

EmStat4T

Operator's Manual

PalmSens BV

Version 007, 2026-11-17

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

Please describe the problem in as much detail 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.

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See Appendix A for CE declaration of conformity.

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Table of Contents

1. Introduction 1
1.1. Scope of this manual 1
1.2. About the EmStat4T 2
1.3. EmStat4T configurations 4
1.4. Modes of operation 5
1.5. Accessories 6
1.6. Software 6
1.7. Symbols used on the equipment and packaging 9
2. Operating the EmStat4T 10
2.1. Preparing for operation 10
2.2. Switching on and off 10
2.3. Charging 10
2.4. Connecting via USB 11
2.5. Connecting via Bluetooth 11
2.6. Touch display 12
2.7. Operating controls and indicators 13
2.8. Sequence of operation 14
2.9. Connection Modules 16
3. Accessories, interconnections and consumables 19
3.1. Interconnections 19
3.2. Suitable accessories 20
3.3. Detachable parts 21
3.4. Special consumable materials 21
4. Running measurements 23
4.1. Handling hazardous substances 23
4.2. Connecting a cell to the potentiostat 25
4.3. Using Screen-Printed Electrodes (SPEs) with the EmStat4T 28
5. Standalone operation 30
5.1. Developing apps 30
5.2. Configuring the style and behavior 32

6. Specifications 35
6.1. System specifications. 35
6.2. Transport and storage conditions 35
6.3. Sound level 36
6.4. SNS Connection Module pin-out 37
6.5. SPE Connection Module pin-out. 37
7. Battery replacement 39
8. Troubleshooting 40
8.1. Dealing with malfunctions and hazardous situations 40
8.2. MethodSCRIPT error codes 42
8.3. Verifying your potentiostat 43
8.4. Noise troubleshooting. 45
8.5. Firmware updates 46
9. Maintenance and compliance 47
9.1. Lithium-Polymer batteries 47
9.2. Temperature compliance 47
9.3. Humidity compliance 47
9.4. Temperature drift. 48
9.5. Atmospheric pressure 48
9.6. Cleaning and decontamination 48
9.7. Disposal of hazardous waste 50
9.8. Periodic calibration and preventive maintenance 51
9.9. Service and repair 51
9.10. Removal from use, transport and disposal. 51
9.11. RoHS Compliance 52
10. Licenses 53
Appendix A: CE Declaration 54
Appendix B: EU Waste Electrical and Electronic Equipment (WEEE) Directive 55

Chapter 1. Introduction

1.1. Scope of this manual

This manual covers the handling, characteristics, troubleshooting, and other practical information regarding the hardware specifics of the EmStat4T, as well as maintenance and compliance.

This manual contains the information for the operator and the responsible body that is required by IEC 61010-1.

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.



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 are well equipped to use all the functionalities of the EmStat4T.

1.2. About the EmStat4T

The EmStat4T is a one-of-a-kind device that functions as a potentiostat, galvanostat, and Electrochemical Impedance Spectroscopy (EIS) analyzer. The battery powered EmStat4T is designed for conducting electrochemical research and can also be used as a standalone reader for specific sensor applications. At its core is the EmStat4M LR potentiostat module and it connects wirelessly (via Bluetooth) or via a USB cable to a PC, smartphone or tablet. Additionally, it can function independently using its integrated touch screen.

A visual editor allows users to create programs on the EmStat4T enabling users without programming experience to develop a wizard-style app for specific sensor applications.

The integrated QR and bar code scanner enables users to easily identify sensors via a QR code on the package, which may also include calibration data, an expiry date, and other useful information. It can also provide the EmStat4T and any apps running on it with this sensor-specific data. Backed by an advanced imaging engine, the scanner supports a broad array of 1D and 2D barcode formats, offering precision down to 0.1 mm (4 mil) and a reliable depth of field up to 400 mm. This ensures high-speed, flexible scanning whether the instrument is deployed out in mobile settings, such as point-of-care environments. Additional use cases involve scanning QR codes for operator information or sample data.



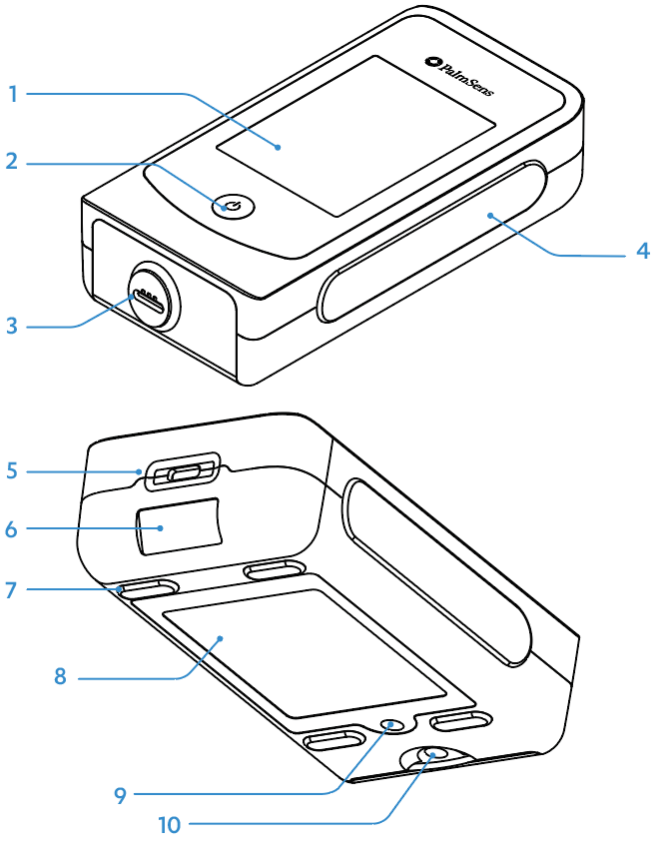
The integrated scanner emits visible light when it is scanning: a red LED aiming light (625 nm ± 10 nm) and white LED illumination (5600 K). The scanner does not contain a laser. Do not stare into the scanner window, and do not point the scanner at the eyes of other persons.

The cell connector located on the front of the device is modular, allowing users to easily exchange it for compatibility with specific sensors or cells.



Figure 1. The EmStat4T SPE (left) and EmStat4T SNS (right)

1.2.1. Features



1. Full-color 2.4" 240x320 TFT touch screen
2. Touch power button
3. Exchangeable sensor interface module
   (Either with LEMO connector for cell cable, or with connector for direct use of Screen-Printed Electrodes or SPEs).
4. Rubber grip
5. USB-C port
6. Integrated 1D/2D QR and barcode scanner
7. Rubber feet
8. 3000 mAh Li-Po battery
9. Screw for the battery lid
10. Screw for releasing the sensor interface module

1.3. EmStat4T configurations

The EmStat4T is available in different configurations. The EmStat4T is available with

or without a license for running Electrochemical Impedance Spectroscopy or EIS. A limited configuration can always be upgraded remotely via software to add functionality. Please contact PalmSens BV, if you are interested in upgrading your EmStat4T.

Two standard options for the front Connection Module are available from PalmSens BV:

1. **Version SNS:** with LEMO connector for use with PalmSens standard 1 meter cell cables.
2. **Version SPE:** with connector for Screen-Printed Electrodes with common 0.1" (2.54 mm) pitch and a maximum width of 10 mm.

For options regarding tailored Connection Modules for a bespoke sensor or cell interface, contact PalmSens BV. The following table shows the available standard configurations of the EmStat4T and the corresponding article codes.

