

# VSP/VMP3

Modular to address all  
your electrochemical applications



## APPLICATIONS

- Energy storage
- Sensors
- Fundamental Electrochemistry
- Corrosion/coating
- Fuel cell
- Photovoltaic cell
- Impedance measurement

# VSP/VMP3

The **VSP/VMP3** are research-grade multichannel potentiostats/galvanostats.

Designed with a modular chassis, up to 16 independent potentiostat channels can be installed. The **VSP/VMP3** are versatile, so they can be equipped with additional capability such as EIS, low or high current options.

The **VSP/VMP3** are controlled from a PC by a USB or an Ethernet connection. Using the Ethernet connection, the **VSP/VMP3** can be installed on a Local Area Network to allow multiple users to access the instrument and follow the measurement from anywhere.

Thanks to its unique CE-to-Ground connection mode, **VSP/VMP3** can also be used for multielectrode experiments.

Moreover, voltages and impedances of the working (eg positive electrode of battery) and counter electrodes (eg negative electrode of battery) can be measured simultaneously.

Each channel 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.

The **VSP/VMP3** are supplied with **EC-Lab®** software. With over 80 techniques that can be sequenced, and with a variety of analysis tools, including EIS modelling with Levenberg-Marquardt and Simplex algorithms.

The **VSP/VMP3** are a complete research grade multichannel workstations.



## FEATURES

- Current ranging from 1 nA up to 400 mA (76 fA with low current option)
- 20 V adjustable reference voltage
- Resolution: 300  $\mu$ V programmable down to 5  $\mu$ V by adjusting the dynamic range
- Acquisition time: 200  $\mu$ s with EC-Lab® (20  $\mu$ s with EC-Lab® Express)
- Simultaneous EIS measurement on WE and CE
- CE-to-Ground mode to perform experiments with several working electrodes, one counter and one reference electrode.
- Stack modes
- Switching time galvano/potentiostat: 10  $\mu$ s

## OPTIONS

- Built-in EIS option (1 MHz to 10  $\mu$ Hz) on each channel
- Low-current option (1 nA) need extra module (use 1 slot)
- Up to 16/5 independent channels for VMP3/VSP respectively
- External boosters available from 2 A up to 100 A
- Load boxes (50 V/150 A)
- SAM-50 (50 V) for stack measurement (VMP3 only).

EC-Lab<sup>®</sup> is the result of more than 15 years of continuous development.

## Versatile and powerful control interface

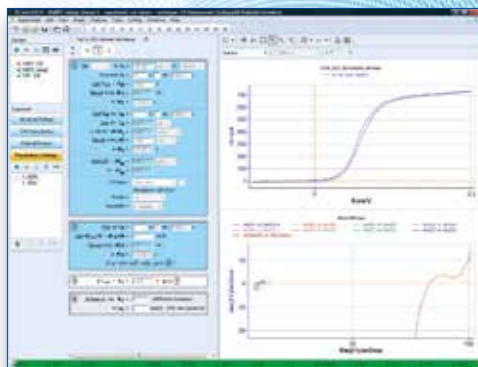
Over 80 techniques are available. The user can also create new protocols with the "technique builder". Two view modes are available in flow charts and in columns. Most of parameters can be modified during the run, with the changes stored into the raw data file. Moreover, the management of the buffer makes the data transfer safer.

### Techniques

- **Voltammetry:** OCV, CV, CVA, CA, CP, SV, LASV, ACV, LSV
- **Impedance (option):** GEIS, PEIS, SGEIS, SPEIS (Mott-Schottky), PEISW
- **Pulsed:** DPV, SWV, DPA, DNPV, NPV, RNPV
- **Ohmic drop determination:** MIR, ZIR, Current Interrupt
- **Battery:** GCPL (1 to 7), PCGA, CLD, CPW, APGC, Urban cycle simulation, ModuloBat, BCD, CED
- **Corrosion:** Linear and Cyclic Polarization, Generalised Corrosion, Pitting, ZRA, ZVC, Corrosimetry, VASP, CASP
- **Fuel/photovoltaic cell:** I-V characterization, CLD, CPW
- **Supercapacitor:** CV, C<sup>st</sup> Current, C<sup>st</sup> Voltage
- **Technique builder:** Modular Potentio/Galvano, Loop, Trigger in/out, Wait, RDEC, Ext App, Send email

