

PalmSens4cTM



Potentiostat / Galvanostat / Impedance Analyzer

- FRA / EIS: 10 μ Hz up to 1 MHz
- 9 current ranges: 100 pA to 10 mA
- High resolution of 0.006 % full scale range
- ± 10 V potential range at 75 μ V resolution (18 bit A/D)
- USB powered
- Always a backup of your data with 4 GB of internal storage

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PalmSens4C: Potentiostat / Galvanostat / Impedance Analyzer

The PalmSens4C is a USB-powered, pocket-size instrument which allows the application of all common voltammetric, amperometric and potentiometric techniques as well as impedance spectroscopy (see below).



Always a backup

The PalmSens4C is equipped with an internal storage of 8 GB. This means all your measurements¹ can automatically be saved on-board as backup. All these measurements can be browsed and transferred back to the PC easily using PSTrace. Your data is always with your instrument wherever you take it.

¹ Not supported: EIS, MultiStep and MixedMode

Supported Techniques

Voltammetric techniques

- | | |
|----------------------------------|-----|
| ▪ Linear Sweep Voltammetry | LSV |
| ▪ Differential Pulse Voltammetry | DPV |
| ▪ Square Wave Voltammetry | SWV |
| ▪ Normal Pulse Voltammetry | NPV |
| ▪ AC Voltammetry | ACV |
| ▪ (Fast) Cyclic Voltammetry | CV |

Note: the above techniques can also be used for stripping voltammetry

Techniques as a function of time

- | | |
|---|------|
| ▪ ChronoAmperometry | CA |
| ▪ Pulsed Amperometric Detection | PAD |
| ▪ Multiple Pulse Amperometric Detection | MPAD |
| ▪ Fast Amperometry | FAMP |
| ▪ ChronoPotentiometry | CP |
| ▪ Open Circuit Potentiometry | OCP |
| ▪ Multistep Amperometry | MA |
| ▪ Multistep Potentiometry | MP |
| ▪ Mixed Mode | MM |

Electrochemical Impedance Spectroscopy (EIS)

Impedance spectroscopy / EIS

- Frequency scan
- Potential scan
- Fixed potential
- Time scan

Next to the classic spectrum (frequency scan with fixed DC potential) a DC potential scan can be done at fixed frequency or a frequency scan at each potential of the potential scan.



PSTrace Software for PC

Select current ranges for auto ranging and the current range to start on.

Switch between plots if curves with different units are available.

Method Editor

Select current range(s):

100 nA, 1 nA, 10 nA, 1 uA, 10 uA, 1 mA, 10 mA

Plot

Charge/mC

Plot

Plot I vs E, Plot C vs t

Measurement data and curves

Session data

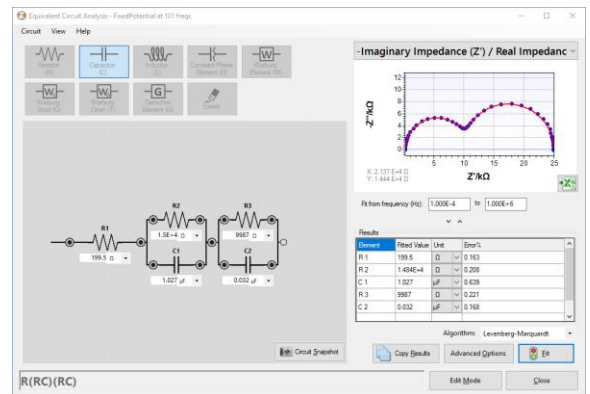
Linear Sweep Voltammetry*
 LSV curve* I vs E
 LSV charge vs time* C vs t

Click on a measurement in the legend to see the available data and to generate more curves.

Click on a curve in the legend to change its title or appearance.

