

## **TBSI M Series System's Manual Version 3.0**

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# 32 CHANNEL MULTIPLEXING HEADSTAGE SYSTEMS

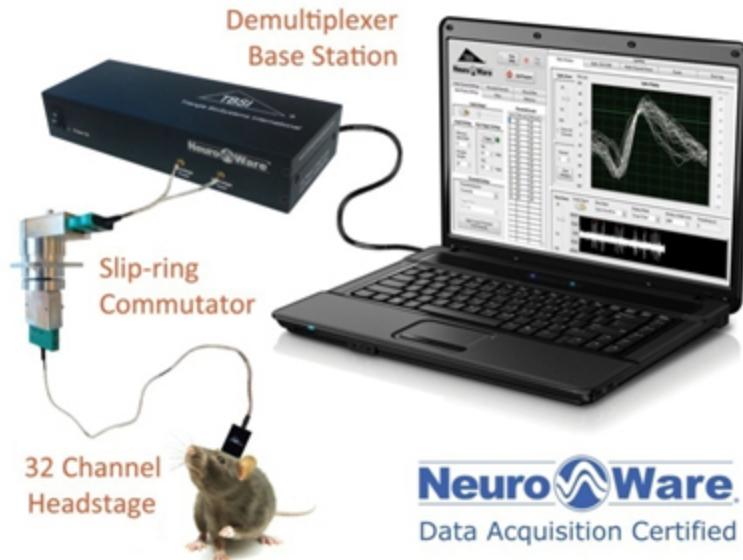


Figure 1: Multiplexing Headstage System

## Introduction

Triangle BioSystems International (TBSI) offers a multiplexed analog headstage that is used to provide a reduced wired connection between implanted electrodes, neural recording and analysis equipment. The main function of the headstage is to precondition the neuron pulse signals and provide a high gain, bandpass filtered buffered connection over a 3 wire cable. Each headstage design is based on a custom, low power VLSI developed by TBSI. The result is a solution with superior performance and reduced wire connection in a very small form-factor with less weight.

The 32 channel high gain, bandpass filter headstages are available with system gain of 800 with an adjustable bandpass filtering from the factory.

## Features

- 3 wire interface cable for 32 channels with typical of 2 to 3 feet length
- 32ch: Size:5x15x20 mm @ 0.8 grams
- Options for multiple headstages providing 62, 93, 124, 155, 186, 207 recording channels with 4, 5, 6, 7, 8, 9 wired cables respectively.
- Available with system gain of 800
- Bandpass filtering of .8Hz to 7khz
- Optional Blue, Red and Green LED available for video tracking
- Option to choose between both Analog and/or Digital outputs



Figure 2: Headstage and Base Station

# System Configuration

See the section entitled [System Setup and Testing](#) for more details on proper system assembly and positioning.

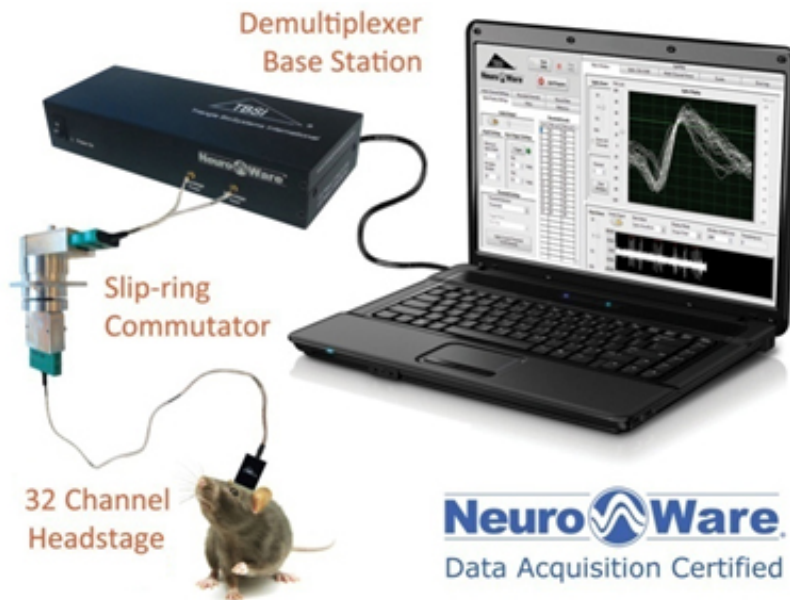


Figure 3: TBSI Multiplexed Recording Setup

# Multiplexed Headstage Specifications

The multiplexed neural headstage system consists of a Tethered Headstage, Slip-ring Commutator, and Demultiplexer Base Station as shown below:

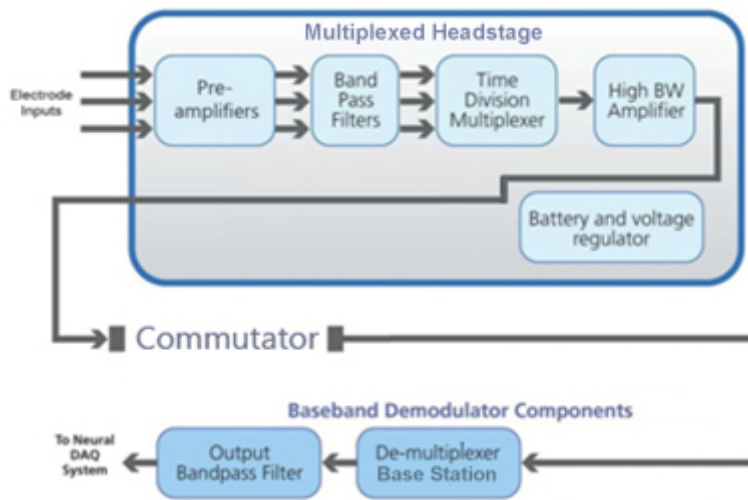


Figure 4: Multiplexed Headstage System Flow Diagram

# Multiplexer System Parts List

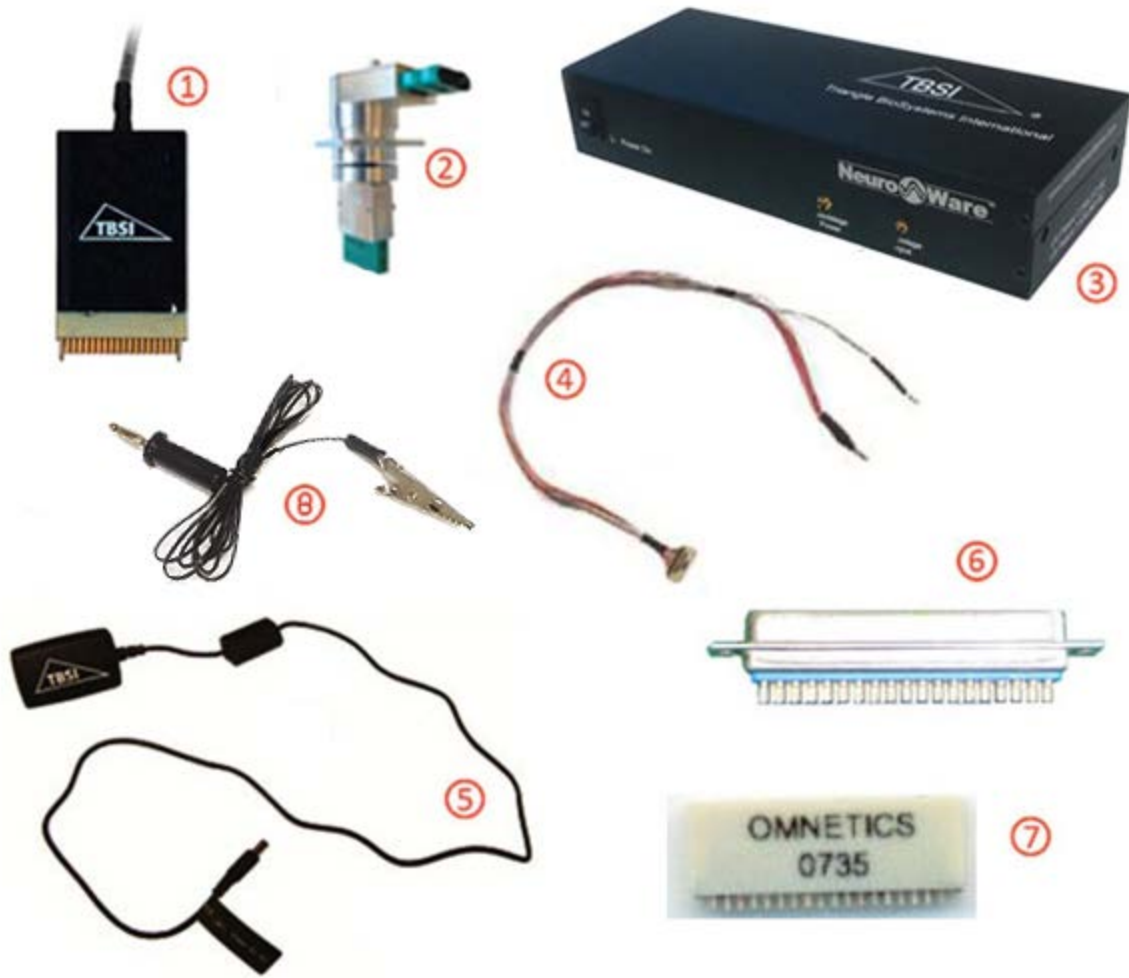


Figure 5: Multiplex System Parts

Multiplexer System Parts List		
Item #	Part Number	Description
1	Various	Headstage
2	Various	Commutator
3	Various	Demultiplexed Base Station
4	Various	Multiplexer Test Cable
5	100-0000-11	Base Station 6 VDC power supply 120 VAC/240 UL and FCC approved
6	202-0001-10	DB37 Connector
7	008-0012-01	Headstage Shorting Plug (For M64 and up)
8	200-0011-00	Earth Ground Cable

# Headstage Specifications

PARAMETER	MIN	TYP	MAX	UNITS	NOTES
<b>Power Supply</b>					
Headstage Pwr supply	2.99	3.0	3.01	V	3.0 Bipolar power (+2.1V, -.9V and ACgnd @ 0V)
Average I cc 3.0V	5.6	6.1	6.7	mA	Without LEDs
<b>Analog Channel</b>					
Max Input voltage range	-2		+2	mV	For gain of 800 System (headstage gain of 100)
Max Output Voltage range	-1.2		+1.2	V	Measured at DB37 connector of Base Station
