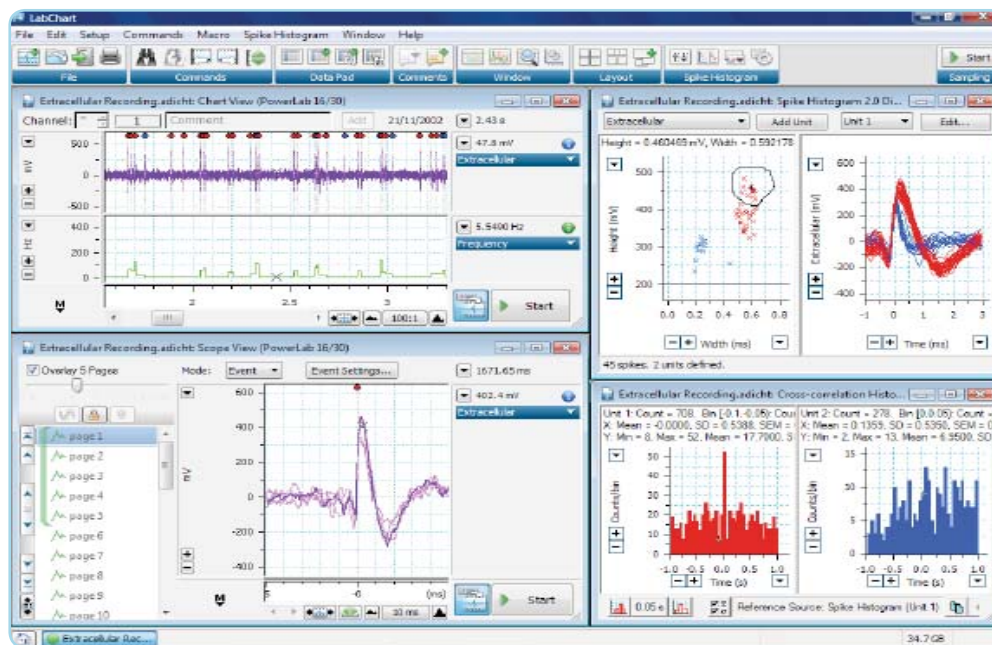


Neurophysiology Research

PowerLab® Systems for Neurophysiology and Electrophysiology



ADInstruments offers a variety of solutions for neuroscientists and electrophysiologists to record and analyze *in vitro* or *in vivo* signals. The combination of PowerLab data acquisition systems with Warner Instruments' amplifiers (and accessories) allows you to perform single/multi-unit extracellular recordings, intracellular current/voltage clamping, patch clamping and epithelial transport studies.

ADInstruments is a world leader in the development and manufacture of computer-based data acquisition systems. PowerLab hardware, supplied with LabChart software, integrates seamlessly with Warner amplifiers. PowerLab data acquisition systems are ideal for use in electrophysiology and neurophysiology studies by providing excellent data integrity, high sampling rates with speeds up to 200 kHz per channel (400 kHz aggregate) and 16-bit full-scale signal resolution. Add-on software modules provide highly specialized data analysis features, for example, advanced extracellular neural spike activity detection, discrimination and analysis using the Spike Histogram module and analysis of action potential, field potential, and evoked response experiments with the Peak Analysis Module.

Warner Instruments has over 20 years experience in providing high quality amplifiers for neuroscience and electrophysiological research. An extensive range of these amplifiers are supplied by ADInstruments for use in most extracellular and intracellular research applications.

Features & Benefits

- Complete neurophysiology and electrophysiology research systems
- Online spike discrimination and analysis
- Flexible continuous or sweep-based acquisition
- Fully programmable dual output stimulator
- Signal and spike-triggered averaging
- Online spectral analysis
- Online peak and evoked response analysis
- High common mode rejection minimizes noise
- High gain selections allow sufficient signal amplifications and accurate recordings
- Resistance and capacitance compensation removes signals distortion



Data Acquisition & Analysis

PowerLab Systems with LabChart Software

PowerLab data recording units, supplied with LabChart provide researchers with a high-speed data acquisition system. They have high signal resolution, numerous filter setting options and data compression features to reduce file size. A PowerLab system, in combination with LabChart software, provides comprehensive signal processing, data recording, display and analysis features for a wide range of research applications.

