VMP3

MULTIPOTENTIOSTAT/GALVANOSTAT

BioLogic
Science Instruments

The world's best multichannel instrument...
... designed to address all your electrochemical applications

- ENERGY STORAGE
- SENSORS
- CORROSION
- FUNDAMENTAL ELECTROCHEMISTRY

The **VMP3** is a research-grade multi-channel potentiostat. Designed with a modular chassis, up to 16 independent potentiostat channels can be installed.
The **VMP3** can be equipped with additional capabilities, including low current modules, impedance and high current via plug-in modules. Each potentiostat installed in the **VMP3** can be connected to an external current booster channel (2, 5, 10, 20, 80 or 100 amps). Each channel of the **VMP3** can switch from current to potential control in 10 µs, making it ideal for battery studies.

The **VMP3** is controlled from a PC by a USB or an Ethernet connection. Using the Ethernet connection, the **VMP3** can be installed on a Local Area Network to allow multiple users to access the instrument.

Each channel has two analog inputs and an analog output to manage external instruments, such as a rotating electrode, or a quartz crystal microbalance, and record the generated data.

The **VMP3** is supplied with two software, **EC-Lab®** and **EC-Lab® Express**. 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 **VMP3** is the best multi-channel workstation on the market.

GENERAL SPECIFICATIONS

- Current ranging from 1 nA up to 400 mA with a 760 pA resolution (76 fA with low current option)
- 20 V adjustable reference voltage
- Resolution: 300 µV programmable down to 5 µV by adjusting the dynamic range
- Acquisition time: 20 µs with EC-Lab® Express
  200 µs with EC-Lab®
- Simultaneous EIS measurement on WE and CE*
- N'Stat mode to perform experiments with several working electrodes, one counter and one reference electrode.

VERSATILE OPTIONS

- EIS option (10 µHz to 1 MHz) on each channel
- Low-current option (1 nA)
- Up to 16 independent channels
- ±4 A and ±8 A built-in kits
- External boosters available from 2 A up to 100 A.

* With EIS option

APPLICATIONS

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 VMP3 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 VMP3 is a big advantage.

CORROSION

The VMP3's low current option is ideal for corrosion experiments. With an input impedance of 10^{14} ohms (with 1 pF in parallel), the VMP3 is able to measure low corrosion rates and to provide EIS data on high impedance coatings.
EC-Lab® offers many standard corrosion techniques and data analysis tools (Tafel and Rp fits) to study corrosion (uniform, pitting...). Using the VMP3 in a multi-electrode mode (N'Stat configuration) is an excellent feature that allows users to acquire the statistics necessary for localized corrosion evaluations.

ENERGY SOURCES AND STORAGE

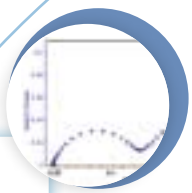
The design and the performance of the VMP3 benefits from the long history of previous EC-Lab® instrument generations (MacPile and VMP) in the fields of intercalation compounds, battery and super-capacitors study. Many techniques are available for battery cycling in both current and potential control 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 VMP3, with its "low-current" option, offers a 76 fA resolution on the 1 nA current range.
The multichannel capability of the VMP3 is an important feature in multi-sensor research applications requiring the use of DNA chips or screen printed electrodes. Differential and pulsed techniques along with impedance measurements and EC-Lab® software analysis tools are especially useful in the development of electrochemical biosensors.

OPTIONS

IMPEDANCE



The VMP3 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 plug-in potentiostat module. The frequency range is from 10 µHz to 1 MHz.
The potentiostat input impedance is 10^{12} Ohms in parallel with 20 pF. Thus, the VMP3 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 the 4 A option, impedance can be performed on energy devices down to 250 µOhms.

4 A/8 A KITS AND OTHER EXTERNAL BOOSTERS

The VMP3 chassis is designed to receive a ±4 A and/or a ±8 A current booster option. The 4 A option uses two slots while the 8 A option uses four slots in the chassis. These options require with an available potentiostat/galvanostat channel board.
In addition, external boosters (installed in a separate chassis) are available to work with any of the potentiostat channels of the VMP3. Booster channels come in ±2 A, ±5 A, ±10 A, ±20 A, ±80, ±100 A versions. These boosters are used for applications requiring high currents such as battery or fuel cell testing, electrochemical synthesis, electroplating and some corrosion applications.

LOW CURRENT

The low current option can be added in series with a potentiostat channel and requires one slot. It extends the current ranges 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.

ADDITIONAL CHANNELS

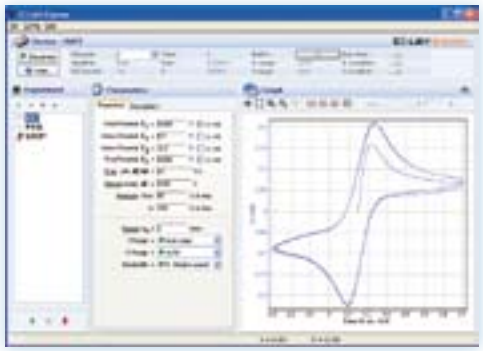
The VMP3 can accommodate up to 16 potentiostat channels, each of which can be impedance capable.

