Data acquisition and analysis

For all aspects of physiological research
“I became interested in ADInstruments after seeing the products shown at the Society for Neurosciences meeting. I love this company and their products. As an investigator in the neurosciences, I deal with many different vendors and many different kinds of equipment and also experience the whole gamut of product quality and customer service. My recent purchase of a PowerLab and LabChart software from ADInstruments stands out as one of the best experiences I have had buying a new product.”

Associate Professor Ken Catania, Vanderbilt University, Tennessee, USA

“My research group are interested in both basic, pathophysiologically relevant research and clinical experimental research. To combine both is somewhat difficult, with an emerging need for advanced technologies. The PowerLab system has provided us with an affordable, top-technological means to detect, accurately record and analyze biomedical signals. We have studied a number of tissue types, involving smooth muscle and mucosa, together with dedicated ECG for detecting autonomic neuropathy in a number of conditions.”

Piero Portincasa, MD, PhD, University of Bari Medical School, Bari, Italy

“In the MRI laboratory at Hoffmann-La Roche, PowerLab has been used since 1999. PowerLab is a central technology platform within our laboratory that performs investigations on an average of 1200 animals per year. During MRI scans the physiological state of each animal is monitored, recorded and archived. With the PowerLab system, ADInstruments has created a physiological monitoring system that stands out because of its reliability and ease of use.”

Stephanie Schöppenthau, Hoffmann-La Roche Ltd

“PowerLabs are very easy to use. They’re intuitive, they’re simple. Because they have no moving parts and no mechanical systems, they’re very robust, they’re very reliable.”

Dr Michael Shatlock, Rayne Institute, St Thomas’ Hospital, UK

“We have been using the ADInstruments PowerLab data acquisition systems, in combination with Millar PVAN Ultra and Transonic Flowmeter, in cardiovascular physiology and pharmacology since our lab was established. ADInstruments software is powerful, easy to use and is regularly updated.”

Dr. Rongli Zhang, The Institute of Molecular Medicine, Peking University, China

“I have been using an eight-channel PowerLab for more than 3 years along with Millar Mikro-Tip catheters for invasive blood pressure monitoring in rodent models. It has helped me immensely in pursuing my doctoral study on diabetic cardiomyopathy. The ADInstruments software is very user friendly and easy to use even for a novice user. With customizable add-on modules like Blood Pressure and ECG Analysis it makes life science research quite easy for us. It would be my pleasure to continue using the PowerLab in my future experiments and I will certainly recommend the same to my colleagues and friends.”

Sandeep Kumar, National Centre for Cell Science, India

“I like that PowerLab allows me to use all of my existing amplifiers and transducers. The intuitive interface makes life easy. I like to change gains and display settings on the fly, something the competitor’s system does not allow.”

Dr. Jerrel L. Wilkens, University of Calgary, Canada
About ADInstruments

Established in 1988, ADInstruments is a market-leading provider of computer-based data acquisition and analysis systems for life science. Our customers include internationally-recognized research hospitals, pharmaceuticals, biotechnology companies, contract research organizations, research institutes and 100% of the Quacquarelli Symonds Top 100 Life Sciences and Biomedical Universities in the World (2010).

Our success comes from providing life science researchers a data acquisition and analysis solution that is user friendly, ensures data integrity, is versatile, and accelerates the research process.

The ADInstruments Advantage

- **Proven track record** with installations in thousands of research institutes, universities, hospital and commercial laboratories around the world.

- **Power and flexibility** to be used in a variety of life science applications. Start with a PowerLab system and simply add an appropriate amplifier, instrument and transducer.

- **Quality and reliability** are synonymous with ADInstruments products. They are manufactured under a quality system certified by an accredited body as complying with ISO 9001:2008. The latest range of research PowerLab systems and signal conditioners are covered by a 5-year warranty to provide peace of mind.

- **Data integrity** is paramount. Our PowerLab data acquisition systems are calibrated and tested to deliver data you can trust.

- **GLP and 21 CFR Part 11 compliance** is facilitated when a PowerLab system is used with the GLP Module and GLP Server software. Together they provide the required user interface, audit trail and signing components for non-repudiation of data.

- **Being the industry leader** for data acquisition is something we’re proud of. With 24 years of design and manufacturing experience, more than 38 000 installations worldwide, over 10 000 research papers we have referenced from research journals, and citations in Google Scholar exceeding 55 000, it’s easy to see why our systems are the preferred choice for life science research all over the globe.

- **Intuitive and powerful software** allows researchers to concentrate on the science. With no programming required, the software is mastered quickly and provides comprehensive recording, display and analysis features.

- **Excellence in customer training and support** is what we are known for. Our staff includes Scientists, Programmers and Engineers that understand your research needs. In addition, with eleven ADInstruments offices and over forty distributors, we provide a truly global support network.

- **ADInstruments complete research systems** provide solutions for Isolated Heart, Isolated Tissue, Blood Pressure Analysis, ECG Analysis, Non-Invasive Blood Pressure, Ventricular Volume, Ventricular Pressure, Blood Flow, Nerve Activity, Cardiac Output, Biopotential, Blood Pressure and SNA Telemetry, Extracellular and Intracellular Recording. Complete research systems include equipment from Gold Standard manufacturers such as Millar Instruments, DMT and Transonic Systems.
Contents

Introducing ADInstruments Systems
A brief description of ADInstruments hardware and software

PowerLab in Research
Applications, hardware configurations and software features for cardiovascular, respiratory, sleep, exercise and neurophysiology research

- Mouse and Rat Applications 8
- Blood, Atrial and Ventricular Pressure 10
- Telemetry 14
- ECG and Heart Rate Variability 16
- Blood Flow, Cardiac Output and Oximetry 18
- Respiratory and Airway 20
- Exercise Physiology 22
- Electrophysiology 24
- Sleep 26
- Psychophysiology 28
- Isolated Tissue 32
- Isolated Perfused Hearts 36

LabChart Software
Overview of acquisition, display and analysis features including LabChart Extensions and LabChart Modules.

- ADInstruments Research Software Overview 40
- Key LabChart Features 42
- LabChart 46
- LabChart Extensions 60
- LabChart Reader 61
- LabChart Pro and LabChart Modules 62
- LabChart Specifications 75
- GLP Client & Server 76
ADInstruments Hardware

Configured Research Systems and a wide range of Signal Conditioners, Instruments, Transducers and Accessories

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerLab Data Acquisition Systems</td>
<td>78</td>
</tr>
<tr>
<td>Research Systems</td>
<td>80</td>
</tr>
<tr>
<td>Signal Conditioners</td>
<td>96</td>
</tr>
<tr>
<td>Instruments</td>
<td>106</td>
</tr>
<tr>
<td>Transducers and Accessories</td>
<td>122</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>122</td>
</tr>
<tr>
<td>Biopotential</td>
<td>124</td>
</tr>
<tr>
<td>Biopotential Consumables</td>
<td>127</td>
</tr>
<tr>
<td>Galvanic Skin Response</td>
<td>128</td>
</tr>
<tr>
<td>Blood and Fluid Flow</td>
<td>128</td>
</tr>
<tr>
<td>Pulse Oximetry</td>
<td>129</td>
</tr>
<tr>
<td>Cardiac Output</td>
<td>130</td>
</tr>
<tr>
<td>Force and Displacement</td>
<td>130</td>
</tr>
<tr>
<td>Heart Sounds</td>
<td>131</td>
</tr>
<tr>
<td>Invasive Blood Pressure</td>
<td>132</td>
</tr>
<tr>
<td>Langendorff</td>
<td>135</td>
</tr>
<tr>
<td>Neurophysiology</td>
<td>136</td>
</tr>
<tr>
<td>Noninvasive Blood Pressure</td>
<td>140</td>
</tr>
<tr>
<td>Pulse and Plethysmography</td>
<td>141</td>
</tr>
<tr>
<td>Respiration</td>
<td>142</td>
</tr>
<tr>
<td>Telemetry</td>
<td>144</td>
</tr>
<tr>
<td>Wireless Neural Recordings</td>
<td>146</td>
</tr>
<tr>
<td>Temperature</td>
<td>146</td>
</tr>
<tr>
<td>Organ Bath Stimulating Electrodes</td>
<td>148</td>
</tr>
<tr>
<td>Event Markers and Headphones</td>
<td>149</td>
</tr>
<tr>
<td>Stimulator Accessories</td>
<td>150</td>
</tr>
<tr>
<td>Psychophysiology</td>
<td>151</td>
</tr>
</tbody>
</table>

Product List

Index of products

PowerLab in Education

Information on PowerLab Systems and software in life science teaching
The core of our product range is the PowerLab® data acquisition unit. When PowerLab hardware is combined with ADInstruments software, researchers have a powerful and versatile data acquisition and analysis system at their command.

PowerLab systems provide the full utility of a multi-channel, real-time chart recorder, polygraph, XY plotter, digital voltmeter and storage oscilloscope with the benefits of easy data handling, remarkable resolution, variable sampling speeds and powerful analysis options.

ADInstruments extends the use of PowerLab systems with a range of complete solutions for specific applications. Our complete research systems typically include ADInstruments signal conditioners, as well as selected specialized instruments, transducers and accessories from leading manufacturers.

**ADInstruments Hardware**

**PowerLab 35 Series**
The PowerLab 35 Series units are available in four, eight and sixteen channels and provide continuous acquisition of up to 200 K samples per second per channel (one or two channels) or an aggregate of 400 K samples per second across all channels. Online computations can be performed at the same high sampling rates and displayed in real time.

The hardware unit has no knobs or dials and absolutely no programming is required. PowerLab systems connect to Windows and Macintosh computers using USB ports.

Typical research applications include:
- Blood, Atrial and Ventricular Pressure
- Blood Flow, Pulse Oximetry and Cardiac Output
- ECG and Heart Rate Variability
- Isolated Tissue
- Isolated Perfused Hearts
- Respiratory and Airway Physiology
- Exercise Physiology
- Neurophysiology/Electrophysiology
- Sleep
- Psychophysiology
- Animal Applications
- Telemetry.

See page 78 for more information.

**Signal Conditioners**

ADInstruments signal conditioners (preamplifiers) connect with PowerLab hardware to acquire the best signal possible for your particular application. See page 96 for more information.

*Software Control and Identification* — All gain and filter settings are selected using the software and saved automatically with your file. Once connected, ADInstruments signal conditioners are automatically identified and configured by ADInstruments software.

ADInstruments range of signal conditioners includes:
- Animal Bio Amp*
- Bio Amp*
- Octal Bio Amp
- Bridge Amp
- Octal Bridge Amp
- Conductivity Pod
- GSR Amp*
- Neuro Amp EX*
- pH/Temperature Amp
- Spirometer
- Stimulus Isolator*
- Thermistor Pod
- Animal Oximeter Pod
- Dual Bio Amp
- BP Amp*
- Quad Bridge Amp
- Cardiac Output Pod
- EOG Pod
- T-type Pod
- Oximeter Pod
- Pod Expander
- Stimulator HC
- Dual Bio Amp/Stimulator*.

*Signal conditioners designed for connection to subjects are certified by external test authority to IEC 60601–1 safety requirements.
Instruments
Our instrument range provides devices from gold-standard manufacturers, for specialized physiological applications, see pages 106 to 121. Our instrument range includes:
- Multi-channel Bio Amps
- Gas Analyzers
- Stimulators
- Intracellular Amplifiers
- Wireless Neural Headstages
- Organ/Tissue Baths
- Wire Myographs
- Isolated Heart Apparatus
- NIBP Devices
- Animal Telemetry Devices
- Temperature Controllers
- Stimulus Presentation Systems.

Transducers and Accessories
ADInstruments supplies an extensive selection of specialized transducers and accessories configured to operate with our signal conditioners. We offer transducers for measuring force, displacement, blood pressure, temperature, pH, air flow, pulse, respiration and much more. For details on transducers and accessories, please see pages 122 to 151.

Complete Research Systems
To save time and allow you to concentrate on research, we have configured research systems that have just about everything you need for specific applications. Each system includes a PowerLab data acquisition unit and software, as well as signal conditioners, instruments, transducers and accessories if required.

We offer complete systems for applications including:
- Blood Pressure
- Blood/Fluid Flow
- Cardiac Output
- Exercise Physiology
- Isolated Tissue
- Working Heart
- Langendorff Heart
- Neurophysiology
- Electrophysiology
- Telemetry
- Ventricular & Atrial Pressure
- Ventricular Pressure-Volume
- Wireless Neural Recording.

There are over forty complete research systems including the Telemetry Small Animal Foundation System shown below. Please see page 91 for more details.

Quality and Safety Standards
All ADInstruments hardware (PowerLab data acquisition systems, signal conditioners and instruments) are manufactured under a quality system certified as complying with ISO 9001:2008 by an accredited certification body. All ADInstruments isolated signal conditioners designed for subject connection are independently certified as being approved to strict IEC 60601-1 and equivalent CSA standards (identified by the use of the following symbols).

Intended Use
All ADInstruments manufactured products are intended for use in teaching and research. ADInstruments products are NOT intended to be used as medical devices or in medical environments and are NOT intended to be used to diagnose, treat, or monitor a subject.

Read our full intended use policy at www.adinstruments.com/support/safetystandards/

Complete Education Solutions
ADInstruments also provides engaging, cost-effective solutions for every level of life and health science education. Our blended learning approach has improved learning outcomes in high schools, colleges and universities.

Enhance learning using student-guiding software, in class and online
LabTutor Teaching Suite is a revolutionary education tool that engages students by efficiently guiding them through interactive experiment activities. These include real-time data acquisition, data analysis, graphing and reports, all within the familiar interface of an Internet browser. Learn more on page 156.
ADInstruments Software

ADInstruments software for research provides comprehensive data display, recording and analysis features that are easy to use and quick to master. Software options are summarized in the table below.

<table>
<thead>
<tr>
<th>Software</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>LabChart</td>
<td>LabChart software offers the functionality of a multi-channel chart recorder, digital oscilloscope, XY plotter and digital voltmeter. Record, display and analyze up to 32 channels of data in real time.</td>
</tr>
<tr>
<td>LabChart Pro</td>
<td>A software package that includes LabChart and all LabChart modules for analysis of application-specific data.</td>
</tr>
<tr>
<td>LabChart Modules</td>
<td>Application-specific acquisition and analysis add-on programs for LabChart software. Modules are available separately or as a collection in LabChart Pro. Examples include ECG Analysis, Blood Pressure, HRV and more.</td>
</tr>
<tr>
<td>LabChart Extensions</td>
<td>Available free of charge to all LabChart users. Extensions provide additional data formatting, filtering, visualization, measurement calculations and other utility features.</td>
</tr>
<tr>
<td>GLP Client and GLP Server</td>
<td>In conjunction with LabChart software, GLP Client and GLP Server software provide PowerLab users with an easy and reliable data acquisition solution for a GLP and 21 CFR Part 11 compliant environment.</td>
</tr>
<tr>
<td>LabChart Reader</td>
<td>A free program that allows scientists who do not use LabChart software to view and analyze (to a limited extent) LabChart data files. This allows PowerLab users to share data and collaborate with colleagues.</td>
</tr>
</tbody>
</table>

LabChart

LabChart software (supplied with all PowerLab systems for research) transforms your Windows or Macintosh computer into a digital chart recorder and oscilloscope that records and displays data in real time. You benefit from easy acquisition, graphical presentation and powerful analysis features.

LabChart lets you start, stop and adjust settings, record data with new settings and keep all this information within a single file. Additionally, any computed analysis or event information is saved within the same file. See page 42 for details.

Scope View

Scope View acts as a multi-channel oscilloscope and averages signals in real time. Pages/sweeps can be generated using data blocks, events or comments in LabChart View. Scope View can be controlled with macros and advanced scripting. There are no sampling or page limits and up to 100 pages can be overlaid.

Scope View provides a number of powerful tools to enhance analysis and display, and improve trace contrast. These include the 3D Depth Overlay feature, Scope Overlay Options dialog box and black/white background toggle. See page 53 for feature details.
LabChart Modules

LabChart modules are software add-ons that provide comprehensive analysis and feature sets for specific applications. LabChart modules are included with the LabChart Pro package, or can be purchased individually.

Modules include:

- Blood Pressure
- Peak Analysis
- ECG Analysis
- Spike Histogram
- HRV
- Video Capture
- Cardiac Output
- DMT Normalization
- Metabolic
- Circadian Analysis
- Dose Response
- PV Loop.

See pages 62–74 for full descriptions of each module.

LabChart Extensions

LabChart extensions are free software plug-ins that extend the functionality of LabChart. They fall into the following groups: File Translation, Filtering, Data Visualization, Measurement and Calibrations and Utility Features.

File translation extensions enable LabChart files to be saved in formats readable by popular packages including Axon and Igor Pro or spreadsheet packages such as Excel. See page 60 for a complete list of LabChart extensions.

Good Laboratory Practice Compliance

LabChart GLP Client and GLP Server provide the user interface, audit trail and signing components that are essential to meet GLP and FDA 21 CFR Part 11 requirements. See page 76 for more information.

LabChart Reader

LabChart Reader is a free downloadable program that lets you share your LabChart data files with colleagues. It enables anyone to open and view LabChart files. The program includes standard LabChart analysis and display features. The advanced analysis tools from LabChart modules and extensions are only available with the full version of LabChart software with LabChart Pro. See page 61.
ADInstruments provides a variety of research systems ideal for *in vivo* and *in vitro* investigation of diverse physiological parameters in mouse and rat models.

**Intravascular Blood and Cardiac Pressure**

The PL3508B49 Mikro-Tip BP Foundation System (page 88) records pressure using high-fidelity Millar Mikro-Tip® Catheters (page 132). Due to their small size and high-frequency response, they’re suitable for use with rats and mice. For ventricular pressure-volume recordings, the PL3516B49 MPVS Ultra Foundation System (page 88) and Millar Mikro-Tip Pressure-Volume Catheters (page 132) are ideal. The Blood Pressure Module (page 62) and PV Loop Module (page 72) provide automated analysis and display of pressure and pressure-volume parameters.

**Biopotential Recordings**

Signals such as ECG, EMG, EEG can be recorded using Needle Electrodes and the FE136 Animal Bio Amp (page 96). To record intracardiac or transesophageal ECG, Millar Electrophysiology Catheters (page 126) are used with a Bio Amp FE132, FE135, ML408 (page 97). ECG signals are analyzed using the ECG Analysis Module (page 68) which provides detection, averaging and analysis of ECG beats.

**Cardiac Output**

The ML313C Cardiac Output Pod (page 100) and Cardiac Output Accessory Kit (page 130) determine cardiac output of small animals using the thermodilution technique. The Cardiac Output Module (page 64) calculates cardiac output from a thermodilution curve recording. Transonic Flowmeters (page 107) and PowerLab systems can also be used to determine cardiac output through volumetric flow. Millar MPVS Ultra Systems (page 88) also provide cardiac output measurements.

**Cardiac Electrophysiology**

The PL3508B36 Cardiac Electrophysiology Foundation System (page 89) includes an 8 channel PowerLab, and the STG3008-EA Intracardiac Electrophysiology Stimulator/Amplifier. Using the EPR-800, 801, 802 Millar Electrophysiology Catheters (page 126), electrical properties of rodent atria and ventricles can be recorded.

**Telemetry**

ADInstruments provides Millar Telemetry Research equipment (page 121) for wireless, high-fidelity signal acquisition from small animals. In conjunction with
PowerLab systems, the solid-state wireless devices provide highly-accurate cardiovascular pressure, biopotential and temperature recordings.

Noninvasive Blood Pressure

The IN125/M NIBP Controller (page 108) in conjunction with a Pulse Transducer/Tail Cuff and PowerLab obtains noninvasive blood pressure measurements from mice and rats. A specialized tail cuff that incorporates a pulse transducer is used to intermittently measure blood pressure based on the periodic occlusion of tail blood flow.

Blood Flow and Oximetry

Blood flow can be measured invasively using Transonic Flow Systems (page 80). A wide range of probes for chronic and acute applications are available. Relative blood flow perfusion can be measured using the IN191 Blood FlowMeter (page 106). The ML325 Animal Oximeter Pod (page 100) is ideal for measuring pulse oximetry from the underside, base of the tail or other well-vascularized surfaces.

Isolated Organ and Tissue

A range of Organ Bath/Tissue Systems (page 81) and Wire Myograph Systems (page 83) are available for isolated muscle studies. The Dose Response Module (page 67) is used to automate the generation of dose response curves. To investigate cardiac function using the isolated heart preparation, Langendorff Heart Systems (page 84) and Working Heart Systems (page 86) are available in a wide range of configurations.

Wireless Neural Recording

5 and 15 channel Wireless Neural Recording Systems (page 94) are available for acquisition of action potential signals (spikes) from individual brain cells (neurons), as well as local field potential (LFP and EEG) signals in small animals such as rodents.
Blood, Atrial and Ventricular Pressure

Invasive Blood Pressure Measurement

ADInstruments supplies systems for invasive blood pressure measurements in a range of animal species. The systems are ideal for recording and analyzing blood pressure and related parameters in both anesthetized and conscious animals.

Mikro-Tip BP Systems

The PL3508B35 Mikro-Tip\textsuperscript{a} BP Foundation System (page 86) offers high-fidelity pressure signal measurements with unparalleled accuracy. Advantages include:

- Precise signal resolution as the pressure sensor is located at the tip, enabling recording at the source of the signal
- No signal attenuation or drift as catheters are solid-state rather than fluid or gel-filled
- Large selection of Millar Mikro-Tip Catheters for a variety of animal species (including mice, rats, cats, dogs, pigs, sheep, cattle, horses, etc.)
- Dual pressure sensor catheters for recording two pressure signals simultaneously (i.e. atrial and ventricular pressure)
- Millar Mikro-Tip Catheters connect easily to a PowerLab system using any ADInstruments Bridge Amp and a Catheter Interface Cable.

Using LabChart features such as Cyclic Measurements, Arithmetic and Data Pad (pages 55-56), BP parameters such as systolic, diastolic and mean blood pressure, as well as heart rate, can be easily recorded and displayed in real-time. The LabChart Blood Pressure Module (page 62) enables beat-by-beat or signal-averaged analyses of arterial and ventricular waveforms. Thousands of individual waveforms can be analyzed in a few seconds. Extracted parameters are provided in a table and if desired, can be easily exported to other software for further statistical analysis.

Millar Mikro-Tip Pressure-Volume Systems

The PL3516B49 MPVS Ultra Foundation System (page 88) simultaneously and continuously measures ventricular pressure and volume with high fidelity from the intact beating hearts of animals. Millar Pressure-Volume Catheters (page 132) are used to measure ventricular pressure and volume using the conductance method and are suitable for use in a wide range of animals.

ADInsitutns Advantage

- Complete systems for cardiovascular pressure and pressure-volume measurement in small and large animals
- The world’s most accurate high fidelity pressure/pressure-volume catheters
- Blood Pressure Module for automated detection, analysis and data extraction from ventricular and arterial pressure signals
- PV Loop Module for graphical display of the pressure-volume relationship and extraction of hemodynamic parameters including pressure volume area, stroke work, and cardiac output.
LabChart software allows researchers to display pressure-volume loops in real time and export parameters of interest to the Data Pad. In addition, the LabChart PV Loop Module (page 72) automatically plots PV loops in real time and calculates up to 30 cardiac parameters including:

- Cardiac Output
- Stroke Work
- Stroke Volume
- Preload Recruitable Stroke Work
- Max and Min dP/dt
- Max and Min dV/dt
- ESPVR and EDPVR
- Arterial Elastance
- Ejection Fraction
- Systolic & Diastolic Pressure
- Tau (τ): Isovolumetric Relaxation Time.

### Telemetry Systems

To facilitate study in conscious, free-roaming animals, ADInstruments provides a range of Millar Telemetry Research Systems (page 91). Telemetry-based studies offer a realistic insight into animal physiology and how it is influenced by the sympathetic nervous system.

#### Telemetry Foundation Systems

These configured research systems enable blood pressure, biopotentials and temperature to be recorded wirelessly using a single, implanted telemeter. Pressure, Biopotential and SNA Telemeters (page 145) feature Millar solid-state sensors that can acquire signal frequencies of up to 2000 Hz. Telemeters are available according to the measured signals.

The innovative SmartPad (page 121) power supply enables simultaneous recharging of the implanted telemeter battery while recording. Each telemeter transmits data on a separate frequency, allowing animals to be housed in the same area without requiring any special shielding.

---

**Select PowerLab citations**


---

**Search our citations database at: www.adinstruments.com/citations**
Fluid-Filled Pressure Catheters

ADInstruments offers several reusable and disposable Pressure Transducers (page 134) for use with fluid-filled catheters and a wide range of species. The MLT844 Physiological Pressure Transducer is highly accurate and features an easy-to-fill dome that can be quickly coupled to the transducer, eliminating any liquid between the transducer and dome diaphragms. This gives the transducer a long life expectancy by ensuring it does not foul. Pressure signals are amplified using a Bridge Amp (page 99) connected to a PowerLab data acquisition system (page 78). The ADInstruments range of Bridge Amps includes Single, Quad and Octal models.

For measuring intravascular blood pressure in humans, the BP Amp (page 99) is electrically isolated and certified for human connection when used with the supplied transducer cable and a sterilized disposable blood pressure transducer. Specialized polyethylene tubing is available for catheterization of arteries in small animals.

The Cyclic Measurements feature (page 55) in LabChart software derives and displays (online or offline) systolic, diastolic and mean arterial pressure, as well as heart rate, from a single blood pressure signal. The Blood Pressure Module (page 62) for LabChart (Windows) enables online or offline analysis of arterial and ventricular waveforms.

Animal Temperature Control

The ML295 Homeothermic Controller and Pad (page 121) maintains body temperature in anesthetized animals during surgical procedures or during chronic in vivo studies. The system is configured for use with small animals including mice, rats and guinea pigs.

Noninvasive Blood Pressure Measurement

Third-party NIBP devices that provide an analog output can be interfaced with PowerLab data acquisition systems. The acquired signals can be analyzed using LabChart software online or offline.

Human Noninvasive Blood Pressure Measurement

The MLE1054-V Finometer MIDI (page 109) is a noninvasive blood pressure device for use with human subjects. It interfaces with PowerLab data acquisition...
systems to provide a digital recording of the reconstructed arterial pulse-pressure waveform. The Finometer MIDI can be used alongside ADInstruments Bio Amps (page 97) to obtain simultaneous ECG recordings.

**LabChart Pro software** (page 62), which includes the ECG Analysis and Blood Pressure Modules, enables researchers to view, manipulate and analyze ECG and blood pressure signals online or offline, without losing raw data. Optional BeatScope Easy Software for Finometer MIDI enables cardiac output calculations to be derived from NIBP data.

### Animal Noninvasive Blood Pressure Measurement

The IN125 NIBP Controller (page 108) is ideal for mice and rats. It connects directly to a PowerLab system and uses a specialized Tail Cuff and Pulse Transducer (page 140) for mice or rats, from which arterial pressure can be determined (based on the periodic occlusion of blood flow to the tail).

To ensure a reliable signal, conscious animals must be trained and properly restrained using Rodent Restrainers (page 140) available in a range of sizes.

### Noninvasive Pulse Tonometry

The Pulse Tonometer (page 140) is a hand-held wand probe equipped with a Millar Mikro-Tip pressure sensor at its tip. It is designed for noninvasive recording of pulse pressure wave contours from humans and animals. The high-frequency response ensures accurate reproduction of pulsatile waveforms. The SPT-301 Millar Non-Invasive Pulse Tonometer features a 1.5 m cable and requires the AEC-10C Catheter Interface Cable for connection to ADInstruments Bridge Amps.
Telemetry

Telemetry offers a number of advantages to researchers including stress-free, long-term recordings from freely moving animals. A variety of Millar Telemetry Research Systems used to monitor and analyze blood pressure, biopotentials (ECG, EMG, EEG), and temperature are available.

Animal Telemetry Systems

ADInstruments & Millar Telemetry Research Systems

Millar Telemetry Research Systems are ideal for wireless monitoring of blood pressure, biopotentials, SNA, temperature and tissue oxygen in rats and other animals such as guinea pigs and rabbits, weighing 200 g or more.

Features of these systems include:
- Wireless recharging of telemeter batteries *in situ* (small animals)
- Independent telemeter frequencies allow normal animal interaction
- Digital data transmission range of up to 5 meters
- Range of telemeter configurations for small animals
- Ability to record three different signals from a single implanted telemeter
- Solid-state sensors with high-sampling frequencies (up to 2000 Hz)
- Power down feature extends rechargeable battery life
- Simultaneous recording from multiple telemeters.

The **PL3516B109 Small Animal Telemetry Foundation System** (page 91) is supplied with the PowerLab 16/35 data acquisition system, LabChart Pro software, SmartPad (Receiver/Charger) and Configurator (control of the SmartPad and Telemeters). Implantable Telemeters (page 145) are selected separately according to the monitored signals.

The following telemeters are available to record up to 3 signals from each device:
- Biopotential and Temperature
- Dual Biopotential and Temperature
- Pressure, Biopotential and Temperature
- Pressure and Temperature
- Dual Pressure and Temperature
- Tissue Oxygen and Temperature
- SNA (sympathetic nerve activity), Pressure and Temperature.

ADInstruments Advantage

- Complete telemetry systems for small animals
- Unique *in situ* recharging and independent signal frequencies allow animal cohabitation
- 32 channels of real-time data acquisition and analysis using LabChart
- Cutting edge solid-state technology provides highly accurate signals
- LabChart Pro with Blood Pressure, ECG Analysis, Circadian Analysis, HRV and Dose Response Modules provide fast, automated analysis of recorded data.
The **SmartPad** (page 121) uses patented inductive power technology to charge the implanted telemeter *in situ*, when the animal is housed over the pad. 24-hour continuous and simultaneous recording and recharging of implanted telemeters is possible. There is no need to send telemeters for battery replacements reducing the overall cost of research and lowering the number of required animals.

The SmartPad receives the telemeter signals and outputs them as voltage to **PowerLab** (page 78) and **LabChart software** (page 40). LabChart allows real-time recording and analysis of up to 32 channels. Parameter detection, extraction and analyses are made easy with features such as Cyclic Measurements, Data Pad and Arithmetic. Powerful VB Scripting can also be used to automate recording, display and analysis tasks.

**LabChart Pro** (page 62), supplied with the Telemetry Foundation Systems, includes a number of specialized software modules that automate detection, extraction and analysis of parameters of interest.

LabChart Pro Modules ideal for telemetry include:
- ECG Analysis
- Blood Pressure
- Circadian Analysis
- Heart Rate Variability
- Spike Histogram
- Peak Analysis.

LabChart’s ability to acquire up to 32 input channels from multiple data acquisition units to a single or multiple files provides added flexibility.
ECG and Heart Rate Variability

Electrocardiograms (ECG) and Heart Rate Variability (HRV) in humans and animals can easily be recorded and analyzed using PowerLab data acquisition systems and a suitable ADInstruments Bio Amp.

**Human ECG**

All ADInstruments Bio Amps (page 97) designed for human connection, provide full electrical isolation to guarantee subject safety. They feature low-noise, high-gain differential amplifiers and software-controlled low-pass, high-pass and notch filters for removal of unwanted signal frequencies.

The FE132 Bio Amp (page 97) is ideal for recording single channel ECG. Two or more channels of ECG or other biopotential measurements can be recorded using the FE135 Dual Bio or ML138 Octal Bio Amp (page 97). For multi-channel ECG, a Dual Bio Amp can record ECG from two standard lead configurations and LabChart can calculate the remaining four leads. Alternatively, the ADInstruments MLA0115 ECG 12-Lead Switch Box (page 124) provides a selection of standard ECG lead configurations using 10 standard lead wires. It supports a direct selection of leads configurations I, II, III, aVF, aVL, aVR and precordial leads V1 to V6.

The ML408 Dual Bio Amp/Stimulator (page 98) combines a human approved stimulator and dual bio amplifier to provide precise electrical stimulation of subjects while recording. ADInstruments also supplies the GT205/F 8 Channel and GT201/F 16 Channel Bio Amps (page 106).

**Animal ECG**

The FE136 Animal Bio Amp (page 96) is an isolated, high-performance, software-controlled differential amplifier used for the measurement of a wide variety of biological signals in animals and isolated tissues. It can be used with Needle Electrodes (page 125) for measuring biopotentials in a variety of animal species. Animal ECG can also be acquired using the MPVS Ultra Systems (page 88). In mice or rats, transesophageal or intracardiac electrographic recordings can be made using the EPR-800, 801 an 802 Millar Electrophysiology Catheters (page 126) in conjunction with a Bio Amp. Renal sympathetic nerve activity (RSNA) can be recorded using the DP301 Single Channel Differential Extracellular Amplifier (page 114) connected to PowerLab.

**ADInstruments Advantage**

- Complete software control of Bio Amps for high-quality signals
- LabChart ECG Analysis and HRV Modules for automatic detection, plotting and extraction of selected parameters
- Scope View for recording and viewing consecutive sweeps of ECG data
- ECG signals can be averaged using the LabChart for Mac SAECG Extension which calculates the averaged cycle of ECG signals
- Spectrum feature for online or offline determination of the power and frequency components of ECG.
Automated Analysis

The **ECG Analysis Module** (page 68) can be used to determine and quantify the salient components of an ECG during or after recording. The module provides powerful detection, analysis and reporting features. These include:

- Detection presets for a range of species, including human, dog, pig, rabbit, guinea pig, rat and mouse
- Presets are customizable for other species
- Extraction of 15 ECG parameters to an exportable table (can be saved as *.txt)
- Beat Classifier View for inclusion or exclusion of ECG beats in analysis
- Signal averaging and parameter plots.

Interbeat interval variation due to sympathetic/parasympathetic influences is easily identified and quantified using the **HRV Module** (page 69). Features include:

- Threshold detector to detect the R component from each ECG waveform and generate RR Interval data
- Automatic beat classification (normal, ectopic or artifact)
- Visual reporting of HRV through the Poincaré Plot, Period Histogram, ΔNN Histogram, Tachogram and LF, HF, and LF/HF parameters
- Display power spectrum of time-based Tachogram (FFT) with Spectrum View
- View limits of LF and HF regions of the Spectrum
- Text-based report including statistical analysis.

The cardiac vector can be calculated and displayed using the LabChart **Cardiac Axis Extension** (page 60). The extension automates the calculation of frontal plane electrocardiograms and the vectorcardiogram. It can also animate the instantaneous cardiac vector display. The **SAECG Extension** (page 60) calculates the averaged cycle of ECG signals. This allows for the removal of noise and unwanted waveforms.

---

**Select PowerLab citations**


---

**Search our citations database at: www.adinstruments.com/citations**

---

*LabChart recording of Human ECG (top window) with premature ventricular contractions (PVCs). ECG Analysis Module allows classification of beats on the basis of noise, form factor and RR interval using the Beat Classifier View (bottom inset). Analysis plots including the Averaging View, Waterfall Plot and QT/RR Plot are shown above.*
Blood Flow, Cardiac Output and Oximetry

PowerLab data acquisition systems, in conjunction with a range of specialized instruments and transducers, allow researchers to record a number of hemodynamic parameters such as blood flow, oximetry and cardiac output.

Blood Flow

Relative Blood Perfusion

Relative blood flow measurements in tissues, organs and skin can easily be recorded using a PowerLab data acquisition system and the laser Doppler based IN191 Blood FlowMeter (page 106). The MRI compatible surface laser Doppler Probes are suitable for measuring blood perfusion of skin, tissue and brain. A variety of needle probes (for animal use only) are available for determining regional blood flow in tissues, organs and small vascular beds.

Perivascular and Tubing Flow Systems

Transonic Systems Flowmeters (page 107) provide accurate flow measurements for in vivo and in vitro applications. The Flowmeters use transit-time ultrasonic technology, the gold standard in volume blood flow measurement for the past two decades. This technology offers unprecedented volume flow resolution. Flowprobes and flowsensors are supplied calibrated and ready for immediate use. Complete Perivascular and Tubing Flow Research Systems (page 80) including PowerLab data acquisition units and LabChart Pro software are available.

A variety of Transonic Flowprobes (page 128) are available for continuous real-time volume flow measurements (mL/min) in conscious and anesthetized animals for acute and chronic studies. These probes are placed around the vessel and do not interfere with blood flow to the target tissues. Available in a wide range of sizes (0.5 to 35 mm) and configurations, the probes are suitable for recording in small and large vessels in a variety of species, ranging from mice through to cows.

Tubing Flowsensors (page 129) are used for volume flow measurements in tubing applications such as isolated perfused organ studies. The in-line flowsensors are easily spliced into laboratory tubing and are calibrated to measure volume flow of water, saline, buffer solutions, blood or other fluids. The four-transducer
sensor design offers precision measurements for flows of less than 1 mL/min up to 100 L/min.

**Cardiac Output**

The **ML313C Cardiac Output Pod** (page 100) with the **MLT1402 T-type Ultra Fast Thermocouple** (page 147) is used to determine cardiac output using the thermodilution method in small animals (mice, rats, guinea pigs). Thermodilution is accurate, cost effective and superior to dye based measurements. The Cardiac Output Pod has a ‘delta’ temperature mode to allow a signal offset to be applied and monitor small temperature variations accurately.

The **Cardiac Output Module** (page 64) calculates cardiac output from selected thermodilution curves recorded in LabChart. Analysis parameters such as injectate temperature, volume, baseline correction and temperature tail-fitting limits are easily adjusted. The calculated data is automatically added to the Data Pad for further analysis.

The **Cardiac Output Accessory Kit** (page 130) includes an accurate syringe and dispenser, catheters, adapters, and taps, to facilitate the measurement of cardiac output.

Cardiac output can also be calculated in small and large animals with the **Transonic Flowmeters** (page 107) and suitable probes, or the **Millar MPVS Ultra** (page 88).

**Oximetry**

The **ML320 Oximeter Pod** (page 100) is suitable for measuring blood oxygen saturation (SpO₂) in humans. It connects directly to a PowerLab unit and is supplied with either a Finger Clip or Ear Clip sensor. The Oximeter Pod provides SpO₂ readings in the range of 70 to 100%. SpO₂ measurement in animals is also available using the **ML325 Animal Oximeter Pod** (page 100).
**Respiratory and Airway**

_In vivo_ or _in vitro_ respiratory and airway research data can be recorded and analyzed using ADInstruments PowerLab data acquisition systems and a range of specialized instruments and transducers.

Frequently recorded parameters include:
- Lung volumes and flow rates
- O₂ and CO₂ analysis
- Respiratory rate
- Lung sounds
- Intrathoracic pressure
- Bronchial/tracheal ring contraction (see Isolated Tissue application, page 32)
- Allergen/inflammation studies.

**Spirometry**

The spirometry technique is commonly used to assess lung function. It measures the amount (volume) and/or speed (flow) of air that is inhaled and exhaled.

The ADInstruments **FE141 Spirometer** (page 103) is a differential pressure transducer that can be used with a variety of **Respiratory Flow Heads** (page 142) for airway and flow studies from small to large animals and humans. For human respiratory studies where minimization of condensation is crucial, the **MLT3813H-V Heated Pneumotach** (Hans Rudolph) 800 L/min flow head with **Heater Controller** (page 142) is ideal.

Real-time respiratory flow and volume measurements are easily made in LabChart with the **Spirometry Extension**. The extension provides:
- Automated calibration of respiratory flow and volume recordings
- Advanced analysis functions
- Generation of flow-volume plots
- Calculation of tidal volume and respiratory rate
- Calculation of minute ventilation, peak inspiratory and expiratory flow.

**ADInstruments Advantage**

- LabChart easily records spirometric flow and volume signals
- The Spirometry Extension processes the raw flow signal and displays respiratory parameters such as tidal volume, minute ventilation, respiratory rate, PIF, PEF, FVC, FEV₁
- Flow/volume or pressure/flow loops can be displayed online with the XY View in LabChart
- Lung sounds can be easily correlated with breathing cycles. The Spectrum feature can be used to easily analyze lung sound frequencies.
Respiratory Gas Analysis

The ADInstruments ML206 Gas Analyzer (page 119) in conjunction with a PowerLab data acquisition system can be used to measure and display concentrations of O\(_2\) and CO\(_2\) in real-time. The fast response time of the Gas Analyzer’s transducers enables accurate respiratory gas analysis from humans. The instrument features a sampling flow control, making it suitable for use in mammalian studies.

Respiratory Rate

The MLT1132 Respiratory Belt Transducer (page 144) or MLT415/A Nasal Temperature Probe (page 148) are recommended for recording respiratory rate in humans. The Respiratory Belt Transducer plugs directly into a PowerLab input and can also be used in large animals such as dogs and pigs. The MLT1010 Finger Pulse Transducer (page 141) can be used for recording respiratory rate in small animals. The Cyclic Variables (page 55) feature in LabChart software can quickly and accurately detect periodic cyclical events and calculate rates from the signal.

Lung Sounds

Lung sounds can be recorded with the MLT208 Digital Stethoscope (page 131) using a high-frequency pulmonary setting. The Digital Stethoscope is a high-sensitivity microphone-based cardiac auscultation transducer. It allows distinction of audible heart sounds while simultaneously recording representative cardiac traces. The stethoscope can be connected directly to a PowerLab BNC input. Lung sounds and respiratory cycles can be easily correlated by recording the signals on separate channels and using the overlay feature in LabChart.

Select PowerLab citations


Search our citations database at: www.adinstruments.com/citations
Exercise Physiology

PowerLab systems provide both power and versatility for exercise/sports physiology applications. The PowerLab, in combination with LabChart Pro, records and analyzes a wide range of parameters. These include:

- Cardiopulmonary signals
- Respiration flow and volume
- Oxygen and carbon dioxide concentrations and rates
- Blood flow
- Heart performance (ECG, heart rate, R-R interval)
- Muscle activity (EMG)
- Reaction times.

Metabolic Studies

The PL3508B80 Exercise Physiology System (page 90) is ideal for studying cardiorespiratory and metabolic function in humans. The system includes a PowerLab 8/35 (8-channel data recording unit with LabChart software), single-channel Bio Amp, Respiratory Gas Analyzer, 4.7 L Gas Mixing Chamber, Spirometer, Thermistor Pod, Metabolic Accessory Kit and the LabChart Pro software suite including the Metabolic Module (page 70).

Airflow and gas concentration of expired air (%O₂ and %CO₂), are measured using the FE141 Spirometer (page 101) and the ML206 Gas Analyzer (page 119). Continuous real-time measurements of V\textsubscript{CO₂}, V\textsubscript{O₂}, V\textsubscript{E} and the Respiratory Exchange Ratio (RER) are easily and automatically calculated and displayed in a number of plots and tables by the Metabolic Module.

For heavy exercise where minimization of condensation is crucial, the MLT3813H-V Heated Pneumotach (Hans Rudolph) 800 L/min flow head with Heater Controller (page 142) is recommended.

Biopotential recording such as ECG and EMG can be made with PowerLab and any of the ADInstruments Bio Amps for human use (page 97). Heart rate can be easily calculated in LabChart from an ECG using Cyclic Measurements.

