



# MultiEmStat

4, 8 or 12 channel potentiostat



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## MultiEmStat multi-channel potentiostat

The MultiEmStat is a versatile device with 4, 8 or 12 independent EmStat<sup>3</sup> or EmStat<sup>3+</sup> potentiostats, each with its own WE, RE and CE.

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   |



MultiEmStat<sup>3</sup> 4 channel



4 (MultiEmStat<sup>3+</sup>), 8 or 12 channel

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

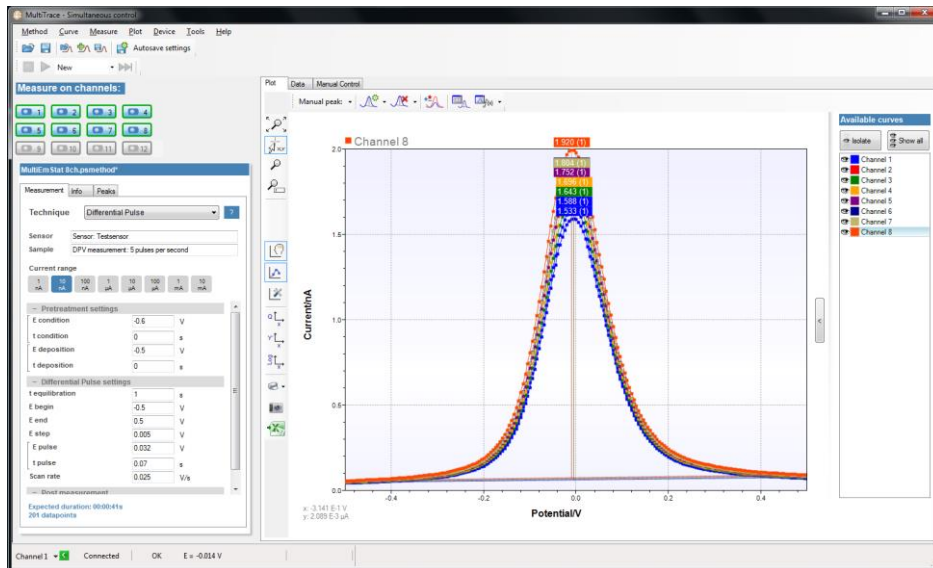
Where possible, the electrochemical techniques can be applied using **auto ranging** which means that the instrument automatically sets the optimal current range. The user can specify the highest as well as lowest current range which might be selected automatically.

See page 7 for instrumental specifications.

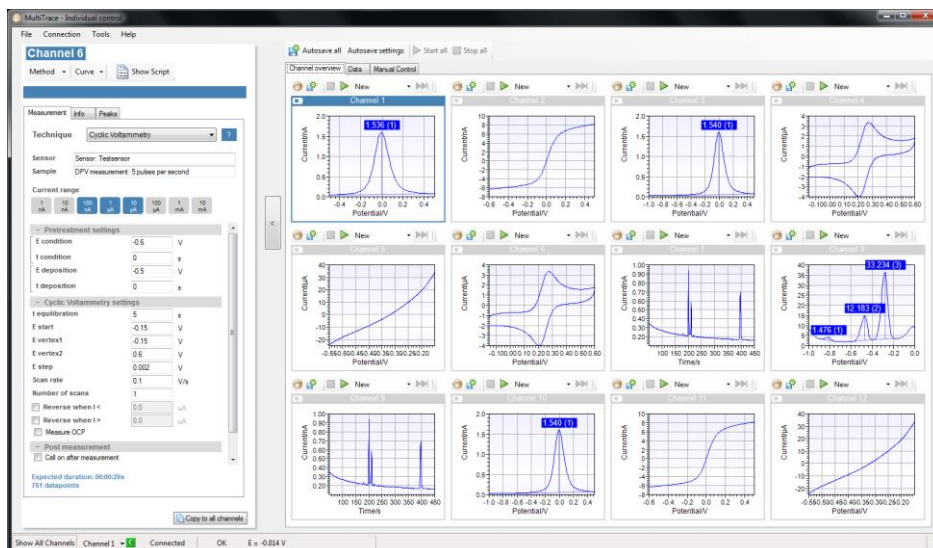
# MultiTrace software

The MultiTrace software controls the individual potentiostats of the multi-channel instruments. MultiTrace is based on the PSTrace program for the PalmSens and EmStat instruments. The program utilizes the multi potentiostat in two modes:

- Simultaneous mode**  
 All potentiostats run the same measurement. The measured curves are displayed in a single plot and stored in a single data file.



- Individual mode**  
 All potentiostats are used independently. Each measurement is started separately and the measured curve is shown in its own plot. Data files are separately stored.



## Available in both modes

### Data analysis

MultiTrace 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.

### 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

A data tab showing the raw measured data for each channel is available in both the simultaneous mode and the individual mode. This data can also be exported to Excel by means of a single click on the Export-to-Excel button next to the plot. A native Excel plot will be generated as well.



The manual control tab allows for controlling the cell and reading potentials and currents of each individual channel.

