PALMSENS 4™

potentiostat / galvanostat / impedance analyzer

PalmSens

Rev. 3-2025-019

Contents

› See for more information:
www.palmsens.com/palmsens4

PalmSens4: Compact, Versatile and Powerful

software for Windows and Android

Your data always secured

The PalmSens4 is equipped with internal storage memory of 8 GB. This allows for storing all your measurement data[1] on-board seamlessly while the measurement is running. All internally stored measurements can be browsed and transferred back to the PC easily using PSTrace.

[1] *Not supported for internal storage: EIS, MultiStep and MixedMode*

Available configurations

The PalmSens4 is available with a ±5V or ±10V dc-potential range and with different maximum frequencies for FRA / EIS. The following table shows the available configurations with corresponding product codes:

	Potential range ±5V [05]	Potential range ±10V [10]
NO EIS [F0]	PS4.F0.05	PS4.F0.10
EIS up to 100 kHz [F1]	PS4.F1.05	PS4.F1.10
EIS up to 1 MHz [F2]	PS4.F2.05	PS4.F2.10

› Configure your ideal PalmSens4:
www.palmsens.com/palmsens4

Supported Techniques

The PalmSens4 supports the following electrochemical 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 or PSA

Other

- Mixed Mode — MM
- Potentiostatic and Galvanostatic Impedance spectroscopy at fixed frequency or frequency scan vs — EIS/GEIS
  - fixed potential or fixed current
  - scanning potential or scanning current
  - time

System Specifications

General		
	PS4.F#.05	PS4.F#.10
▪ dc potential range	±5 V	±10 V
▪ compliance voltage	±10 V	
▪ maximum current	±30 mA (typical)	
▪ max. acquisition rate	150 000 points/s	

Potentiostat (controlled potential mode)	
▪ applied dc-potential resolution	76.3 µV (18-bit)
▪ applied potential accuracy	≤ 0.1% or ±1 mV offset
▪ current ranges	100 pA to 10 mA (9 ranges)
▪ measured current accuracy	< 0.2% of current ±10 pA ±0.1% of range
▪ measured current resolution	0.005% of current range (18-bit, 5 fA on 100 pA range) 0.0025% of 10 mA range

Galvanostat (controlled current mode)	
▪ current ranges	1 nA to 10 mA (8 ranges)
▪ applied dc-current	±6 x applied current range
▪ applied dc-current resolution	0.0076% of applied range (<10 mA) 0.0038% of 10 mA range
▪ applied dc-current accuracy	< 0.2% of current ±10 pA ±0.1% of range
▪ potential ranges	10 mV, 100 mV, 1 V
▪ measured dc-potential resolution	78 µV at ±10 V (1 V range, 18-bit) 7.8 µV at ±1 V (100 mV range) 0.78 µV at ±0.1 V (10 mV range)
▪ measured dc-potential accuracy	≤ 0.05% for |E| <9 V, ≤ 0.2% for |E| ≥9 V or ±1 mV offset

FRA / EIS (impedance measurements)		
config	PS4.F1.##	PS4.F2.##
▪ frequency range	10 µHz to 100 kHz	10 µHz to 1 MHz
▪ ac-amplitude range	1 mV to 0.25 V rms, or 0.7 V p-p	

GEIS (galvanostatic impedance measurements)	
▪ frequency range	10 µHz to 100 kHz (all configurations)
▪ ac-amplitude range	0.001 * range to 0.4 * range rms (<10 mA) 0.001 * range to 0.2 * range rms (10 mA)