Common mode center		0		V	ACgnd @ 0V
DC Offset	-10	0	10	mV	For Bipolar power supplies only
System Gain 800	790	800	810		Factory default gain
Bandwidth @ 3V	.8		7000	Hz	-3dB input signal level BW
Input impedance		11		MΩ	At 1kHz
Output impedance		158		Ω	At 1kHz
Input referred noise		8.5		μVrms	For DC – 10kHz frequency with all inputs grounded
Input referred noise		5.5		μVrms	For 500Hz – 5kHz frequency with all inputs grounded
Channel sample Rate		50		kHz	Per-channel sampling rate
THD			-63	dB	@5kHz and 1 volt p-p input
Phase Delay		30		μSecs	@ 5kHz input
<b>Headstage Mechanical</b>					
Measurements (Length, Width, Height)	24	14	3	mm	Dimensions of 32ch headstage board only
Weight			2.7	g	Headstage only (wire not included in weight)

# Headstage Mechanical Overview

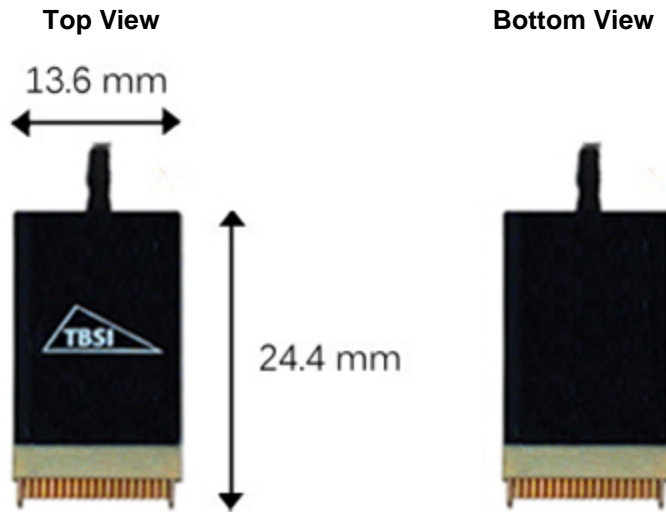


Figure 6: Headstage Mechanical Overview

Complete headstage weight is 2.7 g (coated) or 3.4 grams (standard version)

