

# SP-150

## POTENTIOSTAT/GALVANOSTAT



Simple and Powerful in a versatile chassis

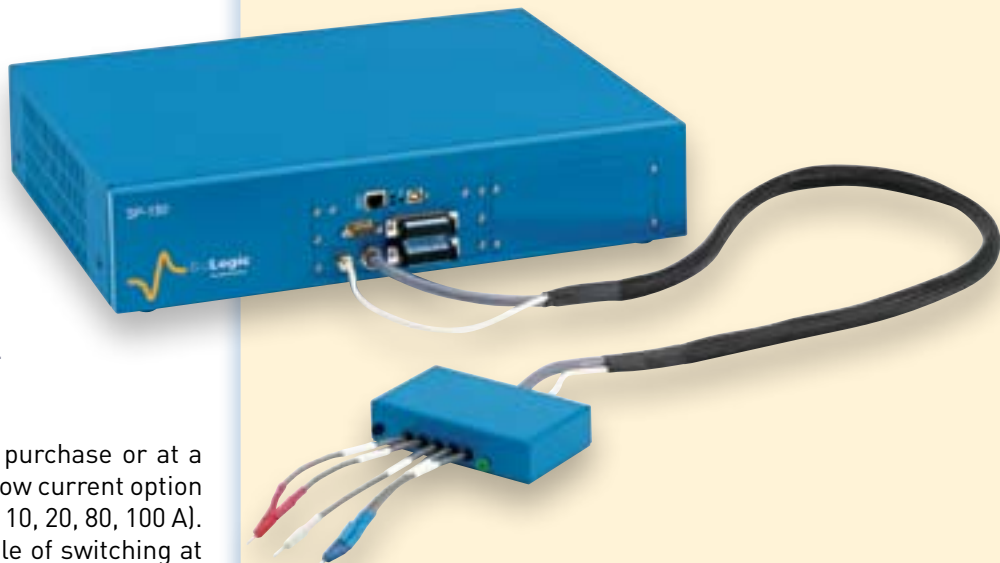
- GENERAL ELECTROCHEMISTRY
- ENERGY STORAGE
- CORROSION
- SENSORS

The **SP-150** potentiostat is an economical research-grade potentiostat. With its modular chassis, this instrument can be customized to address all applications in the area of classical electrochemistry.

The **SP-150** potentiostat can be upgraded at purchase or at a later date with an EIS measurement option, a low current option (1 nA range) and external power boosters (2, 5, 10, 20, 80, 100 A). It is the only instrument on the market capable of switching at 10  $\mu$ s from a potential control to a current control.

The **SP-150** is supplied with **EC-Lab**<sup>®</sup> software package, including **EC-Lab**<sup>®</sup>, **EC-Lab**<sup>®</sup> **Express** and a development package. With over 50 techniques that can be sequenced, and with a variety of analysis tools, including EIS modelling with Levenberg-Marquardt and Simplex algorithms, the **SP-150** is the most powerful single channel potentiostat on the market.

The **SP-150** is controlled from a PC by a USB or an Ethernet. Using the Ethernet connection, the **SP-150** can be installed on a Local Area Network to allow remote access. Moreover, it has two analog inputs and one analog output to manage external instruments, such as a rotating electrode or a quartz crystal microbalance, and record the generated data.



## GENERAL SPECIFICATIONS

- Current ranging from 1 nA up to 800 mA with a 760 pA resolution (76 fA with low current option)
- $\pm 10$  V reference voltage
- Resolution: 300  $\mu$ V programmable down to 5  $\mu$ V by adjusting the dynamic range
- Acquisition time: 20  $\mu$ s with EC-Lab<sup>®</sup> Express  
200  $\mu$ s with EC-Lab<sup>®</sup>
- No limit in time and data recording
- EIS measurements from 10  $\mu$ Hz to 1 MHz\*
- Simultaneous impedance measurement on WE and CE electrodes\*.

\* With EIS option

## FUNDAMENTAL ELECTROCHEMISTRY



Fundamental research in electrochemistry is one of the most demanding applications with respect to instrumentation. This type of research is aimed at exploring material limits, and therefore requires the most advanced instrument capabilities.