Table 1. EmStat4T hardware configurations available from PalmSens BV

Article Code	Connection Module	EIS capable
C-ES4T-SNS.F0	SNS	NO
C-ES4T-SNS.F1	SNS	YES
C-ES4T-SPE.F0	SPE	NO
C-ES4T-SPE.F1	SPE	YES



A license for Electrochemical Impedance Spectroscopy (EIS) can always be upgraded remotely via software.

1.4. Modes of operation

The EmStat4T offers two main modes of operation:

- **Remote Controlled:** In this mode the instrument functions as a standard potentiostat for research purposes, where PSTrace for Windows or the PStouch app for iOS or Android controls the instrument. The connection to the PC, smartphone or tablet can either be via USB or via Bluetooth.
- **Standalone:** With the ability to run apps directly on the device, users perform sensor measurements and analyses without needing a separate computer, making it more portable and convenient.

1.5. Accessories

The EmStat4T is supplied standard with the following items.

EmStat4T SNS & SPE versions include:

- Shielded USB-C cable to USB-A cable
- Dummy cell
- USB stick with software
- A soft-shell carrying case
- Quick Start document
- Operator's Manual
- Certificate of Calibration

EmStat4T SNS version includes additional:

- 1 meter cell cable with 2 mm plugs with stackable connectors
- Croc clips for every lead (2 mm)

1.6. Software

The EmStat4T is used with PSTrace 5.12 for Windows or later. PSTrace 5.12 comes with the integrated Visual MethodSCRIPT Editor and EmStat4T Configuration tool. For regular operation (Remote Controlled Mode), including running measurements and analyzing data, you can control the EmStat4T directly using PSTrace 5.

For building small apps that run on the EmStat4T, and for configuring the instrument's style and behavior, the following two tools within PSTrace 5 can be used:

1. **The Visual MethodSCRIPT Editor:** The Visual MethodSCRIPT Editor and the EmStat4T configuration tool can be used to program the EmStat4T to run small wizard-style apps. The Visual MethodSCRIPT Editor can be found in the PSTrace main menu under 'Tools' › 'Visual MethodSCRIPT Editor...'

   For more information see Section 5.1 on Developing apps.

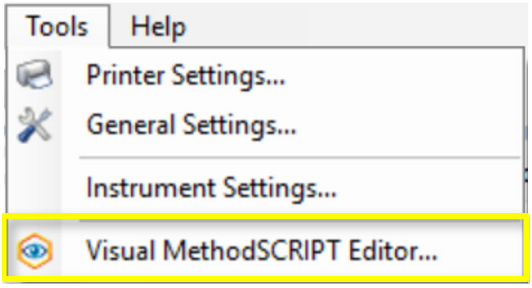


Figure 2. The Tools menu in PSTrace 5.12 or later for opening the Visual MethodSCRIPT Editor

2. **The EmStat4T Configurator:** The EmStat4T Configurator tool can be found in the main menu under 'Tools' › 'Instrument Settings...' and in the window that appears click the button 'EmStat4T Configurator'.

   See for more information Section 5.2 on Configuring the style and behavior.

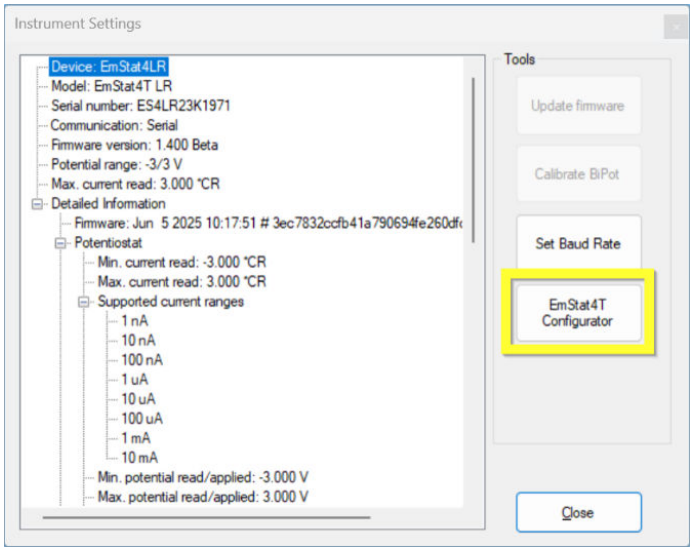


Figure 3. Opening the EmStat4T Configurator tool in PSTrace 5

Additional software tools and resources for the EmStat4T can be downloaded from the product page on the PalmSens website: www.palmsens.com/product/emstat4t

1.6.1. System requirements

The following minimum hardware and software is required to operate the EmStat4T as intended and safely.

Table 2. Minimum system requirements

Item	Requirement
PC operating system	Microsoft Windows 10 or later
PC hardware	Processor: 2 GHz 64-bit (x64) processor, memory: 8 GB, free disk space: 10 GB, screen resolution: 1920 x 1080
PC software	PSTrace 5.12 or later
Smartphone or tablet	Android 11 or later, with the PStouch app
Connection to the host	A USB port for the supplied USB-C to USB-A cable, or Bluetooth 4.0 or later

The EmStat4T does not connect to a computer network itself. It communicates only directly with its host, via USB or Bluetooth. If the host is connected to a network, the responsible body is responsible for the security of that network and of the data that is stored on the host.

1.7. Symbols used on the equipment and packaging

The following table explains the symbols that are used on the EmStat4T, on its packaging and in this manual.

Table 3. Symbols on the equipment

Symbol	Meaning
	Power button (standby). Touch and hold to switch the instrument on or off. See Section 2.7.
	CE marking. The product complies with the applicable European Union legislation. See the EU declaration of conformity in the appendix.
	UKCA marking. The product complies with the applicable legislation of Great Britain.
	The product complies with Part 15 of the FCC Rules (United States). The FCC ID of the Bluetooth module is printed next to the logo.
	The product contains a Bluetooth radio transmitter.
	Do not dispose of the product with household waste. Take it to a collection point for waste electrical and electronic equipment. See Appendix B.

Table 4. Symbols on the packaging

Symbol	Meaning
	Temperature limits for transport and storage. See Section 6.2.
	Humidity limits for transport and storage. See Section 6.2.
	Keep dry. Protect the package from rain and moisture.
	Fragile. Handle the package with care.

Table 5. Symbols used in this manual

Symbol	Meaning
	Warning. Indicates a hazard that can cause injury if the instructions are not followed.
	Caution. Indicates a situation that can cause damage to the instrument or incorrect results if the instructions are not followed.
	Electrostatic discharge (ESD) sensitive. Discharge yourself before you touch the part.
	Note. Gives additional information.

Chapter 2. Operating the EmStat4T

2.1. Preparing for operation

If the EmStat4T was taken from a cold location into a warm humid location, water vapor might condense at the inside. If this is the case, it is important to leave the instrument in the room for at least an hour before switching it on.

2.2. Switching on and off

The power button is located underneath the touch display. To turn on the EmStat4T, touch and hold the power button (no force needed) for two seconds until you hear a short beep, indicating the device is booting. A short melody of three tones sounds when the EmStat4T has fully booted.



Figure 4. Touching the EmStat4T power button

Touch the power button for three seconds to switch the instrument off again.

2.3. Charging

A full charge of the EmStat4T takes about 3 hours. Any USB power source can be used for charging. To charge at maximum speed, ensure you use a charger and cable that can support 1.5 A at 5 V.

