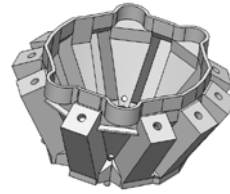


Figure 3.2 Body

### 3.1.2 EIB's

- 2 available options:  
EIB-36-Halo-10-Mini  
EIB-36-QC-Halo-10-Mini

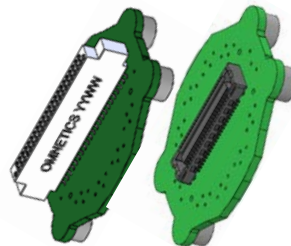


Figure 3.3 EIB-36-Halo-10-Mini  
EIB-36-QC-Halo-10-Mini

### 3.1.3 Exit Tip

- Precision machined Ultem
- Select from Neuralynx Exit Tip Configuration Guide
- Customizable Tips: Contact [sales@neuralynx.com](mailto:sales@neuralynx.com) to order
- Geometry for enhanced dental cement bonding
- 1 use life
- 0.21 grams

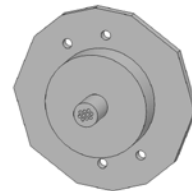


Figure 3.4 Exit Tip

### 3.1.4 Shuttle

- 0.02 grams
- Sleeves of 10

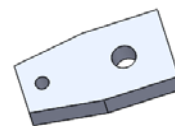


Figure 3.5 Shuttle

### 3.1.5 Included Hardware

- 10 X M1 Drive screw
- 10 X M1 Nut

### 3.1.6 Recommended Supplies (not included)

- Tetrodes
- 5 minute epoxy
- Loctite 242
- EIB pins
- Kwik-Cast / Kwik-seal
- Dental Cement
- X-ACTO blade
- Polymicro tubing

## 3.2 Recommended Additional Products

Neuralynx provides additional products to support the assembly and use of the Halo-10-Mini Microdrive and enhance multichannel electrophysiological research.

### 3.2.1 Halo-10-Mini Assembly Kit

- Assembly Jig
- 2.5mm Hex Driver
- Stereotaxic Mount (see 2.7.2)
- Halo Microdrive Turn Tool (see 2.7.3)



Figure 3.6 Halo-10-Mini Assembly Jig

### 3.2.2 Halo-10-Mini Stereotaxic Mount

- 0.310" Stereotaxic rod attachment

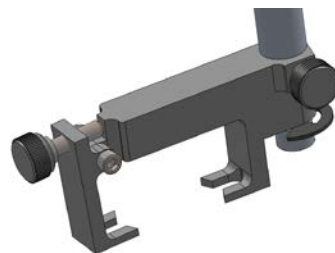


Figure 3.7 Halo-10-Mini Stereotaxic Mount

### 3.2.3 Halo Microdrive Turn Tool

- Locks onto M1 Drive screw.
- 16 indexed increments



Figure 3.8 Halo Microdrive Turn tool

### 3.2.4 Halo-10-Mini Protective Cap

- Protects Omnetics connector or QuickClip® and EIB pins during animal storage.
- Magnetically aligns itself to Halo-10-Mini
- Retained in place with Clips

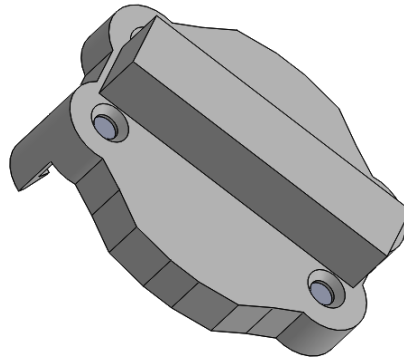


Figure 3.9 Halo-10-Mini Protective Cap

### 3.2.5 Tetrode Assembly Station

- Simplifies construction of tetrodes



Figure 3.10 Tetrode Assembly Station

## 4 Assembling the Microdrive

The following instructions will guide the user through the assembly of the Halo-5 and Halo-10-Mini microdrive.

