

DUAL WIRELESS NEURAL HEADSTAGE SYSTEMS

Features

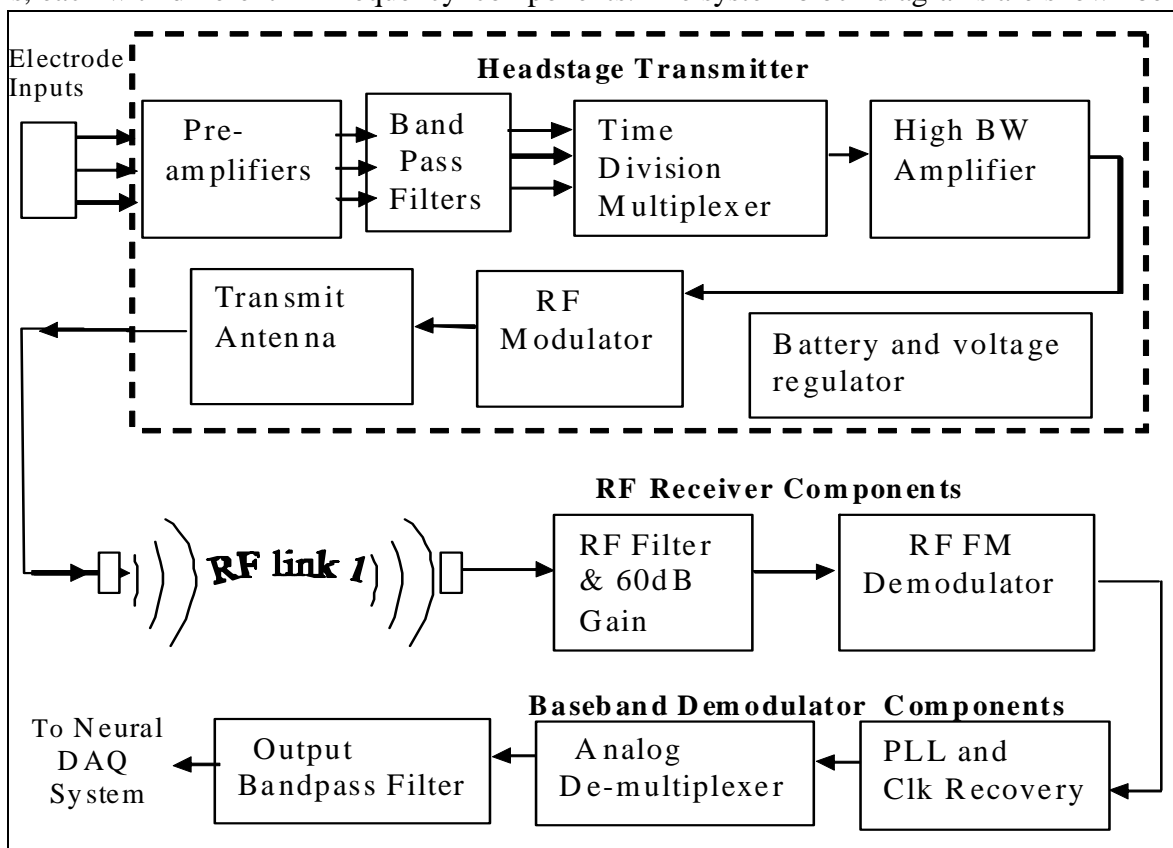
- Wireless operations across 3 meters
- Operates in unlicensed radio band below FCC limits
- Available with 5, 16, 32 and 64 channel wireless systems
- Rechargeable battery power
- Bandpass filtering per channel
.8Hz to 7kHz typical
- 50kHz sampling rate per channel
- Same cage or adjacent cage location proximity

General Description

Triangle BioSystems, Int'l. has developed a dual wireless neural headstage system that allows researchers to continuously and simultaneously monitor two freely moving animals in the same or adjacent cages. Each headstage system has different RF carrier frequencies and radio components that allow any combination of 5, 16, 32 and 64 channel wireless systems to work side by side within the same transmit range of 3 meters. For example, two 32 channel systems, or one 64 channel and one 5 channel, or two 5 channel systems can operate all together in the same cage.