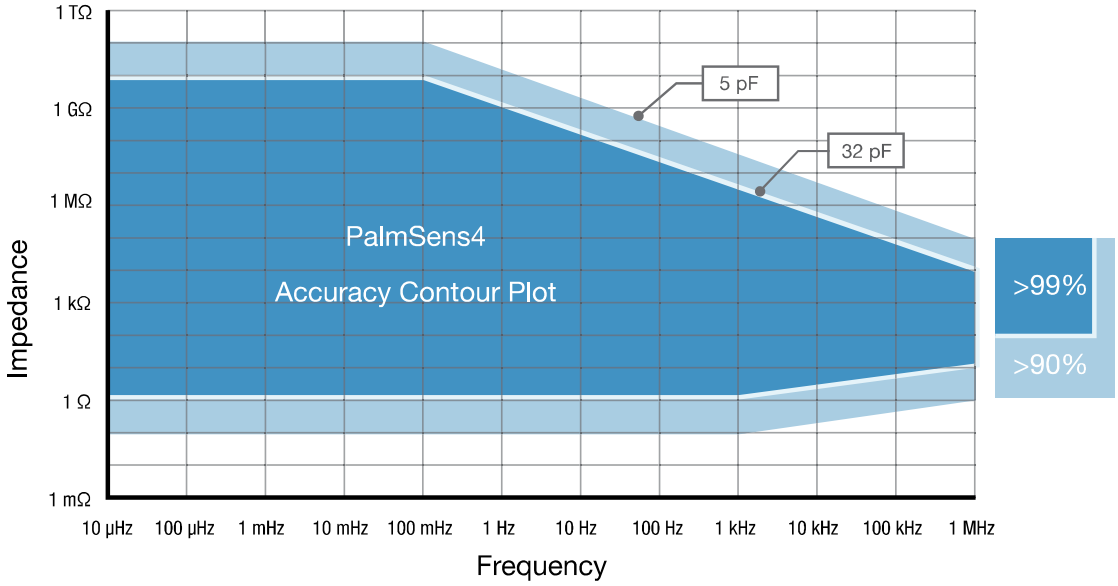
Electrometer	
▪ electrometer amplifier input	> 1 TΩ // 10 pF
▪ bandwidth	1 MHz

Other	
▪ electrode connections	2 mm banana pins for RE, WE, CE and GND
▪ housing	aluminium body with rubber sleeve: 15.7 x 9.7 x 3.5 cm
▪ weight	~ 500 g
▪ temperature range	0 °C to +50 °C[1]
▪ power supply	USB or internal LiPo battery
▪ communication	USB and Bluetooth
▪ battery time	> 16 hours idle time > 5 hours idle time with BiPot module installed > 4 hours with cell on at max. current Extendible by means of power bank
▪ internal storage space	8 GB (or >100 million datapoints)

Auxiliary port (D-Sub 15)	
▪ analog input	±10 V, 18-bit
▪ analog output	0-10 V, 12-bit (1 kOhm output impedance)
▪ digital I/O	4x digital output (5 V) 1x digital input (5 V)
▪ i-out and E-out	raw output of current and potential E-out ±10 V (1 kOhm output impedance) i-out ±6 V (1 kOhm output impedance)
▪ power	5 V-output (max. 150 mA)

[1] All the components of the PalmSens4 are rated to the industrial standard of -40 °C to +85 °C The battery of the PalmSens4 is rated -20 °C to +60 °C when discharging and rated 0 °C to +45 °C when charging. The PalmSens4 is calibrated at 21 °C . The most sensitive components of the PalmSens4 have a temperature drift of 50 ppm. At 1°C or 41 °C, measurement drift of up to 0.1% may be experienced.

EIS Contour Accuracy Plot



Note
The accuracy contour plot was determined under lab conditions using the standard 1 meter cell cable and should be used for reference purposes. Please note that the true limits of an impedance measurement are influenced by all components in the system, e.g. cables, the environment, and the cell.

Measurement Specifications

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

	Parameter	Min	Max
All techniques (unless otherwise specified)	Conditioning time	0	1600 s
	Deposition time	0	1600 s
	Equilibration time	0	1600 s
	Step potential	0.076 mV	250 mV
	Pulse potential	0.076 mV	250 mV
	N data points	3	1,000,000
▪ NPV ▪ DPV	Scan rate	0.1 mV/s (76.3 µV step)	100 mV/s (5 mV step)
	Pulse time	10 ms	300 ms
▪ SWV	Frequency	1 Hz	1250 Hz
▪ ACV	Frequency	1 Hz	2000 Hz
▪ LSV	Scan rate	0.01 mV/s (76.3 µV step)	500 V/s (10 mV step)
▪ CV	Scan rate	0.01 mV/s (76.3 µV step)	500 V/s (200 mV step)
▪ FCV	Scan rate	400 mV/s (76.3 µV step)	500 V/s (10 mV step)
	N averaged scans	2	255
	N equilibration scans	1	255
▪ PAD	Interval time	50 ms	300 s
	Pulse time	1 ms	1 s
	N data points		1,000,000 (> 100 days at 10 s interval)
▪ MPAD	Pulse time	100 ms	2 s
	Run time	1.2 s	100,000 s
	N potential levels	3	3
▪ CA ▪ CP ▪ OCP	Interval time	0.4 ms	300 s
	Run time	1 ms	> year
▪ MM ▪ MA ▪ MP	N cycles	1	20,000
	N levels	1	255
	Level switching overhead time	~80 ms	
▪ FAM	Interval time	0.02 ms	1 s
	Run time	1 ms	30 s
	N data points	3	4000 for interval time < 0.2 ms
▪ EIS	Interval time between measuring frequencies	~900 ms	

