



EmStat MUX8 and MUX16

potentiostat with integrated multiplexer

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EmStatMUX: potentiostat with integrated multiplexer

The EmStat3MUX8 and EmStat3MUX16 are compact instruments comprising a potentiostat and a multiplexer. The potentiostat is the standard EmStat3 device, which provides most of the relevant electroanalytical measurement techniques and is controlled by means of a single USB connection.

EmStat3MUX8

The MUX8 multiplexer allows connecting up to eight electrochemical cells or sensors to the EmStat3 potentiostat. The multiplexer can be used with different electrode or sensor configurations:

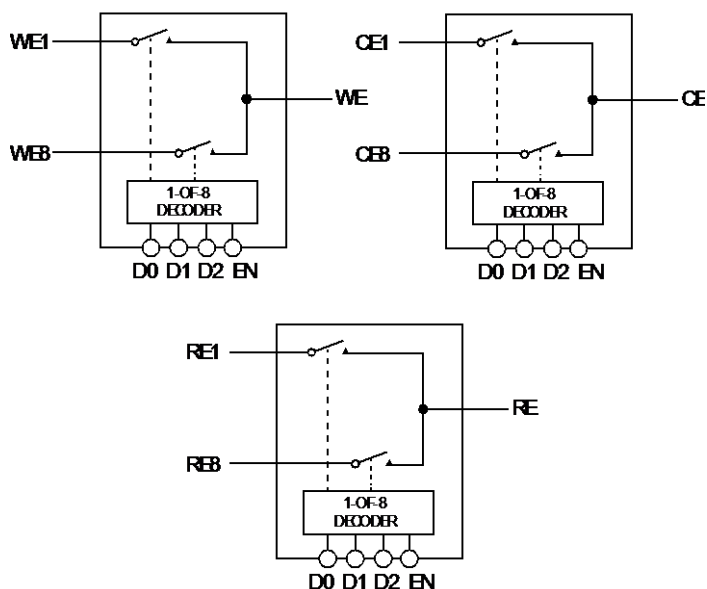
- 1 Eight separate cells or sensors each with a working, reference and counter electrode
- 2 Eight separate cells or sensors each with a working and combined reference and counter electrode
- 3 Cell or sensor array with eight working electrodes sharing one reference and one counter electrode
- 4 Cell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

In all configurations the cells can be multiplexed, leaving the non-selected cells or sensors at open circuit potential.

Configurations 2, 3 and 4 also have the possibility to apply the specified potential to all cells or sensors continuously.

The hardware configuration of the MUX can be changed by using the small switches found at the bottom of the EmStatMUX.

MUX8 functional diagram



EmStat3MUX16

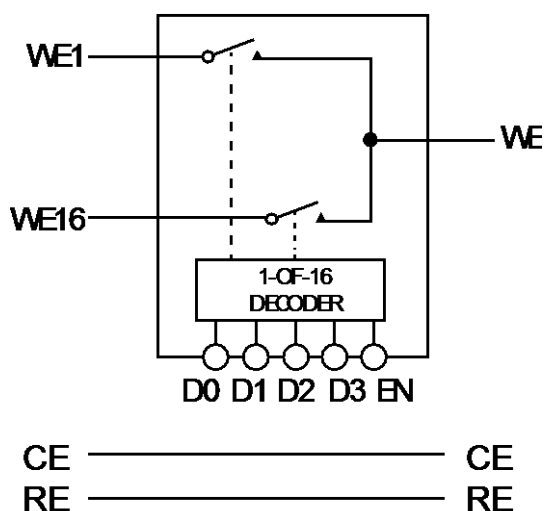
The MUX16 multiplexer allows connecting up to sixteen working electrodes to the EmStat3 potentiostat. The multiplexer can be used with different electrode or sensor configurations:

- 1 Sixteen separate cells or sensors each with a working and combined reference and counter electrode
- 2 Cell or sensor array with sixteen working electrodes sharing one reference and one counter electrode
- 3 Cell or sensor array with sixteen working electrodes all sharing one combined reference/counter electrode

In all configurations the electrodes can be multiplexed, leaving the non-selected electrodes at open circuit or having the potential applied to all working electrodes continuously.

The hardware configuration of the MUX can be changed by using the small switches found at the bottom of the EmStatMUX.

MUX16 functional diagram



Apply potential on all channels simultaneously

It is not possible to apply a potential simultaneously to more than one sensor or cell each with three electrodes unless a two electrode system is used. For applying a potential on multiple three electrode systems a multi-channel potentiostat is required. This is a multi-channel instrument with one potentiostat for each channel.

Another option is to use the auxiliary output of PalmSens or EmStat as standby potential for channels that are not selected. This allows applying a potential on all unselected channels within the auxiliary output range of the potentiostat. This range is 0-4 V for EmStat and PalmSens2 and 0-3 V for PalmSens3.

Software

EmStatMUX is controlled by PStace software for Windows or via PStouch for Android. EmStatMUX on Android requires a phone or tablet that supports USB OTG (On-The-Go). This means that the Android device can act as a USB host.

software for Windows  and Android 



PStace for Windows provides support for all techniques and device functionalities.
PStouch for Android supports all techniques supported by EmStat and PalmSens3 EIS.