System Block Diagram

The dual wireless neural headstage system consists of two separate wireless transmitter headstages and receivers, each with different RF frequency components. The system block diagrams are shown below:

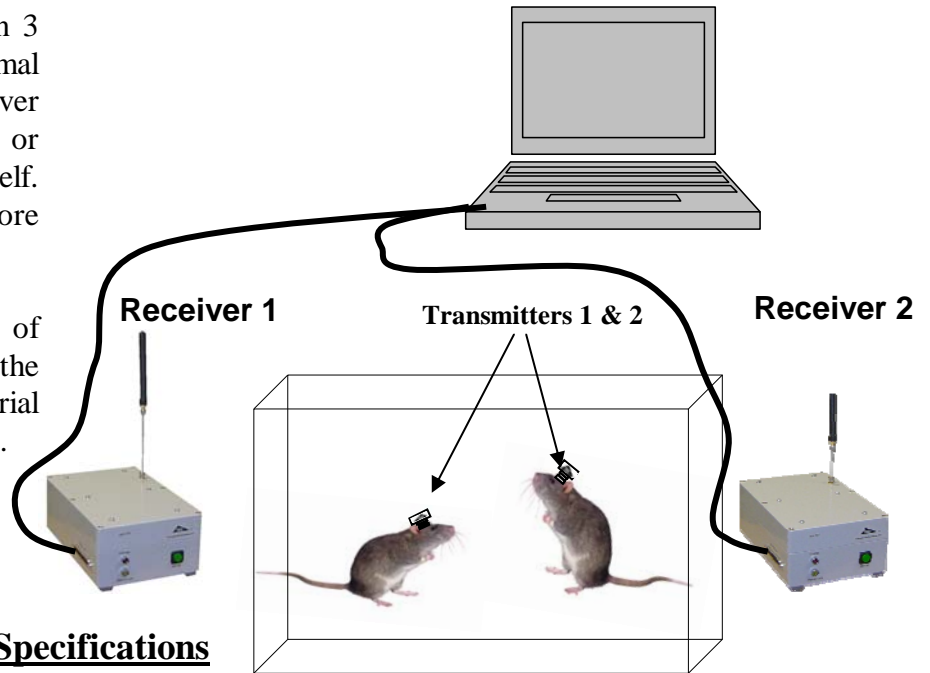


1.0 System Configuration

The dual receivers has to be within 3 meters from each of the animal transmitters at all times. Each receiver can be positioned next to the cage or sit on a shelf inside the cage on a shelf. See page 7, Section 10.0 for more details on system setup.

Be careful not to obstruct the line of site path between the animals and the receiver antennas with any material except for glass, plastic or plexiglass.

Dual Radio Neural recording system



2.0 Headstage Transmitter Specifications

Parameter	Min	Typ	Max	Units	Notes
Power Supply					
3 volt supply	2.75	2.8	2.85	Volts	Power consumption 11.0ma (typical)
Battery life		5.5		Hours	Same as single radio specs
Analog Input Specs					
Input voltage range		4		mVolts	Same as single radio specs
Common mode center		.9		Volts	“
Gain selection		600			“
Bandwidth	.8		6000	Hz	“
Input impedance		10M		ohms	“
Input referred noise		10		µVrms	“
Sampling Rates		50		kHz	“
Radio Specs					
Center frequency1		3.0		GHz	With +/- 100 MHz bandwidth
Center frequency2		3.4		GHz	With +/- 100 MHz bandwidth
Transmit power			300	µV @ 3 meters	FCC Sec.15.109B(a)
Transmit antenna1		3.0		GHz	Tuned chip antenna with circular diversity
Transmit antenna2		3.4		GHz	Tuned chip antenna with circular diversity
Transmit range		3.0		Meters	With receivers on top of cage

3.0 Headstage Mechanical Overviews

Each of the dual headstage transmitters have the same mechanical specifications as the single radio headstage systems. For example the height, width, depth and weight of the dual 5 channel systems have the same dimensions as the single radio 5 channel headstage. The same is true for the 16 channel, 32 channel and 64 channel headstages. Please refer to section 3.0 on page 3 of each of the specific application headstage specifications.

4.0 Wireless Headstage Pinout (Bottom View)

Each of the dual headstage transmitters have the same bottom view pinout as the single radio headstage systems. For example the channel one and pin configurations of the dual 5 channel systems have the pin and I/O locations as the single radio 5 channel headstage. The same is true for the 16 channel, 32 channel and 64 channel headstages. Please refer to section 3.0 on page 3 of each of the specific application headstage specifications.

