

EMSTAT4 MUX™

2-in-1 multiplexed
potentiostat / galvanostat / impedance analyzer



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➤ See for more information:
www.palmsens.com/emstat4mux

2-in-1: Potentiostat with Integrated Multiplexer

Gone are the days with too many cables. With the EmStat4 MUX you have a potentiostat and a multiplexer in one. The EmStat4 MUX is a powerful potentiostat, galvanostat and impedance analyzer and supports all popular electrochemical techniques. Its eight channels allow for sequential measurements, for example eight screen-printed electrodes, or eight working electrodes in eight different cells.



Main Specifications

channels	8 x [Working (WE), Sense (S), Counter (CE) and Reference electrode (RE) and Ground]
potential range	±3 V
max. compliance	±5 V
current ranges	1 nA to 10 mA (8 ranges)
max. current	±30 mA
FRA / EIS	10 μHz to 100 kHz when switching WE, RE and CE 10 μHz to 200 kHz when switching WE and RE+CE combined (2-electrode configuration)
electrodes	WE, S, RE, CE, and Ground, 2 mm banana plugs

See page 9 for more detailed system specifications.

Cell Configurations

The internal multiplexer is designed for use up to 128 channels with 2-, 3- or 4- electrode sensors or cells.

The multiplexer can be used with different electrode or sensor configurations:

1. Eight separate cells or sensors each with a working/sense, reference and counter electrode.
2. Eight separate cells or sensors each with a working/sense and combined reference and counter electrode.
3. Cell or sensor array with eight working/sense electrodes sharing one reference and one counter electrode.
4. Cell or sensor array with eight working/sense electrodes sharing one combined reference/counter electrode.

In all configurations the cells can be multiplexed, leaving the non-selected working electrodes either at open circuit (individually floating) or at Ground potential.

When in configurations 3 and 4, the unselected channels are switched to Ground, they will have the working electrode's potential. This is since the active WE is always at Ground potential.

You can easily change the hardware configuration of the multiplexer as part of the measurement settings in our PStTrace software or the PStouch app for Android.

MUX8-R2 Settings

Connect Sense to WE

Combine RE and CE

Use Common RE and CE on Channel 1

Unselected WE

Disconnect WE (floating)

Switch WE to GND

The hardware configuration can be set in PStTrace.

Connectors

The EmStat4 MUX has the following connectors:

Connector	Function
AUX	Can be used to control an external switch or stirrer or to measure an auxiliary input like temperature.
Link	Connects to Input of next multiplexer, for daisy-chaining multiple multiplexers.
USB-C	For providing extra power in case more than two multiplexers are connected to a single instrument.
Channel 1-4	Connects to WE, RE and CE of channels 1-4.
Channel 5-8	Connects to WE, RE and CE of channels 5-8.



Adding More Channels

The number of available channels can be increased by connecting one or more MUX8-R2 multiplexers to the EmStat4 MUX. The additional multiplexers are daisy chained through the Link to Input of each successive multiplexer. The software automatically detects the total number of channels available.



Magnetic feet

The magnetic feet on the EmStat4 MUX and magnets embedded in the top side of the MUX8-R2 multiplexers ensure a solid and stable stack of instruments.

Cell Connection Options

Option A (default):

The channels are divided into two distinct sets of four sensor cables joined with a D-Sub connector.

Channels 1-4.

Order code: [CBL-SNS-DS25-5S-1_4]

Channels 5-8.

Order code: [CBL-SNS-DS25-5S-5_8]

8x

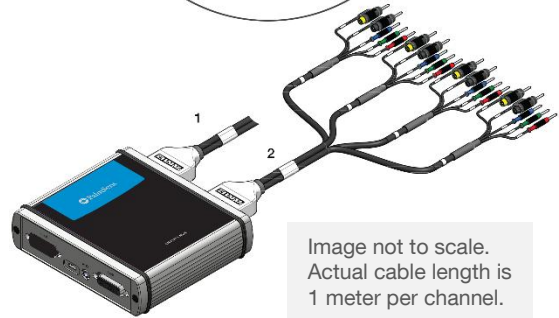
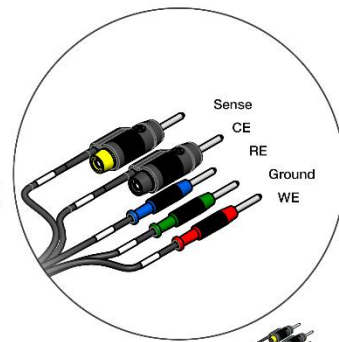


Image not to scale.
Actual cable length is 1 meter per channel.

