Sympathetic Nerve Activity (SNA) Device User Guide

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Acknowledgments

Sympathetic Nerve Activity (SNA) Device User Guide

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1. Introduction

The F50-W-F2 is a Physiotel® transmitter designed to wirelessly acquire sympathetic nerve activity (SNA) from rats and similarly-sized species. The transmitter measures one high bandwidth biopotential signal. It transmits data using a different frequency than other DSI transmitters. Therefore, the F50-W-F2 may be implanted with another DSI transmitter in the same subject allowing the simultaneous measurement of SNA with other data types such as blood pressure, ECG, temperature, and more.

The RPC-3 rodent receiver was developed to support this transmitter and is intended to be placed beneath the subject's cage. It can acquire data from the F50-W-F2 transmitter and another DSI transmitter simultaneously if two devices are implanted in the same subject. When doing so, this requires two slots in the Data Exchange Matrix and acquisition software.

DSI's Dataquest A.R.T. 4.3 and Ponemah 5.0 (with OpenART 4.3) or later versions are required to use the transmitter and receiver. Each acquisition program can acquire the raw electroneurogram (ENG) signal provided. There are some basic analysis functions within each program; however, advanced analysis tools for this application are not yet available. An option to bring an analog signal into a 3rd party acquisition program via a DL11 Analog Output Adapter and is the recommended system configuration at this time.

This application is highly sensitive to noise due to the low signal amplitude and data analysis techniques that are used. For optimal signal quality, DSI strongly recommends using metallic shielding around each subject to reduce the impact of variable electro-magnetic interference that may be present in the data collection area. The use of shielding is described further in Appendix C.

2. Part Numbers and Contents

Part Number	Model Name	Package Contents
270-0153-001	F50-W-F2 Transmitter	The transmitter is shipped sterile in a sealed pouch. The pouch contains a peel-away label with the serial number and calibration value.
272-6008-001	RPC-3 Receiver	The receiver includes two 14 ft (4m) shielded LAN cables and one grounding cable.
273-5003-001	DL11 Analog Adapter	The DL11 includes a 14 ft (4m) LAN cable, BNC to BNC output cable, and a BNC splitter. The power supply is purchased separately.
275-5003-001	Amplified Speaker (Optional)	The speaker includes a US power supply and a 3.5mm to BNC output cable.
276-0170-001	F50-W-F2 Starter Kit	The starter kit includes a radio (wide band receiver), magnet, and User Manual.

3. System Components

This section briefly describes each of the system components:

- F50-W-F2 Transmitter
- RPC-3 Receiver
- DL11 Analog Adapter
- Amplified Speaker

Details on configuring the system components for data acquisition are provided in the next section.

3.1 F50-W-F2 Transmitter

The F50-W-F2 transmitter is a single channel high bandwidth transmitter intended for monitoring sympathetic nerve activity (SNA) in rats and similarly-sized species. It senses nerve activity via the lead/electrode and transmits the data to the receiver located underneath the subject's cage. It transmits using 18MHz (known as 'F2') and can be implanted with another DSI transmitter in the same subject. The F50-W-F2 transmitter can be resterilized and re-implanted in multiple subjects. Some onsite electrode preparation may be necessary. Please see Appendix B for reuse and resterilization information. In addition, the transmitter can be returned to DSI for refurbishment (transmitter exchange).
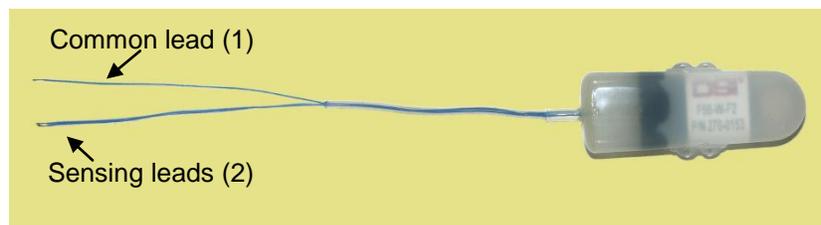
Figure 1: F50-W-F2 Transmitter

3.1.1   Transmitter Specifications

Battery life	2 months continuous
Bandwidth (3dB)	50-1000Hz
Sample rate	5000Hz
Size	12g, 5.5cc
Input signal range	+/- 200µV
Noise floor	10µVpp nominal
Electrode material	Multi-stranded stainless steel (blue Teflon coated)
Lead length	12cm
Number of channels	1 bipolar + common
Intended max cage size	42 x 42 x 18cm*
Min. recommended body weight	200g (250g if used with another device)

Additional receivers may be configured to cover a larger area

3.1.2 Lead/electrode

The leads on the F50-W-F2 transmitter are multi-stranded stainless steel coated in blue Teflon. The overall length of the leads is 12cm. There are two sensing leads which are bundled together in Silastic® tubing and one common lead which exits the bundle at 6cm. The distal 2.5mm of each lead is pre-stripped to create the electrode. Figure 2 depicts the pre-stripped section found on all three leads. <u>This electrode can be shaped as desired for interfacing to the nerve.</u> Most commonly, the electrode is curved into a small hook. A small tab of silicone adhesive has been placed on the distal portion to prevent fraying.

Figure 2: F50-W-F2 Lead/Electrode

3.1.3 Transmitter Use

Like other DSI transmitter models, the F50-W-F2 contains a magnetic switch to turn it on and off. When the device is ON, an audible tone can be heard with the custom radio tuned to 18MHz. **This tone will sound very different from a standard DSI device. The pitch starts out very soft and then ramps up to a high-pitched tone.** The tone can be difficult to distinguish, but the F2 carrier light on the receiver can also aid in determining if the device is on or off. Please see the Appendix for details on using the radio and tuning it to the appropriate frequency. If a second DSI transmitter is implanted in the subject, the same magnet can be used to turn it on and off. Using the magnet can inadvertently turn the unintended device on or off so it is important to observe the both carrier lights on the receiver to ensure the devices are in the correct mode.

3.2 RPC-3 Receiver

The RPC-3 receiver can receive data from a F50-W-F2 transmitter simultaneously with another DSI transmitter implanted in a single animal. Essentially, the RPC-3 consists of two independent receivers contained within the same housing. The RPC-3 receiver is required regardless if you are using just the F50-W-F2 alone or with another DSI transmitter. The RPC-1 receiver that is used with most rodent transmitter models will not function with the F50-W-F2 transmitter.
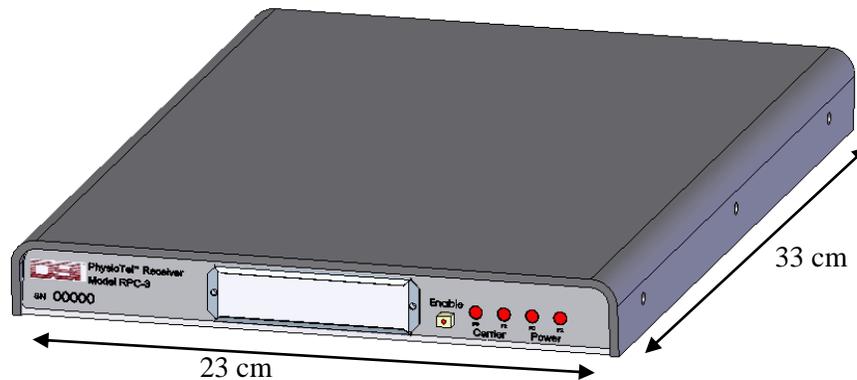
Figure 3**: RPC-3 with dimensions**

The front panel of the RPC-3 has two power lights and two carrier lights each designated with either 'F0' or 'F2' (see Figure 4). F0 corresponds to 455KHz as received from standard DSI transmitter. F2 corresponds to 18MHz as received from an F50-W-F2. The back panel of the RPC-3 has two RJ45 jacks labeled with 'J0-OUTPUT' and 'J2-OUTPUT' (see Figure 5). Either or both jacks may be used depending on how many transmitters are implanted in the subject being monitored. System setup options are described in Section 4.

