

# Digital Lynx SX User Manual



A Flexible, Easy to Use, Low Noise Solution  
For Electrophysiology Data Acquisition

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# 1 Document Revision History

02/28/2011	Rev1.0	Initial Creation
12/23/2011	Rev1.1	Add information on the Digital Lynx Hybrid Input Board (Section 4.3).
06/03/2013	Rev 1.2	Re-sized photos to improve formatting. 12-19-13 Corrected formatting on Page 1: changed from 2 columns to 1. No change in rev level. KB

# 2 Document Overview

This document describes the specifications and features of the Digital Lynx SX. It also explains how to setup your system, test it and start acquiring data. There is a glossary at the end of the document.



Throughout this document you will see this warning sign. An item or topic designated in a warning box is something that Neuralynx feels is important and should be carefully noted.

### 3 Digital Lynx SX Overview

The Digital Lynx SX is the next step in high performance, high density data acquisition for electrophysiology recording. Based on the mature technology of the Digital Lynx S series of systems, we have added many new features and built in the flexibility to accommodate continually improving innovation in the field of electrophysiology research.

#### **New Features**

- Automatically detects which backplane modules are inserted. This makes adding or removing Input Boards or DRS-36 effortless.
- Select from 16 kHz to 40 kHz sampling rates in 2 kHz increments.
- Four 8-Bit I/O ports available for TTLs
- Four analog outputs on two 3.5 mm stereo jacks on the Digital Lynx SX Motherboard front panel.
- Download Digital Lynx SX and backplane module firmware updates from your computer.
- Backward compatible with 10S and 4S systems. You can upgrade your 10S or 4S system to an SX.
- Two Gigabit Ethernet fiber optic links.

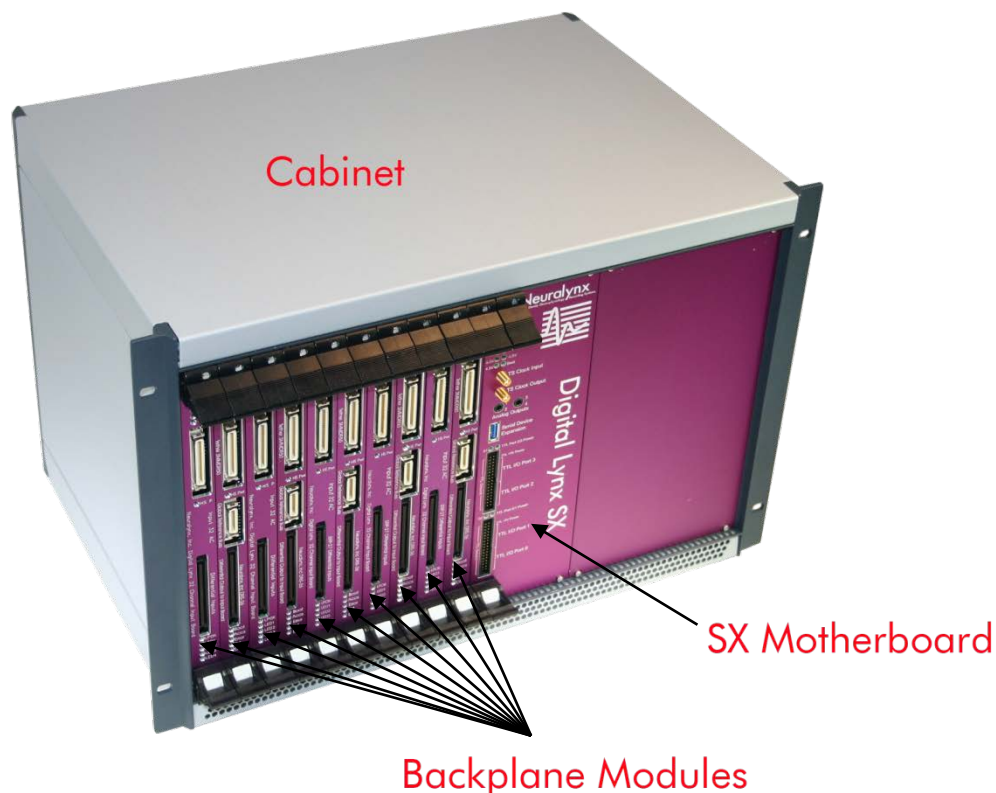
#### **Maintained Features**

- Up to 320 analog inputs per system
- Every analog input is sampled with an individual 24-bit analog to digital converter
- Analog input bandwidth is 0.1 Hz to 8 kHz
- Analog inputs are sampled simultaneously
- Analog input range is +/- 132 millivolts
- Analog inputs are fully differential inputs
- Extremely low input noise levels of 4 microvolt peak (1.3 microvolt RMS) means high quality recordings
- All referencing done by Cheetah Data Acquisition Software—up to 8 selectable references at one time

## 4 Components of the Digital Lynx SX

The Digital Lynx SX is made up of three basic components:

1. An aluminum cabinet that encloses a backplane. The backplane makes it easy and cost effective to start with a system for today's experiment that has the capacity for future experiments.
2. The Digital Lynx SX Motherboard. The Motherboard arbitrates the backplane and offers many inputs and outputs to improve the quality and complexity of your experiments. The SX Motherboard evolved the Digital Lynx S into the Digital Lynx SX.
3. Backplane modules such as Input Boards and DRS-36 plug into the SX backplane to do the work of executing your reference selections and acquiring your data. New backplane modules could be a vehicle for future developments in acquisition technology.



**Figure 4-1 Three Components of the Digital Lynx SX**

## 4.1 SX Cabinet

Using backplane modules, the Digital Lynx SX can be configured to the needs of your experiment. Two types of backplane modules are offered: Input Boards for converting your analog electrode signals to digital and DRS-36 to provide you with software controllable referencing. Unused backplane module slots can be covered with blank panels. This is a good idea as it prevents dust or other harmful materials from entering the Digital Lynx SX.

The picture below shows a 10SX with five Input Boards and five DRS-36 Boards. Each board supports 32 channels. The leftmost slot of the backplane is referred to as Slot 0 and that number increments while counting to the right. In **Figure 4-2** below, Slot 0 is occupied by an Input Board and Slot 1 is occupied by a DRS-36. Four more pairs of Input Board and DRS-36 are present to the right. Slot 10 is for the Digital Lynx SX Motherboard *only*.



**Figure 4-2 A Fully Loaded 10SX Cabinet**

Neuralynx also offers the Digital Lynx 4SX which is significantly smaller and can fit up to four backplane modules.

#### 4.1.1 Removing the SX Motherboard



The SX Motherboard should rarely be removed from the backplane. Only remove this board if instructed by a Neuralynx representative.

If it must be removed, follow these steps:

1. Remove the blank face plate to the right of the SX Motherboard by removing the four screws that secure it. This is necessary because there are cables internally connected to the SX that must be disconnected before removing the board.
2. Disconnect any cables connected to the front of the SX Motherboard.
3. There is a captive screw in the top extraction latch and one in the bottom extraction latch. Unscrew these two screws.
4. Press the white release button on both the top and bottom extraction latches.
5. At the same time, spread the top latch up and the bottom latch down to eject the board from the backplane (**Figure 4-3**). Do not yet remove the board.



