

Wireless Animal Monitoring

Telemetric Acquisition of Pressure, Biopotentials, SNA and Temperature



World-class systems – complete solutions

Telemetry technology from Telemetry Research, and PowerLab data acquisition systems from ADInstruments, combine to create world-leading systems for wireless monitoring of physiological signals in small animals. The revolutionary products provide life science researchers with improved methods for recording pressure signals (such as arterial, venous, bladder, uterine), biopotential signals (such as ECG, EMG, EOG and EEG), low-amplitude nerve activity, and temperature.

Advantages of telemetric data acquisition

By removing the need for tethers, the systems facilitate stress-free, long-term recordings from small animals. High-fidelity signals from a small sensor and wireless digital transmission ensure high-quality data. The power-down feature extends battery life and the recharger technology allows telemeters to be recharged *in situ* and continuously, providing the ability to record 24/7. Independent telemeter frequencies eliminate crosstalk allowing signals to be recorded from multiple animals without the need for special housing.

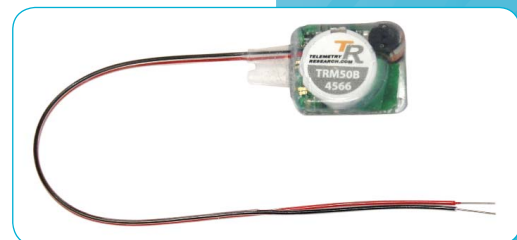
Data integrity and powerful analysis

The ADInstruments PowerLab® data acquisition systems with LabChart® Pro software provide accurate real-time recording and display of the transmitted signals. Online and offline computation and specialized LabChart analysis modules, such as Blood Pressure, HRV and ECG Analysis, provide a comprehensive and powerful range of analysis and display options.

Features & Benefits

- Monitor freely moving animals 24/7
- Record BP, ECG, EEG, EMG, EOG, SNA, and more
- Monitor small animals weighing ≥ 200 g (ideal for rats and larger animals)
- Solid-state pressure telemeters eliminate movement artifact
- Recharge transmitters *in situ* even while recording
- Low cost of ownership: lifetime monitoring and minimal downtime
- Powerful data acquisition and analysis with PowerLab and LabChart Pro software

MLE0050B Biopotential Telemeter suitable for measuring ECG, EEG, EOG, EMG and temperature in all animals 200 g and over



Small Animal Telemetry Foundation System

With this system and suitable telemeters, you can record and analyze a variety of signals including intravascular and intraluminal pressure signals, ECG, EMG, EOG and EEG biopotentials and body temperature.

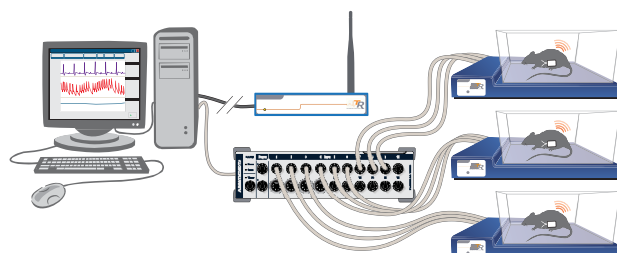
System components:

- 16 channel PowerLab data acquisition unit
- LabChart and LabChart Pro software
- Configurator
- ConfigSoft® software
- SmartPad
- 3 x BNC-BNC Cables (1 m)



Configurator

The Configurator is used to program one of 16 available frequencies in TR5* series small animal telemeters, control the charging field of the SmartPad and place telemeters in low-power safe mode. In conjunction with ConfigSoft, it also conducts diagnostics and reports on the status of telemeters and SmartPads.



Multiple Recording/Charging Set-up (Small Animal)

SmartPad

The SmartPad acts as a wireless receiver and charger. It works with pressure, biopotential and combination telemeters. The analog outputs are low-pass filtered at 1 kHz with a receiving range of up to 5 meters (dependent on lab set-up).

Small animal telemeters

The TR5* series telemeters, available separately, are for use with the Small Animal foundation System. They come in 5 configurations to record either pressure, biopotential, or a combination of both signals as well as temperature. The 3 telemeters which record pressure signals feature Millar Mikro-Tip® solid-state catheter technology. With sampling rates of up to 2000 Hz, these pressure telemeters acquire high fidelity data free of movement artifact.