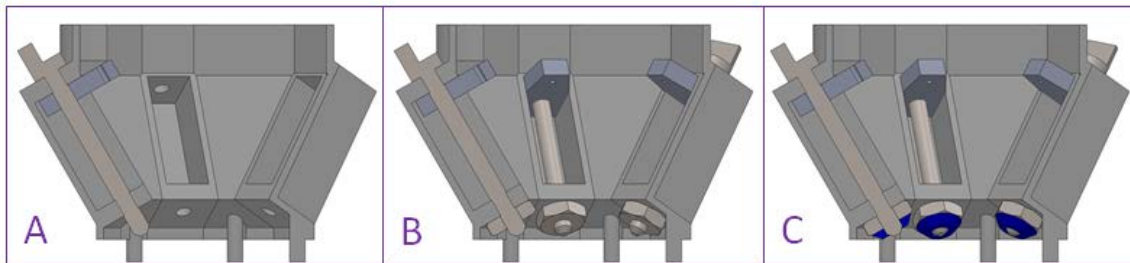
### 4.1 Mounting Shuttles into the Drive Body

To mount the Shuttles into the Drive Body, first insert a shuttle into a drive channel of the Drive Body. Using the Turn Tool, thread an M1 Drive screw through the top pass-through hole on the Drive Body, tap it through the Shuttle, and then thread it through the base pass-through hole on the Drive Body. The Drive screw will form threads as it passes through the shuttle which will require an increased torque. This is represented (image A). Repeat this process for the total number of shuttles necessary.

Next, screw an M1 Nut onto the tip of each of the M1 Drive screws protruding from the bottom of the Body until snug against the Body. Be very particular while mounting the nut: if too loose against the Body, the microdrive will have excessive hysteresis when changing drive directions; if too tight the microdrive will have excessive friction which may result in the nut loosening over time (Image B.)

After all the nuts are mounted, apply a drop of Loctite to junction between each screw and its nut. The Loctite should wick into the threads. Allow Loctite to cure for at least an hour. Using an X-ACTO blade helps deliver the Loctite to the nut without spilling onto the Drive Body. If Loctite spills onto the Body, clean up with a lint free cloth as quickly as possible (Image C.)

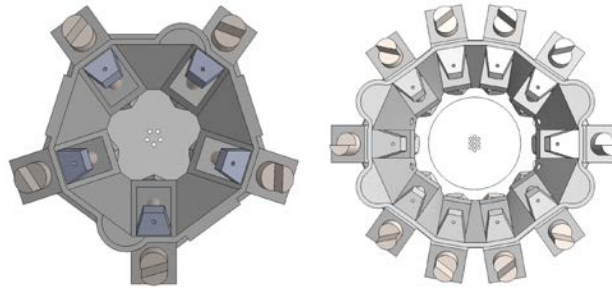
After the Loctite has had time to cure, test each shuttle's mechanics by moving the shuttle all the way up and all the way down. Finish by moving all shuttles to the top of their travel.