Some features of interest include:

Programmable Stimulator

The software-controlled Stimulator allows you to generate a stimulus or series of stimuli from the PowerLab analog outputs. You can quickly select the stimulation waveform's patterns, frequency, duration and output range. Two independent stimulus outputs can be generated using LabChart for Windows and a PowerLab data acquisition unit.

The Stimulator dialog contains a variety of preconfigured stimulus waveforms. Custom stimulus waveforms can be generated by selecting and configuring any combination and number of stimulus segments. All customized waveforms can be saved for future reference.

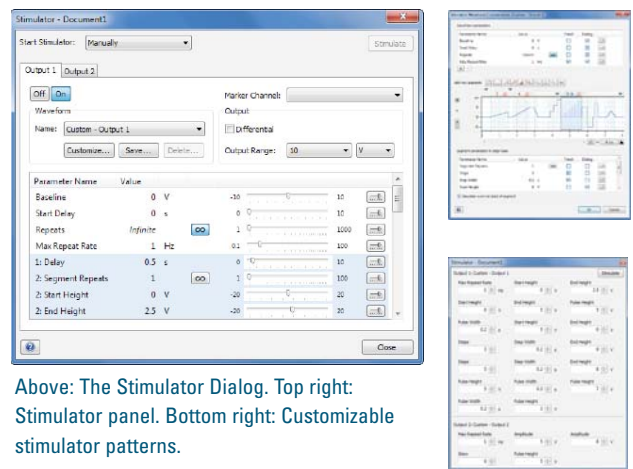
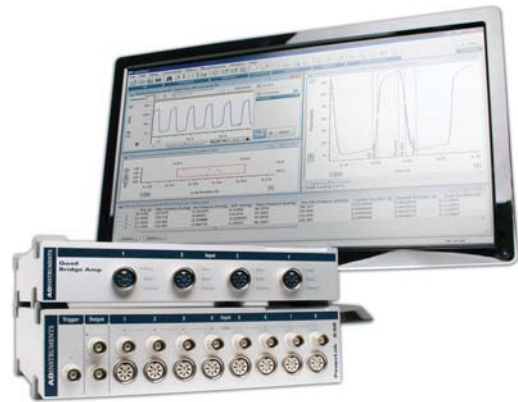
Using a PowerLab data acquisition unit, two independent stimulus outputs can be generated simultaneously. The two waveforms can be easily controlled using the Output 1 and Output 2 Tabs in the Stimulator dialog.

Once the stimulation parameters are set up in the Stimulator dialog, you can easily start or stop stimulation, and change the settings while sampling using the Stimulator panel.

The Stimulator panel floats in front of the active LabChart View window and can be moved around the screen. It gives you quick and easy control of stimulation parameters, including frequency, duration and amplitude for all outputs that are being used.

Scope View

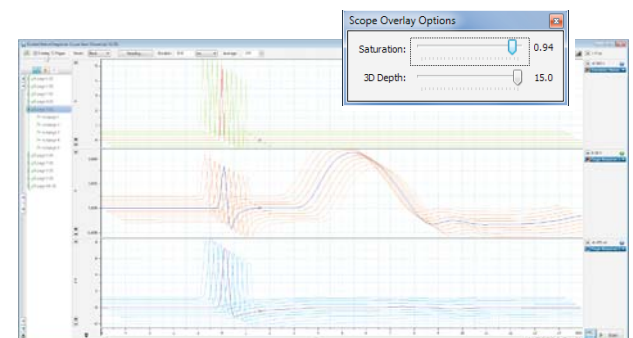
The LabChart Scope View provides a useful tool for displaying and analyzing data recorded in neurophysiology experiments. It provides the display and analysis capabilities of a digital storage oscilloscope within LabChart. Due to the flexibility of LabChart, Scope View can be used to average signals on multiple channels in real time. Scope View is of particular use in analysis of EEG, EMG, spike-triggered averaging, and in evoked potential studies where signal averaging is often required to extract evoked responses from background signal.