Option B:

The cable here shown at the right can be used in case the multiplexer needs to be connected to a fixed setup by means of soldering or screw-terminals.

Order code: [CBL-MUX08R2-HD]



Option C:

You can also connect one or two screw-terminals directly in the multiplexer.

Order code: [MUX08R2-ST]



Option D:

The SPE adapter for our multiplexer allows you to connect 8x Screen Printed Electrodes (SPE's). The pitch of the SPE connector is 2.54 mm and compatible with the most popular brands of SPE's.

Order code: [MUX08R2-SPE]



Supported Techniques

The EmStat4 MUX supports the following electrochemical techniques.

Alternating Mode



In **sequential** mode each channel is set before the next measurement starts. In **alternating** mode, the channels are quickly scanned during each interval time giving a virtual-simultaneous measurement across the selected channels.

Techniques marked with an  can be used in Alternating mode.

Voltammetric techniques


- | | |
|----------------------------|-----|
| ▪ Linear Sweep Voltammetry | LSV |
| ▪ Cyclic Voltammetry | CV |
| ▪ Fast Cyclic Voltammetry | FCV |
| ▪ AC Voltammetry | ACV |

Pulsed techniques

- | | |
|----------------------------------|-----|
| ▪ Differential Pulse Voltammetry | DPV |
| ▪ Square Wave Voltammetry | SWV |
| ▪ Normal Pulse Voltammetry | NPV |

These methods can all be used in their stripping modes which are applied for (ultra-) trace analysis.

Amperometric techniques

- | | | |
|---------------------------------|-----|---|
| ▪ Chronoamperometry | CA |  |
| ▪ Zero Resistance Amperometry | ZRA | |
| ▪ Chronocoulometry | CC | |
| ▪ MultiStep Amperometry | MA | |
| ▪ Fast Amperometry | FAM | |
| ▪ Pulsed Amperometric Detection | PAD | |

Galvanostatic techniques

- | | | |
|------------------------------|-----|---|
| ▪ Linear Sweep Potentiometry | LSP | |
| ▪ Chronopotentiometry | CP |  |
| ▪ MultiStep Potentiometry | MP | |
| ▪ Open Circuit Potentiometry | OCP |  |

Other

- | | |
|--|------------|
| ▪ Mixed Mode | MM |
| ▪ Potentiostatic/Galvanostatic Impedance spectroscopy at fixed frequency or frequency scan vs <ul style="list-style-type: none"> ○ fixed potential or fixed current ○ scanning potential or scanning current ○ time | EIS/GEIS |
| ▪ Fast EIS/GEIS
Very low interval fixed-frequency measurements | FEIS/FGEIS |

Measurement Specifications

The following table shows limits for some technique-specific parameters.

	Parameter	Min	Max
All techniques (unless otherwise specified)	▪ Conditioning time	0	4000 s
	▪ Deposition time	0	4000 s
	▪ Equilibration time	0	4000 s
	▪ Step potential	0.100 mV	250 mV
	▪ N data points	3	1 000 000
▪ NPV ▪ DPV	▪ Scan rate	0.1 mV/s (100 μ V step)	1 V/s (5 mV step)
	▪ Pulse time	0.4 ms	300 ms
▪ SWV	▪ Frequency	1 Hz	1250 Hz
▪ LSV ▪ CV	▪ Scan rate	0.01 mV/s (100 μ V step)	500 V/s (200 mV step)
▪ FCV	▪ Scan rate	0.1 mV/s (100 μ V step)	500 V/s (50 mV step)
	▪ N averaged scans	1	65535
	▪ N equil. scans	0	65535
▪ PAD	▪ Interval time	50 ms	4294 s
	▪ Pulse time	1 ms	1 s
	▪ N data points	3	1 000 000 (> 100 days at 10 s interval)
▪ CA ▪ CP ▪ OCP	▪ Interval time	0.4 ms	4294 s
	▪ Run time	1 ms	> year
▪ MM ▪ MA ▪ MP	▪ N cycles	1	20000
	▪ N levels	1	255
	▪ Level switching overhead time	~1 ms (typical)	-
	▪ Interval time	0.4 ms	4294 s
▪ FAM	▪ Interval time	1 μ s	60 s
	▪ Run time	3 μ s	34 days (60 s interval) 50 ms (1 μ s interval)
	▪ N data points	3	50000
▪ Fast EIS	Interval time between points at fixed frequency	~1 ms (typical)	-