The Exercise Physiology System is supplied with LabChart Pro software (page 62) which includes a number of application specific analysis modules.
LabChart Pro modules useful in exercise physiology studies include:
- Metabolic
- ECG Analysis
- Blood Pressure
- HRV
- Peak Analysis
- Video Capture

ECG signals can be averaged and analyzed using the ECG Analysis Module (page 68). The module automatically detects, analyzes and reports PQRST onset, amplitude and intervals online or offline. The HRV Module (page 69) can analyze the heart rate variability of the recorded ECG, again online or offline. Video Capture (page 74) can be used to record and synchronize a video recording with a LabChart data file recording. Peak Analysis (page 71) offers automatic detection and analysis of non-overlapping peaks in a recording.

**NIBP Measurement**

The MLE1054-V Finometer MIDI (page 109) can be used for noninvasive blood pressure measurements. It can be connected to a PowerLab to record, display and analyze the brachial arterial pressure and beat to beat values of systolic, diastolic and mean pressure. The Blood Pressure Module (page 62) for LabChart for Windows can be used to automatically extract arterial pressure parameters online or offline. Cardiac output can also be calculated with the additional purchase of MLE1055 BeatScope Easy or MLE1056 BeatScope 1.1a software.

Other instruments and transducers that can be interfaced with a PowerLab in exercise physiology studies include oximeters (page 100), blood flowmeters (page 106), pulse transducers (page 141), goniometers (page 131), force transducers (page 130), and temperature sensors (page 146).

---

**Select PowerLab citations**


Electrophysiology

ADInstruments Electrophysiology/Neurophysiology Research Systems include a PowerLab data acquisition system, LabChart Pro software and specialized amplifiers with accessories to record, analyze and display data from extracellular and intracellular studies.

Extracellular Recording

The FE185 Neuro Amp EX (page 102), an extracellular amplifier with extremely low noise, is used to record from single cells or groups of cells in humans or animals using a metal microelectrode. Approved for human use, it is ideal for microneurography studies. The PL3508B73 Extracellular Recording System (page 91) is used for recording signals with an AC/DC preamplifier and headstage with glass or metal microelectrodes. It has excellent CMRR specifications and high DC tolerance. It is best suited for recording of extracellular activity, ECG and EMG in animals.

Intracellular Recording

The PL3508B74-V Intracellular Recording System (page 92) is a low-noise amplifier with low drift and fast response time for recording from high-impedance fluid-filled glass electrodes. Current injection circuitry permits simultaneous stimulation and recording from a single electrode. These features and the lightweight headstage make it ideal for easy and accurate intracellular recording and current injection.

The PL3508B75-V Two Electrode Voltage Clamp Recording System (page 92) and PL3508B76 Oocyte Clamp Workstation System (page 93) are used for clamping large cells and cell structures such as Xenopus Oocytes and squid axons.

Patch Clamp Recording

Several Patch Clamp Recording Systems (page 93) with varying headstage sensitivities are available for measuring current levels passing through whole cells or individual ion channels using a blunt electrode.

Epithelial Voltage Clamp Recording

Epithelial Voltage Clamp Systems (page 92) are available for studies of epithelial transport and the electrical properties of tissue or cell layers held in Ussing Chambers (available separately).

ADInstruments Advantage

- Sample up to 200,000 Hz in a single channel (up to 400,000 Hz aggregate)
- Spike Histogram Module for discrimination and analysis of extracellular data
- Smoothing, Absolute Value, Integration and RMS Arithmetic calculations for data processing
- Scope View for spike-triggered averaging and the overlay of evoked responses
- Peak Analysis Module for analysis of non-overlapping peaks
- Telegraph Extension for correct scale display of data after a gain change.
Stimulators

A PowerLab dual analog output stimulator can be used to stimulate isolated tissue directly or trigger and control other high-powered stimulators. The STG Stimulator series (page 120) is ideal for neurophysiology applications. Features include optically isolated channels and voltage or current stimulation modes with impressive resolution.

Data Analysis

A wide range of electrophysiological signals can be analyzed using LabChart software. LabChart’s Scope View (page 53) is a useful tool for averaging signals on multiple channels in real time. Scope View is of particular use in analysis of EEG, spike-triggered averaging and in evoked potential studies, where signal averaging is often required to extract evoked responses from background signal.

The Spike Histogram Module (page 73) can be used to perform real-time or offline discrimination and analysis of extracellular neural spike activity. Key features include:
- Freeform discriminating and fast template matching
- Selection of 6 customizable analysis histograms
- Removal of unwanted units from multi-unit recordings.

The Peak Analysis Module (page 71) provides a number of features that automate analysis of peaks. These include:
- Real time or offline analysis of peak parameters from action potentials, evoked responses and spikes
- Extracting parameters in a tabular format that can be exported to other programs for further analysis.

The LabChart Telegraph Extension (page 60) makes use of the gain-telegraph output from electrophysiological amplifiers for the continuous display of data at the correct scale after a gain change. LabChart can also save data as ABF (Axon binary format), which can be read by the pClamp software.

Select PowerLab citations


Sleep

PowerLab data acquisition systems provide sleep researchers with a powerful, yet easy-to-use tool for acquiring and analyzing an extensive range of physiological parameters relating to cardiovascular function, sleep disordered breathing, restless leg syndrome and sudden infant death syndrome, in both animal and human subjects.

PowerLab systems (page 78) can record and display up to 32 channels of data simultaneously in LabChart. Variable sampling rates enable synchronous recording of low frequency signals (for example, temperature and respiration) and high frequency signals (for example, EEG and EMG), while ensuring manageable data file sizes. Commonly recorded parameters in sleep studies include:

- Electroencephalogram (EEG/ECoG)
- Electrooculogram (EOG)
- Electromyogram (EMG)
- Electrocardiogram (ECG)
- Respiratory rate, airflow and pressure
- Oxygen saturation
- Intravascular and surface blood flow
- Invasive and noninvasive blood pressure
- Skin and rectal temperature.

Biopotential Recordings

The ML138 Octal Bio Amp (page 97) and GT201/F 16 Channel Bio Amp (page 106) are ideal for recording multiple potentials from a single subject. ADInstruments Bio Amps (page 97) interface with Flat EEG/EMG Electrodes, ECG Clip Electrodes or the Unshielded Lead Wires with Snap-On Connectors (page 125). Alternatively, the EEG Electro-cap Systems (page 127) can be used for human subjects. For animal studies, Alligator Clip Lead Wires or Needle Electrodes are available (page 125).

LabChart (page 40) offers numerous features and advanced modules for analysis of sleep data. The Blood Pressure (page 62), ECG Analysis (page 68) and HRV (page 69) Modules quickly and easily analyze cardiovascular data. The Circadian Analysis Module (page 65) can be used to determine patterns over unlimited durations, and the Spectrum feature allows spectral frequency analysis of signals such as EEG.

ADInstruments Advantage

- Spectral frequency (FFT) analysis of EEG, EMG and snoring sounds with LabChart's Spectrum View
- A selection of digital filters including high, low and band-pass/stop options
- Heart rate variability analysis using the HRV Module
- Circadian Analysis Module for recordings over unlimited durations
- Synchronized video/data recording of the subject with Video Capture Module
- Sampling control and Scope View for stimulus control and the overlay and averaging of responses.
Respiration and Oxygenation

Respiratory Belt Transducers, Spirometer and Flow Heads and Pressure Transducers are available (page 142 onward) to record respiratory rate, airflow and pressures in both animal and human subjects. LabChart’s Cyclic Measurements feature (page 56) and Peak Analysis Module (page 71) provide extensive analysis options for cyclical waveforms (see Respiratory and Airway application pages for further information). The ML320 Oximeter Pod (page 100) and a respiratory Gas Analyzer (page 119) are also available for measuring SpO2 and concentration of O2 and CO2, respectively.

Blood Pressure and Flow

Continuous, noninvasive blood pressure in humans can be easily measured using the MLE1054-V Finometer MIDI (page 109) with a variety of finger cuff sizes. The Blood Pressure Module (page 62) automatically extracts arterial pressure measurements online or offline, while noninvasive cardiac output can be calculated using BeatScope software.

Relative blood flow (in perfusion units) can be measured invasively (needle electrodes) or noninvasively using the IN191 Blood Flowmeter (page 106), while calibrated (mL/min) measurements can be performed using Transonic Blood Flow Systems (page 80) with customizable flowprobes sized appropriately for mice to large animals.

Wireless Animal Recordings

The Telemetry Foundation System (page 91) provides wireless recordings of biopotential, nerve, blood pressure and temperature of an animal during sleep. The systems allow long-term experimental protocols required for analysis of circadian rhythms using the Circadian Analysis Module (page 65). See Telemetry application pages for further information (page 14).

Recording of EMG, EEG and EOG from a human neonate during quiet sleep. Data provided by Dr R. S. C Horne, Monash University.
Psychophysiology

PowerLab data acquisition systems are widely used for researching the psychological basis of physiological processes including autonomic nervous system function, cardiorespiratory control, cortical function, pain and more. Typical research applications include:

- Skin conductance responses (GSR/SCR/EDR)
- Electrocardiography (ECG)
- Heart Rate Variability (HRV)
  - Sympathovagal tone (LF/HF)
- Evoked potentials
  - Visual (VEP)
  - Auditory (AEP)
  - Event-related brain potentials (ERPs)
- Electroencephalography (EEG)
- Reaction time and reflexes
- Stimulus presentation (using systems such as E-Prime and SuperLab)
- Blood pressure
- Skin temperature
- Respiratory analysis
  - Spirometry
  - Respiration rate
- Polygraphy.

Skin Conductance (GSR/EDR)

Skin conductance can be used to measure a subject's anxiety and emotional state. Using FE116 GSR Amp (page 102) and a PowerLab data acquisition unit with LabChart software, skin conductance measurements can be easily recorded and analyzed. The fully isolated and certified safe-for-human-use GSR Amp comes supplied with MLT116F GSR Finger Electrodes (page 128). The MLT117F GSR Finger Electrodes variant provides the option for use with MRI equipment. Extended cable length can be supplied on request.

ADInstruments Advantage

- Spectral frequency (FFT) analysis of ECG, EEG and EMG with LabChart's Spectrum View
- Heart rate variability analysis using the LabChart's HRV Module
- Synchronized video and data with LabChart's Video Capture Module
- PowerLab and LabChart can be interfaced with stimulus presentation software and hardware packages such as SuperLab and E-Prime
- Event Manager Extension for defining and controlling events in LabChart.
Biopotential Recordings

Biopotential signals are recorded using a PowerLab and an ADInstruments Bio Amp (page 94). The choice of the Bio Amp model depends on the number of recording channels required for the application. For ECG and HRV analysis, the FE135 Dual Bio Amp, ML138 Octal Bio Amp or GT201/F 16 Channel Bio Amp (pages 97 & 106) are recommended.

Automated analysis of ECG is possible with the ECG Analysis Module (page 68). Used to determine and quantify components of an ECG, the module provides powerful detection, analysis and reporting features. These include:

- Detection presets for a range of species (human, dog, pig, rabbit, guinea pig, rat and mouse)
- Preset customization for any species
- Beat Classifier for inclusion/exclusion of ECG beats
- Signal averaging and graphical plots
- Automatic extraction of 15 ECG parameters.

When combined with spectral analysis, HRV provides quantitative information about the relative influence of the sympathetic and parasympathetic nervous systems. The HRV Module (page 69) is a comprehensive tool for calculating and analyzing a subject’s HRV online or offline. Inter-beat interval variation can be automatically identified and quantified. Both visual and text based reports are available through the Poincaré Plot, Period Histogram, Delta NN Histogram, Tachogram and Spectrum (FFT) windows (sympathovagal tone) and a statistical report.

For EEG recording, LabChart’s Spectrum View (page 53) provides spectral analysis allowing quantification of the frequency and power components of the subject’s EEG.

Select PowerLab citations


Visual Stimulation and Reaction Times

PowerLab systems can be easily interfaced with stimulus presentation software and hardware. **SuperLab** stimulus presentation software (page 116) enables the presentation, recording and analysis of reaction times to visual and auditory stimuli. Using the **MLE1300 StimTracker** (page 118) reaction times to stimuli presented in SuperLab can be synchronized with physiological signals acquired and analyzed in real time using a PowerLab data acquisition and analysis system.

**RB Series Response Pads** (page 151) can be interfaced directly with a PowerLab via a Response Pad to PowerLab Cable or indirectly via the StimTracker. Response Pads are available with 5, 7 and 8-Buttons.

The **MLAC34 E-Prime Interface Cable** (page 151) allows the PST (Psychology Software Tools) serial response box to connect to the digital inputs on a PowerLab. Eight active keys from the PST Box can be used to trigger Digital Inputs 1–8 (on a suitable PowerLab) and insert Preset Comments into LabChart while recording.

Continuous varying responses to stimuli can be recorded in LabChart using ADInstruments **MLT1601/ST Response Meter** (page 151). This can be used where discrete responses are not warranted.

The **Event Manager Extension** (page 60) for LabChart for Windows allows users to define and monitor events online and perform a variety of user-defined actions. The **Scope View** (page 53) feature provides signal-averaging techniques to investigate visual and auditory-evoked potentials in signals such as EEG.

Cardiorespiratory Effects

PowerLab Systems enable psychophysicologists to monitor cardiorespiratory parameters such as blood pressure, skin temperature, respiratory rate, pulse, and blood perfusion in skin. The **MLT1100 Sphygmomanometer** (page 140) and **MLT201 Cardio Microphone** (page 131) can be used to obtain discrete, noninvasive blood pressure measurements using oscilometry or auscultation.

Continuous, noninvasive blood pressure (NIBP) can be recorded and simultaneously analyzed using the **MLE1054-V Finometer MIDI** (page 109), **PowerLab** and **BP Analysis Module** (page 62). Changes in skin blood perfusion can be obtained using the **IN191 Blood FlowMeter** (page 106) and a standard Surface Probe. Skin temperature can be recorded using a **ML309 Thermistor Pod** (page 105) and a skin temperature probe.
Polygraphy
Polygraphy combines several physiological measures used by researchers to distinguish between truth and deception. Typical physiological measures include:
- Skin conductance
- Skin temperature
- Respiration rate
- Heart rate (derived via Channel Calculations on either pulse or ECG signal).

Skin conductance can be recorded with the use of the GSR Amp (page 102) and a PowerLab. A Thermistor (page 148) with the ML309 Thermistor Pod (page 105) can acquire accurate physiological temperature readings. The respiratory rate can be efficiently recorded using the MLT1132/D Respiratory Belt Transducer (page 144). Heart rate can be derived from a pulse recording using the MLT1010 Pulse Transducer or an ECG recording using an ADInstruments Bio Amp (page 97).

Data and Video Synchronization
Data acquisition can be synchronized with live video recording using the Video Capture Module (page 74). Videos are recorded (typically using USB based web cameras) simultaneously with physiological data. Video analysis allows psychophysiologists to correlate a subject’s behavior (i.e. facial expression) with physiological data (i.e. heart rate variability).

Select PowerLab citations

**Isolated Tissue**

PowerLab systems are well suited to recording physiological and pharmacological properties of isolated tissue including skeletal, cardiac, and smooth muscle.

**Tissue-Organ Bath Systems**

Complete Isolated Tissue Research Systems (pages 81 to 83) featuring organ bath systems with four, eight or sixteen tissue chambers are available in compact and modular styles.

**Compact Encased Tissue-Organ Bath Systems**

The compact, all-in-one organ baths from Panlab allow automatic filling and emptying of tissue chambers. In addition they feature:

- Immersion of all tissue chambers and perfusate warming coils in a single temperature controlled bath
- Individual or simultaneous filling and emptying of tissue chambers
- Compact design to save on bench space
- Bath capacity options between 5 and 50 mL.

**Modular Tissue-Organ Bath Systems**

The modular systems (PL3508B60, PL3508B61, PL3516B62) include a PowerLab, a Radnoti tissue-organ bath, a bridge amplifier and isometric transducers. They offer:

- Traditional, glassware-on-stand design
- Water-jacketed reservoirs and tubing for perfusate temperature stability
- Easy addition and substitution of components
- Modular design for easy customization of glassware
- Bath capacity options between 5 and 300 mL.

Myograph based systems are also available for recording tension in:

- Small isolated blood vessels (>60 μm)
- Large isolated blood vessels (>500 μm)
- Large isolated vessels/tubular structures (<10 mm)
- Isolated muscle strip preparations (<15 mm).

For more information on myograph systems see overleaf and pages 83 and 112 of the hardware section.

**ADInstruments Advantage**

- Complete research systems for isolated tissue experiments
- Dose Response Module for investigating responses to agonists/antagonists
- Data Pad for automated extraction of experimental data
- LabChart software can control stimulation frequency and timing of pulse trains using an external stimulator
- GLP Client for data acquisition and analysis in a 21 CFR Part 11 compliant environment.
Bridge Amplifiers and Transducers

ADInstruments Single, Quad or Octal Bridge Amps (page 99) are software-controlled preamplifiers, providing a range of filter and amplification settings for isometric or isotonic transducers. Once connected, the bridge amplifiers are automatically identified by the PowerLab system and all user-configured settings are stored when the data file is saved. A range of Isometric and Isotonic Transducers (page 130) of varying specifications is available.

Stimulators & Stimulating Electrodes

The PowerLab analog output can be used directly as a stimulator or as a trigger to control the frequency and pulse duration of an external stimulator. ADInstruments also supplies a variety of powerful external stimulators (pages 103 and 119) that supply voltage and/or current stimulation and feature extensive programming options. A range of Stimulating Electrodes (page 149) for various types of tissues and experimental studies are also available (including single/double ring stainless steel or platinum, straight, zig-zag, coil, flat, and L-shaped electrodes).

PowerLab systems can also control perfusion pumps, syringe pumps or auto-injectors via eight TTL compatible digital outputs. The Event Manager Extension (page 60) is ideal for controlling user-defined events.

Software Modules

The Dose Response Module (page 67) provides quick and flexible tools for investigating the relationship between drug concentration and tissue response. The module automatically identifies minimum and maximum response ranges and generates a non-linear fit to the response data for the calculation of EC50 and Hill Slopes.

The Peak Analysis Module (page 71) provides automatic detection and analysis of multiple, but not overlapping, signal peaks in acquired waveforms.
Myography

Wire myographs are ideal for *in vitro* investigations of smooth muscle structure and function in tubular tissues >60 µm in diameter (i.e. vein, artery, bronchi, vas deferens and similar).

Myographs are available individually in single, dual, four-chamber and laser scanning confocal microscopy models. They are also available as part of the complete Myograph Research Systems (page 83) (PL3508B21, PL3508B22, PL3508B23, PL3508B24/TS, PL3508B25) that include a PowerLab data acquisition system, DMT Wire Myograph, LabChart Pro software with the DMT Normalization Module.

Features and benefits include:

- Stainless steel jaws for easy mounting of the tissue
- Small bath volume (5 to 10 mL) to conserve reagents
- Individually heated and aerated chambers to optimize tissue conditions
- Automated control of the micropositioners to determine passive length-tension relationships (DMT510A Auto Dual Wire Myograph only)
- Force measurements easily calibrated into mN using Units Conversion.

The Confocal Wire Myograph (page 113) combines Laser Scanning Confocal Microscopy with myography to allow simultaneous measurements of isometric force and fluorescence (confocal microscope not supplied). Example applications include studies that correlate isometric contractions in isolated, mounted blood vessels and intracellular Ca²⁺ measurements within the vascular smooth muscle cells.

Tissue Normalization

Normalization takes into account the amount of contractile tissue to determine the optimal pretension conditions for each tissue being investigated. Setting the pretension according to these parameters reduces inter- and intra-variability of tissue responses in the preparations. The ADInstruments DMT Normalization Module (page 66) provides the user with the ability to easily and accurately determine and set the optimal pretension parameters for each piece of tissue investigated. The algorithms used in this software module are based on previously validated and published research by Professor Michael Mulvaney (University of Aarhus, Denmark).

Fast data extraction and analysis with Dose Response, DMT Normalization and Peak Analysis Modules, as well as LabChart features such as Timed Add to Data Pad and Multiple Add to Data Pad

Data Pad mini-windows for easy display of current values of measurements or calculations set up in the Data Pad

The LabChart GLP Client and GLP Server software offers a comprehensive audit trail, secure signing and a centralized user authorization system required for GLP and 21 CFR Part 11 (FDA) compliant environments.
Multi Chamber Myographs

ADInstruments supplies Multi Chamber Myographs (pages 112-113) that feature four bath chamber units for simultaneous tension measurements. They are available in several configurations including:

- **DMT620M Multi Chamber Myograph w/Touch Screen** (also available as part of the PL3508B24/TS research system) for microvessels greater than 60 µm diameter
- **DMT720MO Tissue Bath System w/Touch Screen** for large isolated blood vessels (>500 µm) and other large vessels or tubular structures (up to 10 mm), such as trachea or gut mounted as large ring preparation
- **DMT820MS Muscle Strip Myograph w/Touch Screen** for isolated skeletal or other muscle preparations, mounted as a strip (15 mm in length) between clamp supports.

Features of the multi chamber myographs include:

- A graphical color touch screen menu
- Easy interchange of bath chamber type, enabling customized bath configurations
- A built-in temperature control unit
- High-resolution force transducers and micrometers
- Acid-resistant stainless steel chamber
- Individually controlled gas inflow and solution suction in each chamber insert unit
- Analog outputs which can be connected directly to PowerLab for data recording and analysis.

The **DMT100192 Automated Buffer Filler System 2** (page 113) provides an easy and automatic means of replacing buffer in the bath chambers.

**Select PowerLab citations**


**Search our citations database at: www.adinstruments.com/citations**
Isolated Perfused Hearts

PowerLab data acquisition systems are ideal for acquisition and analysis of data from isolated whole-organ perfusion including heart, liver, lung, kidney or mesenteric bed.

Langendorff Heart Preparation

The Langendorff heart technique allows for the examination of cardiac contractile strength (inotropic effects), heart rate (chronotropic effects) and vascular effects without neuronal and hormonal influences. Pressure in the perfusate line is typically monitored using a pressure transducer and bridge amplifier connected to a PowerLab data acquisition system.

To monitor ventricular developed pressure, a fluid-filled balloon-tipped catheter is inserted into the left ventricle and connected to a second pressure transducer and bridge amplifier. The Langendorff Heart preparation can be investigated under conditions of constant perfusate flow or constant perfusate pressure.

ADInstruments provides several Langendorff Systems that include PowerLab data acquisition systems, glassware, amplifiers and transducers. These systems provide:
- Real-time and offline data extraction and analysis capabilities
- Stable environment maintenance for the heart
- Measurement of parameters including:
  - Perfusion pressure
  - Perfusion flow rate
  - Left ventricular developed pressure
  - Maximum and minimum dP/dt
  - Temperature
  - Heart rate
  - Cardiac electrical activity.

Compact Langendorff Heart System

The PL350B2-V Langendorff System (page 84) provides a complete solution for the perfusion and performance monitoring of small animal hearts (mice or rats). The Langendorff Apparatus is a thermostatically controlled unit with two separate perfusate reservoirs that are continually oxygenated and kept at a constant temperature. Constant recirculation of both chambers allows for a quick change...
of perfusate and prevents the formation of air bubbles or entry of air into the heart when switching reservoirs.

The heated junction block above the heart chamber ensures the perfusate is maintained at a constant temperature prior to entering the heart.

The system incorporates the **IN175 STH Pump Controller** (page 111) which, when used in conjunction with the **ML172 Peristaltic Pump** (page 110), removes the need for cumbersome elevated pressure reservoirs and expensive flowmeters. It also allows the user to switch between constant flow and constant pressure modes at the press of a button.

**Traditional Langendorff Heart System**

ADInstruments provides traditional, glassware-style modular **Langendorff Systems** (page 85). These include:

- **PL3508B1-V Langendorff System for Mice** (Constant Pressure)
- **PL3508B3-V Langendorff System for Rats** (Constant Flow)
- **PL3508B4-V Langendorff System for Rats** (Constant Pressure).

The modular design allows the user to select and change from a wide range of glassware. This allows various custom and application-specific configurations. Further features of these systems include:

- Complete water-jacketed glassware and tubing to maintain constant system temperature
- Perfusate and heart temperature monitoring using a T-type Pod and T-type Thermocouple Probe
- Recording cardiac electrical activity using the Animal Bio Amp and Spring Clip Electrodes
- Pacing of the heart by an external stimulator (available separately) controlled via the PowerLab analog outputs
- Option for recirculating the perfusate (excluding Langendorff systems for rats).

---

**Select PowerLab citations**


**Working Heart Preparation**

The working heart preparation enables the investigation of cardiac function in an isolated heart perfused via the normal circulatory pathway. The atrial pressure (preload) and aortic resistance (afterload) are regulated experimentally as the heart circulates perfusate. The aortic and coronary flows can be monitored and the resulting cardiac output calculated. ADInstruments supplies a number of complete research systems featuring all items required for a working heart preparation. Customized options are also available.

**Complete Working Heart Research Systems**

The four Working Heart Systems (page 86) supplied by ADInstruments provide options based on the species of the animal (heart size) and the parameters of interest to be recorded. They are available as a standard system for measuring key working heart parameters or as the ultimate system that enables additional measurements such as flow and cardiac output. These include:

- **PL3508B55-V Working Heart System for Mice**
- **PL3516B56-V Working Heart Ultimate System for Mice**
- **PL3508B50/X-V Working Heart System for Rats/Rabbits**
- **PL3516B51/S-V Working Heart Ultimate System for Rats**

All Working Heart systems include a PowerLab, Radnoti Working Heart Apparatus, Bridge Amps, Animal Bio Amp, Physiological Pressure Transducers, T-type Pod and T-type Thermocouple Probe.

**Features and Benefits**

- Real-time and offline data acquisition, extraction and analysis with PowerLab data acquisition systems and LabChart Pro software
- Measurements including left ventricular pressure, cardiac electrical activity, heart rate, cardiac output, flow and temperature
- Configurations to suit a variety of experimental models
- Stable environment maintenance for the heart
- Modular hi-tech glassware that allows easy customization
- Single-pass perfusion or recirculation modes.

**ADInstruments Advantage**

- Complete research systems for the maintenance and monitoring of working hearts and analysis of recorded data
- Real-time measurements of pressure, cardiac electrical activity, heart rate, cardiac output, flow and temperature
- Data Pad facilitates automatic or manual extraction of experimental data
- LabChart software can be used to control stimulation frequency and timing of pulse trains using an external stimulator.
Working Heart Apparatus
The Radnoti Working Heart Apparatus is ideal for investigating and assessing isolated perfused hearts. Its features include:

- Complete water-jacketing glassware and tubing to maintain a constant temperature and controlled environment
- A threaded lid with access ports for insertion of cannulae, pressure catheters, electrodes and/or temperature probes
- A variety of available glassware sizes and types to suit different applications and animal hearts (such as the heart chamber).

Parameters Recorded
Parameters that can be recorded and analyzed using the Standard Working Heart systems include:

- Left atrial pressure
- Aortic pressure
- Systolic and diastolic pressure from the aortic line
- Heart rate
- Temperature
- Cardiac electrical activity.

Additional parameters recorded and analyzed using the Ultimate Working Heart systems include:

- Atrial inflow, aortic outflow and coronary flow
- Stroke volume and cardiac output
- Left atrial volume
- Left ventricular pressure (LVP)
- Aortic pressure & cardiac contractility
- pH
- Oxygen concentration
- Pacing/electrical stimulation.

Select PowerLab citations


Search our citations database at: www.adinstruments.com/citations


LabChart recording of mouse isolated working heart parameters. Data courtesy of Prof. John Headrick, Heart Foundation Research Centre, Griffith University.

The XY View (above) has been used to create a pressure-flow plot. The Zoom View (right) displays in “Overlay” mode left atrial and left ventricular pressure waveforms.
ADInstruments Research Software Overview

Building on over 25 years of program development, ADInstruments continues to set the standard for life science data acquisition and analysis software.

LabChart (Chart View)  LabChart (Scope View)  Peak Analysis Module

<table>
<thead>
<tr>
<th>Software</th>
<th>Purpose</th>
<th>More Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>LabChart</td>
<td>LabChart software offers the functionality of a multi-channel chart recorder, digital oscilloscope, XY plotter and digital voltmeter. Record, display and analyze up to 32 channels of raw data in real time.</td>
<td>Page 42</td>
</tr>
<tr>
<td>LabChart Extensions</td>
<td>LabChart extensions are available free of charge to all LabChart users. They provide additional data formatting, filtering, visualization, measurement calculations and other utility features.</td>
<td>Page 60</td>
</tr>
<tr>
<td>LabChart Reader</td>
<td>LabChart Reader allows scientists that do not own LabChart software to view and analyze (to a limited extent) LabChart data files. PowerLab users can share data files with their colleagues.</td>
<td>Page 61</td>
</tr>
<tr>
<td>LabChart Modules</td>
<td>LabChart modules are application-specific acquisition and analysis add-on programs for LabChart software. Modules are available separately or as a collection in LabChart Pro.</td>
<td>Page 62</td>
</tr>
<tr>
<td>LabChart Pro</td>
<td>A software package that includes LabChart and all LabChart modules. See list below for individual LabChart module descriptions.</td>
<td>Page 62</td>
</tr>
<tr>
<td>Blood Pressure Module</td>
<td>Detects, analyzes, displays and reports a set of cardiovascular parameters from arterial or ventricular pressure signals. It can be used online or offline.</td>
<td>Page 62</td>
</tr>
<tr>
<td>Cardiac Output Module</td>
<td>Derives Cardiac Output parameters from LabChart thermodilution curves in small animals.</td>
<td>Page 64</td>
</tr>
<tr>
<td>Circadian Analysis Module</td>
<td>Analyzes data that have an inherent daily pattern. It generates graphical and tabular views of the raw and averaged data.</td>
<td>Page 65</td>
</tr>
<tr>
<td>DMT Normalization Module</td>
<td>Calculates the optimal pretension conditions for microvessels prior to commencing experiments using DMT wire myographs.</td>
<td>Page 66</td>
</tr>
</tbody>
</table>
## Software

<table>
<thead>
<tr>
<th>Software</th>
<th>Purpose</th>
<th>More Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose Response Module</td>
<td>Generates dose response curves and calculated values such as EC50 and Hill Slopes from LabChart data. It can be used online or offline.</td>
<td>Page 67</td>
</tr>
<tr>
<td>ECG Analysis Module</td>
<td>Detects ECG components online or offline providing statistical and graphical analyses. It features ECG presets to suit human and animal subjects.</td>
<td>Page 68</td>
</tr>
<tr>
<td>HRV Module</td>
<td>Analyzes variability in ECG or arterial pulse recordings. A variety of parameters, graphs, and a report can be generated online or offline.</td>
<td>Page 69</td>
</tr>
<tr>
<td>Metabolic Module</td>
<td>Enables real-time acquisition and analysis of human metabolic parameters such as RER, V̇CO₂, V̇O₂ and V̇E online or offline.</td>
<td>Page 70</td>
</tr>
<tr>
<td>Peak Analysis Module</td>
<td>Provides automatic detection and analysis of multiple non-overlapping signal peaks in acquired waveforms. The module can be used online or offline.</td>
<td>Page 71</td>
</tr>
<tr>
<td>PV Loop Module</td>
<td>Records and analyzes left ventricular pressure and volume data for hemodynamic research in animals.</td>
<td>Page 72</td>
</tr>
<tr>
<td>Spike Histogram Module</td>
<td>Detects, discriminates and analyzes extracellular neural spike activity online or offline.</td>
<td>Page 73</td>
</tr>
<tr>
<td>Video Capture Module</td>
<td>Synchronizes a video recording with a LabChart data file, and allows simultaneous playback and correlation between data and video recorded events.</td>
<td>Page 74</td>
</tr>
<tr>
<td>GLP Client and GLP Server</td>
<td>In conjunction with LabChart software, GLP Client and GLP Server software provide PowerLab users with an easy and reliable data acquisition solution for a GLP and 21 CFR Part 11 compliant environment.</td>
<td>Page 76</td>
</tr>
</tbody>
</table>

---

**Image Descriptions:**

- **ECG Analysis Module**
- **Dose Response Module**
- **Spike Histogram Module**
- **Metabolic Module**
- **PV Loop Module**
- **Video Capture Module**
1 **Software-Controlled Settings**: Set and adjust PowerLab hardware acquisition settings in LabChart.

2 **Multiple Block Sampling**: Record multiple data blocks with different sampling rates, filters and amplification within a single file.

3 **Input Amplifier**: Adjust amplification, filtering and units conversion, and preview the result in real-time.

4 **Split Bar**: Split the Chart View to compare data recorded earlier with data being recorded in real-time.

5 **Customizable Comments**: Add comments to data during or after recording. Find, edit, move and delete comments after recording.

6 **Channel Calculations**: Perform calculations on signals during or after recording without losing raw data.

7 **DVM Windows**: Monitor a signal’s amplitude, sampling rate or calculated value, as a changing number in a standalone mini-window that can be displayed numerically or graphically (trend data).
8 LabChart Modules & Extensions: Choose from a wide range of specialized software add-ons to speed up and enhance acquisition and analysis of discrete data sets.


10 Cyclic Measurements: Analyze signals using a range of statistics and functions online and offline.

11 Find & Select: Locate data of interest quickly and accurately.

12 Data Pad: Extract, log and analyze large amounts of data in a spreadsheet — manually or automatically. Link Data Pad to OLE programs including Microsoft Excel.

13 XY View: Plot variables against each other and observe their relationship as XY or XYY displays.

14 Zoom View: Magnify data for a detailed view.

15 Marker Tool: Mark a reference point on your recorded data to obtain differential measurements relative to the cursor position.

16 Right Clicking: Access features in a LabChart channel with a single click.
17 Acquire 32 Channels of data with Variable Sampling Rates: Record and analyze up to 32 channels of data. Choose different sampling rates for each channel.

18 Sample from Multiple PowerLabs: Sample data from multiple PowerLab systems (or compatible devices) simultaneously to one or more LabChart files on the same computer.

19 Average Signals on Multiple Channels with Scope View: Turn your computer into a digital oscilloscope to record and display data as sweeps.

20 Display & Analyze Signal Frequencies with Spectrum View: View a signal’s component frequencies as Spectrogram and Power Spectral Density plots.

21 Browse & Install Software Add-ons from LabChart: Use the Feature Manager in LabChart to search for and obtain relevant tools in LabChart extensions or modules.

22 Access Recent Files & LabChart Resources: The Welcome Center provides one-click access to recent data files, settings files, sample files, technical help and a number of online resources.
23 **Generate Two Independent Stimulus Outputs:** Generate two completely customized stimulus waveforms from the analog outputs of a research PowerLab (/SP, /30, and /35 series and later).

24 **Save & Recall Analysis Settings:** Use the Analysis Manager to recall the data selected for analysis in Chart and Scope View. Save and recall settings when using popular LabChart Modules.

25 **Continuously Auto Scale Chart View:** Continuously and automatically adjust the vertical scale of data channels in Chart View so you can see the entire waveform at all times.

26 **Add Guide Lines to the Chart View:** Easily view waveform data crossing threshold values by adding shaded guidelines to any data channel.

27 **Manage Shortcut Keys:** Use the Shortcut Key Manager to view all preset shortcuts and/or customize your own.

28 **Open & Export Many File Types:** Use LabChart to view and analyze data recorded in other applications, or save LabChart data in a range of formats for analysis in other applications.
In conjunction with a PowerLab data acquisition unit, LabChart software provides the data integrity, display and analysis features needed for today's science. LabChart offers easy selection of hardware settings, powerful online and offline analysis options, procedure automation, seamless extraction of experimental data and clever display options.

You can extend LabChart's acquisition and analysis functions to suit specialized areas with LabChart Extensions and LabChart Modules, as well as share data with your colleagues using LabChart Reader.

LabChart can:
- Quickly and easily configure hardware and software settings
- Record, display and analyze 32 channels of data
- Analyze data online or offline
- Display data in specialized Views including Scope, Spectrum, Zoom and XY
- Automatically export recorded values to other graphical or statistical packages
- Ensure compliance with Good Laboratory Practice guidelines and FDA 21 CFR Part 11 regulations when used with GLP Client and GLP Server software.

This section describes a wide range of LabChart’s comprehensive features. Please note that feature availability may vary between Windows and Mac OS versions of LabChart.

ADInstruments’ large software team continuously develops LabChart. We regularly release new versions and add functions to ensure LabChart is compatible with the latest operating systems and hardware technology.

For the latest version of LabChart and new features, visit www.adinstruments.com/LabChart/
Set Up and Start Recording

Experiment optimization

Set up experiments easily in the Input Amplifier dialog:
- Preview and optimize the incoming signal
- Select an appropriate recording range
- Alter the vertical axis to optimize display
- Remove drift and noise with high- and low-pass filters
- Invert the signal and view any signal offset.

Change channel settings in seconds

Set recording and display parameters for every channel in one location. In the Channel Settings dialog you can:
- Rename channels
- Turn channels and channel separators on or off
- Adjust the signal input range
- Select filters and sampling rates for each channel
- Perform units conversion
- Change the color or style of the data trace
- Select and set channel calculations.

Convert raw data into familiar units

Convert the input voltage signal to familiar units (such as %, mmHg, pH, g, or any custom defined unit) by performing a linear calibration with the Units Conversion dialog. The raw data is retained and available for recall at any time.

For non-linear sensors, perform multipoint calibration of up to twelve points using the Multipoint Calibration Extension.

Access recent files & settings

Access recently opened data files and a variety of Quick Links (for technical help and software updates) with LabChart’s Welcome Center.

Use the Recent Files panel to search and open up to 100 of your recent LabChart files or clone their settings for a new LabChart file. You can configure the Welcome Center to include:
- LabChart settings files — use settings files to repeat experiments with the same recording parameters
- LabChart data files — quickly access files from previous experiments for reference or to clone settings
- The ADIPak files (Windows only) — easily pack and install LabChart files and supporting documents (including PDFs, *.txt files and more)
- LabChart Getting Started Tutorials — learn about LabChart using HTML tutorials and sample data files.

More information on page 58.
**LabChart**

**Record Accurate Data with Powerful and Flexible Software**

**Record from multiple devices**
With LabChart you can use one data file to record up to 32 channels of raw data from multiple PowerLab units or other devices. You can also record from multiple PowerLabs and devices into separate data files on the same computer (Windows only).

**Annotate data with comments**
Record relevant information at specific points in your LabChart data as text comments. Add comments:
- Manually by typing into the Comment field during or after recording, or
- Automatically by assigning relevant phrases to specific function keys or trigger events.

You can also:
- View a list of all comments
- Search for comments using a text filter
- Display the date and time of the comment
- Modify, edit, delete or move any comment in the Comments window (Mac: Comments and Exclusions)
- Automatically go to the location of a comment in the recording.

**Select independent sampling rates for every channel (single file)**
Choose the optimal sampling rate for each channel to ensure acquisition of accurate data as well as minimizing file size.

**Record multiple data blocks (single file)**
Record, save and analyze data from any number of experiments in a single LabChart file. LabChart saves continuous data as a Data Block. As well as indicating breaks in recording, each Data Block retains information specific to that block, including:
- Recording range, sampling rate and number of samples
- Channel number and Data Block number
- Filters used
- Date and time of block record.
Keep text notes with your data file
Annotate experiments using LabChart’s Notebook — before, during or after recording. Notebook keeps your notes as part of the data file. They can be recalled with the file at any time, so cannot be misplaced.

Recall recording information
Retain and recall recording parameters and experiment settings for future reference. LabChart’s sophisticated data file structure automatically:
- Stores experimental and analysis settings, computations and comments in each file
- Retains raw data at all times
- Allows data files to be appended
- Protects your data with disk buffering (allows data recall in the event of power failure etc.).

Generate Custom Stimulus Outputs
Use LabChart’s stimulator to generate custom stimulus or series of stimuli from PowerLab’s analog outputs (or an isolated stimulator). You can generate two independent stimulus outputs simultaneously with research PowerLab units from the /SP, /30, and /35 series and later (Windows only).

Quickly select stimulation settings
Use the intuitive Stimulator dialog to select the pattern, frequency, duration and output range of a stimulatory waveform. You can also select the types of output waveforms in continuous or discrete waveform mode.

Preconfigured stimulus waveforms include:
- Pulse
- Step
- Ramp
- Sine
- Triangle

Windows only:
- Double pulse
- Arithmetic
- Step Pulse
- Biphasic pulse

Subject and experiment setup details can be recorded in Notebook.

Stimulator Panels for discrete (top) and continuous (bottom) stimulation.

Stimulator dialog showing preconfigured stimulus waveforms in the drop down menu.
**LabChart**

**Customize stimulator waveforms**
Generate a variety of customized stimulus waveforms by selecting and configuring any number and combination of stimulus segments. All customized stimulation waveforms can be saved and recalled for future use (Windows only).

**Start, stop and adjust stimuli online**
Easily start or stop the stimulation and change the stimulation settings while sampling, using the Stimulator Panel mini-window.

The Stimulator Panel mini-window floats in front of the active Chart View and can be moved around the screen, providing quick and easy control of stimulation parameters such as frequency, duration and amplitude.

**Automate Tasks**

**Use triggers to start & stop recording**
Use LabChart to start or stop recording without manual intervention. Determine how and when LabChart starts and stops recording with the Sampling dialog. You can set the type of trigger event, any delay before recording, how many times to repeat the trigger and how multiple blocks in Scope View are handled.

You can start and stop a recording using an external trigger signal or stimulator, or by setting a threshold voltage to trigger from one of the recording channels. Pre-triggering and post-triggering options are also available.

**Program timed events**
Create a list of actions to be performed during a recording, and LabChart will perform the actions at the times you have specified (Windows: Event Manager Extension, Mac: Timed Events). This is useful in long recordings with repetitive events.

Choose from three event types:
- Set a PowerLab output voltage
- Add a comment
- Apply a digital output configuration that can turn switches (e.g. auto-injectors) on or off.
Record & edit Macros

Automate repetitive tasks, such as recording, event detection and analysis using customizable Macros. LabChart captures your actions as you record the Macro and you can replay your recorded Macro at any time. Commands available for selection during the recording of a Macro include:

- Wait…
- Message…
- Begin Repeat
- End Repeat
- Play Sound…
- Set units conversion… and more!

Event based Macros

Event-driven scripting allows a script to operate continuously, responding efficiently to events as they occur in LabChart.

Events supported include:

- When sampling starts or finishes
- As samples arrive
- When event data arrives
- On LabChart Selection or digital input change
- On external trigger
- On stimulus occurred... and more!

Manage Macros

Manage your macro library using the Manage Macros and Macro Properties dialogs. You can:

- Create, run and delete macros
- Edit macros using VB Scripting (Windows only)
- View macro properties
- Import macros (Windows only)
- Place a recorded macro in the menu or toolbar.

Customize Chart View Display

LabChart's default display mode, Chart View, displays data as continuous waveforms. You can adjust and optimize Chart View to suit your recordings and experiment protocols.