Other functions in PSTrace 5

- Equivalent Circuit Fitting
- Scripting
- Open your data in Origin and Excel with one click of a button
- Save all available curves, measurement data and methods to a single file
- Browse measurements on PalmSens' internal storage
- Direct validation of entered measurement parameters



Integration with 3rd party software:

- Excel
- Origin
- Matlab
- ZView



System requirements

Minimum PC requirements are:

- Windows Vista, 7, 8, or 10 (32-bit or 64-bit)
- 1 GHz or faster 32-bit (x86) or 64-bit (x64) processor
- 1 GB RAM (32-bit) or 2 GB RAM (64-bit)

For more information about software visit www.palmsens.com/software

Measurement Specifications

General pretreatment:

Apply conditioning, deposition or initial potential for: 0 – 1600 s

General voltammetric parameters:

Potential range:	-10 V to +10 V
Step potential:	0.075 mV to 250 mV
Pulse potential:	0.075 mV to 250 mV

Limits of some technique specific parameters for PalmSens4C:

Normal Pulse and Differential Pulse Voltammetry:	Scan rate: 0.1 mV/s (75 μ V step) to 100 mV/s (5 mV step) Pulse time: 10 ms to 300 ms
Square Wave Voltammetry ¹ and AC Voltammetry:	Frequency: 1 Hz to 2000 Hz ¹
Linear Sweep and Cyclic Voltammetry:	Scan rate: 0.01 mV/s (75 μ V step) to 500 V/s (10 mV step)
Pulsed Amperometric Detection:	Interval time: 50 ms to 300 s Pulse time: 1 ms to 1 s Maximum run time: 640000 s (> 7 days at 10 s interval)
Multiple Pulse Amperometric Detection:	Pulse times: 100 ms to 2 s Run time: 10 s to 100000 s Number of potential levels: 3
ChronoAmperometry, ChronoPotentiometry and Open Circuit Potentiometry:	Interval time: 0.25 ms to 300 s Maximum run time: 1000000 s (> 10 days at 300 s interval)
Multistep Amperometry, Multistep Potentiometry and Mixed Mode:	Interval time: 0.25 ms to 300 s Level switching overhead time: \pm 80 ms Number of levels: 1 to 255 Number of cycles: 1 to 20000 Maximum run time: > 1 year
Fast Amperometry:	Interval time: 0.02 ms to 1 s Maximum run time: 30 s Maximum number of points: 65000 (4000 for interval time < 0.2 ms)

Note: some limits of parameters are set for practical reasons and can be modified on request.

¹ PStace provides the option to measure forward and reverse currents separately.

System Specifications

General

- dc-potential range ± 10 V
- compliance voltage ± 10 V
- maximum current ± 30 mA (typical)
- max. acquisition rate 150000 points/s

Potentiostat (controlled potential mode)

- applied dc-potential resolution 75 μ V
- applied potential accuracy $\leq 0.1\%$ ± 1 mV offset
- current ranges 100 pA to 10 mA (9 ranges)
- current accuracy $\leq 0.1\%$ at FSR¹
- measured current resolution 0.006% of current range (5 fA on 100 pA range)

Galvanostat (controlled current mode)

- current ranges 1 nA to 10 mA (8 ranges)
- applied dc-current range ± 6 times applied current range
- applied dc-current resolution 0.005% of applied current range
- measured dc-potential resolution
75 μ V at ± 10 V
7.5 μ V at ± 1 V
0.75 μ V at ± 0.1 V

FRA / EIS (impedance measurements)

- frequency range 10 μ Hz to 1 MHz
- ac-amplitude range 1 mV to 0.25 V rms, or 0.6 V p-p