Figure 4: RPC-3 Front Panel
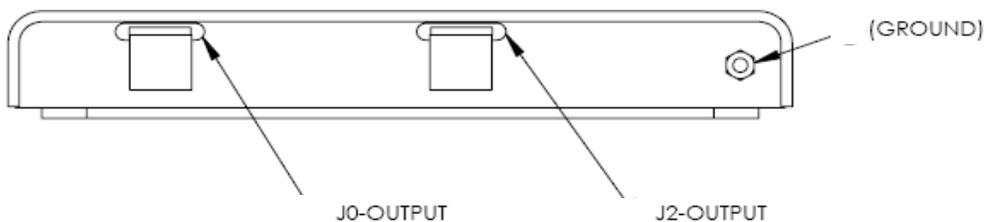
Figure 5: RPC-3 Back Panel

3.2.1 Placing Cage on RPC-3

As with any rodent telemetry device, the cage material should be non-metal to allow the signal transmission from the implanted transmitter to travel to the RPC-3 receiver. The cage should be centered over the receiver to optimize receiving coverage. A maximum cage size of 42x42x18cm (length x width x height) is allowed per receiver. When using Dataquest A.R.T or OpenART acquisition software, additional RPC-3 receivers can be configured as a Distributed Receiver Array (DRA) to cover a larger cage area if necessary. Please consult the Dataquest A.R.T. manual for instructions on configuring a DRA.

3.2.2 Enable Switch

The enable button is located on the front panel adjacent to the carrier and power lights. This switch is used to temporarily disrupt data transmission to the acquisition software. It also controls the carrier lights but has no affect on the power lights which remain on regardless of switch setting as long as the RPC-3 is connected to the DEM. When the switch is enabled (lighted) and a signal is present, the carrier lights will illuminate and data will be transmitted. When the switch is disabled (unlighted), the carrier lights will be off and no data will be transmitted. If a cage is removed from the receiver (i.e. for dosing) while data acquisition is running, DSI recommends disabling the receiver so wrong data is not acquired. There is no need to interact with the acquisition software when doing so. Sampling will resume once the receiver is enabled.

3.2.3 Grounding jack and cable

The back panel of the RPC-3 receiver contains a circular grounding jack. This jack is used to ground the RPC-3 receiver to a metal shelf or other conductive surface. A grounding cable is provided with each RPC-3 receiver. One end of the cable has a 'banana' plug to be inserted into

this jack and the other end contains a clip for attachment to a metal surface, such as the cage rack or a shield. Grounding the receiver can reduce noise in certain environments.

3.3 DL11 Analog Adapter

The DL11 provides an analog signal output for the F50-W-F2 transmitter. Specifically, it provides the raw electroneurogram (ENG) signal. The analog output is provided via the BNC connector on the front panel (see Figure 6). The BNC cable provided can be used to connect it to a 3rd party A/D platform. A BNC splitter is also provided to allow the analog output to be split into two sources. The most common application for this is when an amplified speaker is used during surgery and it is also desirable to view the waveforms on an oscilloscope or in acquisition software.

Near the BNC jack is small hole containing a gain adjustment potentiometer. <u>When the DL11 is shipped the gain has been preset to approximately 100 times (100x) the calibration value associated with the specific F50-W-F2 transmitter.</u> For example, if the calibration value on the transmitter is 400.3, the gain applied in the DL11 will be approximately 4000. A signal input of 10uV would have an output of 40mV.   The gain can be adjusted using a small screw driver and the gain can range from approximately 50 to 200 times the transmitter calibration value.

Figure 6: DL11 Front Panel   **Figure 7: DL11 Back Panel**

3.3.1 DL11 Use

The DL11 connects directly to the RPC-3 receiver via the 'To Receiver' jack on the back panel (see Figure 7). It is not necessary to connect the DL11 to a Data Exchange Matrix (DEM); it can be used independently. When used without a DEM, a power supply must be connected to the back panel.

It is possible to obtain an analog signal and acquire data simultaneously with DSI's acquisition software via the DEM. Connect one end of the LAN cable provided to the 'To DEM' jack on the back panel of the DL11 and connect the other end to a free jack on the DEM. The analog output is provided via the BNC jack on the front panel of the DL11. It is not necessary to have a separate power supply with this scenario. More details on this configuration are provided in Section 4 part D.

Analog output devices are available for some additional DSI transmitter models such as the PA-C40. Configuring the system with an R11CPA pressure analog output adapter is described in Section 4 part B.

3.4 Amplified Speaker – Optional

The amplified speaker provides an audible tone of the analog nerve signal. This audio feedback can aid with optimizing the electrode placement during surgery. The amplified speaker provided by DSI uses the analog signal provided by the DL11 as the input. Other off-the-shelf speakers that accept an analog input may also be used. The cable provided with the speaker has a 3.5mm jack on one end to connect to the 'Input' jack on the front panel (see Figure 8). The other end of the cable includes a BNC jack for interfacing to the DL11 (or the BNC splitter, if used).

A power supply is provided with the speaker and also connects to the front panel. The ON/OFF button must be in the ON position (in) to hear the tone. The volume knob can be adjusted to the desired level.

**Figure 8: Amplified
Speaker Front Panel**

4. System Configurations

There are several ways the hardware can be configured for monitoring sympathetic nerve activity (SNA) and obtaining an electroneurgram (ENG) signal. Obtaining an analog signal to use with a 3rd party acquisition platform is the most common method. This section describes four scenarios and shows the configuration for one subject. Please contact DSI Technical Support for more information on these configurations or if other options are preferred.

A. F50-W-F2 (ENG) via Analog Output with Optional Amplified Speaker
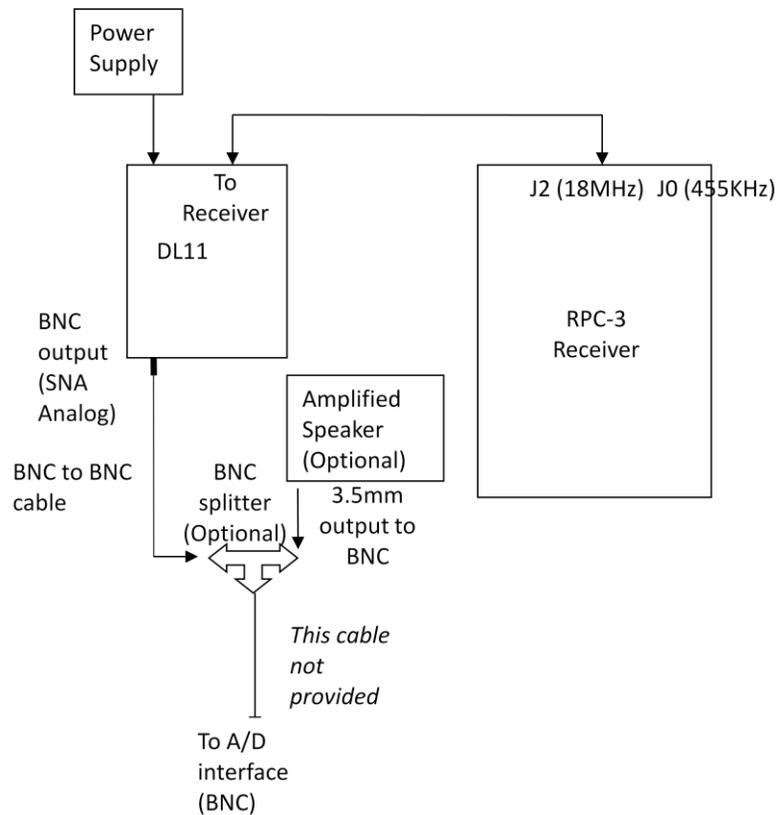
Figure 9: System configuration with analog output

1. Connect the power supply to the back panel of the DL11 adapter.
2. Connect the supplied LAN cable to the jack on the back panel of the DL11 labeled 'To Receiver'.
3. Connect the opposite end of this cable to the 'J2' jack on the back panel of the RPC-3 receiver.
4. Connect the supplied BNC cable to the CH1 jack on the front panel of the DL11. Route the BNC connector to the analog input for your acquisition system.
5. Optionally, the BNC cable can be connected to the supplied BNC splitter. One output from the BNC can be connected to the analog input for your acquisition system and the other output can be connected to the Amplified Speaker.
   a. Connect the power supply to the speaker (not shown in above diagram).
   b. Connect the supplied cable with 3.5mm jack to the front panel of the speaker. The opposite end of the cable is a BNC connected to the BNC splitter.
   c. 1 of the 2 remaining splitter connections can be used to go to an oscilloscope or an A/D converter for an acquisition system.
6. Repeat steps 1 through 4 for additional subjects.

