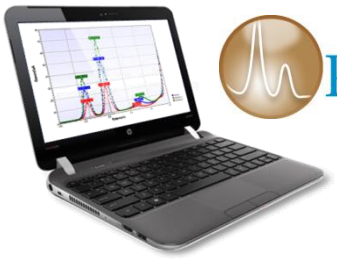
PalmSens

Compact Electrochemical Interfaces

EmStat3 and 3+

potentiostats

Rev. 3-2014



PSTrace

EmStat

potentiostat series

The most compact potentiostats currently available, which allows the application of most of the relevant voltammetric and amperometric techniques.

PSTrace for Windows provides all requirements for using EmStat.

The available methods are:

Voltammetric techniques

- Linear Sweep Voltammetry — LSV
- Differential Pulse Voltammetry — DPV
- Square Wave Voltammetry — SWV
- Normal Pulse Voltammetry — NPV
- Cyclic Voltammetry — CV

Note: these techniques can also be used for stripping voltammetry

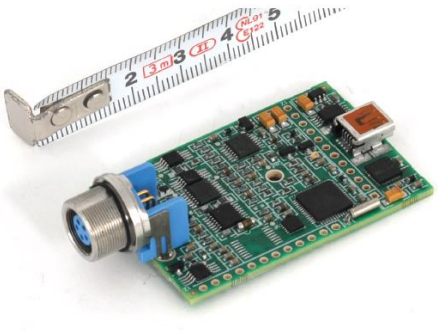
Techniques as a function of time

- Amperometric Detection — AD
- Pulsed Amperometric Detection — PAD
- Multiple Pulse Amperometric Detection — MPAD
- Open Circuit Potentiometry — OCP
- Multistep Amperometry — MA

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 the highest as well as lowest current range which might be selected automatically.

The EmStat PCB's are also available as OEM product.

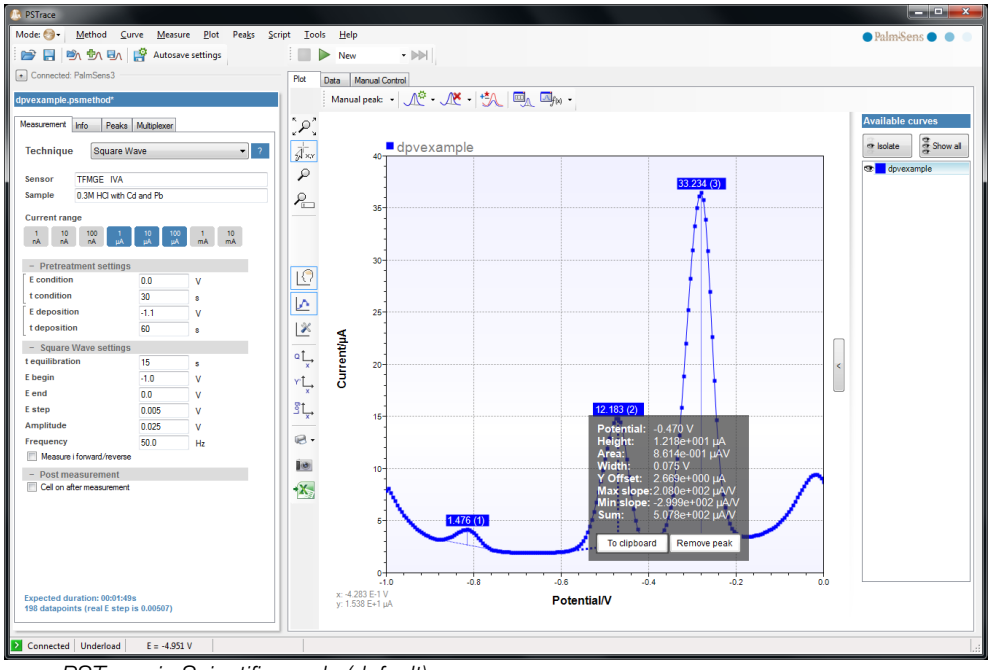


See page 8 for instrumental specifications.