Optional BiPot Specifications

The PalmSens4 can be expanded with a BiPot module for use with a second Working Electrode.

BiPot specifications	
▪ dc-potential range	±5 V
▪ dc-potential resolution	153 µV (16-bit)
▪ dc-offset error	≤ 0.1%, ±1 mV offset
▪ accuracy	≤ 0.1%
▪ current ranges	1 nA to 10 mA (8 ranges)
▪ maximum measured current	i(WE1) + i(WE2) < 30 mA
▪ current resolution	0.005% of current range (5 fA on 100 pA range) 0.0025% of 10mA range
▪ current accuracy	≤ 0.1% current, ±0.2% range
▪ connection	comes with a cell cable with an additional connector for WE2
▪ supported techniques	▪ Linear Sweep Voltammetry ▪ Cyclic Voltammetry ▪ Chronoamperometry ▪ Multistep Amperometry

Optional iR Compensation Module Specifications

iR Compensation for PalmSens4 is available as an in-factory add-on module.

iR Compensation module specifications	
▪ method used for iR-drop compensation	Positive Feedback
▪ resolution of MDAC used for correcting potential	16-bit
▪ max. compensated resistance	1 MOhm
▪ max. bandwidth with iR-drop compensation enabled	10 kHz

Standard PalmSens4 Kit

A standard PalmSens4 kit includes a rugged carrying case with:

- PalmSens4
- USB cable
- 1 meter cell cable with 2 mm banana pins
- 4 croc clips
- PalmSens Dummy Cell

Also included:

- PSTrace software (on USB drive)
- Manual (hardcopy)
- Quick Start document
- Calibration report

Optional:

- 7” Samsung tablet (for PStouch)
- Tablet charger

PalmSens4 standard configuration in case with accessories

PalmSens Dummy Cell

PalmSens4 1 meter cell cable with croc clips

PalmSens4 Accessories

In-factory add-on modules

BiPot add-on module

The BiPot Module is an optional extension for the PalmSens4 and is for applications requiring control of two independent working electrodes. The module fits inside the PalmSens instrument. The PSTrace software supports this module for linear sweep, cyclic voltammetry and amperometric detection with two working electrodes.

See page 9 for BiPot specifications

iR Compensation add-on module

The iR Compensation module is an optional extension for the PalmSens4. The resistance between the reference electrode and the double layer of the specimen can cause a significant potential drop, decreasing the applied potential where it is required. The module provides positive feedback to compensate for the iR-drop between Reference electrode and the outside of the double layer of the electrochemical cell.

See page 9 for iR Compensation module specifications

Other accessories

MUX8-R2 or MUX16 multiplexer

The MUX8-R2 is an 8-channel multiplexer. It allows the PalmSens4 to measure up to 8 cells, switching RE, CE, WE1 and WE2.
In 8-WE mode it can measure up to eight working electrodes on sensor arrays with shared reference and counter electrodes as well. The MUX8-R2 is stackable up to 128 channels.

The MUX16 is a 16-channel multiplexer. It allows the PalmSens4 to measure up to 16 working electrodes with shared counter and reference electrodes.

Magnetic stirrer with Switchbox

The magnetic stirrer controlled by the instrument is ideal for stripping analysis applications. The stirrer is switched on during the conditioning and deposition stages by means of the Switchbox.