2.4. Connecting via USB

The EmStat4T has a USB Type-C (USB-C) port and uses the Full-Speed specification. The EmStat4T can be used with any common USB port. Connect the EmStat4T to your computer using the supplied USB-C cable.

For optimal performance, PalmSens recommends using only the shielded USB-C to USB-A (standard rectangular plug) cable supplied as standard with the instrument. Use of other or longer cables may increase susceptibility to electromagnetic interference and may affect measurement performance. Similarly, if feasible, it is recommended to refrain from utilizing a USB hub or docking station. The USB-C port on the EmStat4T is used for both power and data communication. To operate the device via a PC, make sure PSTrace 5.12 or later is installed, which ensures that the correct drivers are present.

2.5. Connecting via Bluetooth

Every EmStat4T has a unique Bluetooth name. The Bluetooth name of the EmStat4T instrument can be found by tapping the hamburger-menu icon ☰ on the display when the instrument is idle.

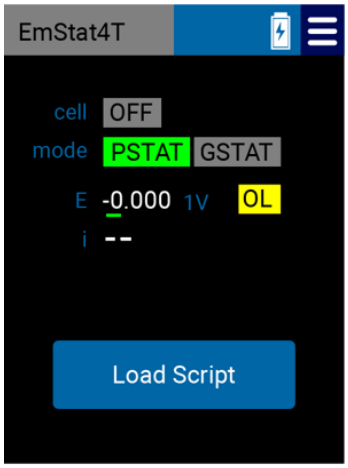


Figure 5. The hamburger menu (three stacked horizontal lines) is found in the upper right corner of the idle screen

The Bluetooth name always starts with the letters PS, followed by the last 4 characters of its MAC address. For example: PS-6AEF. When connecting with the EmStat4T for the first time, a pairing code will be required by the host. This code is shown on the display of the EmStat4T as “Pair Code” when the host is requesting the code and can be 5 or 6 digits. A random Pair Code is generated every time the device is paired with a host.

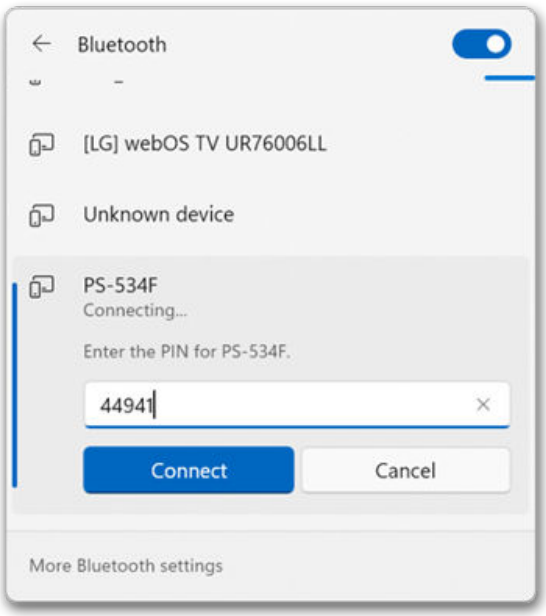


Figure 6. Entering the Pair Code in Windows 11 when connecting for the first time to the EmStat4T

When connecting to the USB port of a PC, Bluetooth will switch off automatically unless there is a Bluetooth connection active. This allows the instrument to be charged via the PC while a Bluetooth connection is present. The instrument can also be charged with any other USB-C power source while a Bluetooth connection is present.

2.6. Touch display

The touch display is meant for use with Wizard-style mini apps which can be designed and generated using the Visual MethodSCRIPT Editor. These apps allow for creating a series of steps the user must follow on the display to run measurements, entering or scanning sensor or user information, doing calculations on the measurement data and presenting and storing the results. This allows for applications where a user or operator is following these steps in an industrial or medical environment carrying out a concentration determination. When the instrument is used in the remote-controlled operation mode, being controlled by a PC or smartphone, the touch screen doesn't serve a purpose apart from showing idle status information and which measurement is running.

2.7. Operating controls and indicators

This section gives an overview of the operating controls and indicators of the EmStat4T and their use. The EmStat4T has no mechanical switches or knobs. It is operated with the touch power button, the touch display and the connected software.



Figure 7. Operating controls and indicators of the EmStat4T

Table 6. Operating controls and indicators

Control or indicator	Location	Function and use
1. Power button	Below the touch display, marked with the standby symbol	Touch and hold for two seconds to switch on. A short beep sounds when the instrument starts, and a melody of three tones when it is ready for use. Touch and hold for three seconds to switch off. See Section 2.2.
2. Touch display	Front of the instrument	Tap buttons and fields on the display to operate the idle screen, the menu and the apps. See Section 2.6.
3. Status bar	Top of the touch display	Shows the name of the instrument and the charge level of the battery.
4. Menu (hamburger icon)	Upper right corner of the idle screen	Opens the instrument information, including the Bluetooth name. See Section 2.5.

Control or indicator	Location	Function and use
5. 'Load Script' button	Idle screen	Opens the list of installed apps. Tap an app to start it.
6. Error messages	Bottom of the touch display, in red	Indicate an error in the app that is running. See Section 8.2.
7. Speaker	Inside the instrument	Gives the start-up sounds. Apps can also give sounds, for example to indicate that a step or measurement has finished.
8. QR and barcode scanner	Scanner window, see Section 1.2.1	Activated by the app when a code must be scanned. Aim the red aiming light at the code. The instrument beeps when the code has been read.
9. Connection Module	Front of the instrument	Connects the SPE, or the cell cable. See Section 2.9.
10. USB-C port	Side of the instrument, see Section 1.2.1	Charging, and communication with a PC. See Section 2.3 and Section 2.4.

2.8. Sequence of operation

This section describes the sequence of operation in each of the operating modes. See also Section 1.4.

2.8.1. Standalone mode

In Standalone mode, the operator runs an app on the EmStat4T. The app guides the operator step by step through the measurement.



Figure 8. The idle screen of the EmStat4T

1. Prepare the workplace, the personal protective equipment and the consumables. See Section 4.1.

2. Switch on the EmStat4T and wait for the melody of three tones. The idle screen appears. If 'Skip Idle Screen' is enabled, the list of apps appears directly. See Section 5.2.
3. Tap 'Load Script' and select the app for your application.
4. Follow the instructions of the app on the display. Depending on the app, these steps can include:
    a. entering or scanning the operator or sample identification
    b. scanning the QR code on the sensor package, for example to read calibration data and the expiration date
    c. inserting the SPE into the SPE Connection Module. See Section 4.3.
    d. applying the sample to the SPE
5. Start the measurement when the app asks you to. Do not remove the SPE, and do not move the instrument, while the measurement is running.
6. Read the result on the display. The result can be stored in the internal storage of the instrument, depending on the app running.
7. Remove the used SPE and dispose of it as described in Section 9.7.
8. Start the next measurement, or return to the idle screen and switch off the instrument.

To stop a measurement before it has finished, use the stop or cancel option of the app, if the app provides one. If the instrument does not respond, see Section 8.1.

2.8.2. Remote Controlled mode

In Remote Controlled mode, the EmStat4T is operated from PSTrace on a PC or from PStouch on a smartphone or tablet. The touch display only shows status information.

