PalmSens
Compact Electrochemical Interfaces

Your Logo

EmStat4M

SOLUTIONS FOR OEM

EmStat Potentiostat Modules / Software Development Tools / Market-Ready Solutions

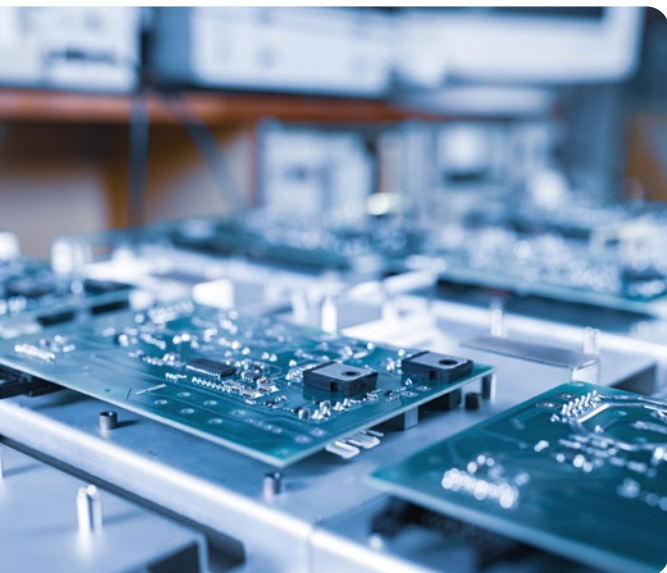# EmStat

Electrochemical Interface Modules

The EmStat-series is designed to meet the OEM's need to incorporate a potentiostat, galvanostat or EIS analyzer into their product. The EmStat modules provide all the common electrochemical techniques with automatic current ranging and options for peripheral control. The EmStat modules are highly suitable for use in dedicated electrochemical instruments.

Application examples include:
- point-of-care instruments
- measurements at remote sites
- water quality monitoring
- voltammetric analyzers
- gas detection systems

Why choose EmStat?

✓ Reduce development time and risk

✓ No surprises: hardware and application evaluation before integration

✓ Easy programming with MethodSCRIPT™

Our EmStat Modules:

EmStat*4M*™

	LR	*HR*
dc-potential range	±3 V	±6 V
compliance voltage	±5 V	±8 V
current ranges	1 nA to 10 mA	100 nA to 100 mA
maximum current	±30 mA	±200 mA
interface	1x WE, 1x CE, 1x RE	1x WE, 1x CE, 1x RE, 1x WE Sense
EIS frequency range	10 µHz to 200 kHz	
ac-amplitude range	1 mV to 900 mV rms, or 2.5 V p-p	
dimensions	62 x 40 x 7 mm	

See **page 5** for more detailed specifications.

EmStat*pico*™

dc-potential range	-1.7 V to +2 V
compliance voltage	-2.0 V to +2.3 V
current ranges	100 nA to 5 mA
maximum current	±3 mA
interface	2x WE, 2x CE, 2x RE
EIS frequency range	0.016 Hz to 200 kHz
ac-amplitude range	1 mV to 0.25 V rms, or 0.708 V p-p
dimensions	18 x 30 x 2.6 mm

See **page 7** for more detailed specifications.

EmStat*4M*™

Electrochemical Interface Module
with Desktop Performance

62 mm

40 mm

MethodSCRIPT™
by PalmSens
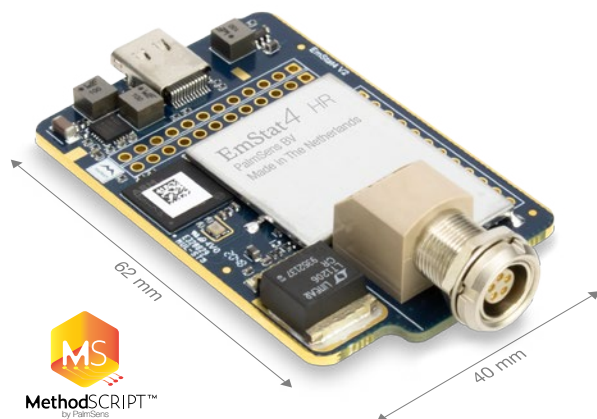
Desktop Performance

The EmStat4M module is a small Potentiostat, Galvanostat, and optional Frequency Response Analyser (FRA) for Electrochemical Impedance Spectroscopy (EIS).

