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 **BioLogic**

Catalog

# Electrochemistry instruments.







As one of the world's foremost designers and manufacturers of high-performance electrochemical measurement instruments, BioLogic has forged its place as a leader in its field.

A comprehensive product portfolio covers cutting-edge products and accessories across every possible area of electrochemistry including battery, fuel cell/electrolyzer and material testing.

And a culture of innovation, continuous improvement and a commitment to customer satisfaction helps BioLogic continue to develop high-performance products that meet the needs of industry and science.



The quality, reliability, and innovation that lies behind BioLogic's product portfolio help shape the future of innovative projects around the world.

Our close proximity with both academic and industrial users helps us understand our clients' needs and develop solutions that truly make a difference – through a marriage of cutting-edge, reliable, high-performance hardware and innovative, user-friendly software.

Our highly qualified support engineers will first work closely with you to fully understand your project and your needs.

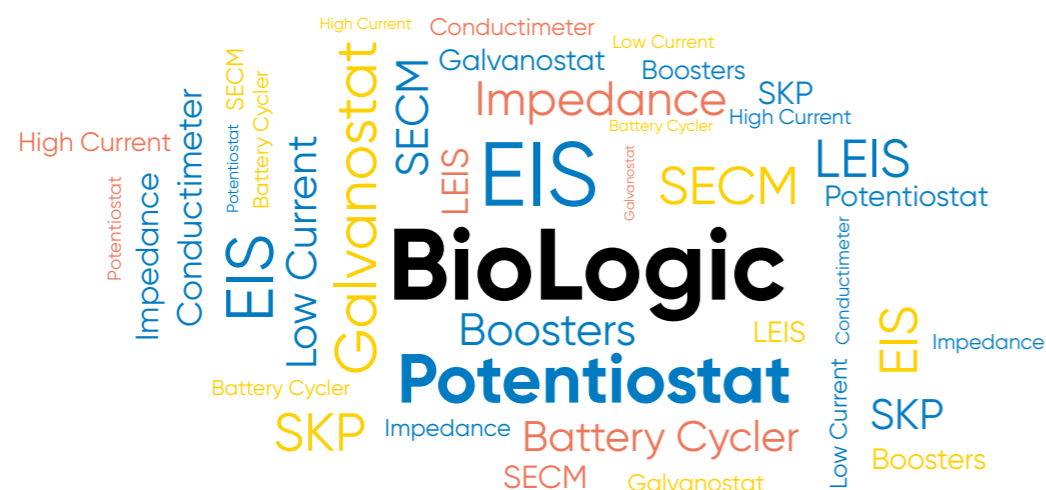
Only then will we start to develop a modular, user-friendly, high-performance measurement solution; one supported by a global technical support network.

So, wherever you are and whatever your field of electrochemistry, BioLogic can provide you with the measurement solution you need to take your research to the next level.

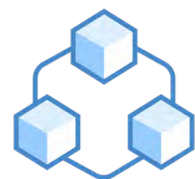
Shaping the future.  
Together.



# A unique and comprehensive range of products.



## Modular systems



- Single to multichannel
- High current boosters up to 800 A
- Extended voltage range up to 60 V
- Low current options (down to aA)
- Multiple user systems
- ARG (Analog Ramp Generator) to perform analog voltage ramp
- Scanning workstations with up to 9 different local techniques (dc-SECM, ac-SECM, LEIS, SKP, SVET, etc.)
- Fully featured impedance analyzer with temperature control

## Controlled by a powerful suite of software



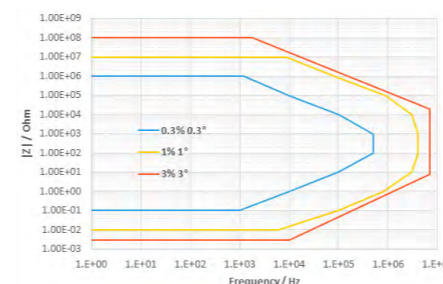
- Intuitive user interface
- Preset techniques for typical electrochemical applications
- Multi-technique experiment builder
- External device control
- Multiple graph display
- Data analysis & fit
- Safety & experimental limits
- Software calibration



# Electrochemical Impedance Spectroscopy

A leader in Electrochemical Impedance Spectroscopy (EIS) technologies, BioLogic strives to place EIS within every researcher's reach, by making it available on all of its instruments.

Integrated EIS makes the transition between AC and DC techniques smooth and flawless. Control techniques on AC sine waves can be superimposed on a DC potential or a DC current value. Additional techniques are also available that impose the sine wave on a varied potential (SPEIS, also known as Mott Schottky technique) or a current (SGEIS) values.



EIS contour plot of SP-300 with standard cable (1.75 m)\*

Finally, sequenceable EIS techniques can be applied to different defined conditions during the frequency sweep. Accuracy is given by the error observed on the phase of impedance module to magnitude. Most of our potentiostats come with a specification of 1%, 1° accuracy below 500 kHz. With the SP-300 potentiostat providing the highest performance reading 0.3%, 0.3°.

## Modeling

BioLogic software offers ZFit, a modeling tool for equivalent circuit fitting. Fourteen elements and two minimization algorithms (DownHill Simplex and Levenberg-Marquardt) are available to analyze impedance data.

\*BioLogic records contour plot data using standard 1.75 m cables as they are more representative of everyday use (even better results are achievable with shorter cables).

- Patented and unique transient state correction technique
  - Drift correction
- Validate EIS measurements quickly and easily with BioLogic Quality Indicators
  - THD: Total Harmonic Distortion quantifies the linearity of the response
  - NSD: Non-Stationary Distortion indicates the effect of time-variance and transient regime
  - NSR: Noise-to-Signal Ratio ensures the signal is large enough compared to measurement noise





## Potentiostat/Galvanostats.

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## Impedance Analyzer.

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Single



## SP-200

### Portable potentiostat/galvanostat

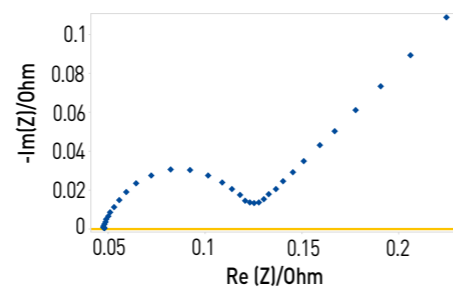
The SP-200 is a **500 mA** research grade potentiostat/galvanostat for users who need to work their budget hard. With the **80 fA** accuracy ultra-low current option, it is the ideal instrument for applications in electrochemistry, particularly corrosion. The SP-200 offers a floating mode, analog filtering and a built-in calibration board.

Additionally, the SP-200 can be purchased with a standard DC potentiostat or an EIS capable one. There is also an Ultra Low Current (ULC) option. On-site experiments can be easily performed thanks to its portable design.

## SP-240

### 4 A of power crammed into a compact chassis

SP-240 is a **4 A** portable potentiostat/galvanostat with EIS. Its integrated booster makes it the perfect instrument for any application in electrochemistry, especially energy device testing.



## SP-300

### Fast, sensitive, stable and modular

The SP-300 is a **500 mA to 10 A** state-of-the-art research grade potentiostat/galvanostat with integrated EIS and remarkable specifications such as 7 MHz max EIS frequency, floating mode, analog filtering, built-in calibration board, and stability bandwidths.

The SP-300's modular chassis accepts an optional high current/high-voltage option board.

Alternatively, the SP-300 can accept a second potentiostat board (either standard or EIS) and function as a Bipotentiostat. It is also a multiple user system as each channel board can be used independently by two different researchers.

### Applications

- General electrochemistry
- Sensors
- Corrosion
- Coatings
- Materials
- Batteries
- Electrolysis/anodizing
- Energy

### Options

- Ultra Low Current: Accuracy down to  $\pm 100$  fA on 1 pA range
- Built-in EIS analyzer: up to 7 MHz
- Analog Ramp Generator: 1 MV/s, acquisition 1  $\mu$ s
- HCV-3048

### Options

- Ultra Low Current: Accuracy down to  $\pm 100$  fA on 1 pA range
- Built-in EIS analyzer: up to 7 MHz
- Internal boosters:
  - $\pm 1$  A/ $\pm 48$  V,  $\pm 2$  A/ $\pm 30$  V,
  - $\pm 4$  A/ $[-3;14]$  V,  $\pm 10$  A/ $[-1;6]$  V
- HCV-3048
- Bi-potentiostat
- Analog Ramp Generator: 1 MV/s, acquisition 1  $\mu$ s

### Applications

- General electrochemistry (RRDE measurements)
- Sensors
- Corrosion
- Electrolysis/anodizing
- Coatings
- Energy



## Premium Potentiostat/Galvanostats

Multi



## Premium Boosters



### VSP-300

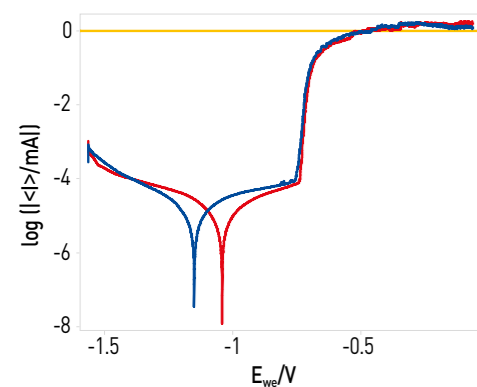
#### Small footprint, multichannel potentiostat

The VSP-300 multichannel potentiostat/galvanostat with integrated EIS is a versatile instrument offering **6 slots**.

