

VMP3

MULTIPOTENTIOSTAT/GALVANOSTAT



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 μ s, 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 **EC-Lab**[®] software package. With over 70 techniques that can be sequenced, and with a variety of analysis tools, including EIS modeling 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 μ V programmable down to 5 μ V by adjusting the dynamic range
- Acquisition time: 200 μ s
- Simultaneous EIS measurement on WE and CE*
- N'Stat mode to perform experiments with several working electrodes, one counter and one reference electrode.
- Stack measurements up to 30 cells

VERSATILE OPTIONS

- EIS option (10 μ Hz to 1 MHz) on each channel
- Low-current option (1 nA range)
- Up to 16 independent channels
- External boosters available from 2 A up to 100 A
- Load boxes: 150 A @ 50 V for stack experiments

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 suitable 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 Bio-Logic 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 stack.

SENSORS

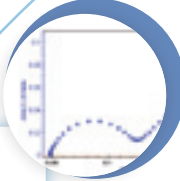


Potentiometric sensors (ion selective electrodes) and amperometric sensors (thin film micro-electrodes or modified electrodes) require good sensitivity to low currents. The **VMP3**, with its "low-current" option, offers a 76 fA resolution on the 1 nA current range.

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 potentiostat modules 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 μ Hz 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 external boosters, impedance can be performed on energy devices.

EXTERNAL BOOSTERS/LOADS



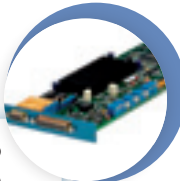
External boosters or load boxes (installed in a separate chassis) are available to work with any potentiostat channel of the **VMP3**. Booster channels come in ± 2 A, ± 5 A, ± 10 A, ± 20 A, ± 80 A, ± 100 A versions. Load boxes come in 150 A/50 V or 50 A/5 V versions. These boosters and loads are used 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 of 76 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 them can be impedance capable and is independent from the others.

EC-Lab®: modular and powerful

Over 70 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. The user can also define and build 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.

EC-Lab® graphics

A comprehensive graphics package

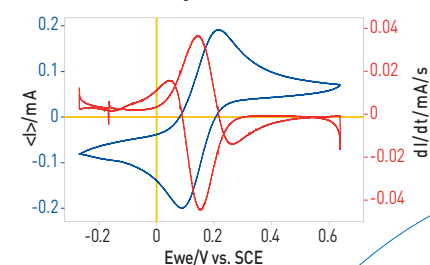
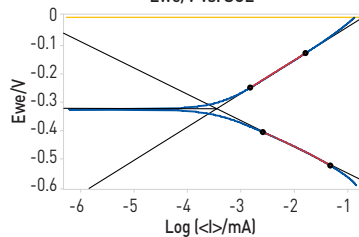
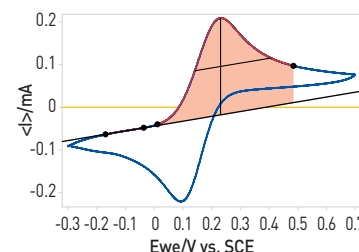
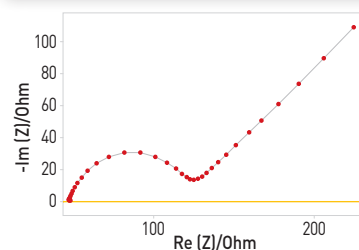
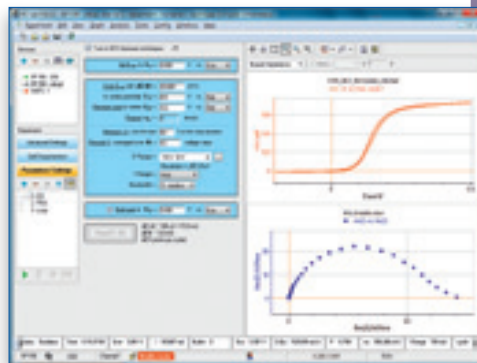
EC-Lab®'s graphic package is provided with the software and includes a powerful tool to create unique graph templates. Using our advanced graph properties, the user can create new variables for each axis. This enables mathematical functions to be performed on data plotted on any axis.

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

EC-Lab®'s EIS modeling package utilizes the equivalent circuit approach. There are over 150 standard circuits and two minimization algorithms available for use in understanding impedance plot information. The user can define and build his own circuit model using a range of thirteen simple elements (R , C , L , L_a , Q , W , G , G_a , G_b , W_d , M , M_a , M_b). A batch processing feature allows fitting of multiple cycles in an impedance experiment.

OEM package

Bio-Logic has developed an OEM package and **LabView®** drivers which are available for our customers. This package includes almost 30 DC and AC techniques. A **Pascal** and **Veeopro®** test program and **LabView®** examples are also provided.



TECHNIQUES

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 7), PCGA, CLD, CPW, APGC, Urban cycle simulation, ModuloBat

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

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

ANALYSIS

- Linear Fit
- Tafel Fit with minimization
- Circular Fit
- R_p 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
- CV simulation/Fit

SPECIFICATIONS

Cell control

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

Current measurement

Ranges	Automatic on every range ± 10 μ A 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 μ 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-bit 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

ACCESSORIES



Test Box 2
(High Precision)



Test Box 3
(Educational)



Battery
Holder 1



Coin cell
holder

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

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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 μ 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

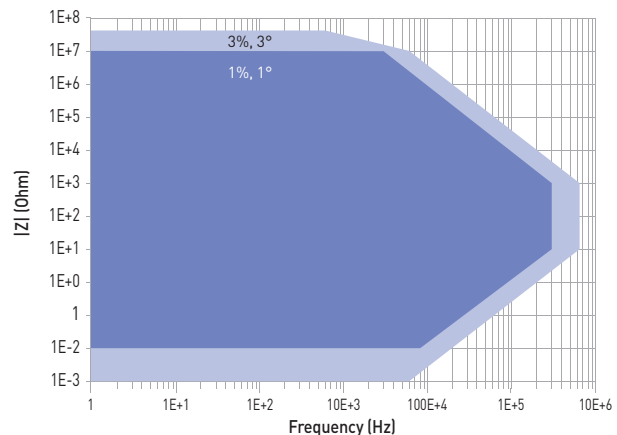
IMPEDANCE OPTION

Impedance

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

IMPEDANCE CONTOUR PLOT

For standard channel board alone



* FSR: Full Scale Range
Specifications subject to change