Rev. 2-2018

PalmSens4™

Potentiostat / Galvanostat / Impedance Analyzer

- FRA / EIS: 10 µHz 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 µV resolution (18 bit A/D)
- USB and battery powered
- Always a backup of your data with 4 GB of internal storage

PalmSens
Compact Electrochemical Interfaces

Contents

PalmSens4: Potentiostat / Galvanostat / Impedance Analyzer

The PalmSens4 is a battery-powered and USB-powered, handheld instrument which allows the application of the most relevant voltammetric, amperometric and potentiometric techniques as well as impedance spectroscopy (see below). Each PalmSens4 is shipped in a rugged carrying case (see page 6). The PalmSens4 together with a Windows or Android device forms a highly mobile electrochemical workstation.

Always a backup

The PalmSens4 is equipped with an internal storage of 4 GB.
This means all your measurements[1] 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*

Available configurations

The PalmSens4 is available with ±5V or ±10V DC-potential ranges and with different maximum frequencies for FRA / EIS. The following table shows the applicable product codes:

	Potential range ±5V [05]	Potential range ±10V [10]
NO EIS [F0]	PS4.F0.05	PS4.F0.10
EIS up to 100 kHz [F1]	PS4.F1.05	PS4.F1.10
EIS up to 1 MHz [F2]	PS4.F2.05	PS4.F2.10

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

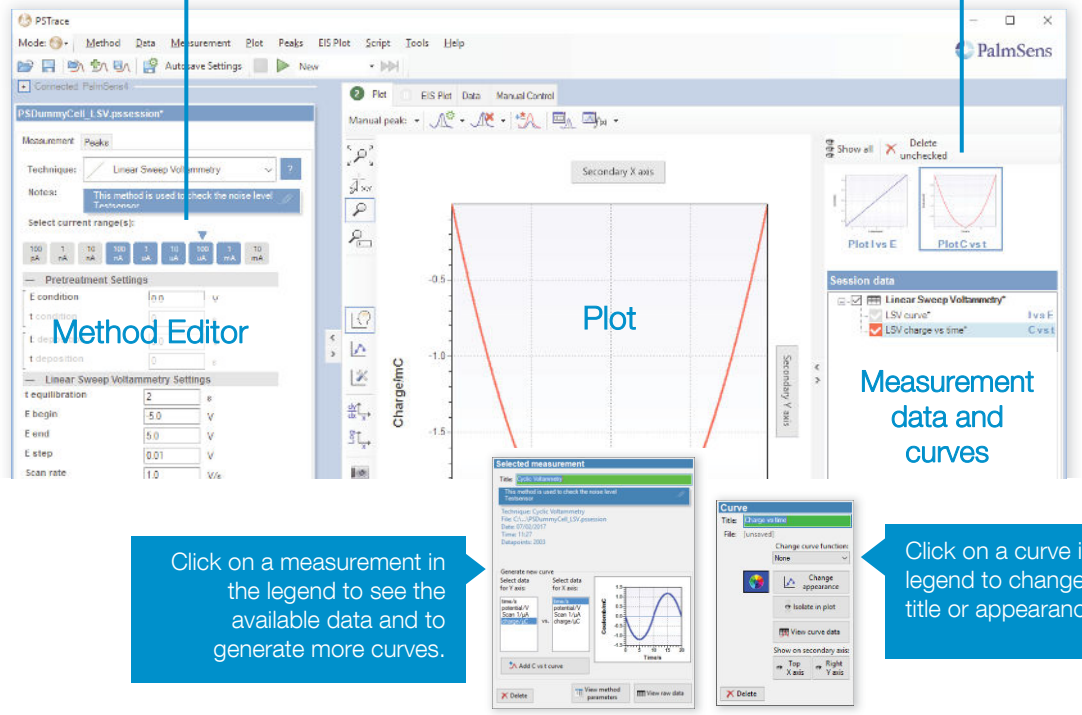
- Frequency scan
- Potential scan
- Fixed potential
- Time scan

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 starting current range.

Switch between plots if curves with different units are available.