System Specifications

General	
▪ dc-potential range	±3 V
▪ compliance voltage	±5 V
▪ maximum current	±30 mA
▪ max. data acquisition rate	1M points/s
▪ control loop bandwidth (stability setting)	32 Hz, 320 Hz, 3.2 kHz, 30 kHz or 570 kHz
▪ current follower bandwidth	23 Hz in 1 nA and 10 nA range 2.3 kHz in 100 nA and 1 uA range 230 kHz in 10 uA and 100 uA range > 500 kHz in ranges 1 mA and higher

Potentiostat (controlled potential mode)	
▪ applied potential resolution	100 µV
▪ applied potential accuracy	≤ 0.2% ±1 mV offset
▪ current ranges	1 nA to 10 mA (8 ranges)
▪ measured current resolution	0.009% of range (92 fA on 1 nA range)
▪ measured current accuracy	< 0.2% of current ±55 pA (25 pA typical) ±0.2% of range

Galvanostat (controlled current mode)	
▪ current ranges	10 nA, 1 uA, 100 uA, 10 mA (4 ranges)
▪ applied dc-current	±3 * range
▪ applied dc-current resolution	0.01% of range
▪ applied dc-current accuracy	< 0.4% of current ±20 pA ±0.2% of range
▪ potential ranges	50 mV, 100 mV, 200 mV, 500 mV, 1 V
▪ measured dc-potential resolution	96 µV at ±3 V (1 V range) 48 µV at ±1.5 V (500 mV) 19.2 µV at ±0.6 V (200 mV) 9.6 µV at ±0.3 V (100 mV) 4.8 µV at ±0.150 V (50 mV)
▪ measured dc-potential accuracy	≤ 0.2% potential, ±1 mV offset

Optional: FRA / EIS (impedance measurements)

▪ frequency range	10 μ Hz to 100 kHz when switching WE/S, RE and CE 10 μ Hz to 200 kHz when switching WE/S and RE+CE combined (2 electrodes configuration)
▪ ac-amplitude range	1 mV to 900 mV rms, or 2.5 V p-p

Optional: GEIS (galvanostatic impedance measurements)

▪ frequency range	10 μ Hz to 100 kHz
▪ ac-amplitude range	0.9 * range A rms

Electrometer

▪ electrometer amplifier input	> 1 T Ω // 10 pF
▪ bandwidth	500 kHz

Other

▪ electrode connections	8x [WE, S, RE, CE, and ground] default with 2 mm banana pins and croc clips
▪ power + communication	USB-C
▪ housing	aluminium body: 13.8 x 12.1 x 3.7 cm ³
▪ weight	500 g
▪ internal storage space	500 MB, equivalent to >15M datapoints or ~1000 measurement files (whichever comes first)

Multiplexer

▪ number of channels	8 (up to 128 channels when adding more MUX8-R2 multiplexers)
▪ on resistance for WE	1.5 Ω typical
▪ charge injection for WE	20 pC typical
▪ switching time	2 ms
▪ switching time when alternating	25 ms (min. 0.5 s interval time when alternating over 8 channels)

Standard EmStat4 MUX Kit

A standard EmStat4 MUX kit includes a rugged carrying case with:

- EmStat4 MUX
- USB-C cable
- 2x 1 meter cell cable assembly (default option, quoted separately)
- Dummy Cell

Also included:

- PStTrace software for Windows (on USB drive)
- Manual (hardcopy)
- Quick Start document
- Calibration report

