

Mini-Amp-64 User Guide

Version 1.0

The information contained herein is the property of Cambridge NeuroTech and it is proprietary and restricted solely to assist Cambridge NeuroTech customers. Neither this document nor the contents may be disclosed, copied, revealed or used in whole or in part for any other purpose without the prior written permission of Cambridge NeuroTech. This document must be returned upon request of Cambridge NeuroTech. Information is subject to change without notice. Cambridge NeuroTech reserves the right to make changes in equipment design or components as progress in engineering or manufacturing may warrant.

Copyright © 2020 Cambridge NeuroTech. All rights reserved. Cambridge Neurotech and the brain logo are trademarks of Cambridge NeuroTech

Original document date 11-1-2020

Updated 24-11-2022

Table of Contents

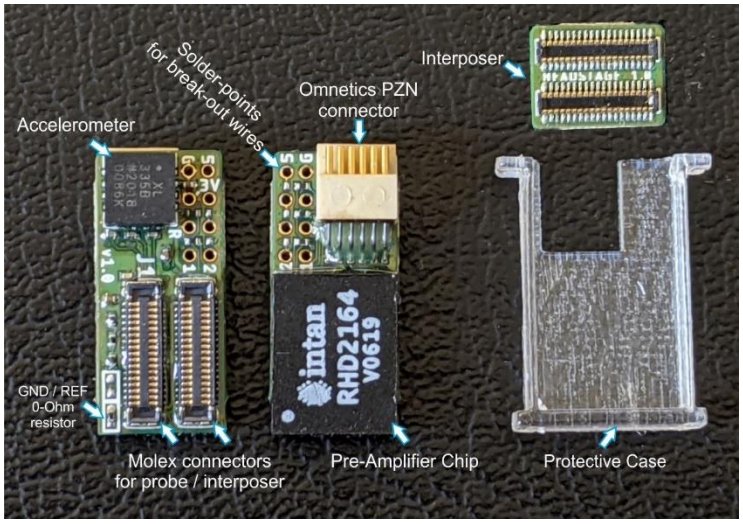
Unpacking and Handling 2
Components: Headstage, Protective Case and Interposer 2
Connecting a Probe to the Headstage (and / or Interposer Board) 2
Connecting a Data Tether to the Headstage 3
Tether Security During Animal Behaviour 3
Accelerometer / Motion-Sensor 3
Impedance Testing 3
Pre-Implantation Preparation 4
Probe Mapping vs Pre-Amplifier Data Channel 4
EEG / EMG Breakouts 5
    Procedure for de-soldering / soldering 5
GND, REF and +3.3V 6
    Procedure for de-soldering / soldering 6
Post-Implant Recovery 6

Unpacking and Handling

The mini-amp-64 headstage is shipped in an anti-static conductive bag – we advise that you take standard anti-static precautions when opening the bag and handling the mini-amp-64 headstage. Ideally you can ground yourself with a dedicated arm-band connected to earth; alternatively touching any exposed metal that is connected to earth will help (i.e. connectors on your computer / experimental rig.

Components: Headstage, Protective Case and Interposer

Each mini-amp-64 is supplied with a 3D-printed protective case and a connector interposer board utilizing Molex connectors (i.e. those that mate the probe to the headstage). The interposer board is an optional component that can be used to prolong the life of the headstage connectors by acting as a sacrificial board that sits between the headstage and probe. The Molex connectors are rated for ~5 mating cycles; although the Molex connectors remain electrically intact for >5 mating cycles: a small plastic 'notch' within the connectors becomes mechanically-worn and connectors may not 'click' when mated. If using the interposer board, leave it connected to the headstage for at least 5x probe connections (i.e. 5 implants) before replacing with a new interposer board.