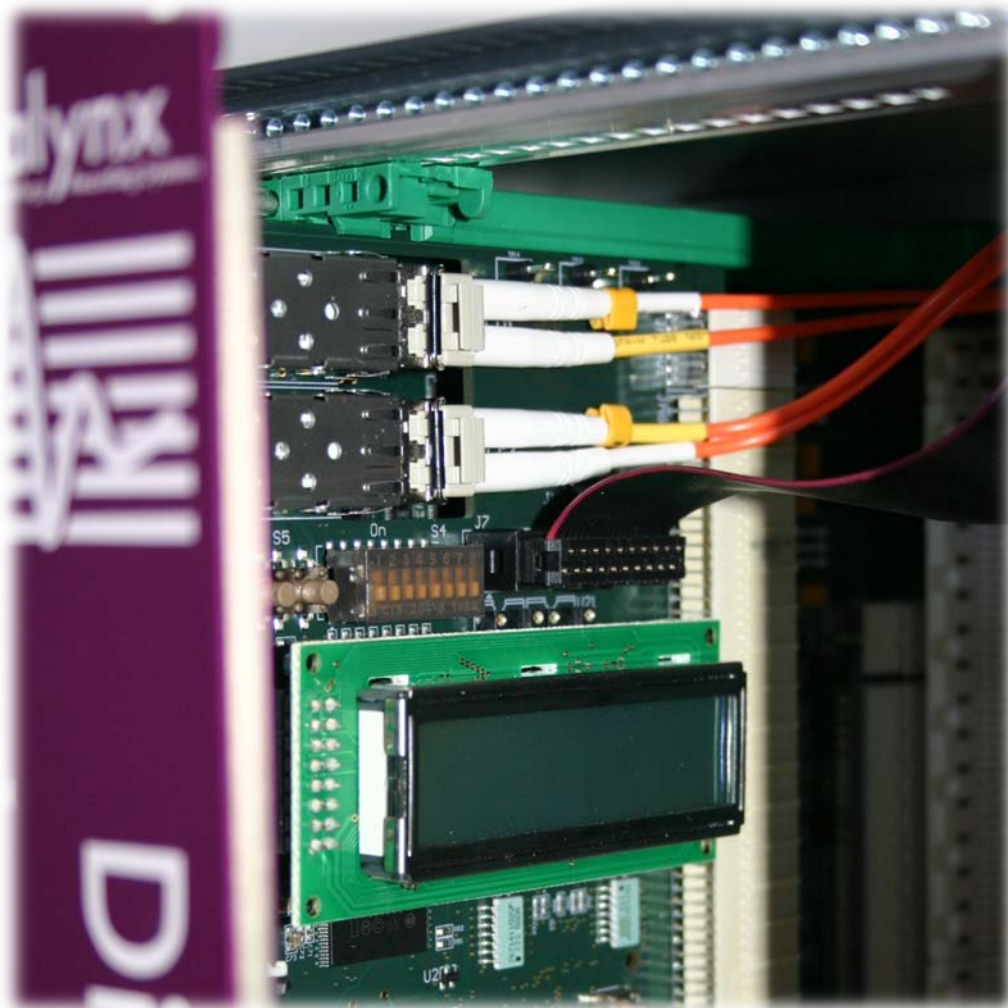
**Figure 4-3 Extraction Latch Motion for Ejecting a Module in a 4SX Model**



6. Slowly slide the board out far enough that you can disconnect the two optical fiber connections near the top of the board (**Figure 4-4**). You must squeeze the optical fiber connector release ramp to disconnect the cable. If the optical transceiver module comes loose while removing the cable, reinsert the module.

If the fiber optic connectors will be left disconnected for more than a few minutes, cover their tips with dust caps. Cover open optical ports with rubber dust covers. See **Appendix A.1** for instructions on proper care of fiber optic parts.

7. Disconnect the black, 20-pin ribbon cable which is plugged in to a 2x10 header between the LCD and the lower optical fiber connector (**Figure 4-4**).
8. After the two optical fibers and the 20-pin ribbon cable are disconnected, slowly remove the SX Motherboard from the Digital Lynx SX cabinet.



**Figure 4-4 SX Motherboard Internal Connections**

### 4.1.2 Inserting the SX Motherboard

1. Partially insert the SX Motherboard into the green slot guides leaving enough space to reach the two fiber optic cables and 20-pin ribbon cable.
2. Reconnect both fiber optic cables. The cable with a cuff labeled 1 must be plugged into the upper optical port. The cable labeled 2 must be plugged into the lower optical port.
3. Plug the 20-pin ribbon cable into the 2x10 pin header between the LCD and the lower optical cable. The 20-pin ribbon cable connector is keyed so that it can be inserted in only one way.
4. Slide the Motherboard in further until it makes contact with the backplane. Gently but firmly push on the left side of the Motherboard front panel to engage the connectors. Do not try to force the Motherboard all the way into its slot.
5. At the same time, pull both extraction latches inward (**Figure 4-5**) until each of them clicks. This ensures proper connection of the Motherboard.



**Figure 4-5 Extraction Latch Motion for Inserting a Module**

### 4.1.3 Removing a Backplane Module

1. Disconnect any cables connected to the module.
2. There is a captive screw in the top extraction latch and one in the bottom extraction latch. Unscrew these two screws.
3. Press the white release button on both the top and bottom extraction latches.
4. Spread the top latch up and bottom the bottom latch down to eject the board from the backplane.

### 4.1.4 Inserting a Backplane Module

When reinserting or adding a backplane module to your system, the extraction latch screws do not need to be screwed in. However, if transporting or shipping your Digital Lynx SX, ensure that all faceplate and extraction latch screws are gently tightened.

1. Slide the backplane module into the green slot guides until it makes contact with the backplane.
2. Push gently but firmly on the front panel of the module to partially insert it into the backplane.
3. At the same time, pull both extraction latches inward (Same as **Figure 4-3** above) until each of them clicks. This ensures the module is properly connected.

#### 4.1.5 SX Cabinet Rear Panel

The cabinet rear panel is a hinged door that is secured with three thumb screws. There are four ports on the rear panel and it is also where your Digital Lynx SX serial number is located. This door should not need to be opened but if it is, do not allow the weight of the door to rest on the cables plugged into it.

Four ports on the rear panel:

1. Main power connection (+15V)
2. Ground (Gnd)
3. Fiber Optic Data Link 1 – Required for communication with Cheetah Data Acquisition Software (DAS)
4. Fiber Optic Data Link 2 – Reserved for future use.



**Figure 4-6 10SX Rear Panel**

## 4.2 SX Motherboard



### On the SX Motherboard Front Panel

- 10 LED status indicators
- Power Switch
- Four 8-Bit I/O ports available for TTLs
- 4 Analog Outputs
- Timestamp Clock Input and Timestamp Clock Output
- Serial device expansion connector



### 4.2.1 Status Indicator LEDs

There are ten status LEDs on the SX Motherboard front panel. After SX boot up, all six LEDs in (Figure 4-7) are on.

1. **15V** – On when the 15 V power supply is plugged into the +15V port on the rear panel of your Digital Lynx SX.
2. **On** – On when the power switch is in the *On* position.
3. **5.5V** – On when 5.5 V backplane power rail is active.
4. **-5.5V** – On when -5.5 V backplane power rail is active.
5. **4.5V** – On when 4.5 V backplane power rail is active. Actual voltage range is 4.5 V to 5 V.
6. **Boot** – Indicates SX Motherboard boot status:
  - Solid on – system is configured and ready for use
  - Blinking slowly – system is booting
  - Off – system is not booting, or boot did not complete

