Lab Rat User Guide

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The Lab Rat Entry Level Recording System

Introduction

The Lab Rat introduces new TDT users to the powerful capabilities of TDT hardware and software and provides current users with a quality teaching and training tool, at an affordable cost.

The Lab Rat is a complete entry-level neurophysiology recording system that allows users to create and execute full neurophysiology experiments with just a laptop, an idea, and a Lab Rat.

Using TDT's state of the art neural recording software, Synapse, the Lab Rat can acquire up to 16 channels of high-fidelity analog signals from any biopotentials, and up to 32 channels from Intan-based digital headstages, at up to ~25kHz. It can even generate its own artificial data so you can design and test experiments without a connected subject.

The Lab Rat serves as the data acquisition and digital & analog I/O interface for TDT's hardware emulation platform, Corpus.

System Requirements

- ✓ Microsoft® Windows® 7 or later
- ✓ 2.0GHz or faster processor (Intel® Core™2 Duo)
- ✓ 2GB of RAM (more recommended)
- ✓ 1GB of available hard-disk space for installation
- ✓ 1024x768 display (1280x800 or higher recommended) with OpenGL-compatible graphics card, and 64MB of VRAM (128MB or higher recommended)
- ✓ USB 3.0 port

Opening the Box

The Lab Rat System comes shipped inside a custom carrying case and includes the following:

1. The Lab Rat Interface Module (LR10) - The main recording and communications interface of the Lab Rat system.

2. AC16LR Headstage and Cable - A 16-channel high impedance headstage for acute recordings.
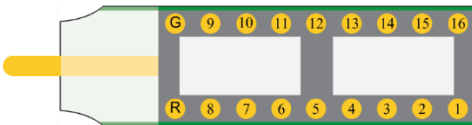
AC16LR Pinout Diagram, looking into the pins

Technical Specifications

Input Range (+/- 2.5 V supply)	+/-1.9 V
Input Impedance	10^{13} Ω
Input Referred Noise	3 μV_{RMS} (300 Hz – 3 kHz) 6 μV_{RMS} (30 Hz – 8 kHz)
Headstage Gain	Unity (1x)
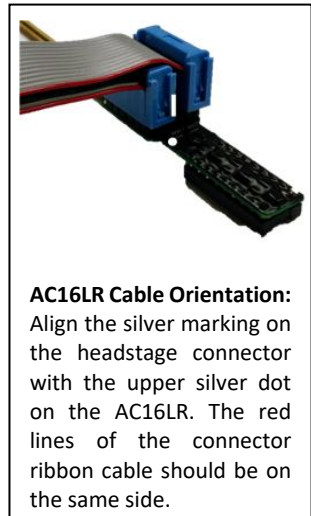
AC16LR Cable Orientation: Align the silver marking on the headstage connector with the upper silver dot on the AC16LR. The red lines of the connector ribbon cable should be on the same side.

3. SB4 Connector - A passive four-channel touch-proof to DB26 breakout adapter for low impedance electrode recordings.

4. USB 3.0 Cable - This USB cable serves as the communication line between the Lab Rat Interface and your computer. One C-to-C cable is included and one A-to-C adapter.

5. Disposable Surface Electrodes
     Please see the Lab Rat Tutorial videos after software installation for a demo experiment setup using these electrodes. More electrodes can be acquired from Rhythmlink https://rhythmlink.com/products/surface-electrodes/

6. USB stick with Synapse Lite software - This 4GB USB stick contains the installation package for Synapse Lite software and Lab Rat Tutorial videos to get you started.

Lab Rat Hardware

Analog Headstage Interface

A DB26 connector for interfacing the AC16LR or the SB4 to the Lab Rat for up to 16 channels of neural signal acquisition.

Digital Headstage Interface

A 12-pin Omnetics nano connector used for interfacing with an Intan-based digital headstage, such as TDT's ZD32 Digital ZIF-Clip® headstage. The interface supports up to 32 channels of digital data acquisition.