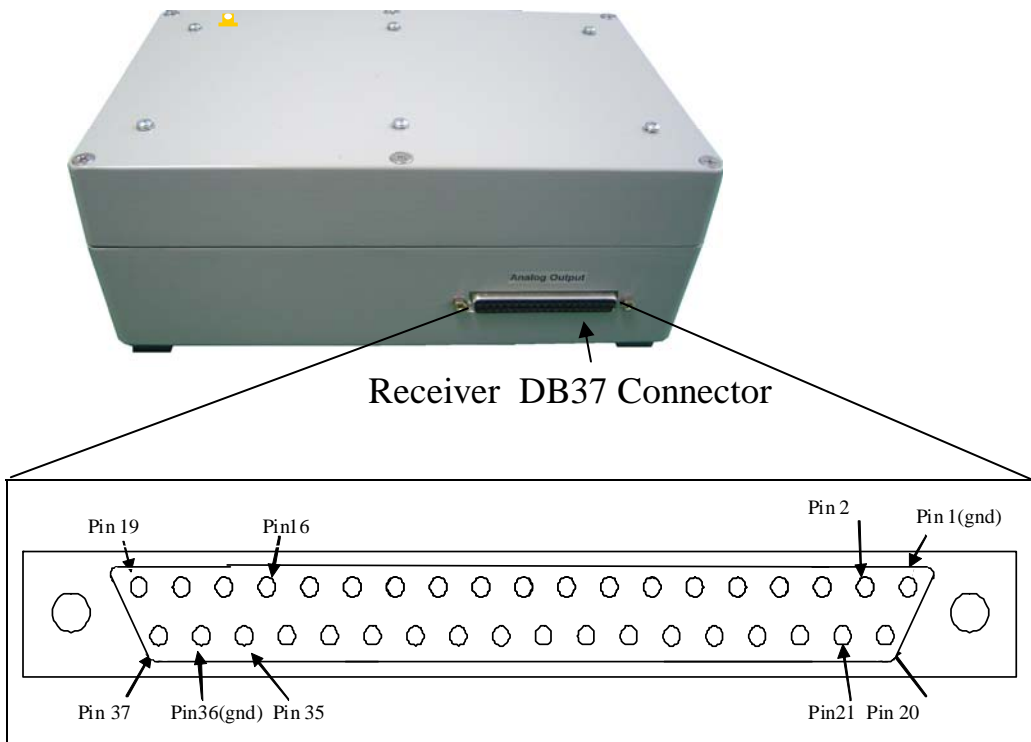
5.0 RF Receivers

Specification summary

- 3.0GHz and 3.4Ghz center transmit frequencies with +/-100MHz FM bandwidth
- 3.0 meter max. range between headstage transmitter and receiver (assuming Plexiglas cage)
- Cable for headstage battery recharging
- Front-end Gain: 60 dB
- Intermediate gain, 10-20 dB
- Input referred noise, typical 4 uVrms
- Input voltage range, +/- 0.5mV
- Analog Channel bandwidth 20 kHz
- DC offset, < 100uVdc
- Phase delay typ. 30 usec at 10kHz
- Receive antenna - black square area on bottom of box
- Signal lock indicator LED on front panel

6.0 Demodulator/Signal Processing Units

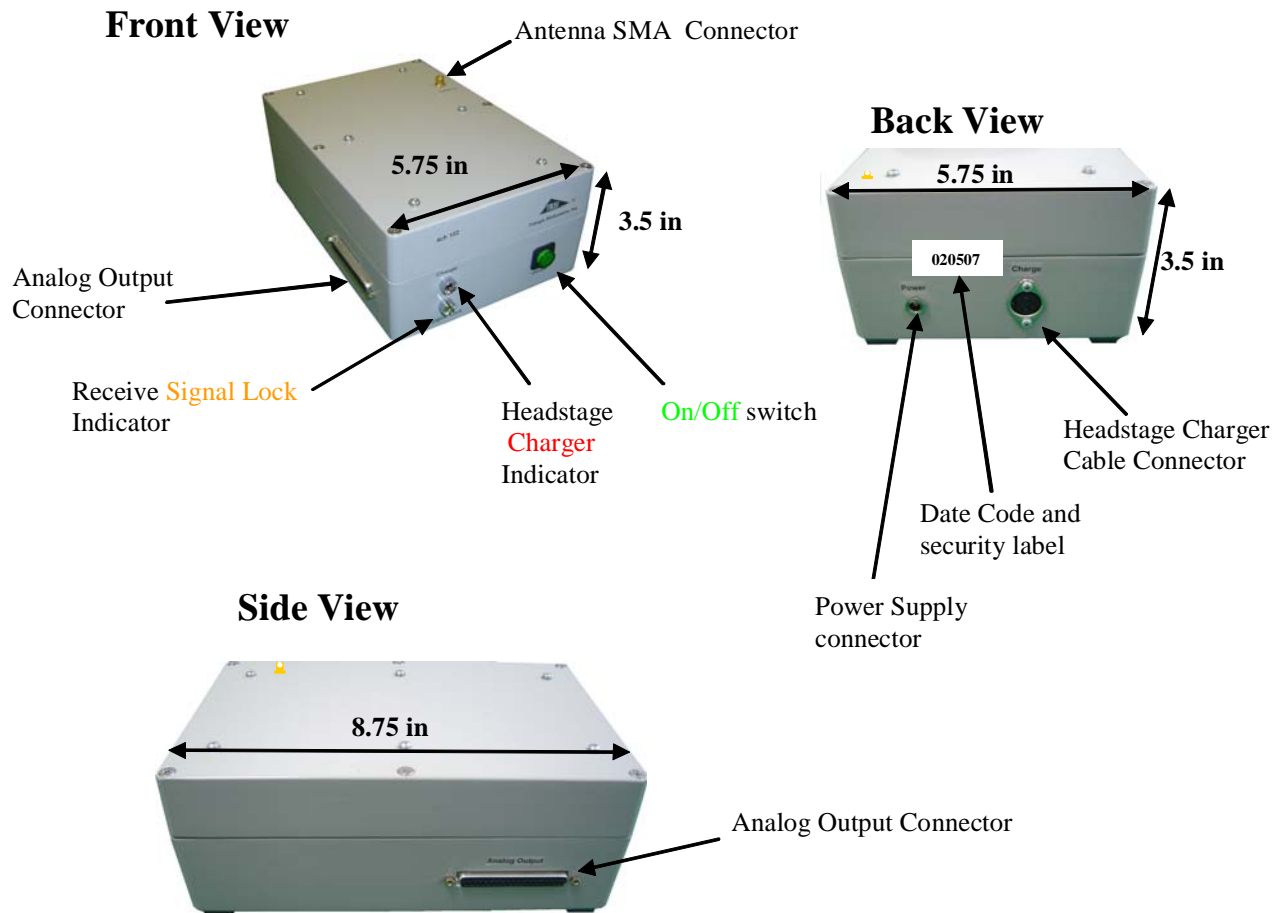
Each of the RF receiver signal are demodulated by a custom digital signal processing system. The signal processing system incorporates a high speed analog to digital converter for demodulating the receiver signal. The demodulated signal is then conditioned via the DSP and converted to an analog output signal. Each of the analog interface is available via a DB37 female connector, connector pin-out below:



7.0 Power Supply

Each of the receivers are powered by an AC line adapter transformer/regulator manufactured by Cincon Electronics. This power unit connects to a 100-240V, at 47-63 hz and is rated at .7 amps AC power source and is UL approved. The model number of this wall unit is TR25150.

8.0 Receiver Mechanical



9.0 Dual Wireless headstage systems part ship list:

Dual Headstages



Dual receivers



Dual Power Supply



Headstage Charger Cable



Dual Mating Connectors



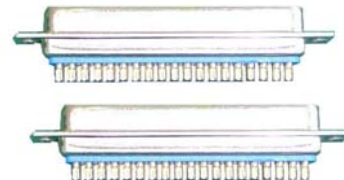
Dual Receiver Antennas with extender cable



Dual Headstage Signal cables for Testing (DB37)



Dual Analog output mating connector



Optional Headstage Mounting Screws (#0-80) at 3/8 inch in length



10.0 System Setup and Test:

Below are 6 instructions to validate radio system setup and transmit range:

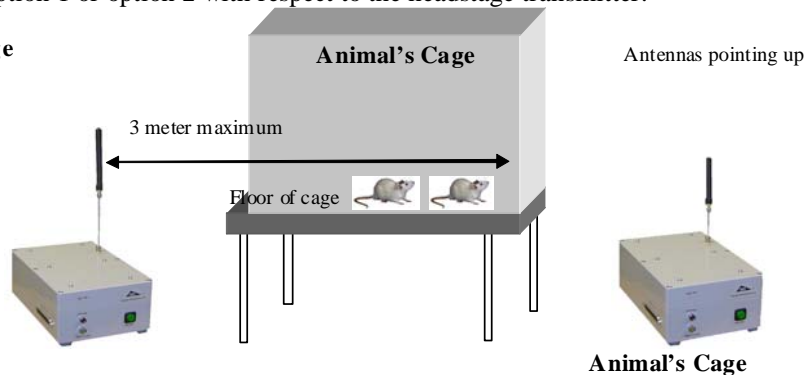
1) Correctly Position each of the Receiver near or inside the animal's cage:

It is critical for transmission performance to correctly position the receiver next to or inside the animal's cage. First screw the antenna cable snugly onto the antenna gold input SMA connector at top of receiver. Position the receiver as shown below with either option 1 or option 2 with respect to the headstage transmitter:

Option 1: Dual Receivers next to cage

Receiver antennas should point upward and the cage height should be positioned so that each animal is horizontal from the antenna.

The maximum distance for each animal from their receiver antenna is 3 meters.