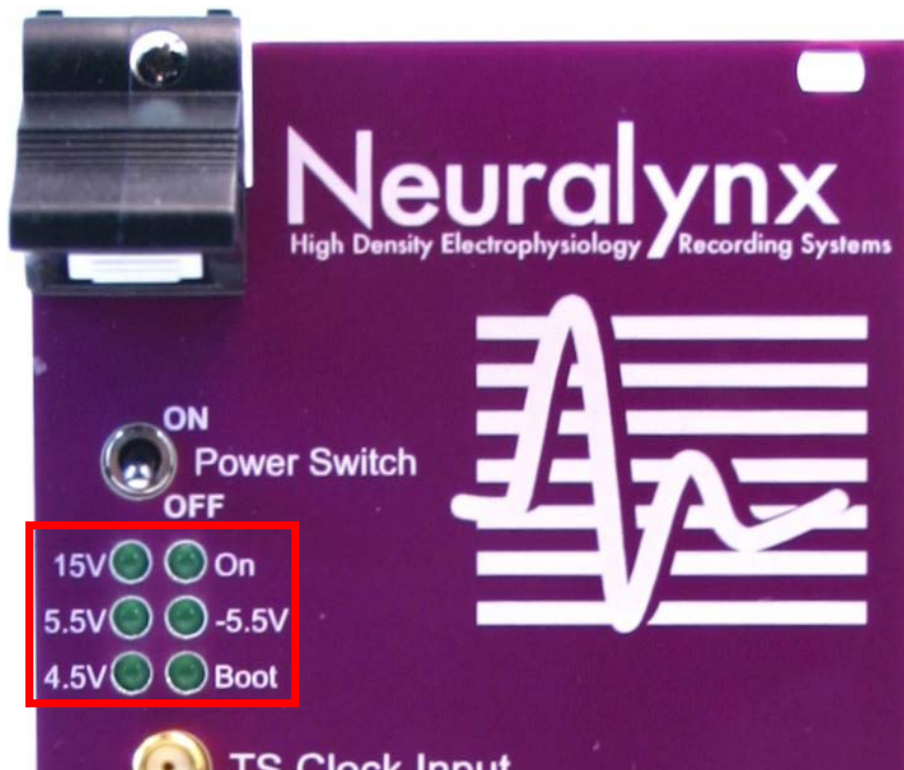


Figure 4-7 System Status LEDs

7. **TTL Port 0/1 Power** – On to indicate 5 V TTL level power is present on the top rightmost pin of TTL Port 0/1, the *lower* 34-pin connector. Off indicates this pin is not powered. This setting is configurable using an internal jumper.
8. **TTL Port 2/3 Power** – On to indicate 5 V TTL level power is present on the top rightmost pin of TTL Port 2/3, the *upper* 34-pin connector. Off indicates this pin is not powered. This setting is configurable using an internal jumper.
9. **S1** – unused
10. **S2** – unused





**Figure 4-8 TTL Power, S1 and S2 LEDs**

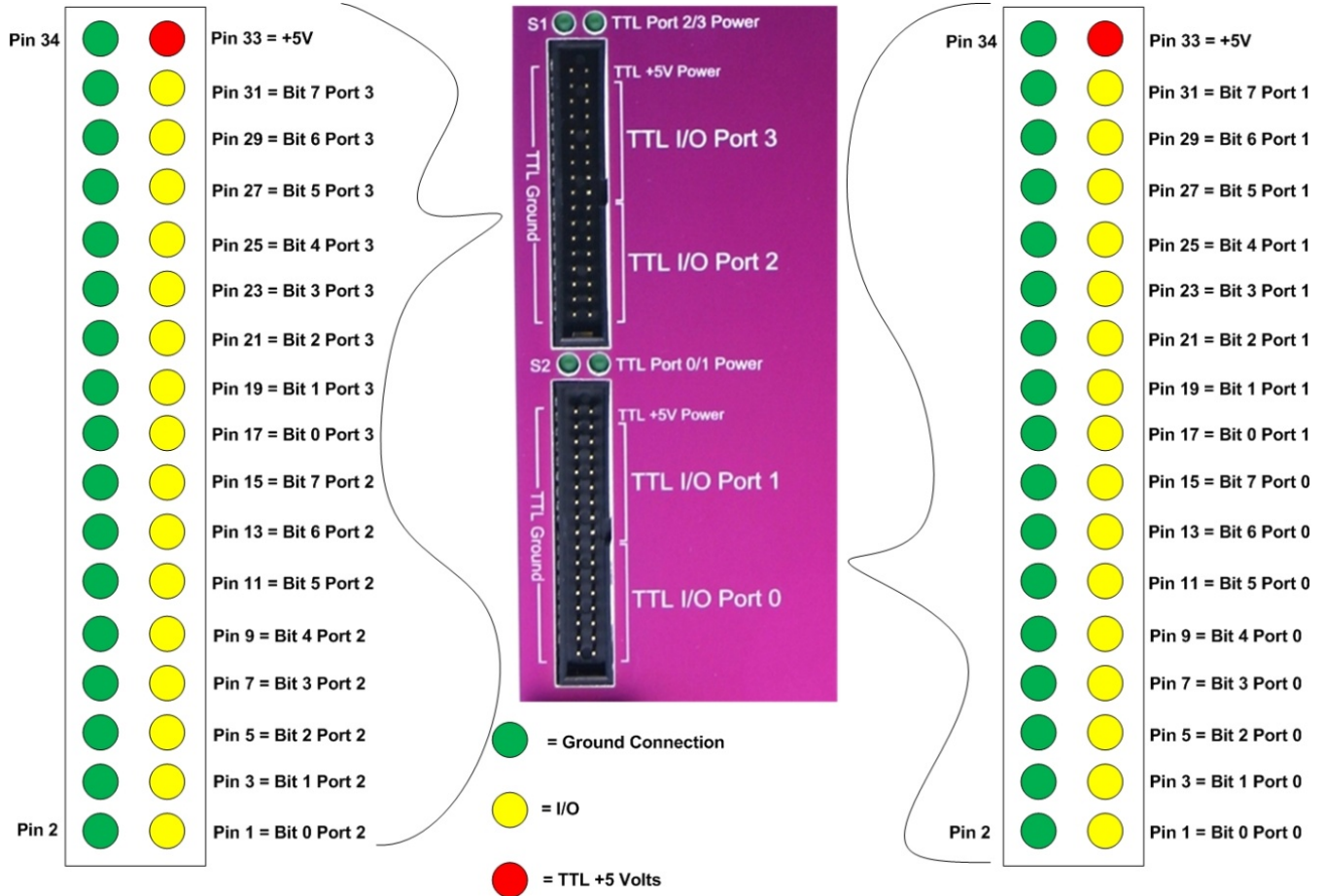
#### **4.2.2 Power Switch**

When the 15V LED indicates that a 15 V power supply is connected to the Digital Lynx SX, the Power Switch enables power to the SX Motherboard. Enabling power to the SX Motherboard begins the Digital Lynx SX boot cycle and illuminates the On, 5.5V, -5.5V and 4.5V LEDs.

### 4.2.3 TTL I/O Ports

The Digital Lynx provides 32 TTLs. They are configurable as inputs or outputs in four groups of eight. TTL I/O Ports 0 through 3 (**Figure 4-9**) represent the four groups of eight TTLs. When configured as outputs, the TTLs can be set high or low and pulsed high or low for pulse durations of 1 millisecond to 10,000 milliseconds. Port direction and other TTL settings are configured using the Cheetah DAS.

