ADINSTRUMENTS
making science easier

# Exercise Physiology

## Metabolic Measurements with PowerLab® Systems and LabChart®

ADInstruments provides a range of specialized products for use in cardiorespiratory and exercise physiology teaching and research. These include PowerLab data acquisition systems, respiratory gas analyzers, spirometers, oximeters, biological amplifiers, blood flow meters, pulse transducers, goniometers, force transducers, temperature sensors and more. ADInstruments human-use signal conditioners are isolated and certified safe for human subjects. All ADInstruments hardware, including PowerLab data acquisition systems and signal conditioners are software controlled. This provides researchers and educators with a powerful, accurate and easy-to-use data acquisition solution.

### Exercise Physiology System

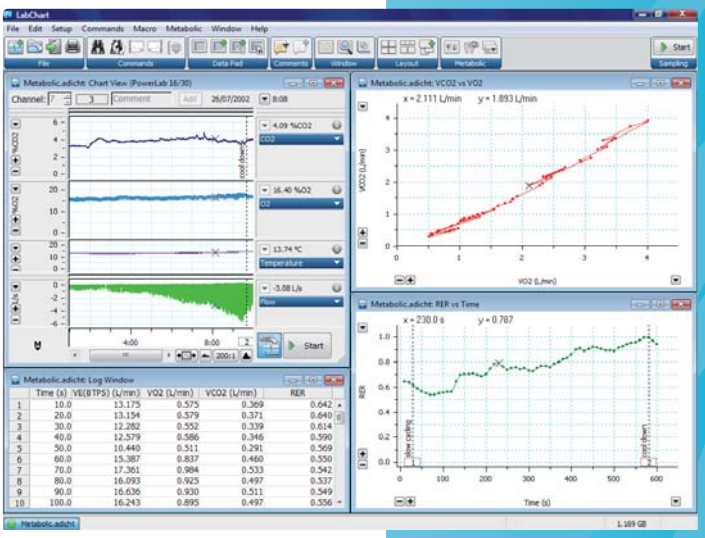
The Exercise Physiology System is ideal for monitoring cardiorespiratory and metabolic function in human subjects. The system includes a PowerLab with LabChart software, gas analysis and spirometry hardware, accessories and a specialized metabolic analysis software module.

In conjunction with a PowerLab, LabChart software records metabolic signals and provides advanced real-time or post-acquisition analysis features. The Metabolic Module for LabChart (Windows® & Mac® OS) automates gas calibration and the calculation of parameters such as RER, $\dot{V}_{CO_2}$, $\dot{V}_{O_2}$ and $\dot{V}_E$. This combination ensures accurate and efficient data analysis.

## Typical Applications

- Metabolic measurements
- Respiratory gas analysis
- Student exercise testing
- Pulmonary function analysis
- Indirect calorimetry
- Anaerobic threshold
- Biopotential measurements
- Spirometry

Below: A recording of expired airflow and gas concentrations ($CO_2$ and $O_2$), $\dot{V}_{CO_2}$, $\dot{V}_{O_2}$ and RER. As expired flow and gas concentration values are collected in the Log Window, the metabolic graphs such as RER vs Time and $\dot{V}_{O_2}$ vs $\dot{V}_{CO_2}$ are updated in real time.



# Software

## LabChart

LabChart acquisition and analysis software provides control of ADInstruments hardware using interactive displays for amplifier range and filter settings. It includes a variety of analysis features such as XY plotting, differential, integral and spectral calculations. Real-time data acquisition and computations are performed with sampling rates of up to 200 kHz per channel (or 400 kHz aggregate). LabChart can continuously record and display up to 32 channels of data (up to 16 raw and 32 calculated signals).

## Metabolic Module

The Metabolic Module for LabChart is included with the ADInstruments Exercise Physiology System. The Module can also be used with custom hardware configurations that include an ADInstruments Spirometer, Gas Mixing Chamber, Gas Analyzer and a PowerLab system with at least four general inputs.

Using simultaneous measurements of airflow [L/s], oxygen [$\%O_2$] and carbon dioxide [$\%CO_2$] concentrations (and accounting for environmental conditions), the module provides fast online or offline calculations of the following parameters:

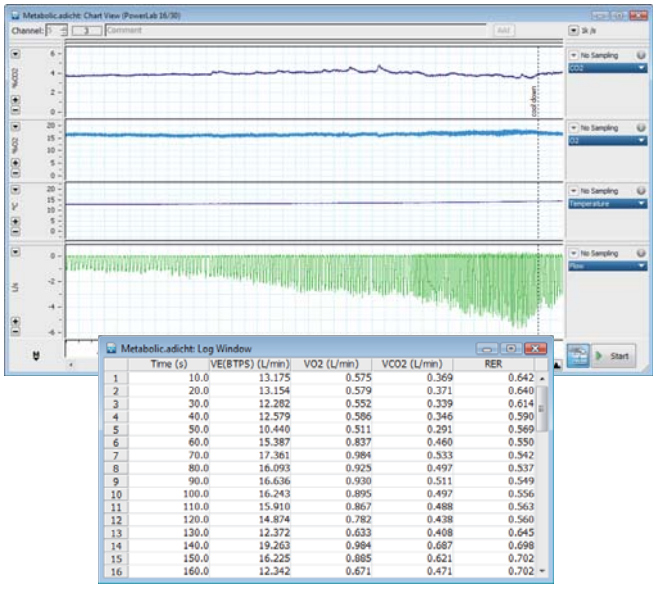
- Expired Minute Ventilation $\dot{V}_E$
- Oxygen Consumption $\dot{V}_{O_2}$
- Carbon Dioxide Production $\dot{V}_{CO_2}$
- Respiratory Exchange Ratio (RER)

