EmStat*4s*™

Operator's Manual

Version 03-2024

PalmSens

If you have problems

First make sure to check the "Troubleshooting" section in this document and the Knowledge Base on our website: **www.palmsens.com/knowledgebase/**
This page contains support information on installation, software updates, and training.

Please make sure your software and firmware are up-to-date.

In case of persistent problems:
Use the contact form: **www.palmsens.com/contact/**
Give us a call: **+31 30 2459211**
Or send an email: **info@palmsens.com**

Try to describe the problem as detailed as possible. Sending us the relevant method files, data files and screenshots can be helpful.

Please include your instrument model and serial numbers, as well as any applicable software and firmware version you are using.

Limited Warranty

Except as otherwise provided herein, PalmSens BV warrants to buyer three years from the date title to the product passes (transfer date of goods from seller to buyer), each product sold hereunder will be free of defects in materials or workmanship and will conform to specifications set forth in PalmSens BV' published data sheets or, where applicable, user manuals for PalmSens BV' system products in effect at the time title passes.

PalmSens BV's sole liability and responsibility for products under this warranty is for PalmSens BV to repair or replace any product that is returned to it by buyer or credit buyer's account for such returned product, provided that PalmSens BV shall have the right to reject any such remedy where PalmSens BV determines that the warranty does not apply product returned to PalmSens BV for warranty service will be shipped to PalmSens BV at buyer's expense and will be returned to buyer at PalmSens BV' expense. PalmSens BV' obligation to honor its warranty for a product is contingent upon receipt of payment in full for such product.

See our website for more detailed information:

www.palmsens.com/terms-and-conditions/

Disclaimers

PalmSens BV cannot guarantee that its instruments will work with all computer systems, operating systems, and third-party software applications hardware/software. The information in this manual has been carefully checked and is believed to be accurate as of the time of compiling. However, PalmSens BV assumes no responsibility for errors that might appear.

See Appendix A for CE declaration of conformity.

Copyrights

Contents

1 Introduction

1.1 The scope of this manual

This manual covers the handling, characteristics, troubleshooting, and other practical information regarding the hardware specifics of the EmStat4S, as well as maintenance and compliance.

Please refer to the "Quick Installation Guide" that was supplied with the instrument for instructions on installing the instrument and the software. Additionally, the section "Getting Started" in the digital "PSTrace Manual", that is installed with the software, provides detailed instructions for conducting first measurements with your instrument.

> *i*
>
> **Initial setup and basic operational instructions for conducting initial measurements are detailed in the "Quick Installation Guide" supplied with the instrument.**

The "PSTrace Manual" is an in-depth document covering not only the PSTrace software but also the hardware limitations for each technique supported by the instrument. It is written to give you a full understanding of both the software and hardware aspects, making sure you're well-equipped to use all the functionalities of the EmStat4S.

Figure 1   EmStat4S LR (left) and EmStat4S HR (right)

1.2 About the EmStat4S

The EmStat4S LR and HR are a USB-powered potentiostat / galvanostat and impedance analyzers. The EmStat-series are available in a standard shielded housing or as bare PCB. The EmStat communication protocols are well described and made available to allow users to embed the potentiostat as part in another system.

With their reliable communication protocols and versatile form factors, the EmStat-series devices are well-suited for a variety of laboratory and research applications.

The EmStat4S LR and HR are the market since 2021. They are the successor of the EmStat3 and EmStat3+ models.

The EmStat4S comes in two different versions; the Low Range (LR) and High Range (HR) version.

- Low Range: for lower currents and potentials. This version can be identified by its blue bottom shell.
- High Range: for higher currents and potentials. This version can be identified by its black bottom shell.

2 Operating the EmStat4S

The EmStat4S is powered and controlled directly by means of a standard USB-C cable. They do not have a power switch or any other type of switch.

2.1 USB Power considerations for EmStat4S HR

During measurements in the 100 mA range, the EmStat4S HR may demand more current than what is officially provided by standard USB 2.0 ports (5V at 500 mA). In cases where the available USB port cannot deliver 5V at 900 mA (or more), or if there is uncertainty about the power output of the USB port, it is essential to utilize the provided USB Y-cable with an additional USB port. This special cable configuration allows the instrument to draw additional power from a second USB port, ensuring optimal performance and accurate measurements. Refer to Figure 2 for an illustration of the USB Y-cable.

Figure 2   USB Y-Cable in case a single USB port does not provide sufficient power for the EmStat4S HR.

2.2 Cell cable

The EmStat4S cell cable connects to the high-end LEMO connector.