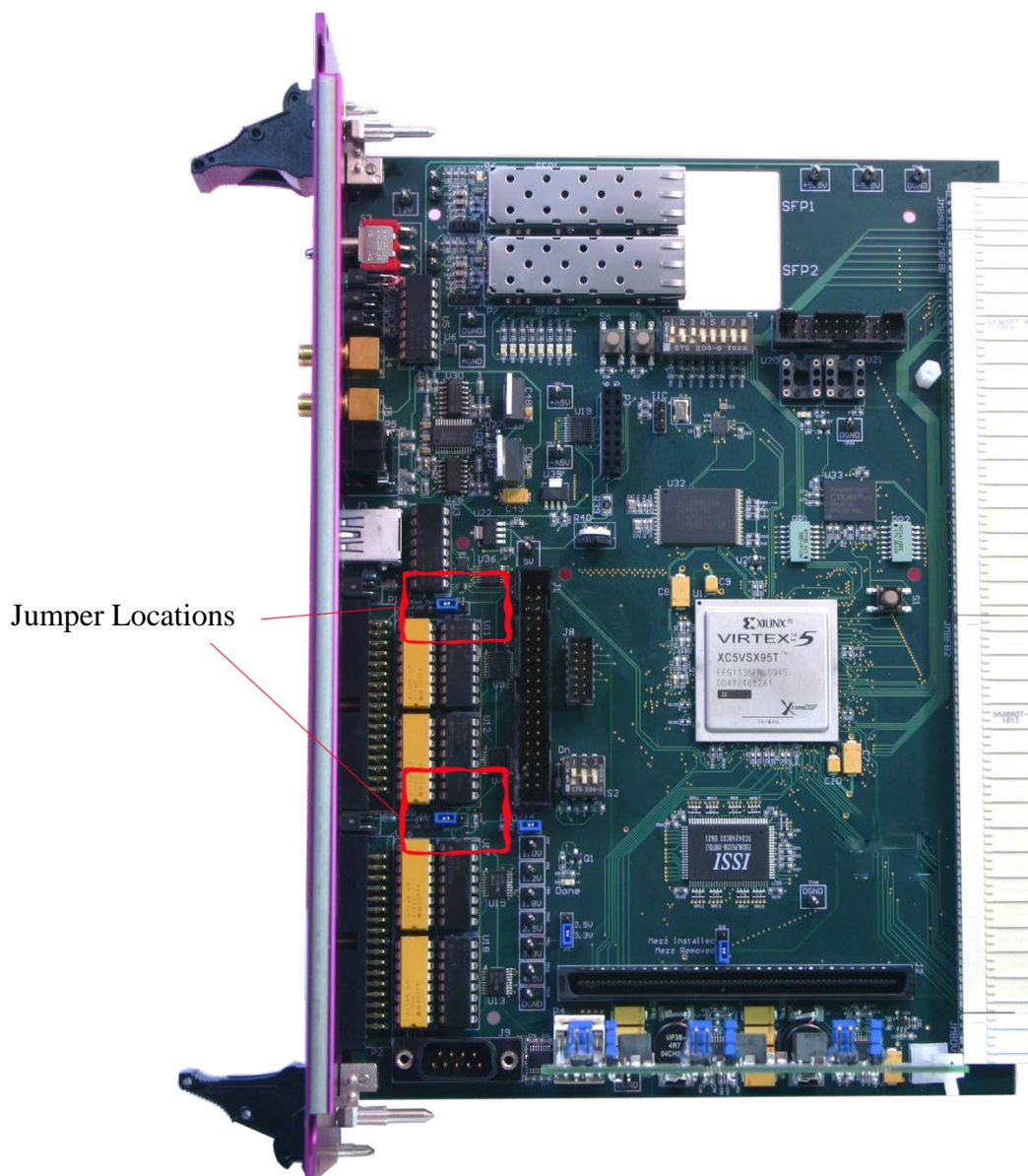
The TTLs are accessible from two 34-pin connectors on the SX Motherboard front panel. Each 34-pin port includes two 8-bit TTL ports (**Figure 4-9**).



**Figure 4-9 TTL Ports**

#### 4.2.3.1 Enabling or Disabling the TTL Port Power Pins

The top rightmost pin on each 34-pin connector is an optional 5 V TTL level power output for powering external TTL devices (see pins designated in red in **Figure 4-9** above). The TTL Port Power LED directly above the power pin is illuminated when the pin power pin is at 5 V. When the LED is off, the pin is not powered. Each of the two optional 5 V TTL power pins is enabled or disabled using a jumper internal to the SX Motherboard (see Figure 4-10 5 V TTL Jumper Location). The jumper for ports 0 and 1 is labeled J14 on the Motherboard and the jumper for ports 2 and 3 is labeled J13.



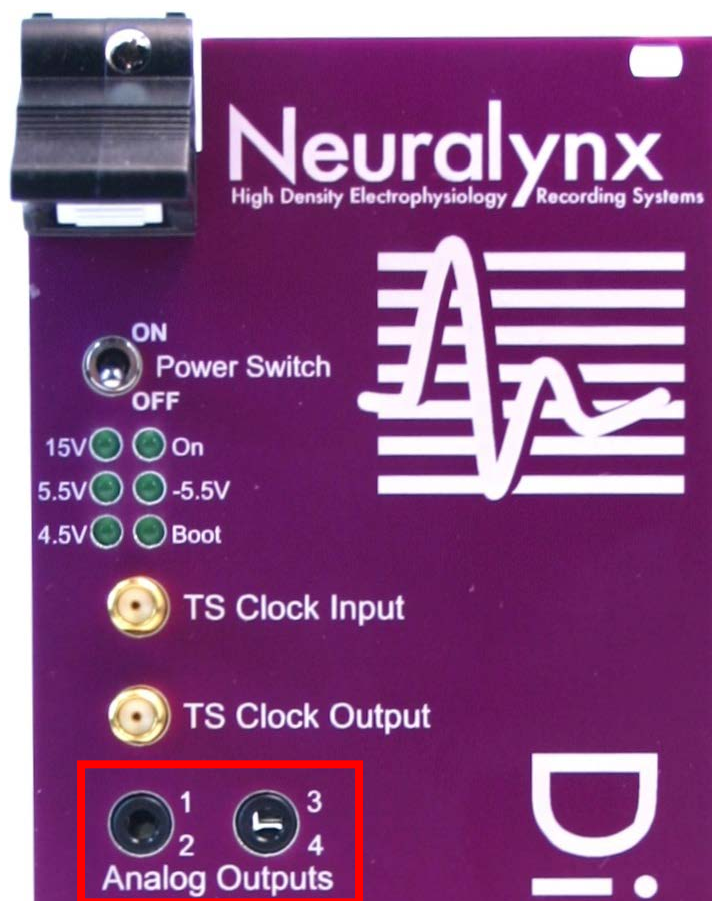
**Figure 4-10 5 V TTL Jumper Locations**

#### **4.2.3.2 TTL Voltage and Current Specifications**

Each motherboard will be shipped with both 5V TTL power pins enabled. This means that there is a 5V source on pin 33 of each 34 pin connector (see Figure 4-9 TTL Ports). This +5 Volts has a current limit of 250 milliamps. If this limit is exceeded, an auto resettable fuse will open to protect internal circuitry. The fuse will automatically close when the circuit causing the current overdraw is disconnected. If you would like to disable this function, move the blue jumper to the right two pins, labeled “off.”

#### 4.2.4 Analog Outputs

Four analog outputs are available through two 3.5 mm stereo jacks on the front panel of the SX Motherboard. Analog outputs are selected using the Cheetah DAS.



**Figure 4-11 3.5 mm Stereo Analog Output Jacks**

These outputs can be used to output any signal you are acquiring with your Digital Lynx SX directly to an audio system or oscilloscope. This includes individual electrodes, stereotrodes, tetrodes and Continuously Sampled Channels (CSC's).

Currently the analog output labeling on the front panel of the SX Motherboard is different than the labeling in Cheetah.

**Table 4-1** explains the difference.

SX Motherboard Label	Cheetah Audio Output Control Label
Analog Output 1	AcqSystem1_Audio0 Left Channel
Analog Output 2	AcqSystem1_Audio0 Right Channel
Analog Output 3	AcqSystem1_Audio1 Left Channel
Analog Output 4	AcqSystem1_Audio1 Right Channel

#### **Table 4-1 Analog Outputs: SX Motherboard Labels and Cheetah Labels**

In Cheetah, high cut and low cut filters can be configured to isolate the data in your signal that you are most interested in. All of these filter settings are also sent to the SX which currently supports only low cut filters from 0.1 Hz to 149.999 Hz. If you set the low cut filter in Cheetah to 150 Hz or greater, your data on the computer will be filtered at the larger cutoff but the analog outputs from the SX Motherboard will still be cut off at 149.999 Hz.

The SX analog outputs do not yet support high cut filtering. Analog signals are output at the same rate at which they are sampled. If your sampling rate is set to 40 kHz, your analog output signal will be updated at a rate of 40 kHz.

### **4.2.5 TS Clock Input and TS Clock Output**

Like the Digital Lynx S, the Digital Lynx SX includes a timestamp with every digitized sample of data that is transmitted to the Cheetah software. The timestamp increments once per microsecond based on a 1 MHz digital clock signal. The Digital Lynx SX always outputs this 1 MHz clock on the TS Clock Output.

The TS Clock Input and TS Clock Output operate at the 2.5 Volt LVCMOS level and use SMA connectors. These connectors provide a robust physical connection with excellent signal integrity.

### **4.2.6 Serial Device Expansion**

This port is for future use and is currently unused.