Component Weights

mini-amp-64 headstage = 0.49 g

connector interposer = 0.11 g

protective case = 0.2 g

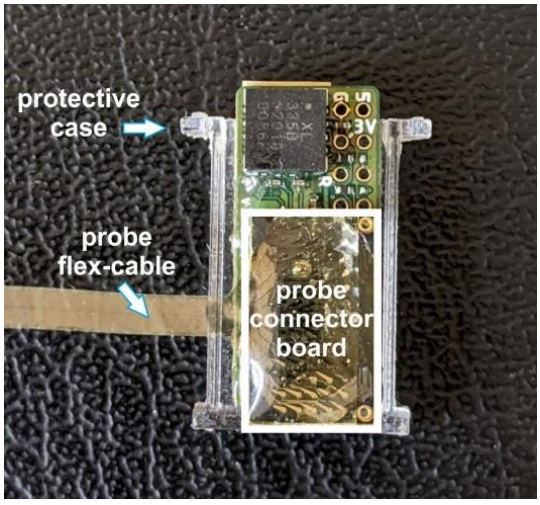
chronic nano-Drive = 0.5 g

silicon neural probe = 0.1 g

TOTAL before cement

1.3 - 1.4 g

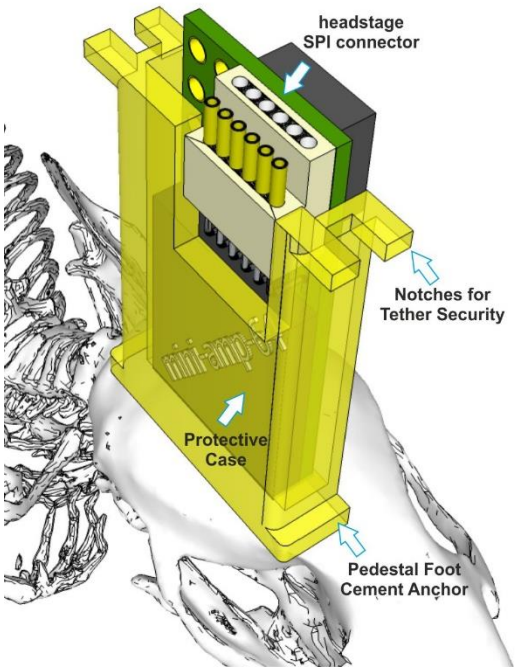
Connecting a Probe to the Headstage (and / or Interposer Board)



If you are using the interposer board, ensure that you orient it correctly with respect to the headstage connectors (the sides of the interposer board are marked "HEADSTAGE" and "PROBE", respectively) and carefully push the "HEADSTAGE" side in the mini-amp-64 connectors. You should feel a gentle 'click' as the connectors mate. Following this, repeat the same process with the probe connector in to the "PROBE" side of the interposer board.

IMPORTANT – the probe MUST be connected as shown otherwise the channel mapping will be inverted and the REF input on the probe connector will not align with its corresponding input pin to the pre-amplifier.

Connecting a Data Tether to the Headstage



The mini-amp-64 uses a 12 pin PZN polarized Omnetics nano-connector which feeds digital data in to an SPI tether cable. SPI tether cables are supplied as standard with Open Ephys and Intan systems. If you are using a system made by Neuralynx, Plexon or TDT, you will need the 'digital' version of their data-acquisition system; each vendor will be able to advise and supply you with the appropriate cabling solution.

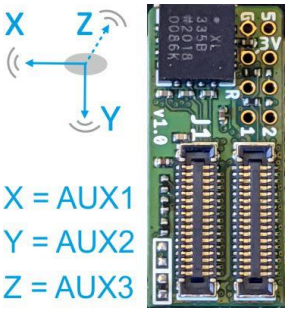
Once implanted, we recommend gentle force when mating and un-mating the SPI tether with the headstage – following connector alignment a gentle rocking motion back-n-forth along the connector-axis is preferrable to direct vertical force; the aim is to minimise mechanical stress on the implant. The use of a cable-commutator is also highly recommended where animals are free to rotate within the experimental setup. We particularly like DragonFly commutators but there are other solutions out there too!

Tether Security During Animal Behaviour

During animal behaviour, you may notice that the data-tether becomes prone to disconnection. This is uncommon in mice and similarly sized animals, however rats and above can commonly generate sufficient force during movement that can lead to disconnection between the tether and headstage. This issue can be remedied by attaching a small orthodontic rubber band to the tether which in turn can be hooked over the dentate / notched profile on the top lip of the headstage protective case. If these notches are not required, they can be removed, as desired.

Accelerometer / Motion-Sensor

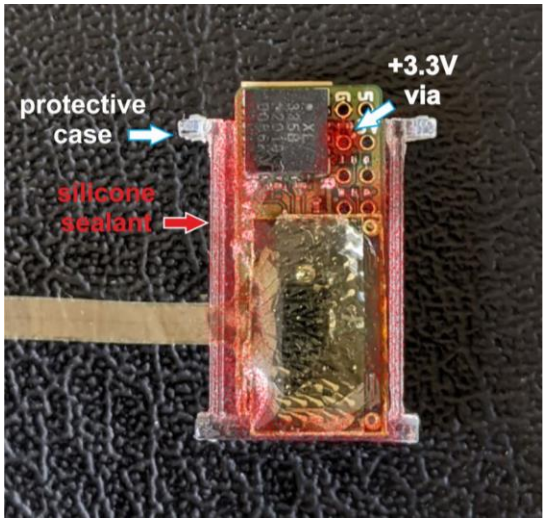
The mini-amp-64 is equipped with an ADXL335 3-axis motion sensor that senses both movement and orientation with respect to gravity. The outputs are fed in to the AUX1, AUX2 and AUX3 inputs on the pre-amplifier chip, corresponding to X, Y and Z-axes, respectively. For Open Ephys and Intan systems, the accelerometer output will be captured automatically. Neuralynx systems do not currently support the accelerometer and we advise you contact us or check with your system vendor if you are in any doubt regarding your data-acquisition system's ability to read the accelerometer output. Please refer to this resource for calibration of the accelerometer: http://intantech.com/files/Intan_RHD2000_accelerometer_calibration.pdf



