

Wireless Animal Monitoring

Telemetric Acquisition of Pressure, Biopotentials, SNA and Temperature



World-Class Systems - Complete Solutions

The latest telemetry technologies and data acquisition systems have been combined to create world-leading systems for wireless monitoring of physiological signals in small and large animals. The revolutionary wireless technology provides 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.

The MLE1024 TR/Millar Solid State Pressure Catheter is the smallest wireless catheter available (sensor tip is just 2 Fr, or 0.66mm). It sets a new standard for telemetry research in small animals, it is configured for extremely low offset drift and a frequency response of 450 Hz.

Advantages of Acquisition using Telemetry

Wireless digital transmission ensures high-quality data transmission using a small sensor. By removing the need for tethers, the systems facilitate stress-free, long-term recordings from animals. The power-down feature extends battery life and the recharger technology allows transmitters to be recharged *in situ* for small animals, providing the ability to record 24/7.

Twelve independent transmitter frequencies allow signals to be recorded from multiple animals in a single cage or area, without the need for special housing or animal isolation.

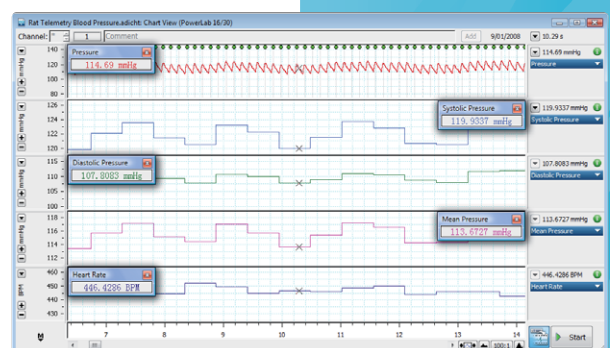
Data Integrity and Powerful Analysis

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

Features & Benefits

- Monitor freely moving lab animals 24/7 or easily set a periodic recording schedule
- Record BP, ECG, EEG, EMG, EOG, SNA, and more
- Monitor small animals (≥ 200 g) with a solid state sensor tip measuring just 2 Fr (0.6 mm)
- Recharge transmitters *in situ* even while recording
- Low cost of ownership: lifetime monitoring, minimal downtime and transducer refurbishment
- Powerful data acquisition and analysis with PowerLab and LabChart Pro software
- Includes scheduling software, Circadian Analysis, ECG, HRV and BP analysis modules

Telemetry recording of rat arterial pressure (top channel) and systolic, diastolic and mean pressure values extracted and displayed in real time (lower channels).



The Next Generation Telemetry Systems



The Telemetry Research Advantage

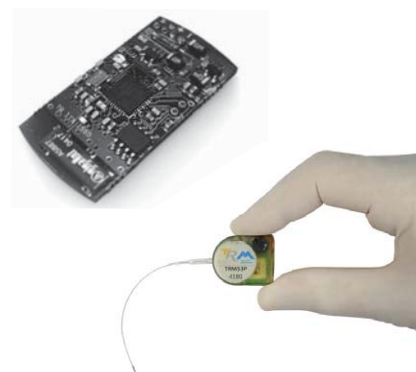
A perfect partner for PowerLab data acquisition systems, Telemetry Research equipment provides innovative wireless solutions for monitoring freely moving laboratory animals. Technological advantages embedded in Telemetry Research equipment open the possibilities of lifetime monitoring, 24/7 recording, recharging *in situ* and minimizing expensive transmitter refurbishments.