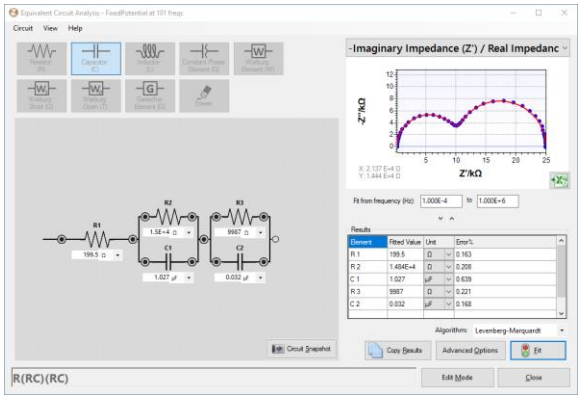


Click on a measurement in the legend to see the available data and to generate more curves.

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 PalmSens4's internal storage
- Dynamic feedback on method parameters



Integration with third 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

PStouch: App for Android

PSTouch is an app for Android devices compatible with all PalmSens and EmStat potentiostats. PSTouch can communicate with PalmSens4 via USB (depending on the Android device) or wirelessly via Bluetooth.

PStouch features:

- Setting up and running measurements
- Loading and saving measured curves
- Analysing and manipulating peaks
- Sharing data directly via e-mail or Dropbox
- Concentration determination by means of Standard Addition or Calibration Curve
- Support for PalmSens accessories such as a Multiplexer or Stirrer

All method and curve files are fully compatible with PSTrace software for Windows.
PStouch is designed for use with tablets and smartphones.

Download it for free in the Google Play Store.

Google play

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:

PS4 Model	PS4.F0.05 PS4.F1.05 PS4.F2.05	PS4.F0.10 PS4.F1.10 PS4.F2.10
Potential range:	-5 V to +5 V	-10 V to +10 V
Step potential:	0.075 mV to 250 mV	0.075 mV to 250 mV
Pulse potential:	0.075 mV to 250 mV	0.075 mV to 250 mV

Limits of some technique specific parameters for PalmSens4:

Normal Pulse and Differential Pulse Voltammetry:	Scan rate: Pulse time:	0.1 mV/s (75 µV step) to 100 mV/s (5 mV step) 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 µV step) to 500 V/s (10 mV step)
Pulsed Amperometric Detection:	Interval time: Pulse time: Maximum run time:	50 ms to 300 s 1 ms to 1 s 640000 s (> 7 days at 10 s interval)
Multiple Pulse Amperometric Detection:	Pulse times: Run time: Number of potential levels:	100 ms to 2 s 10 s to 100000 s 3
ChronoAmperometry, ChronoPotentiometry and Open Circuit Potentiometry:	Interval time: Maximum run time:	0.25 ms to 300 s 1000000 s (> 10 days at 300 s interval)
Multistep Amperometry Multistep Potentiometry and Mixed Mode:	Interval time: Level switching overhead time: Number of levels: Number of cycles: Maximum run time:	0.25 ms to 300 s ±80 ms 1 to 255 1 to 20000 > 1 year
Fast Amperometry:	Interval time: Maximum run time: Maximum number of points:	0.02 ms to 1 s 30 s 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] *PSTrace provides the option to measure forward and reverse currents separately.*

System Specifications

General

▪ dc-potential range	model	PS4.F#.05	PS4.F#.10
		±5 V	±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 µV
▪ applied potential accuracy	≤ 0.1% ±1 mV offset
▪ current ranges	100 pA to 10 mA (9 ranges)
▪ current accuracy	≤ 0.1% at FSR[1]
▪ 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 µV at ±10 V 7.5 µV at ±1 V 0.75 µV at ±0.1 V

FRA / EIS (impedance measurements)

▪ frequency range	model	PS4.F1.##	PS4.F2.##
		10 µHz to 100 kHz	10 µHz to 1 MHz
▪ ac-amplitude range	1 mV to 0.25 V rms, or 0.6 V p-p		