1. Switch on the EmStat4T.
2. Connect the EmStat4T to the PC, smartphone or tablet, via USB or Bluetooth. See Section 2.4 and Section 2.5.
3. Start PSTrace or PStouch and connect to the instrument.
4. Connect the cell, or insert the SPE. See Section 4.2 and Section 4.3.
5. Select the technique, set the parameters and start the measurement in the software. The touch display shows which measurement is running.
6. To stop a measurement before it has finished, use the abort function of the software.
7. After the measurement, disconnect the cell or remove the SPE.
8. Disconnect the instrument in the software, and switch off the EmStat4T.

For details on the techniques and their settings, see the PSTrace Manual.

2.9. Connection Modules

The EmStat4T is supplied with either the SNS Connection Module (Figure 7) for use with the standard 1-meter cell cable provided by PalmSens BV, or the SPE Connection Module (Figure 8) designed for common form-factor screen-printed electrodes.

See also Section 6.5 entitled SPE Connection Module pin-out.

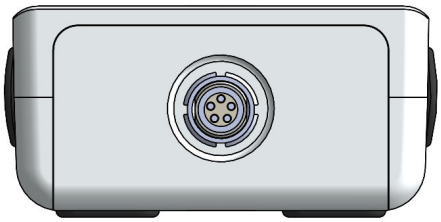


Figure 9. SNS Connection Module with LEMO connector for 1 meter cell cables

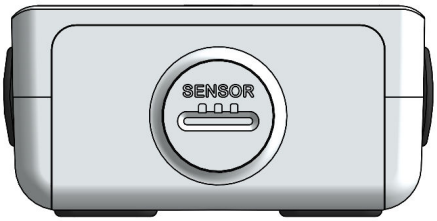


Figure 10. SPE Connection Module with SPE connector for Screen-Printed Electrodes

In the case of the SNS module, the cell cable is connected to the EmStat4T by means of a LEMO push-pull connector. Make sure the red dot on the connector is facing upwards when plugging the connector into the EmStat4T. See Figure 11.

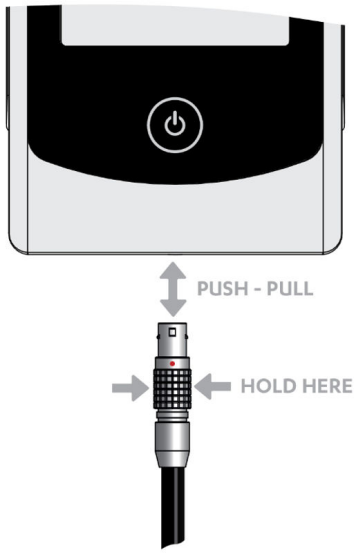


Figure 11. LEMO push-pull cell connector

2.9.1. Replacing the Connection Module

The Connection Module in the front comes standard in two versions, one for use with Screen-Printed Electrodes (SPE version) and one for use with the PalmSens standard 1 meter cell cable. The Connection Module can easily be exchanged by removing the small Philips screw at the bottom side of the device (step 1) and by pushing the Connection Module outwards (step 2). See the figure below.

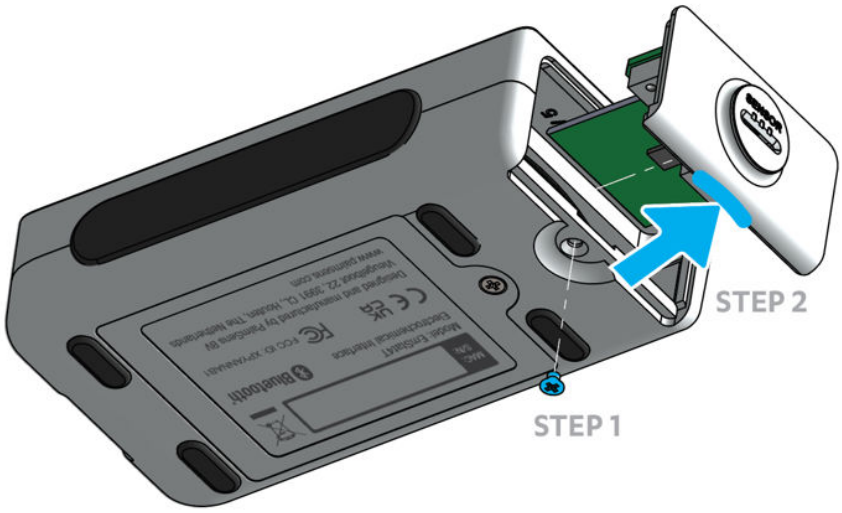


Figure 12. Replacing the Connection Module

Chapter 3. Accessories, interconnections and consumables

This section describes how to connect the EmStat4T to accessories and other equipment. It also lists the suitable accessories, the detachable parts and the special consumable materials for the instrument.



Only use accessories, detachable parts and consumables that are specified in this manual or supplied by PalmSens BV. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

3.1. Interconnections

The EmStat4T has the following interfaces for connecting to accessories and other equipment.

Table 7. EmStat4T interconnections

Interface	Connects to	Requirements and notes
USB-C port	PC, USB charger or other USB power source	Use the supplied shielded USB-C to USB-A cable. Connect only to equipment that complies with IEC 62368-1 (or IEC 60950-1) and provides a Safety Extra-Low Voltage (SELV) USB output of 5 V. For charging at maximum speed, the source must supply 1.5 A. See Section 2.4 and Section 2.3.
Bluetooth	PC, smartphone or tablet	Bluetooth 4.0 (Dual-Mode). No cable is required. See Section 2.5.
SNS Connection Module (LEMO connector)	Electrochemical cell, via the PalmSens 1 meter cell cable	Use only the PalmSens cell cable. Insert the LEMO connector with the red dot facing upwards. See Section 4.2 and Section 6.4.
SPE Connection Module	Screen-Printed Electrode (SPE)	Use only SPEs that meet the specifications in Section 6.5. See Section 4.3.

Connecting to other equipment

Follow these instructions when you connect the EmStat4T to other equipment:

- Switch off the EmStat4T before you connect or disconnect the cell cable or replace the Connection Module.

- Connect the cell leads only to electrochemical cells, sensors, dummy cells or other low-voltage test objects. The cell connections are not rated for any measurement category (CAT II, III or IV). Never connect them to mains circuits, hazardous live circuits, or circuits that exceed the potential and current ranges given in the specifications.
- Do not connect the cell leads to an external voltage source while the cell is switched on, unless the measurement technique requires this and the voltage is within the specified ranges.
- When you use a Faraday cage, connect the green ground lead (AGND) of the cell cable to the cage, and keep the 2 mm plugs inside the cage.
- Route the cables so that they cannot be pulled, crushed or tripped over. Do not bend the cell cable sharply.
- If a measurement requires the cell to be floating, for example when the EmStat4T is used as a ZRA, operate the instrument on its internal battery and connect via Bluetooth. Disconnect the USB cable. See Section 4.2.3.
- Only use the USB-C port for power and data communication. Do not connect the EmStat4T to a USB hub or docking station if it can be avoided, and do not use USB cables longer than the supplied cable.

3.2. Suitable accessories

The following accessories are suitable for use with the EmStat4T. The items that are supplied as standard are listed in Section 1.5. For article codes and ordering information, contact PalmSens BV or visit the EmStat4T product page.