Above: The Stimulator Dialog. Top right: Stimulator panel. Bottom right: Customizable stimulator patterns.



A custom waveform generated in the Stimulator dialog.

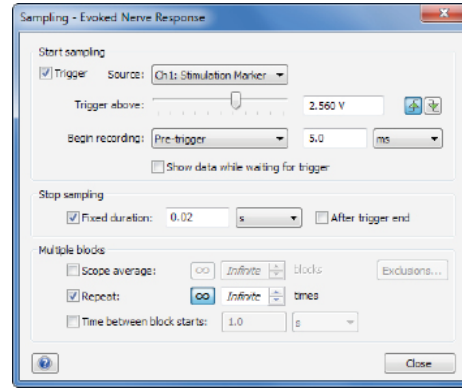


Scope View with Scope overlay options dialog.

Data Acquisition & Analysis

Triggering

You can control how and when LabChart starts and stops recording using the triggering options in the Sampling dialog. You can use the controls to set up the type of trigger event, any delay before recording, how many times to repeat triggering and how multiple blocks in Scope View are handled. You can start and stop a recording using an external trigger source, stimulator or by setting a threshold voltage to trigger from one of the recording channels. Pre-triggering and post-triggering options are available.



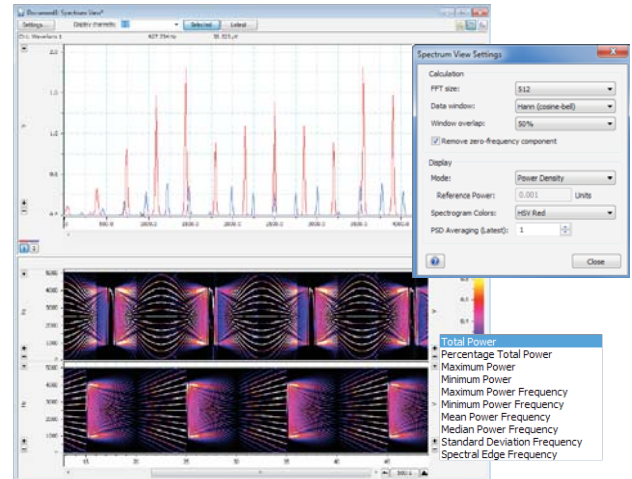
LabChart Triggering dialog showing trigger at 2.56 V, repeated infinitely.

Spectrum

Spectrum is a powerful tool to display, distinguish and analyze the component frequencies of a signal. It is frequently used to isolate electrical noise components or distinguish component waveforms within a signal (such as Alpha, Beta, Delta, Theta and Gamma waveforms within an EEG).

The spectral analysis is represented graphically with the Power Spectral Density (PSD) and the Spectrogram plot. The PSD and Spectrogram panes can be displayed individually or together, in online or offline modes.

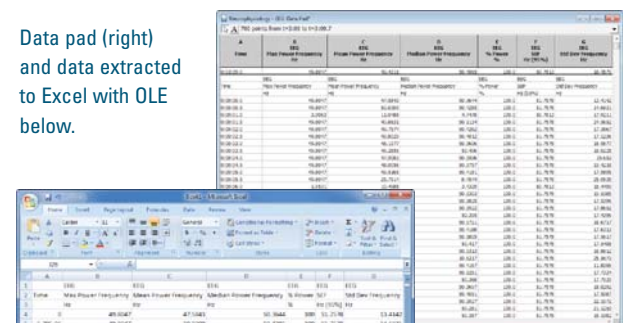
The PSD displays the power of the input signal over a selected frequency range. Single or multiple signals can be analyzed. Spectrum also provides various signal power and frequency calculations which can be added to the Data Pad.