Continuously auto scale data channels

LabChart can dynamically adjust the vertical scale of data channels in Chart View. Continuous Auto Scale allows a detailed and scaled view of all signals without having to make repeated manual adjustments. This is particularly useful for recordings that show large changes in signal amplitude, or those with a shifting baseline.
LabChart
Monitor signal values easily with DVM windows

Visually monitor incoming signal values as numbers and graphical trends with DVM (digital voltmeter) windows. Online DVM windows show the incoming signal value, and after recording, they display the data value at the cursor position.

DVM windows float in front of the Chart View, and can be resized to almost full screen so you can monitor values from a distance. The DVM windows change color when used with Guide Lines and you can navigate backwards and forward through the DVM to see signal trends and values that flank the data point of interest.

Compare data using the Split Bar

Divide the data display area vertically with the Split Bar to compare sections of previously recorded data with incoming signals. You can use the Scroll buttons in both panes to review saved or live data.

Make discrete & relative waveform measurements

Place the Waveform Cursor over data to determine:
- Rate/Time — shows the time at the cursor location
- Range/Amplitude — shows the waveform’s amplitude at the cursor location.

Drag and lock the Marker Tool on a waveform to make measurements relative to its position. As you move the cursor along the waveform, the time and amplitude difference (relative to the Marker position) is displayed. The Marker Tool can also be used in the Zoom View.

Monitor threshold crossings with Guide Lines

Provide a clear visual indication of any threshold crossing with the Guide Lines tool. Manually set the position of two horizontal guidelines across a data channel to highlight particular value ranges of data. You can also set up customized shading of each defined value range.
Use Multiple Data Display Modes

In addition to Chart View’s continuous waveform display of up to 32 channels of raw and/or calculated data, LabChart includes additional data display modes that allow you to extract and visualize your data in versatile ways.

Average signals in Scope View
Turn your computer into a digital oscilloscope with Scope View (Windows only). Using this window you can:
- Average signals on multiple channels in real time
- Record each sweep on a different page to average and overlay during analysis
- Record simultaneously in Scope and Chart Views
- Extract data from Scope View into Data Pad
- Apply Channel Calculations
- Optimize display using 3D Depth, overlay trace color, color saturation and black/white background toggle
- Remove periodic recurring signals using Background Subtraction.

You can generate Scope View pages based on data blocks, Event Markers or Comments.

Analyze frequency in Spectrum View
Convert data from time to frequency domain in Spectrum View (Windows only). With Spectrum View you can:
- Observe and differentiate the component frequencies of a signal (in stacked or overlaid mode)
- Estimate the main frequency component of your signal
- Remove unwanted signal frequencies and background
- Display spectral parameters as continuous waveforms in overlaid or stacked mode
- Export spectral parameters to the Data Pad.

Power Spectral Density — overlays data from multiple channels to display the power of the input signal over a selected frequency range. Single or multiple signals can be analyzed. Using the Spectrum View settings data window you can select the FFT size, type of data window, the extent of window overlap and amplitude zeroing of the first frequency component. PSD display modes include amplitude, power, power density and power attenuation (in decibels).

Spectrogram — a color-coded plot of signal spectral power against time and frequency is displayed in each selected channel. You can customize the Spectrogram’s color scale, and save the Spectrogram matrix for each channel as a text file.
LabChart

Magnify data in Zoom View

Enlarge and display data selections for closer examination. The Zoom View can overlay and stack data from any number of channels. You can repeatedly zoom in on the data by making repeated selections and navigate back and forth between multiple zooms using the undo and redo buttons.

Plot signal relationships in XY View

Plot data in one channel against data from one or two other channels, and establish the relationship between two parameters at the same time in the XY View.

Plotting periodical signals against one another may result in loops. Loop features in the XY View include:
- Direction arrows — to show the direction of the loops
- Fade mode — to fade previous loops
- Loop analysis — to calculate the area of the loop (Windows only).

Analyze Data Online and Offline

Apply built-in Channel Calculations

Convert raw data from one channel to computed data displayed in a new channel with Channel Calculations. You can use Channel Calculations both online and offline, and your raw data is always retained for further analysis.

LabChart’s Channel Calculations include:
- Arithmetic — mathematically manipulate data using algebraic, trigonometric, logarithmic, noise and filtering functions
- Cyclic Measurements — see overleaf for details
- Derivative — display the first and second derivative
- Digital Filter — select from six filter types: low-pass, high-pass, notch, narrow band-pass, band-pass and band-stop
- Integral — measure areas under waveforms
- Smoothing — remove unwanted high frequencies and noise from a waveform
- Shift — shift data in a channel backwards or forwards in the time domain
- Spectrum — display Total Power, Percentage Total Power, Maximum and Minimum Power, Maximum and Minimum Power Frequency, Mean Power Frequency, Median Power Frequency, Standard Deviation Frequency and Spectral Edge Frequency (Windows only).
Process periodic signals with Cyclic Measurements

LabChart can process periodic waveform signals, detect cycles and perform calculations with Cyclic Measurements channel calculations.

Cyclic Measurements calculations include:

- **Rate** — calculate rates e.g. heart rate from ECG or pulse
- **Period** — measure time taken to complete a cycle
- **Frequency** — calculate event frequencies
- **Count** — count number of events or cycles
- **Mean** — derive the mean of a cyclic waveform
- **Min, Max, 1/3 Max + 2/3 Min** — calculate min and max values such as diastolic, systolic and mean BP from a blood pressure trace
- **Height** — calculate maximum minus minimum height
- **Integral** — measure areas under waveforms
- **Variance** — detect variance of values within a given cycle of a waveform
- **Min and Max Derivative** — calculate minimum and maximum derivatives in a given cycle of a waveform
- **Unit Spikes at Events** — place markers on a second channel where a peak occurs on the input channel.

Analyze numerical data with Data Pad

LabChart’s Data Pad features parallel processing and full Unicode support to provide a high-capacity rapid-response data logging system. You can log raw signal points or calculated values from any channel, or perform calculations on exported data.

You can set up unlimited rows in Data Pad to tabulate data and apply different calculations and formulas. Data Pad’s built-in calculation and analysis functions include:

- **Statistics** — calculate the mean, SD, RMS, max and min value, time at max and min values and number of points
- **Selection & Active Point** — obtain the start time, end time, duration and number of points
- **Comments** — list comment time, comment number, the full comment text or extract numbers from the comment text
- **Slope** — get the average slope value, max and min slope or time at max and min slopes
- **Integral** — calculate time integrals online or offline
- **Block Information** — obtain the range, sample interval, block number, block duration, samples in block, start time, start date and sampling rate.
**LabChart**

- **Cyclic Measurements**—calculate or extract periodic parameters from waveforms including frequency, rate, mean, min and max, 1/3 max + 2/3 min, height, integral, variance, min and max derivatives
- **XY Loop Calculations**—using the loop created in the XY View, calculate the area inside the loop, x or y value and slope at the reference point in loop, minimum and maximum x or y value, time at minimum and maximum x or y value, and mean of x or y value
- **Scope**—obtain page number, page duration and page start time containing the active point or selection from Scope View (Windows only)
- **Spectrum**—display maximum power, maximum power frequency, mean power frequency, median power frequency, minimum power, minimum power frequency, percentage total power, spectral edge frequency, SD frequency and total power (Windows only).

You can add values to Data Pad:
- Automatically, by configuring the 'Timed Add to Data Pad' feature prior to recording
- Manually, by selecting data of interest after recording and choosing the 'Add to Data Pad' command. Use the 'Multiple Add to Data Pad' command to repeatedly extract values from recorded data.

Data Pad contents can be saved as a text file or copied into other programs. Using OLE you can also export incoming values to Microsoft Excel in real time, allowing live updates of Microsoft Excel graphs.

**Find and select data**

Quickly find specific points of interest within a data file using the Find and Select feature. Search and make selections on any number of channels based on your desired criteria. Available commands are:
- **Go**—go to a specific location on the data such as data block boundaries
- **Find Data**—find the peaks or troughs in the waveform
- **Find Comment**—search for specified comments
- **Find Event Marker**—search for Markers (Windows only).
Save and recall analysis settings

Use Analysis Manager to save and recall selections of data and/or active points in both Chart and Scope View.

You can also use Analysis Manager with popular LabChart Modules to save the module settings associated with one or more analyses. This enables analysis of separate data regions within a file and multiple analyses of the same or different regions. The results of each analysis can be saved and recalled.

Import and Export Data Easily

Copy and paste data: numbers or images

Transfer data between files and applications with LabChart’s copy and paste functions. You can:
- Copy and paste a data selection (from Chart View or Data Pad) directly into another LabChart file or a different application
- Illustrate reports and presentations quickly — copy Chart, Scope, XY, Zoom or Spectrum Views and paste as an image into a different application.

Export data dynamically to Excel

Export incoming or previously recorded data into Microsoft Excel for numerical analysis and graphing. OLE technology links LabChart and Excel so any changes in the LabChart data are automatically updated in Excel.

You can export into Excel from Chart View, Scope View and Data Pad. Use LabChart’s "Timed Add to Data Pad" feature to plot XY curves in Excel as you record.

Export data to other applications

Export LabChart data for display and analysis in a range of popular software applications. File format options include:
- *.pxp for IGOR Pro software
- *.mat for MATLAB software
- Axon Binary Format (*.abf) for pCLAMP software
- *.wav (uncompressed audio) for a range of applications
- *.edf for European Data Format applications
- *.adidat for earlier versions of LabChart
- LabChart Binary File (*.adibin).
Export LabChart data as *.txt files for use in applications, such as Excel, that accepts tab-delimited text format data. Configure the data you would like to save in the Export dialog.

Options include:
- Export specific channels or include comments and Event Markers in a *.txt file
- Export Data Pad contents as a *.txt file or Unicode text file
- Export Spectrogram or Spectrum PSD data as *.txt files
- Export Scope View page data as a *.txt file.

Import data from other applications
Use LabChart to view and analyze data recorded in other applications. Options include:
- Data recorded in BIOPAC AcqKnowledge software
- Data recorded in Axon pCLAMP software
- WinDAQ data files
- WAV uncompressed audio files (*.wav format)
- EDF (European Data File format) data files
- LabChart Binary File (*.adibin).

Get Help and Find New Features
Access LabChart's Help Center
Browse, search or navigate through hundreds of Help topics in LabChart's Help Center (Windows). Accessed through the main Menu and Chart View menu bar, the Help Center covers LabChart, as well as all extensions and modules. There are also links to our website, software forum and worldwide distribution and support network.

Browse, install & manage software from the Feature Manager
Browse and manage all ADInstruments software modules and extensions in one location. Feature Manager categorizes all available modules and extensions, making it easy to find an add-on that suits your application. You can also search for relevant software using key terms.

You can use Feature Manager to quickly turn LabChart extensions and modules on or off on start up. LabChart will then only load the features you request.

Feature Manager also performs manual or automatic software update checks to ensure you have the latest version of LabChart software and plug-ins.
LabChart Welcome Center

Gain access to LabChart resources and materials within one interface. Open your LabChart files, access all ADInstruments documents (including demo files and supporting documents) and clone document settings easily, as well as access and search up to 100 recently opened files. A collection of Quick Links provides one-click access to popular LabChart features and support.

Included with the Welcome Center Quick Links are:

- **ADInstruments Forum**
  Keep abreast of developments in the scientific community, and connect with peers, technical specialists and ADInstruments product developers.

- **Support**
  View PDF and HTML help documents, or request one-on-one technical assistance from ADInstruments scientists and engineers.

- **New Features**
  Read about the latest developments in LabChart software, modules and extensions that enhance your experiments and analysis.

- **Feature Manager**
  Browse, install and update software quickly and conveniently.

- **Event Center**
  Browse upcoming training and workshop opportunities worldwide.

- **Learning Center**
  Access training videos, web seminars, software tips, technical documents, manuals and brochures.
LabChart Extensions

LabChart Extensions add specific features and functionality to LabChart software and are free to all LabChart users*. Use LabChart’s Feature Manager to browse and install extensions, or visit our website for a complete list.

- **Absorbance** — convert spectrophotometer outputs from Transmittance to Absorbance
- **Amplitude Histogram** — display and analyze a signal’s amplitude distribution (define bin width and analyze mean, standard deviation and standard error)
- **Audio Output** — play recorded LabChart data as sound
- **Cardiac Axis** — automate the calculation of frontal plane ECGs and vector cardiograms and display the instantaneous cardiac vector
- **Curve Fit** — perform non-linear, least squares fitting of built-in and user-defined equations to data that has been recorded as a function of time
- **Event Manager** — monitor user-defined events online using numerous criteria and perform a variety of user-defined actions
- **Evoked Response** — analyze physiological responses to a stimulus; parameters include value, latency, peak height, half-width, latency to peak
- **Export QuickTime** — save LabChart data files as QuickTime movies
- **Fast Response Output** — generate rapid responses from digital outputs of the PowerLab (old model PowerLabs are not supported)
- **Function Generator** — create data using mathematical functions
- **Multipoint Calibration** — perform linear and non-linear multipoint calibration of transducers, sensors, and other devices
- **Peak Parameters** — determine parameters including peak height, width and individual peak slope. Useful for action potentials (cardiac, EPSP and IPSP)
- **pH Measurement** — calibrate pH and ion selective electrodes using single or double point methods
- **Playback File** — record data from a saved LabChart or audio file into a live LabChart file, as if sampling from a PowerLab
- **RMS & Noise** — determine a signal’s power content (RMS gives total power content, including the DC component; Noise gives the AC component only)
- **Savitzky-Golay** — perform offline least-squares smoothing, especially suited to removing noise from data such as ECG and differential calculations
- **Scheduler** — schedule recording across one or more LabChart data files using external scheduling devices such as the TR Scheduler Pod
- **Signal Averaged ECG (SAECG)** — use SAECG to analyze ECG signals and display an averaged cycle to remove noise and unwanted signal components
- **Spirometry** — process pneumotachometer signals and display respiratory parameters (e.g. $V_E$, $V_T$, Frequency, PIF, PEF, FVC, FEV₁). Generate flow volume plots and spirometry reports
- **STM** — display the amplitude of a signal’s frequency components as a function of time (a spectral-temporal map)
- **Telegraph** — use the gain-telegraph output from an electrophysiological amplifier to display data at the correct scale after a gain change
- **Template** — match a data template with similar occurrences in a larger data set. Choice of three algorithms — RMS Error, Correlation or Convolution
- **Ventricular Pressure** — analyze recordings of cardiac ventricular pressure.

*Not all extensions are available for both Windows and Mac operating systems and some extension features may differ between computer platforms.
LabChart Reader

LabChart Reader is a free program that allows anyone to view LabChart data files. The program includes standard LabChart display features and some analyses. LabChart Reader is available for Windows and Mac operating systems from our website.

Use LabChart Reader to:

- Easily collaborate with other scientists
- Ask students to view and analyze real experimental/research data
- Make data files available on/to download from your website.

With LabChart Reader you can:

- Open LabChart data files and view recorded data
- Perform some calculations and analyses
- Analyze data (limited)
- Print data
- Import other file formats
- Install the Cardiac Axis & Spirometry Extensions.

A full version of LabChart is required to:

- Record new data
- Save data
- Use our advanced analysis extensions and modules.
LabChart Pro and LabChart Modules

LabChart Modules provide highly specialized data acquisition and analysis features for specific applications. Modules are available for purchase as a complete set in LabChart Pro or individually. LabChart Pro users are entitled to free software upgrades for five (5) years, conveniently available to download from the ADInstruments website.

Blood Pressure

Blood Pressure Settings dialog.

Identify and analyze various parameters of arterial and ventricular pressure online or offline with the Blood Pressure Module.

Customize analysis settings

Analysis settings can be set prior to (for online analysis) or after recording (for offline analysis). In the Blood Pressure Settings dialog you can select:
- The pressure signal to be analyzed (atrial or ventricular)
- Cycle detection parameters
- Cycle averaging options
- End diastole and Tau fitting options (ventricular pressure only).

For ventricular pressure signals, the end of diastole can be identified using either the pressure signal, or an ECG signal that is synchronized with the pressure signal. The time constant (Tau) provides a measure of the isovolumetric relaxation of the heart.

Once the detection and analysis settings are selected:
- Pressure cycles are automatically identified and marked in the pressure channel
- Marked cycles contain information such as cycle time, number, duration and height.

Chart View of a ventricular pressure recording.
Note: Cycle Markers above the trace and cycle information pop up.
Classify, include or exclude cycles
Use the Classifier View to identify cycles that differ in duration or height, and to include or exclude any cycle groups from the analysis.

Blood Pressure Classifier View. Points outside the cycle height and duration limits (red crosses) are not included in the analysis.

Analyze averaged signals
The Analysis View displays groups of averaged cycles and highlights key parameters calculated by the module. Cycle averaging is a more accurate representation of the blood pressure waveform in the presence of noise or interference.

Blood Pressure Analysis View displaying a ventricular pressure cycle.

Ventricular cycle parameters marked include:
- End diastolic pressure
- Maximum dp/dt
- Maximum pressure
- Minimum dp/dt
- Minimum pressure
- Tau.

Arterial cycle parameters marked include:
- Diastolic pressure
- Systolic pressure
- Dicrotic notch.

Analyze calculated parameters
The Table View displays a wide range of calculated parameters for each averaged cycle. The individual parameters available for selection in the Table View Options dialog vary depending on whether arterial or ventricular signals are being analyzed. The contents of the Table View can be exported for further analysis.

Blood Pressure Table View Options Dialog for ventricular (left) and arterial signals (right).

Display calculated parameters in separate channels
You can display parameters calculated by the Blood Pressure Module as continuous data on separate channels in Chart View. This provides online analysis of blood pressure parameters.

Selected ventricular pressure parameters displayed on separate channels in real time.

Blood Pressure Applications:
- Mouse and Rat (page 8)
- Blood, Atrial and Ventricular Pressure (Page 10)
- Telemetry (page 14)
- Psychophysiology (page 30)
Define the parameters used to calculate cardiac output in the Cardiac Output Settings dialog.

Determine the cardiac output from a recorded thermodilution curve measured in small animals.

With the Cardiac Output Module's analysis tools you can:
- Set experimental and calculation parameters
- Automatically calculate and display cardiac output from recorded thermodilution curves
- Extract and export cardiac output values to other programs for further statistical analyses.

The cardiac output calculation is based on the area under the thermodilution curve and takes account of baseline drift and prolongation of the decay curve due to recirculation of the injectate.

The module calculates cardiac output in mL/min and generates a graphical display featuring the area under the curve. Analysis parameters are quickly and easily selected in the Cardiac Output Settings dialog.

Correct for temperature & baseline drift

The module's settings include a user-defined correction factor option to account for warming of the injectate as it is injected through the catheter, or any other correction factor related to the experimental conditions.

Extrapolate curves to baseline

Depending on the injectate temperature, there may be some permanent cooling of the blood. As the cooled fluid is recirculated, the thermodilution curve does not return to its baseline value. The Tail Fitting range allows the user to define a portion of the downslope of the recorded thermodilution curve, from which an exponential curve is calculated and extrapolated to a baseline. The portion of the downslope used in this calculation is specified as a percentage of the curve full height.

Tabulate calculated values

The Capture option in the settings dialog allows the addition of a comment and the resulting cardiac output values on the selected thermodilution curve.

Selecting ‘Add to Data Pad’ automatically transfers calculated values to the Data Pad spreadsheet.

Each cardiac output determination uses a baseline temperature calculated for each thermodilution curve. Any baseline drift can be corrected by selecting baseline data and choosing ‘Set Baseline Correction’ from the Cardiac Output Settings dialog.

A thermodilution curve showing baseline determination (red line), area under the curve (shaded region) and cardiac output values (top right-hand corner) calculated using the Cardiac Output Module.
Circadian Analysis

Analyze long term recordings with an inherent daily pattern and generate graphical and tabular views of the daily and averaged data with the Circadian Analysis Module.

Each period’s recording is split into a user-determined number of intervals. Interval data are averaged, plotted, displayed numerically and analyzed to determine variables including the minimum, maximum and mean value for each day, as well as the average period.

View, analyze & export calculated data

The Circadian Analysis Table View automatically calculates and displays the following parameters for each day, as well as determining an average day:

- Maximum
- Minimum
- Mean
- Maximum–minimum.

You can export Circadian Analysis Table View data as a tab delimited file into other programs (such as Microsoft Excel).

Display averaged daily data

The Circadian Analysis Averaging View displays and plots the averaged interval data for single or multiple channels. You can choose to:

- View the automatically calculated average daily data
- Show all days as an overlay on top of the average day
- Select a specific day from the highlight drop-down list or by clicking on its trace
- View the values for any specific point in time obtained by hovering over the trace
- View each channel’s data separately, or show multiple channels in the same view.

Features and benefits include:

- Day-by-day analysis of data over multiple channels
- Analysis of continuous, intermittent or calculated data
- Customizable circadian period start time and length
- Optional data exclusion filter.

Customize analysis settings

In the Circadian Analysis Settings dialog you can:

- Select the number of channels to be analyzed
- Choose to analyze the whole channel or a selection
- Adjust time settings including the circadian period (day length), day start time and averaging interval
- Enable and configure data exclusion filter to ignore data outside preset limits for calculating averages
- Adjust the light on/off shading feature to represent day and night in the Averaging View.

Circadian Analysis Applications:

- Blood, Atrial and Ventricular Pressure (page 10)
- Telemetry (page 14)
- Psychophysiology (page 30)
- Sleep Studies (page 26)
DMT Normalization

Calculate optimal pretension conditions for microvascular and other small tubular tissue experiments with the DMT Normalization Module. The module provides a standardized and validated method for use with PowerLab and DMT Wire Myographs.

The DMT Normalization Module:
- Provides online and offline determination of tissue effective pressure
- Calculates the optimal pretension (micrometer setting) for each piece of tissue prior to experimentation.

Standardize tissue tension

As pretension can affect smooth muscle function, it is important to standardize the tension placed on individual tissues before conducting an experiment.

The normalization procedure determines the optimal internal circumference at which each tissue would be relaxed under a transmural pressure of 100 mmHg (denoted as the IC100 index).

In the Normalization Settings dialog you can customize microscopic calibration, target pressure, IC1/IC100 ratio, online averaging time and the delay time between micrometer changes. This ensures the most accurate measurement of resting wall tension.

Collect data during experiments

The module calculates IC100 for each tissue mounted on the wire myograph, and takes into account the tissue’s size and contractile components. You can specify wire diameter and tissue end points (for determination of tissue length) in each LabChart channel’s Normalization window.

When micrometer values and force measurements are entered (either online or offline) the module graphs the measured internal circumference versus the vessel’s resting wall tension, from which the IC100 and IC1 are then calculated.

The module uses these values to calculate the final micrometer setting for uniform and accurate pretension conditions for each tissue being studied prior to the experiment.

DMT Normalization Applications:
- Mouse and Rat (page 8)
- Isolated Tissue (page 32)
Dose Response

Extract and analyze data from in vivo and in vitro experiments with the Dose Response Module.

The Dose Response Module is ideal in the analysis of responses to chemical, electrical or physical agonists or antagonists. Applications include:

- Isolated muscle preparations
  - smooth
  - skeletal
  - cardiac
- Cardiovascular studies
  - blood pressure
  - heart rate
- Neurophysiology
  - membrane potentials
  - nerve activity.

The Dose Response Module:

- Calculates dose and response parameters including average, maximum, maximum-minimum (Response Height), integral (area) and minimum
- Tabulates the results automatically or manually
- Generates instantaneous Hill curves
- Displays single or multiple response curves
- Calculates EC_{50} and Hill slopes
- Exports results in XML and tab-delimited text format.

Dose Comments for quick analysis

Uses comments to identify changes in doses when analyzing data. Predetermined comments can be easily set up and used during experiment protocols. Comments that are not in the correct dose format can be easily converted using the convert comments dialog. Comments can also be used to specify which parameters to analyze and for how long.

Display Tabulated Data & Dose Response Curves

The Dose Response Table View tabulates response parameters. The value of each response in the Table View is linked with the corresponding display in the Dose Response Analysis View and Chart View. The results change automatically when different analysis selections are made.

The Dose Response Results View displays the plotted dose response curves and calculated parameters such as EC_{50} and Hill slopes with their respective standard errors. The Results View provides options for normalizing the curves and changing the units on the x-axis.

Dose Response Modules Results View showing fitted response curves to increasing doses of norepinephrine in a rat blood pressure recording. Fitting parameters for a selected curve are shown on the right.
**ECG Analysis**

Automatically detect and analyze ECG signals from any species with the ECG Analysis Module. The module:
- Analyzes ECG signals both online and offline
- Automatically detects and averages ECG cycles
- Includes preset detection parameters for humans, pigs, dogs, rabbits, guinea pigs, rats and mice
- Leaves raw data unaltered for future analysis
- Links between Chart, ECG Analysis and Table Views for quick navigation to points of interest.

Automatically tabulate ECG variables

The Table View logs variables for each average including:
- P, Q, R, S, T amplitudes
- Time intervals such as RR, PR, JT, QT and QTc.

**View analysis plots online and offline**

For quick analysis of ECG recordings, the module generates analysis plots (online and offline) including:
- QT/RR Plot (QT Interval versus RR Interval)
- QT/Time Plot
- RR/Time Plot
- Waterfall Plot.

You can also display each ECG parameter calculated by the module in a separate channel in Chart View.

**Detect and remove unwanted beats**

In the module’s Classifier View, you can exclude beats with excessive noise (such as muscle activity) in the left panel, while the right panel identifies beats with altered QRS shape.

**Display the average beat**

The Averaging View displays each beat along with the average as determined in the Settings dialog.

The QT interval versus Time plot is ideal for illustrating the effect of dofetilide on the ECG’s QT interval in a rabbit. The ECG Waterfall Plot displays a 3D plot of averaged beats, with obvious QT prolongation.

**ECG Analysis Applications:**

- Mouse and Rat (page 8)
- ECG and Heart Rate Variability (page 16)
- Telemetry (page 14)
HRV

Analyze ECG or pulse signals for variations in the interval between heartbeats with the HRV (Heart Rate Variability) Module.

Display data as graphs & statistics

The HRV Module uses the RR interval data to generate displays including: Poincaré Plot, Period Histogram, Delta RR Histogram, Tachogram and Spectrum. It also generates a Report featuring subject data and HRV statistical measures.

The HRV Module uses a threshold detector to detect the R component from each raw ECG waveform and generate RR Interval data. The module automatically distinguishes and classifies beats into three groups; normal, ectopic or artifact.

With the HRV Module you can:
- Adjust artifact/ectopic interval classification limits
- Exclude artifacts or include beats in the analysis on an individual basis
- Delete short artifact groups or add RR intervals
- Adjust the histogram bin size.

The Analysis Settings dialog.

HRV Applications:
- Exercise Physiology (page 22)
- ECG and Heart Rate Variability (page 16)
- Telemetry (page 14)
- Psychophysiology (page 30)
- Sleep Studies (page 26)
Metabolic

Determine cardiorespiratory function and exercise physiology measurements online and offline with the Metabolic Module.

The module provides a comprehensive set of features for metabolic data acquisition and analysis from human subjects, and is ideal for use with the ADInstruments Exercise Physiology System (see page 90).

The Metabolic Module and Exercise Physiology System are used together in applications including:
- Continuous measurements of metabolic parameters
- Respiratory gas analysis
- Pulmonary function analysis
- Indirect calorimetry
- Spirometry
- Biopotential measurements.

The module uses simultaneous measurements of respiratory gas concentrations and airflow to calculate and display metabolic variables.

Customize experiment settings

The Metabolic Module allows you to:
- Set averaging time (data logging) and recording time (duration of experiment)
- Enter subject details (such as name, age, weight, height and gender)
- Specify environmental settings (such as atmosphere or air conditions)
- Calibrate your data: settings for automated first and second gas calibrations
- Customize reports generated by the module.

Automatically generate variables and graphs

The Metabolic Module automatically calculates and tabulates the following variables in the Log Window:
- $V_E$ expired minute volume (L/min)
- $V_{O2}$ oxygen consumption (L/min)
- $V_{CO2}$ carbon dioxide production (L/min)
- RER respiratory gas ratio.

The module generates seven graphs that plot metabolic variables against time or each other. The plots are constructed from time-averaged data points (tabulated in the Log Window).

The plots and the Log Window are updated in real time and can be printed or exported. Metabolic graphs and calculations are compiled into a report that can be printed or exported to other programs for further analysis.
Peak Analysis

Automatically detect and analyze single or multiple (non-overlapping) peaks in periodic signals with the Peak Analysis Module.

Use the Peak Analysis Module to:
- Automatically detect peaks within an entire channel or data selection
- Automatically tabulate extracted peak parameters for export to other applications
- Detect positive or negative peaks
- Display calculated parameters as continuous signals in LabChart channels
- Navigate between the Chart, Peak Analysis and Table Views.

Choose from default settings for different applications

The Peak Analysis Module can enhance waveform analysis across a wide range of applications. To make analysis setup simple, you can choose between default settings options including:
- **Action Potentials** — for intracellular neuronal action potentials
- **Cardiac Action Potentials** — for monophasic intracellular and extracellular cardiac action potentials
- **Evoked Responses** — for monophasic peaks that follow a stimulus
- **General Unstimulated** — general-purpose detector of unstimulated peaks (offers a wide range of customized options)
- **Population Spikes** — for extracellular evoked responses
- **Synaptic** — for synaptic measurements.

You can further customize the settings and baseline detection options to suit your specific signals and experiments.

Calculate and log selected peak parameters

The Table View displays calculated variables chosen in Table Options for all detected peaks. Values can be exported as a text file or easily added to Data Pad.

Analysis View provides the visual analysis of each peak and its parameters. Examples here show Peak of an aortic flow signal (top left) and a cardiac action potential (bottom right).

Peak Analysis Applications:

- Blood, Atrial and Ventricular Pressure (page 10)
- Mouse and Rat (page 8)
- Blood Flow, Cardiac Output and Oximetry (page 19)
- Isolated Tissue (page 32)
- ECG and Heart Rate Variability (page 16)
- Telemetry (page 14)
- Psychophysiology (page 30)
- Sleep Studies (page 26)
- Isolated Perfused Hearts (page 36)
PV Loop

Record and analyze left ventricular pressure and volume data for hemodynamic research in animals with the PV Loop Module.

You can calculate the area of a loop, as well as a wide range of hemodynamic parameters both online and offline.

Display and analyze PV Loops

In addition to displaying pressure-volume loops in the Loop View you can:
- Examine individual loops
- Choose individual loops to include or exclude from your analysis
- Automatically calculate and display end-systolic and end-diastolic PV relationships (ESPVR and EDPVR) using linear, quadratic or exponential regression fit.

Calibrate volume data

Use the module to:
- Convert data to absolute volumes using Cuvette Calibration — settings files with known volumes of common cuvettes are supplied
- Correct for parallel conductance using saline calibration — calculates and applies the parallel conductance volume correction factor to the volume channel.

Calculate hemodynamic variables

The module’s Hemodynamics Table calculates and logs a wide range of variables including pressure-volume area, stroke work, and cardiac output. You can:
- Calculate and display parameters cycle-by-cycle
- Include or exclude parameters from the table.

Plot linear regression

Display linear regression information on four plots including
1. dP/dt max vs. EDV
2. PVA vs. ESP
3. PVA vs. EDV

PV Loop Applications:

- Ventricular Pressure and Volume (page 10)
Spike Histogram

Analyze extracellular recordings sampled at high rates with the Spike Histogram Module. The module provides a variety of statistical analyses and discriminates online or offline between different units.

Two discrimination methods available

The Spike Discriminator View Window features two powerful discrimination methods for reliable discrimination between units in multi-unit recordings:
- Fast and easy template matching
- Freehand height and width discrimination for precise spike selections.

Generate histograms and display parameters

The module generates analysis graphs from the analyzed spike selection including:
- Amplitude Histogram — displays a histogram of amplitudes
- Interspike interval Histogram — displays a histogram of interval distribution
- Peristimulus Time Histogram — displays the frequency and timing of spike relative to a stimulus or event
- Ratemeter — plots the firing rate against time
- Autocorrelation Histogram — detects periodicity in an individual unit
- Cross-correlation Histogram — detects the temporal dependence of two physiological parameters.

The module calculates and exports 13 parameters for each Histogram Window into LabChart’s Data Pad (including bin size, mean X, SD X, SEM X, mean Y and more).

Integrate with Scope View

The Spike Histogram Module integrates seamlessly with LabChart’s Scope View. Spike units defined in the discriminator window are automatically updated in Scope View Event Mode allowing spike shapes to be individually reviewed.

Analyze data with NeuroExplorer

Using the Spike Histogram Module for Windows, you can save data as a *.nex file and open it in NeuroExplorer for extensive spike train analysis options including Poincaré plots, burst and spectral analysis, and more.

Spike Histogram Applications:
- Neurophysiology and Electrophysiology (page 24)
**Video Capture**

The Video Capture Module adds audio and video capability to LabChart. The module allows the synchronized recording and playback of a Windows Media Video or QuickTime movie with a correlating LabChart data file.

The Video Capture Module records in Windows Media Video or QuickTime movie formats and supports most video cameras with USB connections or input from any frame capture cards supported by DirectShow.

In the Video Capture Settings dialog you can select:
- Video and/or audio recordings
- Start/stop recording controls
- Quality of recording
- Video/audio instrument settings
- Synchronization settings of recording devices with LabChart to allow frame-accurate video/data recordings
- Hard disk space allocation.

**Play video in synchronization with LabChart files**

After recording is finished, the recorded movie can be viewed by clicking on the Movie View dialog box. The movie is played back in tandem with the LabChart data file. When the Movie View is open, the Movie Marker can be used to show the point in the LabChart data file corresponding to the current movie frame. This is useful when trying to find the exact data point corresponding to a particular event, or vice versa.

**Match video events with data points**

You can navigate through data or movie frames by dragging the Movie Marker in LabChart. Alternatively, scroll within the movie and correlate each point in the movie with the corresponding point in the data file. LabChart data files and associated movies are automatically saved in the same file location.

**Video Capture Applications:**

- Psychophysiology (page 30)
- Sleep studies (page 26)
- Telemetry (page 14)
- Exercise Physiology (page 22)
## LabChart Specifications

<table>
<thead>
<tr>
<th></th>
<th>Windows</th>
<th>Mac</th>
</tr>
</thead>
</table>
| Minimum system requirements | - Windows Vista or Windows 7 (32-bit & 64-bit editions)  
- Windows XP  
- 100 MB free hard disk space  
- Display with 1024 x 768 resolution  
- USB interface for operation with PowerLab | - Mac OS X 10.4 or later  
- 100 MB free hard disk space  
- Display with 1024 x 768 resolution  
- USB interface for operation with PowerLab |
| Printers         | Windows compatible                                                      | Mac compatible                                                       |
| Export formats   | Binary, Axon, IGOR, MATLAB, QuickTime, Wav, Text, PVAN, EDF             | IGOR, MATLAB, QuickTime, Text                                        |
| Display mode     | Chart, Zoom, XY View, Scope, Movie (Video Capture Module)              | Chart, Zoom, XY Plot, Movie (Video Capture Module)                   |
| Maximum storage limits | Limited by available computer disk space                              | Limited by available computer disk space                             |
| Channels supported | 32 channels                                                           | 32 channels                                                         |
| Maximum throughput | 400 kHz aggregate (one PowerLab 35 Series unit)  
800 kHz aggregate (two PowerLab 35 Series units)  
Up to 200 kHz per channel (PowerLab 35 Series hardware) | 400 kHz aggregate (PowerLab 35 Series hardware)  
Up to 200 kHz per channel (PowerLab 35 Series hardware) |
| Recording modes  | Continuous to memory (RAM) or disk                                    | Continuous to memory (RAM) or disk                                   |
| Trigger sources  | User, external trigger input, internal timer or channel voltage level | User, external trigger input, internal timer or channel voltage level |
| Trigger modes    | Post-trigger, pre-trigger and event trigger                            | Post-trigger, pre-trigger and event trigger                          |
| Statistics       | Statistics — mean, standard deviation, standard error, maximum value, time at maximum, minimum value, time at minimum, maximum – minimum, number of points, RMS, 1/3 Max + 2/3 Min  
Selection Information — time, date, value, start, end, duration, number of points  
Comments — comment time, comment number, full comment, comment numbers only  
Slope — average, maximum, time at maximum slope, minimum, time at minimum slope  
Integral — integral, integral from minimum, integral from start, integral from baseline  
Block Information — range, sample interval, sampling rate, block number, block duration, samples, start time, start date  
Cyclic Measurements — event count, cycle count, average cyclic frequency, rate, period, minimum/maximum cyclic period, average cyclic minimum, average cyclic maximum, average cyclic height, average 1/3 Max + 2/3 Min  
Scope — page number, page duration and page start time containing the active point or selection from Scope View  
XY Loop Calculations — calculates the area inside the XY loop, x or y value and slope at the reference point in XY loop, minimum and maximum x or y value, time at minimum and maximum x or y value, and mean of x or y value in XY loop in the XY View  
Spectrum — display maximum power, maximum power frequency, mean power frequency, median power frequency, minimum power, minimum power frequency, % total power, spectral edge frequency, SD frequency and total power | Statistics — mean, standard deviation, standard error, maximum value, time at maximum, minimum value, time at minimum, max – min, number of points, integral, integral from minimum, integral from start, integral from baseline, RMS, 1/3 Max + 2/3 Min  
Selection Information — start, end, duration, number of points  
Cursor and comments — time, value, comment full, comment numbers only, comment number, comment time, comment duration  
Slope — average, maximum, time at maximum slope, minimum, time at minimum slope  
Block Information — range, sample interval, sampling rate, block number, block duration, samples, start time, start date  
Cyclic Measurements — event count, cycle count, frequency, rate, period, minimum period, maximum period, average minimum, average maximum, average peak-to-peak, average 1/3 Max + 2/3 Min |
| Online calculations | Arithmetic, Cyclic Measurements, Derivative, Digital Filter, Integral, Shift, Smoothing | Online calculations: Arithmetic, Integral Offline calculations: Cyclic Measurements, Derivative, Digital Filter, Shift, Smoothing |
| Further analysis | Additional extensions and modules are available to increase the functionality and analysis capabilities of LabChart | All care has been taken to provide correct specifications at the time of printing. Specifications are subject to change. See our website for the latest information. |
GLP Client & Server

GLP is the recognized standard for performing non-clinical testing of pharmaceuticals. ADInstruments offers an easy and reliable data acquisition solution for a GLP and 21 CFR Part 11 compliant environment.

Features and benefits include:
- Data acquisition systems that are compliant with GLP and 21 CFR Part 11 regulations
- Centralized authorization system that supports an unlimited number of users
- System that does not allow unauthorized access or tampering of files
- Public-key, private-key user validation to guarantee user authentication
- Easy installation, administration, maintenance and record keeping
- User-friendly system that does not hinder research.

GLP Client

The GLP Client provides the user interface, audit trail and signing components required to meet GLP and 21 CFR Part 11 requirements.

GLP Client features include:
- Securely signed data files to avoid tampering
- Non-editable audit trail
- Preservation of raw data
- Data and audit trail in a single file
- Visual indication of file validity
- Date and time stamping.

LabChart application window with GLP Status Bar. Recorded data is seen on the left screen with the GLP Audit Log on the right.
GLP Server

The GLP Server works together with the GLP Client to provide centralized authorization for signing LabChart files, as well as the means to check validity of signatures. At the administration level, it determines which users are permitted to create, modify or sign GLP documents.

GLP Server provides:
- Verification of signature validity when files are opened
- Users with authority to sign files upon saving
- Access to remote configuration
- Licenses for an unlimited number of users
- Extensive and customizable logging.

When adding a new user a specified GLP certificate and activation period must be selected.

Training and Certification

Introducing a GLP system can present challenges. With this in mind ADInstruments provides on-site installation, training and user certification services.

Calibration Service

ADInstruments can provide periodic calibration of your PowerLab hardware to confirm the system is working within specifications. Calibration can be organized within your GLP time frame and includes a calibration certificate. Ask your ADInstruments representative for more information or see the Support section of our website.
PowerLab Data Acquisition Systems

Full specifications are listed in the Products section of our website: www.ADInstruments.com. Specifications listed in the hardware section are as tested at the time of printing and are subject to change.

PowerLab 35 Series

The PowerLab 35 series models are high performance data acquisition units. A single unit is capable of recording at speeds of up to 400 kHz aggregate and up to 200 kHz per channel, continuously to disk. They are suitable for recording data from an extensive range of life science applications and are compatible with all signal conditioners, instruments and transducers supplied by ADInstruments as well as third party amplifiers that have analog outputs.

The PowerLab 35 series models are supplied with LabChart software and associated manuals and cables. Also available are PowerLab systems featuring LabChart Pro software. LabChart Pro includes all ADInstruments LabChart Modules and five years of free software upgrades.

PL3504 PowerLab 4/35 – 4 channels
PL3508 PowerLab 8/35 – 8 channels
PL3516 PowerLab 16/35 – 16 channels

Highlights

- Fast recording speed — up to 200 000 samples per channel (400 kHz aggregate)
- Integrated Pod inputs (differential inputs, DC power) for a wide range of transducers
- Independently selectable input sensitivities
- High speed USB
- High-pass, low-pass and anti-aliasing filters
- 16-bit resolution
- Independent analog outputs providing stimulation and DC control.
Specifications

Input Amplifiers
- Analog inputs: 4/35 – 4 inputs (4 single ended or 4 differential Pod)
  8/35 – 8 inputs (8 single ended or 4 differential Pod and 4 single ended)
  16/35 – 16 inputs (16 single ended or 4 differential Pod and 12 single ended)
- Input impedance: \( \sim 1 \, \Omega \parallel 100 \, \text{pF} \)
- Input ranges: ±2 mV to ±10 V in 12 steps
- Input coupling: DC or 0.15 Hz (software-selectable)
- Low-pass filters: 1 Hz to 1 kHz or 2:5:10 steps; 2 kHz, 25 kHz

Stimulator Output
- Analog output: 2 independent output channels
- Output ranges: ±200 mV to ±10 V in 6 steps
- Maximum output current: ±50 mA

External Trigger
- Trigger mode: TTL level or contact closure, software selectable

System
- ADC resolution: 16-bit (313 \( \mu \text{V} \) resolution on 10 V range, \( \sim 62 \, \text{nV} \) on 2 mV range)
- Maximum throughput: 400 ksp/s aggregate
- Maximum sampling speed: 200 kHz on one or two inputs 100 kHz on 3 or 4 inputs (independent sampling rates on each channel)
- Digital inputs/outputs: 8 TTL inputs and 8 TTL outputs
- Amplifier/Pod support: PowerLab 4/35 four single ended or four differential Pod ports
  PowerLab 8/35 eight single ended or four single ended and four differential Pod ports
  PowerLab 16/35 sixteen single ended or twelve single ended and four differential Pod ports

Mechanical
- Size: 240 × 260 × 70 mm (9.4” × 10.2” × 2.8”) (W × D × H)
- Power supply: 90–250 VAC, 50/60 Hz
- Enclosure: Aluminium and steel construction
Research Systems

ADInstruments Research Systems provide a range of complete solutions for diverse research applications. They typically consist of a PowerLab system, software, signal conditioners, specialized instruments and transducers. Research Systems are available for a variety of applications including Isolated Heart, Isolated Tissue, Blood Pressure, Exercise Physiology, Neurophysiology and more. For custom options please contact your ADInstruments representative.