The TR5* series small animal telemeters are automatically recognized by the SmartPad which wirelessly recharges the telemeter batteries. Being able to recharge the batteries *in situ* provides the user with the ability to conduct long-term studies, increase the time efficacy and cost efficiency of research. With 16 independent frequencies, signals from multiple animals can be recorded simultaneously (one animal per SmartPad) in a single room with no signal interference or need for special housing. Fully implantable with a biocompatible silicone outer casing, all telemeters are shipped factory calibrated.

Standard telemeter specifications

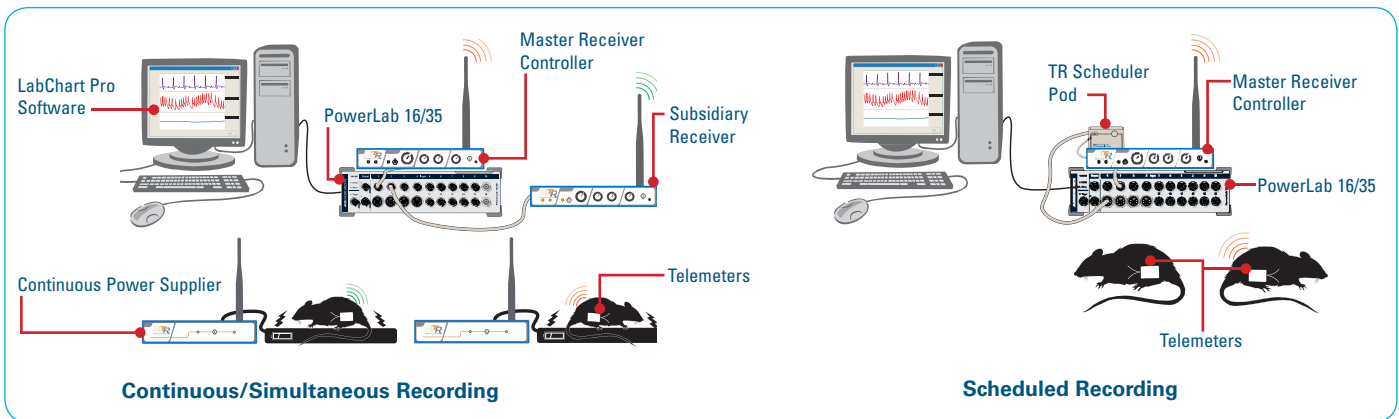
Pressure range and accuracy	-20 to +300 mmHg (± 2 mmHg)	Resolution	A/D 12 bit
Pressure drift	< 4 mmHg per month	Lead length	22 cm
Pressure response	DC to 500 Hz (-3 dB)	Temperature operating range	20 to 41 degrees Celsius
Catheter ambient pressure range	650 to 800 mmHg	Transmission range	Up to 5 m (dependent on lab)
Maximum operating altitude	1300 m	Transmitted signal	Digital 2.4 GHz ISM band
Dimensions (pressure catheter)	660 μ m (2 F) sensor, 500 μ m (1.5 Fr) catheter body, 9 cm length	Dimensions (body)	23 x 28.5 x 10.5 mm
Biopotential input range	± 2 mV	Weight	~12.5 gms
Biopotential high pass characteristics	-3 dB point at 1.5 Hz, AC coupled, single pole	Recharge time	≥ 5 hrs
		Sampling rate	2 kHz

Telemetry SNA & Pressure Foundation System

When combined with the MLE1022 SNA Pressure Telemeter, this system is ideal for recording and analyzing small animal sympathetic nerve activity (SNA), in addition to pressure signals and body temperature. This system can schedule recording periods and take sequential data recordings from up to 8 telemeters. This extends the recording life of the telemeter battery for low-cost uninterrupted data acquisition and reduces recorded data file size for efficient storage of data and results. Multiple simultaneous continuous 24 hour charging and recording is possible with the addition of extra hardware.

System components:

- 16 channel PowerLab data acquisition unit
- LabChart and LabChart Pro software
- TR Scheduler Pod
- SNA and Pressure Master Receiver Controller
- Wireless Continuous Power Supplier
- 3 x BNC-BNC Cables (1 m)



SNA pressure telemeter

Available separately, the fluid-filled MLE1022 SNA Pressure Telemeter can record sympathetic nerve activity, intravascular pressure and temperature from animals ≥ 200 g (for rats and larger animals).

The telemeter battery has a life of approximately six hours and can be recharged within four (depending on initial battery charge). For uninterrupted data collection the battery can be continuously charged using the Wireless Continuous Power Supplier (supplied with SNA and Pressure Foundation System). No battery refurbishment is required.