Table 8. Suitable accessories for the EmStat4T

Accessory	Description	Supplied as standard
Shielded USB-C to USB-A cable	Cable for charging and USB communication with a PC.	Yes
1 meter cell cable	Shielded cell cable with LEMO connector and 2 mm stackable plugs, for use with the SNS Connection Module.	SNS version only
Crocodile clips (2 mm)	One clip for every lead of the cell cable, in the matching color.	SNS version only
Dummy cell	Test circuit for verifying the operation of the instrument. See Section 8.3.	Yes
Soft-shell carrying case	Case for storing and transporting the instrument and its accessories.	Yes

Accessory	Description	Supplied as standard
SNS Connection Module	Front module with LEMO connector for the cell cable.	SNS version only
SPE Connection Module	Front module with connector for Screen-Printed Electrodes.	SPE version only
Tailored Connection Module	Custom front module for a specific sensor or cell interface. Contact PalmSens BV for options.	No
Replacement battery	3000 mAh Lithium-Polymer battery, available from PalmSens BV only.	No

3.3. Detachable parts

The following parts of the EmStat4T can be detached by the user. Switch off the instrument and disconnect all cables before you detach any part. Do not detach or open any other part of the instrument. See Section 9.9.

Table 9. Detachable parts of the EmStat4T

Part	Instructions
USB cable and cell cable	Pull the connector straight out. Do not pull on the cable. To release the LEMO connector, pull on its outer sleeve.
Crocodile clips	Slide the clips on or off the 2 mm plugs of the cell cable.
Connection Module (SNS or SPE)	Remove the Phillips screw at the bottom of the instrument and push the module outwards. See Section 2.9.1.
Battery lid and battery	Remove the Torx 8 screw of the battery lid. Only replace the battery with a battery supplied by PalmSens BV. See Chapter 7.



Do not use the instrument without a Connection Module or with the battery lid removed. An open slot or compartment exposes internal parts to dust, fluids and electrostatic discharge (ESD).

3.4. Special consumable materials

The EmStat4T itself requires no consumable materials for its operation. Depending on the application, the following consumables may be used:

- **Screen-Printed Electrodes (SPEs):** For use with the SPE Connection Module.

SPEs must have connection pads with a 2.54 mm (0.1") pitch, a thickness of 0.1 to 0.8 mm and a maximum width of 10 mm. For a list of compatible manufacturers, visit www.palmsens.com/products/sensors/screen-printed-electrodes/.

- **Sensors and electrodes:** Working, counter and reference electrodes connected via the cell cable. Follow the instructions of the electrode manufacturer for use, storage and maintenance.
- **Electrolytes, reagents and calibration solutions:** Consult the Safety Data Sheet (SDS) of each substance before use. See Section 4.1.

Follow these instructions for all consumables:

- Use single-use consumables only once. Do not clean or reuse them unless they are specifically designed for multiple uses.
- Store consumables as specified by their manufacturer, and store unused SPEs in a dry, dust-free environment.
- Do not use consumables that are damaged or of which the packaging is damaged.
- Dispose of used consumables as described in Section 9.7.

Chapter 4. Running measurements

The PSTrace software for Windows and the PStouch app for Android allows you to perform all electrochemical techniques supported by the connected EmStat4T instrument. This section outlines how to set up a typical measurement using these applications. It covers usage in Remote Controlled Mode, where the instrument is operated entirely via PSTrace or PStouch. In this mode, the EmStat4T's touch screen is not used for control but will display basic status information during measurements.

For detailed information on specific techniques, including their options and limitations, please refer to the **PSTrace Manual**.



The options and limitations for each technique are described in the PSTrace Manual.

More theoretical background information about electrochemical techniques can be found in:

- Christopher M.A. Brett and Ana Maria Oliveira Brett, Electroanalysis (Oxford Chemistry Printers, 64) Oxford Science Publications, ISBN-13: 978-0198548164
- Joseph Wang, Analytical Electrochemistry 4th ed, John Wiley & Sons, ISBN-13 978-1119787693

4.1. Handling hazardous substances

This section describes the correct use of hazardous substances during normal use of the EmStat4T, and the training and personal protection measures that are required.

The EmStat4T itself does not contain hazardous chemical substances that the operator can come into contact with during normal use. However, electrochemical measurements usually involve substances that may be hazardous, such as:

- samples, analytes and standard solutions
- electrolytes, buffers and reagents
- solvents used for sample preparation or for rinsing electrodes
- the filling solutions of reference electrodes, for example saturated potassium chloride, or mercury compounds in calomel electrodes



Hazardous substances can cause injury through contact with skin or eyes, inhalation or ingestion. Before you use any substance, read its Safety Data Sheet (SDS) and follow its instructions for handling,

personal protection and first aid.

4.1.1. Training

The EmStat4T must only be used by operators who:

- have read and understood this manual, and the instructions for use of the sensors and consumables used
- are trained in general laboratory safety and in the safe handling of the chemical substances used in their application
- know the safety procedures of their organization, including what to do in case of a spill, exposure or fire

The responsible body, for example the employer or the laboratory manager, is responsible for making sure that every operator has received this training.

4.1.2. Personal protection measures

Wear personal protective equipment (PPE) as specified in the SDS of the substances used and by the safety procedures of your organization. As a minimum, PalmSens BV recommends:

Table 10. Recommended personal protective equipment

PPE	Recommendation
Gloves	Disposable gloves that are resistant to the substances used, for example nitrile gloves. Replace them immediately when they are contaminated or damaged.
Eye protection	Safety glasses with side shields. Use goggles or a face shield if there is a risk of splashes.
Lab coat	A closed lab coat to protect skin and clothing.
Ventilation	Work in a well-ventilated area. Use a fume hood for volatile, toxic or strongly smelling substances.

4.1.3. Correct use

- Only use the quantities of substances that are required for the measurement.
- Keep containers closed and clearly labeled with their contents and hazards when they are not in use.
- Place the cell, sample containers and reagents on a stable surface, so that they cannot tip over. Do not place containers with liquids on top of, or directly above, the EmStat4T.

- When you apply a sample to an SPE, only apply the volume specified by the sensor manufacturer, and only to the sensing area. Do not let liquid reach the contact pads or the SPE Connection Module.
- Avoid touching the touch display with contaminated gloves. Change your gloves, or clean the display after use as described in Section 9.6.
- Do not eat, drink or apply cosmetics in the work area. Wash your hands after the measurement and after you remove your gloves.
- Do not use the EmStat4T in an explosive atmosphere or near flammable vapors. The instrument is not designed for use in hazardous locations.
- Deal with spills and breakage as described in Section 8.1, and dispose of waste as described in Section 9.7.

4.2. Connecting a cell to the potentiostat

This section describes how to connect the EmStat4T SNS version to an electrochemical cell using the 1-meter cell cable.

The 1-meter cell cable is terminated with 2-mm plugs as the lead connectors for the cell/electrodes/sample. Each lead is accompanied by a crocodile (alligator) clip of the same color. See Table 3 for EmStat4T standard cable lead colors.



We advise keeping an unused lead connected with its crocodile clip. This practice prevents accidental electrical contacts with the exposed 2-mm plug, minimizing the risk of unintended electrical contacts.

Each electrode cable is individually shielded, and the entire cable features an external shielding mesh. The shielding extends up to the beginning of the 2-mm plug. When you are using a Faraday cage, it is advisable to keep the entire 2-mm plugs inside the Faraday cage housing to ensure the cage shields the 2-mm plug.

4.2.1. 2-electrode cell connection

For a 2-electrode setup, combine the counter and reference electrode leads. The counter electrode plug of the cell cable is stackable, allowing for convenient combination.