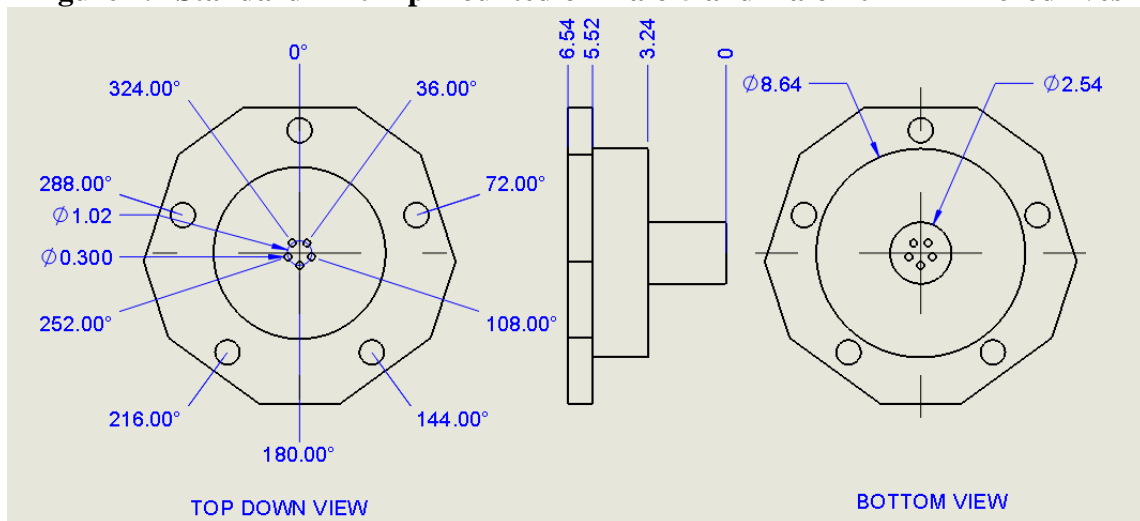
**Figure 4.1 Shuttle Mounting**

## 4.2 Mounting the Exit Tip

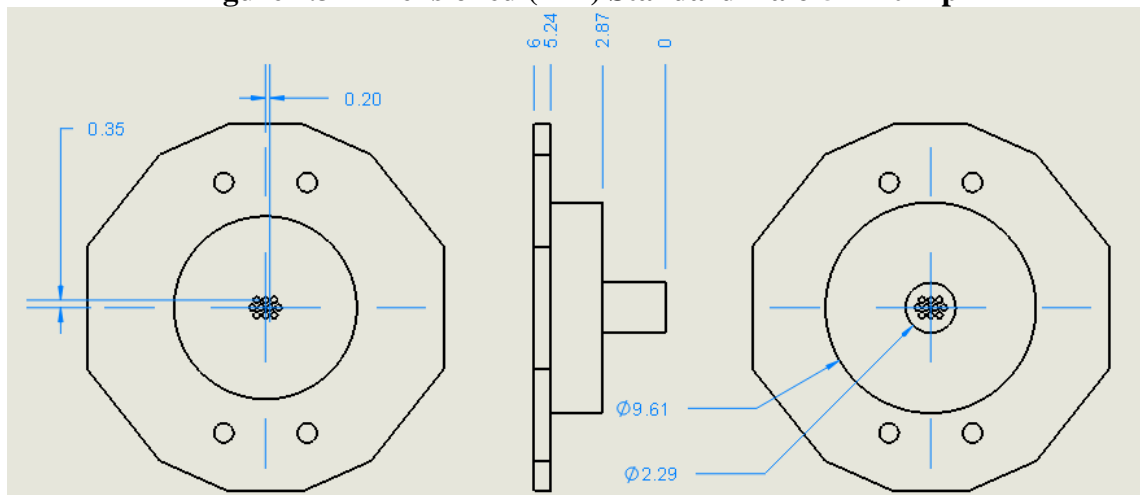
The Halo-5 and Halo-10-Mini Microdrives use an Ultem Exit Tip to act as the neural interface. The Exit Tip passes Tetrodes through the base of the microdrive in a precision pattern to target specific neural zones. The standard Exit Tips mounted on the Halo-5 Microdrive and Halo-10-Mini are shown in Figure 4.2 and the detailed drawings of the two Exit Tips are on figures 4.3 and 4.4 respectively.