B. F50-W-F2 (ENG) and PA-C40 (blood pressure) via Analog Output
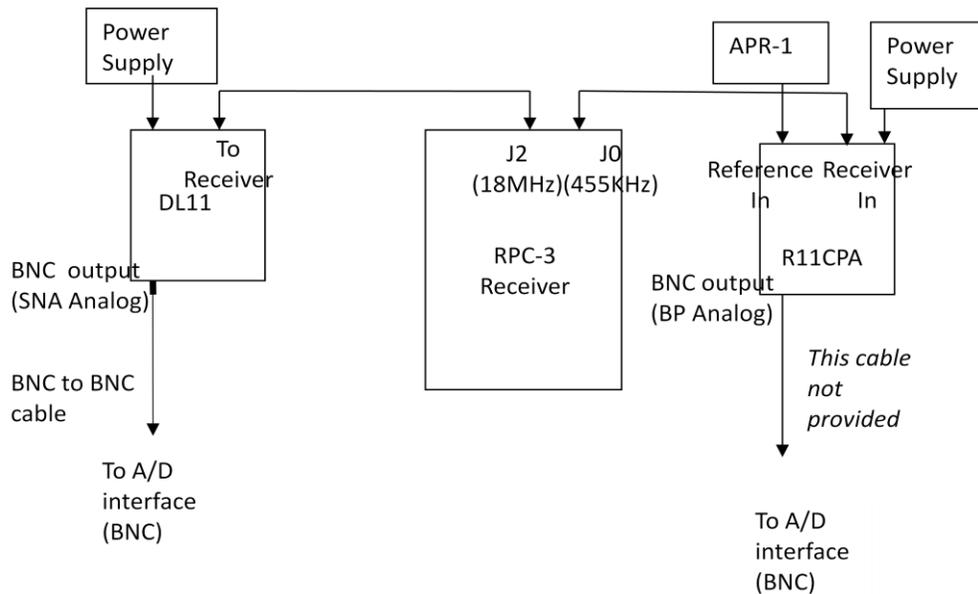
Figure 10: System configuration with analog output including blood pressure

1. Connect the power supply to the back panel of the DL11 adapter.
2. Connect the supplied LAN cable to the jack on the back panel of the DL11 labeled 'To Receiver'.
3. Connect the opposite end of this cable to the 'J2' jack on the back panel of the RPC-3 receiver.
4. Connect the supplied BNC cable to the CH1 jack on the front panel of the DL11. Route the BNC connector to the analog input for your acquisition system to acquire the ENG signal.
5. Optionally, an audio speaker can also be added to the configuration. Please see step 5 in section A above for more information.

The R11CPA adapter is used to provide a calibrated analog pressure signal from a PA-C40 transmitter. Please see the R11CPA user manual supplied separately for more detailed information on configuring the device.

6. Connect the power supply to the back panel of the R11CPA adapter.
7. Connect the supplied LAN cable to the jack on the back panel of the R11CPA labeled 'Receiver In'.
8. Connect the opposite end of this cable to the 'J0' jack on the back panel of the RPC-3 receiver.
9. Connect the Ambient Pressure Reference (APR-1) to the jack on the back panel of the R11CPA labeled 'Reference In'. *Note: it is possible to use the R11CPA without an APR-1. Please see the R11CPA user manual for more information.*
10. Reference the R11CPA user manual for information on the position of the white switches on the front panel. In general, they should be in the following positions:
    a. S1 in the 'Norm' position (down)
    b. S2 in the 'Cal2' position (up)
    c. S3 in the 'Norm' position (down)
    d. S4 in the down position

11. Adjust the thumbwheel dials on the front panel based on the calibration values of the PA-C40 transmitter specifically paired with the R11CPA. Reference the formulas that are provided on the front panel.
12. Connect a BNC cable to the output jack on the front panel of the R11CPA. Route the BNC connector to the analog input for your acquisition system to acquire the blood pressure signal.
    a. The analog output provided is calibrated such that 1V=0mmHg and 2V=100mmHg.
13. Repeat all steps when configuring an additional subject. However, only one APR-1 is needed. It can be daisy-chained from the first R11CPA by connecting a LAN cable from the 'Reference Out' jack of the previous R11CPA to the 'Reference In' jack of the next R11CPA.

C. F50-W-F2 (ENG) and PA-C40 (blood pressure) with Dataquest A.R.T. or OpenART
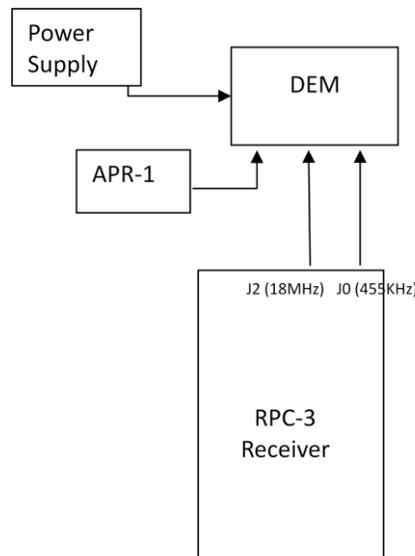
Figure 11**: System configuration using Dataquest A.R.T.**

1. Ensure the power supply is connected to the Data Exchange Matrix (DEM).
2. If you are monitoring blood pressure (i.e. with PA-C40 transmitter), connect an Ambient Pressure Reference (APR-1) to one of the A jacks on the DEM.
3. Connect one LAN cable from any of the C or B jacks on the DEM to the 'J2' jack on the back panel of the RPC-3. This connection will be for the F50-W-F2 transmitter.
4. If another DSI transmitter (i.e. PA-C40) is used in the same subject, connect the other LAN cable from any of the C or B jacks on the DEM to the 'J0' jack on the back panel of the RPC-3.
5. Repeat steps 1-4 for additional subjects.
6. Reference Section 5 for instructions on configuring the software.

Note: There is a limitation in the Data Exchange Matrix (DEM) whereby only <u>one F50-W-F2 transmitter can be sampled at any given time on each DEM</u>. However, other DSI transmitters can be configured and sampled simultaneously (up to four continuous sources per DEM). Scheduled sampling may permit multiple F50-W-F2 transmitters to be used. Please contact DSI Technical Support to discuss configuration and sampling options.

D. F50-W-F2 (ENG) via Dataquest A.R.T with Amplified Speaker (via Analog Output)

This setup is typically used for surgical placement when acquiring the data with Dataquest A.R.T. and there is a preference to also hear the nerve signal with an amplified speaker.
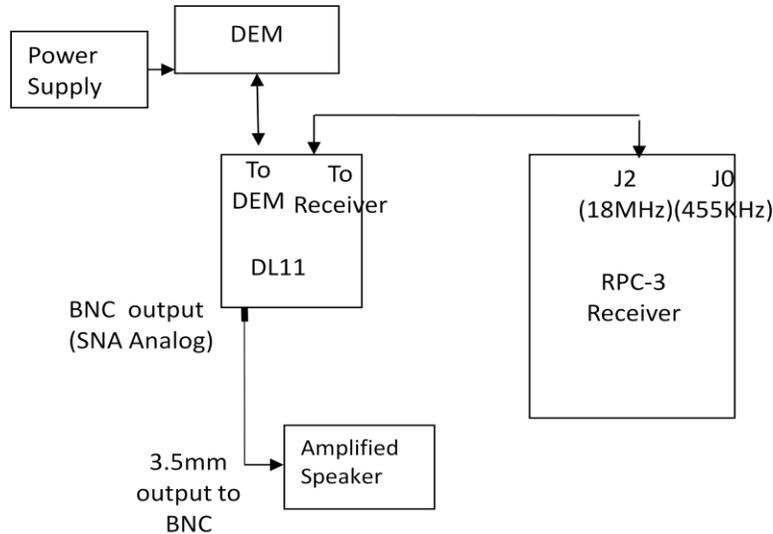
Figure 12: System configuration using A.R.T. and analog output

1. Ensure the power supply is connected to the Data Exchange Matrix (DEM).
2. Connect one LAN cable from any of the C or B jacks on the DEM to the 'To DEM' jack on the back panel of the DL11.
3. Connect one LAN cable from the jack on the back panel of the DL11 labeled 'To Receiver' to the 'J2' jack on the back panel of the RPC-3 receiver.
4. Connect the power supply provided with the Amplified Speaker (not shown on diagram above).
5. Connect the supplied cable from the 3.5mm jack on the Amplified Speaker to the BNC connector on the DL11.

