



32 CHANNEL WIRELESS NEURAL STIMULATOR SYSTEM

Features

- User selectable current drive (0 – 1ma) per channel
- 16 biphasic constant current drivers
- Differential voltage range up to 10v
- Complete power isolation to animal
- Output impedance over 100 Meg ohms between channels when tri-state
- Output “on” impedance of 20 ohms.
- Programmable current direction and magnitude.
- 5 usec accuracy on clock edges
- Pico amp leakage between channels
- Backpack receiver weight is 19 Grams for a 12 hour operation
- A single PC can control up to 16 different animals at one time
- Works with TBSI wireless recording headstages

General Description

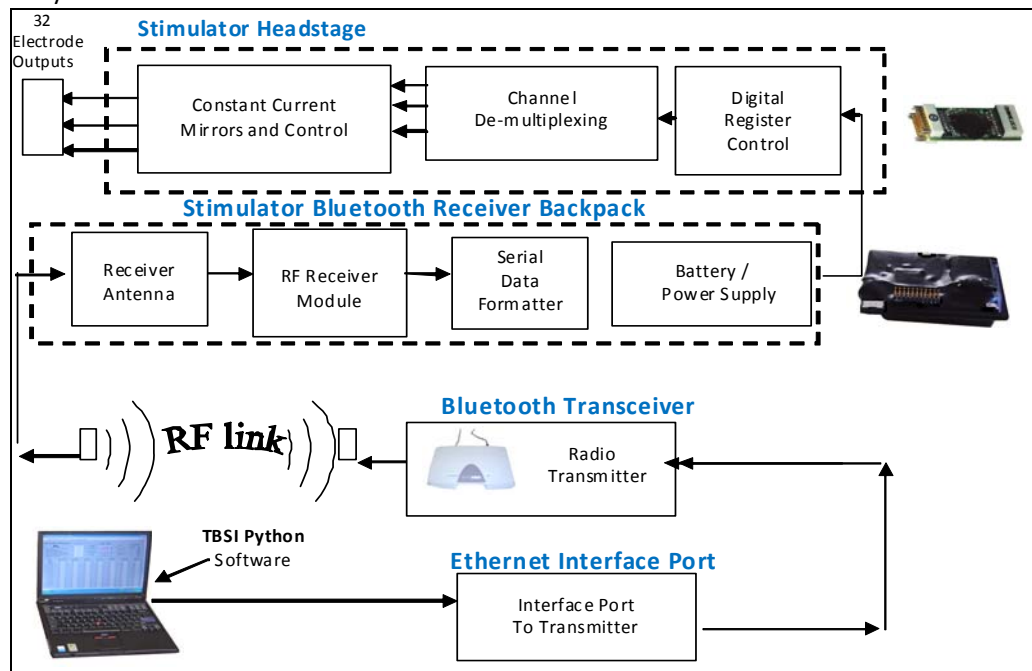
Triangle BioSystems, Inc. offers a unique wireless neural stimulator that can easily be used to replace cumbersome legacy stimulation systems. A graphical Python interface will allow for stimulation control for current level, current polarity, pulse duration, pulse count, timing of the stimulation output, and selection of an external (automatic) or internal (manual) trigger.

While the system default is to verify the current balance to assure all stimulation patterns have equal positive and negative components and the system is prevented from firing, the balance check can be over-ridden by the user. Utilizing a combination of custom IC technology and commercial electronics, TBSI is able to provide unique solution in a small headstage and backpack. With previous experience delivering hundreds of wired headstages, TBSI was able to create a novel stimulator headstage design with biphasic constant-current output and high speed digital circuitry.

The result is this small headstage unit that can be mounted on the animal’s head while providing controlled current stimulation of targeted regions of the brain. This wireless stimulator will work in conjunction with the TBSI wireless neural recording headstages.

System Block Diagram

The wireless neural headstage system consists of a wireless transmitter headstage, an RF receiver and baseband demodulation subsystems as shown below:

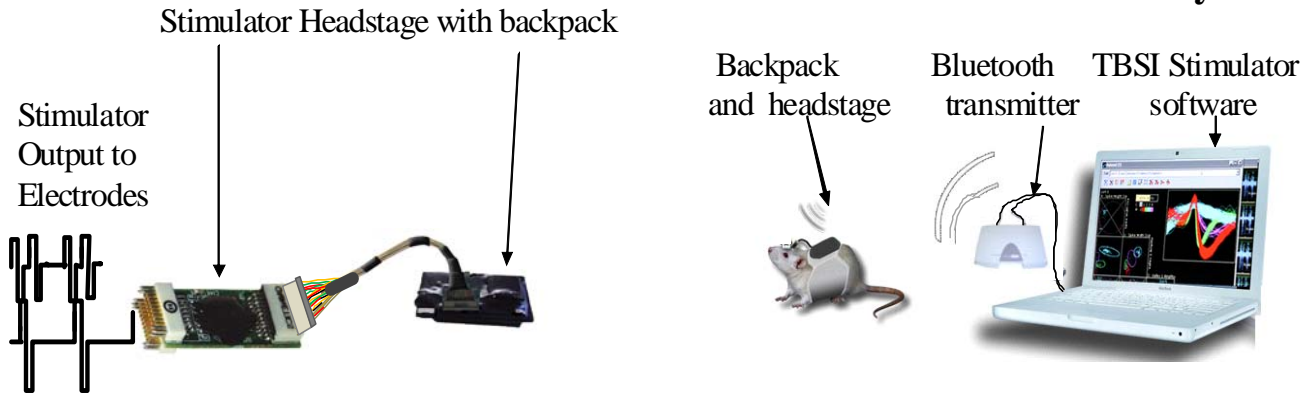




Wireless Stimulator System Configuration

The wireless stimulator system consist of the TBSI stimulator Python software running on a PC , a digital transmitter that will plug into an Ethernet port and a backpack receiver and headstage. Below is a system picture of the wireless stimulator system.

Wireless Stimulator System





2.0 Wireless Stimulator Specifications

Parameter	Min	Nom	Max	Units	Notes
Analog Specifications					
Maximum Current Output/ch			1	mA	When external R bias is 100 ohms
Current Output Accuracy		1		μA	This is set by external resistor tolerance (1%)
Maximum Voltage Output (Diff)			12	Volts	Typically 2x power supply
Common Mode Center		0		Volts	If bipolar supplies (-2.5 – 2.5v) are used
Input Impedance			10	Mohm	Impedance of input gates
Output Impedance when active	40			Ohm	Impedance at 1KHz (estimated) with 50 μA buffer
Output Impedance when tri-state	10			Mohm	
InBand Noise Specs					
PSSR		-60		dB	Power Supply Rejection Ratio
Input Referred Noise		4		μV/(Hz)	Measured with no clock transitions
Power Supply					
Voltage	-3		3	Volts	Bipolar power supply
Current		8		ma	
Mechanical					
Headstage Dimensions		16 x 23		mm	Includes connectors
Headstage Weight		1.8		grams	Includes connectors