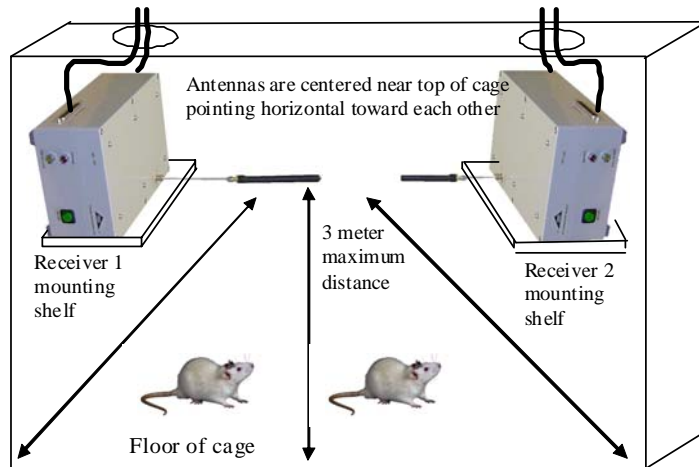
Option 2: Receivers inside cage

Each of the receiver antennas mounted inside the cage should point horizontal toward each other. Each receiver should be rotated on its side and mounted near the top side of the cage.

The analog output connector of the receiver should point upward. The antenna location is somewhat top and center inside the cage which means the receiver is placed off center by 9 inches or so.

Note the maximum distance for each animal that can be away from the antenna is 3 meters.

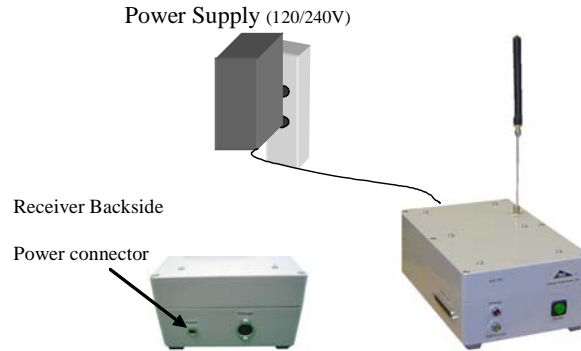
Each of the power cables and analog output cables should exit the top of the cage.



Be careful not to obstruct the line of site path between the animal and the receiver antenna with any material except for plastic, glass or plexiglass. If any ferrous materials are used such as steel, wire mesh, or most metals and any materials that have water such as wood then the range and dropout maybe compromised.

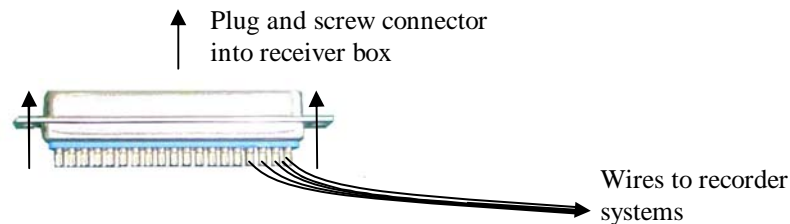
2) Connect power supply to receiver

The power supply cable will plug directly into back of receiver into the power jack connector.



3) Connect signal cable to receiver analog output DB37 connector

4 signal wires and a ground wire can be added to the DB37 mating connector to check for signal output. The length of the wires are not critical and depend on how far the wires need to be routed to the recording system. The analog output wire channel position are describe on page 4 of this document.

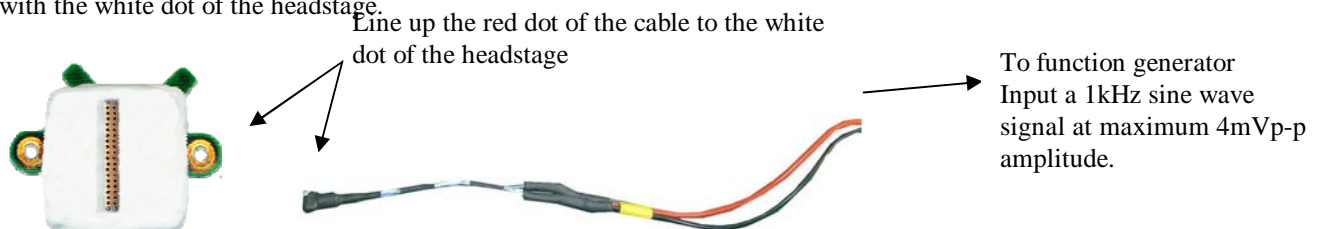


4) Turn on Receiver

Push the Green on/off button of the receiver to turn the receiver on and off. The button will light up **green** when the receiver is turned on and the light go away when the receiver is turned off.

5) Connect a function generator to the headstage via headstage signal cable

A function generator can be attached to the headstage signal cable. Since this is a battery powered headstage, it doesn't matter which signal wire (either red or black) from this cable will connect to the function generator's ground or signal wire. Note the function generator signal output voltage cannot exceed 4 mVp-p otherwise the headstage input voltage range will saturate. The frequency of the input signal can be set to 1Khz. Also be sure the white dot of the cable lines up with the white dot of the headstage.



When the cable is attached to the headstage, the headstage will **TURN ON** and start to transmit. Hence do not forget to unplug the headstage when not being used. Otherwise the battery will be drained.