Minimum PC requirements for PStace:

- Windows XP, Vista, 7 or 8 (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)

See for more information: www.palmsens.com/software

Supported techniques

The following techniques are supported by the EmStat3MUX8 and EmStat3MUX16:

Voltammetric techniques

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

The above techniques can also be used for stripping voltammetry

Techniques as a function of time

- | | |
|---|------|
| ▪ Amperometric Detection / | AD |
| Chronoamperometry | CA |
| ▪ Chronocoulometry | CC |
| ▪ 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 a highest and lowest current range in which the most appropriate range is selected automatically.

See page 5 for system specifications.

General Specifications

General pretreatment

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

General voltammetric parameters

Potential range for EmStat3: -3.000 V to +3.000 V

Potential range for EmStat3+: -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 EmStat3 and EmStat3+

NPV and DPV:	Scan rate:	0.025 mV/s (0.125 mV step) to 50 mV/s (5 mV step)
	Pulse time:	5 ms to 300 ms
SWV ¹ :	Frequency:	1 Hz to 500 Hz ¹
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 hours
	Number of potential levels:	3
Potentiometry at open circuit (OCP):	Interval time:	1 ms to 30 s
	Maximum run time:	hours
Multistep Amperometry:	Interval time:	1 ms to 30 s
	Number of potential levels:	1 to 255
	Number of cycles:	1 to 20000
	Maximum run time:	hours

¹ PSTrace provides the option to measure forward and reverse currents separately.

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

Multiplexer support

All techniques can be used with the multiplexer in a way where all channels are measured sequentially. The techniques Amperometric Detection / Chronoamperometry and Open Circuit Potentiometry can also be measured alternately. In this mode all selected channels are measured during each interval. This results in a pseudo-parallel measurement. The switching time is 32 ms allowing a minimum interval time of 0.25 seconds for 8 channels and 0.50 seconds for 16 channels in alternating mode.

Instrumental specifications

EmStat3 potentiostat

▪ dc-potential range	$\pm 3.000\text{ V}$
▪ compliance voltage	$\pm 5\text{ V}$
▪ applied dc-potential resolution	0.1 mV
▪ applied potential accuracy	$\leq 0.2\text{ \%}$ with max. 2 mV offset error
▪ current ranges	1 nA to 10 mA (8 ranges)
▪ maximum measured current	$\pm 20\text{ mA}$ typical and $\pm 15\text{ mA}$ minimum
▪ current resolution	0.1 \% of current range 1 pA on lowest current range
▪ current accuracy (deviation)	$\leq 1\text{ \%}$ of current range at 1 nA $\leq 0.5\text{ \%}$ at 10 nA $\leq 0.2\text{ \%}$ at 100 nA to $100\text{ }\mu\text{A}$ $\leq 0.5\text{ \%}$ at 1 mA and 10 mA all with max. 0.2 \% offset error
▪ electrometer amplifier input	$> 100\text{ Gohm}$ // 4 pF
▪ rise time	approx. $100\text{ }\mu\text{s}$
▪ sensor connection for single channel input	shielded cable with circular connector for WE, RE, CE

MUX8 multiplexer

▪ number of channels	2 - 8
▪ multiplexer	switches 8 x (WE, CE and RE)
▪ on resistance	2 ohm typical
▪ charge injection	1 pC typical
▪ leakage current	10 pA typical at $25\text{ }^{\circ}\text{C}$
▪ cable	shielded flat cable for 8 x WE, 8 x CE and 8 x RE or optionally the MUX8 Terminal Block with screw terminals. 8 x WE 8 x RE 8 x CE 1 x CE-Direct, used when all WE's share one counter electrode 1 x RE-Direct, used when all WE's share one reference electrode

MUX16 multiplexer

▪ number of channels	2 - 16
▪ multiplexer	16 x WE only, CE and RE are not switched
▪ on resistance	2 ohm typical
▪ charge injection	1 pC typical
▪ leakage current	10 pA typical at $25\text{ }^{\circ}\text{C}$
▪ cable	shielded flat cable for 16 x WE, 1 x CE and 1 x RE or optionally the MUX16 Terminal Block with screw terminals - 16 x WE - 1 x CE-Direct - 1 x RE-Direct

General

▪ housing	aluminium: 89 mm x 35 mm x 85 mm
▪ weight	300 g
▪ power	5 V and 60 to 100 mA max. from USB connector
▪ communication	USB
▪ auxiliary port present	no

Minimum PC requirements (PSTrace):

- 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)

Standard EmStatMUX configuration

A standard EmStatMUX shipment includes:

- EmStat3MUX8 or EmStat3MUX16
- USB cable
- Sensor cable
- 4 croc clips
- Test sensor
- High density cable (D-Sub37)
- PSTrace manual
- Quick start document

Optional

- Connection terminal

Also included:

- PSTrace software + manual
- Quick start document

(see next page for optional accessories)

EmStatMUX accessories

**Connection Terminal**

The optional Connection Terminal is an easy to handle PCB to manage your own cable connections. The connection PCB comes in a grounded metal housing.

**Connection Terminal pre-equipped**

Each of the pre-equipped shielded sensor cables has four banana plugs (working, counter, reference electrode and ground) and the connection PCB comes in a grounded metal housing.

The Connection Terminal is joined to the EmStatMUX16 or MUX16 directly via their D-Sub connectors.

**High density cable**

This high density sensor cable, with stripped end leads, for older models (pre 2013) of the CH8 multiplexer, is suitable to connect up to eight working, counter and reference electrodes. The newer multiplexer models (MUX) are used with a DSub-37 connector.

Please do not hesitate to contact PalmSens for more details:
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