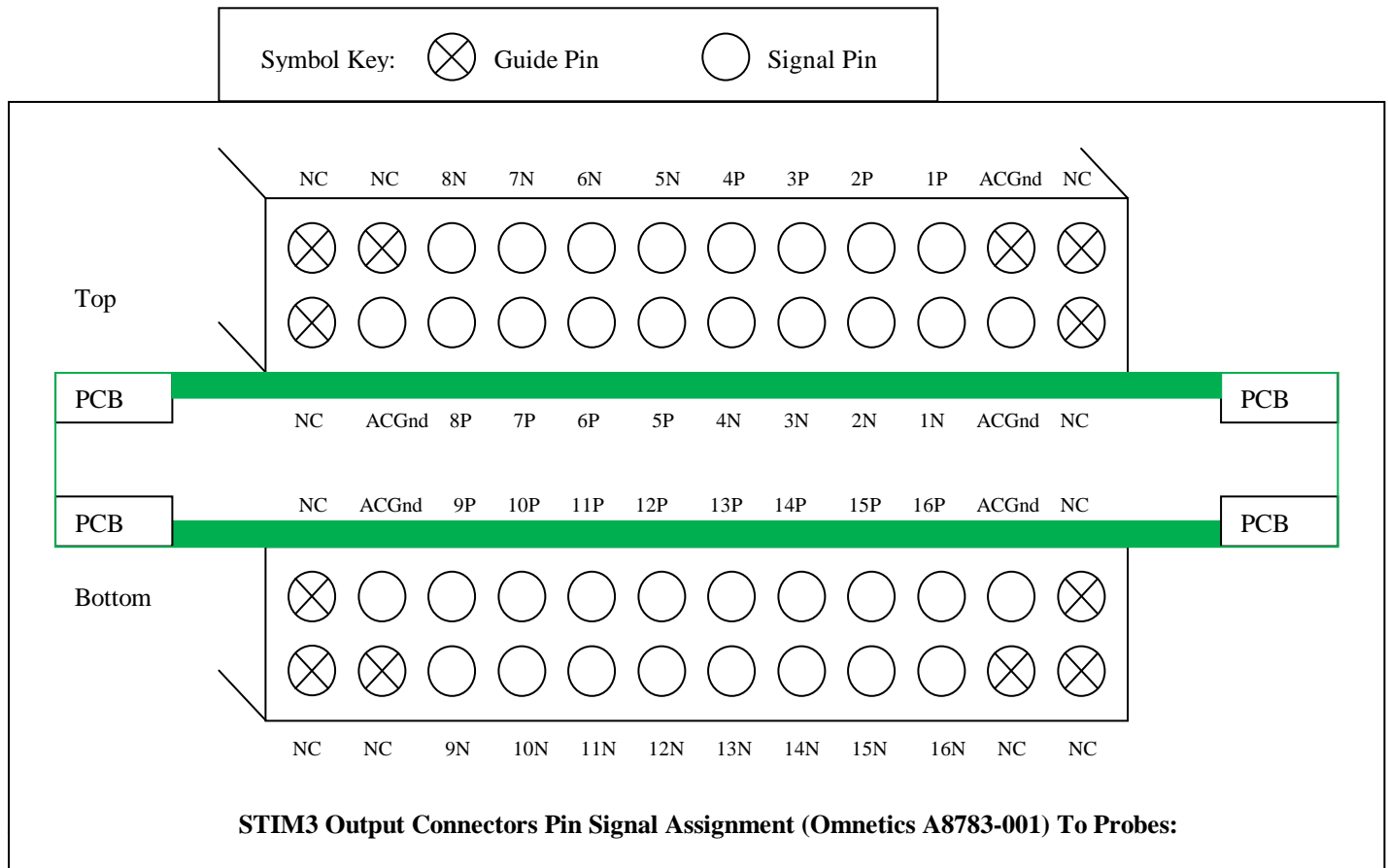


3.0 Wireless Headstage and Backpack Mechanical

	Top Views	Comments
32ch Stimulator Headstage	 16 x 8 x 5 mm	The weight of the headstage is .9 grams.
Stimulator Backpack Receiver	 22 x 30 x 15 mm	The weight of the Bluetooth backpack is 19.7 grams

4.0 Wireless Headstage Pinout

Below is the stimulator headstage pinout looking into the stimulator headstage. NC are no connects.





5.0 Stimulator Ship List

32ch Stimulator headstage



Bluetooth Backpack receiver



Power supply for Transmitter



BLUETOOTH Transmitter



**Electrode Mating Connector Omnetics Male
Dual row Nano 18 Pin Vertical**



Power Charger for Backpack receiver



Headstage Signal cable for Testing



Backpack Rat Jacket



Stimulator Software CD



6.0 System Setup and Test:

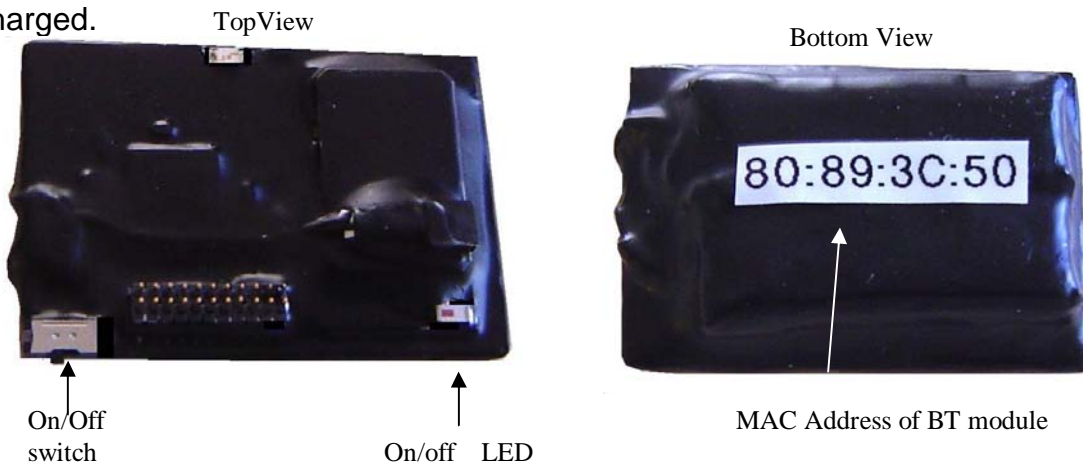
Below are instructions to validate stimulator system setup and transmit range:

1. Connect the Stimulator Cable to the Remote Stimulator backpack, next connect the Stimulator Headstage to the other end of the cable. Remember when connecting the headstage that logo matches with logo on the connectors. When complete the remote stimulator should look like this.



2. Then connect the headstage to the signal source, either the test animal or the Stimulator Test Board supplied in the ship kit.