The module is powered and can communicate either directly via its USB-C port, or it can be mounted on a carrier PCB using standard pin headers for serial (UART) communication, digital and analog I/O.

Optionally the module can be equiped with a high-end LEMO connector for use with our standard shielded sensor cables.

Development Board

The Development Board for the EmStat4M module allows for safe and easy handling of the module and connecting the module to an Arduino or peripherals. The development board comes with many code examples for different languages and platforms. The development board also provides options for making a Bluetooth connection and using a battery.

{ } **PalmSens**
SDK for .NET

Develop your own software based on the examples in the PalmSens Software Development Kits.
See page 13 for more details.

> *Evaluate our modules and instruments with PSTrace for Windows.*
> **See page 11** *for more details.*

Specifications

Supported techniques

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
- Multiple Pulse Amperometric Detection — MPAD

Galvanostatic techniques
- Linear Sweep Potentiometry — LSP
- Chronopotentiometry — CP
- Multistep Potentiometry — MP
- Open Circuit Potentiometry — OCP
- Stripping Chronopotentiometry — SCP / PSA

Impedance spectroscopy
- Potentiostatic — EIS
- Galvanostatic — GEIS *

Other
- Mixed Mode — MM

*This technique will be enabled with PSTrace 5.10.

General model	LR	HR
dc-potential range	±3 V	±6 V
compliance voltage	±5 V	±8 V
maximum current	±30 mA	±200 mA
max. acquisition rate	1M samples/s	

Potentiostat (controlled potential mode)

applied pot. resolution	100 µV	183 µV
applied pot. accuracy	≤ 0.2%, max. ±1 mV offset	
current ranges	1 nA to 10 mA	100 nA to 100 mA
	8 ranges	7 ranges
current resolution	0.009% of range (92 fA on 1 nA range)	
current accuracy	≤ 0.2% at Full Scale Range	

Galvanostat (controlled current mode)

current ranges	10 nA, 1 uA, 100 uA, 10 mA	1 uA, 100 uA, 10 mA, 100 mA
	4 ranges	4 ranges
applied dc-current	±3 times applied current range	
applied current resolution	0.01% of range	0.0183% of range
dc-potential resolution	96 µV (gain 1)	193 µV (gain 1)
	48 µV (gain 2)	96.5 µV (gain 2)
	19.2 µV (gain 5)	38.5 µV (gain 5)
	9.6 µV (gain 10)	19.3 µV (gain 10)
	4.8 µV (gain 20)	9.65 µV (gain 20)
dc-potential accuracy	≤ 0.2% ±1 mV offset	

FRA / EIS (impedance measurements)

frequency range	10 µHz to 200 kHz
ac-amplitude range	1 mV to 900 mV rms, or 2.5 V p-p

Electrometer

input impedance	> 1 TΩ // 10 pF
bandwidth	10 kHz default or 500 kHz for EIS and fast CA/CP

EmStat*pico* ™

Small Footprint Dual-Channel /
(Bi-)Potentiostat Module and EIS Analyzer

18 mm

30 mm

MethodSCRIPT™
by PalmSens

Small and Ultra Low-Power

The Emstat Pico is a joint development by PalmSens BV and Analog Devices Inc. The EmStat Pico is a dual-channel potentiostat module. The two channels can be used either sequentially or in bipotentiostat-mode.
The EmStat Pico module supports the most common electrochemical techniques in an ultra low-power solution for long-term remote site monitoring as well as daily use point of care measurement solutions.

Development Board

The Development Board for the EmStat Pico module allows for safe and easy handling of the module and connecting it to an Arduino or peripherals. It also provides options for direct connection via USB or Bluetooth. The development board comes with many code examples for different languages and platforms.

PalmSens
SDK for .NET

Develop your own software based on the examples in the PalmSens Software Development Kits.

Looking for a high-volume solution?
The **EmStat Pico Core** is what you need. Contact us for more details.