Spectrum View (left), with settings (top right) and display options drop down menu (bottom right).

Data Pad with OLE Linking

Incoming or already recorded values can be exported in real time using OLE client programs such as Excel and Word. The link from LabChart to Excel can be made dependent so that any change to the data selection in LabChart will automatically update the values in Excel. OLE is available from the LabChart View mode as well as the Data Pad.



Data pad (right) and data extracted to Excel with OLE below.

Export options including *.nex

The 'save as' option in Labchart allows the export of data to other formats for further analysis.

Export options include:

- NeuroExplorer file (*.nex)
- Text file (*.txt)
- MATLAB file (*.mat)
- IGOR File (*.pxp)
- Axon Binary file (*.abf)
- WAV file (*.wav)

LabChart Modules

Spike Histogram Module

The Spike Histogram Module for LabChart is an effective tool for online or offline discrimination and analysis of extracellular neural spike activity recorded with LabChart software at high sampling rates. It features two powerful discrimination methods:

- Fast template matching (Windows only)
- Freeform contour discrimination

There are six analysis histograms available in the Spike Histogram Module, which enable you to view discriminated data in real time or offline in automatically generated analysis plots of rate, amplitude, interspike interval and perievent time. Auto-correlation and cross-correlation histograms are also available.

Spike Histogram integrates seamlessly with LabChart Scope View. Spike units defined in the Discriminator View Window can be used as an event source in Scope View, in which spikes may be individually reviewed and used for spike-triggered averaging.

The Spike Histogram Module for Windows provides the additional option of exporting data into NeuroExplorer® software for extensive spike train analysis options including Poincare plots, burst and spectral analysis, and more.

Peak Analysis Module (Windows)

Peak Analysis Module for LabChart can be utilized online or offline to automatically detect and analyze multiple, non-overlapping peaks in recorded waveforms.

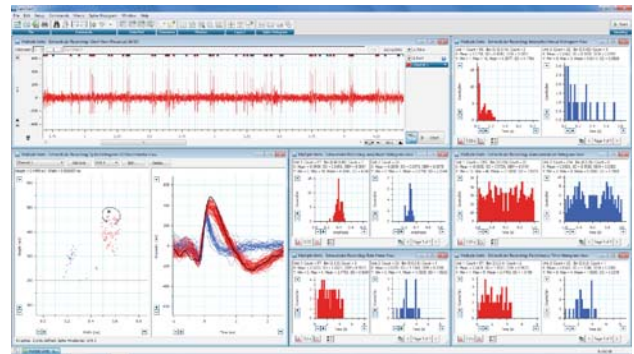
Users can select from one of several default analysis settings available for general waveforms and specific signal types such as:

- Population Spikes
- Action Potentials

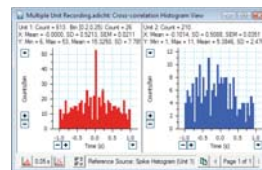
The Population Spike analysis detects and analyzes extracellular evoked responses consisting of a spike population superimposed on an excitatory postsynaptic potential.

The automatically detected peaks are displayed in the Peak Analysis View with highlighted parameter markers, values and peak areas. The detection, calculation and Table View options can be customized for each waveform type and to suit your application.

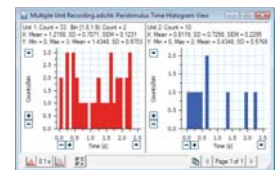
The selected calculated peak parameters are logged to a table that can be easily exported to other applications.