PSTrace main features

Data analysis

PSTrace performs automatic as well as interactive peak detection and shows the peak potential, height, area, and width. Linear regression or integration can be performed on a marked part of the obtained curve. Smoothing of the measured curve is possible with a number of different levels. Curves can be subtracted from each other or subtracted with a (non-)linear baseline.



PSTrace in Scientific mode (default)

Output

Data files can be stored (automatically) and loaded. These files are standard ASCII files and can easily be imported in other programs. With each data file a file with the method parameters is created and the user can create an additional text file (in Word format) with personal comments or information.

Excel

With one click of a button the measured curves are exported from PSTrace to Excel and converted to a (Excel native) graph object.

Multiplexer support

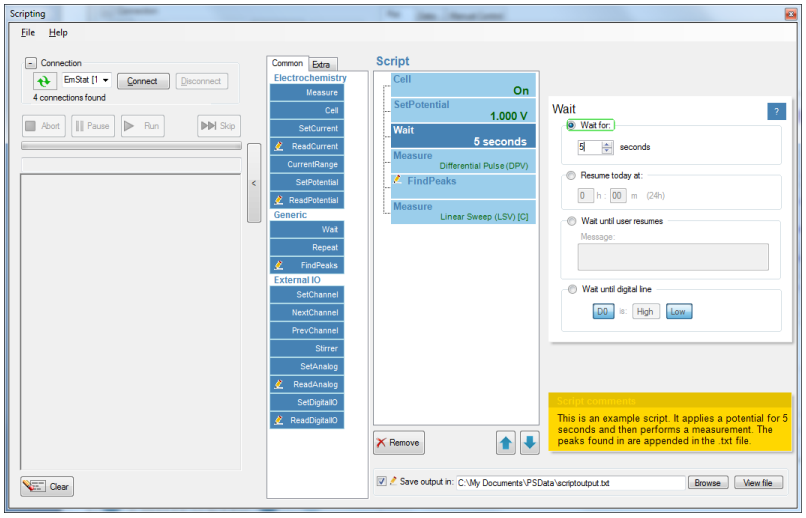
PSTrace supports the MUX8 or MUX16 multiplexer for EmStat. Voltammetric scans can be measured on all 16 or 8 channels consecutively and stored in a single data file. Amperometric detection can be done simultaneously on all channels, with a minimum interval time of 0.25 s (MUX8).

Stirrer support

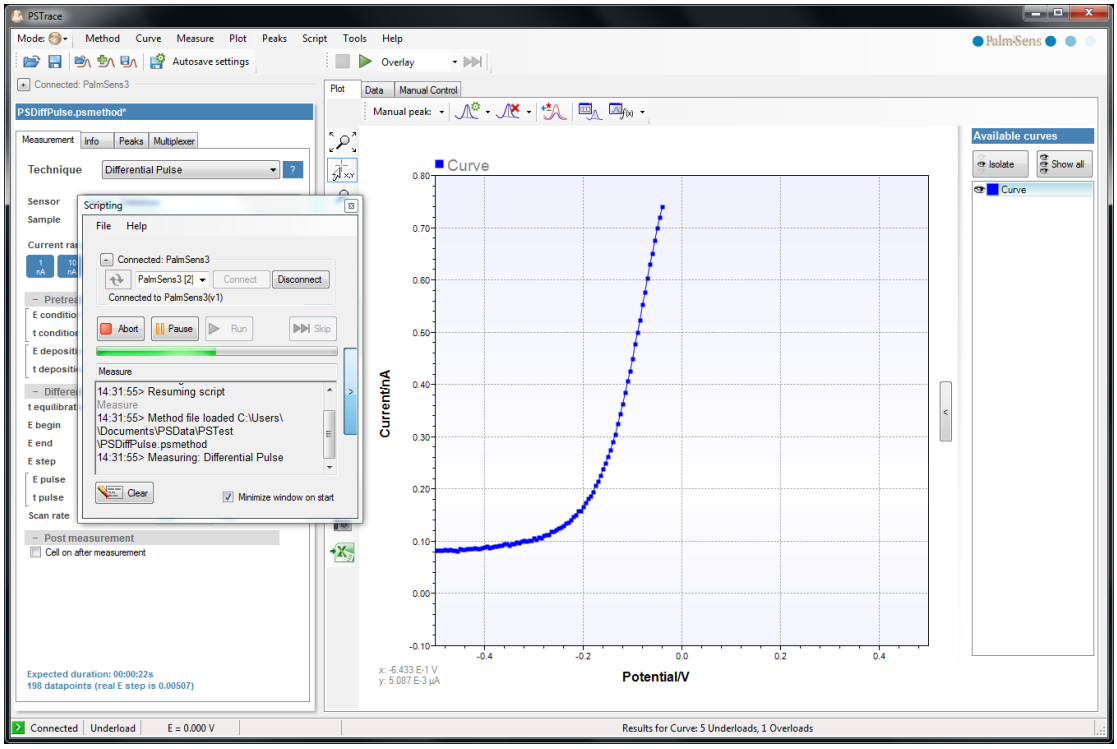
EmStat is capable of controlling a stirrer. EmStat has to be equipped with an optional module for this purpose. The stirrer is automatically switched on during the conditioning and deposition stages and switched off during the equilibration stage and measurement.