## MultiTrace Simultaneous mode

The interface of MultiTrace in the simultaneous mode provides most of the functions as found in PSTrace. In this mode there is one active method that can be run over the selected channels. The method editor provides immediate feedback on values entered and provides direct access to background information about each measurement technique.

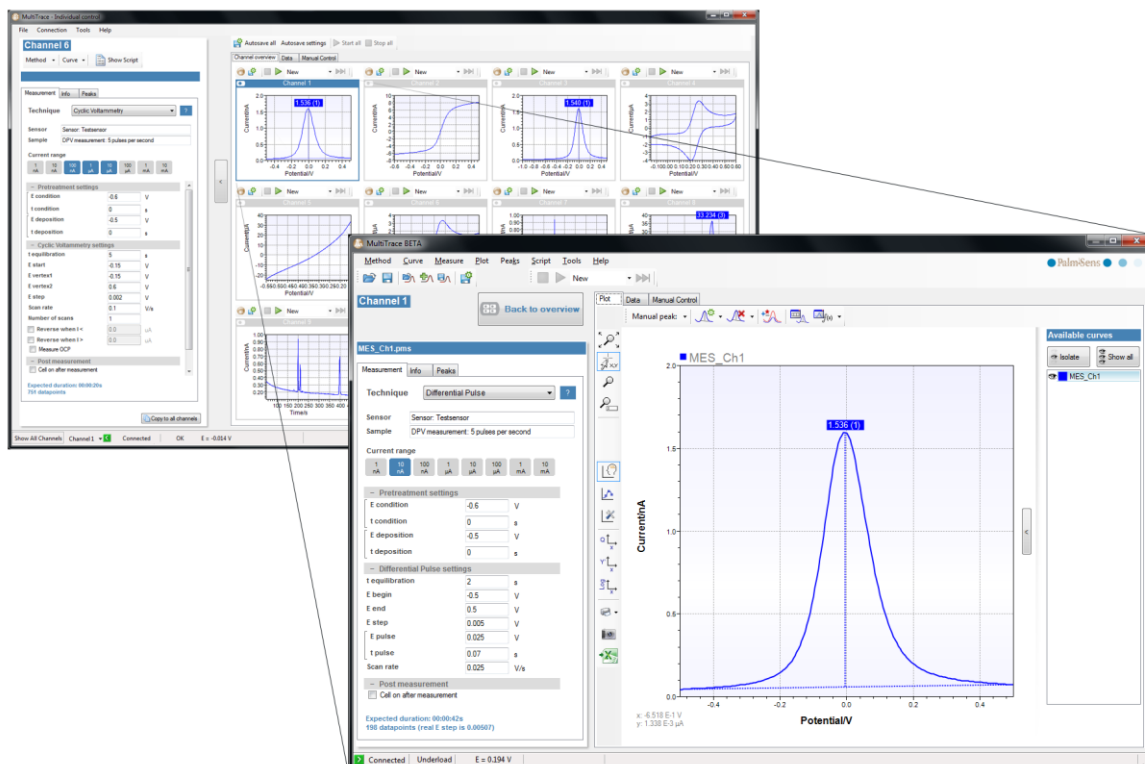
The screenshot shows the MultiTrace software interface in simultaneous mode. The interface is divided into several key areas:

- Menu:** Located at the top, including Method, Curve, Measure, Plot, Device, Tools, and Help.
- Measure toolbar:** Contains a 'New' button and other measurement controls.
- Channel selection:** A grid of 12 numbered buttons (1-12) for selecting measurement channels.
- Method editor:** A central panel for configuring the 'P/SPNoiseTest.psmethod'. It includes:
  - Technique:** Set to 'Linear Sweep'.
  - Sensor:** 'Testsensor'.
  - Sample:** 'This method is used to check the noise level'.
  - Current range:** Selections for 1 nA, 10 nA, 100 nA, 1 µA, 10 µA, 100 µA, 1 mA, and 10 mA.
  - Pretreatment settings:**
    - E condition: -1.2 V
    - t condition: 0 s
    - E deposition: -1.0 V
    - t deposition: 0 s
  - Linear Sweep settings:**
    - t equilibration: 0 s
    - E begin: -0.5 V
    - E end: 0.5 V
    - E step: 0.005 V
    - Scan rate: 0.5 V/s
  - Post measurement:** Includes 'Cell on after measurement'.
  - Auxiliary measurement:** Includes 'Record auxiliary input'.
- Plot window:** A graph showing 'Current/nA' on the y-axis (ranging from -4.0 to 4.0) and voltage on the x-axis. A data point is highlighted with coordinates: x: -3.597 E-1 V, y: -4.264 E-3 µA.
- Status bar:** At the bottom, showing 'Show All Channels', 'Channel 1' (selected), 'Connected', 'Underload', and 'E = 0.065 V'.