Electrometer

- electrometer amplifier input > 1 T Ω // 10 pF
- bandwidth 1 MHz

Other

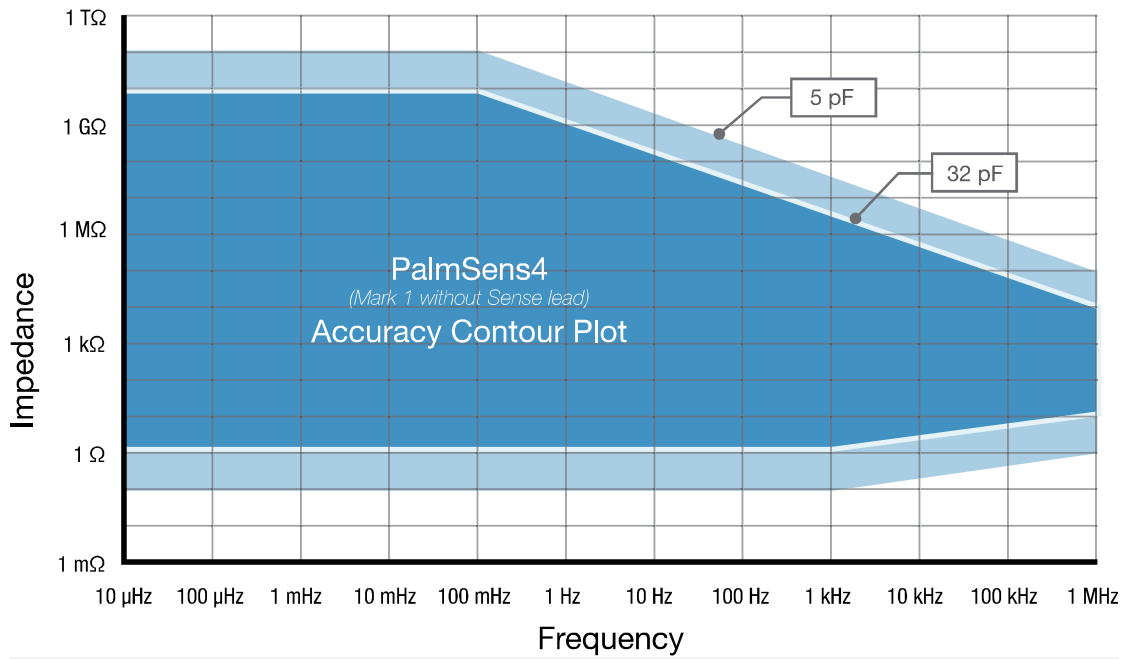
- housing aluminium with rubber sleeve: 15.7 x 9.7 x 3.5 cm³
- weight 630 g
- temperature range 0 $^{\circ}$ C to + 50 $^{\circ}$ C
- power supply USB
- communication USB
- internal storage space 4 GB
or +/- 400000 measurements incl. method parameters
(assuming 200 data points per measurement)

Auxiliary port (D-Sub 15)

- analog input ± 10 V, 18 bit
- analog output 0-10 V, 12 bit (1 kOhm output impedance)
- 4 digital outputs 5 V
- 1 digital input 5 V
- I-out and E-out
raw output of current and potential
E-out ± 10 V (1 kOhm output impedance)
I-out ± 6 V (1 kOhm output impedance)
- power 5 V output (max. 150 mA)

¹ FSR = at full scale range

EIS Contour Accuracy Plot



Note

The accuracy contour plot was determined under lab conditions and should be used for reference purposes. Please note that the true limits of an impedance measurement are influenced by all components in the system, e.g. cables, the environment, and the cell.

PalmSens4C Accessories



MUX8 or MUX16 multiplexer

The MUX8 is an 8 channel multiplexer. It allows the PalmSens4C to measure up to 8 three-electrode cells or 8 sensors (2 or 3 electrode). In 8-WE mode it can measure up to eight working electrodes on sensor arrays with shared reference and counter electrodes.

The MUX16 is a 16 channel multiplexer. It allows the PalmSens4C to measure up to 16 working electrodes with shared counter and reference electrodes.



Magnetic stirrer

The magnetic stirrer controlled by PalmSens is ideal for stripping analysis applications. The stirrer is switched on during the conditioning and deposition stages by means of the Switchbox.



LM35 temperature sensor

This temperature sensor allows for monitoring of temperature during an experiment. Two point calibration allows the user to precisely calibrate the sensor for the required temperature range. The calibration curve shows a linear slope of +10 mV/°C with 0.5°C Ensured Accuracy (at 25°C). It is rated for full 2°C to 150°C range. The sensor has low self-heating (0.08°C in still air).



Differential Electrometer Amplifier (DEA)

The PalmSens Differential Electrometer Amplifier (DEA) is a high impedance input amplifier. It can be used as a floating voltage amplifier with differential input and single output to the auxiliary port of PalmSens.

Default range is -10V to 10V (1x gain). Possible gains are: 2x, 5x, 10x, 20x, 50x, 100x, etc.

Please don't hesitate to contact PalmSens for more details:
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