Scripting

PSTrace allows users to program a sequence of measurements by using Scripting. Such a sequence can include different techniques and provides control commands for the multiplexer as well as for the digital and analog input or output lines.



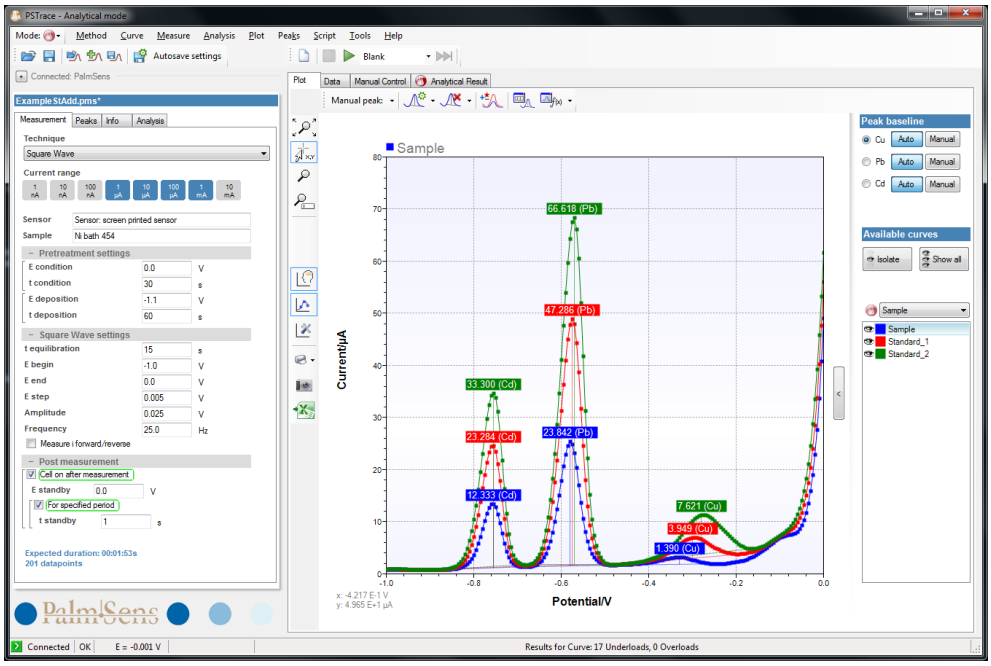
The script output and progress are shown during the run.