Key Benefits

- Up to three signals from the one fully-implantable transmitter
- Real 24/7 continuous recording or easy-to-set-up scheduled recording
- Recharging of transmitters *in situ* – no more downtime or expensive battery replacements
- Independent transmitter frequencies allow co-housing of monitored animals
- Suitable for rats and animals ≥ 200 g (Small transmitter: 24 x 12 x 29 mm; Large transmitter: 68 x 15 x 42 mm)

Telemetry Research Advantages*

Feature	Telemetry Research Technology
Signals	Pressure, temp, SNA, low and high frequency biopotential
Sampling frequency	Up to 8000 Hz
Transmission	Digital transmission offers multiple transmission bands
Animal size	Rats (≥ 200 g) and larger
Recording range	Up to 5 m
Monitor duration	Unlimited – recharge <i>in situ</i>
Continuous data	True 24/7 (using small animal transmitters & recharger)
Schedule data	Remote switch at receiver or via software
Refurbishment	No refurbishment or waiting, recharge and continue
Co-housing/ co-implants	High frequency data from multiple animals
Output format	Standard analog voltage



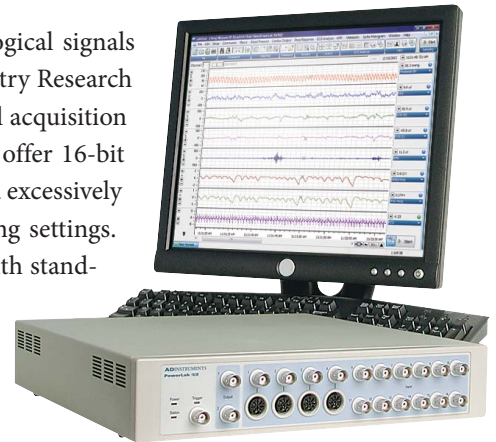
TRM53P Pressure Transmitter Technical Specifications*

Pressure accuracy	± 1 mmHg	Channel	16 transmission frequencies are available to support multiple transmitters in one area
Pressure drift	< 2 mmHg per month	Outer material	Biocompatible polymer
Frequency response	-3 dB at 450 Hz	Transmitter on-off mechanism	Remote control via the receiver
Pressure range	-20 to +300 mmHg	Scheduled acquisition	Hardware supports full remote automated acquisition of pressure waveform e.g. 5 min every 2 hr, or continuous recording
Ambient pressure range	650 to 800 mmHg	Calibration	Calibration values stored within transmitter, no user intervention required
Maximum operating altitude	1300 m		
Temperature operating range	20 to 41 degrees Celsius		
Transmission range	Up to 5 m (dependent on Lab Configuration)		
Transmitted signal	Digital in the 2.4 GHz band		

* Specifications supplied by Telemetry Research

Data Acquisition and Analysis

PowerLab data acquisition systems are ideal for wireless monitoring of physiological signals using telemetry devices. Industry-standard connections interface with the Telemetry Research receivers, the ADInstruments Scheduler Pod and any computer. 4, 8 or 16 channel acquisition systems are available with sampling speeds of up to 200 kHz per channel. They offer 16-bit resolution, a wide range of filtering choices, and data compression options to avoid excessively large data files. LabChart software provides control over hardware and recording settings. LabChart Pro (available with the complete Research Systems, or as an upgrade with stand-alone PowerLab systems) includes powerful and time-saving analysis modules.

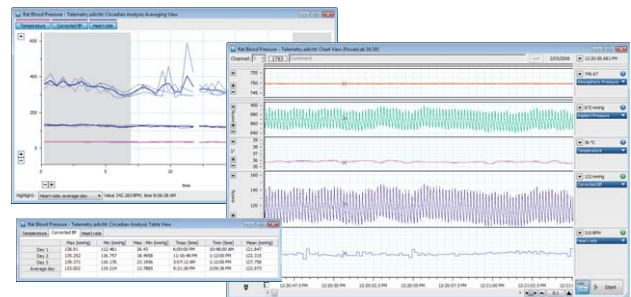


LabChart Pro Software Features

- Up to 32 channels of raw and calculated data
- Software control of amplification and filtering
- Extensive online and offline calculation, analysis and display features
- Cyclic Measurements for detection and extraction of parameters in periodic waveforms
- Spectrum View feature for analysis of power frequencies in ECG and EEG
- Numerous calculations including Integral, Ratemeter, Cyclic Mean, Derivative and many more
- Powerful analysis and automation with LabChart Modules, including PV loop, Blood Pressure, ECG Analysis, Heart Rate Variability, Circadian Analysis, Dose Response and Peak Analysis.