## 32 Channel Headstage Pinout



**.025" Omnetics Female**

**TBSI P/N: A9409**

**Mating Male Electrode Connector**

**TBSI P/N: A9707**

Pin #	Pin Connection	Pin #	Pin Connection
1	GND	19	GND
2	Channel 17	20	Channel 1
3	Channel 18	21	Channel 2
4	Channel 19	22	Channel 3
5	Channel 20	23	Channel 4
6	Channel 21	24	Channel 5
7	Channel 22	25	Channel 6
8	Channel 23	26	Channel 7
9	Channel 24	27	Channel 8
10	Channel 25	28	Channel 9
11	Channel 26	29	Channel 10
12	Channel 27	30	Channel 11
13	Channel 28	31	Channel 12
14	Channel 29	32	Channel 13
15	Channel 30	33	Channel 14
16	Channel 31	34	Channel 15
17	Channel NC	35	Channel 16
18	GND	36	GND

## Demultiplexer Base Station Specifications

- Input referred noise, typical: 4  $\mu$ V RMS
- Input voltage range: +/- 0.5 V
- Analog channel bandwidth: 7 kHz
- DC offset: < 100  $\mu$ VDC
- Phase delay typical: 30  $\mu$ sec at 10 kHz

## Demultiplexer Base Station Mechanical Overview

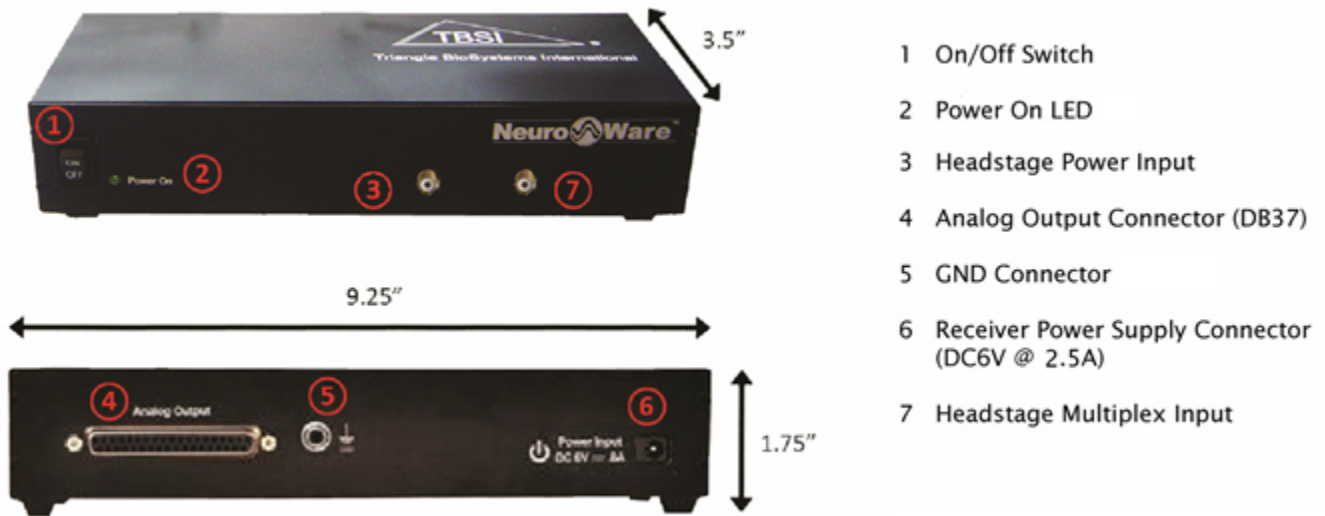


Figure 7: Demultiplexer Base Station Overview

## Demultiplexer Base Station Interface Options

The Base Station is available in many different configurations to accommodate a wide range of data acquisition interface requirements. Custom interface cables for adaption to other Data Acquisition Systems are available upon request and purchase. There are three configurations which are a composition of analog and digital output configurations. The first is purely a digital output, the second is a purely analog output and the third is a combination of digital and analog.