Each channel board can accommodate an Ultra Low Current cable and can be associated with one or several booster kits. Up to 4 booster boards can be plugged in parallel in one VSP-300 chassis.

#### Applications

- Batteries/supercapacitors
- Fuel/photovoltaic cells
- General electrochemistry
- Corrosion
- Sensors
- Materials
- Energy storage



#### Options

- Ultra Low Current: Accuracy down to  $\pm 100$  fA on 1 pA range.
- EIS measurement: up to 7 MHz
- Analog Ramp Generator: 1 MV/s, acquisition 1  $\mu$ s
- Internal boosters:
  - $\pm 1$  A/ $\pm 48$  V
  - $\pm 2$  A/ $\pm 30$  V
  - $\pm 4$  A/ $[-3;14]$  V
  - $\pm 10$  A/ $[-1;6]$  V
- HCV-3048
- Additional potentiostat/galvanostat/EIS

### VMP-300

#### The ultimate multichannel potentiostat

The VMP-300 is the most modular chassis of the range, offering **16 slots** for potentiostats /galvanostats with integrated EIS boards and or booster boards.

They can be combined according to user needs either to reach high currents, or to drive many measurements at the same time on all channels.

EIS measurements can be added as an option. The built-in EIS has a wide frequency range up to 7 MHz.

Low current sensitivity can be improved using the Ultra Low Current option.

All multichannel potentiostats are multiple user systems. Thanks to the Ethernet LAN connection capability, several computers can be connected to the unit at the same time.

### HCV-3048

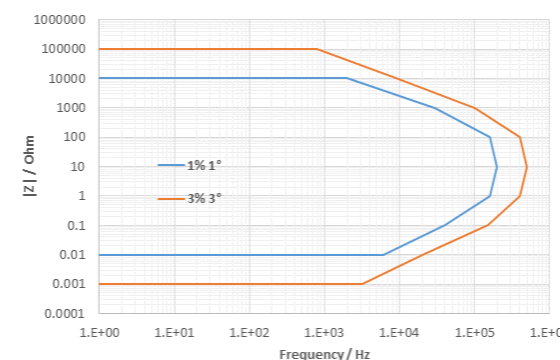
#### An unparalleled combination of power and speed

The HCV-3048 is designed for battery stack/pack characterizations. The continuous maximum current of  **$\pm 30$  A** for a single unit can be extended up to  **$\pm 120$  A** by connecting four units in parallel. The control voltage range is **0-48 V**.

**Impedance spectroscopy (EIS)** provides valuable information on energy storage and conversion products, helping to identify the kinetic properties of multiple processes within the device under test. The HCV-3048 brings unmatched insight to high-power systems.

#### Features

- Max current  $\pm 30$  A
- Voltage range 0-48 V
- EIS up to 500 kHz
- Stackable  $\pm 120$  A



### Internal boosters

#### High current and high-voltage boosters

A range of internal boosters has been designed to increase the current and the voltage specifications of the **SP-300, VSP-300, VMP-300**. Four models are available (see below).

Depending on the instrument chassis, several similar boosters can be connected in parallel to expand the maximum current of the system, up to 150 A.

#### Configurations

- $\pm 1$  A/ $\pm 48$  V
- $\pm 2$  A/ $\pm 30$  V
- $\pm 4$  A/ $[-3;14]$  V
- $\pm 10$  A/ $[-1;6]$  V

#### Features

- Autoranging: exploit existing current range plus the new booster range
- EIS capability up to 2 MHz
- Plug-in modules
- Plug-and-play
- 5-lead connection type
- Parallel boosters to increase max current



Single



Multi



## SP-50e

### Affordable and easy-to-use

The **SP-50e** is a robust, single-channel, general-purpose electrochemical workstation, perfectly suited to both general electrochemistry research needs as well as teaching.

A  $\pm 1$  ampere capable range makes the SP-50e perfect for energy-based applications including battery, supercapacitor, fuel cell, and electrolysis research.

Powered by EC-Lab®, widely recognized by leading scientists as the benchmark control and analysis software for potentiostat/galvanostats, users are able to exploit a wide range of functions covering not just potentiostat control, but electrochemical analysis as well.

There is no need to split tasks across different software applications. Everything can be found in one place – simplifying your professional life, and saving you precious research time. All this, in a compact potentiostat with a reduced laboratory footprint, opening up space on the laboratory bench.

### Applications

- Education/training
- General electrochemistry

### Options

- Built-in EIS analyzer: up to 1 MHz
- RDE control kit

## SP-150e

### A research grade workstation

The **SP-150e** is a potentiostat designed to grow with your research needs. This two-channel, EIS-capable workstation is perfect for a wide range of general electrochemistry applications, but the  $\pm 1$  A current range makes it especially suitable for energy applications including battery, supercapacitor, fuel cell (RRDE compatible), and electrolysis research.

But should you need more power, this versatile instrument will grow with your research needs. The SP-150e is the only ampere workstation to boast high-current capability (800 A with boosters), three EIS quality indicators (THD, NSD, NSR) for EIS validation, and Ethernet compatibility for improved group-working.

It can also be connected to external high current boosters (2, 5, 10, 20, 80 and 100 A) or the FlexP series (see page 16).

### Applications

- General electrochemistry
- Sensors
- Corrosion
- Energy sources
- Coatings

### Options

- Additional potentiostat/galvanostat/EIS
- Built-in EIS analyzer: up to 1 MHz
- External current boosters: Up to 800 A
- RDE control kit

## VSP-3e

### Tailor-made for energy applications

A research-grade multichannel potentiostat/galvanostat, the VSP-3e is purpose-built to meet the demands of energy research applications. With space allocated for up to eight channels, the instrument is flexible enough to meet the demands of researchers and R&D specialists alike. And with  $\pm 1$  A (expandable up to 800A with boosters), Ethernet LAN for improved multiple user/PC connectivity and built-in EIS, the instrument is especially suited to battery research applications.

Energy-specific functionality unique to BioLogic includes:

- Fast CCCV shift (constant current, constant voltage)
- Stack mode (follow individual elements in the pack)
- BCD (Battery capacity determination)
- Automatic plotting for Coulombic efficiency

### Options

- Built-in EIS analyzer: up to 1 MHz
- External current boosters: Up to 800 A
- Internal  $\pm 4$  A booster kit for VSP only
- SAM 50 for stack (50 V) measurement (up to 30 elements with three SAM-50)
- Additional potentiostat/galvanostat/EIS

## VMP-3e

### 16-channel benchmark workstation

A research-grade multichannel potentiostat/galvanostat, the new VMP-3e's modular design, makes it perfect for wide-ranging applications. However, the ability to connect each potentiostat/galvanostat to an external high-current (up to 800 A) booster channel makes it especially suitable for battery research/testing. A standard voltage range of  $\pm 10$  V is extendable to -20 V to +20 V.

For high-end EIS measurements, a 1 MHz specification is complemented by BioLogic Quality Indicators, a feature previously only available on BioLogic Premium instruments. Additional features include CE to GND mode, unique to BioLogic, which enables users to choose from independent channel or multi-electrode configurations and LAN connectivity to improve multi-user working.

### Applications

- Electroanalytical
- General electrochemistry
- Corrosion
- Sensors
- Energy sources
- Energy storage
- Batteries
- Coatings





## VSP

### Affordable, research-grade multichannel potentiostat/galvanostat

The VSP is a research-grade potentiostat system in a **5-channel** modular chassis. Options include EIS capability, 4 A current booster and additional potentiostat channels.

The internal 4 A option takes two slots in the VSP chassis and requires a potentiostat board. External boosters from 2 A up to 800 A can be used with each channel in the VSP.

### Applications

- Electroanalytical
- General electrochemistry
- Corrosion
- Sensors
- Energy sources
- Energy storage
- Batteries
- Coatings

# How to make reliable EIS measurements

Three quality indicators are available in EC-Lab® to ensure the reliability of EIS measurements.

## Total Harmonic Distortion (THD)

THD indicates if the amplitude of the current or potential modulation applied to the system is small enough to consider that the system behaves linearly. If it behaves non-linearly, the output signal will contain some harmonics. THD quantifies the non-linearity by evaluating the amplitudes of the N harmonics. THD is expressed as a percentage. Generally, it is considered that a THD below 5 % is acceptable. In EC-Lab®, it is calculated on the potential and on the current and over 7 harmonics including the fundamental.