**Figure 4.2 Standard Exit Tip mounted on Halo-5 and Halo-10-Mini Microdrives**

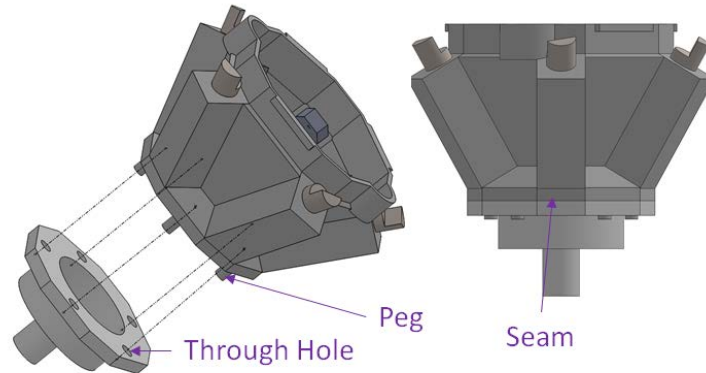


**Figure 4.3 Dimensioned (mm) Standard Halo-5 Exit Tip**



**Figure 4.4 Dimensioned (mm) Standard Halo-10-Mini Exit Tip**

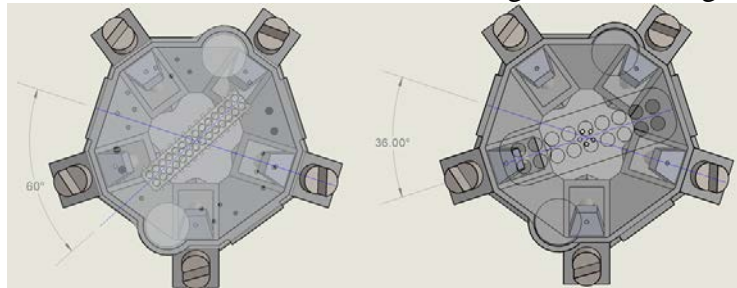
To Mount the Exit Tip to the Microdrive slide the pegs located at the bottom of the Drive Body through the outer through holes of the Exit Tip and press the two parts together. While holding the two parts together, paint Cyanoacrylate along the seam between the two parts. An X-ACTO blade is a good tool for this. Hold the two parts together for a few minutes until the glue is cured.



**Figure 4.5 Mounting Exit Tip to Drive Body**

### **4.3 Alignment Considerations for Halo-5**

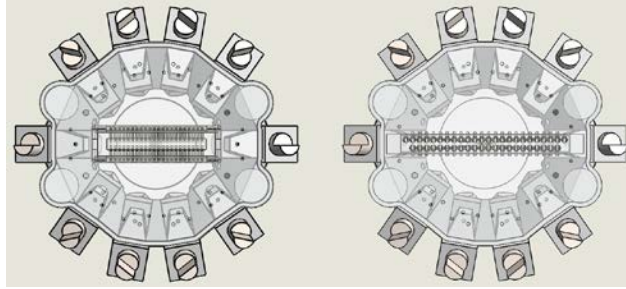
As shown on Figure 4.2 the Exit Tip pattern is radially symmetric to the Drive Body of the Halo-5 resulting in no extra consideration for final construction alignment. If a custom Exit Tip is being used, it should be noted that the connector on top of the EIB does not sit in line with the Stereotaxic grips. To align the Connector to the line of sight of the animal or perpendicular to the line of sight of the animal, an offset of 60 degrees from the stereotaxic grips should be used for the EIB-18 and EIB-16-QC. Use an offset of 36 degrees for the EIB-18-MM. This is illustrated in Figure 4.6 and Figure 5.1.



**Figure 4.6 EIB connector reference locations Halo-5**

### **4.4 Alignment Considerations for Halo-10-Mini**

The Halo-10-Mini has bilateral symmetry as can be seen in figure 4.7. The connector is in line with the stereotaxic mount so no offset needs to be taken into consideration. The standard exit tips exit pattern with respect to the drive is shown in figure 4.2.