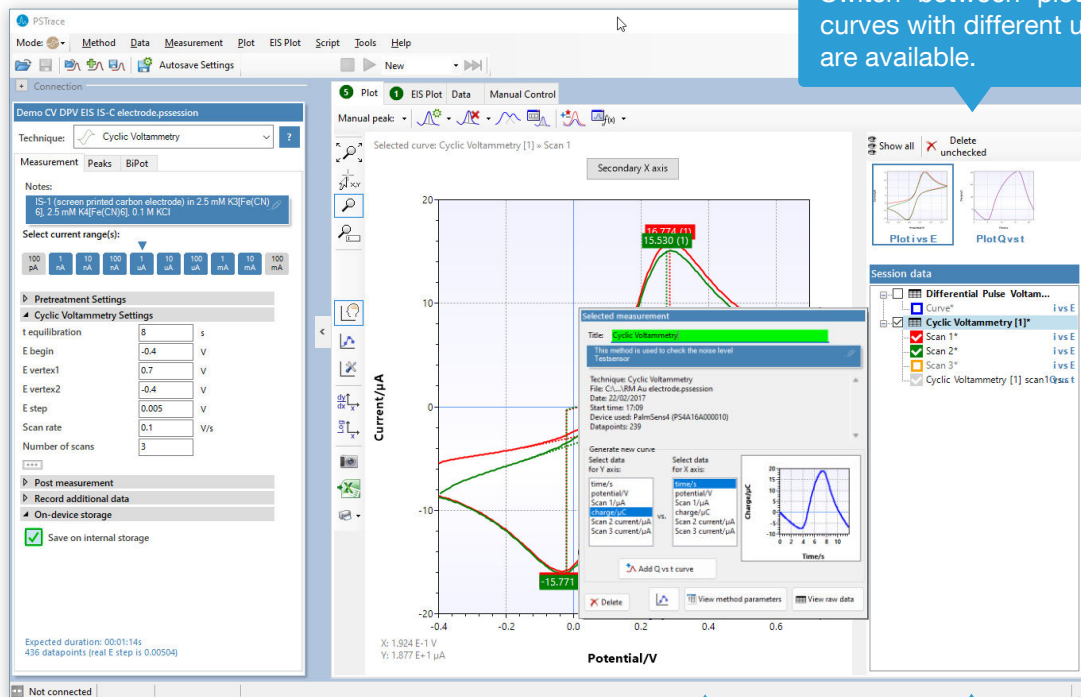


PSTrace: Software for Windows

The EmStat4 MUX operates seamlessly with PSTrace, a free software compatible with all our potentiostats. Additionally, all future updates are provided at no cost.

PSTrace is designed to get the most out of your instrument right after installation, without going through a long learning period. It has three modes:

1. **Scientific mode**, which allows you to run all the techniques our instruments have to offer;
2. **Corrosion mode**, suitable for corrosion analysis with corrosionists terminology and specific curve operations;
3. **Analytical mode**, designed for use with (bio)sensors and allows you to do concentration determinations.

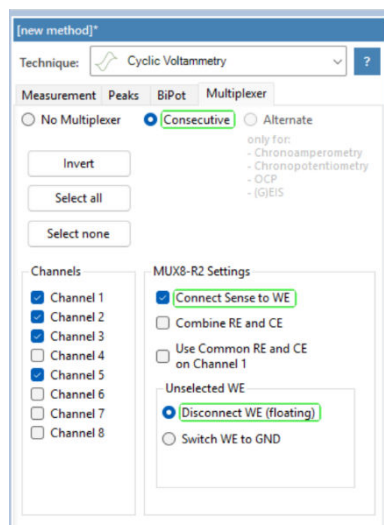


Switch between plots if curves with different units are available.

Setup your measurement easily and get immediate feedback on validity of parameters.

Click on a measurement for detailed information or generating new curves.

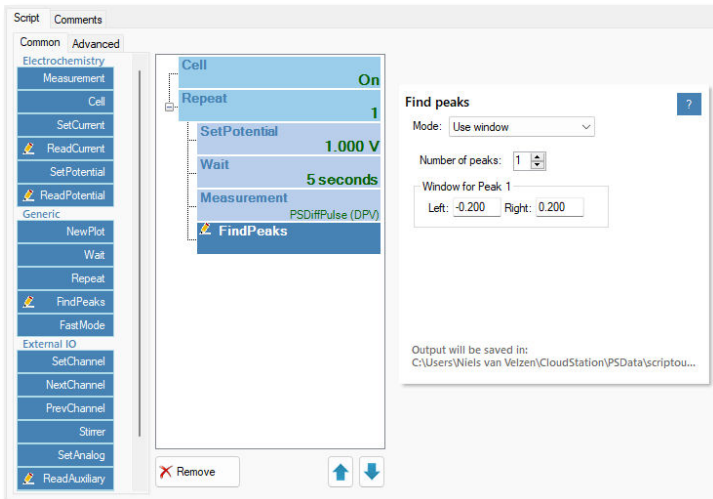
Quickly toggle the visibility of curves or groups of curves.



Easy setting of active multiplexer channels and multiplexer hardware configuration.