Linearity

$$THD_N = \frac{1}{|Y_f|} \sqrt{\sum_{k=2}^N |Y_k|^2}$$

## Non-Stationary Distortion (NSD)

We can distinguish two causes for the non-stationarity of a system: i) the response of the system has not reached its permanent regime; ii) the parameters defining the system are changing with time. The response of a non-stationary system will contain, in addition to the fundamental frequency, some adjacent frequencies. NSD is expressed as a percentage and calculated on the potential and on the current.



Stationary

$$NSD_{\Delta f} = \frac{1}{|Y_f|} \sqrt{|Y_{f-\Delta f}|^2 + |Y_{f+\Delta f}|^2}$$

## Noise to Signal Ratio (NSR)

In an ideal EIS measurement, all the signal energy is contained in the fundamental frequency, but because of various factors such as the accuracy and precision of the measuring device or external perturbations, there might be some energy in other frequencies than the fundamental frequency, the harmonics and the adjacent frequencies. In this document, this additional signal is called noise. It represents all the signals not contained in:




- The fundamental frequency,
- The 7 harmonics used to calculate THD
- The signal at frequencies adjacent to the fundamental frequency used to calculate NSD.



Noise to signal Ratio

$$NSR_f = \frac{1}{|Y_f|} \sqrt{\sum_k |Y_{k\Delta f}|^2}$$

## How do I use them?

Observation	Reason	Solution
High THD	Your system is not linear 	Decrease the perturbation amplitude of the input signal
High NSD	Your system is not yet stationary 	Increase the time of the rest period before the EIS measurement
High NSR	Your output signal is too small 	Increase the perturbation amplitude of the input signal



## FlexP external booster

### Power EIS with FlexP

EIS provides valuable information about working electrical devices. It helps identify the kinetic properties of multiple processes within the device under test.

Power EIS brings unmatched insight to very high-power units that have been out of reach until now. Driven by SP-150e, VSP, VSP-3e or VMP-3e potentiostat/galvanostats, the FlexP brings unparalleled electrochemical knowledge and methodology to high-power applications.

### Configurations

- 60 V/50 A with the FlexP0060 to address battery pack characterization
- 12 V/200 A with the FlexP 0012 to address electrolyzer and fuel cell/electrolyzer characterization



### Features

- Voltage up to 60 V
- Current up to 200 A
- Parallel ability (x4)
- 10 kHz - 1 mHz EIS capable
- Up to 2.4 kW continuous with water cooling
- Cell temperature measurement included

## Internal & external Boosters

### Deliver more power to your application

SP-150e, VSP, VSP-3e and VMP-3e potentiostats can be interfaced to a separate current booster unit. These modular booster units can be filled with different booster boards (2, 5, 10, or 20 A). The standard booster chassis offers 8 available booster slots, each of them connected to a potentiostat board.

For higher current, 80 and 100 A booster units are available. They also exist as stand-alone systems (HCP-803, HCP-1005 see page 17).

### Configurations

- External:
  - ±2 A, ±5 A, ±10 A, ±20 A on ±10 V adjustable from -20 to +20 V
  - ±80 A on ±3 V
  - ±100 A on [0.6 - 5] V
- Internal kit (only for VSP):
  - ±4 A ±10 V adjustable from -20 to +20 V



## HCP-803

### High current potentiostat for supercapacitors and fuel cells

The HCP-803 is a High Current Potentiostat capable of handling **±80 A** with a voltage range of **±3 V**. It is primarily designed for applications in the fuel cell/electrolyzer and supercapacitor areas.

It is a combination of a research quality potentiostat and an 80 A booster built into the same chassis. The potentiostat has the same specifications as the VMP-3e potentiostat boards (with EIS option) when not connected to the booster portion of the unit.



### Applications

- Fuel cell/Electrolyzer
- Photovoltaic systems
- Supercapacitors
- Electroplating
- Battery

## HCP-1005

### More power for battery testing

The HCP-1005 is a compact High Current Potentiostat specially designed to study high capacity secondary batteries. With a voltage range of **0.6 to 5 V** and a current range of **±100 A**, this unit can be used to test Li-ion high current cells. The EIS capability integrated in the chassis is ideal for aging tests.

The HCP-1005 structure is similar to the HCP-803. It combines a research potentiostat and a 100 A booster built into the same chassis.



### Applications

- Lithium-ion
- Nickel-Cadmium
- Nickel-Metal hydride
- Battery

### Features

- Booster range included in the autoranging (for boosters up to 20 A)
- EIS capability
- Plug-in module or external chassis
- Plug-and-play
- 5-lead connection type



# EC-Lab®

## As powerful as it is user-friendly

Your hardware is only ever as good as your software. With 20 years of constant development, EC-Lab, BioLogic's proprietary, patented software has become the benchmark for potentiostat control software.

### Display mode

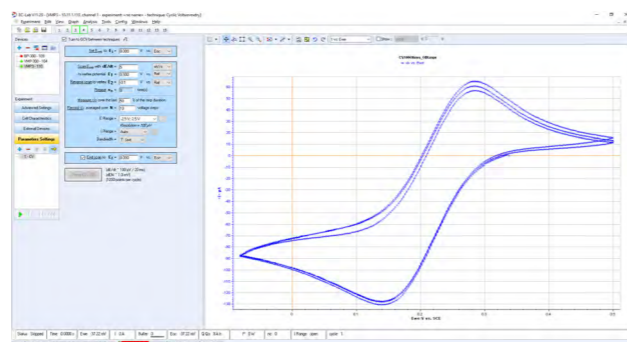
Most of the experimental parameters can be **modified "on the fly"** during the experiment, with the changes stored into the raw data file. The software interface is **adjustable** to create the best possible working environment for the user. EC-Lab's graphics package provided with the software includes a powerful 3D plot feature and a tool to create **unique graph templates**. Using our advanced "Process" function, the user can create new variables for each axis. This enables mathematical functions to be performed on data plotted **on any axis** (x, y1 and y2).

### Experiment sequence builder

**EC-Lab®** software contains more than **80 techniques**. These techniques can address applications in voltammetry, EIS, corrosion and energy source/storage development. A **powerful technique builder** can execute a series of different modular techniques as well as wait and loop tasks to create complex experimental sequences. Moreover, within each technique, the user can create **up to 100 linkable sequences** of an experiment with different parameters. An email can be sent to the user, if desired, to inform him/her when a certain step of the experiment has been reached. Battery cycling can be synchronized with a **temperature control unit**.

### EIS measurements

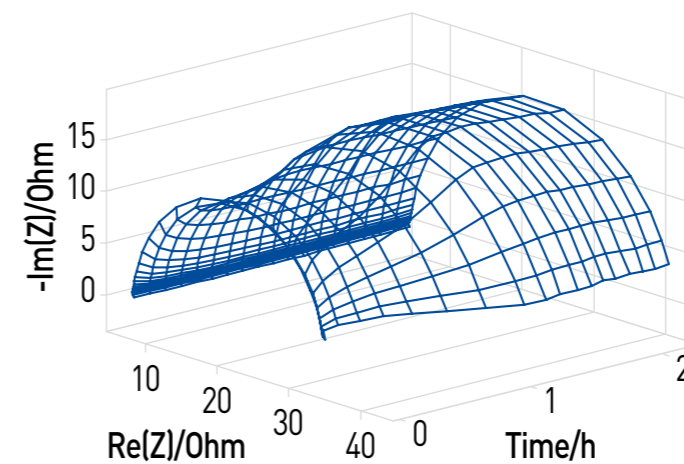
EIS measurements can be made in both controlled potential and controlled current modes from 10 μHz to 7 MHz. The patented **"drift correction"** algorithm and multiple stability parameters allow users to acquire high-quality data from their EIS measurements.



- Impedance spectroscopy
- General electrochemistry
- Electro-analytical
- Corrosion
- Battery
- Super-capacitor
- Fuel cell/Electrolyzer
- Photovoltaic cell

#### EC-Lab® provided with...

- Single potentiostat / galvanostats: SP-50e, SP-150e, SP-200, SP-240, SP-300
- Bipot: SP-150e, SP-300
- Multi-potentiostat / galvanostats: VMP-300, VSP, VMP-3e, VSP-300, VSP-3e
- High current potentiostat / galvanostats: HCP-803, HCP-1005
- Battery test stations: MPG2, MPG-205

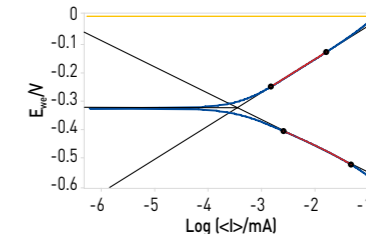


# EC-Lab® Analysis package

## An extended range of analyses

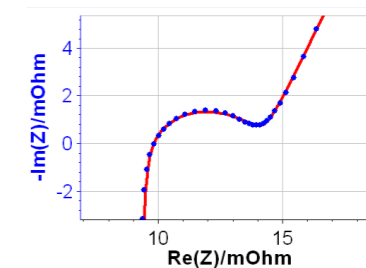
### Display

Powerful electro-analytical analysis tools (such as peak find/height, convection wave, integral, Tafel fit, Rp determination) are available in **EC-Lab®**. These analyses incorporate typical fit routines (linear, polynomial, multi-exponential) and algorithms. All the analysis results are stored in a separate file.