The SP-150 is designed to help scientists perform critical research in electrochemistry such as electron transfer kinetic studies or electrochemical analysis of compounds at low trace levels. Fast potential scans can be used to highlight intermediate species of a reaction. For low current measurements, the excellent sensitivity of the SP-150 with a low current option is a big advantage.

## CORROSION



The SP-150's low current option is ideal for corrosion experiments. With an input impedance of  $10^{14}$  ohms (with 1 pF in parallel), the SP-150 is able to measure low corrosion rates and to provide EIS data on high impedance coatings.

EC-Lab<sup>®</sup> offers many standard techniques and data analysis tools (Tafel and  $R_p$  fits) to study corrosion phenomena (uniform, pitting...).

## ENERGY SOURCES AND STORAGE



The design and the performance of the SP-150 benefits from the long history of previous EC-Lab<sup>®</sup> instrument generations (MacPile and VMP) in the fields of intercalation compounds, battery and super-capacitors study. Many techniques are available for battery cycling in both current and potential control modes. Techniques are now available that allow the simultaneous evaluation of the different elements of a fuel cell stack.

## SENSORS



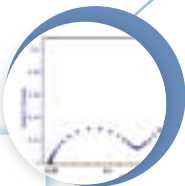
Potentiometric sensors (ion selective electrodes) and amperometric sensors (thin film micro-electrodes or modified electrodes) require good sensitivity to low currents. The SP-150, with its "low-current" option, offers a 76 fA resolution on the 1 nA current range.

Differential and pulsed techniques along with impedance measurements and EC-Lab<sup>®</sup> software analysis tools are especially useful in the development of electrochemical biosensors.

# OPTIONS

## IMPEDANCE

The SP-150 can be outfitted with potentiostats capable of performing Electrochemical Impedance Spectroscopy (EIS). This option provides an integrated sine wave generator and frequency response analyzer built onto the potentiostat board. The frequency range is from 10  $\mu$ Hz to 1 MHz. The potentiostat input impedance is  $10^{12}$  Ohms in parallel with 20 pF. Thus, the SP-150 is suitable for EIS measurements in corrosion experiments or in battery testing and intercalation compounds study. With a low current option, the input impedance increases to  $10^{14}$  Ohms in parallel with 1 pF ideal for thin film study. With an external booster, impedance can be performed on energy devices down to 250  $\mu$ Ohms.



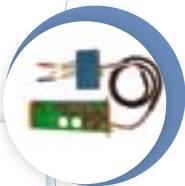
## EXTERNAL CURRENT BOOSTERS

External boosters (installed in a separate chassis) are available to work with the potentiostat channel of the SP-150. Booster channels come in  $\pm 2$  A,  $\pm 5$  A,  $\pm 10$  A,  $\pm 20$  A,  $\pm 80$  A and  $\pm 100$  A versions. These boosters are used for applications requiring high currents such as battery or fuel cell testing, electrochemical synthesis, electroplating or some corrosion applications.



## LOW CURRENT

The low current option can be added in series with the potentiostat channel and requires one slot. It extends the current range of the SP-150 down to 1 nA full scale with a resolution better than 100 fA. Electro-analytical detection can be performed to sub-picoAmp levels. The use of EIS measurements can be extended to the applications of thin film and high impedance coatings.



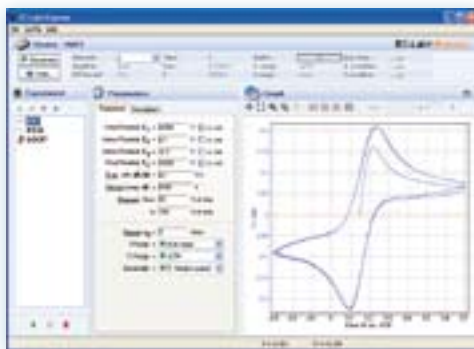
## EC-LAB<sup>®</sup> EXPRESS: EASY TO LEARN SOFTWARE FOR NEW USERS

More than 30 techniques with up to 100 sequences can be linked in EC-Lab<sup>®</sup> software.