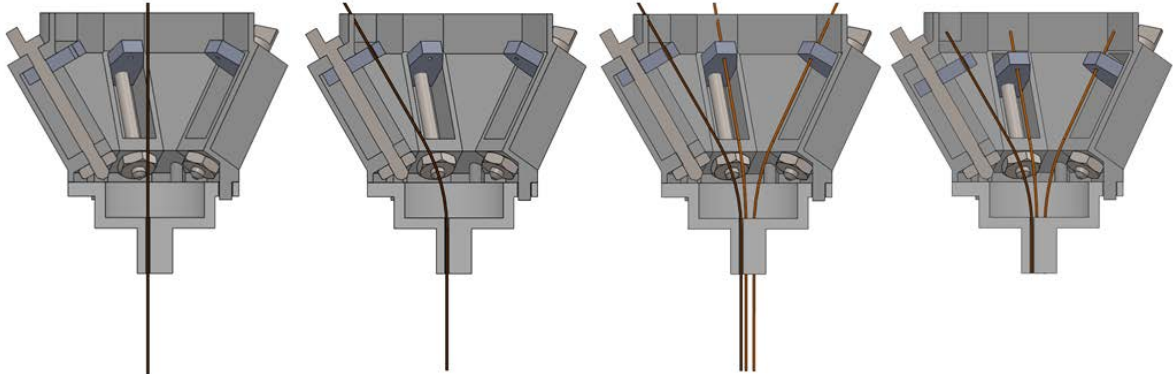


**Figure 4.7 EIB connector reference locations Halo-10-Mini**

#### **4.5 Inserting Polymicro Tubing**

This microdrive utilizes Polymicro tubing to reinforce, guide, and protect tetrodes as they are driven into neural tissue. First, Polymicro tubing is inserted into the Microdrive. Then, tetrodes will be threaded through the polymicro tubing. The components of the drive are aligned as follows: the polymicro is fixed to the shuttles using epoxy; the polymicro then passes through the Exit Tip. Prior to assembling the Microdrive, prep the polymicro Tubing by cleaving the necessary number of strands to a length of ~1.5”.

First, insert Polymicro tubing into the drive through the base of the Exit Tip. Next, thread the Polymicro tubing through mounting hole of the Shuttle. Repeat this process for all the desired shuttles. After mounting all of the desired Shuttles, adjust the length of the Polymicro until it sits flush with the base of the Exit Tip. Also adjust all of the shuttles down four turns so they are 1 mm off the top of their travel. Next, fix the Polymicro tubing in place by placing epoxy on the Shuttle and Polymicro interface. After the epoxy has cured, trim the polymicro to the design length above the Shuttle. These steps are illustrated in Figure 4.8.



**Figure 4.8 Mounting Polymicro into the Halo-5**

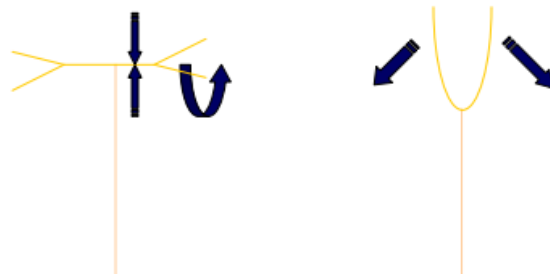
#### **4.6 Loading and Prepping Tetrodes**

There are many different techniques for making tetrodes. Neuralynx’s Assembly Station Manual will guide you through some of those processes.

Prior to loading the drive, the tetrodes need to be prepped. Start by separating the four wires (**Figure 4.9**). First, cut the loop at the top. Pull the two sets of wires down gently until you feel a little resistance, and then give a sharp tug to both sides to keep them

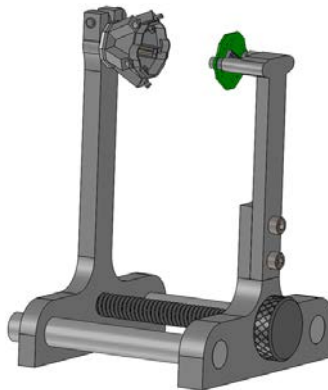
separated. Do the same with each set of two wires. If the ends aren't accessible at first, hold the wires a little below the end and twirl the ends between your fingers sharply until the ends separate enough for you to grab them. Separate and tug to hold as below, using the tetrode tweezers if necessary. If the four wires are of different lengths, or the ends are curly, cut them down until they are all about the same length from the intersection point (where the polyimide coating has stuck them all together from the heat gun).

It's not critical that the tetrodes be any particular length, only that they are all close in length to each other. No single wire should be too long or short when fed into the polymicro. Successful prepping will result with enough straight tetrodes at each end to push through the polymicro and out the Exit Tip, and enough play to span the four separate holes for each wire of the tetrode in the Headstage as well as the gap between the EIB and microdrive on to the Assembly Jig.