The module displays these parameters in real-time plots as well as logging the data to the Log Window. The Metabolic Log Window provides a summary of the data in a spreadsheet format, which can be easily exported to other programs for further analysis or graphing.

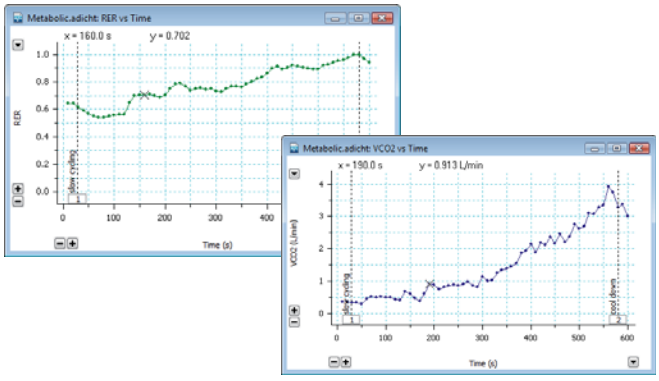
## Spirometry

The incoming respiratory flow and volume data is used by the Spirometry extension to calculate a number of spirometry parameters. These calculations include peak inspiratory flow (PIF), peak expiratory flow (PEF), tidal volume ($V_T$), expired minute ventilation ($\dot{V}_E$), respiratory rate (f) and forced vital capacity (FVC), inspiration and expiration time. LabChart can also display online minute ventilation and tidal volume.

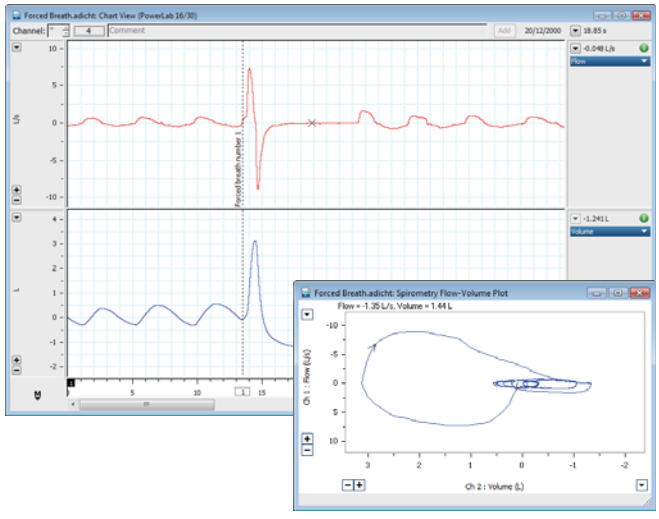
Spirometry reports and flow-volume plots can be easily generated and printed or exported to other programs. The Spirometry feature also allows users to quickly and easily calibrate respiratory flow heads.




LabChart recording of respiratory gas concentrations and airflow. The Log Window displays real-time averaged ventilation and gas calculations.




Graphs such as RER and $\dot{V}_{CO_2}$ versus Time are automatically generated using the Metabolic Module and displayed in real time.




A flow volume recording of a forced expiration. The inset shows a flow-volume loop generated using LabChart's spirometry feature.

# Hardware

## Exercise Physiology System

The ADInstruments Exercise Physiology System measures metabolic function during exercise in humans. The package includes a PowerLab 8/30 (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).

The Exercise Physiology Accessory Kit includes a Respiratory Flow Head (1000 L/min), Face Mask kit (two-way non-rebreathing valve, small and medium mask), Tubing Adapters, Breathing Tube, Desiccant Cartridge, Drying Tube, Silicon Tubing with Connectors, and Thermistor Temperature Sensor.

The Gas Analyzer measures $CO_2$ and $O_2$ concentrations in expired air sampled from the Gas Mixing Chamber, while the Spirometer monitors airflow. The Bio Amp is used for recording biopotentials such as ECG or EMG and the Thermistor Pod monitors the temperature of the respired air. LabChart software with the Metabolic Module records all acquired respiratory gas concentration and flow data for online and offline calculation and reporting of metabolic parameters.