### Fitting

**EC-Lab®**'s EIS modeling package, ZFit, utilizes the equivalent circuit approach. There are over 150 standard circuits and two minimization algorithms available to help understand impedance plot information. The user can define and build his own circuit model using a range of fourteen simple elements (R, C, L, Q, W, G, W<sub>δ</sub>, W<sub>inf</sub>, M, G<sub>α'</sub>, G<sub>β</sub>, L<sub>α'</sub>, M<sub>α'</sub>, M<sub>γ</sub>). The last elements can be assimilated to transmission lines. A batch processing feature allows the fitting of multiple cycles in an impedance experiment. Cable effects can be compensated by using cable compensation tool.



### Simulation

Several tools are available to simulate CV curves, Tafel plots or EIS data. They can be used as training tools. CV Sim allows the user to create data with different mechanisms such as single (E) or multi (up to EEEEE) electron transfer. Electron transfer reactions can also be mixed with chemical reactions to simulate an EC mechanism.

- General electrochemistry
  - Peak Analysis...
  - Wave Analysis...
  - CV Fit...
  - Levich...
  - Koutecky-Levich...
- Corrosion
  - R<sub>p</sub> Fit...
  - Tafel Fit...
  - Electrochemical Noise...
  - Corr Sim...
  - VASP Fit...
  - CASP Fit...
- EIS
  - Z Fit...
  - Z Sim...
  - Mott-Schottky...
  - Compensation...
  - Kramers-Kronig...
- Battery process
  - Process data (capacity, efficiency, energy...)
- Photovoltaic
  - Photovoltaic analysis (fill factor, efficiency...)
- Math
  - Polynomial Fit...
  - Multi-Exponential Fit...
  - Line Fit...
  - Subtract Files...
  - Integral...
  - Min Max...
  - Filter...
  - Fourier Transform...
  - Linear Interpolation...



## Channel Specifications

	Premium	Essential
<b>General</b>		
EIS capability	10 μHz to 7 MHz	10 μHz to 1 MHz
EIS Quality Indicators	yes	yes (with "e" type channel board)
Analog Ramp Generator	yes (1 MV/s), sampling rate 1 μs	n.a.
Floating option	Floating, WE to Ground, CE to Ground	CE to Ground
Permeation (WE to Ground)	Yes	No
Multi-electrode (CE to Ground)	Yes	Yes
Filters	hardware/software	software
Acquisition time	12 μs (1 μs with ARG option)	20 μs
Electrodes connections	2, 3, 4, 5	2, 3, 4, 5
IR compensation	manual, EIS, current interrupt (software and hardware)	manual, EIS, current interrupt (software)
<b>Current</b>		
Maximum current	±500 mA	±400 mA for VSP ±1A for "e" series chassis
Current ranges	with standard board: 9: 10 nA to 1 A with low current option: 13: 1 pA to 1 A	6: 10 μA to 1 A N.A.
Lowest accuracy	with standard board: ±100 pA on 10 nA range with low current option: ±100 fA on 1 pA range	±20 nA on 10 μA range N.A.
Lowest resolution	with standard board: 0.8 pA on 10 nA range with low current option: 80 aA on 1 pA range	0.8 nA on 10 μA range N.A.
Current booster	internal: 1 A, 2 A, 4 A, 10 A, Up to 150 A external: Premium External: HCV-3048 (30A/48 V)	4 A for VSP only 2, 5, 10, 20, 80, 100 A, FlexP0060, FlexP0012
Input impedance	1 TΩ (//10 pF), ULC: 100 TΩ (//6 pF)	1 TΩ (//20 pF)
<b>Voltage</b>		
Compliance	±12 V	±10 V
Max applied potential	±10 V (±48 V with 1 A/48 V booster)	±10 V adjustable between [-20 ; +20] V
Resolution	1 μV on 60 mV	5 μV on 300 mV
Accuracy	< ±1 mV	< 20 mV
Range	±2.5 V, ±5 V, ±10 V, ±25 mV, ±250 mV	±2.5 V, ±5 V, ±10 V
Maximum scan rate	200 V/s (1 MV/s with ARG option)	200 V/s
<b>Control amplifier</b>		
Potentiostat bandwidth	8 MHz	1 MHz
Potentiostat rise/fall time	< 500 ns	< 2 μs
<b>General</b>		
I/O (analog/TTL)	3/2	3/2
Interfaces	Ethernet, USB 2.0	Ethernet, USB 2.0

n.a.: not available

## Chassis Specifications

Premium	SP-200	SP-240	SP-300	VSP-300	VMP-300
Slots available	1	1	2	6	16
Dimension (WxDxH)	167 x 410 x 225 mm	205 x 410 x 225 mm	205 x 410 x 225 mm	254 x 517 x 337 mm	534 x 565 x 315 mm
Weight	7.2 kg	7.5 kg	7.5 kg	20 kg	30 kg
Power Requirement	350 W	350 W	350 W	650 W	1500 W

Essential	SP-50e	SP-150e	VSP	VSP-3e	VMP-3e
Slots available	1	2	5	8	16
Dimension (WxDxH)	136 x 372 x 209 mm	136 x 372 x 209 mm	435 x 335 x 95 mm	225 x 320 x 405 mm	495 x 465 x 260 mm
Weight	3.9 kg	3.9 kg	8 kg	12 kg	15 kg
Power Requirement	110 W	110 W	300 W	1000 W	850 W

## Applications

	Premium				Essential			
	Std	EIS	ULC*	Booster <sup>(1)</sup>	ARG**	Std	EIS	Booster <sup>(2)</sup>
Education	■	■				■	■	
General electrochemistry	■	■	■			■	■	
Electroanalytical	■	■	■			■	■	
Electro-catalysis	■	■	■	■	■	■	■	■
Nanotechnology/sensors	■	■	■	■	■	■	■	
Battery	■	■		■		■	■	■
Supercapacitor	■	■		■	■	■	■	■
Fuel cell/Electrolyzer	■	■		■	■	■	■	■
Solar cells	■	■		■		■	■	■
Electrolysis				■				■
Pack of cells	■	■		■		■	■	■
Corrosion	■	■	■			■	■	
Coatings	■	■	■	■	■	■	■	
Materials	■	■	■	■		■	■	

For each instrument, modules can be mixed together

■ suitable   ■ recommended   ■ excellent

\* ULC: Ultra Low Current   \*\* ARG: Analog Ramp Generator  
(1): more details on page 11  
(2): more details on pages 16 - 17



## Premium boosters

### Specifications

	±1 A/±48 V	±2 A/±30 V	±4 A/[-3;14] V	±10 A/[-1;6] V	±30 A/[0;48] V
<b>Current</b>					
Compliance	±1 A	±2 A	±4 A	±10 A	±30 A (±120 A with 4 units)
Accuracy	< 2 mA on 1 A range	< 4 mA on 2 A range	< 8 mA on 4 A range	< 20 mA on 10 A range	< 150 mA on 30 A range
Auto-ranging	yes	yes	yes	yes	0.3 A; 3 A; 30 A
<b>Voltage</b>					
Compliance	±49 V	±30 V	-3 V ; +14 V	-1 ; +6 V	-1 ; +50 V
Control	±48 V	±30 V	-3 V ; +10 V	-1 ; +6 V	0 ; +48 V
<b>Features</b>					
EIS frequencies	2 MHz - 10 µHz	1 MHz - 10 µHz	1 MHz - 10 µHz	1 MHz - 10 µHz	500 kHz - 10 µHz
Bandwidth (-3 dB)	> 2 MHz	> 3 MHz	> 4 MHz	> 8 MHz	120 kHz
Slew rate (no load)	> 15 V/µs	50 V/µs	50 V/µs	50 V/µs	> 20 V/µs
Rise/fall time (no load)	< 250 ns	< 200 ns	< 200 ns	< 200 ns	< 3 µs
Floating mode	yes	yes	yes	yes	yes
Parallel ability	yes	yes	yes	yes	yes up to 4
Connection	2, 3, 4, 5 leads	2, 3, 4, 5 leads	2, 3, 4, 5 leads	2, 3, 4, 5 leads	2, 3, 4 leads