Blood and Fluid Flow

In vivo and in vitro flow measurements are accurately recorded, displayed and analyzed using PowerLab data acquisition systems and Transonic Systems’ patented ultrasonic transit-time flowmeters.

ADInstruments supplies two types of systems for the measurement of blood and fluid flow. Perivascular systems measure flow in a variety of animal blood vessels by placing a flowprobe external to the vessel. Tubing systems measure the flow of solutions such as water, saline, buffer solutions or blood. High-precision flowsensors in the systems can record flows of less than 1 mL/minute up to 100 L/minute without contact with the fluid.

The systems are suitable for a range of applications including cardiac output, cardiovascular dynamics, renal hypertension, ischemia/reperfusion, extracorporeal shunts and cannulae, as well as studies of artificial heart and pulse duplication/heart valves, isolated perfused organs and hind limbs.

A variety of calibrated ready-to-use flowprobes and flowsensors are available separately (page 128) to provide simple, versatile and extremely accurate measurements for flow applications.

PL3508B11 One Channel Perivascular System
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- T402-PB One Channel Perivascular Flowmeter
- MLAC01 BNC to BNC Cable (1 m)

PL3508B12 One Channel Tubing Flow System
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- T402-TB One Channel Tubing Flowmeter
- MLAC01 BNC to BNC Cable (1 m)

PL3508B13 Two Channel Perivascular System
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- T402-PP Two Channel Perivascular Flowmeter
- MLAC01 BNC to BNC Cable (1 m) (2)

PL3508B14 Two Channel Tubing Flow System
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- T402-TT Two Channel Tubing Flowmeter
- MLAC01 BNC to BNC Cable (1 m) (2)

PL3508B15 Two Channel Perivascular / Tubing Flow System
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- T402-PT Two Channel Perivascular/Tubing Flowmeter
- MLAC01 BNC to BNC Cable (1 m) (2)
Isolated Tissue

PowerLab systems are widely used to record and analyze data from experiments involving isolated tissues. A range of hardware units to accompany these systems (such as multiple chamber organ baths, bridge amplifiers and isometric/isotonic transducers) are also supplied by ADInstruments. The most popular configurations of organ bath systems are listed below.

Radnoti Tissue-Organ Bath Systems

ADInstruments, in conjunction with Radnoti Glass Technology, provides a range of modular organ bath research systems for multiple isolated tissue studies. Radnoti’s highly experienced craftsmen use quality borosilicate glass in their manufacturing process to produce world-class glassware. Supplied with a PowerLab unit, the Tissue-Organ Bath Systems are available in 4, 8 or 16 chamber models and include a temperature bath/circulator, bridge amplifiers and force transducers. Stimulating electrodes for specific tissue types are also available separately (see page 148).

Radnoti systems include innovative High-Tech Tissue-Organ Baths that are available in 5, 10, 25, 50, 100, 200 and 300 mL sizes. A pre-heating coil in the water-jacketed walls of the chamber maintain optimal solution temperature. The bath solution can quickly be drained via a stopcock at the base of the chamber (single-pass mode). The tissue-organ bath can also be used in a recirculating flow mode. Each chamber is supplied with a glass hook tissue support and Teflon needle valve to control oxygenation, and the tissue pretension can easily be adjusted using the transducer positioner.

**PL3508B60/C-V** Radnoti Tissue–Organ Bath System (4 chamber)
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- FE224 Quad Bridge Amp
- MLT0420/RAD Force Transducer (20 g) (4)
- 159920-X1/C† Radnoti 4 Chamber Tissue-Organ Bath
- 170051B-V* Radnoti Thermal Circulator Pump

**PL3508B61/C-V** Radnoti Tissue–Organ Bath System (8 chamber)
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- FE228 Octal Bridge Amp
- MLT0420/RAD Force Transducer (20 g) (8)
- 159920-X1/C† Radnoti 4 Chamber Tissue-Organ Bath (2)
- 170051B-V* Radnoti Thermal Circulator Pump
- 120140-C Radnoti 4 to 8 Chamber Conversion Kit

**PL3516B62/C-V** Radnoti Tissue–Organ Bath System (16 chamber)
- PL3516/P PowerLab 16/35 with LabChart Pro Software
- FE228 Octal Bridge Amp (2)
- MLT0420/RAD Force Transducer (20 g) (16)
- 159920-X1/C† Radnoti 4 Chamber Tissue-Organ Bath (4)
- 170051B-V* Radnoti Thermal Circulator Pump (2)
- 120140-C Radnoti 4 to 8 Chamber Conversion Kit (2)

† Specify chamber size: C = 5, 10, 25, 50, 100, 200, 300 mL
* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V
Panlab Tissue-Organ Baths

ADInstruments supplied a range of compact all-in-one design organ baths from Panlab. They feature automatic filling and emptying of tissue chambers and include reservoir coils, gas diffusers, tissue holders, water pump, thermostat controller and micropositioners. The micropositioner mounting holes can accommodate most force and displacement transducers. Tissue chambers of 25 mL volume are standard, with 5, 10 or 50 mL capacity chambers available on request. A variety of platinum or stainless steel stimulating electrodes (page 149) can also be fitted as optional extras.

**PL3508B5/C-V** Organ Bath System (4 chamber)
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- FE224 Quad Bridge Amp
- MLT0420 Force Transducer (20 g) (4)
- ML0146/C-V* 4 Chamber Organ Bath†

**PL3508B6/C-V** Organ Bath System (8 chamber)
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- FE228 Octal Bridge Amp
- MLT0420 Force Transducer (20 g) (8)
- ML0186/C-V* 8 Chamber Organ Bath†

**PL3516B7/C-V** Organ Bath System (16 chamber)
- PL3516/P PowerLab 16/35 with LabChart Pro Software
- FE228 Octal Bridge Amp (2)
- MLT0420 Force Transducer (20 g) (16)
- ML0186/C-V* 8 Chamber Organ Bath† (2)

† Includes SP3785-V* Thermostat Controller
§ Specify chamber size: C = 5, 10, 25 or 50 mL
* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

---

[Images of Panlab Tissue-Organ Baths and related equipment]
Wire Myograph Systems

The combination of DMT wire myographs and PowerLab data acquisition systems provides a complete solution for pharmacological investigations of smooth muscle reactivity and morphology of small tubular tissues (>60 µm). Single, dual and four-chamber myographs are available, all featuring in-built temperature control, oxygen and suction ports.

The myographs are supplied with a control unit, an in-built high-resolution transducer and micrometer. The high-quality manual or automatic micropositioners provide precise tension control, and the DMT Normalization Module for LabChart software, included with LabChart Pro, allows easy calculation of optimal pretension conditions.

PL3508B21 Single Wire Myograph System
- PL3508/P  PowerLab 8/35 with LabChart Pro Software
- DMT310A  Single Wire Myograph

PL3508B22 Dual Wire Myograph System
- PL3508/P  PowerLab 8/35 with LabChart Pro Software
- DMT410A  Dual Wire Myograph

PL3508B23 Auto Dual Wire Myograph System
- PL3508/P  PowerLab 8/35 with LabChart Pro Software
- DMT510A  Auto Dual Wire Myograph

PL3508B24/TS Multi Chamber Myograph w/Touch Screen System
- PL3508/P  PowerLab 8/35 with LabChart Pro Software
- DMT620M  Multi-Chamber Myograph

PL3508B25 Confocal Wire Myograph System
- PL3508/P  PowerLab 8/35 with LabChart Pro Software
- DMT120CW  Confocal Wire Myograph
Isolated Heart

ADInstruments systems provide an easy way to monitor the performance of an isolated heart in response to the effects of drugs, electrical stimulation and other factors such as pressure, flow and temperature changes. ADInstruments supplies complete Working Heart and Langendorff systems that include a PowerLab unit, LabChart Pro software and all the necessary glassware, signal conditioners, transducers and accessories.

Panlab Langendorff System

ADInstruments and Panlab provide a compact design Langendorff System to study the hemodynamic performance of small mammalian isolated hearts (mice, rats and guinea pigs). The Langendorff system maintains the heart in a temperature controlled organ chamber whilst the coronary arteries are perfused with a nutrient solution, allowing evaluation under conditions of constant perfusate flow or constant pressure.

Switching between constant perfusate flow and pressure is easy using the Minipuls™3 Peristaltic Pump and the STH Pump Controller. The controller eliminates the need for elevated reservoirs and records the flow rate continuously without the additional cost of a flowmeter.

PL3508B2-V* Langendorff System (Constant Pressure or Flow)

- PL3508/P  PowerLab 8/35 with LabChart Pro Software
- ML176  Langendorff Apparatus and Thermostat Controller
- ML172  Minipuls™ 3 Peristaltic Pump
- IN175  STH Pump Controller
- FE221  Bridge Amp (2)
- MLT844  Physiological Pressure Transducer (2)
- MLT1401  T-type Implantable Thermocouple Probe
- ML312  T-type Pod
- FE136  Animal Bio Amp
- MLA1214  Spring Clip Electrodes for FE136 (3 pk)
- MLA2001  Langendorff Transducer Accessory Kit

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V
Radnoti Langendorff Systems

ADInstruments, in conjunction with Radnoti Glass Technology, provides a range of Langendorff research systems to study the performance of an isolated mammalian heart. They include constant perfusion pressure Langendorff systems, where changes in coronary resistance are indicated by changes in flow, and constant perfusion flow Langendorff systems, where changes in coronary resistance are indicated by changes in pressure.

The systems include water-jacketed interconnecting tubing and are supplied complete with lab stand, glassware and tubing, as well as associated clamp hardware. The "quick disconnect" fittings and modular nature of the systems allow easy modification of experimental setup.

All Radnoti Langendorff Systems include:
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- FE221 Bridge Amps (2)
- MLT844 Physiological Pressure Transducer (2)
- ML312 T-type Pod
- MLT1401 T-type Implantable Thermocouple Probe
- FE136 Animal Bio Amp
- MLA1214 Spring Clip Electrodes for FE136 (3 pk)
- MLAC16 BNC-BNC Cable (6 m)
- MLAC17 Front-End Extension Cable Kit
- SP2881 Transducer Brackets (2)

**PL3508B1-V** Langendorff System for Mice (Constant Pressure)
- 130102EZ Radnoti Langendorff Constant Pressure Recirculating Apparatus†

**PL3508B3-V** Langendorff System for Rats (Constant Flow)
- 120103EZ Radnoti Langendorff Constant Flow Non-Recirculating Apparatus†
- 170403 Latex Balloons (Size 3, 10 pack)
- 170423 Flexible Balloon Catheter (for Size 3 & 4 Balloons)

**PL3508B4-V** Langendorff System for Rats (Constant Pressure)
- 120105EZ Radnoti Langendorff Constant Pressure Non-Recirculating Apparatus†
- 170403 Latex Balloons (Size 3, 10 pack)
- 170423 Flexible Balloon Catheter (for Size 3 & 4 Balloons)

† Includes 170051B-V* Radnoti Thermal Circulator Pump
* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V
Radnoti Working Heart Systems

Radnoti Working Heart Systems allow evaluation of isolated mammalian hearts of most sizes (from mice to pigs) while the heart is perfused via the normal circulatory pathway. The researcher can cannulate both the aorta and pulmonary vein to measure left atrial and ventricular function.

All Radnoti Working Heart Systems can be used in single-pass perfusion or recirculation modes. Each system includes water-jacketed interconnecting tubing and features a high-tech heart chamber to maintain a constant temperature environment. Locking ports in the heart chamber provide easy access for cannulae and additional instrumentation or electrodes. Optional Millar Mikro-Tip Pressure Catheters are available (see page 132).

All Radnoti Working Heart Systems include:

- PL3508/P PowerLab 8/35 with LabChart Pro Software
- FE221 Bridge Amp (2)
- MLT844 Physiological Pressure Transducer (2)
- ML312 T-type Pod
- MLT1401 T-type Implantable Thermocouple Probe
- FE136 Animal Bio Amp
- MLA1214 Spring Clip Electrodes for FE136 (3 pk)
- MLAC17 Front-End Extension Cable Kit
- SP2881 Transducer Brackets (2)

**PL3508B50/X-V** Working Heart System for Rats/Rabbits

- 120101BEZ Working Heart Apparatus for Rats/Rabbits†

**PL3508B55/V** Working Heart System for Mice

- 130101EZ-V Working Heart Apparatus for Mice†

† Includes 170051B-V* Radnoti Thermal Circulator Pump

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

§ Specify heart chamber: X = S (rat, guinea pig), M (cat, rabbit), L (pig)
Radnoti Working Heart Ultimate Systems include:

- PL3516/P  PowerLab 16/35 with LabChart Pro Software
- FE224  Quad Bridge Amp
- MLT844  Physiological Pressure Transducers (2)
- SP2881  Transducer Brackets (2)
- ML312  T-type Pod
- MLT1401  T-type Implantable Thermocouple Probe
- FE136  Animal Bio Amp
- MLA1214  Spring Clip Electrodes for FE136 (3 pk)
- FE180  Stimulus Isolator
- MLA260/L  Stimulator Cable (4 mm shrouded to Alligator clip, 2 m)
- ML165  pH Amplifier
- MI-405  Miniature Glass Electrode for pH measurement
- MI-409  Miniature Reference Electrode
- SPR-671  Millar Pressure Catheter (1.1F) (2)
- AEC-10D  Catheter Interface Cable (Low Profile)
- MLT1120  Micro-Oxygen Electrode
- MLT1122  Analog Adapter (for Micro-Oxygen Electrode)
- T402-TT  Two Channel Tubing Flowmeter
- MLAC16  BNC Extension Cable Kit
- MLAC17  Front-End Extension Cable Kit
- SP0169  Teflon Insulated Platinum Wire (3 m)

PL3516B56-V* Working Heart Ultimate System for Mice

- 130101EZ  Working Heart Apparatus for Mice†
- ME1PXN  PXN-Series Inline Flowprobe – 1.2 mm (2)

PL3516B51/S-V* Working Heart Ultimate System for Rats

- 120101BEZ/S  Radnoti Working Heart System for Rats†
- ME3PXN  PXN Inline Flowprobe – 2.4 mm (2)
- 170403  Latex Balloon (Size 3, 10 pack)
- 170423  Flexible Balloon Catheter (for Size 3 & 4 Balloons)

† Includes 170051B-V* Radnoti Thermal Circulator Pump
* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V
Cardiovascular Pressure

PowerLab data acquisition systems and Millar Mikro-Tip catheters provide leading-edge technology to record and analyze high-fidelity cardiovascular pressure signals with unparalleled accuracy. Mikro-Tip catheters offer many advantages over traditional fluid-filled catheters including signal integrity, no signal attenuation and elimination of movement artifact. Due to the catheter configuration, the sensor can be placed directly at the source of the signal, such as the left ventricle of the heart. Though the sensors are robust and some are repairable, it is recommended that extreme care be exercised when using these catheters to prevent irreversible damage.

Please note: Catheters for Dog/Pig/Sheep, Rabbits/Cats and Mice/Rats are available separately (see page 132). For more information or assistance please contact your ADInstruments representative.

**PL3508B35 Mikro-Tip BP Foundation System**
- PL3508/P  PowerLab 8/35 with LabChart Pro Software
- FE221  Bridge Amp
- AEC-10C  Catheter Interface Cable (Viking)
- AEC-10D  Catheter Interface Cable (Low-profile)

Ventricular Pressure-Volume

*In vivo* ventricular pressure and volume can be simultaneously recorded in small (mouse, rat) through to large animals (dog, sheep, pig) with a PowerLab and a suitable Millar Pressure-Volume System. Using the MPVS Ultra, a suitable pressure-volume catheter and PowerLab, pressure and volume can be recorded and displayed with LabChart software in real time. All systems are provided with LabChart Pro including the PV Loop Module for analysis of hemodynamic parameters including maximum and minimum pressure/volume, end-systolic and end-diastolic pressure/volume, cardiac output and stroke work/volume.

The MPVS Ultra Single-Segment systems record PV measurements from mice and rats only. Single-Segment systems can be upgraded to the MPVS Ultra Foundation system with the 880–0168U Software Upgrade.

Please note: A variety of pressure-volume catheters for Dog/Pig/Sheep, Rabbits/Cats, and Mice/Rats are available separately (see page 132).

**PL3516B49 MPVS Ultra Foundation System**
- PL3516/P  PowerLab 16/35 with LabChart Pro Software
- 880-0168  Millar MPVS Ultra (large and small animals)
- 910-1060  Rho Calibration Cuvette Kit
- 880-0169  MPVS Ultra Cable pack (10 ft)
- 880-0172  MPVS Ultra BNC Cable Pack
Cardiac Electrophysiology System

ADInstruments provides a cardiac electrophysiology system for determining the electrical properties of the atrium and ventricle in small animals (ideal for mice and rats). Parameters measured include conduction times, refractory periods, His potentials, sinus and atrioventricular nodal properties and inducibility of abnormal heartbeats.

Please Note: Electrophysiology catheters used to perform pacing and recording protocols from inside the heart (intracardiac) or through the esophagus (transesophageal) are available separately (see page 126).

PL3508B36 Cardiac Electrophysiology Foundation System
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- STG3008-FA Intracardiac Electrophysiology Stimulator/Amplifier
- C-BNC-Lemo Intracardiac Electrophysiology Stimulator/Amplifier Output Cable (Lemo to BNC) (8)
Exercise Physiology

ADInstruments provides complete recording and analysis systems for both pure and applied exercise physiology research.

Exercise Physiology System

The complete Exercise Physiology System records and displays continuous real-time measurements of metabolic parameters such as CO₂ and O₂ concentrations, airflow, airflow temperature, and ECG or EMG. The supplied Metabolic Module provides continuous real-time measurements (tabular and graphical) of $\dot{V}CO_2$, $\dot{V}O_2$ and RER.

PL3508B80 Exercise Physiology System

- PL3508/P PowerLab 8/35 with LabChart Pro Software
- FE132 Bio Amp
- ML206 Gas Analyzer
  - MLA0343 Drying Tube
  - MLA0110 In-line Filters (10pk)
- MLA246 Gas Mixing Chamber
- FE141 Spirometer
- ML309 Thermistor Pod
- MLA240 Exercise Physiology Accessory Kit includes:
  - MLT1000L Respiratory Flow Head (1000 L/min)
  - MLA1029 Face Mask Kit (Adult, Small and Medium)
  - MLA1081 Flow Head Adapter
  - MLA1013 35 mm I.D. Adapter
  - MLA1015 Breathing Tube
  - MLA6024 Desiccant Cartridge
  - MLA0343 Drying Tube
  - MLT415/M Thermistor Temperature Sensor
**Telemetry**

ADInstruments offers telemetry systems to record and transfer information from a wireless system, expanding the range of monitoring capabilities available to researchers. By removing the need for tethers, the systems facilitate stress-reduced, long-term recordings from freely-moving animals.

**Telemetry System**

ADInstruments and Millar have combined the latest data acquisition and telemetry technologies to create a world-leading system that wirelessly monitors the physiological parameters of small animals. The foundation system can be used with a variety of telemeters to record signals, such as intravascular or intraluminal pressure signals, SNA and pressure signals, or ECG, EMG, EOG or EEG signals, or dissolved oxygen. Body temperature can also be recorded from any telemeter.

The SmartPad (TR180) receives data and charges the telemeters, while the Configurator (TR190) is used to configure and control telemeters and SmartPads. Each telemeter sends data on a separate frequency, allowing animals to be co-housed without shielding. A variety of telemeters are available separately (page 145).

**PL3516B109 Telemetry Small Animal Foundation System**

- PL3516/P  PowerLab 16/35 with LabChart Pro Software
- MLE0180  SmartPad (TR180)
- MLE0190  Configurator (TR190)

**Neurophysiology**

Due to their high sampling rates, PowerLab systems are ideal for use in electrophysiology and neurophysiology studies. ADInstruments offers a selection of extracellular, intracellular, two electrode voltage clamps, patch clamps and epithelial voltage clamps.

**Extracellular Recording System**

Record extracellular, EEG and ECG potentials using the DP-311 Differential Amplifier with glass or metal microelectrodes. The low-noise amplifier features excellent common mode rejection, high input impedance, high gain, high DC tolerance and internal calibration signal to test amplifier gain and operation.

**PL3508B73 Extracellular Recording System**

- PL3508/P  PowerLab 8/35 with LabChart Pro Software
- PLA190  19” Rack Adapter
- DP-311  Differential Amplifier with Active Headstage
- ESW-F15N  E Series Electrode Holder (Str, Ag Wire 1.5 mm)
Intracellular Recording System

Designed specifically for intracellular studies, this research system is supplied with PowerLab and a Warner Instruments high-impedance microelectrode amplifier allowing simultaneous current injection stimulation and recording. The system features three output gains (×10, ×20 and ×50) with balance controls, capacitance compensation up to 50 pF, low noise, low drift and fast response time.

**PL3508B74-V* Intracellular Recording System**
- PL3508/P    PowerLab 8/35 with LabChart Pro Software
- PLA190      19” Rack Adapter
- IE-210-V    Intracellular Electrometer Amplifier with Headstage
- ESP/W-F15N  E Series Electrode Holder (Str, Ag-AgCl Pellet & Wire, 1.5 mm)
* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

Epithelial Voltage Clamp System

Two Epithelial Voltage Clamp Systems are provided for the study of epithelial transport and the electrical properties of tissue. The system features high common-mode rejection, independent voltage and current commands, clamp speed selection, membrane resistance measurement circuitry and headstage with model membrane.

**PL3508B77-V Single Channel Epithelial Voltage Clamp System**
- PL3508/P    PowerLab 8/35 with LabChart Pro Software
- PLA190      19” Rack Adapter
- EC-800-V    Epithelial Voltage Clamp (120 V compliance)

**PL3508B78-V Dual Channel Epithelial Voltage Clamp System**
- PL3508/P    PowerLab 8/35 with LabChart Pro Software
- PLA190      19” Rack Adapter
- EC-825A-V   Dual Channel Epithelial Voltage Clamp (50 V compliance)

Two Electrode Voltage Clamp Recording Systems

ADInstruments provides two research solutions with Warner Instruments amplifiers designed for two-electrode, whole-cell voltage clamping of Xenopus Oocytes. The amplifiers are ideal for clamping large cells and cell structures. They feature accurate measurements of bath current, high compliance voltage, low noise, two clamp speeds and fast, stable voltage clamping with extended current measuring range.

**PL3508B75-V* Two Electrode Voltage Clamp Recording System**
- PL3508/P    PowerLab 8/35 with LabChart Pro Software
- PLA190      19” Rack Adapter
- OC-725C-V   Oocyte Clamp Amplifier
  - 7250V      Voltage Headstage
  - 7251I      Bath Clamp Headstage
  - 7259C      Current Electrode Cable
  - 725MC      Oocyte Model Cell
- ESW-F15V    E Series Electrode Holder (Str, Vent, Ag Wire, 1.5 mm)
- E45W-F15VH  E Series Electrode Holder (45°, Vent, Handle, Ag Wire, 1.5 mm)
**PL3508B76-V* Oocyte Clamp Workstation System**

Components of PL3508B75-V as listed above as well as items listed below.

- RC-3Z Oocyte Recording Chamber
- MM-33L Left Micro-Manipulator
- MM-33R Right Micro-Manipulator
- MB/B Magnetic Base (2)

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

**Patch Clamp Recording System**

ADInstruments supplies three Patch Clamp Recording Systems that include the PC-501A multi-purpose patch clamp amplifier. The amplifier features independent V-hold and I-hold circuitry, a 4-pole low-pass Bessel filter, internally generated test signals, variable duration zap circuit and compensation controls.

All Patch Clamp Recording Systems include:

- PL3508/P PowerLab 8/35 with LabChart Pro Software
- PLA190 19” Rack Adapter
- QSW-A15P Q Series Electrode Holder (Str, Port, Ag Wire, 1.5 mm)

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

The system is used for the recording of single channel currents up to ±1 nA.

- PC-501A/10-V Patch Clamp Amplifier with 5101-10G Headstage (10 GΩ)
- MC-10G Model Cell for 5101-10G Headstage (10 GΩ)

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

The system is used for the recording of whole cell studies with currents up to ±10 nA.

- PC-501A/9-V Patch Clamp Amplifier with 5101-01G Headstage (1 GΩ)
- MC-01G Model Cell for 5101-01G Headstage (1 GΩ)

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

The system is used for the recording of whole cell experiments with currents up to ±100 nA.

- PC-501A/8-V Patch Clamp with 5101-100M Headstage (100 MΩ)
- MC-100M Model Cell for 5101-100M Headstage (100 MΩ)
- QSW-A15P Q Series Electrode Holder (Str, Port, Ag Wire, 1.5 mm)

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V
Wireless Neural Signals from small animals with TBSI

In partnership with Triangle BioSystems International Inc. (TBSI), ADInstruments offers industry leading research systems ideal for acquisition of neurological signals from freely moving small animals. TBSI provide small, lightweight headstages with an integrated, rechargeable battery.

**PL3508B82/F 5 Channel Wireless Neural Recording System**
- PL3508/P PowerLab 8/35 with LabChart Pro Software
- TB5469/F TBSI 5 Channel Wireless Neural Headstage Receiver Set
  - TB5663/F TBSI 5 Channel Wireless Neural Receiver
  - TB5653/F TBSI 5 Channel Wireless Neural Headstage (see page 146)
  - Accessories
  - Power supply
- MLAC55 TBSI Receiver to PowerLab Interface Cable (5 Ch)
- MLAC51 TBSI 5 Channel Headstage Testing Cable

**PL3516B83/F 15 Channel Wireless Neural Recording System**
- PL3516/P PowerLab 16/35 with LabChart Pro Software
- TB5470/F TBSI 15 Channel Wireless Neural Headstage Receiver Set
  - TB5664/F TBSI 15 Channel Wireless Neural Receiver
  - TB5656/F TBSI 15 Channel Wireless Neural Headstage (see page 146)
  - Accessories
  - Power supply
- MLAC56 TBSI Receiver to PowerLab Interface Cable (15 Ch)
- MLAC52 TBSI 15 Channel Headstage Testing Cable
Psychophysiology

ADInstruments provides complete all-in-one systems for psychophysiology research (including SuperLab software), which are ideal for experiments based on stimulus presentation and evoked response.

Stimulus Presentation Systems

ADInstruments and Cedrus Corporation provide several flexible stimulus presentation systems for psychophysiology research. These systems are ideal for conducting a range of stimulus presentation and evoked response experiments using two computers (one for stimulus presentation and the other for recording). All stimulus inputs and reaction times are monitored and synchronized to physiological parameters (such as autonomic nervous system activity (EDR), ECG, EEG, EMG or EOG, and heart rate) via TTL event markers to any PowerLab data acquisition unit with digital inputs.

All Stimulus Presentation Systems include:

- **MLE1320** SuperLab (Win/Mac, 1 pack) and StimTracker
  - MLE1302 SuperLab Pro (Win/Mac, 1 pack)
  - MLE1300 StimTracker Universal Marker Interface
- **FE116** GSR Amp
  - MLT116F GSR Finger Electrodes
- **MLA410** Physiology Accessory Kit
  - MLT004/ST Grip Force Transducer
  - MLA92 Push Button Switch
  - MLT1132 Respiratory Belt Transducer
  - MLT1010 Finger Pulse Transducer
  - MLA700 Reusable ECG Electrodes (3)
  - MLAYDG Dry Earth Strap
  - MLAWBT9 EEG Flat Electrodes (5)
  - MLA1090 Electrode Cream
  - MLA1095 Electrode Paste (3 pack)
  - MLA1010 Disposable ECG Electrodes (100)
  - MLA1093 Abrasive Gel

**PL3508B110 Stimulus Presentation Foundation System**

- **PL3508/P** PowerLab 8/35 with LabChart Pro Software
- **FE135** Dual Bio Amp
  - MLA2540 5 Lead Shielded Bio Amp Cable
  - MLA2505 Shielded Lead Wires (5 snap-on)

**PL3516B111 Stimulus Presentation Ultimate System**

- **PL3516/P** PowerLab 16/35 with LabChart Pro Software
- **ML138** Octal Bio Amp
  - MLA0310 Lead Wires (1.8 m, 10 snap-on) (2)
- **MLE1307** Response Pad (7-Buttons)
- **MLE1312** SV-1 Smart Voice Key
- **MLT1601/ST** Response Meter (6 m)
- **MLAC38** Response Pad to PowerLab Cable (2 m)
- **ML309** Thermistor Pod
- **MLT422/A** Skin Temperature Probe (2 m)
Signal Conditioners

ADInstruments signal conditioners are software-controlled amplifiers that operate with PowerLab systems. They extend the recording capabilities of the PowerLab system into specialized fields and applications by accepting inputs from a wide variety of transducers and electrodes. Once connected, our signal conditioners are automatically identified and can be configured by LabChart software.

Software settings allow fast and accurate equipment and protocol setup. Settings are automatically stored when you save the file. Experiment protocols can be repeated with a click of a mouse.

The ADInstruments range of signal conditioners consists of two types:
Amps—connection to PowerLab unit via I2C ports
Pods—connection to PowerLab unit via 8-pin DIN ports or ML305 Pod Expander

The ADInstruments range of signal conditioners includes:
- Animal Bio Amp
- Bio Amp
- Dual Bio Amp
- Octal Bio Amp
- EOG Pod
- Dual Bio Amp/Stimulator
- Bridge Amp
- Quad Bridge Amp
- Octal Bridge Amp
- BP Amp
- Cardiac Output Pod
- Oximeter Pod
- Animal Oximeter Pod
- Conductivity Pod
- pH/Temperature Amp
- GSR Amp
- Pod Expander
- Neuro Amp
- Spirometer
- Stimulator HC
- Stimulus Isolator
- T-type Isolator
- Thermistor Pod

**Biopotentials**

**FE136 Animal Bio Amp**

The Animal Bio Amp is a galvanically isolated, high performance, differential amplifier suitable for the measurement of a wide variety of biological signals in animals and isolated tissues. Supplied with a set of 3 electrode cables with micro-hooks. Recommended for animal use only.

**Specifications**

- Safety: Approved to IEC 60601-1 Standard (BF rating)
- EMC: EN61326-1:2006
- Connection type: Three shrouded 1.5 mm male pin sockets
- Configuration: Isolated differential channel with isolated ground reference
- Input range: ± 5 μV to ± 100 mV full scale in 14 steps (combined PowerLab and Bio Amp)
- Input impedance: 200 MΩ differential
- Input leakage current: < 3 μA rms @ 240 V, 50 Hz
  < 2 μA rms @ 120 V, 60 Hz
- CMRR: > 85 dB (typically, 1 to 60 Hz)
- IMRR: > 130 dB (to true earth, 50 to 60 Hz)
- Noise: 1 Hz to 5 kHz < 1.3 μV rms (< 8 μV peak-to-peak)
  0.3 Hz to 1 kHz < 0.6 μV rms
  0.1 Hz to 100 Hz < 0.35 μV rms (@ 200 samples/second)
- Accuracy: ± 1.5% (all ranges, within Bio Amp)
- Non-linearity: < 0.2% within range
- DC blocking: ± 1 V
- Baseline restore: Automatic

Full specifications are listed on our website: www.ADInstruments.com

Specifications listed are as tested at the time of printing and are subject to change.
FE132 Bio Amp and FE135 Dual Bio Amp

The FE132 Bio Amp and FE135 Dual Bio Amp are fully isolated, high-performance differential amplifiers with filter settings optimized for the measurement of a wide variety of biological signals including EEG, ECG and EMG. They are supplied with a Shielded Bio Amp Cable and Shielded Lead Wires approved for human connection.

Specifications

- **Safety:** Approved to IEC 60601-1 Standard (BF rating)
- **EMC:** EN61326-1:2006
- **Connection type:** Six-pin DIN/MS socket to fit 3-lead (FE132) Bio Amp cable or 5-Lead (FE135) Bio Amp Cable
- **Configuration:** Isolated differential channel with isolated ground reference
- **Input range:** ± 5 μV to ± 100 mV full scale in 14 steps (combined PowerLab and Bio Amp)
- **Input impedance:** 200 MΩ differential
- **Input leakage current:** < 3 μArms @ 240 V, 50 Hz
  - < 2 μArms @ 120 V, 60 Hz
- **CMRR:** > 85 dB (typically, 1 to 60 Hz)
- **IMRR:** > 130 dB (to true earth, 50 to 60 Hz)
- **Noise:**
  - 1 Hz to 5 kHz < 1.3 μVrms (< 8 μV peak-to-peak)
  - 0.3 Hz to 1 kHz < 0.6 μVrms
  - 0.1 Hz to 100 Hz < 0.35 μVrms (@ 200 samples/second)
- **Accuracy:** ± 1.5% (all ranges, within Bio Amp)
- **Non-linearity:** < 0.2% within range
- **DC blocking:** ± 1 V
- **Baseline restore:** Automatic

ML138 Octal Bio Amp

The ML138 Octal Bio Amp consists of eight electrically isolated, high-performance differential input AC amplifiers with a shared ground connector and separate inputs. It is ideal for many bilateral low-level signals including EEG, ECG, EMG, sensory nerve action potentials and smooth muscle studies and is recommended for use where multiple biopotentials are being recorded from a single subject rather than ‘daisy-chaining’ multiple Bio Amps. The ML138 features an audio output for headphones or powered speakers and includes all the necessary cables as well as MLA0310 Lead Wires (1.8 m), 10 snap on.

Specifications

- **Safety:** Tested to IEC60601–1:1998
- **Inputs:** Eight differential channels, common isolated ground
- **Input ranges:** ±5 μV to ±100 mV in 14 steps
- **Input impedance:** 200 MΩ differential, 30 pF to isolated ground (no cable),
- **Isolation:** 4 kVrms at 50 Hz for 1 minute (IEC 60601-1)
- **DC blocking:** ±1 V
- **IMRR:** > 135 dB (to true earth, 50 – 100 Hz)
- **Low-pass filter:** Fourth-order Bessel filter, ±3 % accuracy
- **Low-pass options:** 50, 100, 200, 500, 1k and 5k Hz
  - (EEG mode: 3, 10, 30, 60 and 120 Hz)
- **High-pass filter:** First-order filter, ±0.25% accuracy
- **High-pass options:** 0.02, 0.1, 0.3, 1, 3, 10 Hz (EEG mode: 0.03, 0.1, 0.3, 1 sec)
- **Frequency response:** 0.02 to 5000 Hz
- **Notch filter:** 50 or 60 Hz (auto-sensing)
- **Noise:** < 1.3 μVrms at 5k Hz
- **Baseline restore:** Automatic
- **Input connector:** 17 × 1.5 mm pin shrouded male socket to suit single pin 1.5 mm
- **Audio output:** Stereo jack with mono output, ±200 mV FS, current limited to ±5 mA (Suitable for headphones or powered speakers)
ML317 EOG Pod

The EOG Pod can be used to measure eye movement. The Pod is DC coupled and comes supplied with snap-on shielded lead wires. A front-panel zeroing control allows for manual adjustment of baseline levels.

Specifications

- Amplification ranges: \( \pm 2 \text{ mV}, \pm 1 \text{ mV}, \pm 500 \text{ µV}, \pm 200 \text{ µV}, \pm 100 \text{ µV} \)
- Frequency response: DC to 500 Hz
- Low-pass filter: 500 Hz fixed, 2nd order Butterworth
- Temperature drift: \( \pm 3 \text{ mV/°C} \)
- CMRR: > 80 dB
- IMRR: > 110 dB
- Input impedance: < 100 MΩ
- Front-panel control: Offset knob for initial zeroing of device
- Input bias (maximum): \( \pm 10 \text{ nA} \) at 25°C
- Input connector: 3 shielded lead wire connectors
- Isolation rating: 4 kVrms at 50 Hz for 1 minute

ML408 Dual Bio Amp/Stimulator

Consisting of two fully-isolated, differential amplifiers with an integrated isolated stimulator suitable for human use, the ML408 is optimized for a wide variety of biological signals including ECG and EMG. It is particularly appropriate for studies requiring bilateral measurements and integrated stimulation. The stimulator and dual bio amplifier are both independently electrically isolated. Approved for human connection as a body protected (BF rated) instrument.

Dual Bio Amp Input

- Safety: Approved to IEC 60601-1 Standard (BF rating)
- Connection type: Six-pin DIN/MS socket to fit 5-Lead Bio Amp Cable
- Configuration: 2 differential channels with common isolated ground reference
- Input range: \( \pm 20 \text{ µV} \) to \( \pm 50 \text{ mV} \) full scale in 11 steps (combined Bio Amp and PowerLab)
- Input impedance: 100 MΩ to ground
- Input leakage current: < 6 \( \mu \text{A}_{\text{rms}} \) @ 240 V, 50 Hz
  < 4 \( \mu \text{A}_{\text{rms}} \) @ 120 V, 60 Hz
- CMRR: > 75 dB (DC to 100 Hz) > 60 dB (@ 1 kHz)
- IMRR: > 130 dB (@ 50 to 60 Hz)
- Noise: 0.1 Hz to 5 kHz 1.95 µV 0.1 Hz to 50 Hz 0.5 µV
  0.1 Hz to 1 kHz 1.25 µV 0.1 Hz to 20 Hz 0.2 µV
- Accuracy: ± 1.5% (all ranges, within Bio Amp)
- Non-linearity: < 1% of full scale
- DC blocking: ± 0.5 V
- Baseline restore: Automatic

Isolated Stimulator Output

- Safety: Approved to IEC 60601-1 Standard (BF rating)
- Connection type: Two shrouded 4 mm sockets
- Configuration: Isolated constant-current stimulator with hardware-limited repetition rate
- Output range: 0 to 20 mA in 0.1 mA steps (software-selectable)
- Compliance voltage: 100 to 110 V typical
- Pulse rate: Software-selectable, but hardware-limited to a maximum of 20 Hz for safety
- Safety indicators: A single multi-color indicator displays the isolated stimulator status. A green flash indicates delivery of a valid stimulus. A yellow flash indicates an out-of-compliance condition
- Safety switch: Isolating On-off switch flicks down to disconnect quickly
Blood Pressure, Force and Displacement

FE221 Bridge Amp, FE224 Quad and FE228 Octal Bridge Amps

The Bridge Amps are non-isolated bridge amplifiers for use with force, pressure, displacement and other strain gauge or semiconductor bridge based transducers. They are suitable for cardiac and smooth muscle contraction, animal arterial or venous pressures, force and displacement, and some respiratory applications. DIN input is standard, for transducers with Grass connectors the MLAC11 Grass to DIN Adapter Cable can be used. The FE224 Quad and FE228 Octal Bridge Amps are ideal for use with multiple chamber organ bath systems.

Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC:</td>
<td>EN61326-1:2006</td>
</tr>
<tr>
<td>Connection type:</td>
<td>8-pin DIN socket</td>
</tr>
<tr>
<td>Configuration:</td>
<td>Differential</td>
</tr>
<tr>
<td>Input range:</td>
<td>± 200 μV to ± 5 V full scale in 14 steps (combined PowerLab and Bridge Amp)</td>
</tr>
<tr>
<td>Input impedance:</td>
<td>2 × 1 MΩ (single-ended) 2 MΩ (differential)</td>
</tr>
<tr>
<td>CMRR (differential):</td>
<td>100 dB @ 50 Hz (typical)</td>
</tr>
<tr>
<td>Noise:</td>
<td>&lt; 1 μV&lt;sub&gt;ref&lt;/sub&gt; referred to input at highest gain</td>
</tr>
<tr>
<td>Frequency response:</td>
<td>-3 dB, 2 kHz maximum at all gains with the low-pass filter off</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>± 0.5% (combined PowerLab and Bridge Amp)</td>
</tr>
<tr>
<td>Maximum input voltage:</td>
<td>± 10 V</td>
</tr>
<tr>
<td>Zeroing circuitry:</td>
<td>Software-controlled, either manual or automatic</td>
</tr>
<tr>
<td>Internal offsetting range:</td>
<td>± 10 V (1 to 5 V range)</td>
</tr>
<tr>
<td></td>
<td>± 1 V (100 to 500 mV range)</td>
</tr>
<tr>
<td></td>
<td>± 100 mV (0.2 to 50 mV range)</td>
</tr>
<tr>
<td>Internal offset resolution:</td>
<td>16-bit (internal DAC) ± 32 000 steps about 0 V</td>
</tr>
<tr>
<td>Excitation voltage range:</td>
<td>0 to 20 V DC (± 10 V referred to ground), adjusted by external resistor</td>
</tr>
</tbody>
</table>

FE117 BP Amp

The FE117 is a fully isolated blood pressure amplifier that operates with standard disposable BP transducers. The unit has an offset for sub-ranges and venous (negative-inclusive) ranges. The BP Amp is approved for direct connection (BF rated) and is suitable for invasive arterial, venous and ventricular pressure measurements in humans and animals. The FE117 BP Amp includes the MLAC05 Cable and MLT0670 Disposable BP Transducer.

Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety:</td>
<td>Approved to IEC 60601-1 Standard (BF rating)</td>
</tr>
<tr>
<td>EMC:</td>
<td>EN61326-1:2006</td>
</tr>
<tr>
<td>Connection type:</td>
<td>6-pin socket to fit 6-pin Utah Medical 650–208 transducer cable with a 4-pin transducer connection cable</td>
</tr>
<tr>
<td>Configuration:</td>
<td>Isolated AC Bridge</td>
</tr>
<tr>
<td>Input range:</td>
<td>50 to 250 mmHg full scale in 3 steps (combined PowerLab and BP Amp)</td>
</tr>
<tr>
<td>Sensitivity:</td>
<td>Correct for 5 μV/V/mmHg transducer standard (~350 Ω bridge)</td>
</tr>
<tr>
<td>Input impedance:</td>
<td>&gt; 10 kΩ at 400 Hz AC</td>
</tr>
<tr>
<td>Input leakage current:</td>
<td>&lt; 3 μA&lt;sub&gt;ref&lt;/sub&gt; at 240 V, 50 Hz</td>
</tr>
<tr>
<td></td>
<td>&lt; 2 μA&lt;sub&gt;ref&lt;/sub&gt; at 120 V, 60 Hz</td>
</tr>
<tr>
<td>Frequency response:</td>
<td>-3 dB at 50 Hz</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>± 2% (± 0.2 mmHg) all points, after zero correction</td>
</tr>
<tr>
<td>Zeroing and offset:</td>
<td>Automatic software-controlled fast zeroing, controlled by internal 12-bit DAC; resolution = ± 0.2 mmHg (with supplied transducer)</td>
</tr>
<tr>
<td>Excitation:</td>
<td>5 V&lt;sub&gt;ref&lt;/sub&gt;, AC at 400 Hz ± 5 %</td>
</tr>
</tbody>
</table>
Blood Flow and Pulse Oximetry

ML313C Cardiac Output Pod

The Cardiac Output Pod is used with fast response time T-type thermocouples making it ideal for the determination of cardiac output. It is supplied with a MLT1402 T-type Ultrafast Thermocouple Probe, the MLA313 Cardiac Output Accessory Kit and MLS340 Cardiac Output Module, which provides easy calculation and extraction of cardiac output values using LabChart software. **Not suitable for human use.**

**Specifications**

- **Probe type:** T-type thermocouple (tip maximum outside diameter 0.009")
- **Ranges:** 20° C or 50° C
- **ΔT ranges:** ±1, ±2, ±5, ±10, ±20, ±50 Δ° C
- **Offset range (ΔT):** 25 to 50° C (Abs)
- **Output:** 0 mV = 0° C, 10 mV/° C
- **Temperature accuracy:** < 0.2° C at 35 to 40° C
- **Temperature resolution:** < 0.001° C at ±20 Δ° C range or less
- **DC drift:** 2 µV/° C
- **Response time (@30 Hz):** 13 ms (10 to 90 % rise time on square wave input)
- **Input connector:** Miniature T-type

ML320 Oximeter Pod

The ML320 is a laser diode-based signal conditioner suitable for the measurement of human blood oxygen saturation in the range of 70 to 100%. The Oximeter Pod uses the patented Nonin SpO2 technology and comes supplied with the MLT321 SpO2 Finger Clip (ML320/F) or the MLT322 SpO2 Ear Clip (ML320/E).