### Gas Analyzer Specifications:

| Analyzers | $O_2$ | $CO_2$ |
|---|---|---|
| **Type** | Visible Optical | Infrared Optical |
| **Range** | 0 to 100% | 0 to 10% |
| **Resolution** | 0.01% | 0.1% |
| **Linearity** | 0.2% | 0.1% |

Variable flow 0-200 ml/min (dependent on tubing diameter and length)


MLA240 Exercise Physiology Accessory Kit

ML870B80 Exercise Physiology System

## PTK14 Exercise Physiology Kit

With the addition of a PowerLab data acquisition system, the PTK14 Exercise Physiology Kit allows investigation of respiratory function. This makes it ideal for classroom teaching experiments. To use the PTK14 you need a PowerLab data acquisition system with at least four general input connections. The PTK14 includes the Gas Analyzer, Gas Mixing Chamber, Respiratory Flow Head, Face Mask kit, Desiccant Cartridge, Tubing and Metabolic Module Software.

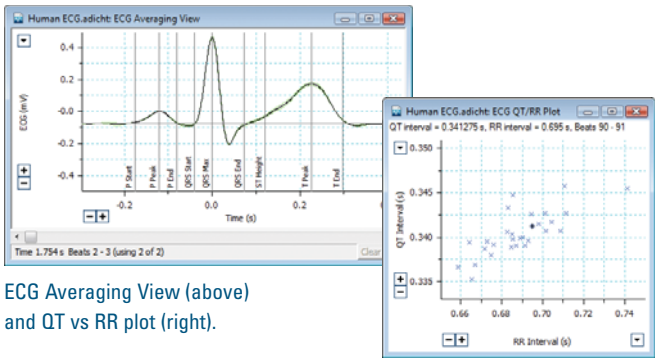
PTK14 Exercise Physiology Kit

# Additional Analysis Software

## ECG Analysis Module

The ECG Analysis Module automatically detects and reports PQRST onset, amplitude and intervals online or offline. Features include:

- Online or offline beat detection and analysis
- Easy to use Beat Classifier
- Graphical representation and tabular reports of QT, PT and QRS Intervals, P, R and T amplitudes
- ECG signal averaging
- Options for calculating QTc

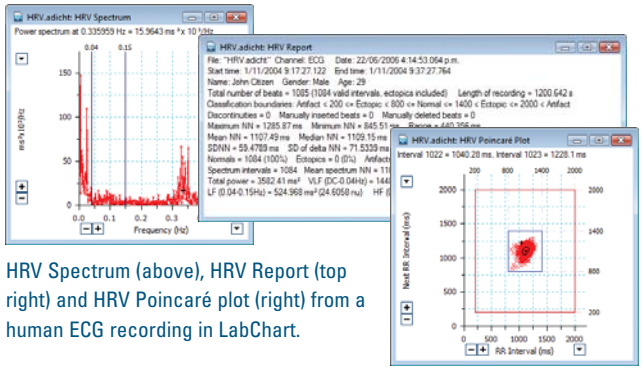



ECG Averaging View (above) and QT vs RR plot (right).

## Heart Rate Variability Module

The HRV Module provides users with the ability to analyze beat-to-beat interval variation. Features include:

- Analysis such as Poincaré, Period Histogram, Delta NN Histogram and Tachogram
- Easy threshold detectors
- Automated beat classification: normal, ectopic or artifact
- Power spectrum analysis




HRV Spectrum (above), HRV Report (top right) and HRV Poincaré plot (right) from a human ECG recording in LabChart.

## Ordering Information

| ML870B80 Exercise Physiology System |
|---|
| 1 x ML870/P PowerLab 8/30 (8 channel data acquisition system) includes LabChart Pro Software* |
| 1 x ML132 Bio Amp |
| 1 x ML206 Gas Analyzer |
| 1 x MLA246 Gas Mixing Chamber |
| 1 x ML141 Spirometer |
| 1 x ML309 Thermistor Pod |
| 1 x MLA240 Exercise Physiology Accessory Kit:<br>1 x MLT1000L Respiratory Flow Head<br>1 x MLA1029 Face Mask Kit<br>1 x MLA1081 Flow Head Adapter<br>1 x MLA1013 35 mm (ID) Adapter<br>1 x MLA1015 Breathing Tube<br>1 x MLA6024 Desiccant Cartridge<br>1 x MLA0343 Drying Tube<br>1 x Thermistor Temperature Sensor<br>2 x Silicon Tube with Luers |

| PTK14 Exercise Physiology Kit† |
|---|
| 1 x ML206 Gas Analyzer |
| 1 x MLA246 Gas Mixing Chamber |
| 1 x MLT1000L Respiratory Flow Head |
| 1 x ML141 Spirometer |
| 1 x MLA1029 Face Mask Kit |
| 1 x MLA1081 Flow Head Adapter |
| 1 x MLA6024 Desiccant Cartridge |
| 1 x MLA1013 35 mm (ID) Adapter |
| 1 x MLA1015 Breathing Tube |
| 1 x MLS240/7 Metabolic Module (Windows® & Mac®) |

| LabChart Software Modules* |
|---|
| MLS240/7 Metabolic (Win® & Mac®) |
| MLS310/7 Heart Rate Variability (Win® & Mac®) |
| MLS360/7 ECG Analysis (Win®) |

* LabChart Pro contains all the LabChart Modules in one value-for-money software suite. † Exercise Physiology Kit requires a PowerLab with at least 4 general purpose inputs

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



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