3. Turn on the Remote Stimulator using the on-board switch. The battery should be fully charged.

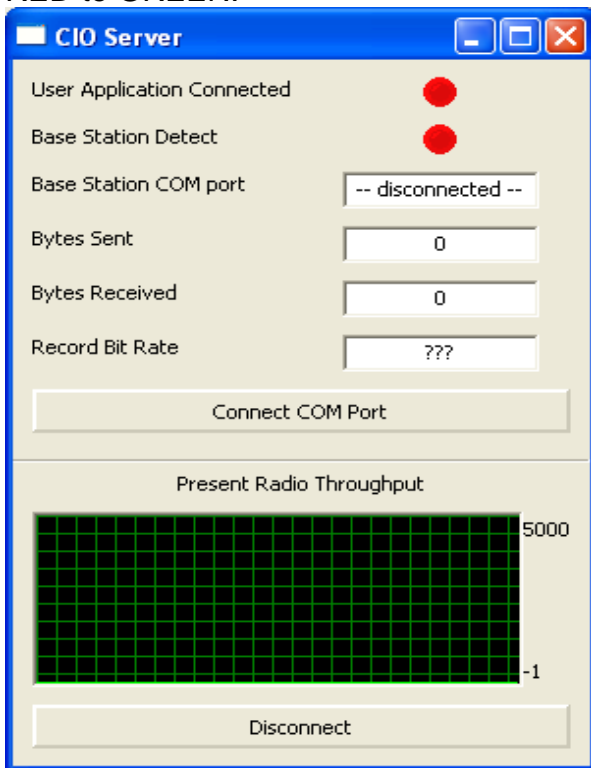




4. Connect the Bluetooth Server to the Same LAN that contains the PC where the software was installed.

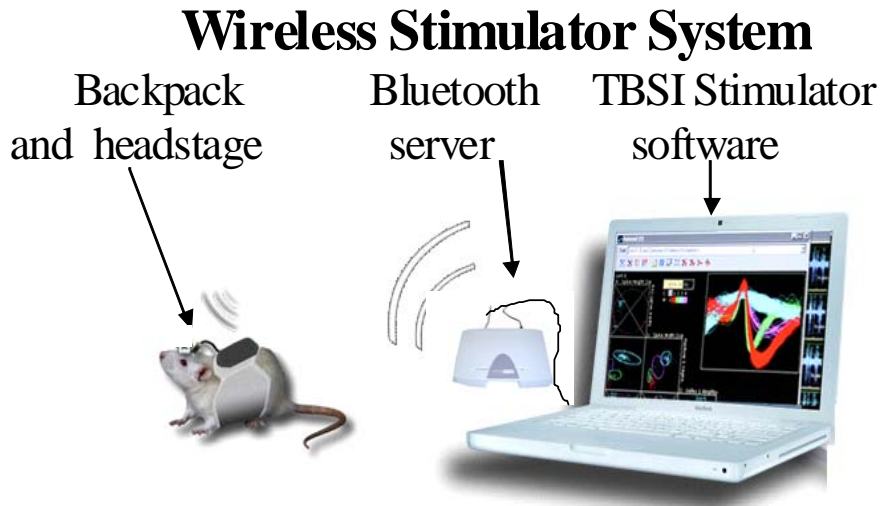


5. On the PC Desktop, start the CIO_Server_App. On the drop down box select the COM Port. Click on the Connect button and the Bluetooth Server Detect light should go from RED to GREEN.



6. On the desktop, start the TBSI_DEMO. The light on the CIO_Server_App User Application Connected should go from RED to GREEN when ready.

7. Now you have everything connected and ready to go.



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 RF signal dropout maybe compromised. Depending on the cage set-up within the lab and location of the receiver, signal dropout or a “dead spot” maybe seen at an exact headstage angle and distance from the receiver. This is due to RF transmission multi-path phenomenon. If a deadspot occurs within the active space of a freely moving animal pathway, one can slightly adjust the receiver distance or angle to move the deadspot to a new space outside the animal’s pathway.

7.0 Application notes

7.1 Mounting the headstage onto the animal

Depending on the animal test and particular experiment, the friction of the Omnetics headstage connector male pins. While place into the electrode female connector maybe 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.



8.0 Charging the backpack lithium ion battery

The wireless headstage includes an integrated rechargeable battery which must be recharged after approximately 12 hours of use. 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 charger 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.

9.0 External Battery and Accessories

External 24 hour and 96 hour rechargeable battery options are available for all 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 a jacket or pouch on the animal usually away from the animal's head. Since the battery is external to the wireless headstage, the 64ch headstage weight is reduced by 1.8 grams to 3 grams versus 4.8 grams. In addition, the 64 ch headstage height is reduced by 4mm for a total height to 8.2mm versus 12.4mm. Below are the accessories for the external battery options, the battery charger, plug adapters and mice and rat jackets to house the battery.

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



Closed Jacket with pocket

Rat Jacket with pocket





Order all rat jackets direct from 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

10.0 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.

11.0 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 919-361-2663 if there are any problems with system setup and function.