EC-LAB® EXPRESS: EASY TO LEARN SOFTWARE FOR NEW USERS

More than 30 techniques with up to 100 sequences can be linked in EC-Lab® Express 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.
Two new features have been implemented:
- the ability to perform impedance measurements simultaneously on the working and on the counter electrode,
- the ability to determine the performance of single cells in a fuel cell stack.

The **VMP3**'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 **VMP3** operates independently from the PC during an experiment.



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

Ohmic Drop Determination
MIR, PZIR, GZIR

Impedance
PEIS, GEIS, SPEIS, SGEIS

Cell stack
Polarization, PEIS, GEIS

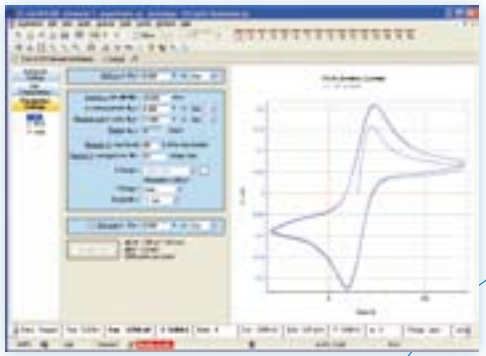
Loop

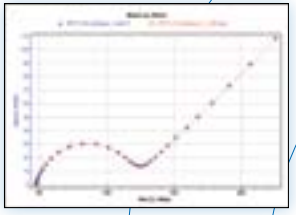
EC-LAB®: MODULAR AND POWERFUL FOR ADVANCED USERS

Over 50 techniques are offered to the user. He 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.
Analysis tools (peak, convection wave, integral), with classical fits (linear, circular) and processes are available with both **EC-Lab®** modes.
EIS modelling is included using the well known circuit descriptor approach. More than 140 circuits with two minimization algorithms are available. The user can also define and built his own circuit model.
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

Batteries
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

SPECIFICATIONS

Cell control

Connection	2, 3, 4 or 5 terminals (+ ground)
Compliance	20 V adjustable from ±10 V to 0-20 V
Maximum current	±400 mA continuous
Maximum potential resolution	300 µV on 20 V programmable down to 5 µV on 200 mV
Maximum current resolution	0.004% of the dynamic range 760 pA on the 10 µA range
Accuracy (DC)	< 0.1% FSR*
Rise time	(10% - 90%) < 2 µs (No load)
Acquisition time	20 µs

Current measurement

Ranges	Automatic on every range ±10 µA to ±1 A (7 ranges)
Maximum current	±400 mA continuous
Maximum resolution	0.004% of the range
Acquisition speed	200,000 samples/second
Accuracy (DC)	< 0.1% FSR*

Potential measurement

Ranges	±2.5 V, ±5 V, ±10 V, ±10 V adjustable
Maximum resolution	0.0015% FSR*, down to 75 µV
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 and features

2 Analog inputs	16 bits resolution with automatic ±2.5 V, ±5 V, ±10 V ranges
1 Analog output	±10 V
Trigger input/output	One each/TTL Level

General

Dimensions	495 x 465 x 260 mm
Power	85-264 V, 47-440 Hz

EIS OPTION

Impedance

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

LOW CURRENT OPTION (LC)

The specifications are the same as for the standard board, except for the following points:

Cell control

Maximum current	±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	±1 nA, ±10 nA, ±100 nA, ±1 µA
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

4 A/8 A BOOSTER KIT

Cell control	4 A	8 A
Maximum current	±4 A continuous	±8 A continuous
Potential ranges	±10 V at 4 A	±10 V at 8 A
Rise and fall time 10% to 90%	Potentio mode: 15 µs Galvano mode: 100 µs	Potentio mode: 20 µs Galvano mode: 100 µs

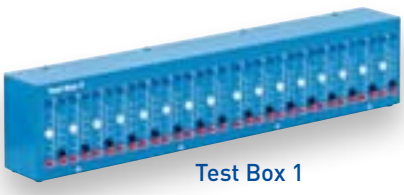
Measurement	4 A	8 A
Potential accuracy (DC)	< 0.1% FSR*	< 0.1% FSR*
Current accuracy (DC)	< 0.2% FSR*	< 0.2% FSR*
Current noise	1 mA peak to peak (0-100 kHz) at 4 A	2 mA peak to peak (0-100 kHz) at 8 A
Potential noise	0.6 mV peak to peak (0-100 kHz)	0.6 mV peak to peak (0-100 kHz) Potential
Maximum continuous dissipated power	50 W	100 W

Electrometer	4 A/8 A
Impedance	10^{10} ohms
Inputs	3 potential leads with 2 differential voltages
Bandwidth	1 MHz

* FSR: Full Scale Range

Specifications subject to change

ACCESSORIES



Test Box 1

Test Box 2 (High Precision)

Test Box 3 (Educational)

Battery Holder 1

Other's: ■ N'Stat box ■ Low current N'Stat box

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