Circadian Analysis Module

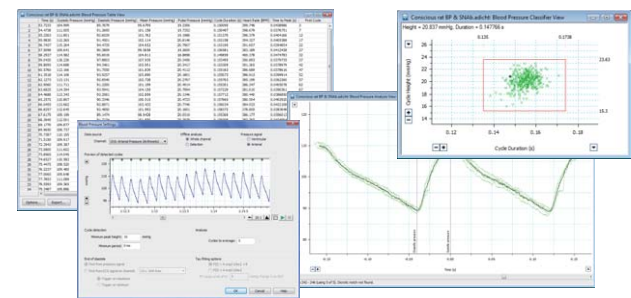
Ideal for long-term animal monitoring, Circadian Analysis analyzes data with a daily pattern, and generates graphical and tabular views of the daily and averaged circadian data. Each day's recording is split into a user-determined number of intervals. The data within each interval is averaged, and these 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

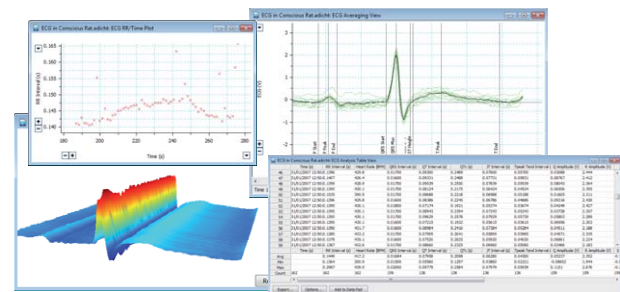
Blood Pressure automatically detects, analyzes and reports a set of cardiovascular parameters from arterial or ventricular pressure signals, either online or offline. The Classifier View allows for easy selection of pressure waveforms for analysis. The Analysis View displays pressure cycles beat-by-beat 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.

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.

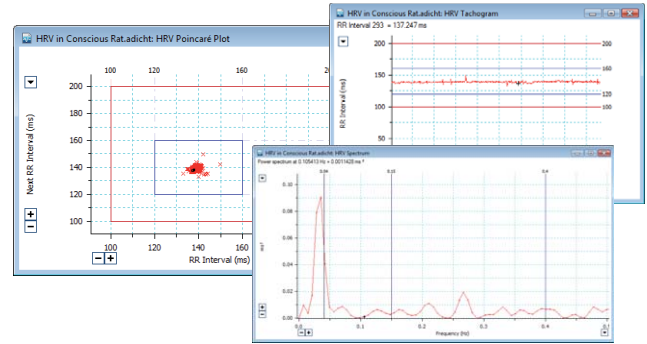


ECG Analysis Module with an averaged Rat ECG signal, Waterfall Plot, RR vs Time Plot and extracted PQRST parameters in Table View.

Data Acquisition and Analysis

HRV Module

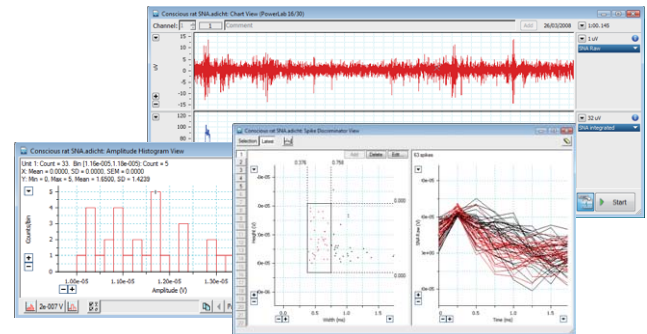
Heart Rate Variability (HRV) Module provides a comprehensive set of tools for the analysis and display of variation in the interval between heartbeats in human and animal electrocardiogram recordings. A threshold detector is used to detect the R waves in the raw ECG data and generate RR intervals that 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