6 x 5 mm
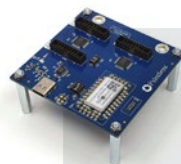
EmStat Pico with multiplexer

palmsens.com/**pico**

Specifications

Supported techniques

Voltammetric techniques
- Linear Sweep Voltammetry   LSV
- Cyclic Voltammetry   CV

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
- Chronocoulometry   CC
- Multistep Amperometry   MA
- Pulsed Amperometric Detection   PAD

Galvanostatic techniques
- Open Circuit Potentiometry   OCP

Other
- Electrochemical Impedance Spectroscopy   EIS

General
- dc-potential range   -1.7 to +2 V
- compliance voltage   -2.0 to +2.3 V
- maximum current   ±3 mA
- max. acquisition rate   400k samples/s

Potentiostat (controlled potential mode)
- channels   2 individual channels (2x WE, 2x RE and 2x CE) or bipotentiostat (2x WE, 1x RE and 1x CE)
- applied potential resolution   537 µV
- applied potential accuracy   < 0.2%, max. ±1 mV offset
- current ranges   100 nA to 5 mA (10 or 12 ranges*)
- current resolution   0.006% of current range (5.5 pA on 100 nA range)
- current accuracy   < 0.5% for ranges >100 nA at Full Scale Range (< 2% for 100 nA range)
- measured potential resolution   56 µV (for OCP)

FRA / EIS (impedance measurements)
- frequency range   0.016 Hz to 200 kHz
- ac-amplitude range   1 mV to 0.25 V rms, or 0.708 V p-p

Electrometer
- input impedance   > 1 TOhm // 10 pF
- bandwidth   250 kHz

Missing a supported technique? MethodSCRIPT allows for creating fully customized electrochemical detection techniques.

* The EmStat Pico module works at three different modes:
1. Low Speed mode: for scan rates up to 1 V/s or a bandwidth of 100 Hz.
2. High Speed mode: for high scan rates and frequencies.
3. Max Range mode: a combination of the Low and High Speed modes for optimal dynamic dc-potential range.

For more detailed information see the Specifications table on our website.

EmStat*pico*™
with MUX16

Compact Board with EmStat Pico Module
for use with 16 or 256 Electrodes

MethodSCRIPT™
by PalmSens

Multiplexed EmStat Pico

This compact board is great for prototyping a multiplexed EmStat Pico potentiostat module with 16 individual or 256 combined channels.
The multiplexer is controlled via MethodSCRIPT™ and can be used in two modes: MUX16 and MUX256 mode (see next page).

Evaluate with PSTrace

The EmStat Pico MUX16 board can be evaluated with PSTrace. The MethodSCRIPT editor gives you full control over the switches settings by simply adding a few lines of code in the generated MethodSCRIPT:

```
14 cell_on
15 loop i <= 0xFFi
16     set_gpio i
17     set_e -1000m
18     wait 100m
19     meas_loop_lsv p c -1 1 10m 1
20         pck_start
21         pck_add p
22         pck_add c
23         pck_end
24     endloop
25     add_var i 0x11i
26 endloop
27 on_finished:
28 cell_off
```

Use with (Bio)FETs

The EmStat Pico MUX16 can be used for the analysis of FET based sensors e.g. chemFET or bioFET. Both transfer curve and output curve analysis are supported. FET arrays of up to 256 (16 x 16) channels can be multiplexed.

> *Evaluate our modules and instruments with PSTrace for Windows.*

palmsens.com/**picomux16**

{ } **PalmSens**
SDK for .NET

Develop your own software based on the examples in the PalmSens Software Development Kits.

Multiplexer specifications

- Modes   16 channels in 3-electrode mux mode
                      256 channels in 2-electrode matrix mode
- On resistance   4 Ω typical
- Charge injection   1 pC typical
- Leakage current   10 pA (per channel) typical at 25 ℃
- Dimensions   75 x 75 mm
- Connectors   3x 16-pins box connector
                      with a pitch of 0.079" (2.00 mm)
                      Or use the 3x adapter boards
                      with screw terminals
- Communication   USB-C or via pin header for UART (Rx/Tx)
- Power   USB-C or via pin header (5V and GND)
                      with a pitch of 0.1" (2.54 mm)