Electrometer

▪ electrometer amplifier input	> 1 TΩ // 10 pF
▪ bandwidth	1 MHz

Other

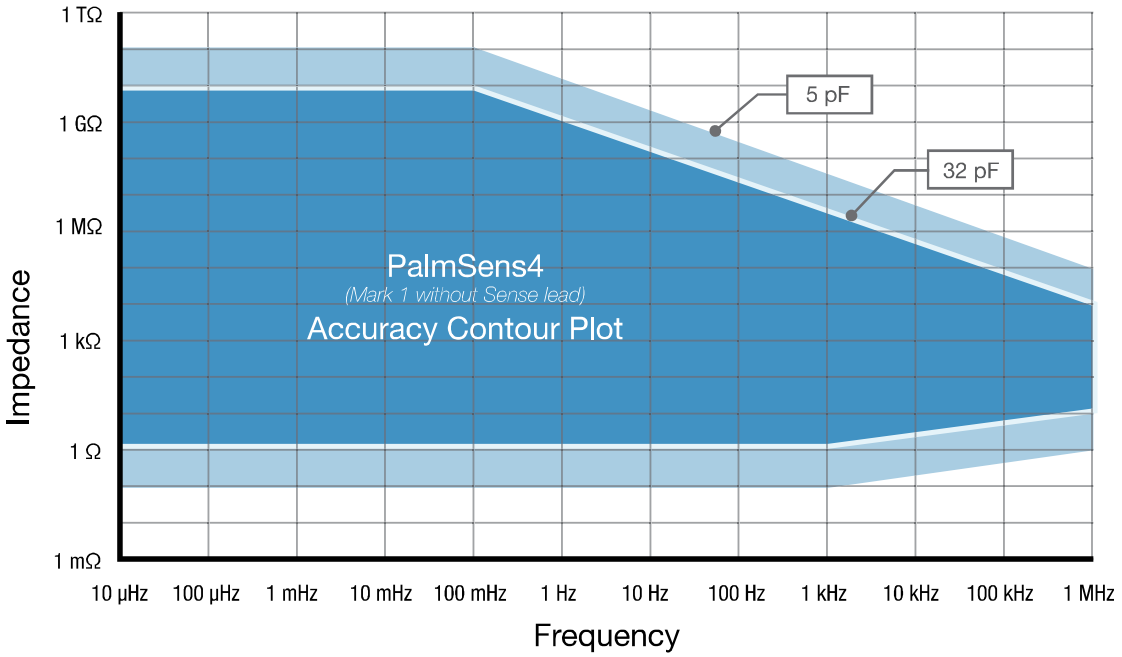
▪ housing	aluminium with rubber sleeve: 15.7 x 9.7 x 3.5 cm^3
▪ weight	500 g
▪ temperature range	0 °C to + 50 °C
▪ power supply	USB or internal LiPo battery
▪ communication	USB and Bluetooth
▪ battery time	> 16 hours idle time > 4 hours with cell on at max. current Extendible by means of power bank
▪ internal storage space	4 GB or +/- 400000 measurements incl. method info (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.

Standard PalmSens4 Configuration

A standard PalmSens4 case includes:

- PalmSens4
- USB A - USB Type C cable
- Sensor cable
- 4 croc clips
- PS Dummy Cell

Also included:

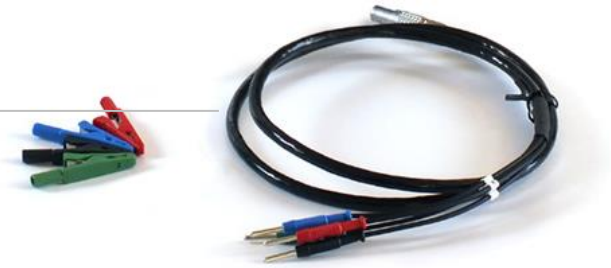
- PSTrace software + manual
- Quick start document

Optional

- *7" tablet*
- *Tablet charger*

PalmSens4 standard configuration in case with accessories.

PalmSens Dummy Cell



PalmSens4 sensor cable with croc clips

PalmSens4 Accessories

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 for monitoring of temperature during an experiment. This is recorded by PSTrace. The convenient two point calibration allows the user to precisely calibrate the sensor for the required temperature range. The Pt1000 temperature sensor for PalmSens4 comes with dongle for connection to PalmSens I/O port.

MUX8 or MUX16 multiplexer

The MUX8 is an 8 channel multiplexer. It allows the PalmSens4 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 PalmSens4 to measure up to 16 working electrodes with shared counter and reference electrodes.

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 -5V to 5V (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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