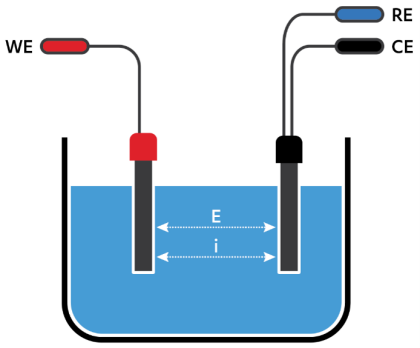


Figure 13. 2-electrode cell connection

During a measurement in a 2-electrode setup, the potential will be applied between the two electrodes, and the current will flow between the same two electrodes. This means the applied potential includes the potential drop across the working electrode's interface, the potential drop across the solution, and the potential drop across the counter electrode's interface. Any changes at the counter electrode will influence the result. If your counter electrode is expected to be stable during the measurement due to low currents or a short duration of the measurement, you can use this setup almost equivalent to a 3-electrode setup. Otherwise, this setup is only used for applications where the full cell potential is an interesting parameter, for example, fuel cells, batteries, capacitors, dummy cells or electronic components.

4.2.2. 3-electrode cell connection

The 3-electrode setup is the most common configuration for electrochemical measurements.

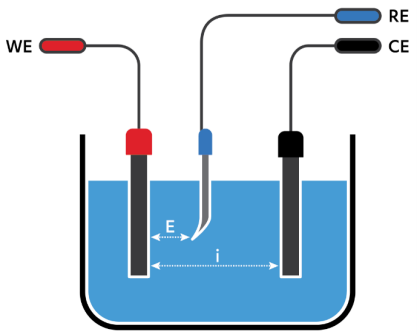


Figure 14. 3-electrode cell connection

Similar to the 2-electrode setup, the working electrode carries the current and potential. In this setup, the counter electrode also carries the current and polarizes versus the working electrode (WE). However, the potential is measured between the working and reference electrodes, denoted as WE vs. RE. This potential is the one set and read in the plot results.

The potential WE vs. CE is referred to as the 'cell potential', and it is recorded in special cases. In potential-controlled experiments, the potentiostat maintains a loop to ensure that the potential read (WE vs. RE) remains as programmed in the setup, consistently driving this potential towards the WE vs. CE polarization.

This has the advantage that the potential drop across the counter electrodes interface is compensated. Another advantage is that the reference electrode does not carry any current and will thus keep a stable potential during the measurement. This means the potential of the working electrode is more accurate and reproducible.

4.2.3. Using the EmStat4T as ZRA

The EmStat4T can also be used as a Zero-Resistance Ammeter (ZRA). A Zero-Resistance Ammeter is a specialized mode used in potentiostats, primarily for measuring current between two electrodes while maintaining zero voltage (potential) difference between them. The ZRA mode ensures that no significant potential is applied between two electrodes, while the current flow between them is accurately measured.

While keeping the potential difference near zero, the potentiostat measures the current flowing between two electrodes. This current is the main variable of interest in ZRA mode, providing valuable insights into processes such as corrosion, galvanic coupling, and other electrochemical phenomena where a potential difference is not deliberately applied but current is exchanged.

If a potentiostat is used as a ZRA, in most setups it needs to be floating (Galvanically Isolated). The reference electrode (blue) and counter electrode (black) connections of the potentiostat need to be stacked and left disconnected to anything else. See the following image for a schematic representation.

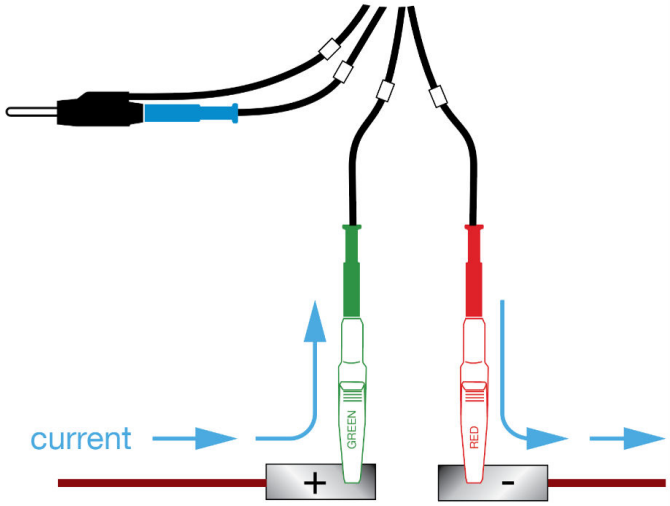


Figure 15. Connecting the EmStat4T cell cable for ZRA measurements

The current flows through the working electrode lead (red) and the ground lead (green). The working electrode is connected to the input of the current follower and the + input is connected to ground. The voltage difference between the working electrode and ground is zero and the current will be measured.

Use the technique Chronoamperometry in software to record the currents. The applied potential setting can be ignored.

4.3. Using Screen-Printed Electrodes (SPEs) with the EmStat4T

This section describes how to use the EmStat4T SPE version with Screen-Printed Electrodes.

The EmStat4T supports direct connection of screen-printed electrodes (SPEs) through the optional SPE Connection Module. This module enables convenient and reliable measurements using disposable or reusable SPEs with standard form factors.

Follow these guidelines while connecting a Screen-Printed Electrode:

1. Gently insert your SPE into the slot of the SPE Connection Module.
2. Ensure the electrode is inserted fully, with all contact pads properly aligned with the module's spring-loaded pins.
3. Avoid excessive force or misalignment to prevent damage to the electrode or the module.

For a list of compatible SPE manufacturers, visit our website:
www.palmsens.com/products/sensors/screen-printed-electrodes/

4.3.1. Maintenance and Tips

- Use SPEs only once if they are single-use; do not attempt to clean or reuse unless they are specifically designed for multiple uses.
- Store unused SPEs in a dry, dust-free environment.
- Periodically inspect the SPE Connection Module for debris or wear. Clean gently using a dry, soft brush if necessary.
- When not using SPEs, consider switching back to the SNS Module for conventional cell connections.

For best results, always use screen-printed electrodes that conform to the standard PalmSens-compatible layout. See also Section 6.5 entitled SPE Connection Module pin-out.

Chapter 5. Standalone operation

The EmStat4T is capable of running MethodSCRIPTs with the extended command set for controlling the display, the internal speaker and the integrated QR code scanner. This section describes how these scripts - which can be regarded as small apps - can be developed, installed and maintained. The section also covers how the styling and naming of the user interface can be modified.

5.1. Developing apps

By using MethodSCRIPT™, small wizard-like apps can be developed for the EmStat4T. These apps can be loaded using the 'Load Script' button which is available in the Idle screen.

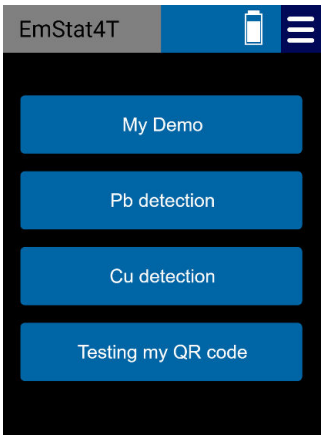


Figure 16. List with available apps on the display of the EmStat4T

5.1.1. Files and folders

The MethodSCRIPTs are stored on the EmStat4T in the folder “display”. Buttons are available on the EmStat4T display to select scripts, where each button can be considered as a slot. Each script file starts with a number followed by an underscore that defines in which slot the script file is available. The “display” folder can contain for example the following script files:

- 1_My Demo
- 2_Pb detection
- 3_Cu detection
- 4_Testing my QR code

Each slot contains a file which contains a MethodSCRIPT™ which again can be loaded using the EmStat4T touch screen.