Note:
- A power supply does not need to be connected to the DL11 when it is connected to a DEM.
- This configuration causes the receiver to not be recognized automatically by A.R.T. Acquisition. Specific instructions for configuring the receiver are described in Appendix D.

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5. Configuring A.R.T. 4.3 Acquisition

This section describes the specific steps required to configure an F50-W-F2 transmitter in Dataquest A.R.T. Please reference the Dataquest A.R.T. user manual for more detailed information on using the program. Versions prior to 4.3 do not support the transmitter and receiver models. Please note that if you have the RPC-3 receiver connected to both a Data Exchange Matrix and a DL11 analog adapter, there are special instructions for the configuration. Please see Appendix D.

1. Connect the hardware as described in the previous section.
2. In A.R.T. 4.3 Acquisition, go to **Hardware|Configuration.**
3. The RPC-3 receiver(s) that are connected should appear automatically. A single receiver will appear twice if both cables are connected from the J0 and J2 jacks to the Data Exchange Matrix. The **RPC-3 F2** receiver definition is used with the F50-W-F2 transmitter and the **RPC-3 F0** definition is use with most other rodent transmitter models.
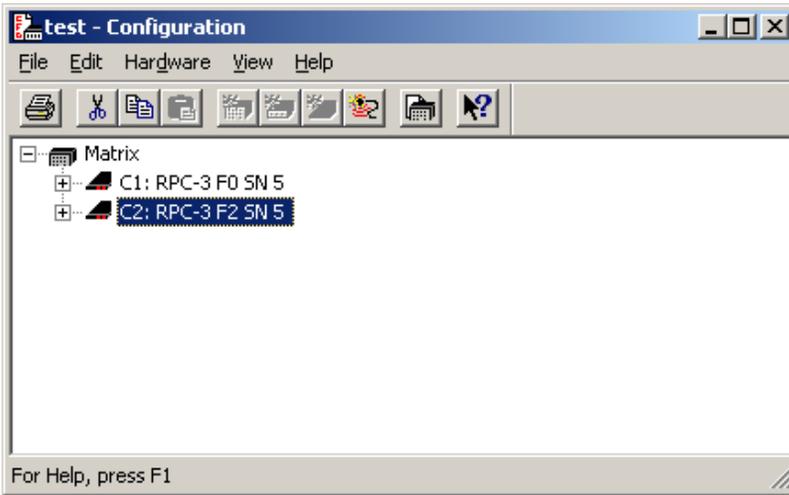
4. Right-click on the RPC-3 F2 receiver model and select **New Transmitter…** Select the **F50-W-F2** transmitter model from the list of available transmitters and enter the corresponding serial number found on the sterile package. Select **Next>**
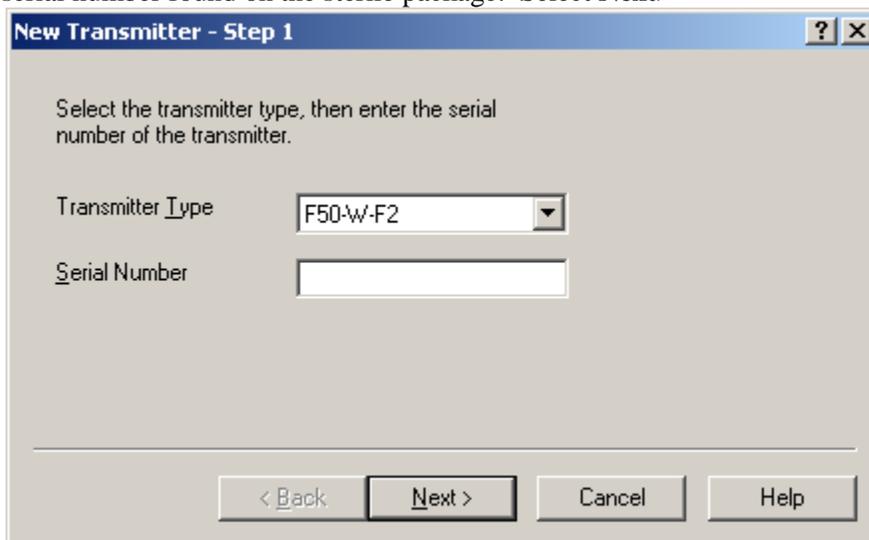
5. Select the appropriate species (i.e. Rat) and enter a unique **Animal ID** name followed by **Finish.**

6. Enter the unique calibration value found on the transmitter's sterile package. The default signal type is **ENG.** The sample rate and filter cutoff can be adjusted by selecting the 'Signal' tab in this same window. Select **OK** and the transmitter is now configured.
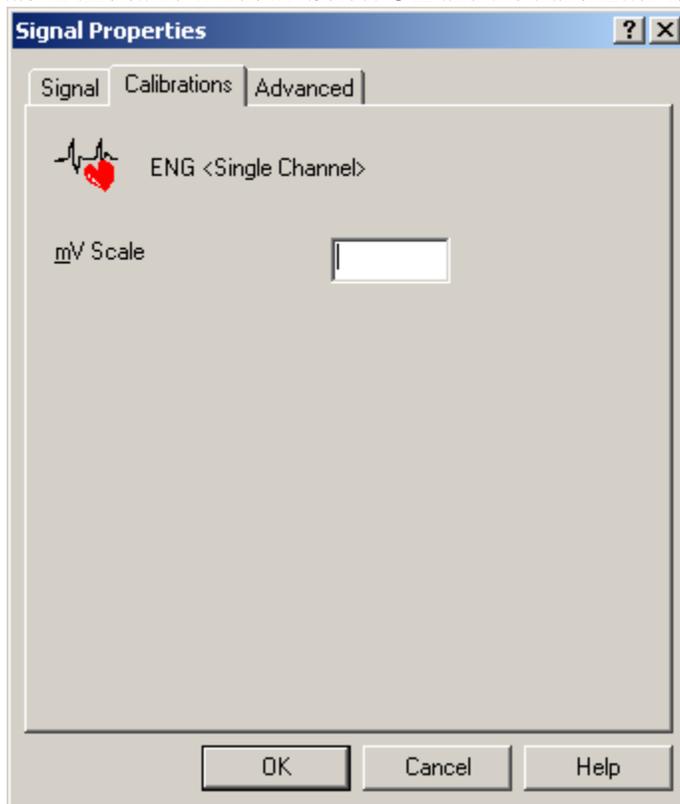
7. If applicable, configure additional transmitters and select File|Exit when finished.
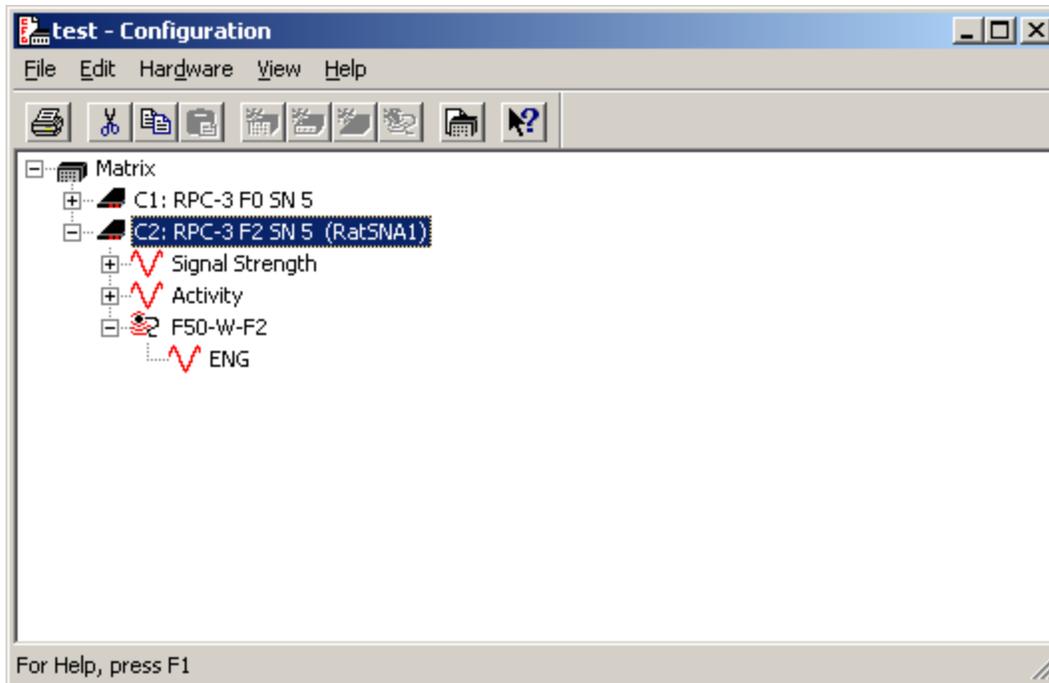
8. In the main Acquisition window, the subject's Source Settings can be accessed by double-clicking the row. These settings are used to configure which waveforms and parameters are saved and the sampling protocol.
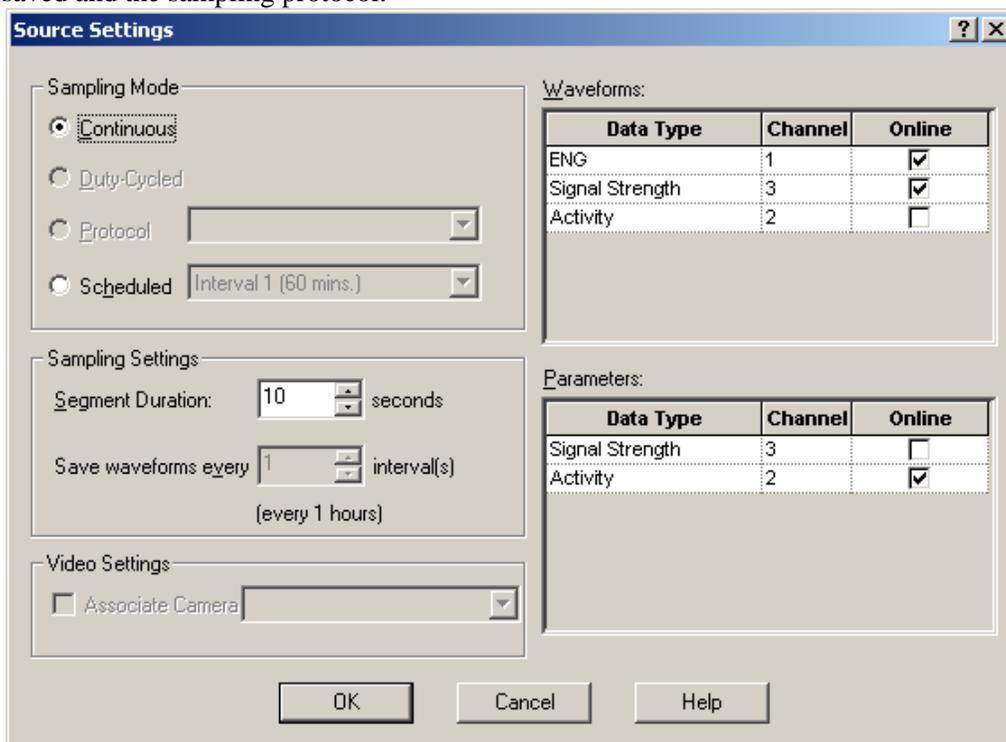
9. Right-click on the subject to begin sampling.