**Specifications**

- **Operating principle:** Non-invasive blood oxygen saturation (SpO2 determination using red and infrared light passed through pulsating blood in vascular tissue)
- **Saturation range:** 70 to 100%
- **Accuracy:** ±2% for adults using Finger clip sensor
- **Measurement wavelength:** Red (660 nm) and Infrared (910 nm)
- **Measurement rate:** 1 reading per second
- **Resolution:** 1% steps
- **SpO2 acquisition time:** ~10 s

ML325 Animal Oximeter Pod

The ML325 is a laser diode-based signal conditioner suitable for the measurement of oxygen saturation in the range of 70 to 100%. The Oximeter Pod uses the patented Nonin SpO2 technology and comes supplied with the MLT323 Animal-Clip (ML325/AC), MLT324 Wrap Sensor (ML325/AW) or MLT325 Base Sensor (ML325/BS).

**Specifications**

- **Operating principle:** Non-invasive blood oxygen saturation (SpO2 determination using red and infrared light passed through pulsating blood in vascular tissue)
- **Saturation range:** 70 to 100%
- **Measurement wavelength:** Red (660 nm) and Infrared (910 nm)
- **Measurement rate:** 1 reading per second
- **Resolution:** 1% steps
- **SpO2 acquisition time:** ~10 s
Chemistry and Biochemistry

ML307 Conductivity Pod

The Conductivity Pod is suitable for monitoring solution conductance and resistance with appropriate conductivity cells. The Pod measures the alternating current across a suitable conductivity cell by applying an AC potential across the pair of platinum plate electrodes. It can be used with any of our conductivity electrodes (see page 123).

Specifications

- Input ranges: 10 µS/V, 100 µS/V, 1 mS/V, 10 mS/V
- Error: < 1% of input range at ≥ 1 mS/V (after user calibration)
- AC waveform amplitude: 20 mV p-p
- AC waveform shape: Triangular
- AC waveform frequency: 1300 Hz (approx)
- Low-pass filter: 200 Hz, 2nd order Butterworth
- Bandwidth: DC to 20 Hz
- Noise: 0.008% full scale
- Electrode connector: BNC

ML165 pH/Temperature Amp

The ML165 pH/Temperature Amp is a signal conditioner suitable for use with pH, ion-selective and potentiometric redox electrodes. The MLT404 RTD Temperature Probe is included and can be used for temperature compensated measurements or as an independent temperature sensor.

Specifications

- Input ranges: ±200 µV to ±2 V in 13 steps
- Output channels: 2
- Input impedance: 10¹³ Ω typical
- Electrode connector: BNC
- Reference connector: 4 mm socket
- Temperature probe: RTD – 100 Ω type (supplied with unit)
- Temperature range: ±100° C
- Temperature accuracy: ±0.2° C
- Resolution: ±0.1° C
- Low-pass filter: 10 Hz, (-3 dB frequency)
- Low-pass filter accuracy: ±3%
- Unfiltered response: > 2 kHz
Galvanic Skin Response

FE116 GSR Amp

The FE116 GSR Amp is a fully isolated, skin conductance response amplifier with low voltage, 75 Hz AC excitation and automatic zeroing. The low level AC excitation reduces electrode polarization artifact found in DC systems. The GSR Amp is galvanically isolated and approved to the IEC 60601-1 standard for human connection as a body protected (BF rated) instrument. It is supplied with MLT116F Finger Electrodes and is suitable for human galvanic skin response studies. MRI compatible Finger Electrodes (MLT117F) are available separately.

Specifications

Safety: Approved to IEC 60601-1 Standard (BF rating)
EMC: EN61326-1:2006
Connection type: 2 × 4 mm shrouded sockets. Custom cable with two shrouded banana plugs and terminated with two dry, stainless steel, bipolar electrodes with Velcro attachment strap suitable for adult fingers
Configuration: Transformer isolation (AC bridge operation)
Input range: 1 to 40 μS full scale in 6 steps (combined PowerLab and GSR Amp)
Input leakage current: < 3 μArms at 240 V, 50 Hz
< 2 μArms at 120 V, 60 Hz
Frequency response: –3 dB at 1 Hz
Accuracy: ± 5%
Zeroing and offset: Automatic software-controlled fast zeroing, controlled by internal 12-bit DAC; ± 0.2 μS resolution
Excitation: Constant-voltage AC excitation (22 mVrms @75 Hz)

Neurophysiology/Electrophysiology

FE185 Neuro Amp EX

The FE185 Neuro Amp EX is a low-noise and high-gain device suitable for recording signals requiring a wide bandpass (100 Hz to 5 kHz) and a high signal to noise ratio. When used with the supplied MLT185 Neuro Amp EX Headstage, it is certified safe for human connection. The Neuro Amp can be used for extracellular recordings from single cells or groups of cells and single nerve fiber recordings.

Specifications

Safety: Approved to IEC 60601-1 Standard (BF rating)
EMC: EN61326-1:2006
Connection type: Five-pin Redel connector
Configuration: one isolated differential channel with isolated ground reference
Input range: ± 20 μV to ± 1 mV full scale in 6 steps (combined PowerLab, Neuro Amp EX front-end and headstage)
Input impedance: 100 MΩ
Low-pass filtering: Fourth-order Bessel filter, ± 3% accuracy.
Frequencies: 1 kHz, 2 kHz, 5 kHz (software selectable)
High-pass filtering: First-order filter, ± 0.25% accuracy.
Frequencies: 100 Hz, 300 Hz, 500 Hz (software-selectable)
Notch filter: Second-order filter, –32 dB attenuation; 50 or 60 Hz frequency (automatic sensing)

Headstage
Gain: ×100
Input leakage current: ~1 pA
Respiration

FE141 Spirometer

The FE141 Spirometer is a precision differential pressure amplifier for measurements of respiratory flow rates with a pneumotach flow head. It is used with the Spirometry Extension, which processes signals from pneumotachs. It displays and calculates respiratory parameters such as tidal volume, minute ventilation, respiratory rate, PIF, PEF, FVC and FEV1. By selecting a suitably sized flow head, the Spirometer can be used with small animals such as mice and rats or large animals and humans.

Specifications

- EMC: EN61326-1:2006
- Connection type: Two female Luer fittings to enable connection to Flow Head via male Luer fittings and suitable tubing.
- Configuration: Differential pressure input, ± 1’’ (2.5 cm) H2O (1.9 mmHg, 249 Pa)
- Input range: ± 20 mV to ± 500 mV full scale in 5 steps (combined PowerLab and Spirometer)
- Pressure sensitivity: 0.5 V per inch (1.27 V per cm) H2O
- Amplifier noise: < 150 μVrms @ 100 Hz
- Temperature drift: 0.05% of full scale per° C
- Warm-up time: ~ 2 minutes
- Maximum input pressure: ± 28.1” H2O (7 kPa)
- Response time: 1 ms (10 to 90% full scale) at maximum bandwidth
- Linearity: ± 0.5% full scale
- Low-pass filtering: 1, 10 or 100 Hz (software-selectable) using fourth-order Bessel
- Max zero pressure offset: < 1% full scale, software removable
- Zero offset correction: Software removed (up to ± 10% full scale)

Stimulation

FE155 Stimulator HC

The FE155 Stimulator HC is a software-controlled, constant-current stimulator with 100 V compliance designed for use in vitro with isolated nerve, muscle or tissue samples. The unit uses the analog output from the PowerLab to produce isolation and software adjustable constant-current pulses of 10 microseconds to 4 milliseconds duration, of 0.1 to 30 Hz pulse frequency and 1, 10 or 100 mA pulse amplitude. It is supplied with MLAC36 Stimulator HC Leads (2 m).

Specifications

- Safety: Not for human connection
- EMC: EN61326-1:2006
- Connection type: Two 2 mm touch-proof safety sockets
- Configuration: Constant-current stimulator with hardware limited repetition rate
- Output range: 1 mA, 10 mA, 100 mA full scale
- Resolution: 1% of full scale (10 μA, 100 μA, or 1 mA)
- Compliance voltage: 100 V fixed
- Pulse duration range: 0.02 to 5.12 ms in 0.02 ms steps
- Duration accuracy: ± 0.01% +5/-0 μs
- Repetition rate: Up to 30 Hz
- Safety switch: Isolating On-Off switch flicks down to disconnect quickly.
FE180 Stimulus Isolator

The FE180 Stimulus Isolator uses the PowerLab analog output to produce isolated constant current pulses. The unit provides adjustable pulse amplitude, width, and frequency. For use with *in vivo* stimulation applications, the FE180 is electrically isolated and suitable for human connection as a body protected (BF rated) instrument.

**Specifications**

- **Safety:** Tested to IEC 60601-1 Standard (BF rating)
- **EMC:** EN61326-1:2006
- **Connection type:** Two shrouded 4 mm sockets
- **Configuration:** Constant-current stimulator with hardware-limited repetition rate
- **Output range:** 100 μA, 1 mA, or 10 mA full scale
- **Resolution:** 1% of full scale (1 μA, 10 μA, or 100 μA)
- **Compliance voltage:** 100 V fixed
- **Pulse duration range:** 0.01 to 2.56 ms in 0.01 ms steps
- **Duration accuracy:** ± 0.01% +5/-0 μS
- **Repetition rate:** Up to 2000 Hz
- **Safety indicators:** A single, multi-color indicator displays the isolated stimulator status. A green flash indicates delivery of a valid stimulus. A yellow flash indicates an out-of-compliance condition (OOC)
- **Safety switch:** Isolating On-Off switch flicks down to disconnect quickly

**Temperature**

ML312 T-type Pod

Suitable for general temperature measurements between 0 to 50°C using standard T-type thermocouples. Compatible transducers include the MLT1400 General-purpose Thermocouple Probe and others listed on page 146 and 147.

**Specifications**

- **Temperature range:** 0 to 20°C or 0 to 50°C
- **Output voltage:** 10 mV/°C (0 V = 0°C) non-linearized
- **Calibration:** Ice point reference calibration provided
- **Temperature accuracy:** ±0.2°C 35 to 40°C
  ±0.5°C 0 to 45°C
  ±1°C 0 to 50°C
- **DC drift:** 2 μV/°C
- **Response time:** ~ 40 ms (10 to 90% of range)
- **Input impedance:** ~ 1 kΩ
- **Input connector:** Miniature T-type
ML309 Thermistor Pod

Suitable for measurements such as skin and nasal temperature as well as respiratory detection, the Thermistor Pod has an operating range between 5 and 45°C and supports both absolute and relative temperature measurements. Suitable transducers include the MLT409 Skin Temperature Probe and the MLT415 Nasal Temperature Probe.

Specifications

- **Thermistor type:** 10 kΩ at 25°C
- **Temperature range:** 5 to 45°C in absolute mode
  - Δ 1°C to Δ 20°C in five ranges with Delta Temp on
- **Temperature accuracy:** ±0.2°C absolute (25 to 45°C)
- **DC drift:** 3 µV/°C
- **Temperature offset range:** 50°C over all (−5°C to 45°C absolute)
- **Response time:** ~ 200 ms (for full scale change in temperature)
  - Overall response will depend on the thermal response of the thermistor probe
- **Input connector:** 3-pin Mini-Audio
Instruments

Our range of Instruments includes devices for specialized fields of research such as organ bath experiments, CO₂ and O₂ analysis, blood flow measurements and neuro/electrophysiology. All feature an analog output suitable for connection to PowerLab data acquisition systems.

The Instruments range includes:
- Biological Amplifiers
- Gas Analyzer
- Blood and Tubing Flow Meters
- Peristaltic Pumps
- Organ Baths and Wire Myographs
- Stimulators
- Invasive and Noninvasive Pressure
- Stimulus Response Devices
- Langendorff and Working Heart Apparatus
- Telemetry Devices
- Neuro/Electrophysiological Amplifiers
- Temperature Devices.

Biopotential Measurements

GT201/F and GT205/F Multi-Channel Bio Amps

The 8 Channel (GT205) and 16 Channel (GT201) Bio Amps are fully isolated biological amplifiers used for measuring multiple biopotentials (EEG, ECG, EMG etc.) in a single subject. Each unit features 2 independent grounds.

Specifications

- Mode of operation: 1 to 16 unipolar/bipolar channels
- Input: Safety sockets for bio-signal electrodes
- Output: ±5 V via 25 pin Sub-D with BNC connectors
- Sensitivity: 500 µV and 5 mV DIP-Switch selectable*
- Low-pass filters: 100 Hz and 1 kHz DIP-Switch selectable*
- High-pass filters: 0.5 Hz and 2 Hz DIP-Switch selectable*
- Notch filters: 50 or 60 Hz; on/off switchable

* Further adjustment of the range/sensitivity and filter settings is applied using LabChart.

Blood Pressure and Flow

IN191 Blood FlowMeter

The IN191 provides continuous measurement of blood cell perfusion in skin and other tissues/organs. For use with PowerLab systems and suitable needle and surface laser Doppler probes (see page 128).

Specifications

- Mode of operation: Continuous laser Doppler flowmetry (1 channel)
- Primary measured: Microvascular blood profusion (Relative RBC Flux)
- LDF units: Relative units (0 to 5000 Blood Perfusion Units, corresponding to 0 to 5 V output)
- BSC units: Relative units (0 to 100% corresponding to 0 to 5 V output)
- Laser power: < 0.5 mW from probe
- Linearity: Up to 0.35% moving scatters by volume
- Flow response time: < 0.2 s
- Reading stability: 5% (measured with standard motility solution)
Transonic Flowmeters
T402 Dual Channel Console and T403 Triple Channel Console

The multi-channel consoles (T402 and T403) provide a housing case for flowmeter modules allowing ‘mix and match’ capabilities to fit individual application requirements. Consoles are supplied with card guides, proprietary backplane with power supply and terminal block analog outputs for data collection. In addition, the console features carrying handles and adjustable feet for easy portability.

T402 Models:
- T402 Dual Channel Console (Blank)
- T402-PB One Channel Perivascular Flowmeter
- T402-TB One Channel Tubing Flowmeter
- T402-PP Two Channel Perivascular Flowmeter
- T402-TT Two Channel Tubing Flowmeter
- T402-PT Two Channel Perivascular/Tubing Flowmeter

T403 Models:
- T403 Triple Channel Console (Blank)
- T403-PBB Three Channel 1 Perivascular/2 Blank Flowmeter
- T403-PPB Three Channel 2 Perivascular/1 Blank Flowmeter
- T403-PPP Three Channel Perivascular Flowmeter
- T403-PPT Three Channel 2 Perivascular/1 Tubing Flowmeter
- T403-PTB Three Channel 1 Perivascular/1 Tubing/1 Blank Flowmeter
- T403-PTT Three Channel 1 Perivascular/2 Tubing Flowmeter
- T403-TBB Three Channel 1 Tubing/2 Blank Flowmeter
- T403-TTB Three Channel 2 Tubing/1 Blank Flowmeter
- T403-TTT Three Channel Tubing Flowmeter

Specifications

Dimensions:  5.21” × 9.25” × 12” (h × w × d)(T402)
             132.3 mm × 234.9 mm × 304.8 mm (h × w × d)
             5.21” × 13.46” × 12” (h × w × d) (T403)
             132.3 mm × 341.9 mm × 304.8 mm (h × w × d)

Weight:  5.8 lbs. (T402)
        7.6 lbs (T403)

Leakage current:  >50 microamperes

AC input:  100 to 240 VAC; 50 to 60 Hz, 50 watts

Fuses:  0.8 Amp fast-blow, mfg bussman # GMA0.8, 250 VAC

T402 module capacity:  Accepts 2 wide flowmeter modules of 20 HP width or 4 narrow flowmeter modules of 10 HP width or a combination of wide and narrow modules

T403 module capacity:  Accepts 3 wide flowmeter modules of 20 HP width or 3 narrow flowmeter modules of 10 HP width or a combination of wide and narrow modules
TS420 Perivascular Flowmeter Module

When used with suitable perivascular flowprobes (PS-Series, PR-Series, PAX-Series), the Perivascular Flowmeter Module measures flow for a range of in vivo applications including cardiac output and cardiovascular dynamics, renal hypertension, ischemia/reperfusion, portal hypertension and hind limb studies. For instantaneous measurement of flow and volume in animal arteries, veins or ducts, a variety of perivascular flowprobes (page 128) are available.

Specifications

- Flow Gain: By a factor of 4 in Low Range mode
- Filters: 0.1, 10, 40 Hz Butterworth filters
- Frequency range: Ultrasonic 600 kHz – 14.4 MHz
- Bandwidth: 160 Hz (accurately characterize flow dynamics at high heart rates, such as mice)
- Display: Analog meter displaying voltage proportional to flow
  Easy access front panel for chronic probe calibration keys

TS410 Tubing Flowmeter Module

The TS410 Flowmeter Module together with sterile inline tubing flowsensors (PXL-Series) provide unparalleled volume flow measurements in tubing circuits, flow chambers and isolated organ apparatus. It is suitable for a variety of applications including extracorporeal shunts and cannulae, artificial heart and Ventricular Assist Device (VAD) performance, pulse duplication/heart valve studies and isolated perfused organ studies. The module automatically identifies the size and scale of the connected flowsensors.

Specifications

- Flow Gain: By a factor of 4 in Low Range mode
- Filters: 0.1, 10, 40 Hz Butterworth filters
- Frequency range: Ultrasonic 600 kHz - 14.4 MHz
- Output: 0 to 1 V (can be calibrated to external recording devices)
- Display: Polarity inversion of analog outputs & flow
- Calibration: Programmable calibration and for different fluid/temperatures
- Alarms: Programmable alarms that include low/high flow and received signal threshold alarm

Noninvasive Blood Pressure

IN125 NIBP Controller (mice and rats)

The IN125 NIBP Controller noninvasively measures intermittent blood pressure in mice and rats by monitoring periodic occlusion of tail blood flow. The IN125 is powered by the PowerLab system and is supplied with a tail cuff and transducer (specify /R for rat or /M for mouse). Animal holders of various sizes are available separately (see page 140).

Specifications

- Maximum cuff pressure: 200 or 280 mmHg
- Measurement cycle time: ~ 20 to 45 seconds (depending on pulse range used)
- Accuracy: ±1%
- Measurement cycle: Voltage or switch triggered (software controlled)
- Pulse signal/filter range: 0.7 to 10 Hz
- Pressure output sensitivity: 0 to 1 V full scale represents 0 to 300 mmHg
MLE1054-V* Finometer® MIDI

The MLE1054-V* Finometer MIDI noninvasively and continuously measures brachial arterial pressure via the finger arterial pressure. The Finometer MIDI reconstructs finger arterial pressure waveform to obtain brachial arterial pressure, making it ideal for research investigating trends of systolic, diastolic and mean blood pressure.

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

Specifications
- Finger cuff pressure: 300 mmHg (maximum)
- Accuracy: ±3 mmHg
- Height sensing range: ±128 mmHg
- Analog signal: I/O connector 1 input, 4 output, 15 pin male, D-type, ±5 V max. (Outputs are brachial pressure, finger cuff pressure, ECG & marker)

Invasive Blood Pressure

TC-510 Millar Pressure Control Unit

The TC-510 Millar Pressure Control Unit (CE approved) passively interfaces the Millar pressure catheter with a strain gauge amplifier. It features an internal calibration circuit (to provide an electrical zero as well as a 100 mmHg calibration signal) and is supplied with a monitor cable for connection to ADInstruments Bridge Amps. For connection to Millar pressure catheters with Viking or low-profile connectors. Catheter interface cables are required and available separately (see page 133).

Specifications
- Number of Channels: 1
- Input Connector Type: Viking
- Output Connector Type: 9 pin sub-D

PCU-2000 Millar Pressure Signal Conditioner

The PCU-2000 Millar Pressure Signal Conditioner is a two-channel amplifier/interface unit for the connection of one or two Millar Mikro-Tip catheters to a CE-approved pressure monitor and PowerLab. Each channel features an electrically isolated input safe for human connection. To connect to PowerLab, two MLAC12 BNC to Audio plugs (6.5 mm connector, 2 m cable) are required and can be purchased separately.

Specifications
- Equipment classifications: II (USA and Canada) and IIb (EU)
- Signal input resistance: 50 MΩ, nominal
- Pressure Transducer Characteristics
  - Transducer sensitivity: 5 mV/V/mmHg, nominal
  - Bridge excitation load resistance: 1000 Ω, nominal
  - 300 Ω, minimum
  - Bridge excitation: 5.0 VDC, nominal
- Pressure Outputs
  - Sensitivity: 1 V/100 mmHg, nominal
  - Accuracy error band: ±1 mmHg or 1% of reading
  - Frequency response: DC to 1000 Hz (–3 dB), minimum
  - Output resistance: 1000 Ω, nominal
  - Noise: <0.3 mmHg peak-to-peak
  - Zero-offset temperature coefficient: <0.15 mmHg/°C
  - Gain temperature coefficient: <0.1%/°C
  - Balance adjustment range: ±140 mmHg, nominal
Isolated Perfused Organs

Radnoti Working Heart Apparatus

Radnoti Working Heart Apparatus are ideal for working, constant flow or constant pressure isolated heart preparations. The reservoir, heart chamber, bubble traps and interconnecting tubes are all water-jacketed to maintain constant perfusate temperature, with the water temperature and flow controlled by the 170051B-V* Radnoti Thermal Circulator Pump.

The apparatus includes a High-Tech Heart Chamber for mice or rats, with special access ports for cannulae and electrodes. Compliance chambers are included to ensure air bubbles are removed from the system. For 120101bEZ specify heart chamber size: S (rat, guinea pig), M (rabbit, cat) or L (pig).

Models:
- 120101bEZ/X-V* Radnoti Working Heart Apparatus for Rats/Rabbits
- 130101EZ-V* Radnoti Working Heart Apparatus for Mice
- 140101EZ-V* Radnoti Working Heart Apparatus for Pigs

* Specify mains power: \( V = 115 \) for 110–115 V or \( V = 220 \) for 220–240 V

Radnoti Langendorff Apparatus

Radnoti Langendorff Apparatus are ideal for constant pressure or constant flow isolated heart preparations in either recirculating or non-recirculating mode. The system uses a 2 L water-jacketed reservoir to maintain and gas the perfusion solution. A peristaltic pump perfuses the heart and a water-jacketed bubble trap removes bubbles from the flow. With additional equipment, left ventricular pressure, apical force (using the in-built pulley system) and coronary resistance can be measured.

Models:
- 120103EZ-V* Radnoti Langendorff constant flow non-recirculating
- 120105EZ-V* Radnoti Langendorff constant pressure non-recirculating
- 130102EZ-V* Radnoti Mouse Langendorff constant pressure recirculating

* Specify mains power: \( V = 115 \) for 110–115 V or \( V = 220 \) for 220–240 V

ML176-V* Langendorff Apparatus & Thermostat Controller

The Langendorff Apparatus unit is a thermostatically controlled self-contained unit ideal for the perfusion of small animal hearts (such as mice, rats, guinea pigs). Two separate perfusate reservoirs are constantly oxygenated in the temperature-controlled water bath and a Thermostat Controller is included.

* Specify mains power: \( V = 115 \) for 110–115 V or \( V = 220 \) for 220–240 V

ML172 Minipuls™3 Peristaltic Pump

The Minipuls 3 Peristaltic Pump is a reliable pulse-free pump that provides ultra-smooth flow. The pump is easily integrated with any system and can be controlled via the digital keypad, or remotely using the IN175 STH Pump Controller (available separately). The pump is supplied with a two-channel head for flow rates between 0.05 to 45 mL/minute (dependent on tubing size).
**IN175 STH Pump Controller**

The IN175 STH Pump Controller allows switching between constant flow and constant pressure conditions when used with a suitable peristaltic pump and pressure transducer. It is ideal for controlling the flow of solution in Langendorff or other isolated perfused organ experiments.

The IN175 connects to a Bridge Amp and Pressure Transducer and uses a negative feedback control circuit to alter the flow rate to maintain constant pressure in the perfusate line (typically within ±1 mmHg). It can also be set to a fixed flow rate when constant flow is required.

The ML172 and IN175 are designed for use with Langendorff Systems only.

---

**Isolated Tissue**

**159920-X1 Radnoti 4 Chamber Tissue-Organ Bath**

This four-chamber modular bath includes a 2 L water-jacketed reservoir, support stand, oxygenating bubblers and transducer positioners. The tissue-organ chambers are available in 5, 10, 25, 50, 100, 200 or 300 mL capacity. All chambers contain a preheating coil within a thick, water-jacketed wall in order to maintain solution at a constant temperature.

The organ baths are provided with a glass hook tissue support, a removable oxygen disperser tube, and a Teflon needle for accurate gas adjustment. Multiple 4-chamber units can be added to form 8 and 16 bath systems. The 159920-X1 is supplied with a 170051B-V* Radnoti Thermal Circulator Pump.

**170051B-V* Radnoti Thermal Circulator Pump Bath**

This bench-top temperature bath/circulator features a high wattage heater for rapid warming of the water bath. The stainless steel corrosion resistant 17 L reservoir has excellent fluid compatibility, a low reservoir liquid level safety shutoff and a bath temperature LED display. In addition, it is easy to clean.

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

**Specifications**

- Reservoir volume: 17 L (4.5 Gallons)
- Temperature range: +12°C to +200°C
- Temperature stability: ± 0.01°C
- Pump flow rate: 15 L/min (Max)

**ML0126, ML0146, ML0186 Tissue/Organ Baths**

ADInstruments supplies Panlab organ baths in two, four and eight-chamber configurations. Each organ bath includes tissue chambers, preheating reservoir coils, gas diffusers, tissue holders, micropositioners, water pump and thermostat controller. The emptying and filling of tissue chambers is automated by electrovalves. A variety of tissue chamber volumes are available (5, 10, 25 and 50 mL).

Models:
- ML0126/C-V  Two Chamber Organ Bath
- ML0146/C-V  Four Chamber Organ Bath
- ML0186/C-V  Eight Chamber Organ Bath

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V
DMT310A, DMT410A, DMT510A Wire Myographs

DMT Wire Myographs are used in studies of vascular reactivity in vessels and muscle strips (>60 µm). The units are available in single or dual configurations with in-built heating, solution draining and gas ports. The auto model (DMT510A) provides automatic control of micropositioners through a controller unit that connects directly to PowerLab via the analog outputs.

Models:
- DMT310A  Single Wire Myograph
- DMT410A  Dual Wire Myograph
- DMT510A  Auto Dual Wire Myograph

Specifications
- Diameter: >60 µm
- Chamber volumes: 10 mL maximum
- Force range: ±200 mN
- Force resolution: ±0.01 mN
- Temperature range: 0 to 50°C
- Temperature resolution: 0.1°C

DMT620M Multi Chamber Myograph w/Touch Screen

The DMT620M is a self contained myograph ideal for investigating the reactivity of up to four separate vessels at once. The vascular tissue can be placed in jaw or pin supports attached to the force transducer and micropositioner. Each chamber has individually-controlled gas inflow and suction (as well as in-built heating). Ideal for drug screening, this system increases throughput and features a graphical color touch-display for easy reading and navigation of menu options.

Specifications
- Vessel size: >60 µm (up to 10 mm with pins)
- Force range: Selectable at ±200, ±400, ±800 and ±1600 mN
- Force resolution: ±0.01 mN
- Temperature range: 0 to 44°C
- Temperature resolution: 0.1°C
- Chamber volume: 6 mL maximum

DMT720MO Tissue Bath System w/Touch Screen

This myograph is ideal for simultaneous measurement of tension in up to four isolated blood vessels (>500 µm) and other large circular tissue preparations (such as trachea or gut mounted as ring preparations up to 10 mm). It is supplied with pin supports for tissue mounting and a graphical color touch-display allows easy reading and navigation of menu options. Each chamber has individually-controlled gas inflow and suction, in-built heating and a high-resolution force transducer.

Specifications
- Diameter: >500 µm (up to 10 mm with pins)
- Force range: Selectable at ±200, ±400, ±800 and ±1600 mN
- Force resolution: ±0.01 mN
- Temperature range: 0 to 44°C
- Temperature resolution: 0.1°C
- Chamber volume: 8 mL maximum
DMT820MS Muscle Strip Myograph w/Touch Screen

The DMT820MS is a state-of-the-art four-channel myograph system for studying muscle strips of up 15 mm in length. Up to four isolated skeletal or other muscle preparations can be measured simultaneously when mounted as a strip between clamp supports. Several types of mounting supports are available to suit user requirements. Each chamber has individually-controlled gas inflow and suction, in-built heating and a graphical color touch-display for easy reading and navigation of menu options.

Specifications

- Tissue length: >3 mm to 15 mm
- Force range: Selectable at ±200, ±400, ±800 and ±1600 mN
- Force resolution: ±0.01 mN
- Temperature range: 0 to 44° C
- Temperature resolution: 0.1° C
- Chamber volume: 4 mL maximum

DMT120CW Confocal Wire Myograph

The Confocal Wire Myograph combines Laser Scanning Confocal Microscopy with artery myography to allow simultaneous measurements of isometric force and fluorescence (confocal microscope not supplied). Example applications include studies that correlate isometric contractions in isolated, mounted blood vessels and intracellular Ca²⁺ measurements. The DMT120CW includes a control unit with temperature control, in-built high-resolution force transducer, and micrometer and analog output for direct connection to a PowerLab.

Specifications

- Vessel size: >60 µm
- Force range: ±200 mN
- Force resolution: ±0.01 mN
- Temperature range: 0 to 50° C
- Temperature resolution: 0.1° C
- Chamber volume: 8 mL maximum

DMT100192 Automated Buffer Filler System 2 (625FS)

This Automated Buffer Filler System 2 (625FS) provides an automatic, reliable and consistent way to replace buffer in the bath chambers of any DMT four channel myograph (DMT620M, DMT720MO and DMT820MS). It attaches easily and fills a selected chamber or all 4 bath chambers simultaneously with buffer by a single touch of a button. Two standard volumes (6 mL and 8 mL) of buffer can be applied. Other volumes are available on request at the time of purchase.
Neurophysiology

Differential Extracellular Amplifiers

The DP-311 is an AC/DC differential amplifier suitable for recording extracellular, ECG and EEG signals using glass or metal microelectrodes. The amplifier has a high common mode rejection ratio (CMRR) to minimize electrical interference, and the amplifier’s high input resistance ensures the high CMRR is not degraded by differences in source impedance at the input. The system is supplied with an active headstage that can be easily mounted in micromanipulators.

The DP-301 Single Channel Differential Amplifier and DP-304-V* Four Channel Differential Amplifier are additional options that can be used for extracellular recording.

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

Specifications for DP-311

- Voltage gain: \( \times 100, \times 1000 \) and \( \times 10000 \)
- Input resistance: 1 TΩ typical
- Leakage current: 50 pA typical
- Common mode rejection ratio: 100 dB min (100000:1) at 60 Hz
- Noise, input shorted: 10 µV p-p, 1 Hz to 10 kHz
- Low frequency filter (high pass): 0.1, 1.0, 10 and 300 Hz
- High frequency filter (low pass): 0.1, 1.0, 3.0 and 10 kHz
- Max. common mode signal: ±3 V
- Output voltage swing: ±10 V
- Output resistance: 220 Ω

Specifications for DP-301 and DP-304-V*

- Voltage Gain: \( \times 10, \times 100, \times 1000 \) & \( \times 10000 \)
- Input Resistance: 1 TΩ typical
- Leakage Current: 1.0 pA typical
- Common Mode Rejection: 120 dB min (1000000:1) at 60 Hz
- Noise, Input Shorted: 8 µV p-p, 1 Hz to 10 kHz typical
- Low Frequency Filter Settings (high pass): DC, 0.1, 1.0, 10 & 300 Hz
- High Frequency Filter Settings (low pass): 0.1, 0.3, 1.0, 3.0, 10 & 50 kHz
- Offset Control Range: ±600 mV min at output, any gain set
- Max. Common Mode Signal: ±2 V
- Output Voltage Swing: ±10 V (±5 V in gain of 10)
- Output Resistance: 50 Ω

Intracellular Amplifier

The IE-210-V* Intracellular Electrometer is an intracellular microelectrode amplifier that measures voltage and/or current across a cell membrane. The low noise, low drift and fast response time result in easy, accurate and reliable recordings. The current injection feature permits simultaneous stimulation and recording with a single electrode, while the high input impedance ensures accurate measurements. The amplifier is supplied with the 2100W headstage and electrode probe.

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

Specifications

- Input Impedance: 500 GΩ
- Output Resistance: 100 Ω
- Gain: \( \times 1 \pm 0.1\% \)
Probe Input Range: ±10 V
Risetime (10 to 90%): 25 µsec, measured through 20 MΩ
Noise Level: 25 µV p-p input shorted (0.1 Hz to 10 kHz) at ×1 output;
250 µV p-p, 20 MΩ at input
Capacitance Compensation: 0 to 50 pF
Leakage Current: 1 pA typical, adjustable to zero
Input Offset: ±200 mV, referred to input
Buzz: Amplitude variable 0 to 15 V
Frequency variable 100 Hz to 10 kHz

Two Electrode Voltage Clamp Amplifier
The OC-725C-V Oocyte Clamp Amplifier is designed for two-electrode, whole-cell voltage clamping of Xenopus oocytes. Features such as the high compliance voltage (±180 V) and unique bath clamp circuitry make the OC-725C ideal for clamping large cells and cell structures such as squid axons.

Specifications for OC-725C-V*
- O/Input Impedance: 500 GΩ, 1 pF
- Output Resistance: 100 Ω
- DC Offset: ±200 mV at input. Variations from zero with 10 turn control (20 mV/turn).
- Noise: (0 to 10 kHz) 3 µV RMS with input grounded
- 20 µV RMS with model cell
- Meter Range: ±199.9 mV full scale
- Capacitance Compensation: 0 to 90 pF

Complete Oocyte Clamp Workstation
The TEV700-V* Complete Oocyte Clamp Workstation provides many of the necessary components typically used with the OC-725C-V* Oocyte Clamp Amplifier for research involving oocytes.

Workstation includes:
- OC-725C-V* Oocyte Clamp Amplifier, which includes:
  - 7250V Voltage Headstage for OC-725C-V
  - 7251I Bath Clamp Headstage for OC-725C-V
  - 7259C Current Electrode Cable for OC-725C-V
  - 725MC Oocyte Model Cell for OC-725C-V
- RC-3Z Oocyte Recording Chamber for OC-725C-V
- MM-33L Left Micro-Manipulator
- MM-33R Right Micro-Manipulator
- MB/B Magnetic Base (2)

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V
Patch Clamp Amplifier

The PC-501A is a multipurpose patch clamp amplifier suitable for both whole cell measurements and single channel studies. Simple modifications such as increasing the holding voltage potential and external voltage signal make the patch clamp amplifier suitable for voltammetric measurements. Installation of internal switches allows transition between normal (patch) and voltammetry operation.

Different headstages are available for measuring currents up to ±1 nA (PC-501A/10-V*), ±10 nA (PC-501A/9-V*) or ±100 nA (PC-501A/8-V*).

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

Specifications

<table>
<thead>
<tr>
<th>Headstage:</th>
<th>10 GΩ resistor with maximum current ±1 nA (5101-10G)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 GΩ resistor with maximum current ±10 nA (5101-01G)</td>
</tr>
<tr>
<td></td>
<td>100 MΩ resistor with maximum current ±100 nA (5101-100M)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noise:</th>
<th>Measured with an 8-pole Bessel filter and 10 GΩ headstage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.06 pA RMS (DC to 1 kHz)</td>
</tr>
<tr>
<td></td>
<td>0.20 pA RMS (DC to 5 kHz)</td>
</tr>
<tr>
<td></td>
<td>0.40 pA RMS (DC to 10 kHz)</td>
</tr>
</tbody>
</table>

| Zap:                 | 1.5 V pulse (0.1 to 10 msec)                             |

| Series resistance compensation: | 0 to 100 MΩ (read from 10 turn digital dial)             |
| Capacity compensation:     | Three ranges with amplitude and time constant adjustment: |
|                            | Fast (0 to 5 μsec)                                      |
|                            | Medium (0 to 2 msec)                                    |
|                            | Slow (0 to 20 msec)                                     |

| Leak subtract:          | Adjustable to 10 GΩ (10 GΩ headstage), 1 GΩ (1 GΩ headstage) or 100 MΩ (100 MΩ headstage) |

| Im output:             | Four-pole Bessel filter with –3 dB frequencies at 0.1, 0.2, 0.5, 1, 2, 5 kHz |

Epithelial Voltage Clamp Amplifiers

For studies of epithelial transport and the electrical properties of tissue, the epithelial voltage clamp amplifiers give accurate measurements of transepithelial voltage, short circuit current and membrane resistance. Various operating modes such as voltage clamp, current clamp, voltmeter, and resistance are available. The high CMRR provides measurements free from the effects of common mode potential changes in a noisy environment. Models include:

- EC-800-V*  Epithelial Voltage Clamp (120 V compliance)
- EC-800LV-V*  Epithelial Voltage Clamp (15 V compliance)
- EC-825A-V*  Dual Channel Epithelial Voltage Clamp (50 V compliance)

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

Specifications

| Input impedance:       | 10 MΩ |
| Input voltage:         | ±1.5 V maximum |
| Common mode voltage:   | ±13 V maximum |
| Common mode rejection ratio (CMRR): | 100 dB at 60 Hz |
| Leakage current:       | 20 pA maximum |
| Offset voltage range:  | ±120 mV |
| Int. clamp potentiometer voltage clamp range: | ±100 mV with 10-turn control |
| Current clamp potentiometer range: | ±1 mA |
| Compliance:            | ±120 V (for EC-800); ±15 V (for EC-800LV); ±50 V (for EC-825A) |
Ussing Chambers

Ussing chambers are used to measure epithelial ion transport in both native tissue and cell monolayers grown on permeable supports. The modular design allows individual inserts (available separately to support a variety of tissue sizes and culture cups) to be easily switched between experiments. Combining the solution reservoir with the chamber housing reduces the size of the apparatus while increasing the system’s ease of use. Ussing chambers are available in single (U9926) or dual-channel (U2500) models.

The U9926 is supplied with the following accessories (×2 for U2500):
- U9975A Ussing Electrode Set (2 Ag-AgCl pellets and 2 Ag wires)
- U9565SC Ussing Electrode Bridge Fitting Kit (12 pk 6 adapters)
- U9406 Tubing Kit (Hose & Luer Fittings) for Ussing Chambers

Models:
- U9926/A Single Ussing Chamber with O-Ring Insert 3.8 mm
- U9926/B Single Ussing Chamber with Pin Insert 3.8 mm
- U9926/C Single Ussing Chamber with Slotted Insert 1.6 × 7 mm 6 Pins
- U9926/M Single Ussing Chamber with Millicell Insert 12 mm
- U9926/S Single Ussing Chamber with Snapwell Insert 12 mm
- U9926/T Single Ussing Chamber with Transwell Insert 6.5 mm
- U2500/A Dual Ussing Chamber with O-Ring Insert 3.8 mm
- U2500/B Dual Ussing Chamber with Pin Insert 3.8 mm
- U2500/C Dual Ussing Chamber with Slotted Insert 1.6 × 7 mm Six Pins
- U2500/M Dual Ussing Chamber with Millicell Insert 12 mm
- U2500/S Dual Ussing Chamber with Snapwell Insert 12 mm
- U2500/T Dual Ussing Chamber with Transwell Insert 6.5 mm

Wireless Neural Receivers

The TBSI Wireless Neural Receivers receive and process signals from any corresponding frequency TBSI headstage (see page 146). They are used for monitoring and recording action and field potentials from freely roaming animals. The receiver connects to the PowerLab data acquisition system via the TBSI Receiver to PowerLab Interface Cable. Wireless Neural Receivers are available in 5 or 15 channels.

Models:
- TB5663/F 5 Channel Wireless Neural Receiver
- TB5664/F 15 Channel Wireless Neural Receiver

Specifications

- Transmission frequency: 3.05 GHz with +/-100 MHz FM bandwidth
- Maximum range: 4 m maximum range between headstage transmitter and receiver (assuming Plexiglass cage)
- Front-end gain: 60 dB
- Intermediate gain: 10 to 20 dB
- Input referred noise: typical 4 μVrms
- Input voltage range: +/- 0.5V
- DC offset: < 100 μVdc
- Phase delay type: 30 μsec at 10 kHz
**Psychophysics**

**MLE1320 SuperLab (Win.Mac, 1 pk) and StimTracker**

SuperLab is stimulus presentation software used for experiments requiring visual stimuli on the screen or auditory stimuli via speakers. It also controls synchronization with the PowerLab data acquisition unit. Recorded responses, including reaction times, are saved as text-only format and can be read by most spreadsheet or statistical software.

The StimTracker Interface is designed to synchronize data between the stimulus presentation system and the PowerLab. It monitors signals from a range of inputs (including the stimulus presentation computer) and sends TTL event markers to any PowerLab with digital inputs. It connects to a PowerLab data acquisition system via MLE1301 Interface Cable (StimTracker to PowerLab).

**Please note:** Typical experimental setup requires two computers, one for stimulus presentation and the other for recording. StimTracker synchronizes data between the two computers.

**Pressure-Volume**

The Millar MPVS Ultra monitors ventricular pressure and volume in small (mouse, rat) through to large animals (dog, sheep, pig). The 880–0168SS Millar MPVS Ultra Single Segment is limited to rats or mice only, however can be updated to the Millar MPVS Ultra by purchasing the 880–0168U Software Upgrade. The MPVS Ultra connects directly to a PowerLab data acquisition unit using BNC-BNC cables.