5.1.2. Creating and installing an app

The Visual MethodSCRIPT Editor, which can be found in PSTrace in the main menu: 'Tools' › 'Visual MethodSCRIPT Editor...'

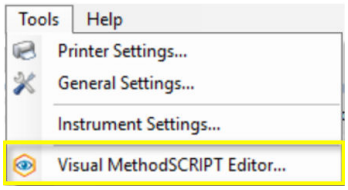


Figure 17. The Tools menu in PSTrace 5.12 or later for opening the Visual MethodSCRIPT Editor

Composing

The Visual MethodSCRIPT Editor allows the user to compose a script by means of dragging and dropping commands from the list at the right-hand side of the window to the script. The software generates the corresponding MethodSCRIPT while composing the script. The script output can be seen in the 'Script Preview' pane. To see the script output click in the menu 'View' › 'Script Preview'.

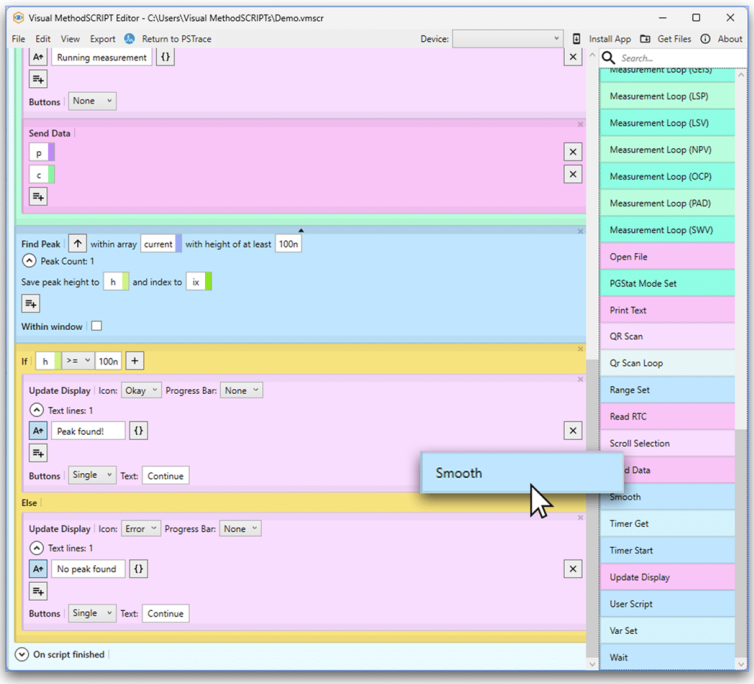


Figure 18. Visual MethodSCRIPT Editor

Installing

When a script is ready for installation on the EmStat4T, click on the button 'Install App' which is found at the right-hand side on the Toolbar. This button opens a window 'Download Script to Device'. The window allows you to set a name for the script and choose a slot button to install (see Figure 19) the script in. The new script always overwrites the existing script in the selected slot.

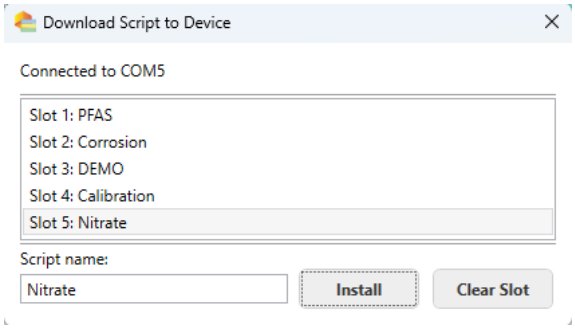


Figure 19. Downloading a MethodSCRIPT to the EmStat4T

Deleting

Deleting a script in a slot and making the slot empty again, is possible using the 'Load data from internal storage' window in PSTrace. To open this window click on the main menu in the PSTrace window: 'Data' › 'Load data from internal storage...'.

5.2. Configuring the style and behavior

Certain images, colors, and labels on the EmStat4T display can be customized to enhance usability for untrained users or to align the user interface with a specific company theme or brand identity.



Figure 20. EmStat4T display with customized user interface

The EmStat4T Configurator tool window

The EmStat4T Configurator tool window can be found in PSTrace 5.12 or later under the menu 'Tools' › 'Instrument settings...' which opens a window showing the 'EmStat4T Configurator' button. See the figure below.

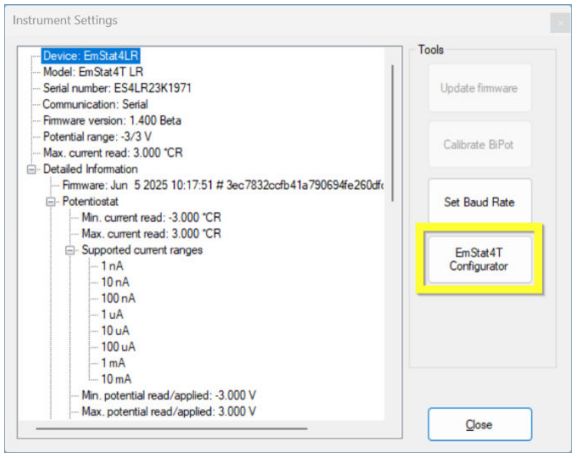


Figure 21. Instrument Settings window with button to open EmStat4T Configurator

The EmStat4T Configurator window contains the following controls:

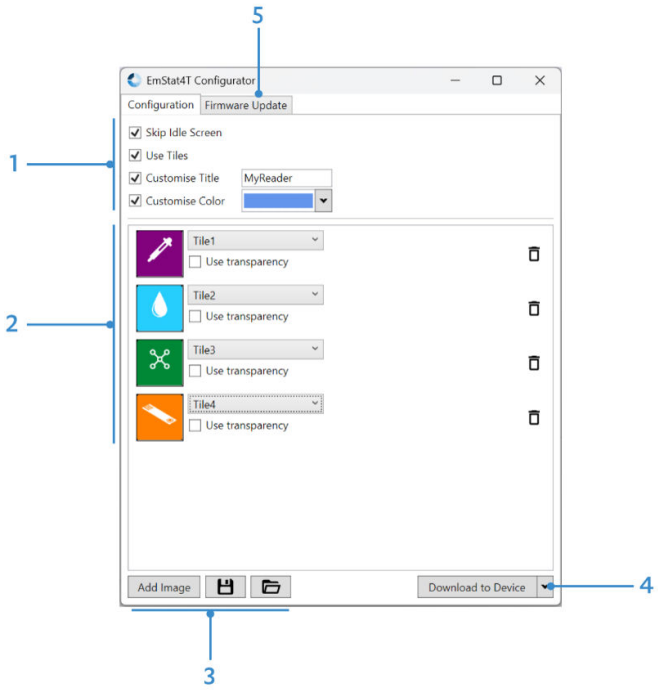


Figure 22. EmStat4T Configurator tool window

The checkboxes under Figure 22 - 1 change the following settings when enabled:

- Skip Idle Screen: when the EmStat4T boots, the screen with cell readings is always skipped and the display shows all the available apps, either as a list or as tiles.
- Use Tiles: makes the EmStat4T show tiles instead of a list with the available apps. The tiles can be customized (see Figure Figure 22 - 2) using images.
- Customise Title: Replaces the default name “EmStat4T” with a custom one.
- Customise Color: Changes the accent colors used in the EmStat4T user interface, for example the button colors.