6. Dataquest A.R.T. Analysis Tools

This section describes the basic analysis tools for the electroneurogram (ENG) signal in Dataquest A.R.T. Analysis. The steps described produce an averaged ENG signal through boxcar filtering. This processed signal is similar to a rectified, integrated ENG signal and can be plotted simultaneously with other parameters, such as blood pressure, acquired from the same subject.

Please refer to the Dataquest A.R.T. user manual for more information on using the program. Additionally, data acquired in Dataquest A.R.T. can be exported in ASCII format for analysis in another program.

1. Load the ENG waveforms and other signals (optional) associated with the subject based on the animal ID names chosen for each device.
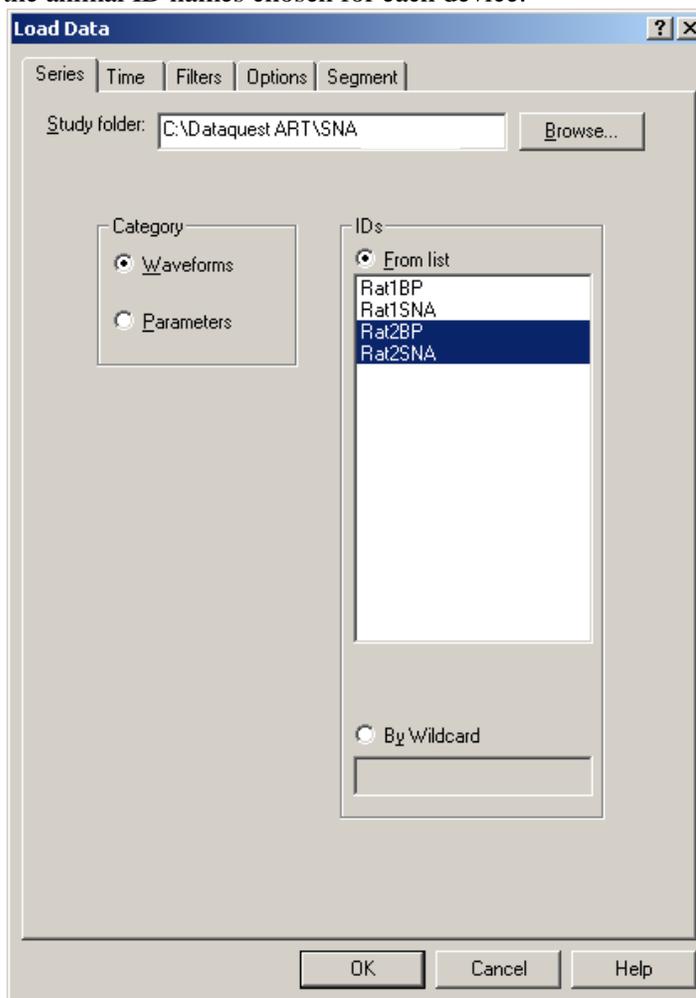
Choose the 'Segment' tab to specify the desired segment duration for plotting if different than what was used when acquiring the data.

2. Select the ENG signal and right-click to access the analysis functions. Choose **Filtering Actions | Highpass…**
3. Select a highpass low end frequency cutoff of 100Hz
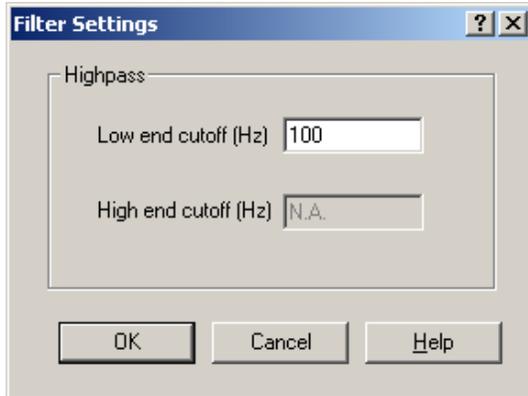
4. Select the resulting data series '*AnimalID*.EMG.Highpass', right-click and choose **General Actions | Full Wave Rectification**
5. Select the resulting data series '*AnimalID*.EMG.Highpass.FWRectifier', right-click and choose **Filtering Actions | Boxcar…**
6. Select a **Pass Mean** filter type and **100msec** averaging interval
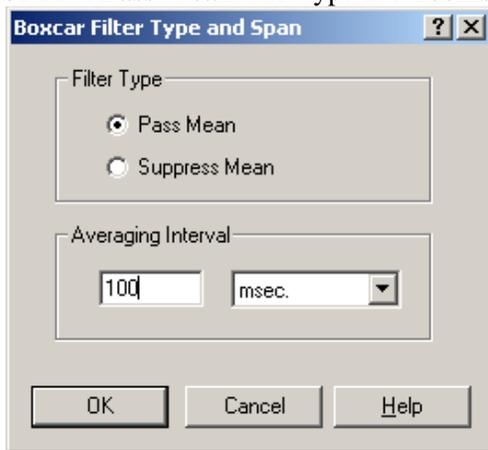
7. Select the resulting signal '*AnimalID*.EMG.Highpass.FWRectifier.Boxcar. If desired, hold the Control key while also selecting the raw nerve data series (EMG) and the blood pressure data series. Right-click and choose **Display Actions|Plot…**
8. Plot by 'Series order' for each trace to appear with a separate axis