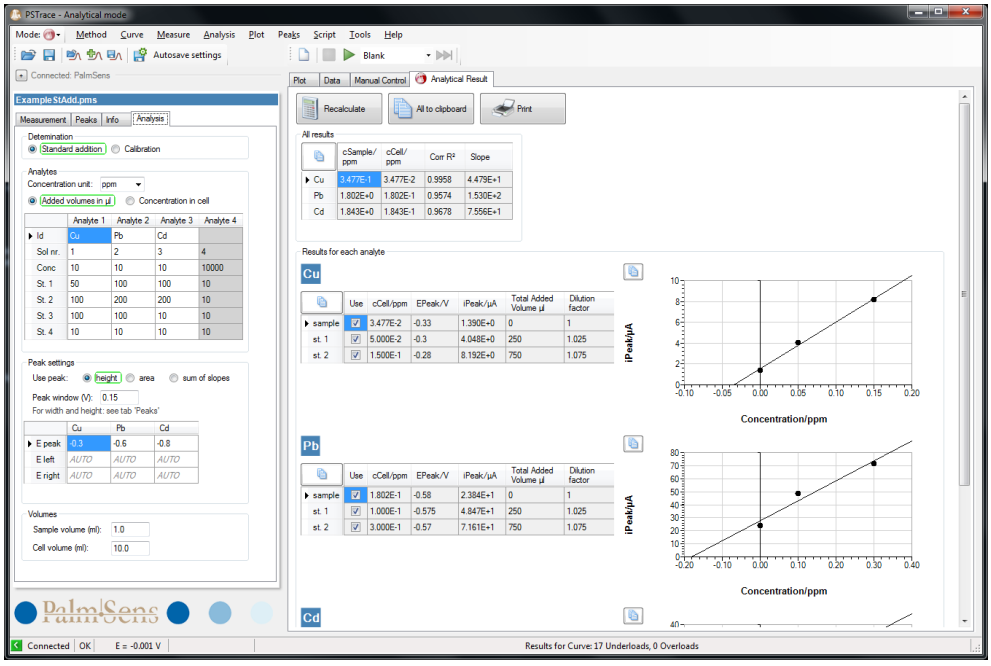
Output of the script is saved as curve files other readings or peak information is appended to a plain text file. A script can also be run directly from command prompt, making it easy to start a script from within a third party interface.

Analytical mode for quantitative analytical determinations

The Analytical mode provides the possibility to perform quantitative voltammetric analysis means of standard addition or using a calibration curve by means of (stripping) voltammetry.



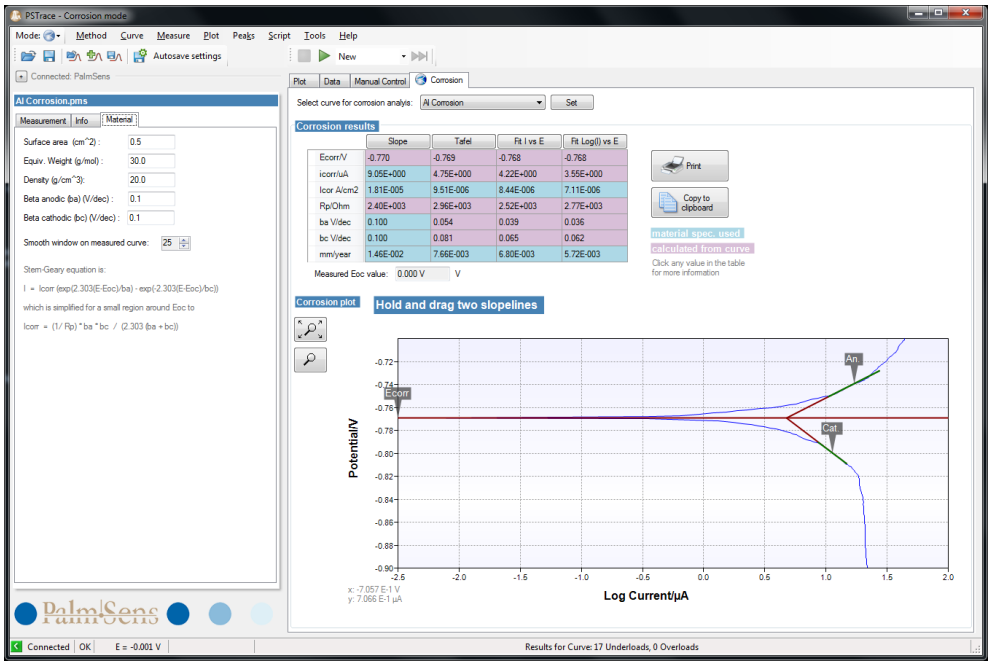
The program allows simultaneous determination of up to 4 components and with up to 4 standard additions or calibration curves. Background subtraction is also supported.