Telemeter specifications

MLE1022 SNA Pressure Telemeter	
Input range (Sympathetic Nerve Activity)	± 60 microV
Input range (pressure)	-20 to +300 mmHg
Sampling rate (SNA)	8 kHz
Sampling rate (pressure)	500 Hz
Data latency	20 ms
Transmission range	Up to 5 m (dependant on lab)
Transmitted signal	Digital 2.4 GHz ISM band
Dimensions/weight	35 x 9 x 23 mm; 15 cm (SNA electrodes), 8 cm (pressure catheter), 13 g
Resolution	A/D 12 bit

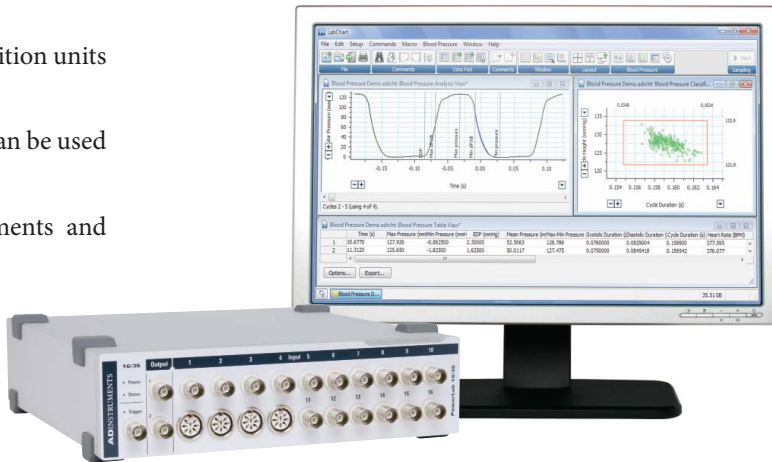
Data Acquisition and Analysis

Telemetry Research devices connect and operate seamlessly with PowerLab data acquisition units. The 16 channel PowerLab unit supplied with the complete telemetry research systems offer 16-bit resolution on all gain ranges, a wide range of hardware and digital filtering options and sampling speeds of up to 200 kHz per channel.

Provided with the PowerLab unit is LabChart Pro software, an easy-to-use software interface for controlling data acquisition settings, display options and expediting analysis. Specialized analysis modules such as Blood Pressure, ECG Analysis, HRV are included for automated data extraction and analysis.

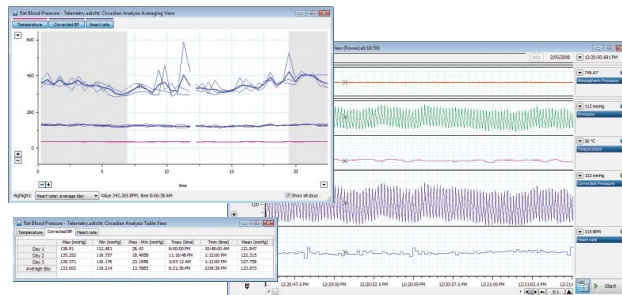
LabChart Pro software comprises

- Up to 32 channels of raw and/or calculated data
- Control of all ADInstruments hardware (data acquisition units and signal conditioners)
- Extensive calculation, analysis and display features can be used online or offline
- Pre-configured and customizable cyclic measurements and calculations for data detection and extraction
- Power frequency analysis options using Spectrum View (for ECG, EEG, etc.)
- Powerful analysis, automation and data extraction with LabChart Modules



Circadian Analysis Module

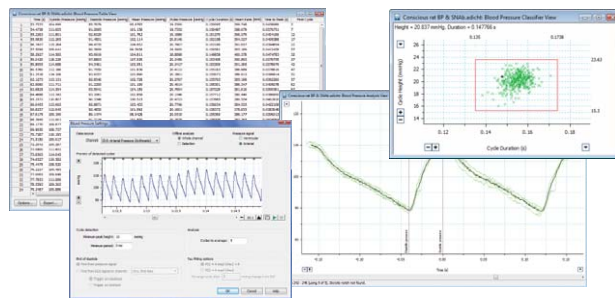
Ideal for long-term animal monitoring, Circadian Analysis analyzes data with a daily pattern, and generates graphical and tabular views of the daily and averaged circadian data. Each day's recording is split into a user-determined number of intervals. The data within each interval is averaged, and these results are plotted, displayed numerically, and analyzed to reveal parameters including the minimum, maximum and mean value for each day as well as the average day.