TMP36 temperature sensor

This temperature sensor allows for monitoring of temperature during an experiment.
The TMP36 provides accuracies of ±1°C at +25°C and ±2°C over the –40°C to +125°C temperature range.The supply current runs well below 50 µA, providing very low self-heating, less than 0.1°C in still air.

Differential Electrometer Amplifier (DEA)

The PalmSens Differential Electrometer Amplifier (DEA) is a high impedance input amplifier. It can be used as a high-precision voltage amplifier with differential input and single output to the auxiliary port of a PalmSens4.

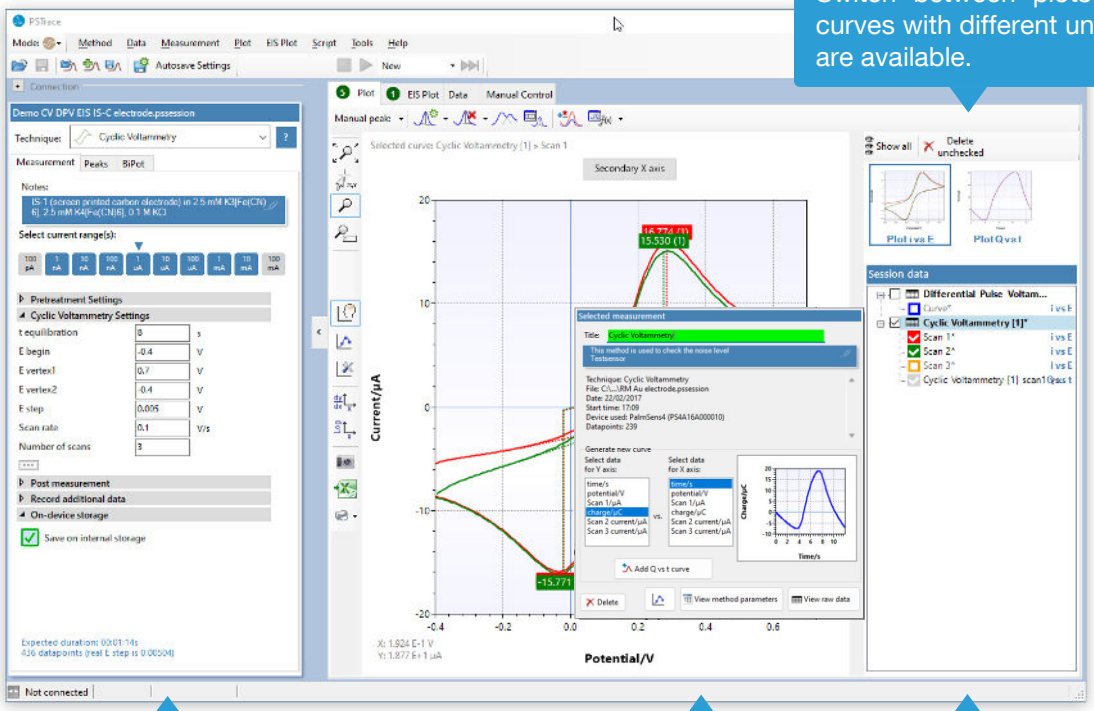
Default range is -10V to 10V (1x gain). Possible gains are: 2x, 5x, 10x, 20x, 50x and 100x.

› See for more information:
www.palmsens.com/accessories

PSTrace: Software for Windows

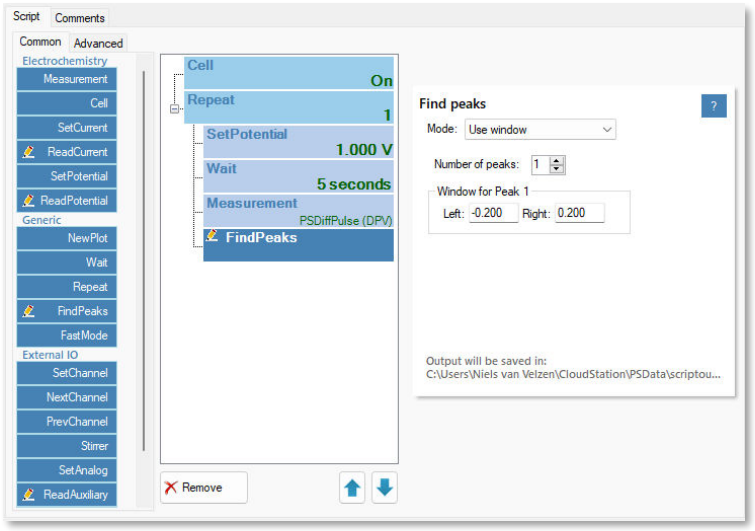
The PalmSens4 operates seamlessly with PSTrace, a free software compatible with all our potentiostats. Additionally, all future updates are provided at no cost.
PSTrace is designed to get the most out of your instrument right after installation, without going through a long learning period. It has three modes:

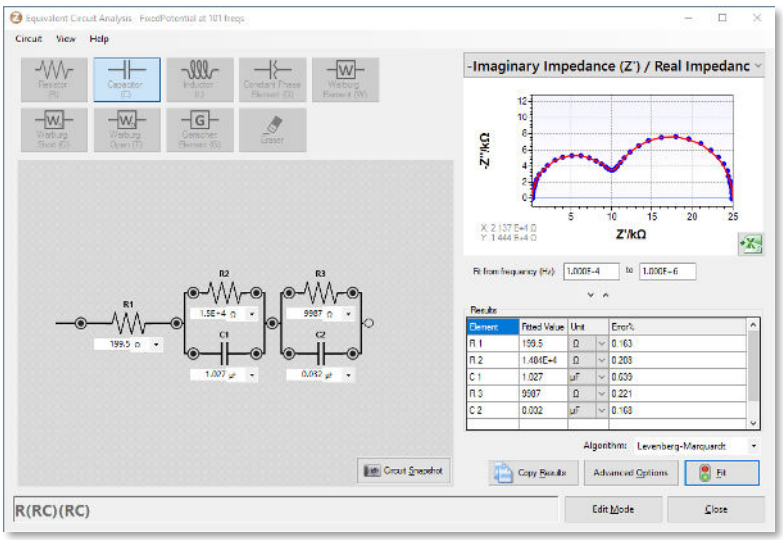
1. **Scientific mode**, which allows you to run all the techniques our instruments have to offer;
2. **Corrosion mode**, suitable for corrosion analysis with corrosionists terminology and specific curve operations;
3. **Analytical mode**, designed for use with (bio)sensors and allows you to do concentration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



Scripting

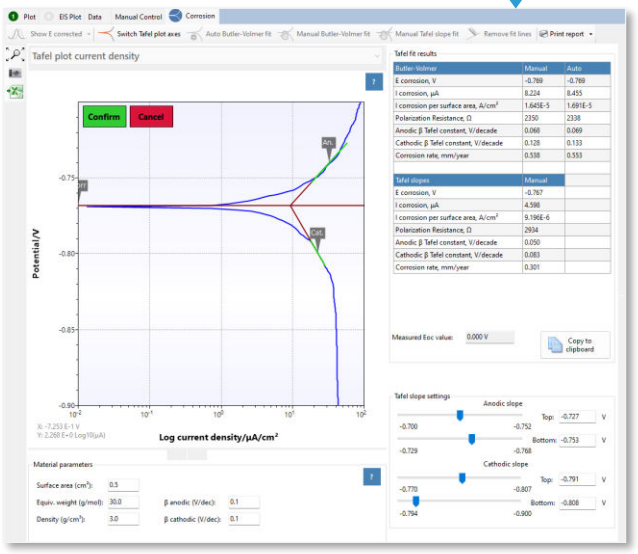
The intuitive script editor allows for easily creating a sequence of measurements or other tasks, by means of dragging and dropping actions in a list.





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

Corrosion mode for Tafel plot analysis and other corrosion data analysis.



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

Integration with third party software

- Excel
- Origin
- Matlab
- ZView

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

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

PStouch: App for Android

GET IT ON Google Play

PStouch is an app for Android devices compatible with all PalmSens, EmStat and Sensit potentiostats.
Works with PalmSens4 via USB (depending on the Android device) or wireless via Bluetooth.