RED DOT UP
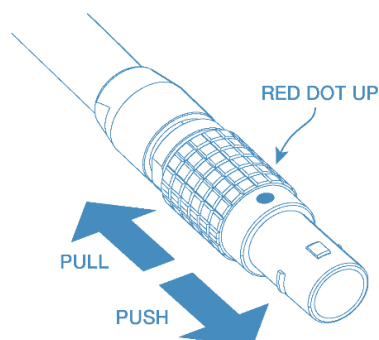
PULL

PUSH

The EmStat4S cell connector is a push-pull connector.
Do not try to twist it!

The EmStat4S HR version comes with an additional Sense lead. In contrast with the EmStat3+, the Sense lead of the EmStat4S HR is active for every current range and should always be connected. This allows the Sense lead to be used in four-electrode measurements.

For more information about making a connection to the cell, see also section: "Connecting a cell to the potentiostat" in the PSTrace Manual.

2.3 Status LED indicator

The EmStat4S has a multi-color status indicator. The following table explains the meaning for each color.

Table 1   EmStat4S status led indicator

Color	State
Steady green	Booting
Steady blue	Cell off (at open circuit)
Steady red	Cell on
Blinking green	Uploading new firmware
Blinking orange	Error state
Blinking red	Fatal error (not responding)

2.4 Cell connector pin-out

The following schematics show the EmStat4S cell connector pin-out and pin functions.
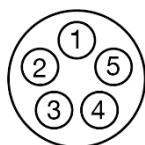
Figure 3   Front view of the female cell connector on the EmStat4S.

Table 2   Cell connector pin functions of the EmStat4S.

Pin	Function	Connector color
1	Reference Electrode (RE)	Blue
2	Reference Electrode Shield	N/A
3	Counter / Auxiliary Electrode (CE)	Black
4	Working Electrode Sense (Sense)	White
5	Working Electrode (WE)	Red
Connector housing	Analog Ground (AGND)	Green

3 Specifications

The Emstat4S comes in two versions: LR (Low Range) and HR (High Range). The version of your EmStat4S can easily be recognized by the color of the bottom shell. The HR as a black bottom shell, and the LR has a blue bottom shell.

The following table shows the main differences between the LR and HR versions.

Table 3   EmStat4S LR and EmStat4S HR specifications

	EmStat*4S LR*	EmStat*4S HR*
Potential range	±3 V	±6 V
Max. compliance voltage	±5 V	±8 V
Current ranges	1 nA to 10 mA (8 ranges)	100 nA to 100 mA (7 ranges)
Max. current	±30 mA	±200 mA
Electrode connections	WE, RE, CE, and ground, 2 mm banana plugs	WE, RE, CE, S, and ground, 2 mm banana plugs

Specifications are subject to change, due to regular firmware updates. See the EmStat4S product page on our website for accurate and detailed specifications.

4 Troubleshooting

4.1 Verifying your potentiostat

Your instrument can be tested by using the test sensor or dummy cell supplied with the instrument.
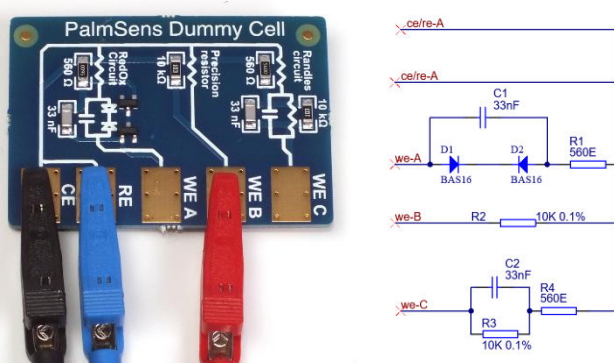

Figure 4   PalmSens Dummy Cell

The easiest way to verify the functioning of your instrument is to use the "WE B" circuit, which consists of a resistor with a value of 10 kΩ with a max deviation of 0.1%.

The WE lead is connected to one side and both RE and CE to the other side of the resistor. If your instrument has a Sense lead, make sure to connect the Sense lead to the WE lead as well.

> ℹ️
>
> **If your instrument has a Sense lead, make sure to connect the Sense lead to the WE lead as well.**

Any of the electrochemical techniques can be applied. The current response obtained with a resistor with value R is equal to the applied potential or potential pulse divided by the value of R. So, if a potential of 0.5 V is applied on a resistor of 10 kΩ, the obtained current should be 0.5 V / 10 kΩ = 50 μA.

Contact PalmSens BV if the problems are found: **info@palmsens.com** and report the problems as detailed as possible.

4.2 Noise

Our instruments are designed with hardware noise suppression filters to reject noise from internal and external sources. If a higher level of noise is your issue, the solving strategies are rather numerous, but the sources for noise are also numerous. Here we describe the most successful and common methods for noise reduction.

To determine the noise levels for your instrument, please refer to section "Measuring the noise level of the instrument" of the PSTrace Manual.