## Display

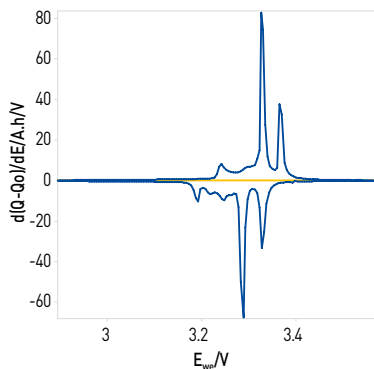
Active data can be shown in multiple graph windows, each with a double y-axis view. The axes (unit, scaling), color, style, and other graphic properties can be modified easily. The user can select multiple graph windows to show the active experiment while analyzing previously stored data.



## Simulation, analysis & fitting

Analysis tools (peak, convection wave, integral), with classical fits (linear, polynomial, circular) and processes are available.

EIS modeling is included using the well known circuit descriptor code approach. More than 150 circuits with two minimization algorithms are available. The user can define and build his own circuit using a range of thirteen elements (R, C, L, La, Q, W, G, Ga, Gb, Wd, M, Ma, Mg). This tool is able to fit successive EIS data cycles.



### General electrochemistry

- Peak Analysis...
- Wave Analysis...
- CV Fit/Sim...

### EIS

- Z Fit...
- Z Sim...
- Mott-Schottky...
- Kramers-Kronig...

### Battery process

- Process data (capacity, efficiency, energy, dq/dE...)

### Photovoltaic

- Photovoltaic analysis (fill factor, efficiency...)

### Corrosion

- R<sub>p</sub> Fit...
- Tafel Fit...
- Electrochemical Noise...
- Corr Sim...
- VASP Fit...
- CASP Fit...

### Math

- Polynomial Fit...
- Multi-Exponential Fit...
- Linear Fit...
- Subtract Files...
- Integral...
- Min Max...
- Filter...
- FTQ
- Fourier Transform...
- Linear Interpolation...

# Specifications

## CHANNEL BOARD

<b>Cell control</b>		<b>Potential measurement</b>	
Connection	2, 3, 4 or 5 terminals (+ ground)	Ranges	$\pm 2.5$ V, $\pm 5$ V, $\pm 10$ V, $\pm 10$ V adjustable
Compliance	20 V adjustable from $\pm 10$ V to [0-20] V	Maximum resolution	0.0015% FSR*, down to 75 $\mu$ V
Maximum current	$\pm 400$ mA continuous	Acquisition speed	200,000 samples/second
Maximum potential resolution	300 $\mu$ V on 20 V programmable down to 5 $\mu$ V on 200 mV	Accuracy (DC)	< 0.1% FSR*
Maximum current resolution	0.004% of the dynamic range 760 pA on the 10 $\mu$ A range	<b>Electrometer</b>	
Accuracy (DC)	< 0.1% FSR*	Inputs	3 potential measurements
Rise time	(10% - 90%) < 2 $\mu$ s (No load)	Impedance	> $10^{12}$ $\Omega$ // < 20 pF
Acquisition time	20 $\mu$ s	Bias current	< 5 pA
<b>Current measurement</b>		<b>Impedance (option)</b>	
Ranges	automatic on every range $\pm 10$ $\mu$ A to $\pm 1$ A (7 ranges)	Frequency range	1 MHz to 10 $\mu$ Hz (accuracy: 1%, 1°)
Maximum resolution	0.004% of the range, 760 pA on the 10 $\mu$ A range	Amplitude	potentio: 1 mVpp to 1 Vpp galvano: 0.1% to 50% of the current range
Acquisition speed	200,000 samples/second	<b>Additional inputs/outputs</b>	
Accuracy (DC)	< 0.1% FSR*	2 analog inputs	16-bit resolution with automatic $\pm 2.5$ V, $\pm 5$ V, $\pm 10$ V ranges
		1 analog output	$\pm 10$ V 16-bit resolution
		1 external trigger	TTL level (1 input / 1 output)

