GAMRY INSTRUMENTS
Redefining Electrochemical Measurement

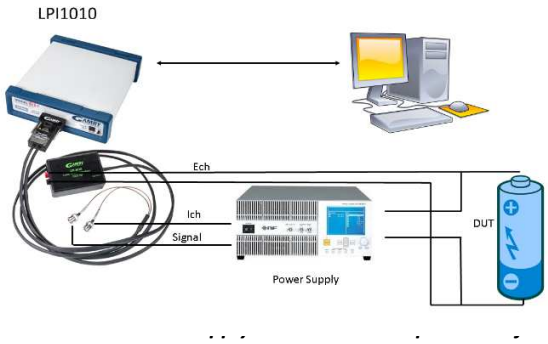
LPI1010 ™ Load/Power Supply Interface *for Batteries and Fuel Cells*

Alternative energy sources are becoming more prevalent as alternatives to fossil fuels become important in the electricity generation equation. Fuel cells and batteries both play their part in this arena for energy storage and conversion. Their success depends on continued improvement in performance. The LPI1010 Load/Power Supply Interface (LPI) was designed to help you make this improvement possible.

Electrochemical impedance spectroscopy (EIS) is a powerful electrochemical technique, which can be particularly useful for battery and fuel cell development. You can use EIS for materials selection and performance evaluation. Fundamental studies of new approaches and optimization of battery and fuel cell performance can both benefit from EIS testing and modeling.

Gamry's LPI measures EIS better than standard EIS systems designed for the laboratory. Lab EIS systems also cannot handle the large voltages in battery packs and fuel cell stacks which can have voltages up to 1000V or moreThe LPI has three different models to handle these voltage ranges; up to 10V, 10-100V and up to 1000V.

A typical system consists of an Interface 1010E potentiostat and an LPI1010 working in conjunction with a Bipolar Power Suppy or Electronic Load (see Systems Information). A schematic of the LPI is shown below for impedance measurements on a battery. A similar arrangement can be used to measure a fuel cell.



Battery. *The measurement of I and E at a given frequency allows the calculation of the impedance.*

The LPI employs an Bipolar Power Supply to source and sink the current from the battery. The sinusoidal excitation signal from the LPI is input to the Power Supply, which modulates the battery current. The current signal from the Power supply is output to the current input channel of the LPI. The voltage of the battery is measured directly by the LPI at the voltage input channel. The system then calculates an impedance from these signals. The LPI measures EIS in either galvanostatic mode or our proprietary hybrid mode.

EIS measured with an LPI1010 can evaluate the Equivalent Series Resistance (ESR) as well as measure a snapshot of your battery (pack) at different states of charge.

The Gamry LPI is designed to accommodate the low impedance of batteries and fuel cells. It can measure impedances as low as 500 nΩ (5×10^{-7} Ω)! It can measure complex impedance over a frequency range of 10 µHz to 20 kHz (the upper limit is determined by the load or power supply).

Using the LPI to Measure EIS of Fuel Cells

The LPI can also measure the impedance of fuel cells. It can help identify problems that limit a fuel cell's efficiency, it can help optimize cell design, and it can determine anodic and cathodic process mechanisms. EIS can be useful in the selection of membranes and the study of membrane impact on performance. Clever placement of reference electrodes in a cell may allow an analyst to separately test subsections of the cell, such as the anode, the cathode, and the electrolyte.

System Information

A full LPI1010 system will consist of an Interface 1010E, LPI1010 (10, 100, or 1000V model) and power supply or load. Gamry Instruments can supply complete LPI systems including a Power Supply or Electronic Load. Custom configurations are available by special order. Older Interface 1010Es will require an upgrade at the factory

before they can operate an LPI1010. Contact the Gamry or your local distributor for further details on these systems.

General Specifications**	Value
Frequency Range	10 uHz – 20 kHz*
Weight	1 kg
Cable lengths	1 m
Signal output to load or power supply	10V full scale, BNC connector

*LPI1010 with NF Power Supply only. Measurement bandwidth is dependent upon customer's power supply or load.

** Specifications subject to change without notice.

Representative image of Gamry Interface 1010E and LPI1010 100V.