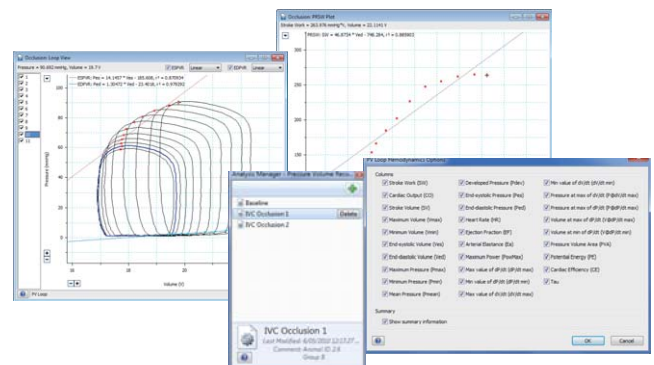
Spike Histogram discriminates and analyzes extracellular neural spike recordings. It is ideal for the analysis of sympathetic nerve activity. The height and width discriminator provides reliable discrimination against unwanted units in multi-unit recordings. This method is better than simple amplitude 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.

PV Loop Module

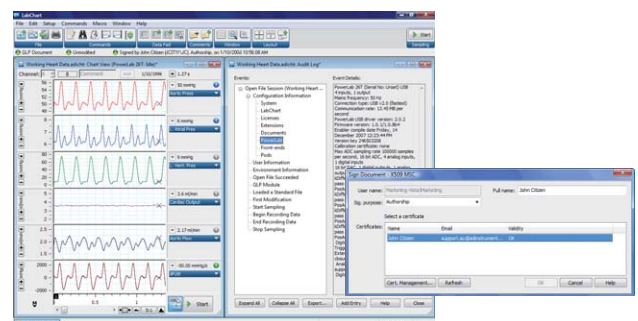
The PV Loop Module provides an easy way to analyze pressure volume loops for hemodynamic research in animals. Individual pressure-volume loops can be selected or excluded from analysis and a variety of hemodynamic parameters are calculated and displayed on a loop-by-loop basis (including pressure-volume area, cardiac output and stroke work). There are several options for displaying linear regression information and data can be corrected for parallel conductance or calibrated to display absolute volumes. The Analysis Manager enables settings from separate data analyses to be saved and recalled for future use.



PV Loop showing Loop View and a PRSW plot generated from a data set saved in the Analysis Manager. Hemodynamic parameters calculated on a loop-by-loop basis are also shown.

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.

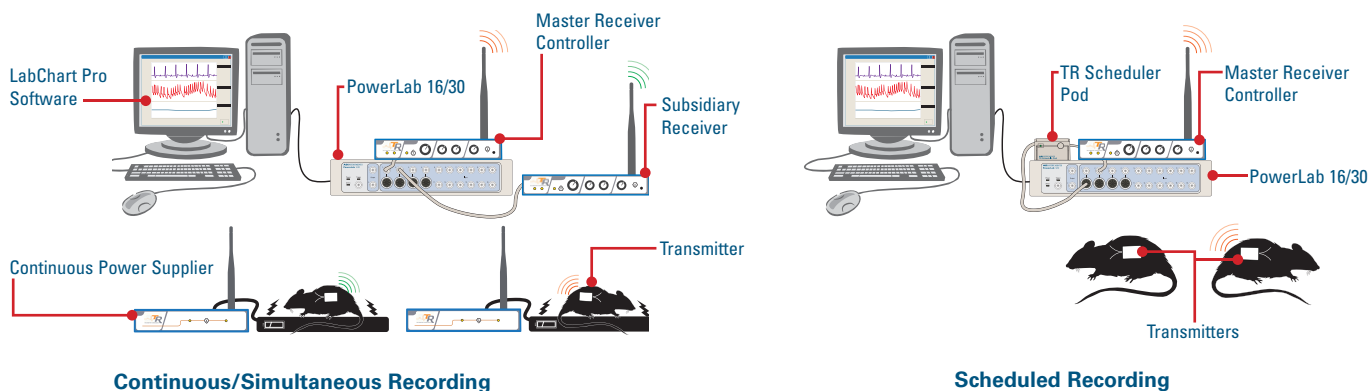


LabChart in GLP Status. The GLP Client and GLP Server provide audit trail, signing components and verification of users required in GLP and 21 CFR part 11 environments.