# Demultiplexer Base Station Analog Output

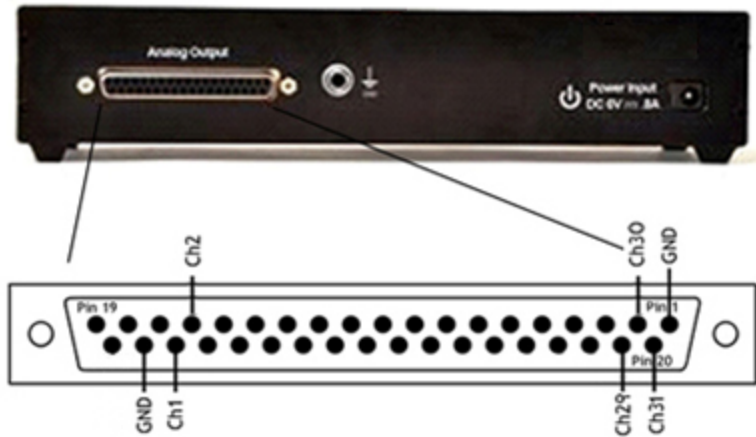


Figure 8: Demultiplexer Base Station Output Image

Pin #	Description
1	GND
2	Channel 30 Output
3	Channel 28 Output
4	Channel 26 Output
5	Channel 24 Output
6	Channel 22 Output
7	Channel 20 Output
8	Channel 18 Output
9	Channel 16 Output
10	Channel 14 Output
11	Channel 12 Output
12	Channel 10 Output
13	Channel 8 Output
14	Channel 6 Output
15	Channel 4 Output
16	Channel 2 Output
17	No Connect
18	No Connect
19	No Connect
20	Channel 31 Output
21	Channel 29 Output
22	Channel 27 Output
23	Channel 25 Output
24	Channel 23 Output
25	Channel 21 Output
26	Channel 19 Output
27	Channel 17 Output
28	Channel 15 Output
29	Channel 13 Output
30	Channel 11 Output
31	Channel 9 Output
32	Channel 7 Output
33	Channel 5 Output
34	Channel 3 Output
35	Channel 1 Output
36	GND
37	No Connect

# Demultiplexer Base Station Digital Interface

TBSI offers an internal DAQ board option and [NeuroWare™](#) software which can be used for data acquisition and analysis. The DAQ board information is sent to the PC via a USB connection.

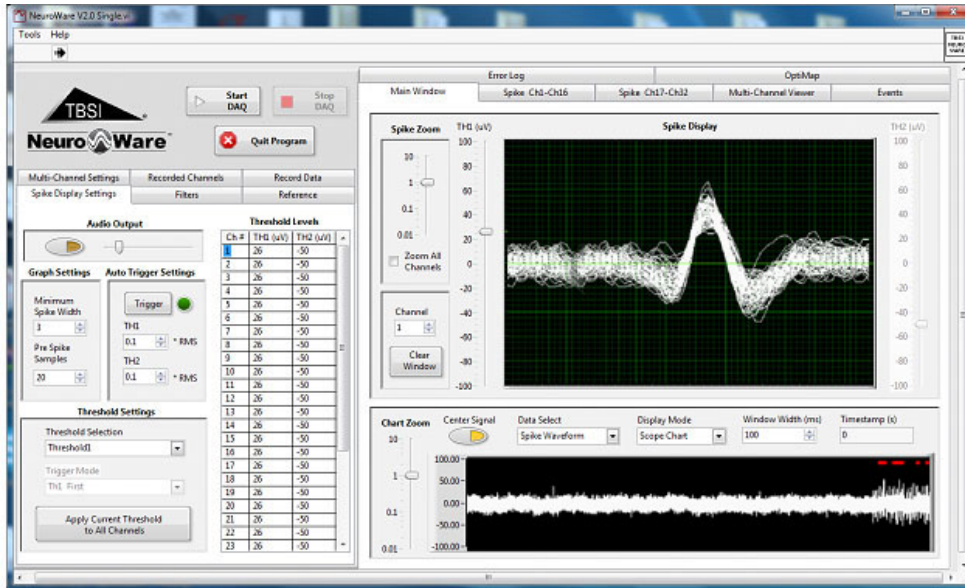


Figure 9: TBSI NeuroWare Screen Shot

# System Setup and Testing

The steps below should be followed when setting up your Multiplex system to optimize its performance.

### 1) Connect power supply to de-multiplexer Base Station

Plug the DC end of the power supply cable into the Base Station. The Base Station is powered by an AC line wall adapter. Use a suitable International adapter to mate the standard US plug to your AC outlet.