Impedance Testing

The RHD2164 chip used in the mini-amp-64 offers built-in impedance testing which can be used to confirm connection of the probe to the headstage. You will need to immerse the probe electrodes in 0.9 % saline along with the GND / REF wire(s) – please refer to this resource for further details: http://intantech.com/files/Intan_RHD2000_series_datasheet.pdf

Pre-Implantation Preparation

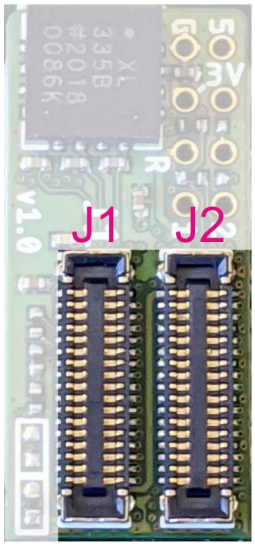


To affix the mini-amp-64 headstage in to the protective case, first apply silicon sealant / adhesive such as Kwik-Kast or SylGard to the inner surface of the case. Gently push the headstage in to the protective case. Carefully seal around the edges of the probe connector board (and interposer board, if used) and cover any remaining exposed parts of headstage with a thin coating of silicone sealant. The aim is to (a) prevent any dental cement used during implantation directly contacting the headstage board, and (b) to provide splash-proof / moisture protection to the probe connectors and other electrically active components on the headstage; in this regard, ensure that you cover the +3.3V via as shown.

Follow the general steps for implantation as laid out in our Silicon Neural Probe Implant Protocol, which can de downloaded from our website. The protective case has small pedestal-feet which are designed to act as anchors within the implant dental cement. Apply cement in sufficient quantity to secure the implant but also be sparing with the cement as this will facilitate headstage recovery at the end of the experiment.

Probe Mapping vs Pre-Amplifier Data Channel

When constructing your data-channel grouping for spike-sorting and / or data visualization please refer to the particular probe map (available on our website) for each style of probe you use with the mini-amp-64 along with the following headstage pin-out map which shows how each electrode on your probe maps to its dedicated Intan data-channel:



Connector J1
Probe ("BOTTOM")

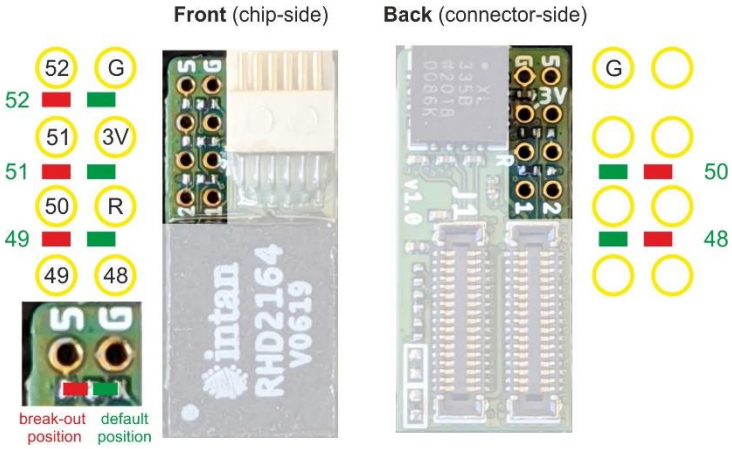
INTAN	Probe	INTAN	Probe
-		-	
63	49	55	33
62	50	53	34
61	51	54	35
60	52	52	36
59	53	51	37
58	54	50	38
57	55	49	39
56	56	48	40
7	57	47	41
6	58	15	42
5	59	13	43
4	60	12	44
3	61	11	45
2	62	9	46
1	63	10	47
0	64	8	48

Connector J2
Probe ("TOP")

INTAN	Probe	INTAN	Probe
REF	REF	GND	GND
46	17	41	1
45	18	39	2
44	19	38	3
43	20	37	4
42	21	35	5
40	22	34	6
36	23	33	7
31	24	32	8
27	25	29	9
23	26	30	10
21	27	28	11
18	28	26	12
19	29	25	13
17	30	24	14
16	31	22	15
14	32	20	16

Intan channels highlighted in **RED** correspond to those channels that can be used for EEG / EMG wire break-outs (see next section), thus if break-outs are used then the corresponding electrode(s) on the probe will no longer be tied to the pre-amplifier.