## Essential boosters

### Specifications

	2/4/5 A	10/20 A	80 A/HCP-803	100 A/HCP-1005
<b>Current</b>				
Compliance	2 A: ±2 A, 4 A: ±4 A, 5 A: ±5 A	10 A: ±10 A, 20 A: ±20 A	±80 A	±100 A
Accuracy	2 A: < 4 mA on 2 A range, 4 A: < 8 mA on 4 A range, 5 A: < 10 mA on 5 A range	10 A: < 20 mA on 10 A range, 20 A: < 40 mA on 20 A range	< 800 mA on 80 A range,	< 1 A on 100 A range
Auto-ranging	yes	yes	no	no
<b>Voltage</b>				
Compliance	±10 V	±10 V	±5 V (At 1 A) ±3 V (At 80 A)	0.6 - 5 V
Control	±10 V adjustable between [-20 ; +20] V	±10 V adjustable between [-20 ; +20] V	±5 V (At 1 A) ±3 V (At 80 A)	0.6 - 5 V
<b>Features</b>				
EIS frequencies	2 A: up to 150 kHz, 4 A: up to 130 kHz, 5 A: up to 125 kHz	10 A: up to 80 kHz, 20 A: up to 30 kHz	up to 20 kHz	up to 10 kHz
Bandwidth (-3dB)	1 MHz	1 MHz	1 MHz	1 MHz
Rise time and fall time (no load)	15 µs (potentio) 40 µs (galvano)	25 to 60 µs (potentio) 50 to 120 µs (galvano)	95 µs (potentio) 150 µs (galvano, 10 mΩ)	1.7 ms (potentio) 4 ms (galvano, 20 mΩ)
Parallel ability	no	no	no	no
Connection	2, 3, 4, 5 terminal leads	2, 3, 4, 5 terminal leads	2, 3, 4, 5 terminal leads	2, 3, 4, 5 terminal leads
<b>General</b>				
1 external input	security to open circuit (TTL level)	security to open circuit (TTL level)	security to open circuit (TTL level) Emergency push button	Security to open circuit (TTL level) Emergency push button

### FlexP 0060

### FlexP 0012

	FlexP 0060	FlexP 0012
<b>Current</b>		
Compliance	50 A up to 200 A (4 in parallel)	200 A up to 800 A (4 in parallel)
Accuracy	0.2% of value ±0.1% FSR < 200 mA at 50 A	0.2% of value ±0.1% FSR < 800 mA at 200 A
<b>Voltage</b>		
Compliance	[-2.5 ; + 60] V (water cooled)	[-2.5 ; 11.9] V (water cooled)
Control	[-2.5 ; + 60] V (water cooled)	[-2.5 ; 11.9] V (water cooled)
<b>Features</b>		
EIS frequencies	10 kHz	10 kHz
Bandwidth (-3dB)	-	-
Rise time and fall time (no load)	< 10 µs	< 20 µs
Parallel ability	yes up to 4	yes up to 4
Connection	2, 3, 4 terminal leads	2, 3, 4 terminal leads
<b>General</b>		
1 external input	embedded (cell temperature and emergency)	embedded (cell temperature and emergency)



## A full range of battery testers



Depending on your application, your requirements for battery/supercapacitor testing can be different (reference electrode required or not, sampling, maximum frequency for EIS, number of channels, etc). BioLogic offers a wide range of testing solutions to match your needs.

**For advanced research measurements,** BioLogic potentiostats/galvanostats are the right choice.

The **BCS-800** series offers the **best in-class performance** of any battery cycler with optional **EIS** and up to **128 channels** in a single cabinet. This high specification and versatility makes it the ideal solution for **advanced high-throughput measurements** as well as common, everyday battery cycling procedures.

The MPG-200 series is an intermediary solution. It offers **research grade** battery testing and can be provided in a rack, with a maximum of 80 channels **to perform many tests simultaneously**. Each channel is an independent potentiostat / galvanostat.

## MPG-200 series

### R&D grade battery test stations

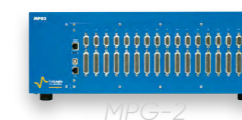
The MPG-200 series is offered in two fixed configurations with or without EIS on every channel:

- MPG-2: 16 channels/100 mA each
- MPG-205: 8 channels/5 A each

The MPG-200 series can be provided in a rack capable of supporting up to 5 units.

Only one computer is necessary to control all units thanks to the solution's Ethernet capability. With this connection, the MPG-200 series can be installed on a Local Area Network to allow multiple users to access instruments and follow battery cycling remotely.

The MPG-200 series offers temperature measurement and three optional connection modes to the battery (battery holder, short or long cables). Each channel has two analog inputs and one analog output to interface with external instruments.



- 16 channels
- 100 mA
- 3 electrodes/5 points



- 8 channels
- 5 A
- 2 electrodes/4 points

### How to choose your battery tester?

	VMP-3e/VMP-300	MPG-200 series	BCS-800 series
Application	High-end research	Research development	High-throughput battery/material screening
Current ranges	1 pA - 150 A	10 $\mu$ A - 5 A	10 $\mu$ A - 120 A
Voltage range	$\pm$ 10 V	$\pm$ 10 V on MPG-2 -2;9 V on MPG-205	0;10 V
EIS frequency range	7 MHz - 10 $\mu$ Hz	100 kHz - 10 $\mu$ Hz	10 kHz - 10 mHz
Built-in EIS	Yes. On each channel	Yes. On each channel	Yes. On each module
Acquisition time	200 $\mu$ s/1 $\mu$ s with ARG option	200 $\mu$ s	2 ms
Electrode connection	2,3-electrode/4-points measurement with CE measurement	2-electrode/4-points measurement 3-electrode/5-points on MPG-2	2-electrode/4-points measurement
HPC measurement	Yes. Down to 6 ppm	Yes. Down to 6 ppm	Yes. Down to 6 ppm
Channels/module	16	16	8
Max Channels/cabinet	-	80	128

### Options

- EIS (100 kHz to 10 $\mu$ Hz)
- Rack (5 units)
- Short (25 cm) or long cables (2.5 & 3 m)
- Temperature probe
- Coin cell, cylindrical and pouch cell holders (see Accessories catalog)
- 5 A booster for MPG 2

### Specifications

- Current ranging: 10  $\mu$ A up to max current with a resolution 0.004% of the range
- Resolution of 300  $\mu$ V programmable down to 5  $\mu$ V by adjusting the dynamic range (100  $\mu$ V resolution on 5 V range)
- Acquisition time: 200  $\mu$ s
- No limit in time and data recording

### Software

Like BioLogic potentiostat / galvanostats, the MPG-200 series is supplied with **EC-Lab® software**. It provides techniques specifically designed for batteries and general electrochemistry applications, such as cyclic voltammetry. An extended range of analyses are also available (capacity, efficiency, energy, etc). Note that **EC-Lab®** allows the control of several VMP-3e/VMP-300 or MPG-200 instruments from one session.



## BCS-800 series

### Battery cycling test stations

Each BCS-800 module is made up of 8 channels. To ensure better accuracy in current control and measurement, **5 current ranges** are available depending on the model.

BCS-815 channels can be connected in parallel to increase the maximum 16 on MPG-2, 8 on MPG-205 current up to **120 A**.

With an 18-bit analog to digital converter for the voltage measurement, the resolution of the BCS-800 is an impressive **40  $\mu$ V**.

EIS-capable modules provide EIS over a frequency range from **10 kHz to 10 mHz** for accurate and fast determination of internal battery resistance on every channel.

BCS-800 modules can be added to a single cabinet. Several sizes are offered (38U, 24U, 12U and 6U).



### Specifications

- Optional high quality EIS: Full scan from 10 kHz to 10 mHz
- 18-bit A/D converter (40  $\mu$ V resolution)
- HPC measurement down to 6 ppm
- Modularity from few  $\mu$ A to 120 A
- Voltage measurement from 0 V to 10 V
- Module mixing (BCS-805/810/815)
- 2 ms acquisition time
- Several cabinet sizes
- Plug-and-play module installation

### Options

#### Connection:

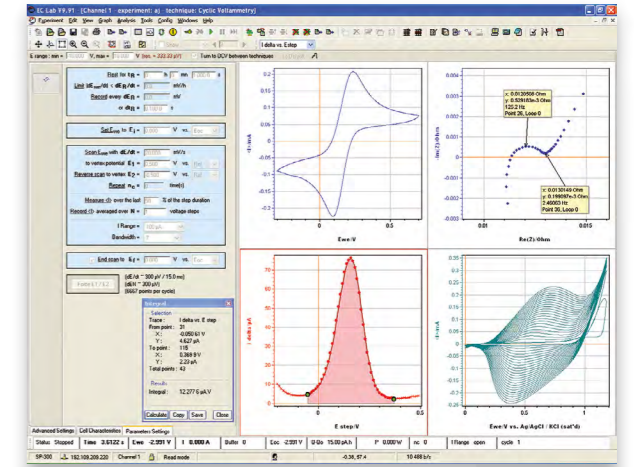
- Cell cable from 25 cm to 10 m
- CCH-1x Coin cell holder
- BH-1i Cylindrical battery holder
- CCH-8 8 positions coin cell holder
- CC8 Current collector to set parallel mode (up to  $\pm$ 120 A)

#### Cabinet:

- Rolling cabinet (38U, 24U)
- Benchtop cabinet (12U, 6U)

BT-Lab<sup>®</sup> provided with...