MUX16 Mode

In the MUX16 mode the WE, RE and CE are all switched at the same time. This allows for 16 individual cells to be connected to the board, each with their own WE, RE and CE.
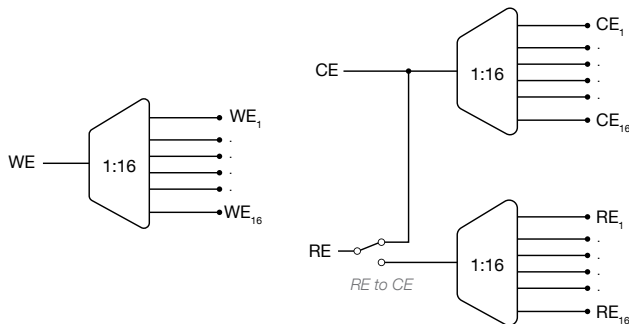
MUX256 Mode

In the MUX256 mode the RE and CE are combined. This allows the WE and RE+CE to be switched in a 2-electrode mode, allowing 256 channels to be addressed as a matrix.
The multiplexer is controlled using 8 digital IO lines, this effectively creates an 8-bit address for the multiplexer.

9
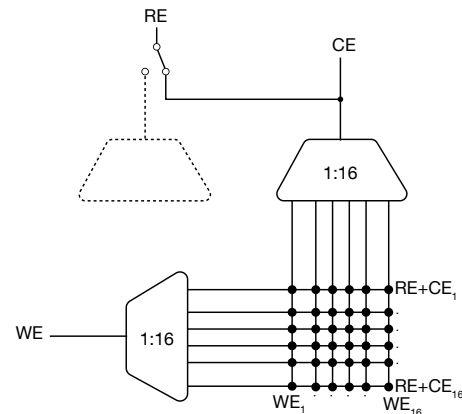
| EmStat Modules |

| **Software Development** |

| Market-Ready Solutions |

Evaluation and Software Development

Use PSTrace to evaluate our modules and market-ready solutions. Then take full control with the PalmSens Software Development Kits (SDKs) for .NET or use the flexible and human-readable MethodSCRIPT™ protocol.

> **See page 11**
  to learn how you can easily and conveniently evaluate our hardware modules or market-ready solutions with your sensor using our **PSTrace software** for Windows.

> **See page 12**
  for more information about the **MethodSCRIPT™** communication protocol.

> **See page 13**
  for more information about how you can speed up your software development with our **Development Kits** for the .NET framework.

PSTrace

for Windows

Evaluating our Modules and Instruments

Our EmStat Development boards work seamlessly with PSTrace for Windows. This allows you to evaluate the potentiostat modules without any programming efforts. PSTrace even generates the MethodSCRIPTs for you.
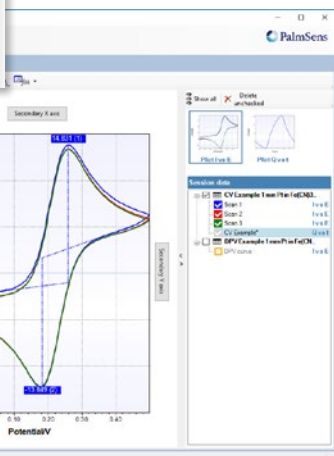
Minimum system requirements
- Windows 7 SP1, 8, 10 or 11 (32-bit or 64-bit)
- 1 gigahertz (GHz) or faster 32-bit (x86) or 64-bit (x64) processor
- 1 gigabyte (GB) RAM (32-bit) or 2 GB RAM (64-bit)

Equivalent Circuit Fitting
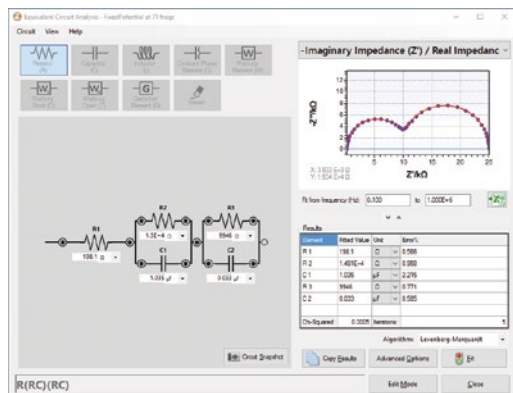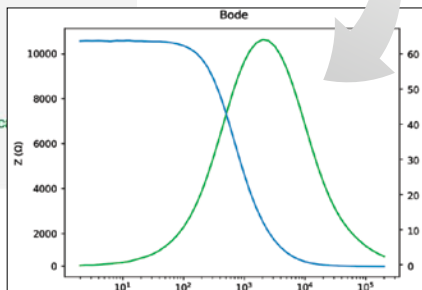