USB-C 3.0 Connector

A reversible USB connector for communication between the Lab Rat and a Windows-based computer. Use the provided C-to-A adapter if your computer/laptop doesn't have a C-style USB connector. The laptop or computer must support USB 3.0.

DB25 Multi I/O Port

This port provides access to 16 bits of digital I/O, two +/-3 V analog inputs, two +/-3 V analog outputs, and power. Pinouts are shown looking into the connector.

Pin	Name	Description	Pin	Name	Description
1	C0	Port C Bit Addressable Digital I/O Bits 0, 2, 4, 6 +3.3V, 10mA max per bit	14	C1	Port C Bit Addressable Digital I/O Bits 1, 3, 5, 7 +3.3V, 10mA max per bit
2	C2		15	C3	
3	C4		16	C5	
4	C6		17	C7	
5	GND	Ground	18	A0	Port A Word Addressable Digital I/O Bits 0, 2, 4, 6 +3.3V, 10mA max per bit
6	A1	Port A Word Addressable Digital I/O Bits 1, 3, 5, 7 +3.3V, 10mA max per bit	19	A2	
7	A3		20	A4	
8	A5		21	A6	
9	A7		22	ADC1	Analog Input Channel 1 +/-3V, 20mA max
10	ADC2	Analog Input Channel 2 +/-3V, 20mA max	23	VBUS	+5V, 150mA max
11	VCC	+3.3V, 250mA max	24	DAC1	Analog Output Channel 1 +/-3V, 20mA max
12	DAC2	Analog Output Channel 2 +/-3V, 20mA max	25	V+	+3.3V, 150mA max
13	V-	-3.3V, 150mA max			

Bit 0 and Bit 1 BNC Ports

Bit0 and Bit1 on the Lab Rat interface module are BNC connections that map to Bits C0 and C1 on the Lab Rat. These connections are ideal for synchronizing the Lab Rat with BNC-based TTL triggers to and from external hardware. These can be configured in the Lab Rat object in Synapse Lite software. When performing TTL communications over BNC cables, be sure to use a shielded and as-short-as-possible cable for maximum signal integrity.

Stereo A/D and D/A Ports

Each of the ADC / DAC ports are 1/8" stereo jacks for two-channel analog signals for interacting with external hardware with up to +/-3V dynamic range. The speaker on the top of the Lab Rat is connected to the first D/A channel. The level knob on the Lab Rat interface module controls the speaker volume. The ADC input impedance is 200kΩ.
Important! Do not exceed +/-5V on the ADC inputs

Status LED

The LED on the Lab Rat interface module indicates the run-time status of the device. Listed below are the various indicator states of the status LED:

Green LED

Solid – device is ready to run, system is idle.
Flashing – device is running and acquiring data.

Red LED

Flashing – device is running but there is a synchronization error with the computer. This happens if Corpus is not reading data fast enough, which means there is some other process on your computer that is consuming too many resources. There will also be a data acquisition error in Synapse Lite. If the error does not resolve itself, check for other running processes that might be interfering with Corpus and restart your recording in Synapse.

Power External Devices

You can use the VCC and VBUS pins on the Multi I/O Port to power external devices, such as sensors, relays, servos, and more. Be sure to check the specs of your external device and compare it to the allowed power draw listed in the LR10 DB25 Multi I/O Port pinout on the previous page.

Getting Started with The Lab Rat

The Lab Rat system is used with Corpus, TDT's S3 hardware emulator, and Synapse Lite, TDT's state of the art neural recording and control software.

Installing Drivers and Software

The USB stick that came with your Lab Rat system includes Synapse Lite installation package.

1. To install the software, run **SynapseLite.exe** on the USB stick.

2. After installation, connect your LR10 to the PC via the USB cable that came with your system.

3. Launch **Synapse Lite** from the desktop shortcut to check the connectivity of your LR10 for the first time. **Synapse Lite** automatically launches **Corpus** when it runs.