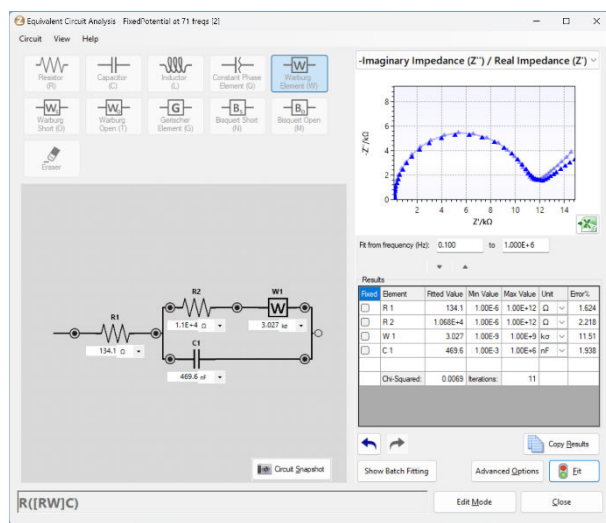
Scripting

The intuitive script editor allows for easily creating a sequence of measurements or other tasks, by means of dragging and dropping actions in a list.



Equivalent Circuit Fitting on EIS data

Use the graphical editor to draw the equivalent circuit or enter the CDC directly.



Other functions in PSTRace

- Concentration determination
- Advanced peak search algorithms
- 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
- Load measurements from the internal storage
- Direct validation of method parameters
- Run custom MethodSCRIPT™ scripts

Minimum System Requirements

- Windows 7, 8, 10 or 11
- 1 GHz or faster 32-bit (x86) or 64-bit (x64) processor
- 2 GB RAM (32-bit) or 4 GB RAM (64-bit)
- Screen resolution of 1280 x 800 pixels

Integration with third-party software

- Excel
- Origin
- Matlab
- ZView



> See for more information:
www.palmsens.com/pstrace

EmStat4 MUX works with MethodSCRIPT™

The MethodSCRIPT™ scripting language is designed to integrate our instruments and potentiostat (modules) effortlessly in your hardware setup, product, or experiment.

MethodSCRIPT™ gives you full control over your potentiostat. The simple script language is parsed on board the instrument and allows for running all supported electrochemical techniques, making it easy to combine different measurements and other tasks.

MethodSCRIPT can be generated, edited, and executed in PStace.

MethodSCRIPT features include:


- Multiplexer control
- (Nested) loops and conditional logic support
- User code during a measurement iteration
- Exact timing control
- Simple math operations on variables (add, sub, mul, div)
- Logging results to internal storage or external SD card and many more...

```

1 e
2 var c
3 var p
4 #Select bandwidth of 40 for 10 points per second
5 set_max_bandwidth 40
6 #Set current range to 1 mA
7 set_range ba 1m
8 #Enable autoranging, between current of 100 uA and 1 mA
9 set_autoranging ba 100u 1m
10 #Turn cell on for measurements
11 cell_on
12 #Equilibrate at -0.5 V for 5 seconds, using a CA measurement
13 meas_loop_ca p c -500m 500m 5
14 pck_start
15 pck_add p
16 pck_add c
17 pck_end
18 endloop
19 #Start LSV measurement from -0.5 V to 1.5 V, with steps of 10 mV
20 #and a scan rate of 100 mV/s
21 meas_loop_lsv p c -500m 1500m 10m 100m
22 #Send package containing set potential and measured WE current.
23 pck_start
24 pck_add p
25 pck_add c
26 pck_end
27 #Abort if current exceeds 1200 uA
28 if c > 1200u
29 abort
30 endloop
31 #Turn off cell when done or aborted
32 on_finished:
33 cell_off
34


```

[Online support on MethodSCRIPT](#)




Write your own software and integrate (generated) MethodSCRIPT scripts. No libraries needed.

MethodSCRIPT is parsed on board the instrument. No DLLs or other type of code libraries are required for using MethodSCRIPT™




MethodSCRIPT™


Code examples are available for:




C/C++




ARDUINO




Swift



Xamarin



python™



Java

[> See for more information:
 www.palmsens.com/methodscript](http://www.palmsens.com/methodscript)

Integrate Electrochemistry into Your Own Applications

Seamless Instrument Control

- Access all PalmSens potentiostats (single- and multi-channel) through our SDKs.
- Full control of measurement techniques, data acquisition, and real-time analysis.

Cross-Platform Support

- **Python SDK**
Script and automate experiments across platforms.
- **Windows .NET SDK**
Easily integrate in C#, VB.NET, or any .NET language.
- **Android & iOS SDKs**
Build mobile apps to run PalmSens instruments in the field.
- **LabVIEW & MATLAB examples**
Quick start for engineers and researchers.



Accelerate Development

- Pre-built code sample
- Clear documentation & active support
- Sample apps to get started within minutes



PalmSens SDKs
put you in control
from the lab to the field



> See for more information:
www.palmsens.com/dev

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in touch with a distributor in your region.



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