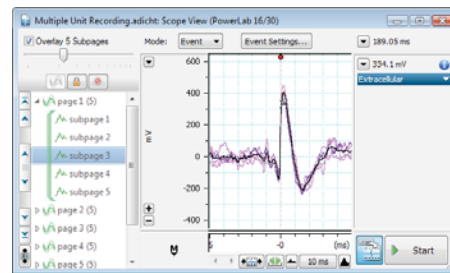
Analysis of extracellular spike data using the Spike Histogram Module.



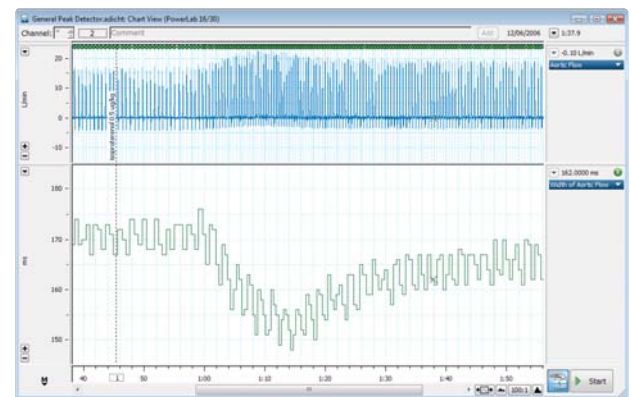
Cross-correlation.



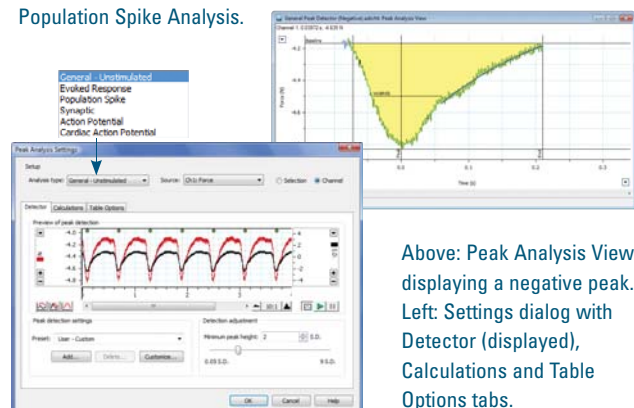
Peristimulus Time.



Spike units defined in Spike Histogram Discriminator Window can be used as an Event Source in LabChart Scope View.



Population Spike Analysis.



Above: Peak Analysis View displaying a negative peak. Left: Settings dialog with Detector (displayed), Calculations and Table Options tabs.

Complete Research Systems

Warner Instruments' amplifiers and accessories are incorporated in our specialized range of neurophysiology systems, ideal for acquiring *in vitro* or *in vivo* signals. Systems are supplied configured specifically for studies involving extracellular recordings, intracellular current/voltage clamping, patch clamping, and epithelial transport studies. These systems may be used with either (or both) high impedance glass or metal microelectrodes (microelectrodes are not included in research systems).

PL3508B73 Extracellular Recording System

The PL3508B73 is well-suited to single/multi-unit extracellular, EEG and ECG recordings with glass or metal microelectrodes (microelectrodes not included). The system features the low noise DP-311 Differential Amplifier with excellent common mode rejection, high input impedance, high gain, high DC tolerance and an internal calibration signal to test amplifier gain and operation.

An active headstage and E Series Electrode Holder (1.5 mm capillary) are included with this system. LabChart Pro is provided with this system, which incorporates all LabChart modules such as Spike Histogram.



PL3508B73 Extracellular Recording System

PL3508B74-V Intracellular Recording System

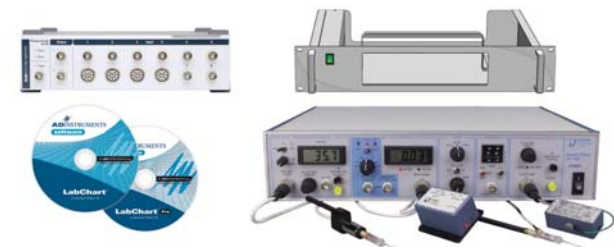
The PL3508B74-V is designed for intracellular studies using the IE-210-V Intracellular Electrometer Amplifier, which allows simultaneous current injection stimulation and recording using a single microelectrode (microelectrode not included). The amplifier features three output gains (x10, x20 and x50) with balance controls, capacitance compensation up to 50 pF, low noise, low drift and fast response time. Cell impalement is facilitated with a Buzz voltage control that is variable in both frequency and amplitude.

