



PalmSens3TM

potentiostat / galvanostat / impedance analyser

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PalmSens3: potentiostat / galvanostat / impedance analyser

PalmSens3 is a battery-powered, handheld instrument which allows the application of the most relevant voltammetric, amperometric and potentiometric techniques as well as impedance spectroscopy. Each PalmSens3 is shipped in a rugged carrying case (see page 7).

PalmSens3 can be controlled by PC and tablets as well as phones using Android.



PSTrace for Windows provides support for all techniques and device functionalities.

Minimum PC requirements are:

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



PStouch for Android supports all techniques supported by PalmSens3. See also the Mobile Expansion Pack on page 8.

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

Supported techniques

Voltammetric techniques

▪ Linear Sweep Voltammetry	LSV
▪ Differential Pulse Voltammetry	DPV
▪ Square Wave Voltammetry	SWV
▪ Normal Pulse Voltammetry	NPV
▪ ac Voltammetry	acV
▪ Cyclic Voltammetry	CV
▪ Stripping Chronopotentiometry (or PSA)	SCP

Note: these techniques can also be used for stripping voltammetry

Techniques as a function of time

▪ Amperometric Detection / Chronoamperometry	AD / CA
▪ Pulsed Amperometric Detection	PAD
▪ Multiple Pulse Amperometric Detection	MPAD
▪ Fast Amperometry	FAMP
▪ Potentiometry	POT
▪ Open Circuit Potentiometry	OCP
▪ Multistep Amperometry	MA
▪ Multistep Potentiometry	MP

Impedance spectroscopy / EIS

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

A potential scan can be done at fixed frequency or making a frequency scan at each potential.

The current is measured using a **zero resistance ammeter (ZRA)**.

Where possible, the electrochemical techniques can be applied using **auto ranging** which means that the instrument automatically sets the optimal current range. The user can specify a highest and lowest current range in which the most appropriate range is selected automatically.

See page 5 for system specifications.

Measurement specifications

General pretreatment:

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

General voltammetric parameters:

Potential range: -5.000 V to + 5.000 V
 Step potential: 0.1 mV to 250 mV
 Pulse potential: 1 mV to 250 mV

Limits of some technique specific parameters for PalmSens3:

NPV and DPV:	Scan rate:	0.15 mV/s (0.15mV step) to 100 mV/s (5 mV step)
	Pulse time:	10 ms to 300 ms
SWV¹:	Frequency:	1 Hz to 2000 Hz ¹
acV:	Frequency:	1 Hz to 2000 Hz
SCP:	Sampling rate:	Approx. 100 kHz, max. 100 s
LSV and CV:	Scan rate:	0.01 mV/s (0.15 mV step) to 500 V/s (5 mV step)
AD and PAD:	Interval time:	1 ms (10 ms for PAD) to 300 s
	Pulse time:	1 ms to 1 s
	Run time:	10 s to 100000 s
	Maximum number of points:	65000
MPAD:	Pulse times:	100 ms to 2 s
	Run time:	10 s to 100000 s
	Number of potential levels:	3
	Maximum number of points:	65000
Fast amperometry:	Interval time:	0.01 ms to 1 s
	Maximum run time:	30 s
	Maximum number of points:	20000, but 4000 for interval time < 0.2 ms
Potentiometry at constant current or at open circuit:	Interval time:	1 ms to 300 s
	Maximum run time:	100000 s
Multistep amperometry and potentiometry	Interval time:	100 ms to 30 s
	Number of potential levels:	1 to 255
	Number of cycles:	1 to 20000
	Maximum run time:	100000 s

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



Controlled potential mode (potentiostat)

- dc-potential range $\pm 5.000\text{ V}$
- compliance voltage $\pm 8.0\text{ V}$
- dc-potential resolution 0.15 mV
- applied potential accuracy $\leq 0.2\%$
with max. 2 mV offset error
- current ranges 100 pA to 10 mA (9 ranges)
- maximum measured current $\pm 30\text{ mA}$ (typical)
- current resolution 0.01% of current range
- accuracy $\leq 5\%$ at 100 pA
 $\leq 1\%$ of current range at 1 nA
 $\leq 0.5\%$ at 10 nA
 $\leq 0.2\%$ at 100 nA to 1 mA
 $\leq 0.5\%$ at 10 mA
all with max. 0.2 % offset error
- max. acquisition rate $200\,000\text{ data points/s}$

Controlled current mode (galvanostat)

- current ranges $1\text{ }\mu\text{A}$ to 10 mA
- dc-current range ± 3.000 times selected current range
- dc-current resolution 0.01% of selected current range
- max. dc-offset error $\leq 0.2\%$
- current accuracy (deviation) $\leq 0.4\%$
- maximum output voltage $\pm 8\text{ V}$

Impedance measurements

- frequency range $100\text{ }\mu\text{Hz}$ to 50 kHz
- ac- amplitude range 1 mV to 0.3 V (rms)

General

- electrometer amplifier input $> 100\text{ Gohm} // 4\text{ pF}$
- rise time programmable from min. $0.5\text{ }\mu\text{s}$