BCS-805, BCS-810, BCS-815



## BT-Lab<sup>®</sup>

### An interface specifically designed for battery testing

BT-Lab<sup>®</sup> software offers great usability and flexibility for battery cycling. The powerful «ModuloBat» sequence builder offers **15 control modes for easy programming** of unique sequences, while the interface is informative and simple, simultaneously showing the experiment parameters and the corresponding graph of each selected channel.

### Global view

All channels can be viewed **simultaneously** on an advanced global view. The status of each channel is displayed with different colors to give quick, informative, and visual indicators. The time, current, voltage and charge values can be all displayed simultaneously.

### Comprehensive graphic and analysis package

The BT-Lab<sup>®</sup> graphic package is embedded in the software and includes powerful tools to create **graph templates** and analyze data. This package offers a unique trace filtering option by channel. This results in a multigraph window capable of displaying **up to 128 graphs** within a single window. With the advanced graph properties, the user can add and customize new variables for each axis. Powerful analysis tools (dQ/dV, HPC, etc) are also available in BT-Lab<sup>®</sup>.

### EIS capability

BT-Lab<sup>®</sup> software includes the capability for electrochemical impedance spectroscopy (EIS) measurement **on every channel** of EIS-capable modules, in a frequency range of 10 kHz to 10 mHz both in potentiostatic and galvanostatic modes. A **drift correction** option is available to correct the voltage drift of the battery during the EIS measurement.

### ModuloBat

#### 15 control modes:

- Constant Current/Voltage/Power/Resistance
- Voltage/Current Scan
- Galvano/Potential EIS
- DCIR
- Galvano/Potential ACIR
- Current Interrupt
- Rest/Loop
- Urban Profile Import

#### Up to 100 sequences

#### 3 limits per sequence

#### 3 recording conditions per sequence

#### Modify on the fly



# Battery Test Stations & Cyclers

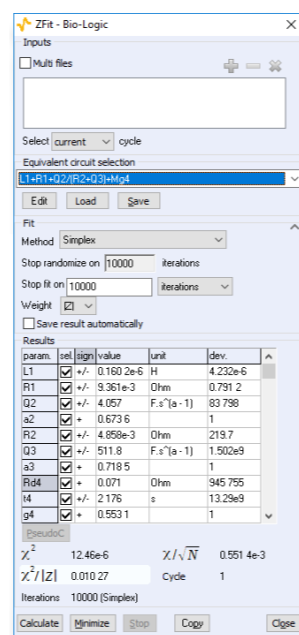
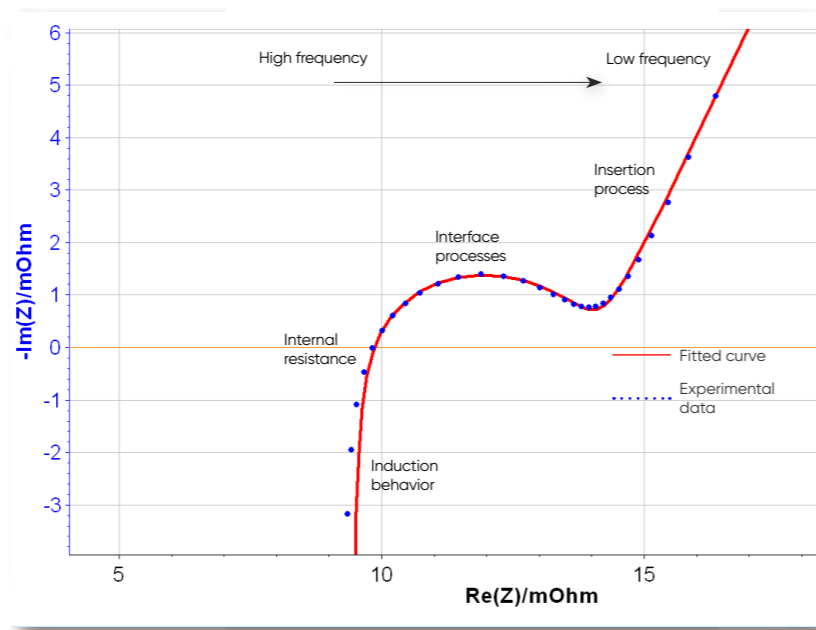
## Why impedance measurement for battery testing?

The BCS-800 series, with its fast bandwidth controllers, offers both **potentio** and **galvano**-control for EIS measurements in a **10 kHz to 10 mHz** frequency range, with a user-specified number of data points and recorded frequency range. The user also controls the excitation amplitude. Impedance spectroscopy can be used as a standalone technique, but it can also be seamlessly incorporated into the ModuloBat technique to record the impedance spectrum of the battery, either in equilibrium or steady-state conditions. This means you not only can record a spectrum of the cell at a constant voltage, but also under a given galvanostatic load.

If there are sources of **uncompensated inductance** or capacitance in the cell, only a full-impedance spectrum can be a reliable measure of internal resistance through an automated spectrum fitting procedure.

The low frequency range of the spectrum is an invaluable source of information concerning Li<sup>+</sup> diffusion within the electrolyte (separator), as well as porosity within electrodes and inside the active material particles.

**18-bit** resolution allows the recording of small-amplitude EIS on top of substantial DC currents with very high levels of accuracy.



## Specifications

	MPG-2	MPG-205
Channels/module	16	8
Cell connection	2, 3, 4 or 5 terminal leads	2 or 4 terminal leads
<b>Cell control</b>		
Compliance	±10 V @ 100 mA	-2 V; 9 V @ 5 A
Maximum current	±100 mA continuous	±5 A continuous
Maximum potential	10 V @ 100 mA	9 V @ 5 A
Potential resolution		300 µV down to 5 µV
Current resolution		0.004% of FSR* / 0.8 nA
Current accuracy		±0.1% of control ±0.01% of FSR*
<b>Voltage measurement</b>		
Ranges	±10 V, ±5 V, ±2.5 V	0 - 5 V, 0 - 10 V
Accuracy		±0.1% of control ±0.01% of FSR*
Resolution		0.004% of FSR*
Acquisition speed		200 µs
Noise (peak to peak 0-100 kHz)		600 µV
<b>Current measurement</b>		
Ranges	±100 mA, ±10 mA, ±1 mA, ±100 µA, ±10 µA, autorange	±5 A, ±1 A, ±100 mA, ±10 mA, ±1 mA, ±100 µA, ±10 µA, autorange
Accuracy		±0.1% of control ±0.01% of FSR*
<b>EIS option</b>		
Frequency range		100 kHz to 10 µHz
Amplitude		1 mVpp to 1 Vpp, 0.1% to 50% of the current range
Mode		Single Sine, Multi Sine, FFT analysis
<b>General</b>		
Dimensions (W x D x H)	260 x 495 x 465 mm	254 x 494 x 454 mm
Power requirements	350 W, 85-264 V, 47-440 Hz	860 W, 85-264 Vac, 47-440 Hz
Weight	17 kg	25 kg

	BCS-805	BCS-810	BCS-815
Channels / module	8	8	8
<b>Voltage</b>			
Range	0 V to 10 V	0 V to 10 V	0 V to 9 V
Control resolution	150 µV	150 µV	150 µV
Measurement resolution	40 µV (18 bit)	40 µV (18 bit)	40 µV (18 bit)
Accuracy	<±0.01% of value ±0.3 mV	<±0.01% of value ±0.3 mV	<±0.01% of value ±0.3 mV
Slew rate	150 kV/s	150 kV/s	3 kV/s
<b>Current</b>			
Max (continuous) per channel	±150 mA	±1.5 A	±15 A
Ranges	5: 100 mA down to 10 µA	5: 1 A down to 0.1 mA	5: 10 A down to 1 mA
Control resolution	Down to 800 pA	Down to 8 nA	Down to 80 nA
Measurement resolution	Down to 0.2 nA (18 bit)	Down to 2 nA (18 bit)	Down to 20 nA (18 bit)
Accuracy	< 0.05% of value ±0.015% of FSR	< 0.05% of value ±0.015% of FSR < 0.1% of value ±0.015% of FSR (1 A range)	< 0.05% of value ±0.015% of FSR < 0.1% of value ±0.015% of FSR (1 A range) < 0.3% of value ±0.04% of FSR (10 A range)
Parallel ability	No	No	Yes Up to ± 120 A with 8 channels
<b>EIS</b>			
Built-in	On each module	On each module	On each module
Range	10 kHz - 10 mHz	10 kHz - 10 mHz	10 kHz - 10 mHz
<b>Measurement</b>			
Thermocouple	n.a	K Type on each channel -25 °C +200 °C with accuracy of ±2 °C	K Type on each channel -25 °C +200 °C with accuracy of ±2 °C
Analog in	1 (18 bit) on each module	1 (18 bit) on each module	1 (18 bit) on each module
Analog out	1 (16 bit) on each module	1 (16 bit) on each module	1 (16 bit) on each module
<b>Cell connection</b>			
	4 terminal leads + Guard	4 terminal leads + Guard	4 terminal leads
<b>General</b>			
Height	1U	2U	4U
Weight	5 kg	10 kg	23 kg
Power consumption	60 W	220 W	1700 W



# Impedance Analyzer.

A wide range of comprehensive solutions.