### **4.3 Backplane Modules**

The Digital Lynx backplane provides the backbone for a scalable and future ready acquisition system. But it is the backplane modules that do the work of taking low noise data from your lab environment, preserving its integrity and then relaying that data to you.

Neuralynx currently offers two types of backplane modules.

#### **4.3.1 Hybrid Input Board**

The Digital Lynx Hybrid Input Board is a Backplane Module that adds 32 Hybrid Coupled Channels to a Digital Lynx SX Data Acquisition System. It seamlessly integrates extremely low noise differential amplifiers( $1.4\mu V_{RMS}$  Full Bandwidth) with 24 bit A/D converters sampling at rates between 16KHz and 40KHz. Each Channel is Hybrid Coupled, meaning large DC potentials, up to  $\pm 1V$ , and small AC signals, up to  $\pm 132mV$ , can be measured in unison without any DC errors or loss of high resolution. Each channel also boasts very high CMRR ensuring exceptional reference subtraction and immunity from external electromagnetic interference sources. All analog inputs are ESD protected up to Level 4 by IEC 61000-4-2 Standards while maintaining extremely low leakage currents. Input boards can be paired with Digital Reference Selectors (DRS) for software controlled signal referencing. For more information on the Digital Lynx Hybrid Input Board refer to its manual on the Neuralynx Website. The Digital Lynx Hybrid Input Board is a direct replacement for the Digital Lynx AC and DC Input Boards.



**Figure 4-12 Hybrid Input Board**

#### **4.3.2 DRS-36**

A Digital Reference Selector (DRS) is paired with an Input board to provide software controlled referencing for Digital Lynx acquisition systems. Each DRS is capable of selecting up to eight signals that can be used as references for each of the 32 acquisition channels of an Input board. A global reference connection allows for sharing of references between DRS boards using the included global reference modules. All reference selections are made using the Cheetah Data Acquisition Software.





**Figure 4-13 DRS-36**

It is clear that the Digital Lynx backplane architecture offers a lot of flexibility but another benefit is that any free slot in your Digital Lynx SX is a slot that could house the next innovative backplane module from Neuralynx.

### **4.3.3 AC Input Board**

The Digital Lynx AC Input board adds 32 AC-coupled acquisition channels to a Digital Lynx acquisition system. Each input board digitizes incoming analog data at 32 kHz with a very low 1.3 uV of noise. AC coupling allows for recording of signals between 0.16 Hz and 8.5 kHz, eliminating DC artifacts in neural signals. Input boards can be paired with Digital Reference Selectors (DRS) for software controlled signal referencing.

#### **4.3.4 DC Input Board**

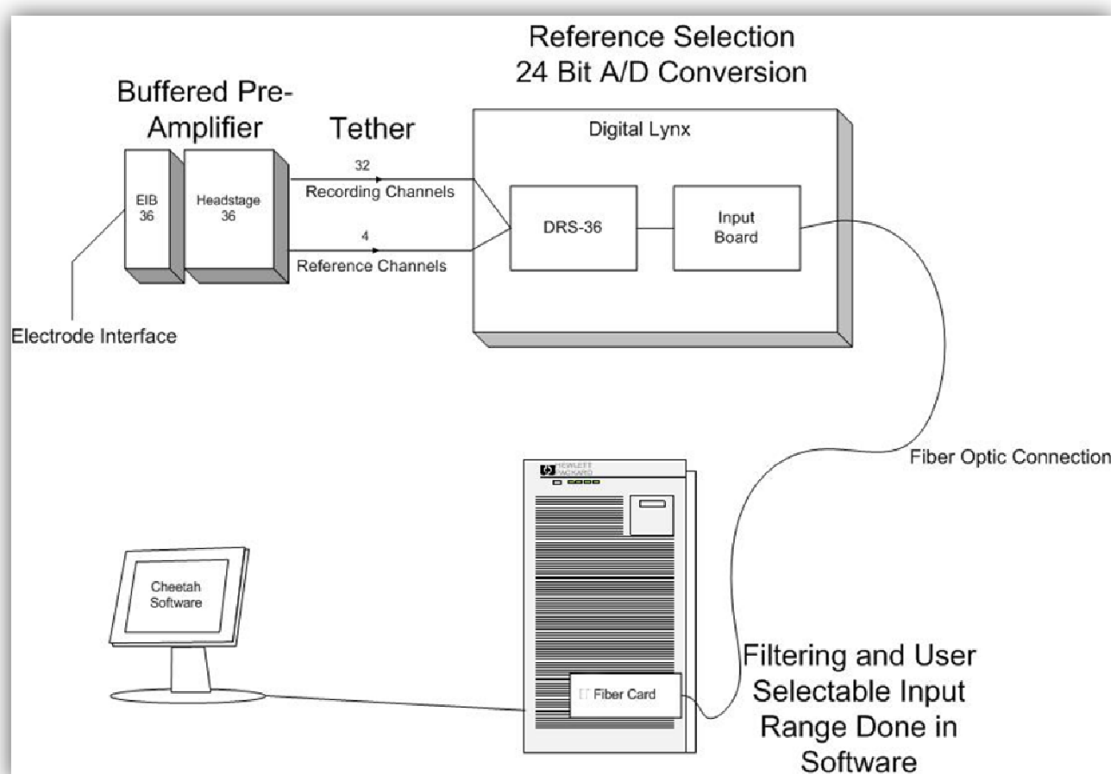
The Digital Lynx DC Input board adds 32 DC coupled acquisition channels to a Digital Lynx acquisition system. Each input board digitizes incoming analog data at 32 kHz with a very low 1.3 uV of noise. DC coupling allows for recording of signals between 0 Hz and 8.5 kHz, allowing acquisition of DC coupled external signals such as those from eye trackers. Input boards can be paired with Digital Reference Selectors (DRS) for software controlled signal referencing.

## 5 Setting Up Your Digital Lynx SX

Your Digital Lynx SX is configured before it is shipped to you. If using DRS-36 for referencing, setup is simple.

Setup of the Digital Lynx SX includes:

1. Mounting the Digital Lynx cabinet on a table, cart or rack.
2. Setting up your new computer.
3. Connecting the 15 Volt power supply to the Digital Lynx SX.
4. Connecting a fiber optic cable from your computer to your Digital Lynx SX.



**Figure 5-1 SX Setup**

If you purchased DRS-36 boards with your Digital Lynx SX, they are pre-installed in your Digital Lynx SX system.

## 5.1 Computer Setup

### 5.1.1 Physical Setup

Place your monitor and tower and plug them into the same power strip. Plug in keyboard and mouse. Do this by following all HP documentation which can be found in the HP Computer box.

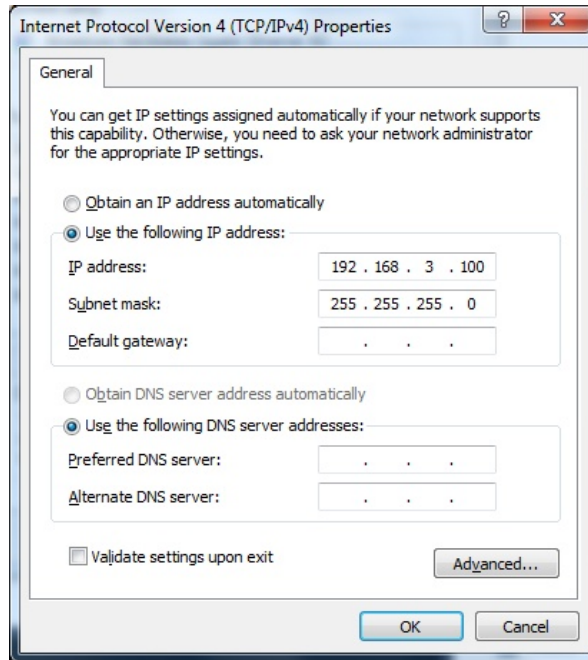
### 5.1.2 Configuring Optical Ethernet Interface



Some of the computer screen shots in this section might slightly differ from the screen images that you see on your computer. This is dependent on what type of Ethernet Card is in your system. Please contact [support@neuralynx.com](mailto:support@neuralynx.com) for any questions.