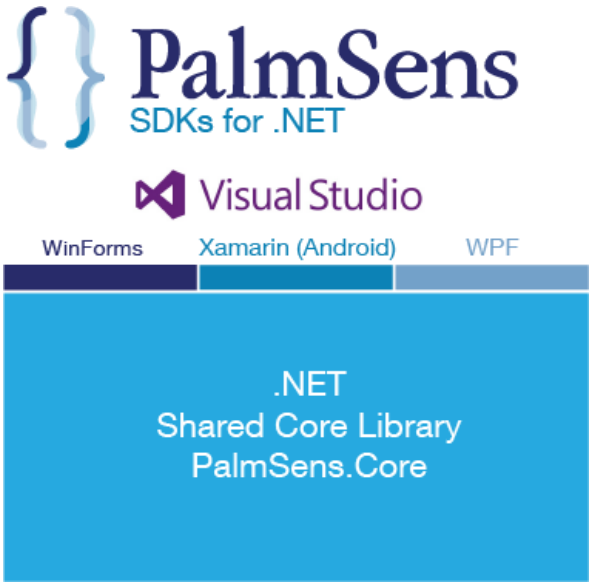
PStouch features:

- Setting up and running measurements
- Loading and saving measured curves
- Analysing and manipulating peaks
- Sharing measurement data directly via any service like email or Dropbox
- Concentration determination by means of Standard Addition or Calibration Curve
- Support for PalmSens accessories such as a Multiplexer or Stirrer
- All method and curve files are fully compatible with PSTrace software for Windows.

› See for more information:
www.palmsens.com/pstouch

Software Development Kits for .NET

Develop your own application in no time for use with any PalmSens instrument or potentiostat (module). Our SDKs are free of charge.

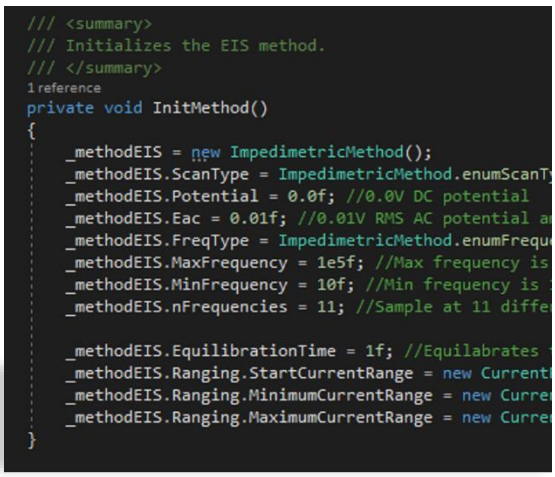


There are three PalmSens Software Development Kits (SDKs) for .NET. Each SDK can be used with any of our instruments or OEM potentiostat modules to develop your own software. The SDK's come with a set of examples that shows how to use the libraries. PalmSens SDKs with examples are available for the following .NET Frameworks:

- WinForms
- Xamarin (Android)
- WPF

Each SDK comes with code examples for:

- Connecting
- Running measurements and plotting data
- Manual control of the cell
- Accessing and processing measured data
- Analyzing and manipulating data
- Peak detection
- Equivalent Circuit Fitting on impedance data
- Saving and loading files



```
/// <summary>
/// Initializes the EIS method.
/// </summary>
1 reference
private void InitMethod()
{
    _methodEIS = new ImpedimetricMethod();
    _methodEIS.ScanType = ImpedimetricMethod.enumScanT
    _methodEIS.Potential = 0.0f; //0.0V DC potential
    _methodEIS.Eac = 0.01f; //0.01V RMS AC potential a
    _methodEIS.FreqType = ImpedimetricMethod.enumFrequ
    _methodEIS.MaxFrequency = 1e5f; //Max frequency is
    _methodEIS.MinFrequency = 10f; //Min frequency is
    _methodEIS.nFrequencies = 11; //Sample at 11 diffe

    _methodEIS.EquilibrationTime = 1f; //Equilabrates
    _methodEIS.Ranging.StartCurrentRange = new Current
    _methodEIS.Ranging.MinimumCurrentRange = new Curre
    _methodEIS.Ranging.MaximumCurrentRange = new Curre
}
```

› See for more information:
www.palmsens.com/sdk

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Please contact us at **info@palmsens.com** or go to our website to get in touch with a distributor in your region.

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