This software is very easy-to-use. The settings and graph are shown on one screen view. An experiment selector enables the user to quickly switch between techniques.

The **SP-150**'s advanced digital design allows the user to set data sampling and recording conditions without any limit on the number of data points taken. The **SP-150** operates independently from the PC during an experiment.

With this software the **SP-150** is able to perform EIS measurements simultaneously on the working and on the counter electrodes.



### TECHNIQUES

**Voltammetric techniques**  
OCV, CV, CVA, CA, CP, Potentio/Galvano Dynamic

**Pulsed techniques**  
DPV, DNPV, SWV, DPA

**Corrosion**  
Linear and Cyclic Polarization, Generalized Corrosion, Pitting, ZRA

**Impedance**  
PEIS, GEIS, SPEIS, SGEIS

**PEM stack**  
Polarization, PEIS, GEIS  
Loop

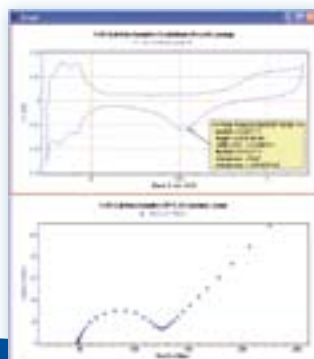
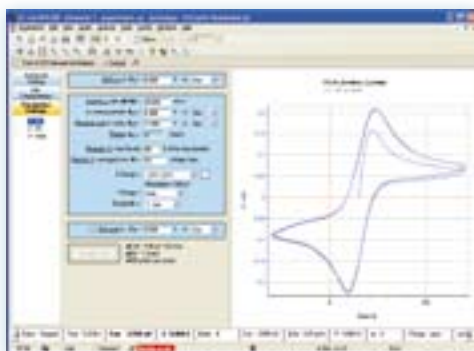
## EC-LAB<sup>®</sup>: MODULAR AND POWERFUL FOR ADVANCED USERS

Over 50 techniques are now available. The user can also create new protocols with the "technique builder".

Two view modes are available in flow charts and in columns. Many parameters can be modified during the run, with the changes stored into the raw data file.

Active data can be shown in multiple graph windows, each with a double y-axis view. The axes (unit, scaling), color and style, and other graphic properties can be modified easily.

The user can use multiple graph windows to show the active experiment while analyzing previously stored data.



**Voltammetric techniques**  
OCV, CV, CVA, CA, CP, SV, LASV, ACV

**Impedance Spectroscopy**  
GEIS, PEIS, SGEIS, SPEIS (Mott-Schottky)

**Pulsed techniques**  
DPV, SWV, DPA, DNPV, NPV

**Technique builder**  
Modular Potentio/Galvano, Loop, Trigger in/out, Wait

**Ohmic drop determination**  
MIR, ZIR, Current Interrupt

**Battery**  
GCPL (1 to 5), PCGA, CLD, CPW, APGC, Urban cycle simulation

**Corrosion**  
Linear and Cyclic Polarization, Generalised Corrosion, Pitting, ZRA, ZVC, Corrosimetry, VASP, CASP

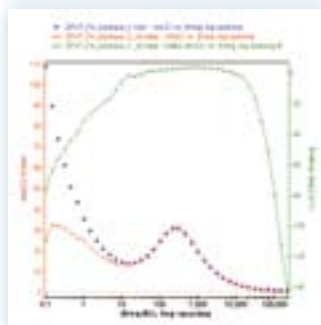
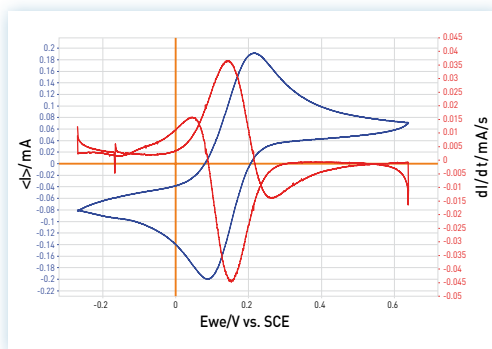
**Fuel cell/photovoltaic**  
I-V characterization, CLD, CPW

## ANALYSIS TOOLS

EIS modelling is included using the well known circuit descriptor code approach.