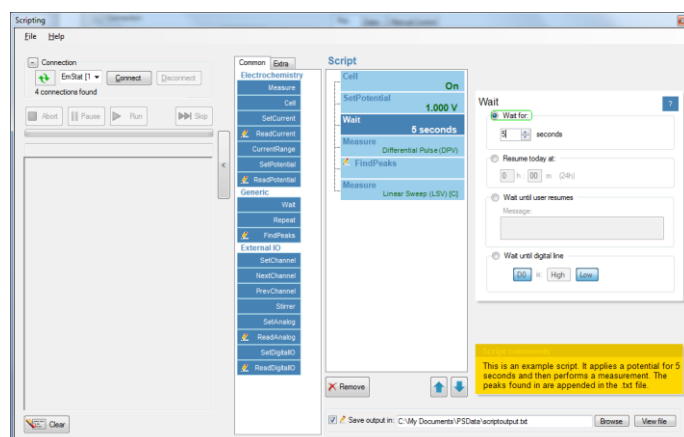
## MultiTrace Individual mode

The individual mode shows 4, 8 or 12 small plot windows. Each plot window has its own active method. The method that is active with the selected plot window is reflected at the left hand side of the window. The editor allows for direct manipulation and validation of the parameters. The set of active methods on all channels can be saved to a project file.

Double clicking on a small plot opens a fully functional PSTrace window.



The individual mode also supports the option to run a sequence of measurements on a specific channel by using Scripting. Such a sequence can include different techniques and provides control commands for manual cell control or digital input or output lines<sup>1</sup>.



<sup>1</sup> Additional digital input or output lines, e.g. for stirrer control requires to be specified on ordering.

## Specifications of general parameters

### General pretreatment:

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

### General voltammetric parameters:

Potential range for MultiEmStat <sup>3</sup> :	-3.000 V to +3.000 V
Potential range for MultiEmStat <sup>3+</sup> :	-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 MultiEmStat<sup>3</sup> and MultiEmStat<sup>3+</sup>:

NPV and DPV:	Scan rate:	0.025 mV/s (0.125 mV step) to 500 mV/s (5 mV step)
	Pulse time:	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:	1 ms to 300 s
	Run time:	1 s to hours
PAD:	Interval time:	50 ms to 300 s
	Pulse time:	1 ms to 1 s
	Run time:	10 s to hours
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
Potentiometry at open circuit:	Interval time:	1 ms to 30 s
	Maximum run time:	100000 s
Multistep Amperometry:	Interval time:	100 ms to 30 s
	Number of potential levels:	1 to 255
	Number of cycles:	1 to 20000
	Maximum number of points:	200000

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

*(1) MultiTrace provides the option to measure forward and reverse currents separately.*



Backside of the MultiEmStat<sup>3</sup> 4 channel

## Instrumental specifications

	MultiEmStat <sup>3</sup>	MultiEmStat <sup>3+</sup>
- compliance voltage	± 5 V	± 8 V
- dc-potential range	± 3.000 V	± 4.000 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)	1 nA to 100 mA (9 ranges)
- maximum measured current	± 20 mA typical and ± 15 mA minimum	± 100 mA typical

*Current is measured using a ZRA (zero resistance ammeter)*

- 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 µA ≤ 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 for MultiEmStat3 - 4 channel:

- material:	aluminum
- dimensions:	115 mm x 85 mm x 35 mm
- weight:	+/- 260 g
- power:	5V external adapter

Housing for all other configurations:

- material:	aluminum
- dimensions:	120 mm x 210 mm x 75 mm
- weight:	+/- 2000 g
- power:	9V external adapter

- interfacing	USB
- sensor connection	shielded cable with circular connector for WE, Sense (MultiEmStat <sup>3+</sup> ), RE and CE.
- external I/O options <sup>2</sup>	analog: 1 input and 1 output channel (both 0 V - 4.096 V) digital: 1 input/output and 3 output lines (maximum rating: -0.3 V to 5.3 V)
- minimum PC requirements for MultiTrace	Windows 7, 2 GHz processor and 2 GB RAM.

<sup>2</sup> External I/O line do not come as standard, requires to be specified on ordering



## Options

### Galvanic isolation

For each MultiEmStat galvanic isolation (G.I.) is optional. Galvanic isolation is available for the whole system where all individual channels share the same floating ground or for each channel individually where each channel has its own floating ground. All galvanically isolated instruments are built in the large housing.

### Pt1000 temperature sensor

Each channel can be equipped with a Pt1000 temperature sensor.

### Magnetic stirrers

Each channel can be used with a magnetic stirrer for stripping voltammetry. The stirrer is controlled by means of the Switchbox.

## Related instrument



## EmStat<sup>3</sup> 4WE

The EmStat<sup>3</sup> 4WE is a versatile device with a standard EmStat<sup>3</sup> potentiostat and additionally 1, 2 or 3 bipotentiostat modules.

The instrument is used for electrochemical systems with 1, 2, 3 or 4 working electrodes (WE1 - 4) all sharing the same counter (CE) and reference electrodes (RE) or combined CE/RE.

Please do not hesitate to contact PalmSens for more details:  
[info@palsens.com](mailto:info@palsens.com)

**PalmSens BV**  
The Netherlands  
[www.palsens.com](http://www.palsens.com)

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