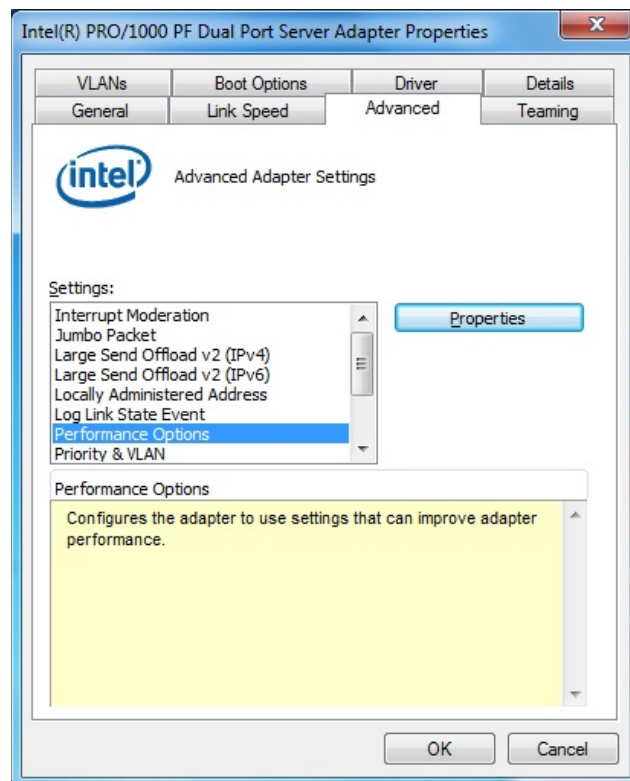
Your computer's optical Ethernet interface is preconfigured by Neuralynx. But if it needs to be reconfigured, the following requirements must be met:

1. The Ethernet interface must have an IP address that is on the same subnet as the Digital Lynx SX. In the following example, the subnets are in bold type. If the Digital Lynx SX IP is **192.168.3.10**, you could select **192.168.3.100** for the IP of your Ethernet interface.
2. Set the subnet mask to 255.255.255.0.
3. Do not enter a gateway IP.

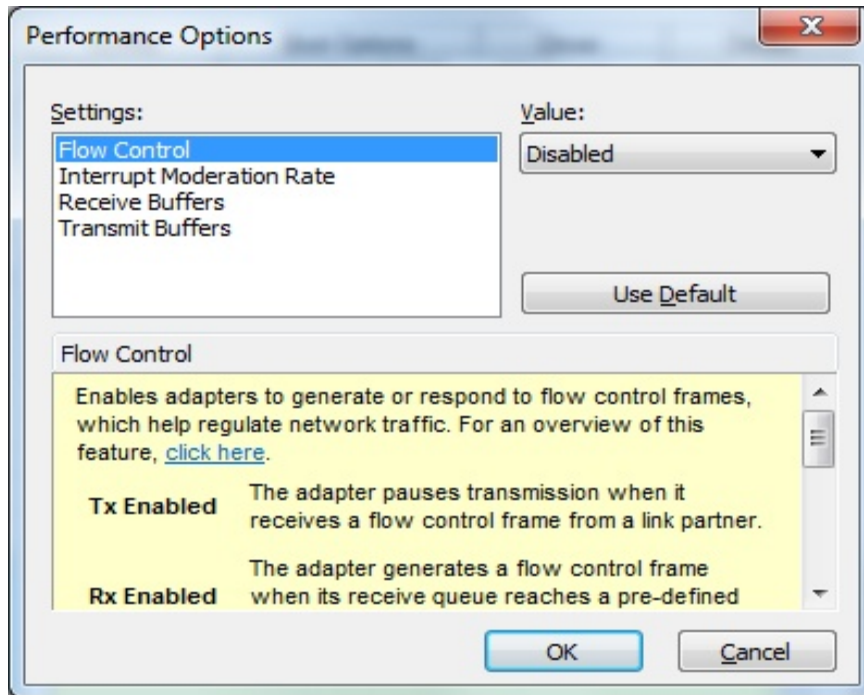


**Figure 5-2 Setting IP Address for the SX**

4. In the advanced settings (**Figure 5-3**) for your Ethernet interface, Flow Control must be set to *Disabled* (**Figure 5-4**).

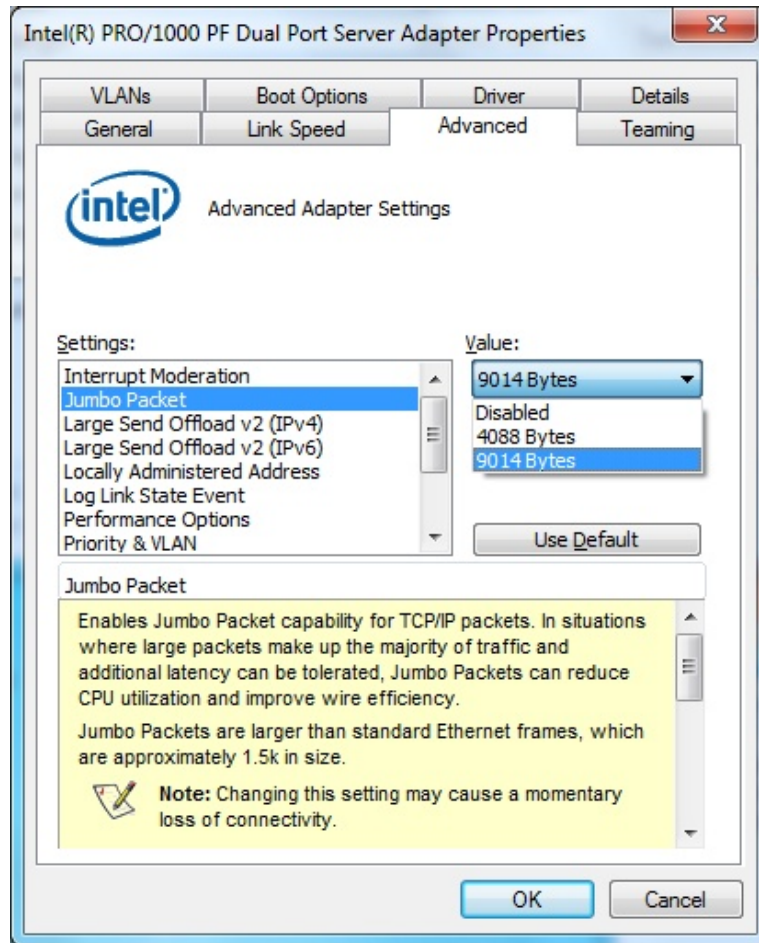


**Figure 5-3 Advanced Settings**



**Figure 5-4 Disabling Flow Control**

5. Enable jumbo packets in the advanced settings of your Ethernet interface (**Figure 5-5 Enabling Jumbo Packets**).



**Figure 5-5 Enabling Jumbo Packets**

6. Firewall must allow Cheetah to receive public and private TCP and UDP packets.

## **5.2 SX Cabinet Setup**

All data acquisition hardware is within the Digital Lynx SX cabinet and setup is simple. Mount the Digital Lynx cabinet at a convenient location on a table, desk, cart or in a standard 19" rack. For specific dimensions of the Digital Lynx SX cases (vented and non-vented) please contact [support@neuralynx.com](mailto:support@neuralynx.com).