An E Series Electrode Holder (1.5 mm capillary) and a small, lightweight probe headstage are included with this system.

The RB-1 Remote Buzz Control (3 m cable) for convenient remote operation of the buzz voltage and the BB-15 Breakaway Box that allows application of large voltages to the electrode for iontophoretic injection of dyes or drugs are also available for use with the IE-210-V Intracellular Electrometer.



PL3508B74-V Intracellular Recording System



PL3508B75-V Two Electrode Voltage Clamp Recording System

PL3508B75-V Two Electrode Voltage Clamp Recording System and PL3508B76-V Oocyte Clamp Workstation System

The PL3508B75-V and PL3508B76-V systems are designed for two-electrode, whole-cell voltage clamping of large cells and cell structures using the OC-725C-V Oocyte Clamp Amplifier. The amplifier's unique bath clamp circuitry provides accurate bath current measurements, high compliance voltage, low noise, two clamp speeds and fast stable voltage clamping with extended current measuring range. The OC-725C-V amplifier is supplied with an oocyte model cell, voltage headstage, bath clamp headstage and current electrode cable. Two E Series Electrode Holders (1.5 mm capillary) are supplied with these systems (straight and with handle 45° Style). The PL3508B76-V provides an additional oocyte recording chamber, left and right micro-manipulators and magnetic stands.

Complete Research Systems

PL3508B79 Patch Clamp Recording Systems

The PL3508B79 Patch Clamp Recording Systems are suitable for both whole cell measurements and single channel studies using the PC-501A multi-purpose patch clamp amplifier. The amplifier features independent “V” hold and “I” hold circuitry, three operating modes, a 4-pole low-pass Bessel filter, internally generated test signals, variable duration zap circuit and compensation controls. Each system includes a straight Q Series Electrode Holder (1.5 mm capillary) and a model cell allowing installation and amplifier testing in an isolated environment.

The PL3508B79 is available with the option of three different headstages to suit your application:

PL3508B79/8V Patch Clamp Recording System with 5101-100M Headstage

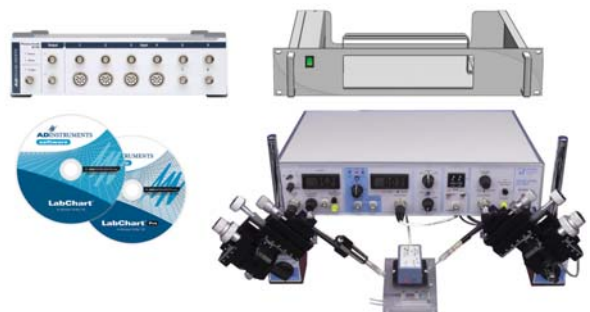
Suitable for whole cell recordings with currents up to ± 100 nA

PL3508B79/9V Patch Clamp Recording System with 5101-01G Headstage

Suitable for whole cell recordings with currents up to ± 10 nA

PL3508B79/10V Patch Clamp Recording System with 5101-10G Headstage

Suitable for single channel recordings with currents up to ± 1 nA



PL3508B76-V Oocyte Clamp Workstation System



PL3508B79 Patch Clamp Recording System

Epithelial Voltage Clamp Systems

The Epithelial Voltage Clamp Systems are designed for the studies of epithelial transport and the electrical properties of tissue such as measuring transepithelial voltage, short circuit current, and membrane resistance. A variety of self-contained Ussing Chambers are available separately with inserts that can be easily exchanged between experiments.