## LOW CURRENT option

<b>Cell control</b>		<b>Current measurement</b>	
Maximum current	$\pm 100$ mA continuous	Ranges	$\pm 1$ nA, $\pm 10$ nA, $\pm 100$ nA, $\pm 1$ $\mu$ A
Maximum current resolution	0.004% of the dynamic range, programmable: 76 fA on the 1 nA range	Maximum resolution	0.004% of the range down to 76 fA
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	Accuracy	< 1% FSR* on the 1 nA range < 0.5% FSR* on the 10 nA range < 0.1% FSR* on the other ranges
<b>Electrometer</b>		<b>Electrometer</b>	
Impedance	$10^{14}$ $\Omega$ // 1 pF	Impedance	$10^{14}$ $\Omega$ // 1 pF
Bias current	60 fA typical, 150 fA max at 25 °C	Bias current	60 fA typical, 150 fA max at 25 °C
Bandwidth	1 MHz	Bandwidth	1 MHz

## CURRENT BOOSTERS option

<b>Cell control</b>		<b>2/4/5 A</b>	<b>10/20 A</b>	<b>80/100 A</b>	
Compliance		adjustable $\pm 10$ V range	adjustable $\pm 10$ V range	80 A: $\pm 3$ V, 100 A: 0.6 - 5 V	
Maximum current		2 A: $\pm 2$ A, 4 A: $\pm 4$ A, 5 A: $\pm 5$ A	10 A: $\pm 10$ A, 20 A: $\pm 20$ A	80 A: $\pm 80$ A, 100 A: $\pm 100$ A	
Maximum potential		$\pm 20$ V	$\pm 20$ V	80 A: $\pm 3$ V, 100 A: 0.6 - 5 V	
Rise time and fall time	potentio: 15 $\mu$ s galvano: 40 $\mu$ s	25 to 60 $\mu$ s	50 to 120 $\mu$ s	95 $\mu$ s to 1.7 ms 150 $\mu$ s to 4.0 ms	
<b>Measurement</b>		<b>Measurement</b>		<b>Measurement</b>	
Current 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	80 A: < 160 mA on 80 A range, 100 A: < 200 mA on 100 A range	
<b>Electrometer</b>		<b>Electrometer</b>		<b>Electrometer</b>	
Bandwidth		1 MHz	1 MHz	1 MHz	
<b>EIS</b>		<b>EIS</b>		<b>EIS</b>	
Max frequency (accuracy 1%, 1°)		2 A: up to 150 kHz, 4 A: up to 130 kHz 5 A: up to 120 kHz	10 A: up to 80 kHz, 20 A: up to 80 kHz	80 A: up to 15 kHz, 100 A: up to 10 kHz	
Amplitude	potentio: 0.5 mV to 0.5 V galvano: 0.1% to 50% of the current range	0.5 mV to 0.5 V	0.1% to 50% of the current range	0.5 mV to 0.5 V	0.1% to 50% of the current range

## CHASSIS

<b>VSP</b>		<b>VMP3</b>		<b>External booster</b>	
Dimensions (W x D x H)	435 x 335 x 95 mm	495 x 465 x 260 mm	495 x 465 x 284 mm		
Weight	8 kg	20 kg	24 kg		
Power	90-264 V, 47-440 Hz	90-264 V, 47-440 Hz	90-264 V, 47-440 Hz		
Slots	5	16	4		

\* FSR: Full Scale Range  
Specifications subject to change