### 5.3 Connecting 15 Volt Power Supply



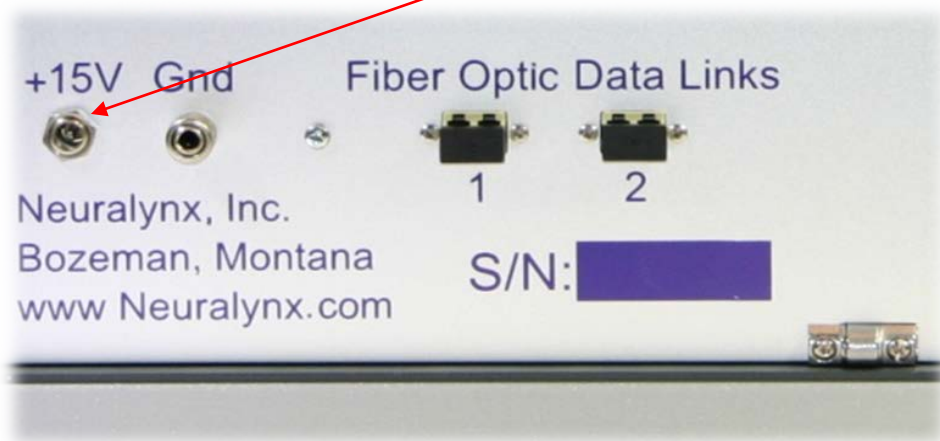
The Digital Lynx SX should be used only with the 15 V power supply supplied by Neuralynx.



**Figure 5-6 SX Power Supply**

The power supply has a universal input AC power input which means that the input voltage range is 100 to 240 VAC. This makes the power supply compatible with most of the world's power systems.

Connect the power supply to the port on the rear panel labeled +15V (**Figure 5-7** below).



**Figure 5-7 Digital Lynx SX Rear Panel Connections**



## **5.4 Optional Ground Connection**

The Gnd connection (**Figure 5-7** above) accepts either a standard banana plug or a wire. In most setups, this ground connection is not needed. It should only be used if a strong noise source is present and Neuralynx recommends grounding the cabinet as a solution.

Connecting a wire to Gnd:

1. Unscrew the knurled ground connection cover.
2. Insert a stripped wire into the post hole.
3. Wrap the bare wire approximately one turn around the post.
4. Screw the knurled cover back down to secure the wire.

## **5.5 Connecting Fiber Optic Data Link**

Your Digital Lynx SX system includes at least one fiber optic cable (**Figure 5-8**). Please read **Appendix A.1** on fiber optic cable care before continuing.



**Figure 5-8 Fiber Optic Cable**

1. Connect this cable to the port labeled Fiber Optic Data Link 1 on the rear panel of your Digital Lynx SX. The connector will click when secured.

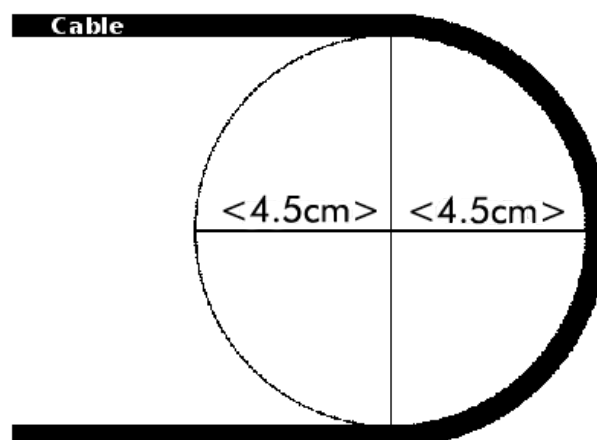


**Figure 5-9 Fiber Optic Connection to SX Rear Panel**

2. Route the fiber optic cable to the computer. The performance of a fiber optic cable can be negatively affected by bending the cable too severely. It is important to maintain a bend radius larger than 4.5 cm at all times.

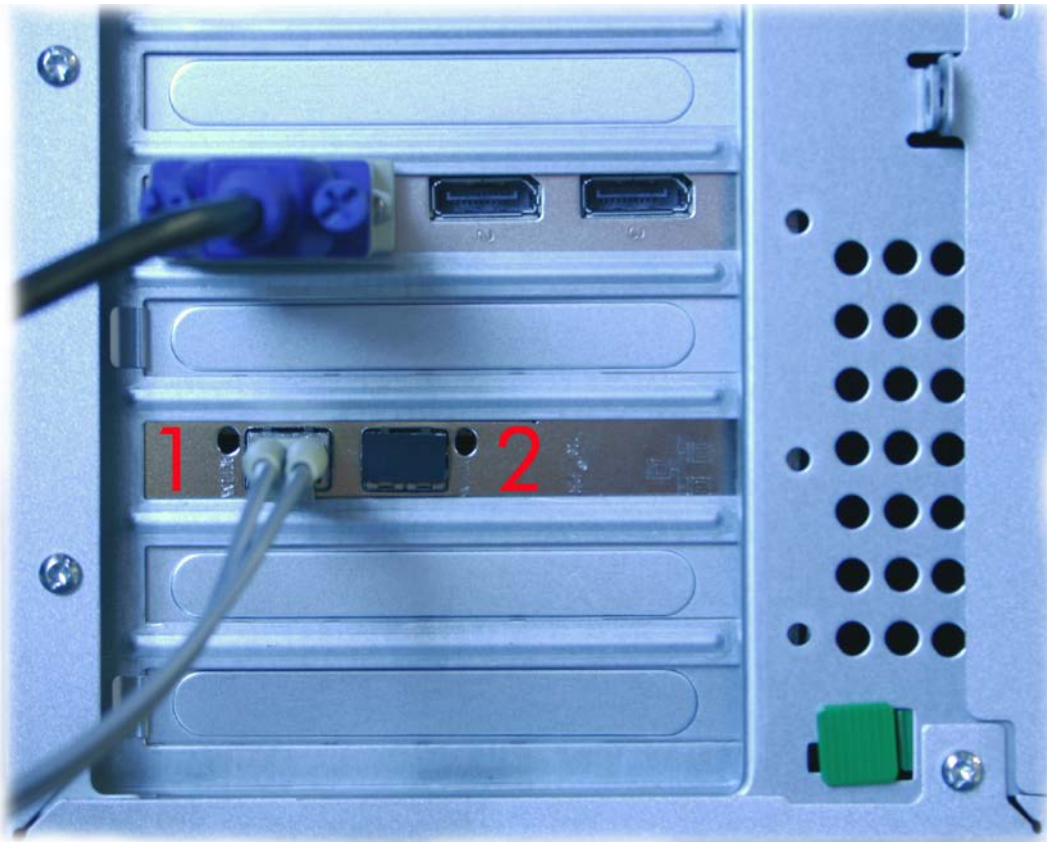


Bending the cable to a radius of less than 4.5 cm can cause damage to the glass enclosed which will cause transmission degradation.



**Figure 5-10 Fiber Optic Minimum Bend Radius**

3. On the back of the computer, locate the optical fiber port and connect the other end of the fiber optic cable. The connector will click when secured. If there are multiple ports on the card, select the left port (see port labeled “1” in **Figure 5-11** Fiber Optic Connection to Computer.) Depending on the system setup, the card in your PC might look slightly different than the one in the image below.



**Figure 5-11 Fiber Optic Connection to Computer**

## 6 Testing your Digital Lynx SX



Before beginning your first recording session, Neuralynx strongly recommends testing your setup to confirm your system works as expected and that no electrical noise from the surrounding environment will interfere with your data.

### 6.1.1 Turning Digital Lynx SX On

Move the *Power Switch* on the Digital Lynx SX Motherboard front panel to the *On* position. The SX Motherboard performs the following operations during the boot cycle:

1. Check the computer for new firmware. (boot LED blinking)
2. If there is new firmware, download it. (boot LED blinking)
3. Program backplane modules. (boot LED blinking)
4. Wait for Cheetah connection. (boot LED stays on)

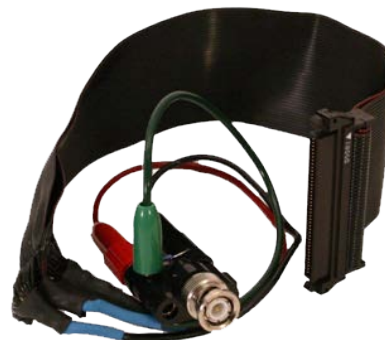
After the boot cycle completes, the five LEDs on the bottom of each Input Board display a specific LED pattern. All Input Boards will display the same LED sequence. LED1, LED3 and LED4 will blink sequentially. LP\_OK and LED2 remain on. DRS-36 boards will have LEDs Boot, D4 and D5 on, Error off and Accs may be on or off.