4.2.1 Power grid

Your power grid is usually using an alternating current. This undulating current influences the measured currents. PSTrace and PStouch have a filter for this mains frequency. In PSTrace, check in the 'Tools' menu under 'General Settings' if the mains frequency is set correctly.

4.2.2 Electrical fields

Our environment is filled with electrical fields. Some of them are created by devices around us as side effects or in case of wireless communication on purpose. Although it is a bad idea to measure directly next to an electric arc furnace, it is usually not possible to have a workspace free of electrical fields, especially not during point-of-care measurements. A Faraday cage is usually sufficient to create a field-free environment. A metal box or cage out of metal mesh is a good Faraday cage. Even a shield out of aluminum foil can help. Place your electrochemical cell inside the Faraday cage and connect the cage to the ground lead (green) of the potentiostat. The cable delivered with your EmStat or PalmSens has an inbuilt shield and should protect your signal outside the Faraday cage. This is one of the most effective methods to reduce noise.

4.2.3 Cables

Cables should not be unnecessarily long, since they act as antennas for noise, but the cable delivered with your EmStat or PalmSens has an inbuilt shield and as long as you use the original cable, there is little reason to worry about cable induced noise.

4.2.4 Grounding

Ground your measurement equipment. The best way to connect your equipment is star-shaped, that is all parts are connected with the ground at the same point. In an electrochemical lab that point is usually one small space of the faraday cage. This way earth loops that induce noise are avoided.

4.2.5 Contacts

Check if the contacts are corroded. If so, remove the stains, for example with sandpaper.

5 Maintenance and compliance

5.1 Temperature compliance

Our instruments are designed for indoor use at ambient temperatures between 0 °C and 45 °C. All the components of PalmSens products (except their batteries) are rated to the industrial temperature standard of -40 °C to +85 °C.

5.2 Humidity compliance

PalmSens instruments have not been tested in high humidity environments.

Elevated humidity however may cause measurement errors if condensation forms on the electronics. This affects measurements in the nA ranges or lower. Prolonged exposure to a condensing environment may severely decrease the life expectancy of the instrument and void its warranty.

5.3 Temperature drift

PalmSens instruments are calibrated at 21 °C. The most sensitive components of the instrument have temperature drift of 50 ppm. For instance at 1 °C or 41 °C, measurement drift of up to 0.1% may be experienced.

5.4 Atmospheric pressure

PalmSens instruments are not intended for use in safety-critical applications. Consequently, the power supplies utilized are not selected based on a specific pressure rating.

5.5 Cleaning

Make sure to disconnect your instrument from any cell or power source, if applicable, prior to cleaning. Use a cloth lightly dampened with either clean water or water containing a mild detergent to clean the outside of the instrument. Alternatively, you can use isopropyl alcohol. Avoid using a wet rag and prevent any fluids from entering the instrument. It is crucial not to immerse the instrument in any cleaning solution.

5.6 Periodic calibration and preventive maintenance

PalmSens instruments are designed in a way that eliminates the need for periodic calibration. While not mandatory, PalmSens does provide a calibration service for users with specific demands such as QC/ISO purposes. This service includes a new calibration certificate.

It's important to note that PalmSens instruments do not require preventive maintenance, further simplifying their use and reducing the overall maintenance demands on users.

5.7 Service and repair

Except for the battery in some models, your PalmSens instrument contains no user-serviceable parts internally. Any service or maintenance needs should be directed to a qualified service technician employed by PalmSens BV. Attempting to access or modify internal components without proper expertise may result in additional damage to the instrument and void warranties. It is recommended to rely on authorized service personnel for any required maintenance or repairs.

5.8 RoHS Compliance

All instruments from PalmSens have been built using lead free components and lead-free solder. They are in compliance with the European RoHS initiative.

A. EU Declaration of conformity

PalmSens

EU DECLARATION OF CONFORMITY

$C\ E$

Certificate number: PSDOC-ES4S-B

Manufacturer: PalmSens BV
Address: Vleugelboot 22,
3991 CL Houten,
The Netherlands

This declaration is valid for the following product:

EmStat4S (HR/LR), Portable electrochemical analyser
- USB power and communications
- 1 meter cell cable

The object of the declaration described above is in conformity with the Electromagnetic-Compatibility Directive 2014/30/EU (EMCD) and applicable standards listed below:

EMC
- EN 61326-1

This declaration is issued under the sole responsibility of PalmSens BV.

Date: 29th of November 2023

C.J. van Velzen, CTO

B. EU Waste Electrical and Electronic Equipment (WEEE) Directive

The pictogram shown above, located on the product(s) and / or accompanying documents means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste. For proper treatment, recovery and recycling, please take this product(s) to designated collection points where it will be accepted free of charge.

Alternatively, in some countries, you may be able to return your products to your local retailer upon purchase of an equivalent new product. Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling. Please contact your local authority for further details of your nearest designated collection point. Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

PalmSens