4. **Corpus** emulates an RZ2 with 8 DSPs, and an LR10 will appear as connected hardware.
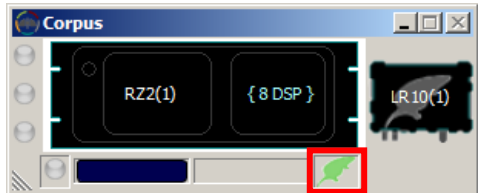
    Green Rat Icon will appear in Corpus if your interface module is connected and running at USB 3.0 speeds.

    Red Rat Icon will appear if you are running at USB 2.0 speed, and you should change to a USB 3.0 port.

    Gray Rat Icon will appear if LR10 is not detected.

5. Watch the *Lab Rat Tutorial* videos that installed to your desktop to get started with the **Synapse Lite** software. These will familiarize you with the core elements of Synapse and guide you through your first Lab Rat experiment where you will acquire real biopotentials using your Lab Rat hardware and perform online signal processing.

Corpus

Corpus is a software program that runs on any Windows PC and provides emulation capabilities of TDT's S3 hardware. Corpus automatically launches when you start Synapse Lite. The LR10 serves as a peripheral acquisition and surrogate I/O device of a standard RZ2 hardware device.

The emulator simulates hardware function in *pseudo* real-time, but unlike real hardware, Corpus will slow down processing and stretch time as its processing limits are exceeded. This means that Lab Rat experiments with high processing demands may experience a time delay in data acquisition and feedback control.

Synapse Lite

Synapse is TDT's industry-leading neurophysiology experiment platform. With Synapse, investigators can design complex neurophysiology experiments to acquire data and control conditional outputs by simply placing a few experiment modules, called Gizmos, into a processing tree. This powerful software enables the execution of standard neuroscience protocols, such as online PCA spike sorting or stimulation, in a matter of minutes. More complicated behavioral paradigms, with or without closed-loop feedback, can be easily achieved with our over 25 ready-made gizmos or an infinite number of user-made custom gizmos.

Synapse Lite is an almost complete version of Synapse, with minor elements removed for compatibility with the Lab Rat system. Acquisition and I/O processes for experimental/ gizmo dependencies can be setup through the Lab Rat Object in the Processing Tree, described on the next page.

Controlling the Lab Rat in Synapse

The Big Picture

The LR10 Object is the nexus for all interactions with the Lab Rat interface module. The LR10 Object is independent in the processing tree. However, the acquisition processing and I/O functionality are internally dependent on Corpus and emulated RZ2 hardware.

Settings for analog and digital amplifiers, simulated neural data generation for experiment testing, and multi I/O communications are modified within the Lab Rat Object. The picture below is a big picture look at the LR10 HAL when Synapse Lite is first opened.

Learning More

Reading is the whetstone that sharpens the sword of the mind. To learn more about elements that could not be covered in full detail in this manual, such as TDT System 3, Corpus, or Synapse, please see the System 3 Manual and Synapse Manual.

Click this button on the upper right of Synapse Lite to jump to the Lab Rat section of the Synapse Manual for more detailed information on the specific settings and functionality.

Click this button on the upper right to send us feedback on Synapse, anything you'd like to see added or changed, or anything else you think we can improve on. We love to hear from you. It helps us shape our software and product line to meet all our customers' needs.

Ready To Do More?

Looking to do more elegant or heavy neurophysiology experiments, such as chronic freely-behaving recordings, real-time feedback control, or high channel count multi-modal data acquisition? Then it is time to join the thousands of other happy customers that have full TDT systems by upgrading today! If you are ready to learn more about what a full TDT hardware system can offer, please contact our sales team by email (sales@tdt.com) or phone (+1.386.462.9622). Our Sales Representatives will work with you to design a custom system that meets your exact needs.