Circadian Analysis Averaging & Table Views with a LabChart recording of Rat BP using ADInstruments and Telemetry Research systems.

Blood Pressure Module

Blood Pressure automatically detects, analyzes and reports a set of cardiovascular parameters from arterial or ventricular pressure signals, either online or offline. The Classifier View allows for easy selection of pressure waveforms for analysis. The Analysis View displays pressure cycles beat-by-beat or as the average of a specified number of cycles. Depending on the type of pressure signal under investigation, commonly reported parameters are labeled. These measurements are logged in the Table View for easy exporting.

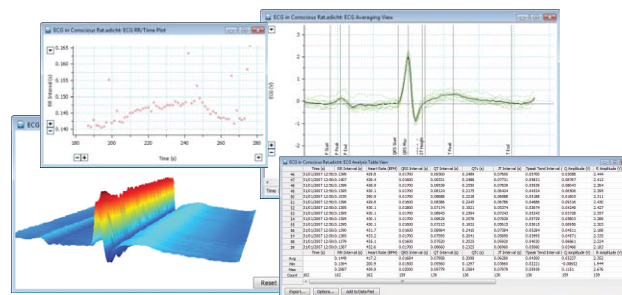


Blood Pressure Module analyzing rat arterial pressure. Settings, Classifier, Averaging and Table Views are shown.

Data Acquisition and Analysis

ECG Analysis Module

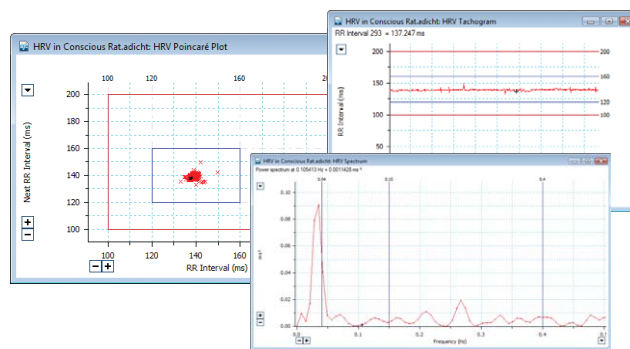
ECG Analysis automatically detects and reports the PQRST onset, amplitude and intervals either online or offline. Default settings make detection and analysis faster, with settings available for mice through to humans. Settings can also be customized for any species. The Beat Classifier provides an easy visual method for the selection or exclusion of normal and atypical beats in analysis. Features include waveform averaging, graphical plots (QT vs. RR, QT vs. t, RR vs. t) and tabular presentation of extracted parameters.



ECG Analysis Module with an averaged Rat ECG signal, Waterfall Plot, RR vs Time Plot and extracted PQRST parameters in Table View.

HRV Module

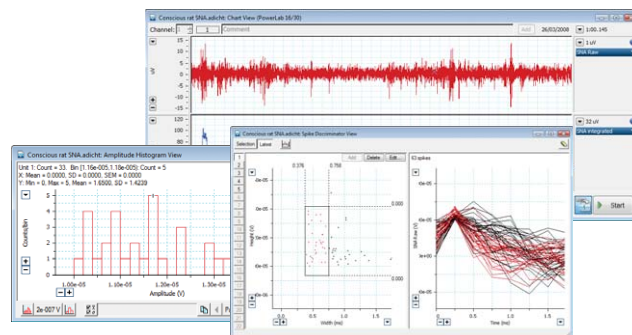
Heart Rate Variability (HRV) Module provides a comprehensive set of tools for the analysis and display of variation in the interval between heartbeats in human and animal electrocardiogram recordings. A threshold detector is used to detect the R waves in the raw ECG data and generate RR intervals that are classified as normal, ectopic or artifact. From the classified RR intervals a range of HRV plots, spectral measurements, statistical histograms and reports are calculated and displayed.



Heart Rate Variability Module analyzing Rat ECG in real time. Poincaré, Tachogram and Spectrum Views are displayed.

Spike Histogram Module

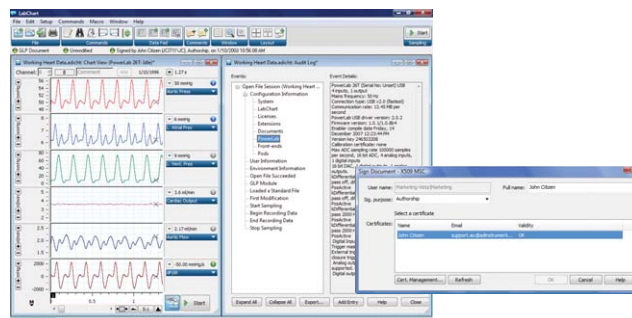
Spike Histogram discriminates and analyzes extracellular neural spike recordings. It is ideal for the analysis of sympathetic nerve activity. The height and width discriminator provides reliable discrimination against unwanted units in multi-unit recordings. This method is better than simple amplitude window discrimination and faster than template matching. The module provides online and offline discrimination and analysis, and the recorded data can be reanalyzed at anytime with modified discriminator settings.