Epithelial Voltage Clamp systems that are available include:

PL3508B77-V Single Channel Epithelial Voltage Clamp System

Features the EC-800-V Epithelial Voltage Clamp (120 V compliance) amplifier

PL3508B78-V Dual Channel Epithelial Voltage Clamp System

Features the EC-825A-V Dual Channel Epithelial Voltage Clamp (50 V compliance) amplifier



PL3508B77-V Single Channel Epithelial Voltage Clamp System

Additional Electrophysiology Products

In addition to those featured in the Neurophysiology Research Systems, a number of Warner Instruments' amplifiers are also available for separate purchase.

DP-301 Single Channel and DP-304-V Four Channel Differential Amplifiers

Ideal for EEG, ECG and extracellular recordings, these AC/DC amplifiers feature high input impedance, high common mode rejection, low noise, high gain, high DC tolerance and bandwidth filtering. Both are supplied with standard IC-2S input cables which are not terminated at the outboard end (cables with 2 mm pin and alligator clip are also available). The DP-301 is powered with four standard 9 V batteries allowing it to be conveniently placed at the site of measurement.



DP-304 Four Channel Differential Amplifier

IE-251A-V Intracellular Low Cost Electrometer

The IE-251A-V is an economical alternative to the IE-210-V amplifier and is well suited for teaching laboratories. It features low noise and drift-free recording (from glass microelectrodes) and a small and lightweight active headstage (included), which can easily be mounted on a micro-manipulator.



IE-251A-V Intracellular Low Cost Electrometer

EC-800LV-V Epithelial Voltage Clamp (15V compliance)

The EC-800LV-V is an economical clamp, providing a milder environment for the membrane. It is suitable for studies that do not require high compliance such as small tissue samples or monolayers in set-ups with low access resistance.



DP-301 Single Channel Differential Amplifier

Supplementary items

FE180 Electronic Stimulator

Provides options for single pulse, paired pulse, pulse train and repeat pulse operation. Biphasic stimuli are also supported. The booster amplifier to allow field stimulation with a maximum output of 50V.



FE180 Electronic Stimulator

ML1101 Stimulus Isolator

Insulates the output for the FE180 Electronic Stimulator from ground.



ML1101 Stimulus Isolator

MLS063 NeuroExplorer for Windows

Powerful offline data analysis program for neurophysiology. It includes a wide range of spike train analysis options including coherence analysis, principal component analysis, population PST histograms and Poincare maps of interspike intervals. Spike trains that have been sorted and defined can be saved in the *.nex format and opened directly by NeuroExplorer. Continuous data files can be saved as text and easily imported to NeuroExplorer.

Ordering Information

Neurophysiology Research Systems

Note: The equipment from Warner Instruments in this brochure is not intended for connection to human subjects.

PL3508B73 Extracellular Recording System

- 1 x PL3508/P PowerLab 8/35 with LabChart Pro*
- 1 x MLA190 19" Rack Adapter
- 1 x DP-311 Differential Amplifier with Active Headstage
- 1 x ESP-F15N E Series Electrode Holder (Str, Ag Wire, 1.5 mm)

PL3508B74-V Intracellular Recording System

- 1 x PL3508/P PowerLab 8/35 with LabChart Pro*
- 1 x MLA190 19" Rack Adapter
- 1 x IE-210-V Intracellular Electrometer
- 1 x ESP-F15N E Series Electrode Holder (Str, Ag-AgCl Pellet & Wire, 1.5 mm)