Main window

MethodSCRIPT editor

MethodSCRIPT™
by PalmSens

Example MethodSCRIPT for running an EIS measurement:

```
e
#Declare variables
var h
var r
var j
#Initialize device
set_pgstat_mode 3
#Set starting current range
set_cr 1m
#Turn cell on for measurement
cell_on
#Start EIS scan from 200kHz to 2 Hz in 41 steps
meas_loop_eis h r j 10m 200k 2 41 0
    #Send results of measurement loop step
    pck_start
    #Send frequency
    pck_add h
    #Send Z real
    pck_add r
    #Send Z imaginary
    pck_add j
    pck_end
    #Continue with next step of EIS sc
endloop
#Turn cell off after measurement
cell_off
```

Code examples available for:

- Visual Studio
- Java
- python
- Swift
- C/C++
- ARDUINO
- Xamarin

Direct Communication with the Potentiostat Module

MethodSCRIPT™ is the language our latest generation of potentiostats speaks. It allows you to communicate directly with the potentiostat (module) from any operating system or microcontroller.
The MethodSCRIPT™ scripting language is designed to integrate our OEM potentiostat (modules) effortlessly in your hardware setup or product.

No Libraries Needed

No DLLs or other type of code libraries are required. MethodSCRIPT™ allows developers to program a human-readable script directly into the potentiostat module by means of a serial connection. The simple script language allows for running all supported electrochemical techniques or even composing your own techniques. And it makes it easy to combine different measurements and other tasks.

More Script Features

- Use of variables
- (Nested) loops
- Logging results to an SD card
- Digital I/O
- Reading auxiliary values like pH or temperature
- Going to sleep or hibernate mode
- Waking up on external trigger

palmsens.com/**methodscript**

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PalmSens
SDK for .NET

Quickly and Effortlessly write Powerful Software with our .NET Libraries

If you have some experience in writing software in C#, Visual Basic or another .NET language, our free Software Development Kits are a great solution for speeding up your R&D and shortening your time to market.

There are multiple PalmSens SDKs for .NET. Each SDK can be used with any of our instruments or OEM potentiostat modules to develop your own software. The SDKs come with a set of examples that shows how to use the libraries. PalmSens SDKs with examples are available for the following .NET Frameworks: **WinForms, Xamarin (Android iOS) and WPF.**

Visual Studio
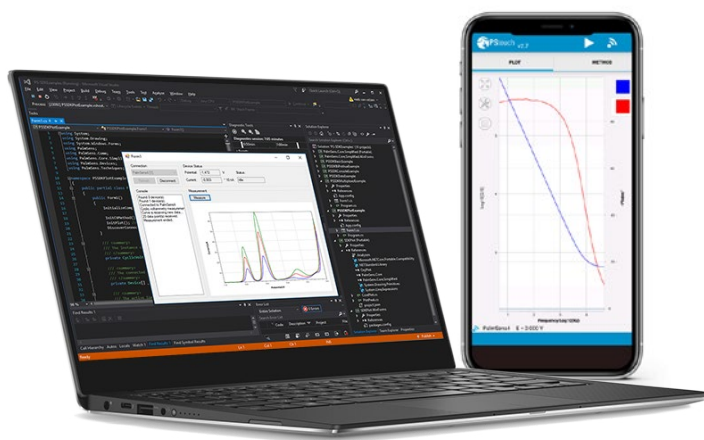
WinForms	Xamarin (Android)	WPF
	.NET Shared Core Library PalmSens.Core	

Code examples for all .NET SDKs show how to:
- Connect to one or more instruments
- Run measurements
- Access and process measured data
- Do peak detection
- Do equivalent circuit fitting on impedance data
- Save and load files
- and more