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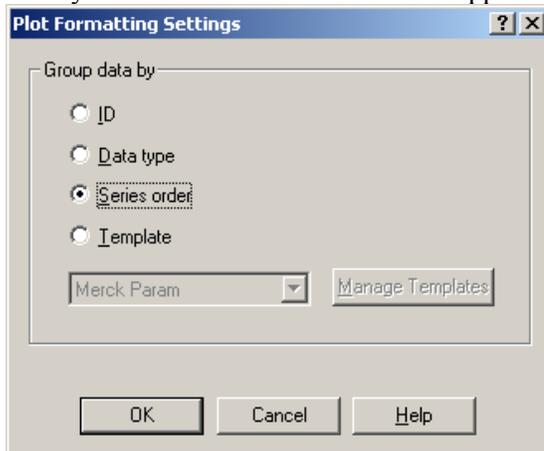
9. Manually adjust the axis range by double-clicking the y-axis if desired
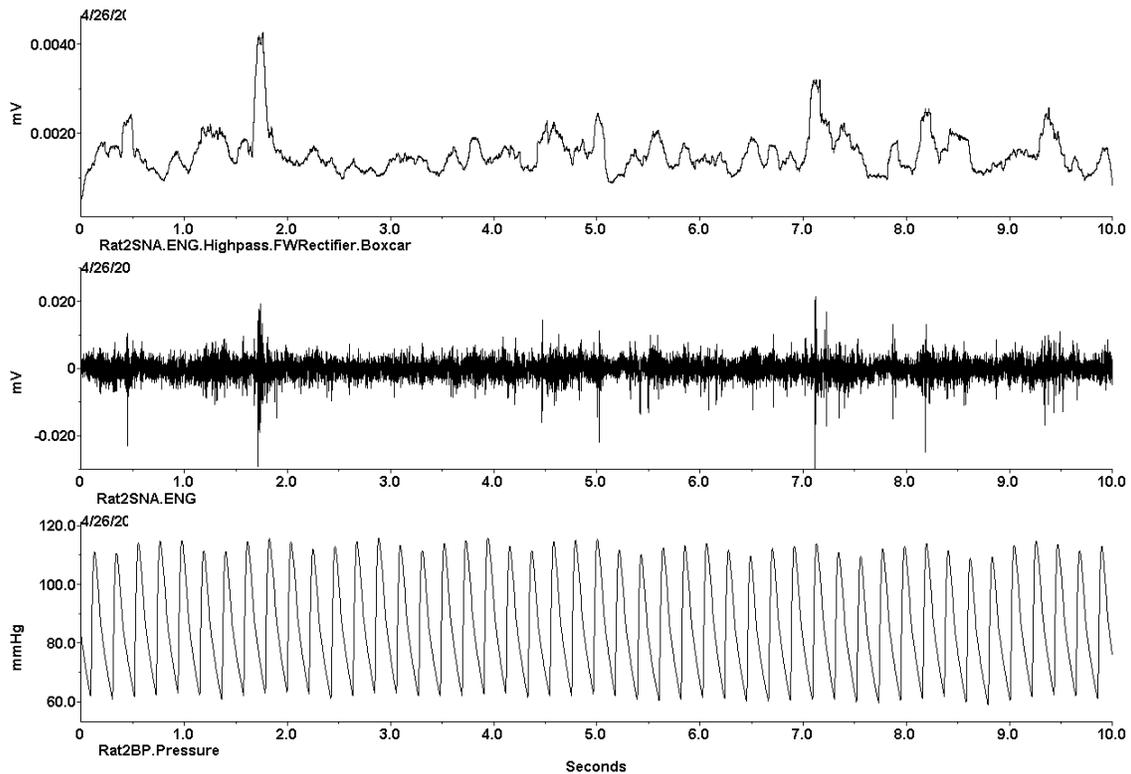
Figure 13: From top to bottom: Processed ENG signal, ENG waveform, Blood Pressure waveform

10. Press the page down/page up key to scroll through the data set by segment

Additional background:
Boxcar filtering (with window 100 msec) achieves similar effect as signal analog averaging. According to the article [1] it is one of the methods of quantifying neural activity. The scale of the boxcar filtered (i.e. moving averaged) signal is different from the integrated signal. However, if the data is presented in arbitrary units and normalized – this might not be a problem.

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[1] F. A. Hoff, et. al. Comparison of four methods of averaging nerve activity. *Am J Physiol Regulatory Integrative Comp Physiol* 251:700-711, 1986.

7. Surgical Recommendations

At this time, DSI does not offer complete surgical instructions for placing the electrode for chronic SNA monitoring. Additional information will be made available as soon as possible.

- Manipulate the nerve as little as possible. Use a glass hook to place the nerve on the electrode.
- Placing a small piece of Parafilm® under the nerve can help prevent moisture from shorting the electrical connection between the electrode and the nerve. The ground electrode can be tucked under the Parafilm® if it is placed near the sensing electrodes.
- Carefully dry the nerve and electrodes completely using sterile absorbtion materials like cotton-tipped applicators, absorption triangles, or Kimwipes® before encasing the region in a silicone elastomer adhesive to secure the electrode to the nerve. Commonly used adhesives are Kwik-Sil and SilGel®.
- Make sure that the silicone completely surrounds the nerve on the electrode. If the silicone is not viscous enough it will not protect the nerve/electrode interface. If the silicone is too viscous, gaps can be created which will allow moisture to short the electrical connection. Allow the silicone to cure completely (follow manufacturer's directions).
- Anchor the cured silicone region to the underlying tissue using a small amount of cyanoacrylate fast-acting adhesive (i.e. Super Glue) on each edge to help stabilize the nerve/electrode interface when there is movement.
- After securing the electrode region, anchor the lead body multiple times to surrounding tissue with non-absorbable suture to protect the electrodes from movement strain.
- It is recommended that the F50-W-F2 is placed subcutaneously on the back. (If another DSI transmitter is used in the same subject, it can be placed intraperitoneally. Suture aids are provided on either side of the transmitter body to anchor the device in place to prevent strain on the lead due to movement. Typically, only one suture rib is used depending on the transmitter placement and which side is accessible.
- Avoid incisions that go directly over the transmitter. Instead, create a subcutaneous pocket on either side of the incision for the transmitter body. The pocket should be formed by using small, blunt-tipped, dissecting scissors.
- Size the pocket according to the dimensions of the device, an excess of dead space in the pocket may result in seroma formation. However, if the pocket is too small, it can lead to pressure necrosis.
- After the pocket is made, irrigate it with sterile saline and insert the transmitter into the pocket. Close any remaining dead space in the subcutaneous pocket with absorbable suture under the skin. This will reduce the incidence of seroma formation.
- Close the dorsal skin incision with suture or wound clips.

Appendix A: Modified Radio

The F50-W-F2 transmits using different frequency (18MHz) than most other DSI transmitters. As a result, a different radio must be used to verify if the transmitter is on or off. The same radio can also be used with a standard DSI transmitter (455KHz). Please refer to the instructions supplied with the GP-4L radio for additional information.

Transmitters are shipped in the OFF mode and the battery in the transmitter is not activated. However, DSI recommends verifying the device did not turn on during shipment prior to storing the transmitter. See Section 3.1.3 for more information on turning the transmitter on and off.

1. To activate the F50-W-F2 transmitter:
   a. Slide the switch on the left-hand side of the radio to the 'S2' position
   b. Turn on the radio
   c. Tune the radio so the display reads 18.00 MHz
   d. Use the magnet to activate the transmitter (see F50-W-F2 section). A tone should be heard with the radio.
2. To activate a standard DSI transmitter (i.e. PA-C40):
   a. Slide the switch on the left-hand side of the radio to the 'MW' position
   b. Turn on the radio
   c. Tune the radio so the display reads 455 KHz
   d. Use the magnet to activate the transmitter. A tone should be heard with the radio.

Appendix B: Onsite Sterilization and Transmitter Reuse

The F50-W-F2 can be reused in multiple subjects provided there is sufficient length of electrode and battery life for another implantation. This section provides recommendations for cleaning the transmitter, preparing new electrodes, and resterilization. Please note that a lead coupler kit for this transmitter model does not exist. When the lead becomes too short for additional uses, it must be returned to DSI for refurbishment.