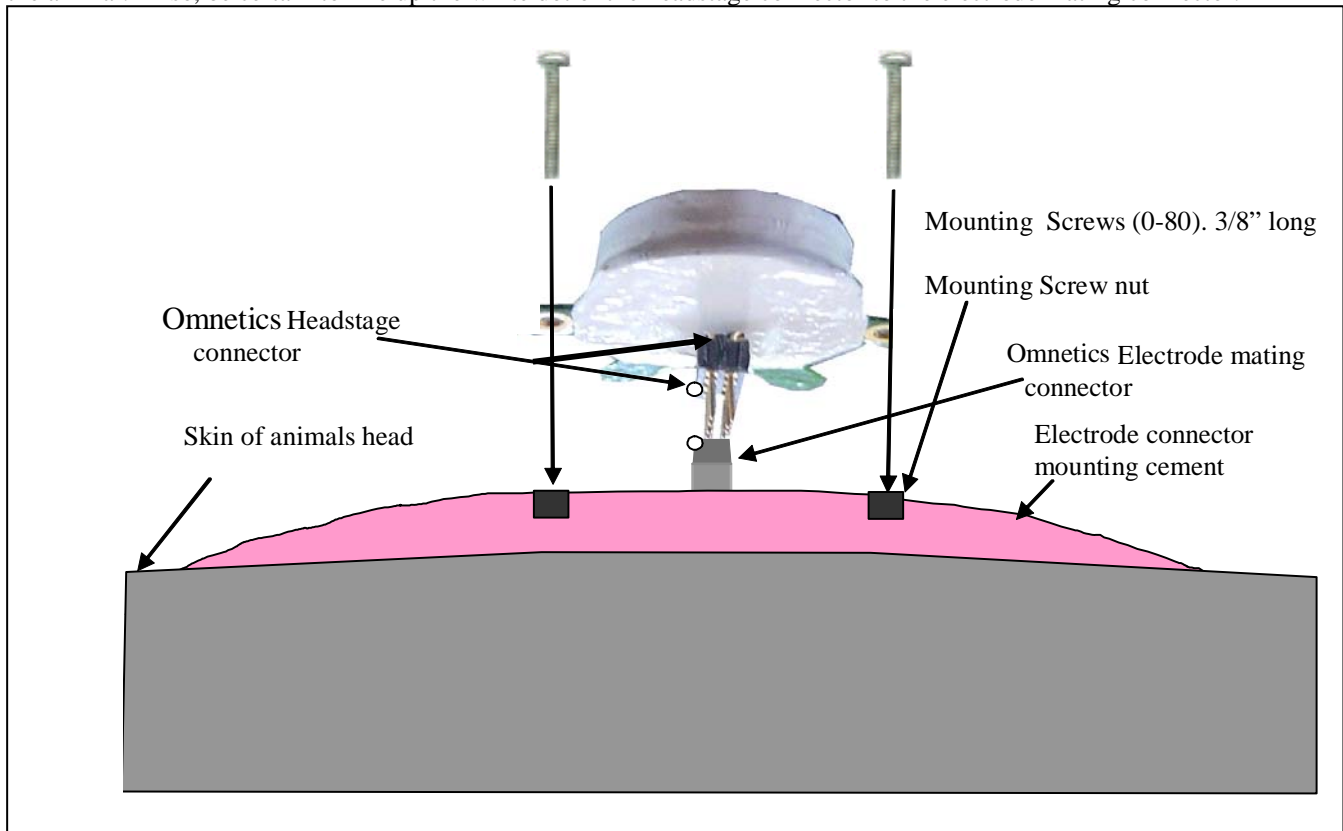
6) Signal Lock LED and measure analog output signals

Once the headstage is turned on by connecting the signal cable to the headstage from Step 5, and the receiver is turn on, the **"Signal Lock"** LED in on the receiver front panel should light right away. Once lit, you can measure the analog output signals using an oscilloscope. Please note the system gain is 600 so the analog output values should be $\sim 600 \cdot V_{p-p}$ of function generator output.