**Figure 4.9 Tetrode Tip Separating**

To insert the tetrodes into the microdrive, first return the shuttles to the top of their travel. Next, mount the assembled microdrive onto the Assembly Jig as shown in figure 4.10. Then select the proper EIB mounting fixture on the other side of the Assembly Jig. The EIB-18 and EIB-16-QC use magnets to hold the EIB in place for tetrode pinning while the EIB-18MM uses a mechanical grip. Thread the prepped tetrodes through the polymicro tubing until they are flush with the base of the Exit Tip: ~1mm of tetrode extends past the end of the Polymicro. Fasten the tetrode in place using the same process as the Polymicro. Next, thread the individual electrode wires through the appropriate location on the EIB. On the side opposite of the microdrive, fold a piece of tape over itself with the wire in the center to prevent the wire from pulling back through and to add some gravitational force to keep the wire taut. Repeat this process for all desired tetrodes.

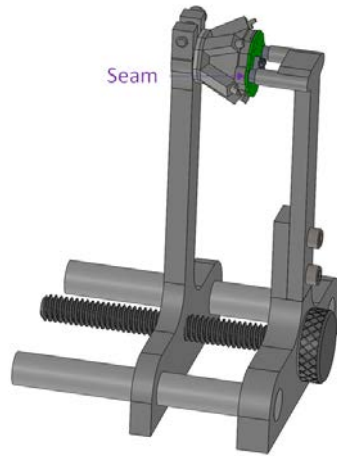


**Figure 4.10 Microdrive and EIB mounted in Assembly Jig**



## 4.7 Pinning Tetrodes

Lower all shuttles to the lowest possible position. Move the Assembly Jig so the EIB is sitting flush to the top of the assembled microdrive. Paint on Cyanoacrylate onto the seam between the EIB and Drive Body same as for Exit Tip to Drive Body. Pull each tetrode to remove slack and then pin them in place. Return the shuttles to the top of their travel.



**Figure 4.11 Pinned and Fully Assembled Microdrive**

## 5 Implanting the Microdrive

### 5.1 Stereotaxic Mount

A Stereotaxic Mount (purchased from Neurolynx) is used to hold the microdrive during surgery. The Stereotaxic Mount holds the microdrive at the top by way of mounting shelves. The rotation of the clamp can be fixed to the 0.310" stereotaxic rod using a knurled thumb screw. The microdrive is held firmly in place using the clamp adjust knurled thumb screw. The clamp closes as the screw is progressed forward. After the microdrive has been implanted, the clamp is loosened and removed from the microdrive.

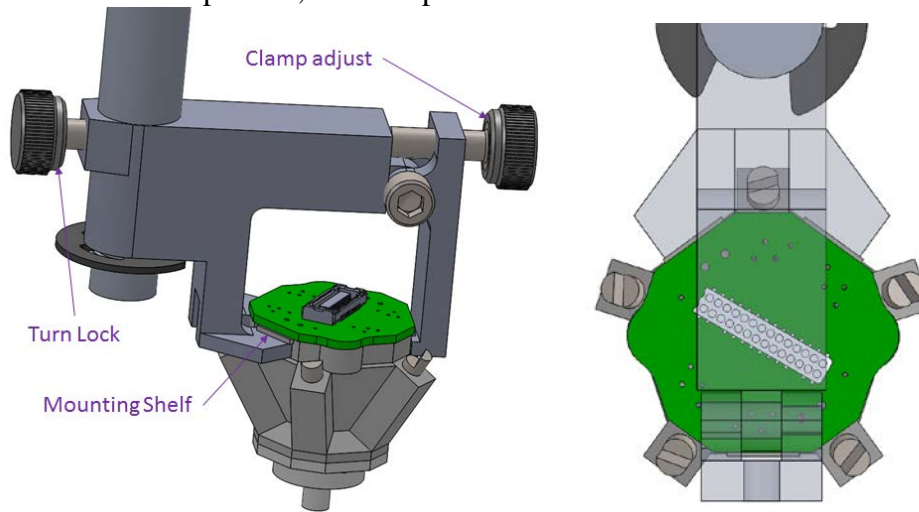


Figure 5.1 Stereotaxic Mount

### 5.2 Craniotomy

The Exit Tip is designed to be as biocompatible as possible by minimizing craniotomy size. Kwik-seal is intended to seal the exposed area of the craniotomy and the Exit Tip which will then be affixed using Dental Cement. It is recommended to affix bone screws for grounding in a location which will be covered by dental cement to protect the grounding wires from breaking.