Complete Research Systems

Continuous/Simultaneous Recording vs Scheduled Recording

The combination of ADInstruments data acquisition hardware and software with the Telemetry Research transmitters, receivers and recharging plates, allows researchers to monitor animals in two modes: continuous/simultaneous or scheduled. Using transmitters, receivers and rechargers for small animals (one per animal) allows continuous 24 hour recording. Transmitters can be recharged *in situ* while recording and data can be acquired from a number of animals simultaneously. Scheduled recording on the other hand can be performed using the ADInstruments Scheduler Pod and the Scheduler Software Extension (Windows only). This allows you to record consecutively from a number of animals, one at a time, using just one receiver. The recording schedule is easily set up using the LabChart Scheduler Extension. Up to 8 transmitters can be scheduled.



Telemetry Foundation Systems

The Telemetry Foundation Systems, and supporting accessories, allow researchers to record the following signal combinations:

- Biopotential and Temperature
- Blood Pressure
- Dual Biopotential and Temperature
- Pressure and Temperature
- Pressure, Biopotential and Temperature
- Pressure, SNA and Temperature

Telemetry Foundation Systems include a 16 channel PowerLab system with LabChart Pro software, TR Scheduler Pod, Master Receiver Controller (MRC), and Wireless Continuous Power Supply (Small Animal). This enables continuous and scheduled recording options.

Customers must select the number, type and size of the transmitters, and order these items in addition to the Foundation System. For continuous recording from multiple animals, additional subsidiary receivers (one per additional animal) must be purchased. Recharging of large animal transmitters *in situ* requires the MLE1007WPC Wireless Power Charger.

Sample Telemetry Foundation System

The range of Telemetry Foundation Systems and accessories is listed on the back page of this brochure. The five systems listed cover the most common applications. If you require a customized version for your application, do not hesitate to contact us with your requirements. The system listed and pictured here is ML880B107 Telemetry SNA and Pressure Foundation System. It includes:

- ML880 PowerLab 16/30 (sixteen channels)
- MLS260 LabChart Pro
- ML319 TR Scheduler Pod (with Scheduler Extension)
- MLE1162 SNA and Pressure MRC Unit
- MLE1006CPS Wireless Power Supplier (Small Animal Transmitter)
- 3 x MLAC01 BNC-BNC Cables

Transmitters recommended for use with this system include:

- MLE1022 Telemetry SNA and Pressure Transmitter (Small Animal Transmitter)
- MLE1023 Telemetry SNA and Pressure Transmitter (Large Animal Transmitter)*



ML880B107 Telemetry SNA and Pressure Foundation System

Ordering Information

Important Notice: Due to patents on Telemetry Blood Pressure Devices, the Telemetry Pressure Systems listed below cannot be sold in a small number of countries until the existing patents expire. Please contact ADInstruments for more information.