1. The lead can be cut to remove the transmitter from a subject. Take care to cut the lead as close as possible to the nerve/electrode interface to preserve the lead length. After the transmitter has been removed from the previous animal, rinse the transmitter with tap water.
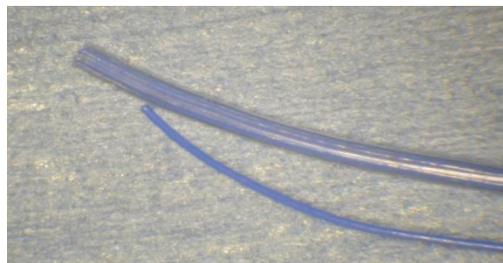
Figure 14: F50-W-F2 transmitter leads cut for removal from a subject

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2. Tie a piece of suture tightly around the end of the leads to prevent any moisture or cleaning fluids from migrating inside. For the two sensing leads, the suture can be tied around the silastic tubing that bundles them together. For the common wire, the suture can be tied around the blue Teflon as shown in Figure 15.
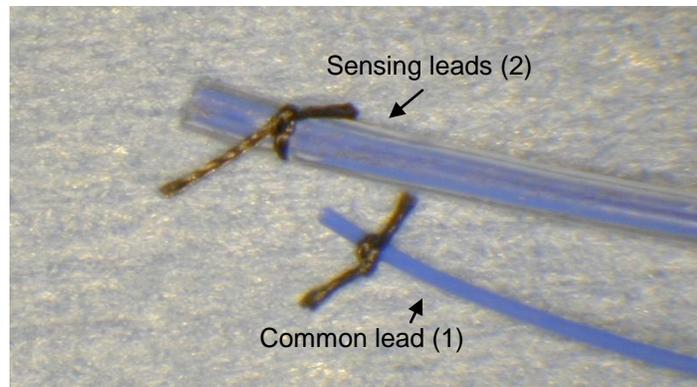
Figure 15: Sutures are tied to the ends of the leads to prevent fluid from migrating inside

3. Clean the transmitter using one of the recommended enzymatic detergents. See www.datasci.com for complete cleaning instructions. Sterilization will occur in a later step.
4. After cleaning the transmitter, cut the leads just proximal to the sutures to expose a fresh piece of lead. Discard the cut portion including the suture.
5. Using a new scalpel blade, score and remove the Silastic tubing covering the sensing electrodes approximately 3.0 mm back from the end of the lead. Next, use the scalpel blade to score and remove 2.5mm of Teflon from each lead (including the common lead) to expose the multi-stranded stainless steel wire. Wearing gloves makes handling the Teflon easier.
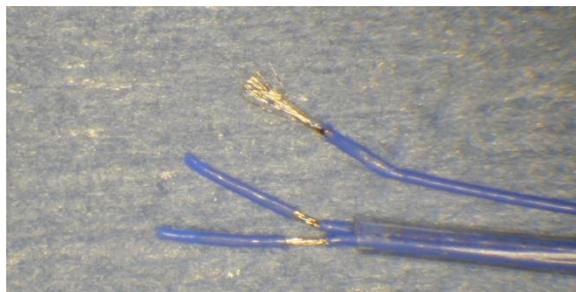
Figure 16: The Teflon is stripped from the distal portion of the leads to expose the wire and create the electrode to interface to the nerve

6. While holding one lead at the Teflon coated region, use a pair of forceps or hemostats on the end of the exposed region and rotate while applying slight tension. This will twist the individual wires from each lead together to minimize fraying. Twist a little of the wire, release the forceps and then twist more until the entire length of exposed wire is tightly twisted together.
7. Apply a very small amount of NUSIL MED-1511 Medical Adhesive (PN 002464-001) to the end of the wire to secure the twist. Be sure to apply the NUSIL in the same direction as the twist of the wire to prevent the wire from unwinding.
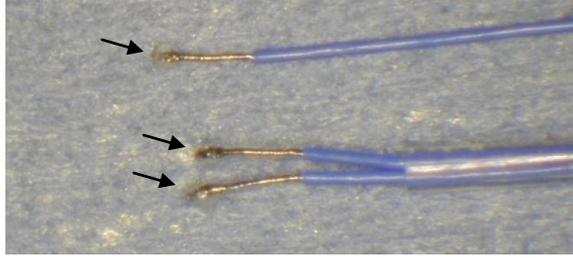
Figure 17: Nusil silicone adhesive applied to the ends of each lead to minimize fraying

8. Repeat steps 6-7 for the remaining two leads.
9. Allow the NUSIL to cure overnight.
10. Follow resterilization steps found at www.datasci.com. Before placing the lead in the sterilant, tie a suture around the end of the Teflon again to prevent fluid from seeping up the lead. The suture can remain on the lead while it is implanted to minimize bodily fluids from traveling up the lead.

Appendix C: Shielding Recommendations

The F50-W-F2 transmitter transmits the signal using a different frequency (18MHz) compared to existing DSI PhysioTel™ transmitters. Ambient noise characteristics at this frequency may be different than standard DSI transmitters and the use of shielding reduces the amount of ambient noise that is acquired by the RPC-3 receiver. The use of shielding between vertically and horizontally placed cages also reduces the device transmission range and potential for cross-talk. Due to the sensitivity of the ENG signal to noise, DSI highly recommends using shielding to optimize the signal quality.

There are a number of ways to shield cages to prevent electromagnetic noise interference in the data. Shielding can be used around individual animal cages and also around Data Exchange Matrices and other hardware used near the receivers. The shielding material should consist of conductive metal such as copper, stain-less steel, or aluminum. A sample shield is shown in Figure 13. This design allows for receiver cabling to exit out the back.
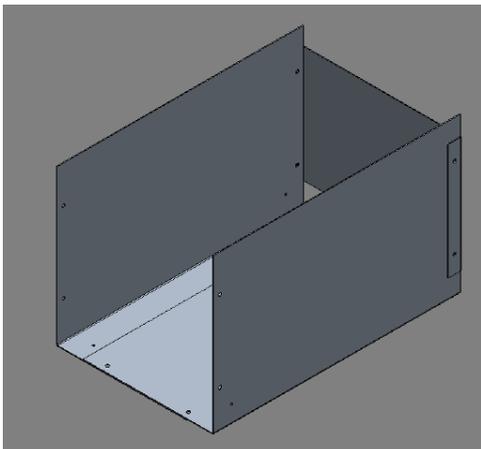
Figure 18: Example of a metal shield designed to be used around individual cages

Appendix D: Configuring Dataquest A.R.T when using the RPC-3 with a DL11 analog output adapter

This section describes the specific steps required to configure an F50-W-F2 transmitter in Dataquest A.R.T. when a DL11 analog output adapter is also used. This setup scenario is common during surgery when an amplified speaker is used while also acquiring data in the software. When the DL11 is connected to the RPC-3 receiver, the receiver is not automatically recognized by Dataquest A.R.T. In this scenario, the receiver must be configured manually as an older receiver model in order for it to be used. Please follow these steps closely.