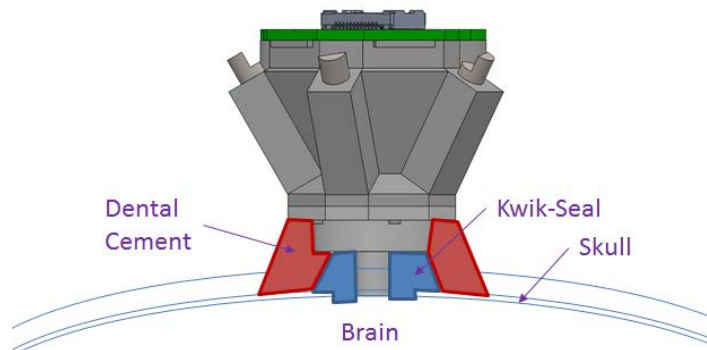


Figure 5.2 Craniotomy

## 6 Protective Cap

A Protective Cap designed for the Omnetics connector can be purchased from Neuralynx and used to protect the sockets of the connector while not being used for recording. The Cap utilizes the QuickClip aligning magnetics to align the Protective Cap and then clips add additional retention. To apply the Protective cap, allow the magnets to self-align to the proper polarity on the EIB. Next, press down on the cap until the clips slide below the mounting shelf on the Drive Body. To remove the Protective Cap, place perpendicular pressure on the clips to clear the mounting shelf while pulling up on the cap.

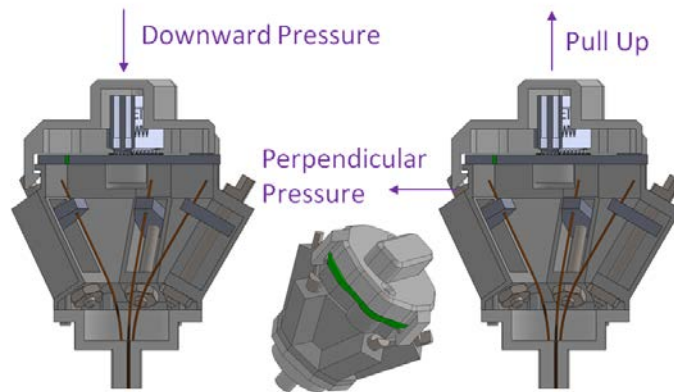


Figure 6.1 Halo-5 Microdrive Protective Cap

## 7 Custom Exit Tip

The Halo-5 Microdrive can be modified at the Exit Tip to accommodate a wide range of large scale electrophysiology studies. Contact Neuralynx Sales for more information.

## 8 Optogenetics

The Halo-5 Microdrive is compatible with the Fiber Mounted LED (FLED) Optogenetic system. For more information read the FLED User Manual or contact Neuralynx Sales and Support.

## 9 Glossary

*EIB* – Electrode Interface Board.

*O.D.* – Outer Diameter

*I.D.* – Inner Diameter

*Polymicro tubing* – Silica Capillary

*Polyimide tubing* – Polymer based tubing

*Ultem* – A biocompatible plastic

*Cyanoacrylate* – Super Glue

*Tetrode* – Four microwires twisted together for improved resolution in electrophysiological recordings

*Pitch* – The distance along the axis that is covered by one complete rotation

## 10 Vendor List

- McMaster-Carr
  - Loctite 242
  - epoxy
  - X-ACTO blades
  
- THORLABS
  - fiber
  
- Molex Electronic Solutions
  - polymicro tubing - TSP100170
  
- World Precision Instruments
  - Kwik-cast

## 11 Neuralynx Contact

To purchase Microdrive, Microdrive accessories, Microdrive replacement parts, or to learn more about the Halo-5 Microdrive contact [Sales@Neuralynx.com](mailto:Sales@Neuralynx.com). For assistance in construction or implementation of Halo-5 Microdrive contact [support@neuralynx.com](mailto:support@neuralynx.com).