EEG / EMG Breakouts



The mini-amp-64 offers the user the choice of up 5x break-out channels that are routed to the Intan chip preamplifier along with the probe channels. By default, the break-out solder vias are NOT connected to the preamplifier (i.e. probe channels are tied to the pre-amplifier). To connect the desired break-out vias you will need to change the position of the corresponding zero-Ohm resistor as shown in the diagram opposite. By default, all zero-Ohm resistors are in the 'green' position and must be moved to the 'red' position to tie the via to the pre-amplifier – the numbers indicated in each via above correspond to the Intan data-channels (which are zero indexed).

USING BREAKOUT CHANNELS

GREEN = DEFAULT POSITION OF 0-Ohm RESISTOR

RED = BREAK-OUT CHANNEL ACTIVE

*Numbers in **green** indicate break-out resistor position for the corresponding amplifier channel*

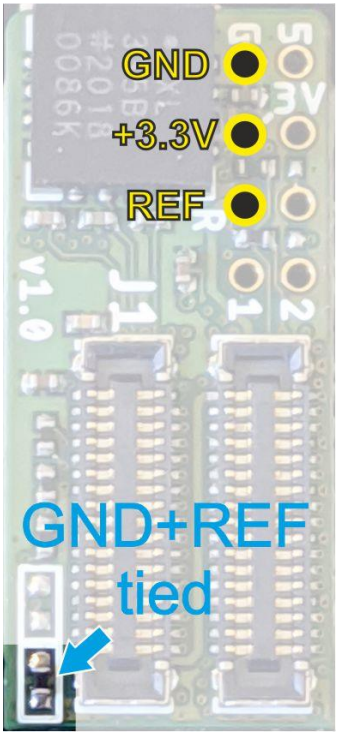
*Numbers in **black** indicate via location (i.e. amplifier channel number) for solder attach of your breakout wire / sensor*

When using the break-out channels, please refer to your probe map (and the pin-out map in this document) to work out which probe electrode(s) you will be disconnecting when using the break-out channels. Following this step, you can solder your chosen EEG /EMG wire(s) to the relevant via(s).

Procedure for de-soldering / soldering

The best way to accomplish this is with a small tipped soldering iron and lots of high quality, non-boiling liquid flux (e.g. MG Chemicals 8341 or similar). You can never use too much flux. Just clean it off afterwards using MG Chemicals 413B or similar. This process can be repeated as many times as desired provided you are careful not to rip the solder-pads from the headstage board!

GND, REF and +3.3V



By default, GND and REF inputs are tied-together. Many users run in this configuration, however, where separate GND and REF are required (e.g. a noisy rig, etc) you can un-tie GND and REF by de-soldering the zero-Ohm resistor, as shown here. Removing this resistor will allow the REF to be accessed independently using the REF-labelled via hole, as illustrated in the previous section.

By default, our probes are manufactured with factory-attached wires corresponding to GND and REF (white wire and red wire, respectively). If you are working with amplifier GND and REF tied then you only need either one of these wires to connect to your chosen skull-screw. If you untie GND and REF on the headstage then both wires will be required to make electrical contact with the animal, ideally via dedicated skull screws. Alternatively, if you prefer NOT to use the probe wires you can remove them and re-solder them to the appropriate vias on the headstage.

+3.3V power is also made available, as desired, for user-attached sensors – such sensors must generate signals that do no exceed the input-voltage of the Intan RHD2164 chip – please refer to specific Intan documentation.

Procedure for de-soldering / soldering

The best way to accomplish this is with a small tipped soldering iron and lots of high quality, non-boiling liquid flux (e.g. MG Chemicals 8341 or similar). You can never use too much flux. Just clean it off afterwards using MG Chemicals 413B or similar. This process can be repeated as many times as desired provided you are careful not to rip the solder-pads from the headstage board!

Post-Implant Recovery

In order to recover the headstage from the implant, carefully remove the dental cement without transmitting crush-forces or twisting-motion to the headstage. Removal of silicone sealant can be achieved with blunt-serrated forceps to peel the sealant away from the headstage board. Replacement protective cases and interposer boards, can be ordered as required. We recommend you connect your headstage to your data-acquisition system to perform a quick health check, prior to reuse on your next animal.