From impedance analyzer to temperature control units and sample holders



## MTZ-35

### 35 MHz Impedance Analyzer

The **MTZ-35** is an impedance analyzer dedicated to electrical characterization over the frequency range of **10 μHz to 35 MHz**.

The **MTZ-35** can be coupled with the High Temperature Furnace **HTF-1100** and the Intermediate Temperature System **ITS-e** in order to investigate materials properties over a wide temperature range (**-40 °C to 1100 °C**).

Three kinds of sample holders are offered: HTSH-1100 for high temperature use, Controlled Environment Sample Holder CESH-e for intermediate temperature use (-40 °C to 150 °C) and HTCC for liquids/gels materials in the temperature range between -50 °C and 180 °C.

### Applications

- Ceramics
- Solid electrolytes
- Polymers
- Rubbers
- Dielectrics
- Composites
- Solar/photovoltaic cells
- Semiconductors
- Biological cells
- Liquids
- Electronic components

### Specifications

Generator	
Frequency range	10 μHz to 35 MHz
Voltage range DC	100 μV to ±10 V
Voltage range AC	100 μV to 10 V
Measurement ranges	
Inductance	10 nH to 10 kH
Capacitance	1 pF to 1000 μF
Resistance	1 mΩ to 500 MΩ
Basic accuracy	0.1%

# Impedance Analyzer.



ITS-e



HTF-1100

### Temperature Control Unit

	Operating Temp	Features
HTF-1100	RT to 1100 °C	Heating rate adjustable K-type thermocouple
ITS-e	-35 to 150 °C	Temperature accuracy: 0.3 °C PT1000 probes



HTSH-1100



CESH-e on its base

### Sample Holders

	Operating Temp.	Features	Compatibility
HTSH-1100 Φ=25 mm	RT to 1100 °C	Quartz tube for controlled atmosphere Leak tight up to 2 bar relative K-type thermocouple	HTF-1100 Tubular furnaces
HTSH-1100 Φ=12 mm			
HTSH-1100 Φ=03 mm			
CESH-e	-40 to 150 °C	For In-plane and Through-plane electrical measurements	ITS-e and other temperature units
HTCC Platinized	-50 to 180 °C	Cell factor: K= k=1.0 +/- 10% cm <sup>-1</sup> Volume: 0.5 - 1.0 mL	ITS-e and other temperature units
HTCC Non-platinized			

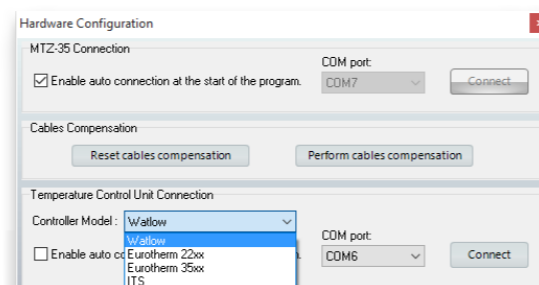
## MT-Lab® Software

**MT-Lab®** is an intuitive software used to control the MTZ-35. It also controls several temperature control units:

- High temperature furnace (HTF-1100)
- Intermediate Temperature System (ITS-e)
- Temperature control systems using Eurotherm 22xx/35xx controllers

### Open circuit/Short circuit compensation

**MT-Lab®** software is provided with a compensation protocol for the compensation of residual impedance due to cell cables and test fixtures.

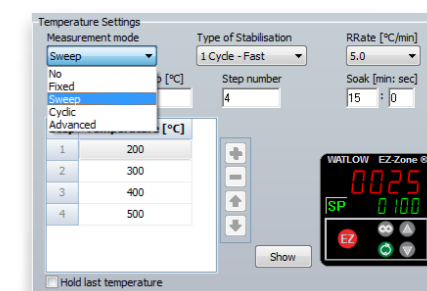


### Temperature control management

Five temperature control modes are available with **MT-Lab®**. The software offers a wide range of heating rates and two temperature stabilization modes (fast and precise) based on closed-loop temperature regulation. Temperature control is optimized. Setpoint temperatures are reachable and adjustable without overshoot.

### A complete graphics package

**MT-Lab®** is very easy-to-use software. The settings and graphs are displayable on one screen view. The software includes numerous graphic tools and advanced tools for equivalent circuit modeling (ZFit). Users can build their own circuit model using a range of 14 electrical elements (R, C, L, Q, L<sub>α</sub>, W, W<sub>d</sub>, W<sub>infr</sub>, M, M<sub>d</sub>, M<sub>g</sub>, G, G<sub>d</sub>, G<sub>B</sub>).

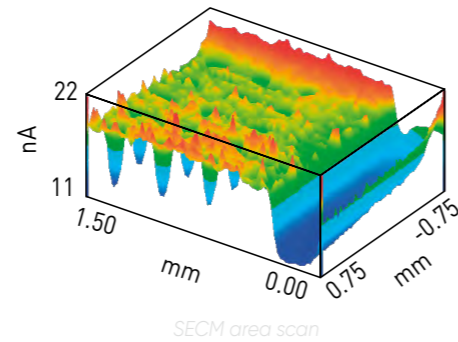
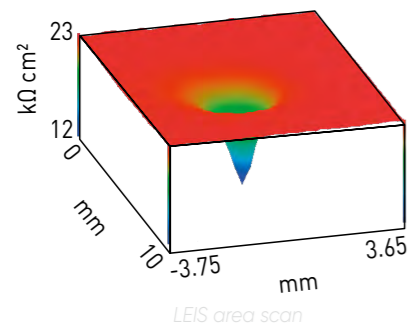


# Scanning Electrochemical Workstation.

## Systems for localized electrochemistry measurement

The traditional potentiostat/galvanostat measures an average response of the electrode material, which is often considered to be homogeneous. However, for more detailed studies, it is interesting to look beyond this homogeneity to study the spatial dependence of electrode properties.

Our modular localized electrochemistry platform can include up to 9 distinct localized measurement techniques. The table below summarizes the techniques, the type of information that can be obtained, the resolution and typical applications.



Scanning techniques	Information	Resolution	Applications	
SECM	Scanning ElectroChemical Microscopy	reactivity, conductivity	probe size	Biology, catalysis, corrosion and coatings, materials, sensors, and sustainable energy, including fuel cells and batteries
ac-SECM	Alternating Current Scanning ElectroChemical Microscopy	reactivity, conductivity, or localized EIS (no mediator required)	probe size	Biology, catalysis, corrosion and coatings, materials, sensors, and sustainable energy, including fuel cells and batteries
ic-SECM	Intermittent Contact Scanning ElectroChemical Microscopy	topography and reactivity or conductivity or localized EIS.	probe size	Biology, catalysis, corrosion and coatings, materials, sensors, and sustainable energy, including fuel cells and batteries
LEIS	Localized Electrochemical Impedance Spectroscopy	local impedance of the sample	hundreds of $\mu\text{m}$	Batteries, and corrosion and coatings
SVP (SVET)	Scanning Vibrating Probe (Scanning Vibrating Electrode Technique)	electrochemical activity	tens of $\mu\text{m}$	Biology, batteries, and corrosion and coatings
SDS (SDC)	Scanning Droplet System (Cell)	dc electrochemistry in a droplet of electrolyte	hundreds of $\mu\text{m}$	Catalysis, corrosion and coatings, and materials
ac-SDS	Alternating Current Scanning Droplet System	impedance in a droplet of electrolyte	hundreds of $\mu\text{m}$	Catalysis, corrosion and coatings, and materials
SKP	Scanning Kelvin Probe	contact potential difference related to work function, and/or corrosion potential/topography	probe size	Corrosion and coatings, materials, and sustainable energy, particularly photovoltaics
OSP	Optical Surface Profiler	topography	100 nm (Z) 30 $\mu\text{m}$ (X & Y)	any field, complementary to the above