Figure 10: Power Supply Image

### 2) Connect signal output cable to Base Station analog output DB37 connector

If you have an Analog Output Base Station, connect the analog output cable to the DB37 connector. It can be added to the DB37 mating connector to check for signal output. The lengths of the wires are not critical. The analog output channel positions are described in the section entitled [Base Station Signal Interface – Analog Output](#).

If you have a Digital Base Station, plug the USB cord into the Base Station and PC and follow the instructions provided in the [Neuroware Manual](#) or your data acquisition software for signal acquisition and viewing.

### 3) Turn on Base Station

Turn on Base Station, the power light will illuminate.

### 4) Connect a function generator to the headstage via headstage signal cable

Once the Base Station and headstage (see #7 below) have both been switched on, the “Signal Lock” LED on the Base Station front panel should light up. After confirming the signal lock integrity, you can view the analog signals (output from the DB37 connector on the back of the Base Station) with an oscilloscope. Please note the default system gain is 800, therefore you can expect the analog output values to be about 800 Vp-p of the signal from the function generator. Connect function generator to test cable with an input of 1kHz Sine Wave signal at maximum 4m Vp-p amplitude.



Figure 11: Headstage and Signal Cable

## Headstage Accessory Options

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Three optional biosensors. These accessories replace channels typically used for neural recording on the headstage. The features can be installed individually or together in any combination. See the [TBSI Biosensors Brochure](#) for more information.

### Accelerometer

This accelerometer will measure x, y, and z acceleration and outputs the information via three recording channels.

### Ultrasonic Microphone

This single ultrasonic microphone enables recording of audio frequencies between 1 kHz and 35 kHz using one recording channel.

### Temperature Sensor

A Thermistor temperature sensor option is available. The sensor must be attached to a mating connector and externalized to the head of the animal much like traditional recording electrodes. This sensor utilizes one recording channel.



*Figure 12: Headstage with Temperature Sensor*

## LED Headstage Options

Red, blue and green LED options are available for the 32 channel headstage for video tracking. The LEDs are placed facing upward on the top headstage and are utilized to allow for video tracking. Both LEDs turn on with the On/Off switch.



Figure 13: Headstage with LED's

## Multiple Headstages and demux receivers

The 32, 64, 96 and 128 channel M-series are shown below:

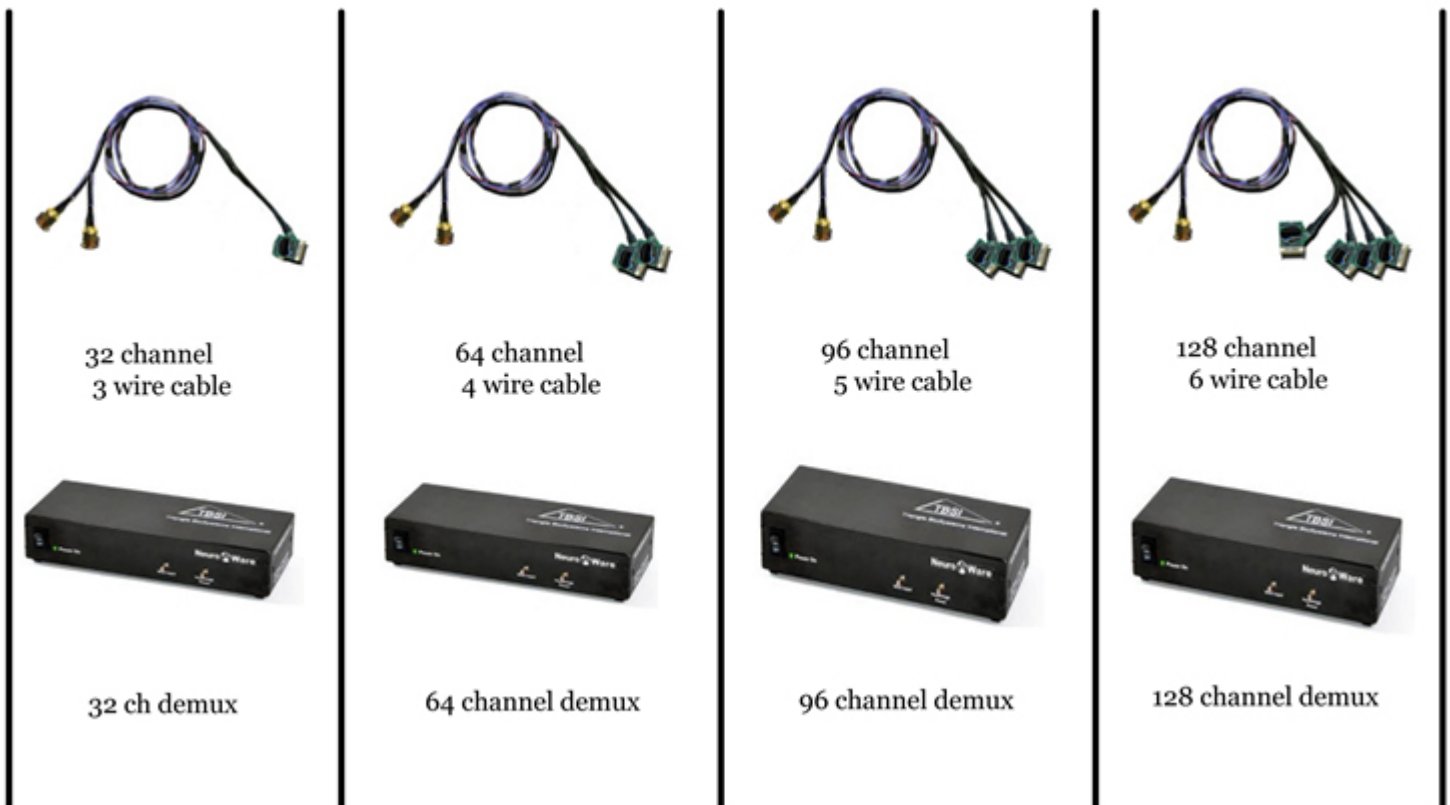


Figure 14: Multiple Headstages and Receivers

For every 32 channels there is an addition DB37 Connector output to accommodate the new output load.

# Commutators

To learn more about our commutators please refer to our [commutator brochure](#).

## Gain and Phase Response

Please refer to the section of this document entitled "[Headstage Transmitter Specifications](#)" for numerical data on bandwidth and input referred noise.

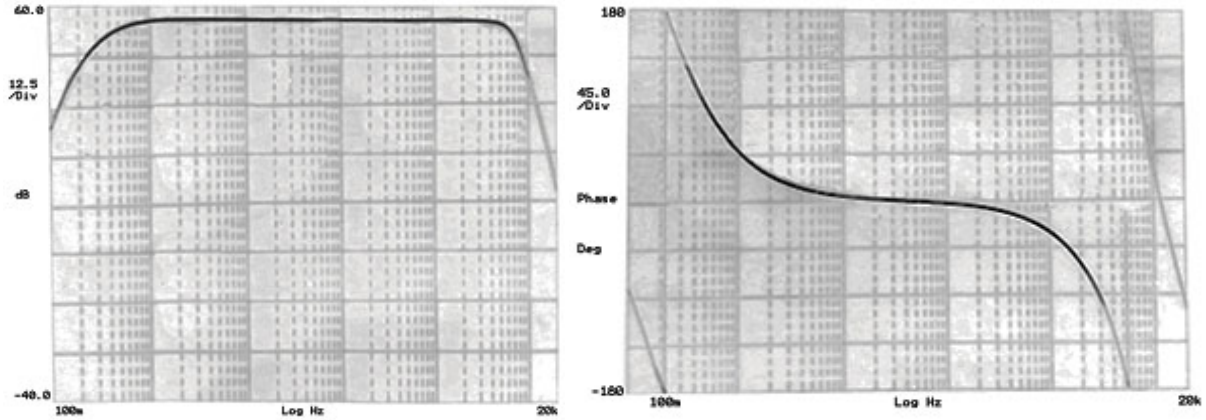


Figure 15: Gain and Phase Response Graphs

## Troubleshooting

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**Problem:** No neural signals are visible on any of the analog outputs at the DB37 connector.

**Suggestion:** Verify the AC power connection is in place and the green "Power" LED is illuminated on the front of the Base Station box.

**Problem:** Not all channels are visible on the neural signal.

**Suggestion:** Make sure the headstage connection to the animal is secure.

## Application Notes

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- 1) If you do not intend to record from all of the available signal channels you must ground any unused channels at the electrode connector or EIB interface. Failure to do so can create artifact noise from the floating channels on the other signal channels.

## Contact Us

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