1. Connect the hardware as described in Section 4 part D.
2. In A.R.T. 4.3 Acquisition, go to **Hardware|Configuration.** The RPC-3 F2 receiver(s) that are connected to a DL11 will not appear automatically. Note which jack on the DEM each RPC-3 F2 receiver is physically connected.
3. Click on the **Matrix** then right-click and choose **New Receiver…**
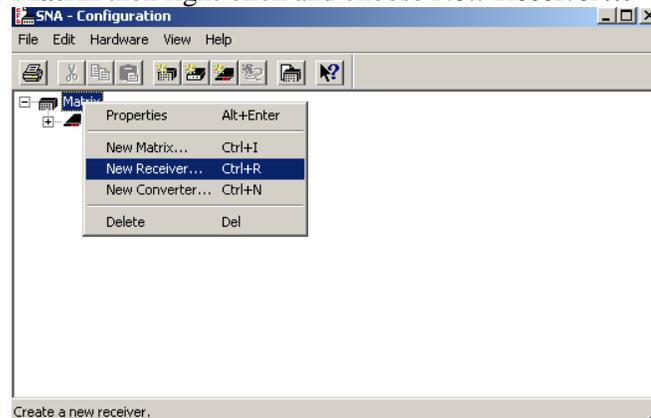
4. Select receiver type **RMC-410** and enter the serial number found on the RPC-3 that is being configured. Select **Next>**
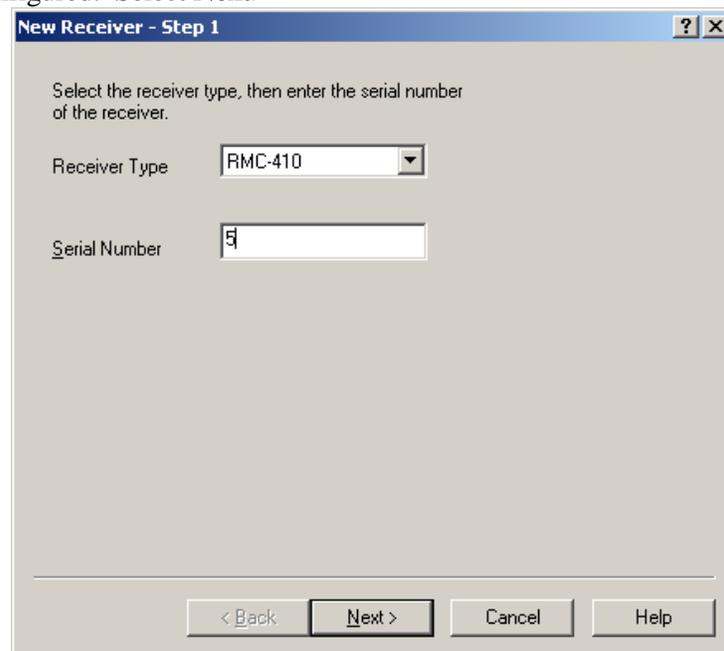
5. Choose the jack on the Matrix where the RPC-3 F2 is physically connected (example shows jack C2) then **Finish**

6. Choose **Yes** when prompted to add a New Transmitter to the receiver

7. Select the **F50-W-F2** transmitter model from the list of available transmitters and enter the corresponding serial number found on the sterile package. Select **Next>**

8. Select the appropriate species (i.e. Rat) and enter a unique **Animal ID** name followed by **Finish.**

9. Enter the unique calibration value found on the transmitter's sterile package. The default signal type is **ENG.** The sample rate and filter cutoff can be adjusted by selecting the 'Signal' tab in this same window. Select **OK** and the transmitter is now configured.

10. After the transmitter has been configured, select the RMC-410 receiver, **right-click** and choose **Properties…**
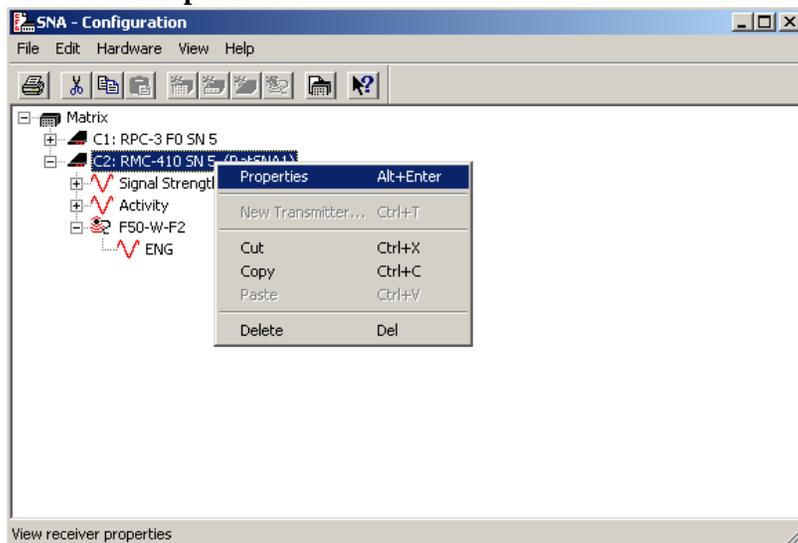
11. Change the Type of the receiver from an RMC-410 to an **RA1010,** re-enter the serial number, and select **OK**
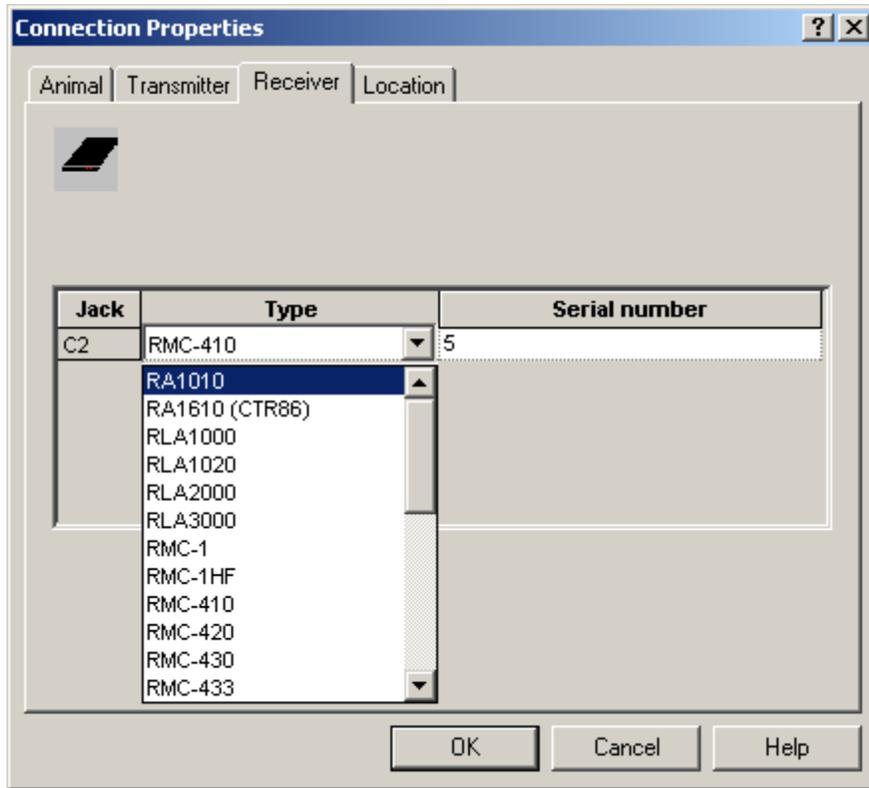
12. The receiver is now configured.
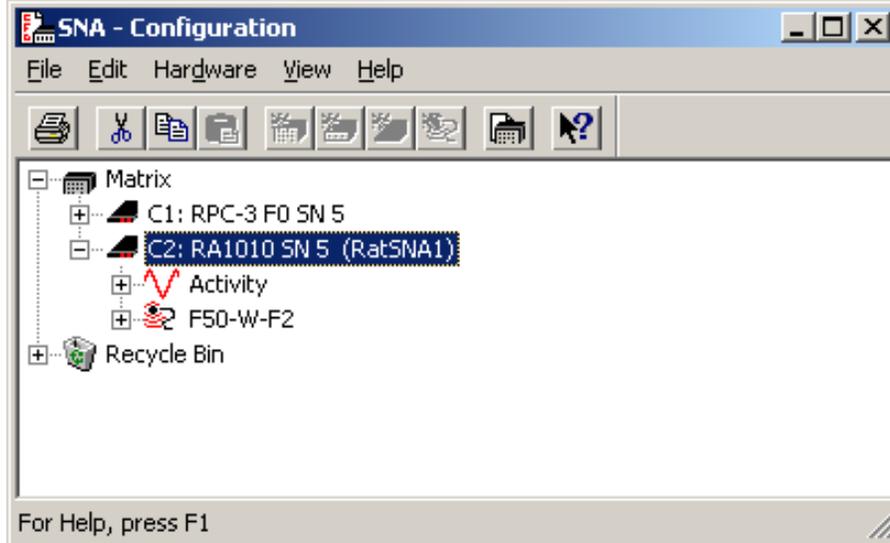
Note: If the other jack of the RPC-3 receiver (J0) is connected to the DEM, it will automatically be detected and configured as an RPC-3 F0 device. A standard DSI rodent transmitter (i.e. PA-C40) can be added to this receiver without special configuration steps. However, if an analog output device is also configured to this portion of the receiver (i.e. an R11CPA); it will need to be manually configured as an RA1010 model as well.