Code examples available for:

Xamarin   Visual Studio

python   MATLAB

LabVIEW

palmsens.com/**dev**

13

Emstat Modules

Software Development

Market-Ready Solutions

Reduce your Time-to-Market with our Market-Ready Solutions

Our Sensit-series and EmStat Go potentiostat for OEM are ideal for use with electrochemical sensor applications.
Both instruments allow for rebranding and tailoring of the connections and functionalities to work seamlessly with your sensor design. The Sensit BT and Sensit Smart have an integrated EmStat Pico module. The EmStat Go integrates either the EmStat4M LR module or the Emstat Pico module.

sensit /SMART™

With integrated **EmStat Pico**

MethodSCRIPT™
by PalmSens

Your logo here

⚡ USB powered

▦ 43 x 25 x 11 mm

⚖ 10 g

⟜ USB type C

Smartphone Potentiostat

The Sensit Smart is our smallest market-ready potentiostat available. The Sensit Smart can be inserted directly in a smartphone or tablet to be controlled with PStouch for Android. You can use the USB-C Female to USB-A cable to connect the Sensit Smart to a classic USB port on your PC and control the Sensit Smart via our PC software PSTrace.

Or you can build your own apps for the Sensit Smart, **see page 13**.

PStouch for Android

Sensor Connector Specifications

- Sensor pitch: 2.54 mm
- Electrode connections: RE, WE and CE
- Allowed sensor thickness: Between 0.1 and 0.8 mm
- Maximum sensor width: 11 mm

Compatible with most common Screen-Printed Electrodes.

palmsens.com/smart

sensit /BT ™

with integrated **EmStat Pico**

Your logo here

⚡ Battery or USB

📏 75 x 55 x 23 mm

⚖ 75 g

🔌 USB type C

🅱 Bluetooth

💾 500 MB storage on-board

❯ *See page 7 for potentiostat specifications.*

❯ *Evaluate our modules and instruments with PSTrace for Windows.*
See page 11 for more details.

palmsens.com/**bt**

Handheld and Wireless Dual-Channel Potentiostat

The Sensit BT connects via Bluetooth to your smartphone, tablet or PC. Use the USB-C port to charge the Sensit BT or connect to a classic USB port on your PC. The Sensit BT has either one or two connectors for Screen Printed Electrodes, or a cable with 2 mm banana plugs for connecting to a cell.

Sensor Connector Specifications for Sensit BT.SPE

- Sensor pitch: 2.54 mm
- Electrode connections: RE (x2), WE (x2) and CE (x2)
- Allowed sensor thickness: Between 0.1 and 0.8 mm
- Maximum sensor width: 11 mm

Sensor Connector Specifications for Sensit BT.SNS

- Cable length   40 cm
- Electrode connections   RE, WE, WE2, CE
- Connectors   2 mm banana

Need a custom sensor connection?
Contact us.

Sensit BT.SNS   *Sensit BT.SPE*

EmStat GO™

with integrated **EmStat Pico** or **EmStat4M LR**

Your logo here

- ⚡ Battery or USB
- 📏 118 x 69 x 33 mm
- ⚖️ ±250 g
- 🔌 USB type C
- ᛒ Bluetooth (optional)
- 🗄️ 500 MB internal storage

> Evaluate our modules and instruments with PSTrace for Windows.
> **See page 11** for more details.

Rugged Modular Potentiostat

The EmStat Go is a rugged modular, battery powered, handheld potentiostat. The device consists of a standard base unit and a customer-specific Sensor Extension module. The extension module can be equiped with one or more sensor connectors, multiplexing capabilities, temperature sensor, or other interface units you require for your sensor application. Measurements are carried out either on the internal EmStat Pico or EmStat4M LR module. The EmStat Go allows you to go to market as soon as your electrochemical sensor is ready for it.