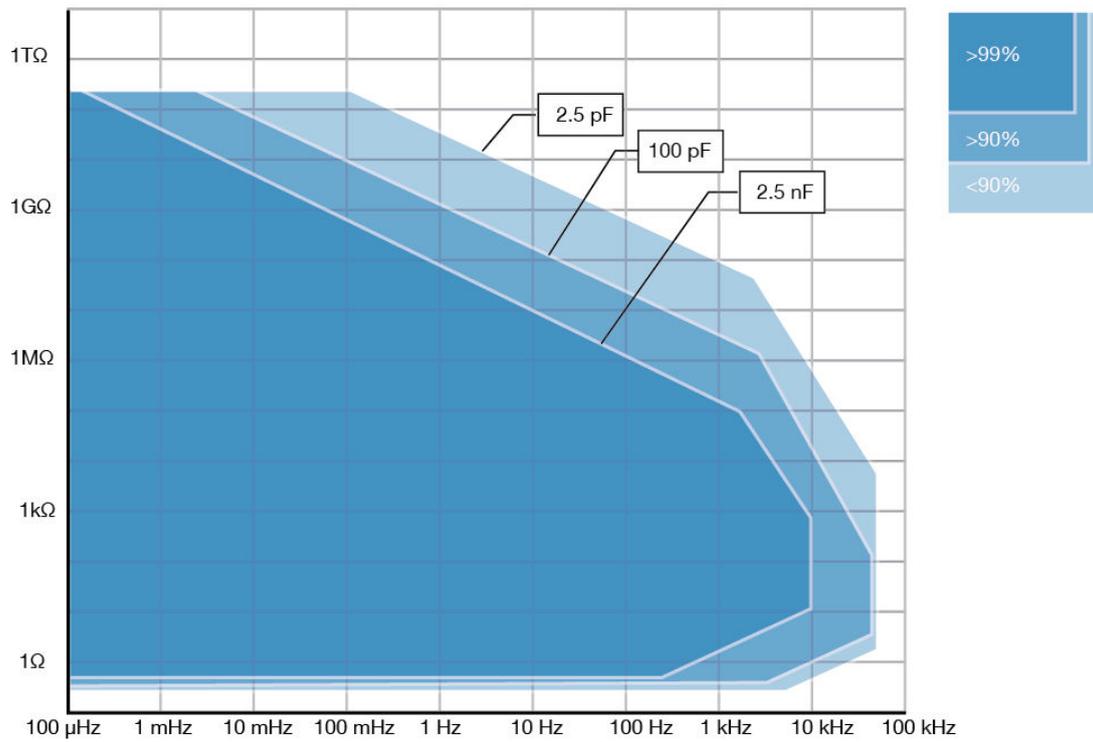
Other

- keypad run, skip, abort, backlight and power
- housing aluminium: $155\text{ mm} \times 85\text{ mm} \times 35\text{ mm}$
- weight 430 g
- temperature range 0° C to $+40^\circ\text{ C}$
- power supply USB or internal Li-ion battery
- battery time >10 hours idle time
 >9 hours idle time with Bluetooth extension
- communication USB, RS232 or TTL (via auxiliary port)

Auxiliary port (D-Sub 15)

- analog input $0\text{--}3\text{ V}$, 12 bit
- analog output $0\text{--}3\text{ V}$, 16 bit
- 4 digital outputs and 1 digital input $0\text{--}3.3\text{ V}$
- I-out and E-out raw output of current and potential
- serial comms Rx / Tx (RS232 or TTL)
- power 5 V output (max. 50 mA)

Frequency Response Analyser for EIS accuracy contour 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, like cables, the environment, and the cell.

Standard PalmSens3 configuration

A standard PalmSens3 case includes:

- PalmSens3
- Mini-USB cable
- Sensor cable
- 4 croc clips
- Test sensor

Also included:

- PStTrace software + manual
- Quick start document

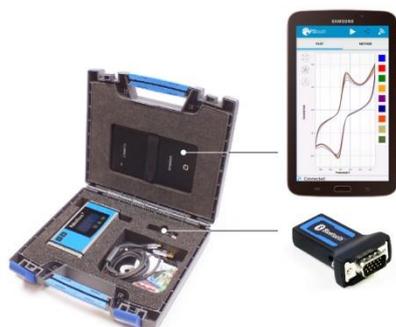
Optional

- 7" tablet
 - Bluetooth extension
 - Tablet charger
- (see *Mobile expansion pack* on next page)



*PalmSens3 in standard carrying case
(showing optional tablet and Bluetooth extension)*

PalmSens3 accessories



Mobile expansion pack

Upgrade to enable wireless control of PalmSens for PC and (mini-) laptop for optimal mobility.

A tablet with PStouch and Bluetooth extension for PalmSens3 allows you to run your experiments anywhere.



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.



Pt1000

This temperature sensor allows the user to monitor the temperature during an experiment and record it via PSTrace. The convenient two point calibration allows you to precisely calibrate the sensor for the needed temperature range. The Pt1000 temperature sensor for PalmSens3 comes with dongle for connection to PalmSens I/O port.



MUX8 or MUX16 multiplexer

The MUX8 is a multiplexer for use with 2 to 8 sensors or three-electrode cells. It is connected to the PalmSens instrument. This device allows application of sensor arrays with up to eight working electrodes sharing the reference and counter electrodes, but also with eight working, eight counter and eight reference electrodes. The device can also be used with two-electrode sensor arrays.

The MUX16 is a multiplexer for use with 16 working electrodes all sharing the same counter and same reference electrode in a single solution or for 16 working electrodes each with a combined reference/counter electrode in separate solutions.



BiPot extension

A bipotentiostat module is available for use with two working electrodes.

This module can be set in two different configurations. Configuration 1: the second WE is kept at a constant potential

Configuration 2: the second WE scans at a fixed potential offset with respect to the first WE. In both modes the current for both WE's are simultaneously recorded in linear sweep and cyclic voltammetry as well as amperometric detection.

Building in the module needs to be done at PalmSens' workshop.



Differential Electrometer Amplifier (DEA)

The PalmSens Differential Electrometer Amplifier (DEA) is a general purpose 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 -5V to 5V (1x gain). Possible gains are: 2x, 5x, 10x, 20x, 50x, 100x, etc.

Please do not hesitate to contact PalmSens for more details:
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