PL3508B75-V Two Electrode Voltage Clamp Recording System

- 1 x PL3508/P PowerLab 8/35 with LabChart Pro*
- 1 x MLA190 19" Rack Adapter
- 1 x OC-725C-V Oocyte Clamp Amplifier which includes:
 - 7250V Oocyte Clamp Replacement Voltage Headstage
 - 7251I Oocyte Clamp Replacement Bath Clamp Headstage
 - 7259C Oocyte Clamp Replacement Current Electrode Cable
 - 725MC Oocyte Model Cell
- 1 x ESW-F15V E Series Electrode Holder (Str, Vent, Ag Wire, 1.5 mm)
- 1 x ESP/W-F15 N Series Electrode Holder (45°, Vent, Handle, Ag Wire, 1.5 mm)

PL3508B76-V Oocyte Clamp Workstation System

- 1 x PL3508/P PowerLab 8/35 with LabChart Pro*
- 1 x MLA190 19" Rack Adapter
- 1 x OC-725C-V Oocyte Clamp Amplifier which includes:
 - 7250V Oocyte Clamp Replacement Voltage Headstage
 - 7251I Oocyte Clamp Replacement Bath Clamp Headstage
 - 7259C Oocyte Clamp Replacement Current Electrode Cable
 - 725MC Oocyte Model Cell
- 1 x RC-3Z Oocyte Recording Chamber
- 1 x MM-33L Left Micro-Manipulator
- 1 x MM-33R Right Micro-Manipulator
- 2 x MB/B Magnetic Base
- 1 x ESW-F15V E Series Electrode Holder (Str, Vent, Ag Wire, 1.5 mm)
- 1 x E45W-F15VH E Series Electrode Holder (45°, Vent, Handle, Ag Wire, 1.5 mm)

PL3508B77-V Single Channel Epithelial Voltage Clamp System PL3508B78-V Dual Channel Epithelial Voltage Clamp System

- 1 x PL3508/P PowerLab 8/35 with LabChart Pro*
- 1 x PLA190 19" Rack Adapter
- 1 x EC-800-V Epithelial Voltage Clamp (120V compliance)
OR
- 1 x EC-825A-V Dual Channel Epithelial Voltage Clamp (50V compliance)

PL3508B79/8V Patch Clamp Recording System with 5101-100M Headstage PL3508B79/9V Patch Clamp Recording System with 5101-01G Headstage PL3508B79/10V Patch Clamp Recording System with 5101-10G Headstage

- 1 x PL3508/P PowerLab 8/35 with LabChart Pro*
- 1 x PLA190 19" Rack Adapter
- 1 x PC-501A/8-V Patch Clamp with 5101-100M Headstage (100 M Ω)
OR
- 1 x PC-501A/9-V Patch Clamp with 5101-01G Headstage (1 G Ω)
OR
- 1 x PC-501A/10-V Patch Clamp with 5101-10G Headstage (10 G Ω)
- 1 x MC-100M Model Cell for 5101-100M Headstage (100 M Ω)
OR
- 1 x MC-01G Model Cell for 5101-01G Headstage (1 G Ω)
OR
- 1 x MC-10G Model Cell for 5101-10G Headstage (10 G Ω)
- 1 x QSW-A15P Q Series Electrode Holder (Str, Port, Ag Wire, 1.5 mm)

Individual Items

| Instruments | |
|-------------|---|
| DP-301 | Single Channel Differential Amplifier |
| DP-304-V | Four Channel Differential Amplifier |
| IE-251A-V | Intracellular Low Cost Electrometer |
| EC-800LV-V | Epithelial Voltage Clamp (15V compliance) |
| FE180 | Electronic Stimulator |
| ML1101 | Stimulus Isolator |
| MLS063/3 | NeuroExplorer® (Windows® – 3 user licenses) |

*LabChart Pro includes all LabChart Modules in one value-for-money software suite.

 Share your data with colleagues. Free LabChart Reader – download to view and analyze LabChart data.

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PowerLab systems and signal conditioners meet the European EMC directive. ADInstruments signal conditioners for human use are approved to the IEC60601-1 patient safety standard and meet the CSA C22.2 No. 601.1-M90 and UL Std No. 2601-1 safety of medical electrical equipment standards.



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