11.0 Application notes

11.1 Mounting the headstage onto the animal

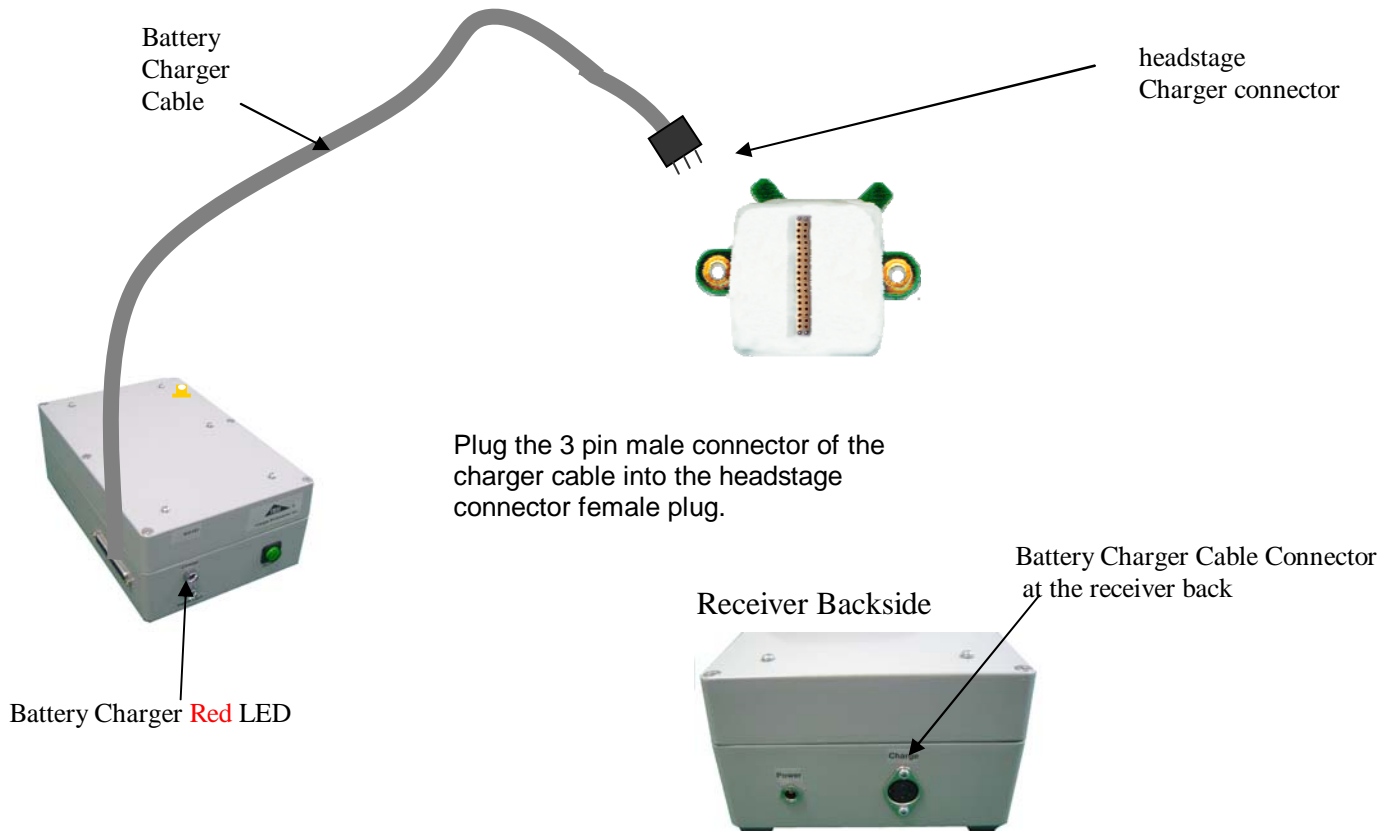
Depending on the animal test and particular experiment, the friction of the Omnetics headstage connector male pins while placed into the electrode female connector may be sufficient to keep the headstage mounted securely to the animal. However, if additional mounting support is required, optional mounting screws can be used to securely mount the 31 channel headstage to the animal. Also, be certain to line up the white dot of the headstage connector to the electrode mating connector.



11.2 Charging the headstage lithium ion battery

The wireless headstage includes an integrated rechargeable battery which must be recharged after the specified battery life of each W series headstage. Recharging is accomplished by the following procedure:

1. Turn off receiver unit.
2. Connect battery charging cable to the “Charge Cable” connector on the back panel of the receiver. This cable connector is keyed and can only be plugged in one way.
3. Plug opposite end of the charging cable into the headstage connector on the wireless headstage (see diagram below). Make sure the 3 pins of the charging cable line up to the charger connector of the headstage connector.
4. Turn on the receiver (the “Charge” Red LED on the front panel of the receiver should now be illuminated)
5. The battery will be fully charged in approximately 1.5 hours. The “Charge” red light on the receiver will turn off when battery is fully charged.



12.0 External Battery and Accessories

External 24 hour and 96 hour rechargeable battery options are available for all dual wireless headstages to provide enough battery life for overnight sleep and 4 day long recording studies. For this external battery headstage scenario, the battery is outside the headstage is removable for recharging via a connector. Usually the external battery is mounted in an jacket or pouch on the animal usually away from the animal's head. Since the battery is external to the wireless headstage, the headstage weight is reduced by 1.8 grams. In addition, the headstage height is reduced by 4mm Below are the accessories for the external battery options, the battery charger, plug adapters and mice and rat jackets to house the battery.