The plots and tables show the results of the voltammetric analysis.

Corrosion mode

The corrosion mode of PSTrace provides corrosion relevant data analysis:
- Linear polarization, from which the polarization resistance is obtained,
- Tafel plots, from which the corrosion rate is obtained.



The corrosion rate or polarization resistance can be obtained from the measured curve by means of drawing straight lines specified by the user or by means of a numerical fit method of the corrosion parameters using the theoretical Stern-Geary equation.

Specifications of general parameters

General pretreatment:
Apply conditioning, deposition or begin potential for: 0 – 1600 s

General voltammetric parameters:
Potential range for EmStat^3: -3.000 V to +3.000 V
Potential range for EmStat^{3+}: -4.000 V to +4.000 V
Step potential: 0.125 mV to 250 mV
Pulse potential: 0.125 mV to 250 mV

Limits of some technique specific parameters for EmStat^3 and EmStat^{3+}:

NPV and DPV:	Scan rate: Pulse time:	0.025 mV/s (0.125 mV step) to 50 mV/s (5 mV step) 5 ms to 300 ms
SWV:	Frequency:	1 Hz to 500 Hz
LSV and CV:	Scan rate:	0.01 mV/s (0.1 mV step) to 5 V/s (5 mV step)
AD:	Interval time: Run time:	1 ms to 300 s 1 s to hours
PAD:	Interval time: Pulse time: Run time:	50 ms to 300 s 1 ms to 1 s 10 s to hours
MPAD:	Pulse times: Run time: Number of potential levels:	100 ms to 2 s 10 s to hours 3
Potentiometry at open circuit (OCP):	Interval time: Maximum run time:	1 ms to 30 s hours
Multistep Amperometry:	Interval time: Number of potential levels: Number of cycles: Maximum run time:	1 ms to 30 s 1 to 255 1 to 20000 hours

Note: some limits of parameters are set for practical reasons and can be modified on requ7est.
(1) *PSTrace provides the option to measure forward and reverse currents separately.*

Instrumental specifications

	EmStat3	EmStat3+
- dc-potential range	± 3.000 V	± 4.000 V
- compliance voltage	± 5 V	± 8 V
- applied dc-potential resolution	0.1 mV	0.125 mV
- max. dc-offset error	2 mV	3 mV
- accuracy	≤ 0.2 %	≤ 0.3 %
- current ranges	1 nA to 10 mA (8 ranges) using a ZRA (zero resistance ammeter)	1 nA to 100 mA (9 ranges) using a ZRA (zero resistance ammeter)
- maximum measured current	± 20 mA typical and ± 15 mA minimum	± 100 mA typical

- current resolution	0.1 % of current range 1 pA on lowest current range
- accuracy	≤ 0.5 % of current range at 10 nA and ≤ 1 % at 1 nA ≤ 0.2 % at 100 nA to 100 uA ≤ 0.5 % at 1 mA, 10 mA and 100 mA all with additional 0.2 % offset error
- electrometer amplifier input	> 100 Gohm // 4 pF
- rise time	approx. 100 µs
- housing	anodized aluminium: 6.7 cm x 5.0 cm x (1.9 to 2.8 cm)
- weight	0.085 kg
- power	5 V, 130 mA (ES^3) or 500 mA (ES^{3+}) from USB connector
- interfacing	USB
- external I/O options	analog: 1 input and 1 output channel (both 0 V - 4.096 V) digital: 4 in/output lines (maximum rating: -0.3 V to 5.3 V)
- sensor connection	shielded cable with circular connector for WE, Sense (ES^{3+}), RE and CE.

Note:
$EmStat^3$ and $EmStat^{3+}$ are also available as a printed circuit board for integration in other instruments.

Standard carrying case

Options

Pt1000 temperature sensor
EmStat^3 can be equiped with a Pt1000 temperature sensor. This requires a factory based adjustment.

Magnetic stirrer
The magnetic stirrer controlled by EmStat is ideal for stripping analysis applications. The stirrer is switched on during the conditioning and deposition stages by means of the Switchbox.
EmStat has to be equipped from factory with the socket for this Switchbox.

Please do not hesitate to contact PalmSens for more details:
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