# Scanning Electrochemical Workstation.

## M470

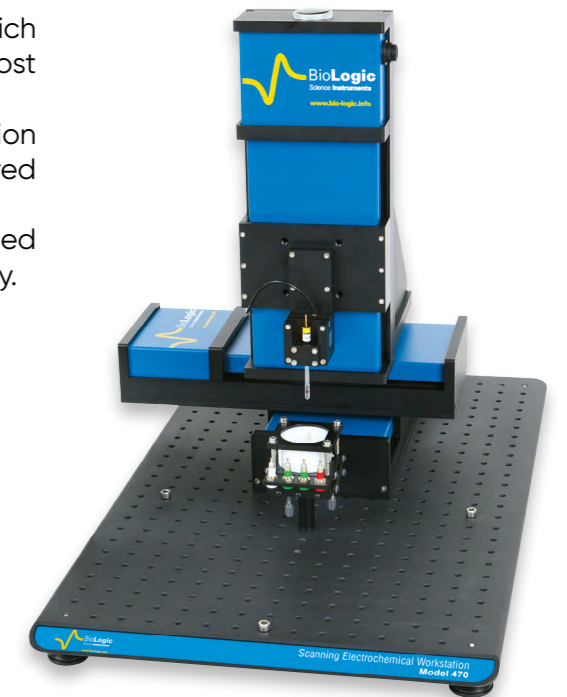
### Ultra-high-resolution scanning stage with multiple modular techniques

The M470 is the 4th generation of scanning probe systems, which includes a high-resolution scanning stage and the most comprehensive range of modular scanning probe techniques. The M470 achieves the perfect balance of scan speed, resolution and accuracy to deliver the highest standard in spatially resolved electrochemical measurements. The fast, precise, closed-loop positioning system is designed specifically for the demands of scanning probe electrochemistry.

### 9 available techniques

SECM\* LEIS\* ac-SDS\*  
ac-SECM\* SVET\* SKP  
ic-SECM\* SDS\* OSP

\* Additional: Electrochemistry, Corrosion and EIS suites included.



### Options



The M470 is compatible with a large range of potentiostat / galvanostats:

- Single potentiostat: SP-200 and SP-240
- Multichannel potentiostat: SP-300, VSP-300 and VMP-300

Any SP-/VSP-/VMP-configuration offers high dc current measurement sensitivity and increased EIS bandwidth. Owners of Premium potentiostats have the option of purchasing the M470 system with a hardware interface to connect to their existing potentiostat.

To facilitate the mounting of low current amplifiers near the electrochemical cell, adjustable stands and brackets are provided which mount directly to the M470 base plate.



## Glove Box Cables

Optional glove box cables are available for the M470. The cables replace the standard cables of the M470 allowing the control unit to remain outside of the glove box, while the scan head and attached devices are used inside the glove box. Each set includes the necessary cables and bulk head connector.



## Scan-Lab® Software

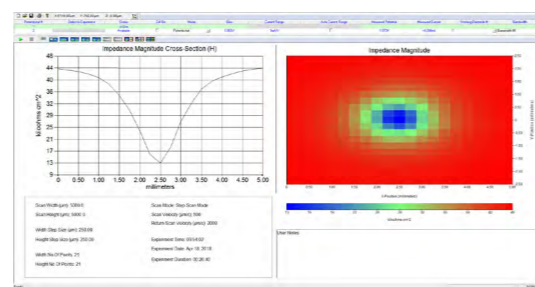
All scanning probe microscopy systems come with **lifetime software updates** that allow the user to benefit from new features.

The user is able to select an experiment from within the technique to provide a powerful user interface, fully configurable with options to save and recall complex setups.

Data can be manipulated within the experiment and allows 2D and **3D heat map** presentations as well as advanced analysis features. All experiments can be combined in a cutting-edge sequencing engine that incorporates logic elements such as loops, delays, probe movement and more, to provide a powerful research tool now and for the future.

3D IsoPlot adds a further component to the line-up by providing fully rendered **3D data** display. 3D IsoPlot allows data to be rotated, angled, flipped, scaled, zoomed and more to provide beautifully rendered imagery over a huge range of scales suitable for large posters or projections.

The Microscopic Image Rapid Analysis (MIRA) package rounds off the line-up with 2D and 3D surface analysis features for experiments such as approach curves and area scan imagery. This truly powerful package is gaining popularity due to its strong analytical capabilities.



## Probes

The foundation of a great measurement is a great probe, that's why we provide one of the most comprehensive range of probes, each individually characterized.

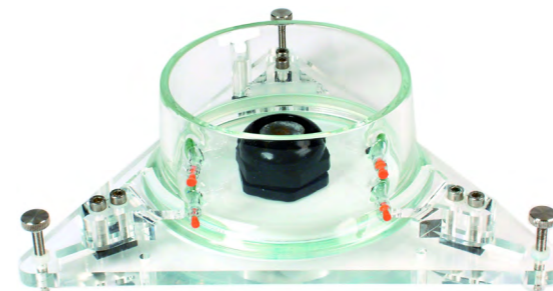
Technique	Materials	Options / sizes
SECM / ic-SECM	fused silica & platinum: Ø 4 mm	10, 15, 25 µm
SECM	borosilicate & platinum: Ø 2 mm	1, 2, 5, 10, 15 or 25 µm †
SVP (SVET)	LDPE & platinum	> 5 µm
LEIS	LDPE & platinum	> 5 µm
SKP	brass & tungsten	150 or 500 µm
SDS	PEEK	100 or 500 µm

† Each pack includes a 2 mm to 4 mm adaptor.



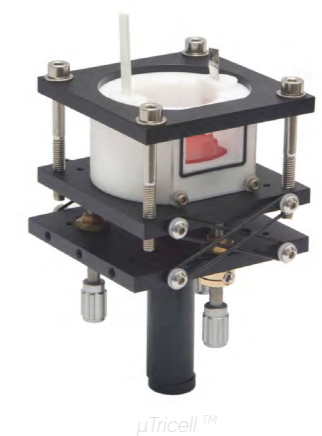
## Tools

A wide variety of optional accessories are also available, including various probe options, cell options (**environmental TriCell™**, **µTriCell™**, **shallow µTriCell™**, **Foil Cell**) and long working distance optical video microscope (**VCAM3**). Additionally, the **USB-PIO** module allows the M470 to monitor digital signal levels and switch external hardware synchronized with experiments and movements.



## Specification

	M470
Number of techniques	9 techniques
Modular upgradability	yes
Positioning resolution	20 nm
Scanning range	110 mm
Max. scan speed	10 mm/s
Piezo positioning	yes (ic-SECM)
Potential range	±10 V
Current ranges	1 A to 100 pA
Analog to digital resolution	24-bit
Impedance range (VMP 300)	10 µHz to 3 MHz
VMP 300 family compatibility	yes







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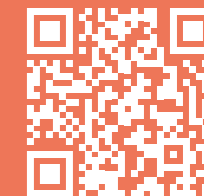
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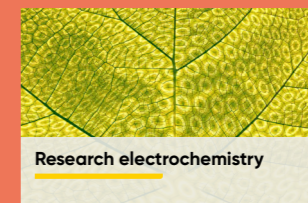
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Energy storage and conversion



Research electrochemistry



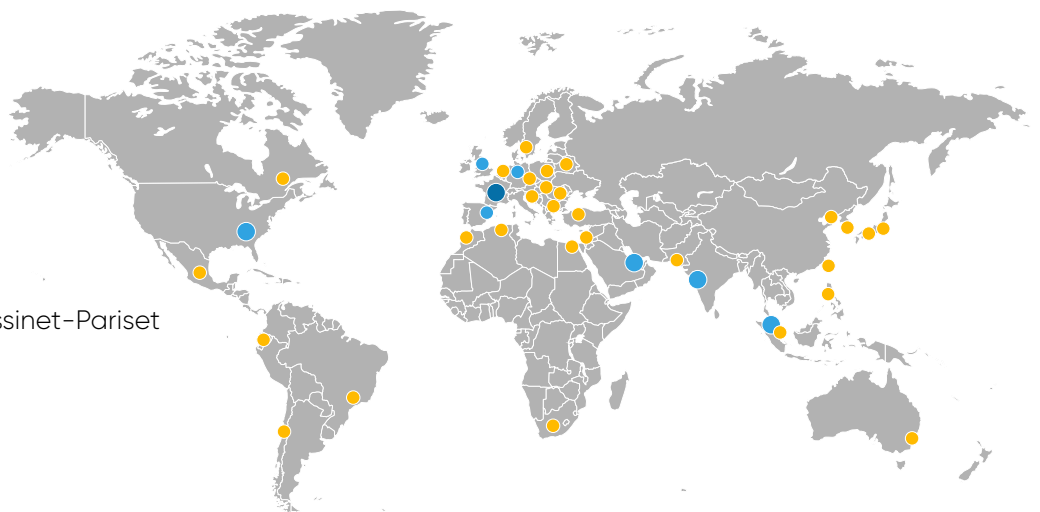
Research electrochemistry



Materials science



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