The EmStat Go integrates one of the following potentiostat modules:

	EmStat Pico	EmStat 4M LR
▪ dc-potential range	-1.7 to +2 V	±3 V
▪ compliance voltage	-2.0 to +2.3 V	±5 V
▪ measured dc-potential resolution	0.280 mV	4.8 µV
▪ current ranges	100 nA to 5 mA	1 nA to 10 mA
▪ maximum current	±3 mA	±30 mA
▪ EIS capable	✓	✓
▪ more specifications	**page 7**	**page 5**

Default Sensor Connector Specifications

- ▪ Sensor pitch: 2.54 mm
- ▪ Electrode connections: RE, WE and CE
- ▪ Allowed sensor thickness: Between 0.1 and 0.8 mm
- ▪ Maximum sensor width: 11 mm

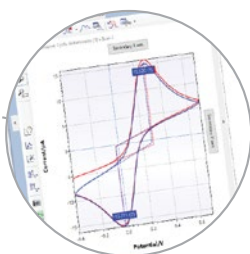*Contact us for information about a tailored connector to match your sensor design.*

palmsens.com/go

MethodSCRIPT™
by PalmSens

How MethodSCRIPT accellerates your time-to-market

STEP 1

Use the EmStat Development Board to work on your sensor application

STEP 2

Fine-tune your electrochemistry for optimal use of the EmStat module

STEP 3

Transfer the generated MethodSCRIPT™ to your EmStat powered end-user product

STEP 4

Run the exact same validated measurements in your end-user product on a calibrated EmStat module

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Sensors
and Accessories

SPE connector

SPE connector for 2mm plug

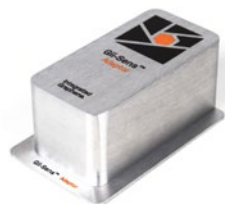
ItalSens Gold SPE

ItalSens Carbon SPE

BVT-AC1 SPE

Integrated Graphene Gii-Sens

Connector for SPE

Integrated Graphene SPE Adapter

Visit our website for

Connectors
Connecting screen-printed electrodes, electrode arrays, etc. to your potentiostat requires often a special connection interface. Our website provides different alternatives for connecting our instruments with your electrodes.

Screen-Printed Electrodes
Our catalog includes a collection of thick film and thin film electrodes. Many of these electrodes can be used as disposable, some are also suitable for multiple use.

Custom sensor development

Mass-producing sensors with a constant quality requires dedication and experience. We help you to get in touch with companies dedicated to sensor production. Use our network of professional electrode producers for your bespoke electrodes.
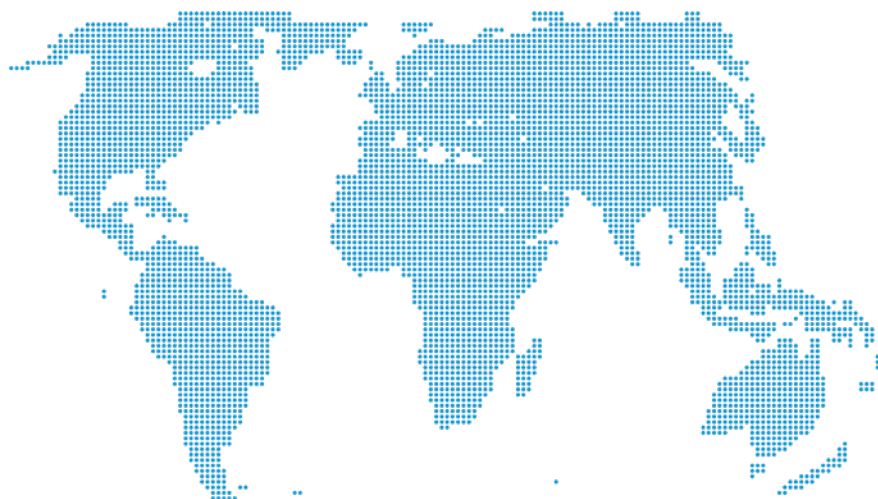
Worldwide distribution

At PalmSens BV we are committed to making electrochemistry easier, more portable, and more accessible for novice and advanced researchers.
We provide a comprehensive range of instruments for most types of electrochemistry with an emphasis on mobility.
We manufacture the world's smallest commercially available potentiostat module with EIS capabilities: the EmStat Pico. While our unique flagship instrument, the PalmSens4, is one of the most versatile and compact frequency response analysis (FRA) / EIS capable device in the market.

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Partner of:

ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™
ALLIANCES