**Models:**

- **880-0168** Millar MPVS Ultra (large & small animals)
- **880-0168SS** Millar MPVS Ultra Single Segment

**Specifications**

<table>
<thead>
<tr>
<th>Pressure Outputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td>1 V/100 mmHg, nominal</td>
</tr>
<tr>
<td>Frequency response:</td>
<td>DC to 400 Hz (3 dB)</td>
</tr>
<tr>
<td>Noise:</td>
<td>&lt;0.3 mmHg peak-to-peak</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume/Conductance Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
</tr>
<tr>
<td>Frequency response:</td>
</tr>
<tr>
<td>Noise:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range:</td>
</tr>
<tr>
<td>Output accuracy:</td>
</tr>
</tbody>
</table>

**ECG**

- **Gain:** 2000 ×
- **Frequency response:** 0.5 Hz to 30 Hz (–3 dB attenuation). Software enabled/disabled 60 Hz notch filter
Respiratory Gas Analysis
ML206 Gas Analyzer

The ML206 Gas Analyzer is used for measurement of respiratory gas concentration from small animals, such as rats, through to large animals and humans. It contains an infrared carbon dioxide sensor and optical oxygen detector fed from a damped micro vacuum sampling pump. The analyzer samples expired gas from a mixing chamber. The Flow Control dial on the front of the unit enables variable flow rates of 35 to 200 mL/min (maximum values may vary for different sized and lengths of tubing). The ability to vary the flow rates of the vacuum pump makes the unit ideal for human and animal research.

Specifications
Sampling flow range: 35 to 200 mL/minute (Rates vary due to size of tubing)

Oxygen analyzer channel
- Operating range: 0 to 100% corresponding to 0 to 1 V
- Resolution: 0.01%
- 10 to 90% response time: 440 ms (200 mL/minute)*

Carbon dioxide analyzer channel
- Operating range: 0 to 10% corresponding to 0 to 1 V
- Resolution: 0.1%
- 10 to 90% response time: 430 ms (200 mL/minute)*

* Response times tested with in-line filter and drying tube attached.

Stimulators
ML1001 Electronic Stimulator and ML1101 Stimulus Isolator

The ML1001 Electronic Stimulator is used for electrical stimulation in physiological and pharmacological research experiments. The Electronic Stimulator provides options for single pulse, paired pulse, pulse train, repeat pulse and biphasic stimuli operation using either constant voltage or current. It is equipped with a booster amplifier for a maximum field stimulation output of 50 V and input terminals for signal mixing and modulation (with an external signal). When used with the ML1101 Stimulus Isolator, the output from the Electronic Stimulator can be insulated from ground to minimize the stimulation area, ensuring greater precision and less artifact.

Specifications
- Input pulse: ±3.5 V or over, 10 μs or over
- Input impedance: 10 kΩ or over
- External trigger level: 0 to +10 V continuous variable
- Input voltage range: +10 V
- Stimulation:
  - Direct Stimulation = ±10 V or ±10 mA
  - Field Stimulation = ±50 V or ±400 mA
  - Isolated Stimulation = ±10 V or ±10 mA (connected to ML1101 Stimulus Isolator)
- Frequency: 50/60 Hz
- Power: AC 110 V, 220 V or 240 V ±10%
BSI-950 Biphasic Stimulus Isolator

The BSI-950 is an economical analog input–analog output stimulus isolation unit for use with externally generated stimulation signals. The AC powered stages are photo isolated from the battery powered output stage.

Specifications

- **Input:** Analog ±10 V (10 V input = full range output)
- **Output current:** ±0.05, ±0.1, ±0.5, ±1, ±5 mA full scale ranges
- **Output voltage:** ±0.5, ±1, ±5, ±10, ±50, ±100 V full scale ranges
- **Linearity:** < 1% deviation over entire output range
- **Rise and fall times:** 8 μs, 1 mA through to 10 kΩ load
- **Source resistance:** 10 kΩ, 1% tolerance (in voltage mode)
- **Power supply:** External AC supply, isolated power source, 9 V transistor batteries

Combined Pulse/Train Stimulator (4 channels)

The CS200 Combined Pulse/Train Stimulator is a four channel pulse/train current stimulator (0 to 200 mA) for *in vitro* muscle stimulation in tissue/organ bath systems, especially myograph systems requiring current stimulation. There are a variety of stimulation modes including single, continuous and frequency regulated steps. Programmed stimulation protocols can easily be stored and reloaded in one of the five internal program memories. Myograph field stimulation studies will require special chamber covers (available separately) to place the electrodes.

Specifications

<table>
<thead>
<tr>
<th>Pulse Generator</th>
<th>Train Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency:</strong></td>
<td>mode 1: off</td>
</tr>
<tr>
<td>0.1 to 256 Hz</td>
<td>mode 2: single</td>
</tr>
<tr>
<td><strong>Pulse duration:</strong></td>
<td>mode 3: continues</td>
</tr>
<tr>
<td>0.03 to 500 ms</td>
<td>mode 4: frequency step</td>
</tr>
<tr>
<td><strong>Current:</strong></td>
<td>train duration:</td>
</tr>
<tr>
<td>0 to 100 mA</td>
<td>0.1 to 3600 s</td>
</tr>
<tr>
<td><strong>Compliance:</strong></td>
<td>train delay:</td>
</tr>
<tr>
<td>50 Volts</td>
<td>0.1 to 3600 s</td>
</tr>
<tr>
<td><strong>Rise/Fall time:</strong></td>
<td>mono/bipolar</td>
</tr>
<tr>
<td>1.5 ms</td>
<td></td>
</tr>
</tbody>
</table>

STG4004 4 Channel Stimulus Generator and STG4008 8 Channel Stimulus Generator

Stimulus Generators are available in optically isolated four and eight channel configurations for the integrated stimulation of independent output channels. These units serve a wide variety of applications including *in vitro* and *in vivo* neurophysiology, as well as short term and long term stimulations. The stimulus generators are general-purpose stimulators that can be triggered directly from PowerLab, and are supplied with the MC Stimulus II software for Windows (XP and Vista compatible) to create complex current and voltage stimulus waveforms.

Specifications

- **Current output range:** –1.6 mA to +1.6 mA with 100 nA resolution
- **Maximum compliance voltage:** 120 V
- **Voltage output range:** –8 V to + 8 V with 1 mV resolution
- **Maximum output current:** ±20 mA
- **Trigger (TTL) input:** Four for STG4004 and eight for STG4008 (BNC connector)
- **Trigger (TTL) output:** Four for STG4004 and eight for STG4008 (BNC connector)
- **Time resolution:** 20 μs
- **Power:** 110 or 240 VAC (specify destination country when ordering)
STG3008-FA Stimulator
The BSI-950 is an economical analog input-analog output stimulus isolation unit for use with externally generated stimulation signals. The AC powered stages are photo isolated from the battery powered output stage.

Specifications
- Input: Analog ±10 V (10 V input = full range output)
- Output current: ±0.05, ±0.5, ±1, ±5, ±10 mA full scale ranges
- Output voltage: ±0.5, ±1, ±5, ±10, ±50, ±100 V full scale ranges
- Linearity: < 1% deviation over entire output range
- Rise and fall times: 8 μs, 1 mA through to 10 kΩ load
- Source resistance: 10 kΩ, 1% tolerance (in voltage mode)
- Power supply: External AC supply, isolated power source, 9 V transistor batteries
- Rise and fall times: 8 μs, 1 mA through to 10 kΩ load
- Source resistance: 10 kΩ, 1% tolerance (in voltage mode)

Telemetry Products
Configurator and SmartPad
The Configurator and software are used to control the SmartPad and Telemeters. It is easy to configure the channel frequency, acquire diagnostic information, switch off the Telemeter and control the charging field of the SmartPad. Each SmartPad unit acquires signal and/or charges one Telemeter. The receiving range is up to 5 meters and one SmartPad is required for each Telemeter.

Telemetry Instruments include:
- MLE0180 SmartPad (TR180)
- MLE0190 Configurator (TR190)

Temperature Control
ML290-V* Thermometer for T-type Thermocouples
The ML290-V* is a battery operated thermometer for use with T-type Thermocouples. It features highly accurate fast readings, with automatic correction for ambient temperature. It is supplied with a stand and a cable for connection to a PowerLab.
* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

Specifications:
- Temperature Range: –100° C to +200° C
- Resolution: 0.1° C
- Accuracy: 0.1° C ±1 digit between 0 to 50° C, 0.1% ±1 digit over full range
- Compensation: Auto-compensated to 0.1° C from 0° C to 50° C
- Analog Output: Approximately 10 mV per °C
- Size: 5” × 2 1/2” × 6” (127 mm × 63.5 mm × 152.4 mm)

ML295 Homeothermic Controller and Pad
The ML295 includes a heating pad for mice, rats or guinea pigs (102 × 152 mm) and a dual set point control circuit as a safety measure to prevent overshooting the set temperature. The ML295/R is supplied with a MLT1403 Rectal Probe for Rats and the ML295/M is supplied with a MLT1404 Rectal Probe for Mice.
Transducers and Accessories

ADInstruments supplies a wide range of transducers that are configured to operate with PowerLab front-end signal conditioners or Pods. No wiring is required — you simply plug them in and use them. The range includes transducers for measuring force, displacement, blood pressure, temperature, heart rate, pH, airflow and more.

When ordering transducers, please be aware of different connector options, as some transducers offer more than one. For example, when ordering the MLT1020 Plethysmograph, specify MLT1020/PPG for Velcro strap, MLT1020/FC for finger clip, or MLT1020/EC for ear clip option.

Biochemistry

MLT1120 Micro-Oxygen Electrode

Used to detect oxygen concentration in small volume samples, this electrode is supplied with a MLT1121 Membrane Housing Kit that contains 6 replacement Teflon® membranes, a bottle of electrolyte solution, a bulb pipette and 5 polishing pads. The MLT1122 Analog Adapter (ordered separately) is required to connect the electrode to a PowerLab.

MLT1123 Micro-Oxygen Electrode (Flow-Through)

Ideal for detecting oxygen in a continuous flow (such as water, blood, urine or physiological fluid), this electrode features low oxygen consumption, fast response (<20 s) and requires less than a drop of liquid. It is supplied with a MLT1124 Membrane Housing Kit that contains 6 T-membranes and a bottle of electrolyte solution. The MLT1122 Analog Adapter (ordered separately) is required to connect the electrode to a PowerLab.

MLT1122 Analog Adapter

Allows connection of MLT1120 Micro-Oxygen Electrode or MLT1123 Micro-Oxygen Electrode (Flow-Through) to a PowerLab.
MLT1121 Membrane Housing Kit (for MLT1120)
Used with the MLT1120 Micro-Oxygen Electrode, this kit includes 6 replacement Teflon® membranes, a bottle of electrolyte solution, a bulb pipette and 5 polishing pads.

MLT1124 Membrane Housing Kit (for MLT1123)
Used with the MLT1123 Micro-Oxygen Electrode (Flow-Through), this kit includes 6 T-membranes and a bottle of electrolyte solution.

MLT1115 Galvanic Oxygen Electrode
Used to detect oxygen concentration in an aqueous solution, this electrode connects to PowerLab BNC inputs. The output, in air-saturated deionized water, is typically between 20 to 35 mV at 25° C with oxygen consumption of $3.45 \times 10^{-10}$ to $13 \text{ mol O}_2 / \text{s per mV of signal}$.

MLA042 pH Electrode
Suitable for operation between 0 and 60° C and 0 and 14 pH, the combination pH Electrode has a double junction which is easily cleaned and ideal for low ionic strength and biological samples. Appropriate for use with the ML165 pH Amp.

MLA060 Redox Electrode
Used to detect the redox potential of an aqueous solution between 0 and 60° C, this electrode is suitable for use with the ML165 pH Amp. The double junction is easily cleaned, making it suitable for biological samples.

MLT915 Dip-In Conductivity Electrode
Used to monitor the conductivity of samples such as water, urine and other physiological fluids, the MLT915 is 14.6 cm long, with an outer diameter of 3.2 mm and immersion depth of 5 mm. The cell constant is approximately 1. The electrode is used with the ML307 Conductivity Pod.

MLT908 Flow-Thru Conductivity Electrode
Used to monitor the conductance of continuous streams of water, urine and other physiological fluids. It has a cell volume of 0.093 mL and attaches to tubing with an internal diameter of 3.2 mm (1/8”). The electrode is used with the ML307 Conductivity Pod.

MLT916 Flow-Thru Conductivity Electrode
Used to monitor the conductance of continuous streams of water, urine and other physiological fluids. It has a cell volume of 0.017 mL and attaches to tubing with an internal diameter of 1.6 mm (1/16”). The electrode is used with the ML307 Conductivity Pod.
**MLT226 Reflective Drop Counter**
The MLT226 Reflective Drop Counter sensor features a high-power infrared emitting diode and a phototransistor for counting drops. The counter is suitable for titration experiments (using a burette) or measurement of physiological fluids collected from rodents (such as urine and gastric juices). A background correction circuit removes ambient light interference at the detector. It connects directly to a PowerLab Pod port.

**MI-405 Miniature Glass Electrode for pH**
The MI-405 Miniature Glass Electrode for pH can be used in many general-purpose analysis applications and microchemical studies. The electrode is used with the ML165 pH Amp and an external reference electrode (such as the MI-409 Miniature Reference Electrode).

**MI-409 Miniature Reference Electrode**
Used with the ML165 pH Amp and any pH or ion selective electrodes, this reference electrode has an internal Ag-AgCl reference electrode with KCl filling solution, and is supplied with two reference barrels and a bottle of 3 M KCl.

**Biopotential**

**MLA0115 ECG 12 Lead Switch Box**
The MLA0115 allows for the mechanical selection of standard lead configurations using 10 standard lead wires. It supports the direct selection of type I, II, III, aVF, aVL, aVR, and V1 to V6 lead configurations. The Switch Box is supplied with MLA0311 Lead Wires (1 m, 10 snap on). The MLA0115/S is suitable for use with the FE132 Bio Amp and PL3508B80 Exercise Physiology System, as well as the FE135 Dual Bio Amp or ML408 Bio Amp/Stimulator.

**Shielded Bio Amp Cables and Lead Wires**

**MLA2340 3-Lead Shielded Bio Amp Cable** connects to MLA2503 Shielded Lead Wires (3 snap on) for use with the FE132 Bio Amp.

**MLA2540 5-Lead Shielded Bio Amp Cable** connects to MLA2505 Shielded Lead Wires (5 snap on) for use with the FE135 Dual Bio Amp or ML408 Dual Bio Amp/Stimulator.

**MLA1605 Shielded Lead Wires (5 Alligator Clip, 25 cm)** are for use with the MLA2540 5-Lead Shielded Bio Amp Cable.

**MLA1615 Shielded Lead Wires (5 Alligator Clip, 100 cm)** are for use with MLA2340 or MLA2540 Shielded Bio Amp cables.

**MLA1610 Shielded Lead Wires (5 Micro-Hooks)** are for use with the MLA2540 5-Lead Shielded Bio Amp Cable. The Micro-Hooks are constructed of molded nylon with a stainless steel spring and gold-plated beryllium copper hooks.
Unshielded Bio Amp Cables and Lead Wires

**MLA1340 3-Lead Bio Amp Cable** connects to MLA0313 Lead Wires (3 snap on) for use with the FE132 Bio Amp.

**MLA1540 5-Lead Bio Amp Cable** connects to MLA0315 Lead Wires (5 snap on) for use with the FE135 Dual Bio Amp or ML408 Dual Bio Amp/Stimulator.

**10-pack of Unshielded Lead Wires** suitable for use with any ADInstruments ECG Lead Switch Box are available in lengths of 1 m (MLA0311) and 1.8 m (MLA0310).

**MLA1505 Lead Wires (5 Alligator Clip)** are used with the MLA1540 5-Lead Bio Amp Cable.

**MLAC29 Octal Bio Linking Cable**
Links the negative inputs of the ML138 Octal Bio Amp for 12-lead ECG recordings. It has seven 1.5 mm shrouded female plugs and one 1.5 mm shrouded male connector.

**MLA1212 Micro-Hook Electrodes for FE136 (3 pk)**
Supplied with FE136 Animal Bio Amp, the Micro-Hooks are made of molded nylon with a stainless steel spring and gold-plated beryllium copper hooks.

**MLA1213 Needle Electrodes for FE136 (3 pk)**
Surgical steel needle electrodes (29 gauge, 12 mm length) for the FE136 Animal Bio Amp.

**MLA1214 Spring Clip Electrodes for FE136 (3 pk)**
Gold-plated spring clip electrodes for use with the FE136 Animal Bio Amp are ideal for measuring cardiac electrical activity in isolated heart preparations.

**MLA1515 Bio Cable - Animal Use Only**
Used for measuring biopotentials such as EMG and ECG in animals, the MLA1515 Bio Cable (Dual Bio to 5 Alligator clips, 1 m) has a 6-pin plug to 5 alligator clips and connects to the FE135 Dual Bio Amp or ML408 Dual Bio Amp/Stimulator.

**EEG Electrodes**

**MLAWBT9 EEG Flat Electrodes**: set of five gold-plated, hat-shaped disk recording electrodes suitable for EEG and EMG measurements. The electrodes have a diameter of 9 mm, cable length of 185 cm, and feature a cavity in the top for electrolyte injection.

**MLAIME EEG Clip Electrodes**: set of two silver ear clip electrodes, 9.5 mm wide with 190 cm long leads. Suitable for EEG and EMG recordings, the leads from these electrodes connect directly into any ADInstruments Bio Amp Cable (MLA2540, MLA2340, MLA1340 or MLA1540).

The MLAWBT9 and MLAIME electrodes can also be used with the ML138 Octal Bio Amp, GT205 8 Channel and GT201 16 Channel Bio Amps.
MLA700 Reusable ECG Electrodes
A pack of 3 reusable clamp electrodes (8 cm) with a 24 cm² area to maximize skin contact. Suitable for attachment to the wrists or ankles (with MLA1090 Electrode Cream), these electrodes can be connected to any Bio Amp Cable with snap-connect Lead Wires (MLA2503 or MLA2505).

MLA710 Chest ECG Electrodes (suction)
A set of 3 suction electrodes 30 mm in diameter. They can be connected to any ADInstruments Bio Amp Cable using snap-on Lead Wires providing good contact and low noise.

MLADDB30 Recording Bar Electrode
The Recording Bar Electrode is used in EMG experiments. It has concave 9 mm contacts with 30 mm spacing and is fitted with shrouded 1.6 mm connectors suitable for connection to Shielded Bio Amp Cables MLA2340 and MLA2540.

MLAYDG Dry Earth Strap
Suitable for use in biopotential measurements and human nerve conduction, this strap does not require a conductive solution. It is suitable for attachment to limbs up to 100 mm in diameter (approximately 315 mm circumference) and is fitted with a snap button suitable for connection to both shielded and unshielded lead wires.

Millar Electrophysiology Catheters
These catheters are used with the STG3008-FA Intracardiac Electrophysiology Stimulator/Amplifier to determine the electrical properties of the atrium and ventricle in rats or mice. They can also be used with any ADInstruments Bio Amps via the EPC-5A EPR Catheter Interface Cable (ordered separately) for recording cardiac electrical potentials only. These catheters are non-repairable.

Millar Electrophysiology Catheters include:
- EPR-800 Millar Electrophysiology Catheter (1.1F, 8E, 1.0 mm, 4.5 cm)
- EPR-801 Millar Electrophysiology Catheter (1.1F, 8E, 1.0 mm, 4.5 cm Lumen)
- EPR-802 Millar Electrophysiology Catheter (1.6F, 8E, 1.0 mm, 12.5 cm)

EPC-5A EPR Catheter Interface Cable (5 ft)
The EPC-5A Catheter Interface Cable (5 ft) has a Redel connector to eight 1.5 mm shrouded sockets and includes a pack of ten 2 mm adaptors for connection to the FE136 Animal Bio Amp. It connects the Electrophysiology Catheters to any ADInstruments Bio Amp.

MLE2002 Model 1089 MK III Checktrode®
The Model 1089 MK III Checktrode® provides rapid and easy evaluation of total electrode contact impedance and offset voltage between two applied electrodes. Because EEG recordings are easily contaminated by noise and interference due to high contact impedance, this model assists in reducing electrode contact impedance with the skin before recording data.
EEG Electro-cap System
The MLAEC EEG Electro-cap System is available in medium and large sizes. Included in both systems is an electrode adapter (suits MLA2540 Shielded Bio Amp Cable and Multi-Channel Bio Amps), body harness, quick insert electrode, ear electrodes (1 pair), disposable sponge disks (×100), needle/syringe kit, electro-gel (16 oz), head measuring tape, ivory cleaning liquid and manual. Specify MLAEC1 for the medium cap only system, or MLAEC2 for the large and medium cap system.

Biopotential Consumables
MLA415 Biopotential Accessory Kit
A selection of items used for the preparation of sites prior to biopotential measurements such as EEG, EOG, EMG and ECG. The kit includes MLA1090 Electrode Cream (3×), MLA1095 Electrode Paste (3pk), MLA1010B ECG Electrodes (1000pk), MLA1093B Abrasive Gel (3pk) and MLA1094 Alcohol Swabs (1000pk).

MLA1090 and MLA1090B Electrode Cream
MLA1090 Electrode Cream (150 mL) provides improved contact for MLA700 Reusable ECG Electrodes. A bulk pack of 12 bottles is also available (MLA1090B).

MLA1092 and MLA1092B Abrasive Pads—Non-sterile
MLA1092 Abrasive Pads (2 sheets) are two 115 × 155 mm abrasive pads (single use only) used to prepare skin prior to the application of electrodes. A bulk pack of 20 (155 × 230 mm) sheets of abrasive pads is also available (MLA1092B).

MLA1093 and MLA1093B Abrasive Gel
MLA1093 Abrasive Gel is a single (4 oz) tube containing microbeads to prepare skin prior to attaching electrodes for biopotential measurements. A bulk pack of 3 tubes is also available (MLA1093B).

MLA1094 Alcohol Swabs (1000)
Individually wrapped isopropyl alcohol (70%) swabs, ideal for preparation of sites used for biopotential measurements (EEG, ECG, EOG and EMG).

MLA1095 and MLA1095B Electrode Paste
MLA1095 Electrode Paste (3 Pack) is a pack of three 120 mL tubes for use with MLAWT9 EEG Flat Electrodes. It provides improved contact when recording biopotentials. A bulk pack of 6 tubes is also available (MLA1095B).

MLA1010 and MLA1010B Disposable ECG Electrodes
MLA1010 is a pack of 100 disposable ECG electrodes that measure ECG or other bioelectric potentials with snap-connect lead wires. A bulk pack of 1000 Disposable ECG Electrodes (MLA1010B) is also available.
**Galvanic Skin Response**

**MLT116F and MLT117F GSR Finger Electrodes**

These bipolar finger electrodes are ideal for detecting galvanic skin response. Both MLT116F and MLT117F are suitable for connection to the FE116 GSR Amp, however only the MLT117F model is MRI compatible.

**Blood Flow**

**Laser Doppler Probes**

A variety of surface and needle laser Doppler probes are available for measuring cutaneous organ or tissue microvascular blood flow.

Available probes include:
- MNP100XP Standard Pencil Probe (surface limited access)
- MNP110XP Fine Needle Probe (tissue insertion)
- MNP150XP Bent Tip Pencil Probe (oral surface and nasal areas)
- MSP100XP Standard Surface Probe (cutaneous blood perfusion)
- MSP110XP Digit Probe (skin blood perfusion of the digits)
- MSP300XP Miniature Surface Probe (surface monitoring, suturable)
- MSP310XP Miniature Surface Probe (surface monitoring, adhesive; MRI Compatible)

**Transonic Perivascular Flowprobes and Flowsensors**

Perivascular flowprobes from Transonic are ideal for acute and chronic measurements of flow in both small and large animal blood vessels. Available in a variety of configurations, the probes do not interfere with flow to target tissues, as they are placed external to the vessel.

Tubing flowsensors are used for the measurement of flow volume in non-aerated liquids including saline, buffer solutions, blood, water and other organic fluids with high resolution and low offset. Flowsensors are available in a variety of tubing sizes and can be calibrated and programmed for up to 4 different fluid/temperature/tubing combinations.

For further assistance or advice in selecting flowprobes and flowsensors for a specific application, please consult your ADInstruments representative.

- **PS and PR Series Perivascular Flowprobes**
  The PS and PR series include the 0.5 to 0.7 mm nanoprobe for mice and 1 to 20 mm precision probes for any vessel, making them the smallest probes available. They are easily stabilized under the microscope with a micromanipulator for experiments in anesthetized rodents. In addition, precision probes are available as MA (standard acute use) or MC (custom implantable configuration).

- **PAU Series CONFidence™ Perivascular Flowprobes**
  These 8 to 28 mm perivascular flowprobes are designed to measure chronic and acute cardiac output in large animal models with accuracy, enhanced reliability and ease of use. Supplied with form-fitting Ultrafit Liner cushions for safe and easy placement, the liner encircles the vessel and slips into the transducer shell to stay in place without a clip.
**PMP Series Perivascular Flowprobes**
These 2 to 14 mm flowprobes are designed with handles for intraoperative measurements in preclinical animal trials where devices that match those used in clinical surgical settings are preferred.

**V Series Perivascular Flowprobes**
This original flowprobe series includes 0.5 to 0.7 mm microcirculation probes for acute flow measurements in small vessels (<0.7 mm). These flowprobes have mirrored ultrasonic illumination and a stabilizing handle. They will also require more acoustic coupling gel than the PS and PR series nanopores.

**PXL Series Clamp-on Flowsensors**
These precision flowsensors clip on the outside of standard laboratory or extracorporeal tubing and apply ultrasound energy through the tubing to monitor instantaneous and average volume flow. The flowsensors maintain total physical and electrical output.

**MLA191 Calibration Kit for IN191**
The Calibration Kit contains a positioning device, to which the probe and cable can be attached, providing probe stability during calibration. Also included is a bottle of Motility Standard (a colloidal solution of suspended latex spheres, which are of a standard size and concentration).

**MSP140AR Adhesive Rings for Probes (200)**
Used to secure laser Doppler surface probes to a subject.

**Pulse Oximetry**

**MLT321 and MLT322 Oximetry Transducers (Human)**
The MLT321 and MLT322 measure human blood oxygen saturation in the range of 70% to 100%. Short pulses of light at two different frequencies are transmitted through the tissue with the intensity scaled to read in % SpO₂.

The MLT321 SpO₂ Finger Clip Sensor is supplied with the ML320/F Oximeter Pod (Finger clip) and the MLT322 SpO₂ Ear Clip Sensor is supplied with the ML320/E Oximeter Pod (Ear clip).
MLT323, MLT324 and MLT325 Oximetry Transducers (Animal)

The MLT323, MLT324 and MLT325 are used to measure blood oxygen saturation (SpO2) in animals. The transducers are designed for animal applications where little transducer motion is expected. The MLT323 SpO2 Animal Clip is an ultra-sensitive clip-on sensor for use on tongue, paw pad or tail. The MLT324 SpO2 Wrap Sensor is a flexible wrap sensor that can be placed on the toe (large animal) or base of the tail (small animal). The MLT325 SpO2 Base Sensor Transducer is a transflectance sensor that allows convenient sensor placement on the underside, base of the tail or other well-vascularized surfaces of the animal.

Cardiac Output

MLA313 Cardiac Output Accessory Kit

The MLA313 Cardiac Output Accessory Kit provides accurate and reproducible injection solution volumes for the determination of cardiac output. The kit can be used with the ML313C Cardiac Output Pod (with thermocouple) or ML313 Cardiac Output Pod (no thermocouple). It includes a Hamilton glass syringe (250 µl) and repeating dispenser, polyethylene tubing, 6 Luer needle hubs, 4 three-way stopcocks and 2 Touhy Borst Adapters.

Force and Displacement

MLT0201 Force Transducer (5 mg to 25 g)

The MLT0201 is an isometric transducer with a range of 5 mg to 25 g with a resolution of ± 2 mg using a 360 Ω strain gauge. It is ideal for isolated tissue studies and operates with the ADInstruments range of tissue and organ bath models, as well as any ADInstruments Bridge Amp. Specify MLT0201/RAD if using with Radnoti Tissue-Organ Baths.

MLT0202 Sensitive Force Transducer (0 to 25 g)

The MLT0202 is a high-sensitivity isometric force transducer with a range of 0 to 25 g, using a 624 Ω strain gauge. It is ideal for isolated tissue studies and operates with our range of tissue and organ bath models, as well as any ADInstruments Bridge Amp.

MLT0402 Force Transducer (2 g)

The MLT0402 is a sensitive isometric force transducer suitable for measuring small forces. It is ideal for isolated tissue and organ bath studies where forces up to 2 g are expected. The transducer is suitable for connection to any ADInstruments Bridge Amp.

MLT0420 Force Transducer (20 g)

The MLT0420 is a sensitive isometric force transducer ideal for measuring force during isolated tissue and organ bath studies where small forces up to 20 g are expected. The transducer is suitable for connection to any ADInstruments Bridge Amp.
**MLT0015 High Grade Isotonic Transducer**
The MLT0015 is a high-performance isotonic transducer suitable for the measurement of displacements with preadjusted loads in the range of ±15°. Recommended for use with our range of organ bath models, it is suitable for connection to the FE221 Bridge Amp, FE224 Quad Bridge Amp and FE228 Octal Bridge Amp.

**MLT1030 Wide Range Force Transducer (10 mg to 1 kg)**
The MLT1030 is a semi-isometric 10 mg to 1 kg force transducer ideal for measuring muscle contractions and general force measurements requiring a wide dynamic range. Consisting of five blades, the rigidity of the transducer can be adjusted for the required sensitivity. Supplied with either audio connector (MLT1030/A) or an 8-pin DIN connector (MLT1030/D).

**MLTS700 Goniometer**
The MLTS700 Goniometer (Joint Angle Sensor) measures the angle of single degree of freedom joints such as the knee and elbow via a light sensor. Angle is determined by the amount of light passing through a pair of optic fibers along the length of the cantilever. The sensor plugs directly into a PowerLab Pod port.

**MLTS720 Miniature Goniometer**
The MLTS720 Miniature Goniometer (Joint Angle Sensor) measures the angle of single degree of freedom in small joints (including fingers and toes) and connects directly to a PowerLab Pod port. The sensor can be attached to a subject with a reusable and flexible adhesive polymer directly on the skin, or a glove/bio-compatible tape that allows easy adjustments along the natural axis of the joint.

**159901A-V* Force Transducer with Amplifier**
The 159901A-V* Force Transducer is supplied with an amplifier and output for connection to PowerLab and converts picofarad capacitance into an amplified DC output voltage. Transducer linearity is within +1% with a high DC voltage output and freedom from drift.

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

**Heart Sounds**
**MLT208 Digital Stethoscope**
The MLT208 Digital Stethoscope provides unsurpassed natural sound quality and can be connected directly to a PowerLab BNC input. It allows the user to listen to heart sounds while simultaneously recording representative cardiac traces.

**MLT201 Cardio Microphone**
The Cardio Microphone converts heart sounds into electrical signals. The MLT201 records heart sounds in the frequency range of 10 to 600 Hz and is suitable for direct connection to PowerLab Pod ports.
Invasive Blood Pressure

Millar Mikro-Tip® Blood Pressure Catheters

Millar Mikro-Tip Pressure Catheters are used for blood or cardiac pressure measurements in animal research ONLY. The micro pressure sensors provide accurate pressure measurements at the source of the signal. These catheters connect to any ADInstruments Bridge Amplifier via AEC-10C or AEC-10D Catheter Interface Cables (depending on the catheter connector type). ADInstruments supplies a range of nylon (Ny), polyimide (PI), polyurethane (PU) and woven Dacron (WD) catheters ranging from 1F (small animals) to 7F (large animals).

- **SPR-1000** Pressure Catheter (1F, Single, Straight, PI, 20 cm)*
- **SPR-671** Pressure Catheter (1.4F, Single, Straight, Ny, 15 cm)
- **SPR-407** Pressure Catheter (2F, Single, Straight, Ny, 140 cm)
- **SPR-320** Pressure Catheter (2F, Single, Straight, PU, 140 cm)
- **SPR-882** Pressure Catheter (3F, Single, Straight, Ny, 140 cm)
- **SPR-721** Pressure Catheter (2.5F, Dual, Straight, PU, 135 cm)
- **SPR-524** Pressure Catheter (3.5F, Single, Straight, Ny, 100 cm)*
- **MPR-500** Pressure Catheter (5F, Single, PU, 70 cm)*
- **SPR-350** Pressure Catheter (5F, Single, Curved, PU/W, 120 cm)

Millar Mikro-Tip® Pressure-Volume Catheters

Designed for use in large and small animals, the Mikro-Tip ultra-miniature PV catheters can simultaneously measure ventricular pressure and volume from a continuously-beating intact heart, without affecting normal heart function. These catheters connect any 880–0168SS Millar MPVS Ultra Single Segment or 880–0168 Millar MPVS Ultra (large and small animals) via the 880–0169 MPVS Ultra Cable Pack (10 ft). PV catheters are available in a range of sizes and configurations from 1 to 6 French.

Mouse Pressure-Volume Catheters

- **PVR-1030** Mouse PV Catheter (1F, 4E, 3.0 mm, 4.5 cm, PI)*
- **PVR-1035** Mouse PV Catheter (1F, 4E, 3.5 mm, 4.5 cm, PI)*
- **PVR-1045** Mouse PV Catheter (1F, 4E, 4.5 mm, 4.5 cm, PI)*
- **SPR-839** Mouse PV Catheter (1.4F, 4E, 4.5 mm, 4.5 cm, PI)
- **SPR-853** Mouse PV Catheter (1.4F, 4E, 4 mm, Taper)
- **SPR-864** Mouse PV Catheter (1.4F, 2P, 4E, 4.5 mm, Carotid)
- **SPR-848** Mouse PV Catheter (1.4F, 2P, 4E, 4.5 mm, Apical)
- **SPR-866** Mouse PV Catheter (1.4F, 6E, Selectable Seg, 4 mm/6 mm)

Rat Pressure-Volume Catheters

- **SPR-847** Rat PV Catheter (1.4F, 4E, 9 mm, PI, 15 cm)
- **SPR-869** Rat PV Catheter (2F, 4E, 6 mm, PI, 15 cm)
- **SPR-838** Rat PV Catheter (2F, 4E, 9 mm, PI, 15 cm)
- **SPR-878** Rat PV Catheter (2F, 4E, 12 mm, PI, 15 cm)
- **SPR-858** Rat PV Catheter (2F, 4E, 14 mm, PI, 15 cm)
- **SPR-901** Rat PV Catheter (2F, 2P, 4E, 9 mm, Carotid, 15 cm)
- **SPR-902** Rat PV Catheter (2F, 2P, 4E, 9 mm, Apical, 15 cm)
- **SPR-819** Rat PV Catheter (1.4F, 6E, Selectable Seg, 9 mm/14 mm)
Multi-Segmented Pressure Volume Catheters
- SPR-877  PV Catheter (3F, 10E, 2.5 mm, DField, 120 cm)
- SPR-889  PV Catheter (3F, 10E, 3 mm, SField, U-tip, 80 cm)
- SPR-894  PV Catheter (3F, 10E, 4 mm, DField, U-tip, 80 cm)

Millar Ventri-Cath™ Pressure-Volume Catheters
The Ventri-Cath™ multi segment pressure-volume catheter offers economical real-time pressure, volume and internal ECG measurements for large animal models. These catheters connect to any 880–0168 Millar MPVS Ultra (large and small animals) via the CEC-10PV PV Extension Cable (VC to MPVS Ultra, 10 ft).

Mikro-Tip Ventri-Cath™ P-V Catheters — Dog/Pig/Sheep
- VENTRI-CATH-507 PVCatheter (5F, 12E, 7 mm, DField, Pigtail, 122 cm)
- VENTRI-CATH-507S PVCatheter (5F, 12E, 7 mm, DField, Straight, 122 cm)
- VENTRI-CATH-510 PVCatheter (5F, 12E, 10 mm, DField, Pigtail, 122 cm)
- VENTRI-CATH-510S PVCatheter (5F, 12E, 10 mm, DField, Straight, 122 cm)
- VENTRI-CATH-512 PVCatheter (5F, 12E, 12 mm, DField, Pigtail, 122 cm)
- VENTRI-CATH-512S PVCatheter (5F, 12E, 12 mm, DField, Straight, 122 cm)
- VENTRI-CATH-515 PVCatheter (5F, 12E, 15 mm, DField, Pigtail, 122 cm)
- VENTRI-CATH-515S Catheter (5F, 12E, 15 mm, DField, Straight, 122 cm)
- SPR-562–1 PV Catheter (6F, 2P, 12E, 7 mm, DField, Pigtail, PU, 125 cm)*

1F = 0.33 mm
E = Electrode number
P = Pressure transducer number
* = Non-repairable
Note: Catheter interface cables are required for connection to ADInstruments Bridge Amplifiers.

Catheter Interface Cables
A variety of catheter interface cables are available for connecting Millar catheters to any ADInstruments Bridge Amp, TC-510 Pressure Control Unit or PCU-2000 Pressure Signal Conditioner. Catheter interface cables are also available for connection to the MPVS Ultra Pressure-Volume Unit.

- **For ADInstruments Bridge Amps**
  - AEC-10C Catheter Interface Cable (Viking to DIN 8, 10 ft)
  - AEC-10D Catheter Interface Cable (Low Profile to DIN 8, 10 ft)
- **For TC-510 Pressure Control Unit**
  - TEC-10C Catheter Interface Cable (Viking to TC-510, 10 ft)
  - TEC-10D Catheter Interface Cable (Low Profile to TC-510, 10 ft)
- **For PCU-2000 Pressure Signal Conditioner**
  - PEC-10C Catheter Interface Cable (Viking to PCU-2000, 10 ft)
  - PEC-10D Catheter Interface Cable (Low Profile to PCU-2000, 10 ft)
- **For MPVS Ultra Pressure-Volume Unit**
  - 880–0169 MPVS Ultra Cable Pack (10 ft)
  - CEC-10PV PV Extension Cable (VC to MPVS Ultra, 10 ft)
MLT844 Physiological Pressure Transducer
A highly accurate piezo-resistive transducer (-20 to 300 mmHg with accuracy of ±0.5%) for recording arterial and venous blood pressure, as well as intracranial, gastric and intrauterine pressures, and urodynamic parameters (by catheterization). Designed for animal use only, maximum excitation of 15 V DC or AC can be applied to the transducer. A transducer holder, three disposable clip-on domes and 4-pin to DIN connector cable are supplied with the transducer, which is suitable for use with the FE221 Bridge Amp, FE224 Quad Bridge Amps or FE228 Octal Bridge Amp. To mount the MLT844, the MLA845 Transducer Bracket (featuring a retort stand) can be purchased separately.

MLA844 Disposable Clip-On BP Domes
Set of ten disposable clip-on domes for use with the MLT844 Physiological Pressure Transducer can be purchased as spare parts.

MLT0670 Disposable BP Transducer (stopcock)
The MLT0670 Disposable BP Transducer is a lightweight transducer for consistent and accurate readings of arterial and venous blood pressure in humans and animals. With an operating range of −50 to +300 mmHg (with an accuracy of ±2% in the range of −50 to +200 mmHg), it requires 2 to 10 V DC or 5 V rms AC excitation. ADInstruments does not guarantee the sterility of the transducer, therefore it MUST be gas sterilized prior to use with human subjects. It is used with the FE117 BP Amp and the MLAC05 BP Amp to Deltran II Cable.

MLA1052 Pressure Gauge
The MLA1052 Pressure Gauge and accessories are suitable for the calibration of conventional fluid-filled or Millar Mikro-Tip pressure transducers. It is supplied with three 20 mL syringes, three Touhy Borst adaptors, three 4-way stopcocks, sphygmomanometer and silicon tubing (1 m and 2 × 0.5 m).

MLT0380/D Reusable BP Transducer
The MLT0380/D is for direct measurement of arterial and venous blood pressure in large animals. For animal use only, a maximum excitation of 6 V DC can be applied to the transducer. It can be cold sterilized and is suitable for use with the FE221 Bridge Amp, FE224 Quad Bridge Amps and FE228 Octal Bridge Amp. An 8-pin DIN connector is supplied standard.

MLT0699 Disposable BP Transducer (no stopcock)
The MLT0699 Disposable BP Transducer is a low-cost, lightweight blood pressure transducer that provides consistent and accurate readings of arterial and venous blood pressure in animals of all sizes. For animal use only, it has an operating range of −50 to +300 mmHg and requires 2 to 10 V DC or 5 V rms AC excitation. The MLT0699 Blood Pressure Transducer connects to a Bridge Amp with the MLAC06 Adapter Cable.

MLT1199 Disposable BP Transducer/Cable Kit
For animal use only, the MLT1199 combines the MLT0699 Disposable Blood Pressure Transducer and MLAC06 Adapter Cable for direct measurement of
blood pressure (−50 to +300 mmHg). The transducer is suitable for connection to the FE221 Bridge Amp, FE224 Quad Bridge Amp or FE228 Octal Bridge Amp.

**MLAC06 DIN (8) to MLT0699 or MLT0670 Cable**

The MLAC06 adapter cable is used with the MLT0699 or MLT0670 Disposable BP Transducers for connection to the FE221 Bridge Amp, FE224 Quad Bridge Amp or FE228 Octal Bridge Amp.

**910–1060 Rho Calibration Cuvette Kit**

The Rho Calibration Cuvette kit is used for calibrating Pressure-Volume catheters and the Millar MPVS Ultra unit. Supplied with the PL3516B46 MPVS Ultra Foundation System, it can also be used for measuring cardiac output.

**910–1048 Volume Calibration Cuvette (Rat P-V Catheters)**

The 910–1048 Volume Calibration Cuvette features 2 to 15 mm wells for the calibration of rat single segment Pressure-Volume Catheters and the Millar MPVS Ultra unit. The cuvette is supplied with the PL3508B47/R MPVS Ultra Single Segment Foundation System for Rats.

**910–1049 Volume Calibration Cuvette (Mouse P-V Catheters)**

Supplied with the PL3508B47/M MPVS Ultra Single Segment Foundation System for Mice, the 910–1049 Volume Calibration Cuvette features 1.5 to 4.0 mm wells for the calibration of mouse single segment Pressure-Volume Catheters and the Millar MPVS Ultra unit.

**Langendorff**

**MLA2001 Langendorff Transducer Accessory Kit**

For use with ADInstruments Langendorff System, the MLA2001 Langendorff Transducer Accessory Kit contains four Male Luer plugs, four 4-way Luer stopcocks, two 300 mm Extension Tubings, two Male Luer connectors and an SP2881 Transducer Bracket.

**170403 Latex Balloons (size 3 for rats, 10 pk)**

The 170403 Latex Balloons are used in the measurement of isovolumetric pressures in isolated hearts of rats weighing between 100 to 200 g. Balloons are 3 × 7 mm with an approximate volume of 0.03 mL and supplied in a pack of 10. For use with the 174023 Flexible Balloon Catheter connected to the MLT844 Physiological Pressure Transducer and Bridge Amp.