External 24 hour battery
Weight: 12 Grams
Size: 1.5 x 1.1 x .2 inches



External 90 hour battery
Weight: 44grams
Size: 2 x 1.5 x .4 inches



Battery charger
and battery connector



Multi-plug adapters
for Europe and Asia

Mice and Rat jackets are required for external battery option



Pocket and front leg jackets
Large, med, small sizes



Opened Jacket with pocket



Closed Jacket with pocket

Order all rat jackets direct to Teresa Woodger-Price teresa@lomir.com at Lomir Medical.

The address is below:

Lomir Biomedical

458 East Main Street

Malone, NY 12953

Tel toll free 877-425-3604, or 518 483 7697; Fax 518 483 8195

The part numbers for the rat jackets are

RJ 02 Medium (250-300g)

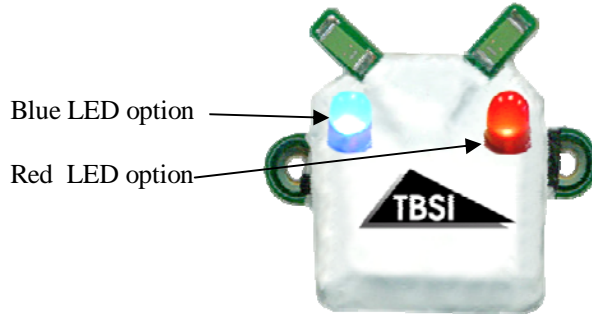
RJ 03 Large (300-500g)

RJ 04 X-Large (500g+)

RJ INP Rat jacket insert/pocket

13.0 LED Headstage Options

Red and blue LED options are available for the 31 channel headstage for video tracking. The LEDs are placed facing upward on the top headstage and plenty bright enough to allow for video tracking. Both LEDs turn on with the On/Off switch. Please note that with the use of these LEDs, the battery life is reduced by 30%.

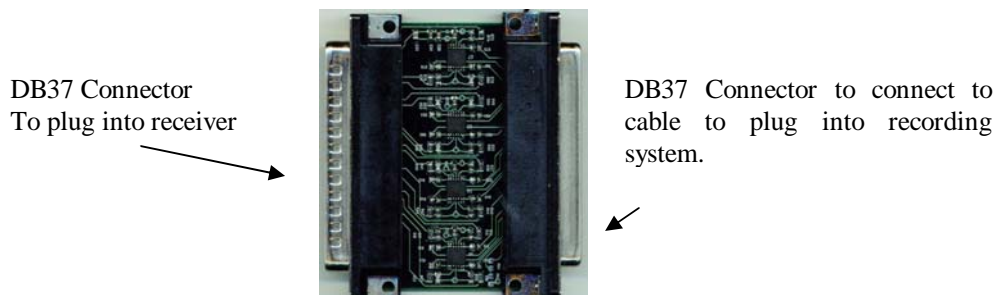


14.0 Electrodes

Microprobe Inc., NeuroNexus, Neurolync and CD Neural Technologies offer a variety of electrode arrays that connect to all of our headstages. Please visit our website <http://www.trianglebiosystems.com/Products/Electrodes.aspx> to connect to all the vendors' websites.

15.0 Gain Reduction Board Options

TBSI offers a gain reduction board option to reduce the analog channel voltage gain from 600 to a voltage gain of 2. This will allow the wireless analog outputs to directly connect into the Blackrock and Neuralynx preamps without saturating the preamp inputs. These gain reduction boards will plug into each of the DB37 connector on the receiver and provide an identical DB37 output connector. All pre-existing cables to the receiver can still be used since the connector pinout is preserved.



TBSI's Gain Reduction board (divide by 300)

14.0 Trouble Shooting

Problem: No neural signals are visible on any of the Analog Outputs at the DB37 connector

Solution: Verify the AC power connection is in place and the Green "Power" LED is illuminated on the RF Receiver Box, as well as the Green LED on the power button on the Signal Demodulator Unit. Also, verify that "Signal Lock" light is illuminated which confirms that the receiver is receiving the transmitted signal from the headstage.

Problem: Visible neural signal is missing information.

Solution: Keep the animal within the 3 meter range of the receiver. If you exceed this range, the radio signal from the headstage will not be strong enough to maintain reliable signal monitoring of the animal. Also, be sure to keep the area under the RF Receiver unit's antenna free from metallic objects, which will reduce signal range.

Note: the Wireless Headstage is a low-power device, it is critical that the RF receiver be carefully located for the system to operate. DO NOT place the Receiver on outside a metal wire cage. Try to minimize the distance between the Receiver and the Wireless Headstage. The best orientation is the Receiver is shown on page 9.

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

Solution: Make sure the headstage connection is secure to the animal.

Call customer TBSI customer support 919-544 -3061 if there are any problems with system setup and function.