ML880B103 Telemetry Biopotential Foundation System*†	ML880B104 Telemetry Pressure Foundation System*†	ML880B105 Telemetry Pressure and Biopotential Foundation System*†
1 x ML880/P PowerLab 16/30 includes LabChart Pro software	1 x ML880/P PowerLab 16/30 includes LabChart Pro software	1 x ML880/P PowerLab 16/30 includes LabChart Pro software
1 x ML319 TR Scheduler Pod	1 x ML319 TR Scheduler Pod	1 x ML319 TR Scheduler Pod
1 x MLE1051 Biopotential MRC unit	1 x MLE1131 Pressure MRC unit	1 x MLE1135 Pressure & Biopotential MRC unit
1 x MLE1006CPS Wireless Continuous Power Supplier (Small Animal)	1 x MLE1006CPS Wireless Continuous Power Supplier (Small Animal)	1 x MLE1006CPS Wireless Continuous Power Supplier (Small Animal)
2 x MLAC01 BNC-BNC cables	2 x MLAC01 BNC-BNC cables	3 x MLAC01 BNC-BNC cables
ML880B106 Telemetry Dual Biopotential Foundation System*†	ML880B107 Telemetry SNA and Pressure Foundation System*†	ML880B108 Telemetry Blood Pressure Foundation System*†
1 x ML880/P PowerLab 16/30 includes LabChart Pro software	1 x ML880/P PowerLab 16/30 includes LabChart Pro software	1 x ML880/P PowerLab 16/30 includes LabChart Pro software
1 x ML319 TR Scheduler Pod	1 x ML319 TR Scheduler Pod	1 x ML319 TR Scheduler Pod
1 x MLE1052 Dual Biopotential MRC unit	1 x MLE1162 SNA and Pressure MRC unit	1 x MLE1151 TR/Millar Pressure MRC unit
1 x MLE1006CPS Wireless Continuous Power Supplier (Small Animal)	1 x MLE1006CPS Wireless Continuous Power Supplier (Small Animal)	1 x MLE1005CPS Wireless Continuous Power Supplier (Small Animal, Millar)
3 x MLAC01 BNC-BNC cables	3 x MLAC01 BNC-BNC cables	2 x MLAC01 BNC-BNC cables

*Transmitter Selection

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

†Additional Charger

MLE1007WPC Wireless Power Charger must be purchased separately for recharging Large Animal Transmitters *in situ*.

Telemetry Transmitters

MLE1024 TR/Millar Pressure Transmitter (Small Animal) TRM53P	MLE1011 Telemetry Biopotential Transmitter (Large Animal)†
MLE1010 Telemetry Biopotential Transmitter (Small Animal)	MLE1013 Telemetry Dual Biopotential Transmitter (Large Animal)†
MLE1012 Telemetry Dual Biopotential Transmitter (Small Animal)	MLE1015 Telemetry Pressure Transmitter (Large Animal)†
MLE1016 Telemetry Pressure & Biopotential Transmitter (Small Animal)	MLE1017 Telemetry Pressure & Biopotential Transmitter (Large Animal)†
MLE1022 Telemetry SNA & Pressure Transmitter (Small Animal)	MLE1023 Telemetry SNA & Pressure Transmitter (Large Animal)†

Accessories

MLE1141 Blood Pressure Consumable Pack	MLE1142 SNA Consumable Pack
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Software

MLS060/7 LabChart	MLS330/7 GLP Client and MLS335 GLP Server
MLS260 LabChart Pro	(Modules are also available for individual purchase.)



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

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



ADINSTRUMENTS.com

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North America

Tel: +1 888 965 6040
Fax: +1 866 965 9293
info.ad@adstruments.com

United Kingdom

Tel: +44 1865 891 623
Fax: +44 1865 890 800
info.uk@adstruments.com

Germany

Tel: +49 6226 970105
Fax: +49 6226 970106
info.de@adstruments.com

North Asia

Tel: +86 21 5830 5639
Fax: +86 21 5830 5640
info.cn@adstruments.com

South East Asia

Tel: +60 3 8024 5296
Fax: +60 3 8023 6307
info.sea@adstruments.com

Japan

Tel: +81 52 932 6462
Fax: +81 52 932 6755
info.jp@adstruments.com

South America

Tel: +56 2 356 6749
Fax: +56 2 356 6786
info.cl@adstruments.com

Brazil

Tel: +55 11 3266 2393
Fax: +55 11 3266 2392
info.br@adstruments.com

Indian Subcontinent

Tel: +91 11 2693 3930
Fax: +91 11 2693 3929
info.in@adstruments.com

Australia

Tel: +61 2 8818 3400
Fax: +61 2 8818 3499
info.au@adstruments.com

New Zealand

Tel: +64 3 477 4646
Fax: +64 3 477 4346
info.nz@adstruments.com

International

Tel: +61 2 8818 3400
Fax: +61 2 8818 3499
info.au@adstruments.com