### 6.1.2 Testing your Inputs

As of September, 2005, all new systems ship with an Input Test Cable (Figure 6-1 Input Test Cable).

This cable is for testing signal pass-through and Common Mode Rejection (CMR) on the inputs to your Input Boards.

The signal pass-through test confirms that analog inputs applied directly to your Input Board are converted to digital and transmitted to Cheetah as expected. The CMR test verifies the integrity of the input and conversion process.



**Figure 6-1 Input Test Cable**

Because differential signaling offers the best noise performance, Neuralynx data acquisition systems use differential signaling to transmit electrophysiological signals from the headstage preamplifier to the Cheetah DAS. This method of signal transmission uses two wires per signal. These two wires are typically referred to as positive and negative. With the Neuralynx system, your electrode signals connect to the positive inputs and your references connect to the negative inputs.

The Input Test Cable ties all 32 positive input signals together to the red banana plug and all 32 negative input signals to the black banana plug. The input grounds are connected to the green banana plug.

Banana Plug Wiring Summary:

- Red 32 Positive Inputs
- Black 32 Negative Inputs
- Green 16 Ground Connections

The Input Test Cable is designed to be used with a signal generator. The maximum signal input range of an Input Board is from -132 millivolts to +132 millivolts. Thus when using the Input Test Cable, the signal generator output amplitude should not exceed this range. Note that the Input Test Cable will not attenuate the signal generator output as is the case with a Neuralynx Signal Mouse.

A banana jack to BNC adapter is needed to connect the Input Board Test Cable to the signal generator. This adapter is included with your system (see **Figure 6-1** Input Test Cable).

### 6.1.2.1 Signal Pass-Through Test

1. Connect red banana jack to the signal of the signal generator.
2. Connect black to the signal generator ground.
3. Connect green to the signal generator ground.
4. Set the signal generator output to a 1 mV, 20 Hz square wave. This will put 1 mV spikes on the spike channels and a 1 mV square wave signal on the CSC channels, depending on frequency filtering settings.
5. Adjust the CSC input range so you can see an unclipped waveform on the displays. Please reference Cheetah Quickstart guide or the Cheetah Reference Guide for detailed information.

### **6.1.2.2 Common Mode Rejection Test**

The Common Mode Rejection (CMR) test connects the same signal to all positive and negative inputs of the Input Board. The purpose is to confirm that on all channels; (positive input) - (negative input)  $\cong 0$ . A result near zero indicates that the inputs are working properly.

1. Connect red banana jack to the signal of the signal generator.
2. Connect black banana jack to the signal of the signal generator.
3. Connect green banana jack to signal generator ground.
4. Set the signal generator to a 5 V, 20 Hz sine wave. If you are using a Minirator, use its maximum output amplitude instead of 5 V.
5. You should see a very small signal when the input range is set to  $\pm 25$  microvolts. This test is only valid for CSC displays as spike channels will need to see a spike which will not occur for a 20 Hz sine wave input.

### **6.1.2.3 Final System Test**

After you inspect all system components it is good practice to perform a complete system test with a Signal Mouse. The complete setup of this can be found in the Digital Lynx SX Installation Guide.

## Appendix A Digital Lynx SX Care and Maintenance

### A.1 Fiber Optic Cables and Connectors

The fiber optic cable connectors have a latch that clicks when engaged. There is a small release ramp (**Figure A.1-1**) that is squeezed to release the latch. Be gentle with the fiber optic cable and connector; the exposed tips of the connector are polished for proper light transfer and must not be touched or scratched.



**Figure A.1-1 Fiber Optic Connector**

The fiber optic cable should not be bent at sharp angles. When routing the cable from the Digital Lynx to the computer, avoid bends in the cable with a radius less than 4.5 cm.

Before inserting a fiber optic cable, two dust caps must be removed. These dust caps must be saved to protect the fiber optic cable ends when the cable is disconnected from the system.

There are small black soft rubber dust covers that are inserted into each of the fiber optic ports on the back of the computer and Digital Lynx SX. These black dust covers must be removed before the optic cable can be connected. Save these dust covers. They should be placed back into empty fiber optic receptacles whenever a fiber cable is disconnected for an extended period.



**Figure A.1-2 Fiber Optic Port Cover**

Once removed, dust caps and dust plugs should be stored in a bag or container for later use.



**Figure A.1-3 Storage of Fiber Optics Protection Equipment**



## **A.2 Electrical Connectors**

Contamination due to dirty connectors or corrosion can cause poor performance, intermittent signal degradation or in some cases total device failure. To prevent this it is a good idea to clean your connectors periodically. This will depend on how often the connector is exposed to environmental elements such as excessive humidity or frequent handling (your hands can leave oil on connectors).

Each Digital Lynx SX system is shipped with a DeoxIT Technicians Survival Kit. The kit contains three different contact care solutions. When using these products, avoid spraying directly onto the surface of a connector. Use the applicators provided in the kit. Please contact [support@neuralynx.com](mailto:support@neuralynx.com) if you have any questions.

To clean a connector, follow this procedure:

1. Use DeoxIT to clean connector contacts.
2. Use DeoxIT Gold to condition and maintain connector contacts.
3. Use DeoxIT Shield to prevent build up and corrosion in severe environments.
4. Allow the connector to dry completely before using. You can use gas duster (also known as canned air) to accelerate the drying process.

## Appendix B Glossary

### B.1 Terms

**Cheetah** – Cheetah is the name of the Neuralynx data acquisition software. Its full name is Cheetah Data Acquisition Software or Cheetah DAS.

**Common Mode Rejection** – of a differential signal (or other device) measures the tendency of the device to reject input signals common to both input leads. A high CMRR is important in applications where the signal of interest is represented by a small voltage fluctuation superimposed on a (possibly large) voltage offset, or when relevant information is contained in the voltage difference between two signals.

**Differential Signal** –All Neuralynx amplifiers are differential. This means that they subtract a reference from the original source and each output is the difference.

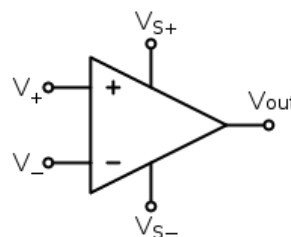


Figure B.1-1 Differential Signal

**DRS-36** – A Neuralynx backplane module used in concert with Input Boards to allow software controllable reference selection. With a DRS-36, you can use any electrode as a reference. (see Section 4.3.2)

**Headstage (HS)** – This device is an electrical amplifier. It is placed as near as possible to the electrode interface in order to preserve the integrity of the signals produced on electrodes and send those signals to the Digital Lynx to convert them from analog to digital.



Figure B.1-2 HS-36

**Input Board** – A Neuralynx backplane module that converts analog input signals to digital. (see Section **Error! Reference source not found.**)

**Signal Mouse (SM)** – A Neuralynx product used to apply test signals through the headstage preamplifiers. It is useful in confirming that your system is working from headstage to Cheetah before using the system in an experiment.



**Figure B.1-3 SM-36**

**Tether Extension** – A shielded cable available in 6, 15, or 25 foot extensions. This cable is a robust cable used to extend a tether's overall distance.

**Timestamp clock** – Every sample taken by the Digital Lynx is transmitted back to the computer with a time value that is relative to the when the Digital Lynx powered up. The time values, known as timestamps are accurate to one microsecond.

**TTL** – This acronym stands for Transistor-Transistor Logic. It describes a common class of digital circuits that can be used to communicate digital signals. In a lab environment some useful digital signals could be the occurrence of an event or to open or close doors in a maze.

## **B.2 Unit Abbreviations**

**hertz** – Hz

**kilohertz** – kHz

**millimeter** – mm

**megahertz** – MHz

**millivolt** – mV

**microvolt** –  $\mu$ V

**volt** – V