**170423 Flexible Balloon Catheter (for sizes 3 & 4)**

The 170423 Flexible Balloon Catheter is a single flexible Teflon catheter used in the measurement of left ventricular pressure in the isolated rat heart preparation. For use with the 170403 Latex Balloons.
IC-2S and IC-4M Input Cable Sets

The IC-2S provides two BNC input cables for use with the DP-301 and DP-304 amplifiers. The IC-2S cables do not terminate at the outboard end, while the optional IC-4M cables terminate with a 2 mm pin and alligator clip.

Electrode Holder E Series

The Electrode Holder E Series is suitable for applications including extracellular, intracellular and two electrode voltage clamp recordings. The holders are made from vapor polished annealed acrylic and are available with different glass capillary diameters.

- **Differential Amplifier Electrode Holders (For use with DP-311 Differential Amplifier)**
  - ESW-F10N E Series Electrode Holder (Str, Ag Wire, 1.0 mm)
  - ESW-F12N E Series Electrode Holder (Str, Ag Wire, 1.2 mm)
  - ESW-F15N E Series Electrode Holder (Str, Ag Wire, 1.5 mm)
  - ESW-F20N E Series Electrode Holder (Str, Ag Wire, 2.0 mm)

- **Intracellular Electrometer Electrode Holders (for use with the IE-210 and IE-251A Intracellular Electrometers)**
  - ESP-F10N E Series Electrode Holder (Str, Ag-AgCl Pellet, 1.0 mm)
  - ESP-F12N E Series Electrode Holder (Str, Ag-AgCl Pellet, 1.2 mm)
  - ESP-F15N E Series Electrode Holder (Str, Ag-AgCl Pellet, 1.5 mm)
  - ESP-F20N E Series Electrode Holder (Str, Ag-AgCl Pellet, 2.0 mm)
  - ESP/W-F10N E Series Electrode Holder (Str, Ag-AgCl Pellet & Wire, 1.0 mm)
  - ESP/W-F12N E Series Electrode Holder (Str, Ag-AgCl Pellet & Wire, 1.2 mm)
  - ESP/W-F15N E Series Electrode Holder (Str, Ag-AgCl Pellet & Wire, 1.5 mm)
  - ESP/W-F20N E Series Electrode Holder (Str, Ag-AgCl Pellet & Wire, 2.0 mm)

- **Two Electrode Voltage Clamp Amplifier Electrode Holders (for use with the OC-725C Oocyte Clamp Amplifier and voltage headstage)**
  - ESW-F10V E Series Electrode Holder (Str, Vent, Ag Wire, 1.0 mm)
  - ESW-F12V E Series Electrode Holder (Str, Vent, Ag Wire, 1.2 mm)
  - ESW-F15V E Series Electrode Holder (Str, Vent, Ag Wire, 1.5 mm)
  - ESW-F20V E Series Electrode Holder (Str, Vent, Ag Wire, 2.0 mm)

- **For use with current electrodes**
  - E45W-F10VH E Series Electrode Holder (45°, Vent, Handle, Ag Wire, 1.0 mm)
  - E45W-F12VH E Series Electrode Holder (45°, Vent, Handle, Ag Wire, 1.2 mm)
  - E45W-F15VH E Series Electrode Holder (45°, Vent, Handle, Ag Wire, 1.5 mm)
  - E45W-F20VH E Series Electrode Holder (45°, Vent, Handle, Ag Wire, 2.0 mm)
Electrode Holder Q Series

The Electrode Holder Q Series is designed for patch clamp amplifiers. Vents in the holder prevent cell damage due to pressure build-up inside the electrode. Holders are made from polycarbonate that reduces noise level during recording. The connector pins are gold-plated with Teflon or polycarbonate insulators.

- QSW-A10P Q Series Electrode Holder (Str, Port, Ag Wire, 1.0 mm)
- QSW-A12P Q Series Electrode Holder (Str, Port, Ag Wire, 1.2 mm)
- QSW-A15P Q Series Electrode Holder (Str, Port, Ag Wire, 1.5 mm)
- QSW-A17P Q Series Electrode Holder (Str, Port, Ag Wire, 1.7 mm)
- QSW-A20P Q Series Electrode Holder (Str, Port, Ag Wire, 2.0 mm)

PJ2–5 2 mm Jack, Uninsulated (pack of 5)

The PJ2–5 is a pack of 5 uninsulated Jacks for use with the Electrode Holder E Series and DP-311 Differential Amplifier.

2100W Headstage for IE-210-V

The 2100W Headstage for Intracellular Electrometer features high impedance and capacitance compensation for use in intracellular recording. The 2100 W Headstage is for use with the IE-210 Intracellular Electrometer.

3110W Headstage for DP-311

The 3110W Headstage for DP-311 features high impedance and capacitance compensation for extracellular studies. The 3110W Headstage is for use with the DP-311 Differential Amplifier.

BB-15 Breakaway Box for IE-210-V

The BB-15 connects to the IE-210 Intracellular Electrometer allowing large voltages to be applied to the electrode for iontophoretic injection of dyes or drugs. Voltages up to ±200 V may be applied without damage to the probe input.

RB-1 Remote Buzz control for IE-210-V

The RB-1 Remote Buzz control provides convenient remote operation of the Buzz voltage with variable frequency and amplitude to facilitate cell impalement. It is for use with the IE-210 Intracellular Electrometer and supplied with a 3 m length cable.

725MC Oocyte Model Cell for OC-725C-V

The 725MC Oocyte Model Cell is for use with the OC-725C Oocyte Clamp Amplifier. The model cell can be used for calibration purposes or to test the accuracy of the amplifier. It connects the voltage/current probes to the bath clamp allowing all aspects of the amplifier’s function to be tested.

7251I Bath Clamp Headstage for OC-725C-V

The 7251I Bath Clamp Headstage clamps the bath potential at zero and creates a virtual ground potential to provide accurate bath current measurement. The large current measuring range allows smaller currents to be amplified and larger currents to be recorded without output saturation and the headstage eliminates series resistance compensation.
**RC-3Z Oocyte Recording Chamber for OC-725C-V**

The RC-3Z chamber is suitable for the study of oocytes and other large cell structures when using the OC-725C Oocyte Clamp Amplifier. The chamber consists of a narrow bath allowing rapid solution exchange and a wider bath for easy electrode access. It is included in the TEV700 Complete Oocyte Clamp Workstation and PL3508B76 Oocyte Clamp Workstation System.

**7250V Voltage Headstage for OC-725C-V**

The 7250V Voltage Headstage is supplied with the OC-725C and features a small size, single-ended and high-impedance probe. It is supplied with a convenient mounting rod and a 2 m cable for easy attachment to the micropositioner.

**7255DI Differential Headstage for OC-725C-V**

The 7255DI Differential Headstage is designed for dual oocyte studies where two oocytes are clamped in a common bath. It is longer than the 7250V probe with two additional inputs. The differential headstage subtracts the voltage drop across the series resistance in the bath.

**7259C Current Electrode Cable for OC-725C-V**

The 7259C Current Electrode Cable is a 2 m shielded cable that connects to an electrode holder with a 2 mm pin jack (supplied) and the OC-725C-V Oocyte Clamp Amplifier with a 3-pin connector (also supplied).

**WA10–5 1 mm Pin with Bare Silver Wire**  
(100 mm L, 0.25 mm D, 2 pk)

The WA10-5 consists of two 1 mm pins attached to a bare silver wire (100 mm long and 0.25 mm diameter). It is supplied with the OC-725C Oocyte Clamp Amplifier.

**WA30–5 26 1 mm Pin with Insulated Wire**  
(300 mm L, 26 Gauge, 3 pk)

The WA30-5 consists of three 1 mm pins attached to a 26 gauge, 30 cm long insulated wire. It is for use with the OC-725C Oocyte Clamp Amplifier for grounding, shielding, and other electrical connections.

**5101 Headstages for PC-501A**

The 5101 Headstage features a high-impedance solid-state current to voltage converter for use with PC-501A Patch Clamp Amplifier. Different headstages are available for each amplifier, including:
- 5101-10G Headstage for PC-501A/10-V (10 GΩ)
- 5101-01G Headstage for PC-501A/9-V (1 GΩ)
- 5101-100M Headstage for PC-501A/8-V (100 MΩ)
Model Cells for PC-501A
For convenient and accurate cell simulations (system testing purposes) three varieties of model cell are available for use with the PC-501A Patch Clamp Amplifier:
- MC-10G 10 GΩ Model Cell for PC-501A/10-V
- MC-01G 1 GΩ Model Cell for PC-501A/9-V
- MC-100M 100 MΩ Model Cell for PC-501A/8-V

U9406 Tubing Kit (Hose & Luer Fittings) for Ussing Chambers
For use with single or dual Ussing Chambers.

U9565SC Electrode Bridge Fitting Kit (12 Fittings & 6 Adapters)
For use with single or dual Ussing Chambers.

U9605 O-rings for Ussing Chambers (4 pk)
A four pack of O-rings for use with the single and dual Ussing Chambers.

U9924 Tissue Insert and Culture Cups for Ussing Chambers
For use with single or dual Ussing Chambers, the U9924 tissue insert adapters and culture cups available are:
- U9924A-04 Round Tissue Insert (3.8 mm) with O-ring
- U9924B-04 Round Tissue Insert (3.8 mm) with 5 Pins
- U9924C-03 Slotted Tissue Insert (1.6 × 7 mm) with 6 Pins
- U9924F-09 Falcon Culture Cup Insert (9.0 mm)
- U9924M-12 Millicell Culture Cup Insert (12 mm)
- U9924S Snapwell Culture Cup Insert (12 mm)
- U9924T-06 Transwell Culture Cup Insert (6.5 mm)

U9975A Ussing Electrode Set (2 Ag-AgCl Pellets and 2 Ag Wires)
This set comprises four electrodes, two Ag-AgCl pellet electrodes (for voltage), two Ag wire electrodes (for current), a 1 m wire and an amplifier to headstage connector cable.

U9985 Bridge Fitting Adapters for Ussing Chambers (6 pk)
The U9985 Bridge Fitting Adapters for Ussing Chambers (6 pk) are for use with single or dual Ussing Chambers.
Noninvasive Blood Pressure

**MLT1100 Sphygmomanometer**

The MLT1100 is for measuring systolic blood pressure in human subjects. The unit is coupled to a pressure transducer and is supplied with both an adult and child-sized cuff. The transducer gives stable readings in the range of –50 to +300 mmHg and requires 2 to 10 V DC or 5 Vrms AC excitation. The MLT1100/A Sphygmomanometer is supplied with an audio connector for connection to the ML301 Bridge Pod and the MLT1100/D Sphygmomanometer is supplied with an 8-pin DIN connector for use with any ADInstruments Bridge Amp.

**MLT125M and MLT125R Pulse Transducer/Pressure Cuff for NIBP**

The MLT125M (mouse) and MLT125R (rat) Pulse Transducer/Pressure Cuffs are used with the IN125 NIBP System. They are specialized pressure cuffs and pulse transducers for intermittent measurement of blood pressure based on periodic occlusion of tail blood flow in mice and rats. For animal use only.

**Rodent Restrainers**

The rodent restrainers are constructed with Perspex and come in six sizes. The space inside the chamber can be adjusted by the slide piston. Slots and holes are provided for ventilation and drug administration. The rodent restrainers can be used with the rodent MLA5030 Rodent Tail Cuff Holder base to secure the rat or mouse tail transducer and cuff.

- MLA5016 Rodent Restrainer for Mice (up to 35 g)
- MLA5018 Rodent Restrainer for Mice (up to 50 g)
- MLA5020 Rodent Restrainer for Rats (80 to 200 g)
- MLA5022 Rodent Restrainer for Rats (180 to 320 g)
- MLA5024 Rodent Restrainer for Rats (300 to 440 g)
- MLA5025 Rodent Restrainer for Rats (440 to 550 g)

**MLA5030 Rodent Tail Cuff Holder**

The MLA5030 Rodent Tail Cuff Holder secures the MLT125 Pulse Transducer/Pressure Cuff for NIBP when attached to a mouse or rat tail. The holder can also be used with all ADInstruments rodent restrainers.

**SPT-301 Non-Invasive Pulse Tonometer**

For noninvasive recording of pulse pressure wave contour, the SPT-301 Non-Invasive Pulse Tonometer is equipped with a Mikro-Tip pressure sensor. The hand-held wand probe is constructed of stainless steel with a diameter of 6.35 mm (0.25”), length of 152.4 mm (6”) and a cable length of 150 cm (79”). It requires an AEC-10C Catheter Interface Cable for connection to an ADInstruments Bridge Amps. For human and animal use.
FMS Finger Cuffs
The FMS finger-cuffs are used with the MLE1054-V Finometer MIDI. Finger Cuffs are available in 3 sizes: MLE1057 FMS Finger Cuffs (small), MLE1058 FMS Finger Cuffs (medium) and MLE1059 FMS Finger Cuffs (large).

MLE1060 FMS Height Correction Unit
MLE1060 is used to correct hydrostatic blood pressure changes caused by movement of the hand away from heart level. It is a liquid filled tube with sensors at both ends to measure their relative vertical distance. The FMS Height Correction Unit is used with the MLE1054-V Finometer MIDI.

MLE1061 FMS RS 232 Cable
The MLE1061 connects the MLE1054-V Finometer MIDI to a PC RS232 (COM) port. It allows online recording and remote control of the device using BeatScope Easy software.

MLE1062 FMS ECG module
The MLE1062 has three leads that acquire an analog ECG signal for simultaneous recording and storage with a blood pressure waveform originating from the MLE1054-V Finometer MIDI.

MLE1063 FMS Analog I/O box
The MLE1063 FMS Analog I/O box allows up to four analog signals from the MLE1054-V Finometer MIDI to be recorded using a PowerLab. Signals include finger pressure, reconstructed brachial artery pressure and ECG (available only when used with MLE1062 FMS ECG Module).

Pulse and Plethysmography
MLT1010 Piezo Electric Pulse Transducer
This small, durable piezo-electric device records changes in peripheral pulse pressure by converting force from the finger blood pressure pulse into an electrical signal. Applications include measurement of pulse rate or small animal respiratory activity. The unit does not require excitation and can be connected directly to a PowerLab BNC input (MLE1010) or 8-pin DIN Input (MLT1010/D).

Infrared Plethysmographs
Infrared (IR) photoelectric sensors are used to record pulsatile blood flow changes in the finger or ear. The IR plethysmographs require 6 V to 9 V DC excitation and connect directly to a PowerLab Pod port, ADInstruments Bridge Amp or ML142 GP Amp. IR plethysmographs include:
- MLT1020EC IR Plethysmograph – Ear Clip
- MLT1020FC IR Plethysmograph – Finger Clip
- MLT1020PPG IR Plethysmograph – Velcro Strap
**Respiration**

**MLT3813H-V* Heated Pneumotach 800 L and Heater Controller**

The MLT3813H-V* features a Hans Rudolph 800 L/min flowhead with heat controller. It is used in experiments involving continuously exercising humans to minimize the distortion effects of condensation on the flow head. Recommended for use with the FE141 Spirometer. It requires MLA1011A Clean Bore Tubing & Flow Head Adapter.

* Specify mains power: V = 115 for 110–115 V or V = 220 for 220–240 V

**Respiratory Flow Heads**

Used for measurements such as pulmonary function, respiration, airflow and exercise tests, the following flow heads can be used with the FE141 Spirometer or ML311 Spirometer Pod (which has a differential pressure transducer to measure airflow):

- **MLT1L** ±1 L for mice and rats
- **MLT10L** ±10 L for rabbits
- **MLT300L** ±300 L for humans (at rest)
- **MLT1000L** ±1000 L for humans (during exercise or lung function tests)

**Calibration Syringes**

The Hans Rudolph calibration syringes provide an easy and reliable method of calibrating respiratory measurement equipment. Volumes ranging from 100 mL to 3 L are stocked. Larger volumes up to 7 L are available on request.

- **MLA5510A Calibration Syringe** (0.1 L, Small Outlet)
- **MLA5510B Calibration Syringe** (0.1 L, Large Outlet)
- **MLA5550 Calibration Syringe** (0.5 L)
- **MLA5540 Calibration Syringe** (1 L)
- **MLA5530 Calibration Syringe** (3 L)

**MLA246 Gas Mixing Chamber**

The MLA246 Gas Mixing Chamber has a capacity of 4.7 L to collect, mix and sample expired respiratory gases. It is suitable for use with the ML206 Gas Analyzer and is included in the PL3508B80 Exercise Physiology System. Three 2 mm (0.08”) male luer lock connectors allow sampling lines to be connected to the unit and 35 mm (1.4”) inlet and exhaust ports are provided.

**MLA140 Spirometer Kit**

A number of disposable items for use in a respiratory laboratory. The Spirometer Kit contains: MLA1026 Reusable Mouthpieces (10), MLA1008 Nose Clips (50), MLA304 Disposable Filters (50), MLA1011A Clean Bore Tubing (25 cm × 35 mm ID), Flow Head Adapter (connects to the MLT300L), MLT1000L Respiratory Flow Heads and MLT3813H-V (individual components may be purchased separately).
MLA1028 Face Mask (adult medium)
The MLA1028 Face Mask with head strap features a two-way non-rebreathing valve to separate inspired and expired gases. The MLA1028 is ideal for use in exercise testing and respiratory research.

MLA1029 Face Mask Kit (adult small and medium)
The MLA1028 Face Mask Kit features a head strap, Y-shaped two-way non-rebreathing valve (to separate inspired and expired air) and an interchangeable Adult Face Mask (medium or small). The MLA1029 is ideal for use in exercise testing and respiratory research.

MLA0343 Drying Tube
The Drying Tube is a 30 cm length of 1.3 diameter Nafion tubing. It is used for drying gas streams (to atmospheric conditions) in respiratory experiments. It is suitable for use with the ML206 Gas Analyzer and the MLA6024 Desiccant Cartridge if used in a humid environment.

MLA0110 In-line Filters
The MLA0110 is a pack of 10 filters that feature hydrophobic membranes (0.45 µm pore-size, disc size of 17 mm). Male/female luer connectors connect to the MLA0343 Drying Tube and sampling port of the ML206 Gas Analyzer to protect the transducers from moisture and damaging particulates. It is supplied with the ML206 Gas Analyzer.

MLA304 Disposable Filters
The MLA304 is a pack of 50 disposable droplet filters that remove water droplets from the airstream and prevent cross-contamination without impairing airflow. They can be used with the MLA1026 Reusable Mouthpieces and MLA1011A Clean Bore Tubing & Flow Head Adapter.

MLA1008 Nose Clips
The MLA1008 is a pack of 50 disposable nose clips that prevents nasal breathing during respiratory measurements.

MLA1015 Breathing Tube
The MLA1015 is a smooth bore tubing with the dimensions of 183 cm (6’) length of 35 mm (1.4”) internal diameter. It features integral fittings for connection to the MLA246 Gas Mixing Chamber and MLA1028 Face Mask.

MLA1013 Tubing Adapter (35 mm ID)
The MLA1013 Tubing Adaptor (5 cm long, internal diameter 35 mm) connects the MLT1000L to the MLA246 Gas Mixing Chamber outlet port. The Tubing Adapter is included with the PTK20 Exercise Breathing Kit.
MLA1011A Clean-bore Tubing & Tubing Adapter
The MLA1011A tube (25 cm long, inner diameter 35 mm) connects the MLA304 Disposable Filters to the MLT300L, MLT1000 and MLT3813H-V. The MLA1011A is included with the PTK20 Exercise Breathing Kit.

MLA1081 Flow Head Adapter
The MLA1081 Flow Head Adapter connects the MLA1011 Clean Bore Tubing to MLT300L, MLT1000L and MLT3813H-V. It is included in the PTK20 Exercise Breathing Kit.

MLA1026 Reusable Mouthpieces (10 pk)
A pack of 10 vinyl mouthpieces that can be cold sterilized for reuse. They are used with MLA304 Disposable Filters and are ideal for use in the respiratory classroom.

MLA6024 Desiccant Cartridge
The MLA6024 Desiccant Cartridge is reusable and contains Naﬁon tubing and desiccant material (to remove moisture from a gas stream). The desiccant material indicates expiration by changing from blue to pink in color and can be replaced with MLA6026 Desiccant Refill (available separately). The cartridge is ideal for use in exercise/sports physiology studies.

MLT1132 Piezo Respiratory Belt Transducer
The MLT1132 is a respiratory belt transducer based on a piezo-electric device that requires no excitation. Connecting directly to a PowerLab BNC input, the transducer produces a voltage when there is a change in thoracic or abdominal circumference due to respiration proportional to changes in length. It is suitable for large animal or human use.

MLA240 Exercise Physiology Accessory Kit
Included with the PL3508B80 Exercise Physiology System, this kit contains a MLT1000L Respiratory Flow Head 1000 L, MLA1029 Face Mask Kit, MLA1081 Flow Head Adapter, MLA1013 Tubing Adapter (35 mm ID), MLA6024 Desiccant Cartridge, MLA1015 Breathing Tube, MLA0343 Drying Tubing, MLT415/M Thermistor Temperature Sensor and two 1 mm Silicon Tubes (1 mm ID, 30 cm length) with Luers.

Telemetry
Telemeters measure, process and transmit high-fidelity pressure, sympathetic nerve activity (SNA), biopotential (i.e., ECG, EMG, EEG) and tissue oxygenation via telemetry from within the animal. The telemeters recharge wirelessly in vivo and can operate for approximately 4 hours between recharging. The telemeters are made of biocompatible silicone and weigh approximately 12 gm. The telemeter is programmed via the MLE0190 Telemetry Configurator (TR190) with one of 16 independent transmission frequencies. They have a transmission range of up to 5 m.
Pressure Telemeter

- **MLE0054P TR/Millar Pressure Telemeter (TRM54P)**
  The MLE0054P Pressure Telemeter (TRM54P) measures intravascular/intralumenal pressure (–20 to 300 ± 2 mmHg) and temperature in small animals weighing ≥ 200 g.

Dual Pressure Telemeter

- **MLE0054PP TR/Millar Dual Pressure Telemeter (TRM54PP)**
  The MLE0054PP Dual Pressure Telemeter (TRM54PP) measures two intravascular or intralumenal pressures (–20 to 300 ± 2 mmHg) and temperature in small animals weighing ≥ 200 g.

Pressure and Biopotential Telemeter

- **MLE0054PB TR/Millar Pressure Biopotential Telemeter (TRM54PB)**
  The MLE0054PB Pressure Biopotential Telemeter (TRM54PB) measures two intravascular or intralumenal pressures (–20 to 300 ± 2 mmHg), biopotentials (such as ECG, EEG, EOG or EMG) and temperature in small animals ≥ 200 g.

Biopotential Telemeter

- **MLE0050B Biopotential Telemeter (TRM50B)**
  The MLE0050B Biopotential Telemeter (TRM50B) measures biopotentials (such as ECG, EEG, EOG or EMG) and temperature in small animals weighing ≥ 200 g.

Dual Biopotential Telemeter

- **MLE0050BB Dual Biopotential Telemeter (TRM50BB)**
  The MLE0050BB Dual Biopotential Telemeter (TRM50BB) measures biopotentials (such as ECG, EEG, EOG or EMG) and temperature in small animals weighing ≥ 200 g.

Tissue Oxygen Telemeter

- **MLE0057Y Tissue Oxygen Telemeter (TR57Y)**
  The MLE0057Y Tissue Oxygen Telemeter (TR57Y) is an implantable potentiostat for measuring tissue oxygen concentration. The unit is approximately 12 g in weight and is suitable for small animals weighing ≥ 200 g.

SNA and Pressure Transmitter

- **MLE0056SP TR/Millar SNA Pressure Telemeter (TRM56SP)**
  The MLE0056SP TR/Millar SNA Pressure Telemeter (TRM56SP) measures Sympathetic Nerve Activity, intravascular or intralumenal pressure (–20 to 300 ± 2 mmHg) and temperature in small animals weighing ≥ 200 g.
Wireless Neural Recordings

Headstages

5 or 15 Channel Wireless Neural Headstages record signals (Local Field Potentials or LFPs, EEGs, single unit or spike data) from an animal and transmits them to the Wireless Neural Receiver on the corresponding frequency. Attached to the headstage is an Omnetics female connector to facilitate connection to the microelectrodes. ADInstruments does NOT provide any microelectrodes or the mounting accessories.

The wireless headstages are supplied standard as Dipped. Covered options are available but must be specified at the time of purchase.

Headstage models include:
- TB5653/F – 5 Channel Wireless Neural Headstage
- TB5656/F – 15 Channel Wireless Neural Headstage
- TB5662/COL – TBSI Headstage LED Option
- B5658/F – 15 Channel Wireless Neural Headstage w/24 Hr Battery
- TB5654/F – 5 Channel Wireless Neural Headstage w/5 Hr Battery
- TB5655/F – 5 Channel Wireless Neural Headstage w/24 Hr Battery

TBSI to PowerLab Interface Cables

Connects the Wireless Neural Receiver and a PowerLab data acquisition system and is available for either 5 (MLAC55) or 15 (MLAC56) channels. It consists of an analog output mating connector (DB37) at one end and either 5 or 15 BNC connectors at the other end. Multiple received signals (Local Field Potentials or LFPs, single unit or spike data) processed by the receiver can be transferred directly and recorded by the PowerLab data acquisition system.

TBSI Headstage Test Cables

The MLAC52 TBSI 15 Channel Headstage Test Cable or MLAC51 TBSI 5 Channel Headstage Test Cable provides the ability to test the transmission of either 15 or 5 Channel Wireless Neural Headstages with the corresponding Wireless Neural Receiver. A PowerLab data acquisition unit and LabChart software are required to generate the appropriate test waveforms.

Temperature

MLT1400 General-purpose Thermocouple Probe

A T-type temperature probe suitable for use in liquids, gases and semi-solids to a maximum of 400° C. The MLT1400 is supplied with a 2-pin T-type connector for use with the ML312 T-type Pod or ML290-V Thermometer for T-type Thermocouples.

MLT1401 T-type Implantable Thermocouple Probe

A flexible T-type microprobe for temperature measurements in liquids and semi-solids, as well as tissue (needle supplied). It is suitable for temperature measurements up to 150° C. The MLT1401 is used in the ADInstruments Langendorff System and is MRI compatible. The MLT1401 is supplied with a 2-pin T-type connector for use with the ML312 T-type Pod or ML290-V Thermometer for T-type Thermocouples.
**MLT1402 T-type Ultra Fast Thermocouple Probe**

A tissue implantable T-type microprobe with an ultra fast response time of 5 ms for temperatures up to 150° C. The diameter tip of the thermocouple is 0.76 mm and is inserted into the tissue with a supplied 23 gauge hypodermic needle. The MLT1402 is supplied with a 2-pin T-type connector for use with the ML312 T-type Pod, ML290-V Thermometer for T-type Thermocouples or ML313B Cardiac Output Pod.

**MLT1405 T-type Implantable Thermocouple Probe**

The MLT1405 is a flexible T-type microprobe for temperature measurements in liquids and semi-solids. It can be inserted into tissue with the supplied needle and is also suitable for measuring rectal temperature in small animals. It has a time constant of 0.08 seconds with a temperature measurement threshold of 150° C. The MLT1405 is supplied with a 2-pin T-type connector for use with the ML312 T-type Pod, ML313B Cardiac Output Pod or ML290-V Thermometer (for T-type Thermocouples).

**MLT1406 Needle Microprobe Thermocouple**

The MLT1406 is a fast-response needle thermocouple probe for temperature measurements in tissues, semi-solids and liquids. It is suitable for very small specimens and can measure temperature up to 200° C with a 1.5 m lead probe and a 1 cm long 29 gauge needle. The MLT1406 is supplied with a 2-pin T-type connector for use with the ML312 T-type Pod or ML290-V Thermometer for T-type Thermocouples.

**MLT1403 Rectal Probe for Rats**

The MLT1403 is suitable for measuring small animal (such as rat and guinea pig) rectal temperature and is functional in the range of –273° C to 125° C. The probe consists of a 25.4 mm stainless steel shaft with a smooth ball tip (3.2 mm diameter). The MLT1403 is supplied with the ML295/R Homeothermic Controller and Plate (for rats) and a 2-pin T-type connector for use with the ML312 T-type Pod or ML290-V Thermometer for T-type Thermocouples.

**MLT1404 Rectal Probe for Mice**

Suitable for measuring rectal temperature in small animals such as mice, hamsters or rat pups, this probe consists of a 19 mm stainless steel shaft with a smooth ball tip (1.7 mm diameter). The MLT1404 is supplied with the ML295/M Homeothermic Controller and Plate (for mice) and a 2-pin T-type connector for use with the ML312 T-type Pod or ML290-V Thermometer for T-type Thermocouples.

**MLT1407 Large Animal Rectal Probe**

A flexible, vinyl covered and soft tipped isolated rectal probe which measures temperature up to 90° C with a time constant of 5.0 seconds and a 1.5 m lead. It is suitable for use with rabbits and larger animals. The MLT1407 is supplied with a 2-pin T-type connector for use with the ML312 T-type Pod or ML290-V Thermometer for T-type Thermocouples.
MLT422 Skin Temperature Probe (2 m)
The Skin Temperature Probe operates between 0°C and 50°C for continuous skin temperature monitoring as an indicator of body temperature. It is suitable in applications such as biomedical temperature monitoring requiring high sensitivity and rapid response. It is supplied with an audio connector (MLT422/A) for use with the ML309 Thermistor Pod or an 8-pin DIN connector (MLT422/D) for use with any ADInstruments Bridge Amp or ML142 GP Amp.

MLT415 Nasal Temperature Probe
The Nasal Temperature Probe is ideal for measuring nasal air temperature as an indicator of respiration. Supplied with the standard lead length (9 m), the MLT415 operates between 0°C and 50°C and can be cold sterilized between subjects. It is supplied with an audio connector (MLT415/A) for use with the ML309 Thermistor Pod or an 8-pin DIN connector (MLT415/D) for use with any ADInstruments Bridge Amp or ML142 GP Amp. For a unit with a lead length of 10 m, please order either MLT415/AL (for connection to ML309) or MLT415/DL (for connection to an ADInstruments Bridge Amp or ML142).

MLT415/M Thermistor Temperature Sensor
Ideal for measuring air temperature from a gas mixing chamber by providing a relative large change in resistance as a function of temperature (~4%/°C). It operates between 0°C and 50°C and is suitable for connection to the ML309 Thermistor Pod. Included as part of the MLA240 Metabolic Accessory Kit, the MLT415/M can be attached to the MLA246 Gas Mixing Chamber and ML206 Gas Analyzer for CO₂ and O₂ analysis in metabolic studies.

MLT1101 Thermocouple/Analog Converter
The MLT1101 Thermocouple/Analog Converter converts a thermocouple input signal to an amplified analog output for use with Digital Multimeters, recorders and dataloggers. It is supplied with the MLAC09 BNC to 4 mm Banana Plug Adapter for connection to PowerLab BNC input.

Tissue-Organ Bath Stimulating Electrodes
Stimulating Platinum Electrodes for Radnoti Tissue-Organ Baths
Several combinations of interchangeable tissue supports and stimulating electrode inserts are available for ≥ 10 mL Radnoti tissue-organ baths. This design provides both vertical and horizontal adjustment of electrodes for precise electrode placement.

Electrodes include:
- 160152–11 Universal Holder with Straight Electrode
- 160152–12 Universal Holder with Zig-Zag Electrode
- 160152–14 Universal Holder with L-Shaped Electrode
- 160152–15 Universal Holder with Flat Electrode
Field Stimulating Electrodes for Radnoti Tissue-Organ Baths

Constructed of platinum wire sealed in glass, these electrodes feature a dual vertical spiral coil design with a 1 cm gap that generates a large, uniform electrical field surrounding the tissue. They are ideal for stimulating sections of blood vessels, and other smooth or skeletal muscle preparations or any type of tissue that requires field stimulation.

Electrodes include:
- 158812 Platinum Field Stimulating Electrode (5 to 10 mL)
- 158814 Platinum Field Stimulating Electrode (25 to 50 mL)

Stimulating Electrodes with Tissue Support for Radnoti Tissue-Organ Baths

Several stimulating electrodes combined with a tissue support are available for isolated tissue research. They are designed for both the 5 to 10 mL and the 25 to 50 mL Radnoti tissue-organ baths.

Electrodes include:
- 160121 L-Type Stimulating Electrode with Tissue Support
- 160131 Ring Type Stimulating Electrode with Tissue Support
- 160151 “ZZ” Type Stimulating Electrode with Tissue Support

Stimulating Electrodes for Panlab Tissue-Organ Baths

<table>
<thead>
<tr>
<th>Type of Electrode</th>
<th>Platinum</th>
<th>Stainless Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Single Ring*</td>
<td>MLA0301/ID</td>
<td>MLA0305/ID</td>
</tr>
<tr>
<td>B) Double Ring (20 mm between poles)*</td>
<td>MLA0302/ID</td>
<td>MLA0306/ID</td>
</tr>
<tr>
<td>C) 3 mm Length Pole</td>
<td>MLA0303</td>
<td>MLA0307</td>
</tr>
<tr>
<td>D) Double Ring (15 mm between poles)</td>
<td>MLA0304</td>
<td>MLA0308</td>
</tr>
</tbody>
</table>

* ID = 6.5, 8 or 10 mm inner diameter

Event Markers

MLA91 Foot Switch

Used as a triggering device, the MLA91 Foot Switch can either be connected to the PowerLab trigger input (to provide triggering signals) or one of the channel inputs (for inserting comments). The foot switch has normally open contact that gives a TTL output (momentary action) when depressed.

MLA92 Push Button Switch

For triggering, timing or marking when connected to any PowerLab BNC input. (Normally open contact.)

MLA93 Tendon Hammer

For mechanical triggering in human reflex studies. It can connect to any PowerLab BNC input channel to provide triggering, timer or marker signals. The sensor within the head provides a momentary pulse when a surface is struck. Pulse strength is proportional to the striking force.
**Headphones**

**MLA1250 Headphones**

With a high-fidelity and high-impedance stereo headphone, the MLA1250 is suitable for connection to the audio output of the FE132 Bio Amp, FE135 Dual Bio Amp and ML408 Dual Bio Amp/Stimulator.

**Stimulator Accessories**

**MLA250 Stimulator Cable (BNC to Alligator clip)**

The MLA250 cable with two male BNC connectors to three alligator clip is suitable for use as a stimulator cable. It connects to the stimulator output on PowerLabs.

**MLA260 Stimulator Cable (4 mm shrouded to Alligator clip, 50 cm)**

A 50 cm cable with two shrouded 4 mm connectors to two alligator clips suitable for stimulation. It can be connected to any PowerLab with in-built isolated stimulators, the FE180 Stimulus Isolator or the ML408 Dual Bio Amp/Stimulator. If a longer cable is required the MLA260/L Stimulator Cable (2 m) is also available.

**MLA265 Stimulator Rod with Cable**

Suitable for deep nerve stimulation experiments in humans, the MLA265 Stimulator Rod with cable can be used with any PowerLab with in-built isolated stimulators, or the FE180 Isolated Stimulator or the ML408 Dual Bio Amp/Stimulator.

**MLA270 Stimulator Cable (BNC to Micro-Hooks)**

The MLA270 Stimulator Cable is supplied with two male BNC connectors to three Micro-Hooks (molded nylon with a stainless steel spring), and gold-plated beryllium copper hooks.

**MLA0320 Animal Nerve Stimulating Electrode**

Suitable for nerve and muscle stimulation in animals, the MLA320 consists of two exposed gold-plated brass rounded tip electrodes that are separated by 3 mm. The rod has a 200 mm plastic handle allowing easy handling and precise positioning using a suitable positioning clamp.

**MLADD30F30 Stimulating Bar Electrode**

Suitable for use in conduction experiments. The MLADD30 has flat 9 mm contacts with 30 mm spacing and is fitted with shrouded 4 mm connectors suitable for connection to the FE180 Stimulus Isolator or ML408 Dual Bio Amp/Stimulator.
Psychophysiology
MLT1601/ST Response Meter (6 m)

The slide control, with a 10-point Likert scale, provides the subject with the ability to quantify their response to a range of stimuli. The Response Meter connects directly to a Pod input of a PowerLab data acquisition unit and the response is recorded by LabChart software. Several Response Meters can be connected to the PowerLab, which allows multiple subjects to respond simultaneously to the same stimuli.

MLAC34 E-Prime Interface Cable (2 m)

The MLAC34 is a 25 pin D-type (M) to 15 pin D-type (F) adapter cable (2 m) that can be used to connect a PST serial response box to the digital inputs on a PowerLab. Eight active keys (D0-D7) from the PST Box can be used to trigger Digital Inputs 1 to 8 (on a suitable PowerLab) for LabChart's preset comments.

Response Pad

High quality, ergonomic design and removable key tops make this pad ideal for response experiments. The pad is compatible with a number of stimulus presentation packages including SuperLab, E-Prime, Inquisit and Medex.

The Response Pad can be connected directly to the digital input of the PowerLab data acquisition unit using the MLAC38 Response Pad to PowerLab Cable (2 m).