Telemetric Rat SNA recording with Spike Histogram Module's Discriminator and Amplitude Histogram Views.

GLP Client and GLP Server

Meeting 21 CFR Part 11 requirements for data acquisition in pharmaceutical research is a necessity. The ADInstruments GLP Client and GLP Server provide PowerLab users with an elegant solution that is easy to adopt, use and ensures that the recorded data can be trusted. The GLP Client provides the user interface, audit trail and signing components required to meet 21 CFR Part 11 requirements, while GLP Server software provides a centralized way to authorize the signing of LabChart files as well as a means to check the validity of the signatures. It determines which users are permitted to create, modify or sign GLP documents.



LabChart in GLP Status. The GLP Client and GLP Server provide audit trail, signing components and verification of users required in GLP and 21 CFR part 11 environments.

Ordering Information

PL3516B109 Telemetry Small Animal Foundation System*	PL3516B107 Telemetry SNA and Pressure Foundation System*
1 x PL3516 PowerLab 16/35 includes LabChart Pro software	1 x PL3516 PowerLab 16/35 includes LabChart Pro software
1 x MLE0180 SmartPad	1 x ML319 TR Scheduler Pod
1 x MLE0190 Configurator	1 x MLE1162 SNA and Pressure MRC
3 x MLAC01 BNC-BNC cables	1 x MLE1006CPS Wireless Continuous Power Supplier (Small Animal)
	3 x MLAC01 BNC-BNC cables

*Telemeter Selection

Due to the variety of applications and sizes, telemeters must be ordered separately from the table below. Please contact your ADInstruments representative for assistance.

Telemeters
MLE1022 SNA Pressure Telemeter - does not operate with SmartPad
MLE0054P TR/Millar Pressure Telemeter (TR54P, Small)
MLE0054PP TR/Millar Dual Pressure Telemeter (TR54PP, Small)
MLE0054PB TR/Millar Pressure Biopotential Telemeter (TR54PB, Small)
MLE0050B Biopotential Telemeter (TR50B, Small)
MLE0050BB Dual Biopotential Telemeter (TR50BB, Small)

Accessories	
MLE1140 TR/Millar Pressure Starter Pack w/instruments	MLE1141 TR Pressure Consumable Pack (for gel telemeters)
MLE1142 SNA Consumable Pack	MLE1145 TR/Millar Pressure Consumable Pack
MLE1150 Telemetry Antenna Extension- does not operate with SmartPad	

Specialized analysis modules

All specialized software modules are provided as part of LabChart Pro software (supplied with Telemetry Foundation Research Systems). They can also be purchased individually.

Dose Response – generate dose response curves, EC₅₀ values and additional parameters

Blood Pressure – automatically detects, analyzes and reports parameters from arterial or ventricular pressure recordings

ECG Analysis – detects and reports the onset, amplitude and interval times of PQRST from human and animal ECG signals

Heart Rate Variability – displays and analyzes variation in the interval between heartbeats in human and animal ECG

Peak Analysis – automatic detection and analysis of multiple, but not overlapping, signal waveforms from recordings

Circadian Analysis – analyze and generate graphical and tabular views for daily and averaged circadian data

Metabolic – provides real-time measurements of parameters such as: \dot{V}_{CO_2} , \dot{V}_{O_2} , \dot{V}_E and RER

Spike Histogram – detects, discriminates and analyzes extracellular spike activity generating a range of plots and statistics

Cardiac Output – calculates cardiac output from a LabChart recording of a thermodilution curve measured in animals

Video Capture – allows the synchronized recording and playback of a QuickTime movie and LabChart data file

DMT Normalization – calculates and standardizes optimal vessel pretension conditions using the wire myograph

PV Loop – analyze left ventricular pressure and volume data, calculates loop area and a wide range of hemodynamic parameters

*LabChart Pro does not include GLP Client and GLP Server software.

 Showcase your data for free using LabChart Reader. Download now to view and analyze LabChart data.

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



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