More than 140 circuits with two minimization algorithms are available. The user can define and built his own circuit using a range of eight elements (R, C, L, Q, W, G, Wd, M). This tool is able to fit successive EIS data cycles.

Analysis tools (peak, convection wave, integral), with classical fits (linear, circular) and processes are available with both **EC-Lab®** modes.



- Linear Fit
- Tafel Fit with minimization
- Circular Fit
- Rp Determination
- Min/Max Determination
- Integral Calculation
- Derivative Calculation
- Peak Analysis
- Wave Analysis (convection)
- Mott-Schottky
- Impedance data Fitting
- Pseudocapacitance
- Impedance Simulation
- Kramers-Kronig
- Statistical Processes
- File subtraction
- Numerical filtering
- Fourier Transform
- Interpolation
- Electrochemical Noise Analysis

## SPECIFICATIONS

### Cell control

Connection	2, 3, 4 or 5 terminals (+ ground)
Compliance	20 V adjustable from $\pm 10$ V to 0-20 V
Maximum current	$\pm 800$ mA continuous
Maximum potential resolution	300 $\mu$ V on 20 V programmable down to 5 $\mu$ V on 200 mV
Maximum current resolution	0.004% of the dynamic range 760 pA on the 10 $\mu$ A range
Accuracy (DC)	< 0.1% FSR*
Rise time	(10% - 90%) < 2 $\mu$ s (No load)
Acquisition time	20 $\mu$ s

### Current measurement

Ranges	Automatic on every range $\pm 10$ $\mu$ A to $\pm 800$ mA (7 ranges)
Maximum resolution	0.004% of the range
Acquisition speed	200,000 samples/second
Accuracy (DC)	< 0.1% FSR*

### Potential measurement

Ranges	$\pm 2.5$ V, $\pm 5$ V, $\pm 10$ V, $\pm 10$ V adjustable
Maximum resolution	0.0015% FSR*, down to 75 $\mu$ V
Acquisition speed	200,000 samples/second
Accuracy (DC)	< 0.1% FSR*

### Electrometer

Inputs	3 potential measurements
Impedance	> $10^{12}$ ohms in parallel with < 20 pF
Bias current	< 5 pA

### Additional inputs/outputs

2 Analog inputs	16 bits resolution with automatic $\pm 2.5$ V, $\pm 5$ V, $\pm 10$ V ranges
1 Analog output	$\pm 10$ V
1 External trigger input	TTL Level
1 External trigger output	TTL Level

### General

Dimensions	435 x 335 x 95 mm
Weight	7.2 kg
Power	85-264 V, 47-440 Hz
PC configuration	Windows 32 bits

## IMPEDANCE (Z) OPTION

### Impedance

Frequency range	10 $\mu$ Hz to 1 MHz (accuracy: 1%, 1°)
Amplitude	1 mVpp to 1 Vpp 0.1% to 50% of the current range

## LOW CURRENT OPTION

### Cell control

Maximum current	$\pm 100$ mA continuous
Maximum current resolution	0.004% of the dynamic range, programmable: 76 fA on the 1 nA range
Applied current accuracy	< 1% FSR* on the 1 nA range < 0.5% FSR* on the 10 nA range < 0.1% FSR* on the other ranges

### Current measurement

Ranges	$\pm 1$ nA, $\pm 10$ nA, $\pm 100$ nA, $\pm 1$ $\mu$ A
Maximum resolution	0.004% of the range down to 76.3 fA
Accuracy	< 1% FSR* on the 1 nA range < 0.5% FSR* on the 10 nA range < 0.1% FSR* on the other ranges

### Electrometer

Impedance	$10^{14}$ ohms in parallel with 1 pF
Bias current	60 fA typical, 150 fA max at 25 °C
Bandwidth	1 MHz

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\* FSR: Full Scale Range  
Specifications subject to change