Models include:
- MLE1305 Response Pad (5-Buttons)
- MLE1307 Response Pad (7-Buttons)
- MLE1308 Response Pad (8-Buttons, Comfort)
- MLE1309 Response Pad (8-Buttons, Large)

MLE1312 SV-1 Smart Voice Key

Ideal for experiments requiring a vocal response, the SV-1 Smart Voice Key monitors the participant’s voice level and reports when it rises above a user specified threshold. A USB-serial adapter can be purchased separately if connection is required using the computers USB port.
<table>
<thead>
<tr>
<th>Product area</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PowerLab Data Acquisition Systems</strong></td>
<td></td>
</tr>
<tr>
<td>PL3504 PowerLab 4/35 – 4 channels</td>
<td>78</td>
</tr>
<tr>
<td>PL3508 PowerLab 8/35 – 8 channels</td>
<td>78</td>
</tr>
<tr>
<td>PL3516 PowerLab 16/35 – 16 channels</td>
<td>78</td>
</tr>
<tr>
<td><strong>Research Systems</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Blood and Fluid Flow</strong></td>
<td></td>
</tr>
<tr>
<td>PL3508B11 One Channel Perivascular System</td>
<td>80</td>
</tr>
<tr>
<td>PL3508B12 One Channel Tubing Flow System</td>
<td>80</td>
</tr>
<tr>
<td>PL3508B13 Two Channel Perivascular System</td>
<td>80</td>
</tr>
<tr>
<td>PL3508B14 Two Channel Tubing Flow System</td>
<td>80</td>
</tr>
<tr>
<td>PL3508B15 Two Channel Perivascular / Tubing Flow System</td>
<td>80</td>
</tr>
<tr>
<td><strong>Isolated Tissue</strong></td>
<td></td>
</tr>
<tr>
<td>PL3508B60/C-V† Radnoti Tissue–Organ Bath System</td>
<td>81</td>
</tr>
<tr>
<td>(4 chamber)</td>
<td></td>
</tr>
<tr>
<td>PL3508B61/C-V† Radnoti Tissue–Organ Bath System</td>
<td>81</td>
</tr>
<tr>
<td>(8 chamber)</td>
<td></td>
</tr>
<tr>
<td>PL3516B62/C-V† Radnoti Tissue–Organ Bath System</td>
<td>81</td>
</tr>
<tr>
<td>(16 chamber)</td>
<td></td>
</tr>
<tr>
<td>PL3508B5/C-V† Organ Bath System (4 chamber)</td>
<td>82</td>
</tr>
<tr>
<td>PL3508B6/C-V† Organ Bath System (8 chamber)</td>
<td>82</td>
</tr>
<tr>
<td>PL3516B7/C-V† Organ Bath System (16 chamber)</td>
<td>82</td>
</tr>
<tr>
<td>PL3508B21 Single Wire Myograph System</td>
<td>83</td>
</tr>
<tr>
<td>PL3508B22 Dual Wire Myograph System</td>
<td>83</td>
</tr>
<tr>
<td>PL3508B23 Auto Dual Wire Myograph System</td>
<td>83</td>
</tr>
<tr>
<td>PL3508B24/T-S Multi Chamber Myograph w/Touch</td>
<td>83</td>
</tr>
<tr>
<td>Screen System</td>
<td></td>
</tr>
<tr>
<td>PL3508B25 Confocal Wire Myograph System</td>
<td>83</td>
</tr>
<tr>
<td><strong>Isolated Heart</strong></td>
<td></td>
</tr>
<tr>
<td>PL3508B2-V* Langendorff System (Constant Pressure</td>
<td>84</td>
</tr>
<tr>
<td>or Flow)</td>
<td></td>
</tr>
<tr>
<td>PL3508B1-V* Langendorff System for Mice (Constant</td>
<td>85</td>
</tr>
<tr>
<td>Pressure)</td>
<td></td>
</tr>
<tr>
<td>PL3508B3-V* Langendorff System for Rats (Constant</td>
<td>85</td>
</tr>
<tr>
<td>Pressure)</td>
<td></td>
</tr>
<tr>
<td>PL3508B4-V* Langendorff System for Rats (Constant</td>
<td>85</td>
</tr>
<tr>
<td>Pressure)</td>
<td></td>
</tr>
<tr>
<td>PL3508B50/X-V‡ Working Heart System for Rats/Rabbits</td>
<td>86</td>
</tr>
<tr>
<td>PL3508B55/V* Working Heart System for Mice</td>
<td>86</td>
</tr>
<tr>
<td>PL3516B56-V* Working Heart Ultimate System for Mice</td>
<td>87</td>
</tr>
<tr>
<td>PL3516B51/S-V* Working Heart Ultimate System for Rats</td>
<td>87</td>
</tr>
<tr>
<td><strong>Cardiovascular Pressure</strong></td>
<td></td>
</tr>
<tr>
<td>PL3508B35 Mikro-Tip BP Foundation System</td>
<td>88</td>
</tr>
<tr>
<td><strong>Ventricular Pressure-Volume</strong></td>
<td></td>
</tr>
<tr>
<td>PL3516B49 MPVS-Ultra Foundation System</td>
<td>88</td>
</tr>
<tr>
<td>PL3508B48/M MPVS-Ultra Single Segment Foundation System for Mice</td>
<td>89</td>
</tr>
<tr>
<td>PL3508B48/R MPVS-Ultra Single Segment Foundation System for Rats</td>
<td>89</td>
</tr>
<tr>
<td><strong>Exercise Physiology</strong></td>
<td></td>
</tr>
<tr>
<td>PL3508B80 Exercise Physiology System</td>
<td>90</td>
</tr>
<tr>
<td><strong>Telemetry</strong></td>
<td></td>
</tr>
<tr>
<td>PL3516B109 Telemetry Small Animal Foundation</td>
<td>91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product area</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neurophysiology</strong></td>
<td></td>
</tr>
<tr>
<td>PL3508B73 Extracellular Recording System</td>
<td>91</td>
</tr>
<tr>
<td>PL3508B74/V Intracellular Recording System</td>
<td>92</td>
</tr>
<tr>
<td>PL3508B77-V Single Channel Epithelial Voltage Clamp System</td>
<td>92</td>
</tr>
<tr>
<td>PL3508B78-V Dual Channel Epithelial Voltage Clamp System</td>
<td>92</td>
</tr>
<tr>
<td>PL3508B75-V‡ Two Electrode Voltage Clamp System</td>
<td>92</td>
</tr>
<tr>
<td>PL3508B76-V‡ Oocyte Clamp Workstation System</td>
<td>93</td>
</tr>
<tr>
<td>PL3508B79/10-V‡ Patch Clamp Recording System with</td>
<td>93</td>
</tr>
<tr>
<td>5101-10G Headstage</td>
<td></td>
</tr>
<tr>
<td>PL3508B79/9-V‡ Patch Clamp Recording System with</td>
<td>93</td>
</tr>
<tr>
<td>5101-01G Headstage</td>
<td></td>
</tr>
<tr>
<td>PL3508B82/F 5 Channel Wireless Neural Recording</td>
<td>94</td>
</tr>
<tr>
<td>System</td>
<td></td>
</tr>
<tr>
<td>PL3516B83/F 15 Channel Wireless Neural Recording System</td>
<td>94</td>
</tr>
<tr>
<td><strong>Psychophysiology</strong></td>
<td></td>
</tr>
<tr>
<td>PL3508B110 Stimulus Presentation Foundation System</td>
<td>95</td>
</tr>
<tr>
<td>PL3516B111 Stimulus Presentation Ultimate System</td>
<td>95</td>
</tr>
<tr>
<td><strong>Signal Conditioners</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Biotopentials</strong></td>
<td></td>
</tr>
<tr>
<td>FE136 Animal Bio Amp</td>
<td>96</td>
</tr>
<tr>
<td>FE132 Bio Amp</td>
<td>97</td>
</tr>
<tr>
<td>FE135 Dual Bio Amp</td>
<td>97</td>
</tr>
<tr>
<td>ML138 Octal Bio Amp</td>
<td>97</td>
</tr>
<tr>
<td>ML317 EOG Pod</td>
<td>98</td>
</tr>
<tr>
<td>ML408 Dual Bio Amp/ Stimulator</td>
<td>98</td>
</tr>
<tr>
<td><strong>Blood Pressure, Force and Displacement</strong></td>
<td></td>
</tr>
<tr>
<td>FE221 Bridge Amp</td>
<td>99</td>
</tr>
<tr>
<td>FE224 Quad Bridge Amp</td>
<td>99</td>
</tr>
<tr>
<td>FE228 Octal Bridge Amp</td>
<td>99</td>
</tr>
<tr>
<td>FE117 BP Amp</td>
<td>99</td>
</tr>
<tr>
<td><strong>Blood Flow and Pulse Oximetry</strong></td>
<td></td>
</tr>
<tr>
<td>ML313C Cardiac Output Pod</td>
<td>100</td>
</tr>
<tr>
<td>ML320 Oximeter Pod</td>
<td>100</td>
</tr>
<tr>
<td>ML325 Animal Oximeter Pod</td>
<td>100</td>
</tr>
<tr>
<td><strong>Chemistry and Biochemistry</strong></td>
<td></td>
</tr>
<tr>
<td>ML307 Conductivity Pod</td>
<td>101</td>
</tr>
<tr>
<td>FE165 pH/Temperature Amp</td>
<td>101</td>
</tr>
<tr>
<td><strong>Galvanic Skin Response</strong></td>
<td></td>
</tr>
<tr>
<td>FE116 GSR Amp</td>
<td>102</td>
</tr>
<tr>
<td><strong>Neurophysiology/Electrophysiology</strong></td>
<td></td>
</tr>
<tr>
<td>FE185 Neuro Amp EX</td>
<td>103</td>
</tr>
<tr>
<td><strong>Respiration</strong></td>
<td></td>
</tr>
<tr>
<td>FE141 Spirometer</td>
<td>103</td>
</tr>
<tr>
<td><strong>Stimulation</strong></td>
<td></td>
</tr>
<tr>
<td>FE155 Stimulator HC</td>
<td>103</td>
</tr>
<tr>
<td>FE180 Stimulus Isolator</td>
<td>104</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
</tr>
<tr>
<td>ML312 T-type Pod</td>
<td>104</td>
</tr>
<tr>
<td>Product area</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>ML309</td>
<td>105</td>
</tr>
<tr>
<td><strong>Instruments</strong></td>
<td></td>
</tr>
<tr>
<td>Biopotential Measurements</td>
<td></td>
</tr>
<tr>
<td>GT201/F</td>
<td>106</td>
</tr>
<tr>
<td>GT205/F</td>
<td>106</td>
</tr>
<tr>
<td>Blood Pressure and Flow</td>
<td></td>
</tr>
<tr>
<td>IN191</td>
<td>106</td>
</tr>
<tr>
<td>T402</td>
<td>107</td>
</tr>
<tr>
<td>T403</td>
<td>107</td>
</tr>
<tr>
<td>TS420</td>
<td>108</td>
</tr>
<tr>
<td>TS410</td>
<td>108</td>
</tr>
<tr>
<td>Non-Invasive Blood Pressure</td>
<td></td>
</tr>
<tr>
<td>IN125</td>
<td>108</td>
</tr>
<tr>
<td>MLE1054-V*</td>
<td>109</td>
</tr>
<tr>
<td>Invasive Blood Pressure</td>
<td></td>
</tr>
<tr>
<td>TC-510</td>
<td>109</td>
</tr>
<tr>
<td>PCU-2000</td>
<td>109</td>
</tr>
<tr>
<td>Isolated Perfused Organs</td>
<td></td>
</tr>
<tr>
<td>Radnoti Working Heart Apparatus</td>
<td>110</td>
</tr>
<tr>
<td>120101EZ/V*</td>
<td></td>
</tr>
<tr>
<td>130101EZ/V*</td>
<td></td>
</tr>
<tr>
<td>140101EZ/V*</td>
<td></td>
</tr>
<tr>
<td>Radnoti Langendorff Apparatus</td>
<td>110</td>
</tr>
<tr>
<td>120103EZ/V*</td>
<td></td>
</tr>
<tr>
<td>120105EZ/V*</td>
<td></td>
</tr>
<tr>
<td>130102EZ/V*</td>
<td></td>
</tr>
<tr>
<td>ML176-V*</td>
<td></td>
</tr>
<tr>
<td>ML172</td>
<td>110</td>
</tr>
<tr>
<td>IN175</td>
<td>111</td>
</tr>
<tr>
<td>Isolated Tissue</td>
<td></td>
</tr>
<tr>
<td>159920-X1</td>
<td>111</td>
</tr>
<tr>
<td>170051B-V*</td>
<td>111</td>
</tr>
<tr>
<td>ML0126/C-V</td>
<td>111</td>
</tr>
<tr>
<td>ML0146/C-V</td>
<td>111</td>
</tr>
<tr>
<td>ML0186/C-V</td>
<td>111</td>
</tr>
<tr>
<td>DMT310A</td>
<td>112</td>
</tr>
<tr>
<td>DMT410A</td>
<td>112</td>
</tr>
<tr>
<td>DMT510A</td>
<td>112</td>
</tr>
<tr>
<td>DMT620M</td>
<td>112</td>
</tr>
<tr>
<td>DMT720M0</td>
<td>112</td>
</tr>
<tr>
<td>DMT820MS</td>
<td>113</td>
</tr>
<tr>
<td>DMT120CW</td>
<td>113</td>
</tr>
<tr>
<td>DMT100192</td>
<td>113</td>
</tr>
<tr>
<td>Neurophysiology</td>
<td></td>
</tr>
<tr>
<td>DP-311, DP-301 and DP-304</td>
<td>114</td>
</tr>
<tr>
<td><strong>Product area</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Page</strong></td>
<td></td>
</tr>
<tr>
<td><strong>IE-210-V</strong></td>
<td>114</td>
</tr>
<tr>
<td><strong>OC-725C-V</strong></td>
<td>115</td>
</tr>
<tr>
<td><strong>TEV700-V</strong></td>
<td>115</td>
</tr>
<tr>
<td><strong>PC-501A</strong></td>
<td>116</td>
</tr>
<tr>
<td><strong>EC-800-V</strong></td>
<td>116</td>
</tr>
<tr>
<td><strong>EC-800LV-V</strong></td>
<td>116</td>
</tr>
<tr>
<td><strong>EC-825A-V</strong></td>
<td>116</td>
</tr>
<tr>
<td><strong>U9926, U2500</strong></td>
<td>117</td>
</tr>
<tr>
<td><strong>TB5663/F</strong></td>
<td>117</td>
</tr>
<tr>
<td><strong>TB5664/F</strong></td>
<td>117</td>
</tr>
<tr>
<td><strong>Psychophysiology</strong></td>
<td></td>
</tr>
<tr>
<td>MLE1320</td>
<td>118</td>
</tr>
<tr>
<td><strong>Pressure-Volume</strong></td>
<td></td>
</tr>
<tr>
<td>880-0168</td>
<td>118</td>
</tr>
<tr>
<td>880-0168S</td>
<td>118</td>
</tr>
<tr>
<td><strong>Respiratory Gas Analysis</strong></td>
<td></td>
</tr>
<tr>
<td>ML206</td>
<td>119</td>
</tr>
<tr>
<td><strong>Stimulators</strong></td>
<td></td>
</tr>
<tr>
<td>MLE1001</td>
<td>119</td>
</tr>
<tr>
<td>MLE1101</td>
<td>119</td>
</tr>
<tr>
<td>BSI-950</td>
<td>120</td>
</tr>
<tr>
<td>CS200</td>
<td>120</td>
</tr>
<tr>
<td>STG4004</td>
<td>120</td>
</tr>
<tr>
<td>STG4008</td>
<td>120</td>
</tr>
<tr>
<td>STG3008-FA</td>
<td>120</td>
</tr>
<tr>
<td><strong>Telemetry Research</strong></td>
<td></td>
</tr>
<tr>
<td>MLE0180</td>
<td>121</td>
</tr>
<tr>
<td>MLE0190</td>
<td>121</td>
</tr>
<tr>
<td><strong>Temperature Control</strong></td>
<td></td>
</tr>
<tr>
<td>ML290-V*</td>
<td>121</td>
</tr>
<tr>
<td>ML295</td>
<td>121</td>
</tr>
<tr>
<td><strong>Transducers and Accessories</strong></td>
<td></td>
</tr>
<tr>
<td>MLE1120</td>
<td>122</td>
</tr>
<tr>
<td>MLE1123</td>
<td>122</td>
</tr>
<tr>
<td>MLE1122</td>
<td>122</td>
</tr>
<tr>
<td>MLE1121</td>
<td>123</td>
</tr>
<tr>
<td>MLE1124</td>
<td>123</td>
</tr>
<tr>
<td>MLE1115</td>
<td>123</td>
</tr>
<tr>
<td>MLA042</td>
<td>123</td>
</tr>
<tr>
<td>MLA060</td>
<td>123</td>
</tr>
<tr>
<td>MLT915</td>
<td>123</td>
</tr>
<tr>
<td>MLT908</td>
<td>123</td>
</tr>
<tr>
<td>MLT916</td>
<td>123</td>
</tr>
<tr>
<td>MLT226</td>
<td>124</td>
</tr>
<tr>
<td>MI-405</td>
<td>124</td>
</tr>
<tr>
<td>MI-409</td>
<td>124</td>
</tr>
<tr>
<td><strong>Biopotential</strong></td>
<td></td>
</tr>
<tr>
<td>MLE0115</td>
<td>124</td>
</tr>
<tr>
<td>Shielded Bio Amp Cables and Lead Wires</td>
<td>124</td>
</tr>
<tr>
<td>Product area</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Unshielded Bio Amp Cables and Lead Wires</td>
<td>125</td>
</tr>
<tr>
<td>MLAC29 Unshielded Bio Amp Cable</td>
<td>125</td>
</tr>
<tr>
<td>MLA1212 Micro-Hook Electrodes for FE136 (3 pk)</td>
<td>125</td>
</tr>
<tr>
<td>MLA1213 Needle Electrodes for FE136 (3 pk)</td>
<td>125</td>
</tr>
<tr>
<td>MLA1214 Spring Clip Electrodes for FE136 (3 pk)</td>
<td>125</td>
</tr>
<tr>
<td>MLA1515 Bio Cable - Animal Use Only</td>
<td>125</td>
</tr>
<tr>
<td>MLAWBT9 EEC Flat Electrodes</td>
<td>125</td>
</tr>
<tr>
<td>MLAIME EEG Clip Electrodes</td>
<td>125</td>
</tr>
<tr>
<td>MLA700 Reusable ECG Electrodes</td>
<td>126</td>
</tr>
<tr>
<td>MLA710 Chest ECG Electrodes (suction)</td>
<td>126</td>
</tr>
<tr>
<td>MLADDB30 Recording Bar Electrode</td>
<td>126</td>
</tr>
<tr>
<td>MLAYDG Dry Earth Strap</td>
<td>126</td>
</tr>
<tr>
<td>EPR-800 Millar Electrophysiology Catheter (1.1F, 8E, 1.1 mm, 4.5 cm)</td>
<td>126</td>
</tr>
<tr>
<td>EPR-801 Millar Electrophysiology Catheter (1.1F, 8E, 1.1 mm, 4.5 cm Lumen)</td>
<td>126</td>
</tr>
<tr>
<td>EPR-802 Millar Electrophysiology Catheter (1.6F, 8E, 1.1 mm, 12.5 cm)</td>
<td>126</td>
</tr>
<tr>
<td>EPC-5A EPR Catheter Interface Cable (5 ft)</td>
<td>126</td>
</tr>
<tr>
<td>MLE2002 Model 1089 MK III Checktrode©</td>
<td>126</td>
</tr>
<tr>
<td>MLAEC EEG Electro-cap System</td>
<td>127</td>
</tr>
<tr>
<td>Biopotential Consumables</td>
<td></td>
</tr>
<tr>
<td>MLA415 Biopotential Accessory Kit</td>
<td>127</td>
</tr>
<tr>
<td>MLA1090 Electrode Cream</td>
<td>127</td>
</tr>
<tr>
<td>MLA1090B Electrode Cream</td>
<td>127</td>
</tr>
<tr>
<td>MLA1092 Abrasive Pads — Non-sterile</td>
<td>127</td>
</tr>
<tr>
<td>MLA1092B Abrasive Pads — Non-sterile</td>
<td>127</td>
</tr>
<tr>
<td>MLA1093 Abrasive Gel</td>
<td>127</td>
</tr>
<tr>
<td>MLA1093B Abrasive Gel</td>
<td>127</td>
</tr>
<tr>
<td>MLA1094 Alcohol Swabs (1000)</td>
<td>127</td>
</tr>
<tr>
<td>MLA1095 Electrode Paste</td>
<td>127</td>
</tr>
<tr>
<td>MLA1095B Electrode Paste</td>
<td>127</td>
</tr>
<tr>
<td>MLA1010 Disposable ECG Electrodes</td>
<td>127</td>
</tr>
<tr>
<td>MLA1010B Disposable ECG Electrodes</td>
<td>127</td>
</tr>
<tr>
<td>Galvanic Skin Response</td>
<td></td>
</tr>
<tr>
<td>MLT116F GSR Finger Electrodes</td>
<td>128</td>
</tr>
<tr>
<td>MLT117F GSR Finger Electrodes</td>
<td>128</td>
</tr>
<tr>
<td>Blood and Fluid Flow</td>
<td></td>
</tr>
<tr>
<td>Laser Doppler Probes</td>
<td>128</td>
</tr>
<tr>
<td>Transonic Perivascular Flowprobes and Flow Sensors</td>
<td>128</td>
</tr>
<tr>
<td>MLA191 Calibration Kit for IN191</td>
<td>129</td>
</tr>
<tr>
<td>MSP140AR Adhesive Rings for Probes (200)</td>
<td>129</td>
</tr>
<tr>
<td>Pulse Oximetry</td>
<td></td>
</tr>
<tr>
<td>MLT321 Oximetry Transducers (Human)</td>
<td>129</td>
</tr>
<tr>
<td>MLT322 Oximetry Transducers (Human)</td>
<td>129</td>
</tr>
<tr>
<td>MLT323 Oximetry Transducers (Animal)</td>
<td>130</td>
</tr>
<tr>
<td>MLT324 Oximetry Transducers (Animal)</td>
<td>130</td>
</tr>
<tr>
<td>MLT325 Oximetry Transducers (Animal)</td>
<td>130</td>
</tr>
<tr>
<td>Cardiac Output</td>
<td></td>
</tr>
<tr>
<td>MLA313 Cardiac Output Accessory Kit</td>
<td>130</td>
</tr>
<tr>
<td>Force and Displacement</td>
<td></td>
</tr>
<tr>
<td>MLT0201 Force Transducer (5 mg to 25 g)</td>
<td>130</td>
</tr>
<tr>
<td>MLT0202 Sensitive Force Transducer (0 to 25 g)</td>
<td>130</td>
</tr>
<tr>
<td>Product area</td>
<td>Page</td>
</tr>
<tr>
<td>MLT0402 Force Transducer (2 g)</td>
<td>130</td>
</tr>
<tr>
<td>MLT0420 Force Transducer (20 g)</td>
<td>130</td>
</tr>
<tr>
<td>MLT0015 High Grade Isotonic Transducer</td>
<td>131</td>
</tr>
<tr>
<td>MLT030 Wide Range Force Transducer (10 mg to 1 kg)</td>
<td>131</td>
</tr>
<tr>
<td>MLTS700 Goniometer</td>
<td>131</td>
</tr>
<tr>
<td>MLTS720 Miniature Goniometer</td>
<td>131</td>
</tr>
<tr>
<td>159901A-V* Force Transducer with Amplifier</td>
<td>131</td>
</tr>
<tr>
<td>Heart Sounds</td>
<td></td>
</tr>
<tr>
<td>MLT208 Digital Stethoscope</td>
<td>131</td>
</tr>
<tr>
<td>MLT201 Cardio Microphone</td>
<td>131</td>
</tr>
<tr>
<td>Invasive Blood Pressure</td>
<td></td>
</tr>
<tr>
<td>Millar Mikro-Tip® Blood Pressure Catheters</td>
<td>132</td>
</tr>
<tr>
<td>Millar Mikro-Tip® Pressure-Volume Catheters</td>
<td>132</td>
</tr>
<tr>
<td>Mouse Pressure-Volume Catheters</td>
<td>132</td>
</tr>
<tr>
<td>Rat Pressure-Volume Catheters</td>
<td>132</td>
</tr>
<tr>
<td>Multi-Segmented Pressure Volume Catheters</td>
<td>133</td>
</tr>
<tr>
<td>Millar Ventri-Cath™ Pressure-Volume Catheters</td>
<td>133</td>
</tr>
<tr>
<td>Mikro-Tip Ventri-Cath™ P-V Catheters — Dog/Pig/Sheep</td>
<td>133</td>
</tr>
<tr>
<td>Catheter Interface Cables</td>
<td></td>
</tr>
<tr>
<td>MLT844 Physiological Pressure Transducer</td>
<td>134</td>
</tr>
<tr>
<td>MLT844 Disposable Clip-On BP Domes</td>
<td>134</td>
</tr>
<tr>
<td>MLT0670 Disposable BP Transducer (stopcock)</td>
<td>134</td>
</tr>
<tr>
<td>MLA1052 Pressure Gauge</td>
<td>134</td>
</tr>
<tr>
<td>MLT0380/D Reusable BP Transducer</td>
<td>134</td>
</tr>
<tr>
<td>MLT0699 Disposable BP Transducer (no stopcock)</td>
<td>134</td>
</tr>
<tr>
<td>MLT1199 Disposable BP Transducer/Cable Kit</td>
<td>134</td>
</tr>
<tr>
<td>MLA06 IN (8) to MLT0699 or MLT0670 Cable</td>
<td>135</td>
</tr>
<tr>
<td>910-0080 Rho Calibration Cuvette Kit</td>
<td>135</td>
</tr>
<tr>
<td>910-0048 Volume Calibration Cuvette (Rat P-V Catheters)</td>
<td>135</td>
</tr>
<tr>
<td>910-0049 Volume Calibration Cuvette (Mouse P-V Catheters)</td>
<td>135</td>
</tr>
<tr>
<td>Langendorff</td>
<td></td>
</tr>
<tr>
<td>MLA2001 Langendorff Transducer Accessory Kit</td>
<td>135</td>
</tr>
<tr>
<td>17043 Latex Balloons (size 3 for rats, 10 pk)</td>
<td>135</td>
</tr>
<tr>
<td>170423 Flexible Balloon Catheter</td>
<td>135</td>
</tr>
<tr>
<td>Neurophysiology</td>
<td></td>
</tr>
<tr>
<td>IC-2S Input Cable Sets</td>
<td>136</td>
</tr>
<tr>
<td>IC-4M Input Cable Sets</td>
<td>136</td>
</tr>
<tr>
<td>Electrode Holder E Series</td>
<td>136</td>
</tr>
<tr>
<td>Electrode Holder Q Series</td>
<td>137</td>
</tr>
<tr>
<td>PJ2-5 2 mm Jack, Uninsulated (pack of 5)</td>
<td>137</td>
</tr>
<tr>
<td>2100W Headstage for IE-210-V</td>
<td>137</td>
</tr>
<tr>
<td>3110W Headstage for DP-311</td>
<td>137</td>
</tr>
<tr>
<td>BB-15 Breakaway Box for IE-210-V</td>
<td>137</td>
</tr>
<tr>
<td>RB-1 Remote Buzz control for IE-210-V</td>
<td>137</td>
</tr>
<tr>
<td>725MC Oocyte Model Cell for OC-725C-V</td>
<td>137</td>
</tr>
<tr>
<td>7251I Bath Clamp Headstage for OC-725C-V</td>
<td>137</td>
</tr>
<tr>
<td>RC-3Z Oocyte Recording Chamber for OC-725C-V</td>
<td>138</td>
</tr>
<tr>
<td>7250V Voltage Headstage for OC-725C-V</td>
<td>138</td>
</tr>
<tr>
<td>7255DI Differential Headstage for OC-725C-V</td>
<td>138</td>
</tr>
</tbody>
</table>
### Product area Page

<table>
<thead>
<tr>
<th>Product area</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product area Page</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Telemetry</strong></td>
<td></td>
</tr>
<tr>
<td>MLE0054P TR/Millar Pressure Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0054PP TR/Millar Dual Pressure Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0054PB TR/Millar Pressure and Biopotential Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0050B Biopotential Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0050BB Dual Biopotential Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0057Y Tissue Oxygen Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE1022 TR/Millar SNA Pressure Telemeter</td>
<td>145</td>
</tr>
<tr>
<td><strong>Wireless Neural Recordings</strong></td>
<td></td>
</tr>
<tr>
<td>Headstages</td>
<td>146</td>
</tr>
<tr>
<td>TBSI to PowerLab Interface Cables</td>
<td>146</td>
</tr>
<tr>
<td>TBSI Headstage Test Cables</td>
<td>146</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
</tr>
<tr>
<td>MLT1400 General-purpose Thermocouple Probe</td>
<td>146</td>
</tr>
<tr>
<td>MLT1401 T-type Implantable Thermocouple Probe</td>
<td>146</td>
</tr>
<tr>
<td>MLT1402 T-type Ultra Fast Thermocouple Probe</td>
<td>147</td>
</tr>
<tr>
<td>MLT1405 T-type Implantable Thermocouple Probe</td>
<td>147</td>
</tr>
<tr>
<td>MLT1406 Needle Microprobe Thermocouple</td>
<td>147</td>
</tr>
<tr>
<td>MLT1403 Rectal Probe for Rats</td>
<td>147</td>
</tr>
<tr>
<td>MLT1404 Rectal Probe for Mice</td>
<td>147</td>
</tr>
<tr>
<td>MLT1407 Large Animal Rectal Probe</td>
<td>147</td>
</tr>
<tr>
<td>MLT422 Skin Temperature Probe (2 m)</td>
<td>148</td>
</tr>
<tr>
<td>MLT415 Nasal Temperature Probe</td>
<td>148</td>
</tr>
<tr>
<td>MLT415/M hermistor Temperature Sensor</td>
<td>148</td>
</tr>
<tr>
<td>MLT1101 Thermocouple/Analog Converter</td>
<td>148</td>
</tr>
<tr>
<td><strong>Tissue-Organ Bath Stimulating Electrodes</strong></td>
<td></td>
</tr>
<tr>
<td>Stimulating Platinum Electrodes for Radnoti Tissue-Organ Baths</td>
<td>148</td>
</tr>
<tr>
<td>Field Stimulating Electrodes for Radnoti Tissue-Organ Baths</td>
<td>149</td>
</tr>
<tr>
<td>Stimulating Electrodes with Tissue Support for Radnoti Tissue-Organ Baths</td>
<td>149</td>
</tr>
<tr>
<td><strong>Stimulating Electrodes for Panlab Tissue-Organ Baths</strong></td>
<td>149</td>
</tr>
<tr>
<td><strong>Event Markers and Headphones</strong></td>
<td></td>
</tr>
<tr>
<td>MLA91 Foot Switch</td>
<td>149</td>
</tr>
<tr>
<td>MLA92 Push Button Switch</td>
<td>149</td>
</tr>
<tr>
<td>MLA93 Tendon Hammer</td>
<td>149</td>
</tr>
<tr>
<td>MLA1250 Headphones</td>
<td>150</td>
</tr>
<tr>
<td><strong>Stimulator Accessories</strong></td>
<td></td>
</tr>
<tr>
<td>MLA250 Stimulator Cable (BNC to Alligator clip)</td>
<td>150</td>
</tr>
<tr>
<td>MLA260 Stimulator Cable (4 mm shrouded to Alligator clip, 50 cm)</td>
<td>150</td>
</tr>
<tr>
<td>MLA265 Stimulator Rod with Cable</td>
<td>150</td>
</tr>
<tr>
<td>MLA270 Stimulator Cable (BNC to Micro-Hooks)</td>
<td>150</td>
</tr>
<tr>
<td>MLA0320 Animal Nerve Stimulating Electrode</td>
<td>150</td>
</tr>
<tr>
<td>MLA0030 Stimulating Bar Electrode</td>
<td>150</td>
</tr>
<tr>
<td><strong>Psychophysiology</strong></td>
<td></td>
</tr>
<tr>
<td>MLE0054P TR/Millar Pressure Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0054PP TR/Millar Dual Pressure Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0054PB TR/Millar Pressure and Biopotential Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0050B Biopotential Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0050BB Dual Biopotential Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE0057Y Tissue Oxygen Telemeter</td>
<td>145</td>
</tr>
<tr>
<td>MLE1022 TR/Millar SNA Pressure Telemeter</td>
<td>145</td>
</tr>
</tbody>
</table>

### Product area Page

<table>
<thead>
<tr>
<th>Product area</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7259C</td>
<td>138</td>
</tr>
<tr>
<td>WA10-0</td>
<td>138</td>
</tr>
<tr>
<td>WA30-0</td>
<td>138</td>
</tr>
<tr>
<td>5101</td>
<td>138</td>
</tr>
<tr>
<td>Model Cells for PC-501A</td>
<td>139</td>
</tr>
<tr>
<td>U9406</td>
<td>139</td>
</tr>
<tr>
<td>U9565S</td>
<td>139</td>
</tr>
<tr>
<td>U9605</td>
<td>139</td>
</tr>
<tr>
<td>U9924</td>
<td>139</td>
</tr>
<tr>
<td>U9975A</td>
<td>139</td>
</tr>
<tr>
<td>U9985</td>
<td>139</td>
</tr>
<tr>
<td><strong>Noninvasive Blood Pressure</strong></td>
<td></td>
</tr>
<tr>
<td>MLT1100 Sphymomanometer</td>
<td>140</td>
</tr>
<tr>
<td>MLT125M Pulse Transducer/Pressure Cuff for NIBP</td>
<td>140</td>
</tr>
<tr>
<td>MLT125R Pulse Transducer/Pressure Cuff for NIBP</td>
<td>140</td>
</tr>
<tr>
<td><strong>Pulse and Plethysmography</strong></td>
<td></td>
</tr>
<tr>
<td>MLT1010 Piezo Electric Pulse Transducer</td>
<td>141</td>
</tr>
<tr>
<td><strong>Respiration</strong></td>
<td></td>
</tr>
<tr>
<td>MLT3813H-V* Heated Pneumotach 800 L and Heater Controller</td>
<td>142</td>
</tr>
<tr>
<td><strong>Calibration Syringes</strong></td>
<td></td>
</tr>
<tr>
<td>MLA246 Gas Mixing Chamber</td>
<td>142</td>
</tr>
<tr>
<td>MLA140 Spirometer Kit</td>
<td>142</td>
</tr>
<tr>
<td>MLA1028 Face Mask (adult medium)</td>
<td>143</td>
</tr>
<tr>
<td>MLA1029 Face Mask Kit (adult small and medium)</td>
<td>143</td>
</tr>
<tr>
<td>MLA0343 Drying Tube</td>
<td>143</td>
</tr>
<tr>
<td>MLA0110 In-line Filters</td>
<td>143</td>
</tr>
<tr>
<td>MLA304 Disposable Filters</td>
<td>143</td>
</tr>
<tr>
<td>MLA1008 Nose Clips</td>
<td>143</td>
</tr>
<tr>
<td>MLA1015 Breathing Tube</td>
<td>143</td>
</tr>
<tr>
<td>MLA1013 Tubing Adapter (35 mm ID)</td>
<td>143</td>
</tr>
<tr>
<td>MLA1011A Clean-bore Tubing &amp; Tubing Adapter</td>
<td>144</td>
</tr>
<tr>
<td>MLA1081 Flow Head Adapter</td>
<td>144</td>
</tr>
<tr>
<td>MLA1026 Reusable Mouthpieces (10 pk)</td>
<td>144</td>
</tr>
<tr>
<td>MLA6024 Desican Cartridge</td>
<td>144</td>
</tr>
<tr>
<td>MLI132 Piezo Respiratory Belt Transducer</td>
<td>144</td>
</tr>
<tr>
<td>MLA240 Exercise Physiology Accessory Kit</td>
<td>144</td>
</tr>
</tbody>
</table>
introducing education systems

ADInstruments Solutions for Education

ADInstruments provides engaging and cost-effective solutions for every level of life and health science education. Our innovative approach has improved learning outcomes in high schools, colleges and universities. Teaching systems are available for a range of disciplines including:

- **Life Science**
  - Human physiology
  - Pharmacology
  - Animal physiology
- **Bioengineering**
- **Sports science**
- **Psychophysiology**
- **Biochemistry**

- **Health Science**
  - Medicine
  - Nursing
  - Allied health

At the core of our education product range are PowerLab data acquisition systems. The hardware is supplied with LabTutor and/or LabChart Teaching Suites to provide a powerful, flexible and easy-to-use solution for education.

LabTutor Teaching Suite

Enhance learning with self-guided software, in class & online

LabTutor Teaching Suite is a revolutionary education tool that uses blended education techniques to improve learning outcomes. The software engages students in class by efficiently guiding them through interactive experiment activities, including real-time data acquisition, data analysis, graphing and reports.

When the class ends, LabTutor Online gives students the ability to continue learning outside the lab. Using Internet-connected computers and smart devices (including the iPad), students can access their experiment content for post-lab evaluation or report completion, and to prepare for the next lab.

Teach, customize, manage and provide online access with LabTutor Teaching Suite

The LabTutor Teaching Suite comprises the following features:

- **LabTutor Experiments** — Over 100 experiments and 500 exercises. Collections include Human Physiology, Animal Physiology, Exercise Physiology, Biology, Pharmacology, Psychophysiology, Medical Laboratories, and Applied Nursing. A typical experiment features extensive scientific background, objectives and equipment setup, real data acquisition, data analysis and a report section, all in a single browser-based interface. Applied Nursing and Medical Laboratories collections additionally include real patient case studies including HD videos, medical test data and expert diagnoses.

- **LabTutor Server** — Enables management of courses, classes, students and experiments from a single computer.

- **LabAuthor** — An easy-to-use tool for editing or creating LabTutor experiments including multimedia components.

- **LabTutor Online** — Enables students to access experiments for lab preparation and report completion/submission. It also allows educators to check individual student progress and review reports anytime, anywhere. LabTutor Online users get exclusive access to a range of quality science video documentaries.

LabTutor citation: Martina Zimmermann and Gunter P. Eckert, Advan in Physiol Edu 34: 1–10, 2010

LabTutor was introduced by Goethe University, Germany when the Dept of Pharmacology switched from lecture-based teaching to an active learning course. The outcome was better exam results in the independent state-wide exam and more satisfied students. “significantly higher marks were reached, thus suggesting that the subjective positive evaluation of the practical orientation of the course was accompanied by objectively assessable learning success” page 9.
Resources for educators

www.adinstruments.com
The ADInstruments website has a wealth of resources to help with your life science laboratory courses. Browse through the latest equipment and software options, download ready-to-use experiments, read and view PowerLab teaching case studies and see how your peers are using our systems.

www.adinstruments.com/forum
The ADInstruments Software Forum is an interactive online environment where PowerLab users and ADInstruments application specialists can share their knowledge and expertise. It is a great place to ask questions, make suggestions, share ideas, tips and experiments. Members get direct support from programmers as well as education and research application scientists.

LabChart Teaching Suite
Advanced learning using versatile research-grade software
LabChart (for Windows or Mac OS) is research-grade software with a powerful and flexible interface that makes it ideal for introductory through to advanced courses and post-graduate projects. The software is well-suited for applications where students will require an understanding of detailed data acquisition principles and extensive analysis options.

LabChart’s depth of features allows students to grow. They are able to access and utilize more features as their knowledge of the software and science increases. (See extensive LabChart features on pages 40–75.)

Choice of teaching experiments and materials
Our collection of LabChart educator support materials includes over 50 configured experiments for Human Physiology, Animal Physiology, General Biology and Psychophysiology. Each experiment includes Instructor Guides, Settings Files and Student Protocols. Each component can be edited to suit your curriculum or equipment setup.

More LabChart software options
LabChart Reader — A free application that allows you, your colleagues and students to share, view and conduct limited analyses of LabChart data, without the need for a PowerLab system.

Modules — LabChart software add-ons that provide highly specialized data acquisition, display and analysis features for specific applications. The modules speed up software setup for experimental protocols and automate analysis of data. Examples of LabChart modules include: ECG Analysis, Blood Pressure, Heart Rate Variability, Peak Analysis, Metabolic, Spike Histogram, Video Capture and more.

PowerLab with LabChart was introduced by West Chester University, USA to implement an inquiry-based learning approach in physiology labs. The goal was to improve students’ critical and analytical-thinking skills. Assessment of all aspects was positive.

“These changes were made possible with the purchase of PowerLab, a powerful computerized data-acquisition system that enabled students to collect and analyze data easily.”
introducing education systems

PowerLab hardware: safe and reliable

ADInstruments PowerLab data acquisition systems are powerful, flexible and easy-to-use. Available in two or four channel systems (some featuring an in-built dual bio amp and isolated stimulator), there is a PowerLab data acquisition unit suitable to cover the experimental requirements of any life science education class.

Manufactured under the ISO9001:2008 quality system and approved for human connection, PowerLab data acquisition units for teaching are safe, reliable, and are provided with a three year warranty for peace-of-mind.

PowerLab Teaching Systems allow students to develop an understanding of physiology by recording and analyzing their own data. They are suitable for use in a wide range of life science education disciplines, from basic animal biology to undergraduate medical courses.

ADInstruments Teaching Systems: complete or customized

We understand that not all life science courses are the same. Our range of teaching systems and resources cater to the different requirements of today's student laboratory, providing educators with tools for a wide range of applications and course levels.

ADInstruments Teaching Systems

Our systems include all the hardware and software your students will need to perform life science experiments. Speak to your ADInstruments representative about your curriculum requirements. We will help you find a system that meets your requirements, whether that means choosing one of our configured teaching systems, or working with you to put together a custom solution.

Extend your experiment range with Teaching Kits

Increase the number and type of experiments students can complete with your existing ADInstruments Teaching Systems by adding Teaching Kits. Teaching Kits provide the additional amplifiers, transducers and accessories for investigations in specific subject areas.

Teaching Kits available:
- Human Respiratory Kit
- Nerve and Muscle Kits
- Pharmacology Kit
- Reflex Kit
- Biochemistry Kit
- Wireless Heart Rate Kit
- EOG Kit
- Exercise Breathing Kit
- Pharmacology Kit
- Stimulus Presentation Kit
LabTutor experiments

Revolutionizing life science teaching and learning

All LabTutor experiments include background information, detailed experimental setup and exercises, as well as easy-to-follow data acquisition, analysis and reporting protocols.

The experiments listed below have been configured for use with the PowerLab LabTutor Teaching Systems. If you require further information or advice please contact your ADInstruments representative.

The experiment list includes two recent additions: Medical Laboratories and Applied Nursing collections, both of which help students to connect bioscience theory with clinical practise. These two collections bring real patients into the lab with HD video interviews and real medical test results.

### Human Physiology
- Blood Pressure
- Breathing
- Cardiorespiratory Effects of Exercise
- Cardiovascular Effects of Exercise
- ECG & Heart Sounds
- ECG & Peripheral Circulation
- Electroencephalography (EEG)
- Electromyography (EMG)
- Electro-oculography (EOG)
- Gut Absorption
- Mechanics of Ventilation
- Muscle
- Reflexes and Reaction Times
- Respiratory Air Flow and Volume
- Sensory Illusions
- Sensory Physiology
- The Diving Response
- The Stroop Test
- Water Balance

### Exercise Physiology
- Aerobic Fitness Testing
- Anaerobic Fitness Testing
- Energy Expenditure & Exercise
- Energy Metabolism
- Introduction to Fitness Testing
- Respiratory Gas Analysis Procedure

### Animal Physiology
- Cockroach Sensory Nerve
- Cockroach Ventral Nerve Cord
- Earthworm Action Potentials
- Earthworm Smooth Muscle
- Frog Heart
- Frog Neuromuscular Junction
- Frog Skeletal Muscle
- Frog Nerve
- Gin Trap Closure Reflex
- Insect Metabolism
- Intracellular Action Potentials
- Mammalian Blood Pressure - Reflex Regulation
- Mammalian Blood Pressure & Blood Flow
- Mammalian Respiration - Nerve Effects
- Mammalian Respiration - O2 & CO2 Effects

### Pharmacology
- Airways Resistance
- Chick Biventer Cervicis
- Mammalian Atria
- Mammalian Blood Pressure - Drug Effects
- Mammalian Diaphragm
- Mammalian Heart
- Mammalian Jejunum
- Mammalian Uterus
- Stimulated Ileum
- Stimulated Rat Vas Deferens
- Toad Rectus Abdominis
- Unstimulated Ileum
- Unstimulated Rat Vas Deferens
- Vascular Resistance
- Vascular Smooth Muscle

### Psychophysiology
- EDR & Classical Conditioning
- Electrophysiological Response (EDR)
- Introduction to Psychophysiology Methods
- Perception & The Size-Weight Illusion
- Visual Evoked Potential (VEP)

### General Biology
- Acid-Base Titration
- Biological Membranes
- Cellular Respiration
- Introduction to Spectrophotometry
- Photosynthesis - Carbon Dioxide Fixation
- Photosynthesis - Oxygen Production
- Temperature Effects on Enzyme Performance

### Medical Laboratories
- Autonomic Nervous System
- Blood Pressure
- Body Temperature
- Brain Structure and Reflexes
- Glucose Metabolism
- Heart and Circulation
- Heart and Electrocardiography
- Heart Sounds
- Kidney and Urine
- Lung Function
- Muscle and Fatigue
- Muscle Function
- Peripheral Nerve Function
- Sensory Physiology
- Vision

### Applied Nursing
- Autonomic Nervous System
- Blood Pressure
- Body Temperature
- Brain Structure and Reflexes
- Childbirth
- Glucose Metabolism
- Heart and Circulation
- Heart and Electrocardiography
- Heart Sounds
- Kidney & Urine
- Lung Function
- Muscle and Fatigue
- Muscle Function
- Peripheral Nerve Function
- Pregnancy

### Guided PBL
- Guided PBL - Blood Pressure
- Guided PBL - ECG & Pulse
- Guided PBL - Electromyography (EMG)
- Guided PBL - Respiratory Air Flow and Volume

Check regularly to download new and updated teaching experiments:

www.adinstruments.com/solutions/experiments/
Our commitment to customer support is second to none. In addition to our extensive web-based resources, we provide a number of training and support services.

**Getting started...**

**Hardware & software installation**
To ensure correct installation and use of your newly acquired products, on-site systems installation and training is available at reasonable rates from experienced ADInstruments staff and distributor representatives.

**Product training**
We offer a range of training courses to get your research started quickly and easily including hands on workshops, free training videos and live web seminars. Workshops are held at ADInstruments' Training Centers and many other locations around the world. Training courses and materials are also available for intermediate and advanced users. Find out more at the Learning Center page on our website.

**Now you’re underway...**

**Technical support**
Customers can register online to get free web, email and telephone technical support related to our products. Visit www.adinstruments.com/register

**Latest software updates and upgrades**
Free updates to newer versions of software that “fix” any known operating issues can be downloaded from our website. Our software continues to evolve via significant affordable upgrades that are released regularly.

**Website resources**
There is far more than the latest product information at www.adinstruments.com. You can register for upcoming training courses, download free training videos, search our large citation data base, contribute to the customer forum, find answers in the FAQ knowledge base and get detailed application information in the Solutions section.

**GLP and 21 CFR Part 11 services**
For research organizations working in 21 CFR Part 11 environments, we offer GLP Software as well as professional services including: On-site System Installation and Training, System Maintenance and Calibration.

**5 Year Hardware Warranty**
ADInstruments commitment to quality has enabled us to offer a five year warranty on ADInstruments PowerLab data acquisition systems as well as many other products. ADInstruments will repair or replace any damaged equipment at no cost to the user during the warranty period. Naturally, this applies only to defects that have occurred under proper and normal conditions of use. Complete warranty information is available on our website.

**Worldwide support network**
The most valuable resource of ADInstruments is our people. To ensure customer support and training is readily accessible, our experts in life science research are located across a global support network of offices and distributors in more than 50 countries.

**Talk to us to find out more...**
For further information about any of our Training, Services or Support, contact your nearest ADInstruments office (see back cover) or follow the links at www.adinstruments.com/contactus

**Trademark, warranty and legal information**
ADInstruments, PowerLab, MacLab, LabChart and LabTutor are registered trademarks of ADInstruments Pty Ltd. Apple, Macintosh, Mac are registered trademarks of Apple Computer Inc. Microsoft and Windows are registered trademarks of Microsoft Corporation. All other trademarks are the property of their respective owners. "5-year warranty applies to ADInstruments PowerLab data acquisition units (Product Number Prefix: PL) and Front-end Signal Conditioners (Product Number Prefix: FE). These are warranted against defects in materials and workmanship for a period of 5 years from the date of purchase. Other PowerLab data acquisition units and ADInstruments manufactured Front-end and Pod Signal Conditioners, and Instruments are warranted of a period of 3 years from the date of purchase, with the exception of the Blood FlowMeter, Gas Analyzer, NIBP System and STH Pump Controller (covered by a 12-month warranty). Every effort has been made to ensure the accuracy of information. However, ADInstruments assumes no responsibility for its accuracy. Information is subject to change without notice. Latest information is available on www.adinstruments.com/company/legal