The area under Figure 22 - 2 contains a list with images that were added using the 'Add Image' button. Each button can be configured to be used for a specific purpose. Options include using the image as:

- **Splash:** This image is shown when the EmStat4T boots. The maximum size of the image is 240x320 pixels. It is strongly recommended to use a smaller image to prevent noticeable delays during boot-up.
- **UserIcon#:** These user icons can be used with the 'Update Display' command in MethodSCRIPT. The icons should be 80 pixels tall and can be maximum 240 pixels wide.
- **Tile#:** These images are used as icon for the corresponding app when the 'Use Tiles' setting is enabled. The size of these images should be 105 x 105 pixels.

The settings can be saved and loaded with the buttons found at the bottom of the screen (Figure 22 - 3). This can be useful if the same settings need to be programmed into any new EmStat4T.

To store the new settings to the EmStat4T use the 'Download to Device' button, see Figure 22 - 4.

Firmware updates

The regular firmware update tool of PSTrace cannot be used for firmware updates to the EmStat4T. Use the tab 'Firmware Update' in the EmStat4T Configurator Tool instead (Figure 22 - 5). See also Section 8.5 entitled Firmware updates.

Chapter 6. Specifications

6.1. System specifications

The EmStat4T is based on the EmStat4M LR potentiostat module. Specifications are subject to change due to firmware updates; See the EmStat4T product webpage for current, detailed specifications.

Table 11. EmStat4T-specific specifications

EmStat4T key specifications			
Housing	11.8 x 6.8 x 3.3 cm		
Weight	310 g		
Power source	USB-C or internal Li-Po battery		
Battery	Connected via Bluetooth: ~3 hours with cell on at 10 mA current (~5 hours with cell off)		
Communications	USB Type-C port (recommended USB cable: supplied shielded USB-C to USB-A cable) or Bluetooth (4.0 - Dual-Mode)		
Internal storage	500 MB, equivalent to >15M datapoints		
Integrated QR barcode reader (supported formats and optical depth of field)*			
Compatible Formats	UPC-A, UPC-E, EAN-8, EAN-13, Code 128, GS1-128, Code 39, Code 93, Code 11, Interleaved 2-of-5, Matrix 2-of-5, Industrial 2-of-5, Codabar, MSI, GS1 DataBar, Datalogic 2-of-5, QR Code, Data Matrix, PDF 417, Micro PDF 417, Aztec Code		
Format	**Precision**	**Near**	**Far**
Code 39	0.1 mm (4 mil) - 1.0 mm (40 mil)	25 mm	400 mm
EAN-13	0.33 mm (13 mil)	50 mm	200 mm
QR Code	20.0 mil	25 mm	210 mm

**Test Conditions: T = 25°C, Illumination = 200 LUX, PCS = 0.9. The data provided above serves as a performance baseline indicative of standard scanner operations. For the complete, comprehensive technical specification visit the EmStat4T product webpage.*



Specifications are subject to change, due to firmware updates. See the EmStat4T product webpage for current specifications.

6.2. Transport and storage conditions

The following environmental conditions apply to the transport and storage of the EmStat4T. The essential conditions are also shown on the packaging with symbols. See Section 1.7.

Table 12. Environmental conditions for transport and storage

Condition	Transport	Storage
Temperature	–20 °C to +60 °C	–10 °C to +30 °C (+15 °C to +25 °C recommended for long-term storage)
Relative humidity	5 % to 95 %, non-condensing	10 % to 85 %, non-condensing
Charge state	30 % to 50 %	50 %, over long periods batteries should be cycled every 90 days.
Air pressure	50 kPa to 106 kPa for air freight. UN 38.3 battery certification already includes an altitude test down to 11.6 kPa.	-

- Transport and store the EmStat4T in its original packaging or in the supplied carrying case, protected from moisture, dust and direct sunlight.
- The EmStat4T contains a Lithium-Polymer battery. When you ship the instrument, follow the applicable regulations for the transport of lithium batteries contained in equipment (UN 3481).
- Before you use the instrument after transport or storage, let it adjust to the room temperature. See Section 2.1.

6.3. Sound level

All sound pressure levels produced by the EmStat4T in normal use are 70 dB(A) or lower (reference sound pressure: 20 µPa).

6.4. SNS Connection Module pin-out

The following schematics show the EmStat4T cell connector pin-out and pin functions.

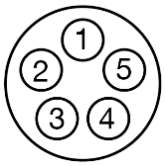


Figure 23. Front view of the female cell connector on the EmStat4T

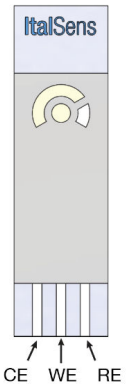
Table 13. Cell connector pin functions of the EmStat4T

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

6.5. SPE Connection Module pin-out

The following table shows the EmStat4T SPE connector specifications.

Table 14. SPE connector specifications of the EmStat4T

Connection pads	
Connection pads pitch	2.54 mm (0.1")
Sensor thickness	0.1 to 0.8 mm
Max. sensor width	10 mm

Ceramic substrates can have very sharp edges that might damage the SPE connector.



When inserting a Screen-Printed Electrode (SPE), avoid touching the electrode areas. Finger contact can contaminate the surfaces and degrade measurement quality. The electrodes also connect directly to sensitive instrument inputs and touching them may cause electrostatic discharge (ESD) that can damage the circuitry.

Handle the sensor only by its non-electrode edges and ensure you are discharged before insertion.

Chapter 7. Battery replacement

Required:

- Screwdriver: Torx 8
- A 3000 mAh LiPo battery acquired from PalmSens BV

Step 1: Open the battery compartment

Unscrew the single screw and remove the battery lid. Then gently pull on the battery connector to disconnect it.



Figure 24. EmStat4X with the battery lid removed

Step 2: Place the new battery

Connect the new 3000 mAh battery as received from PalmSens BV and place it in the battery compartment with the wires folded at the side of the battery.



The use of an unauthorized battery may compromise safety, pose a risk of fire, and result in irreversible damage to the device.

Step 3: Close the housing

Put the lid and the gasket back in place and close the housing. Do not use excessive force when tightening the screw.

Chapter 8. Troubleshooting

8.1. Dealing with malfunctions and hazardous situations

This section describes the actions an operator must take to deal with a hazard resulting from spills, lock-ups, container breakage and similar malfunctions of the EmStat4T. Follow the safety procedures of your organization in addition to these instructions.



If you are in doubt whether the EmStat4T can be used safely, stop using it, switch it off, disconnect it from all power sources and contact PalmSens BV. Do not attempt to open or repair the instrument yourself. See Section 9.9.

8.1.1. General actions

In case of any malfunction or hazardous situation:

1. Stop the running measurement, if possible.
2. Remove the SPE from the SPE Connection Module, or disconnect the cell cable from the cell.
3. Switch off the EmStat4T and disconnect the USB cable.
4. Wear suitable personal protective equipment (PPE), such as gloves and safety glasses, when hazardous substances may be involved.
5. Deal with the situation as described below.
6. Do not use the instrument again until you have confirmed that it works correctly. See Section 8.3.

8.1.2. Spills on or into the instrument

If a sample, reagent, electrolyte or other liquid is spilled on the EmStat4T:

1. Follow the general actions above. Do not switch the instrument on again while it is wet.
2. Absorb the liquid with a disposable absorbent wipe. Do not spread the liquid or push it into the SPE Connection Module slot, the USB-C port or the battery compartment.
3. Clean and decontaminate the instrument as described in Section 9.6.
4. Dispose of the used wipes and gloves as described in Section 9.7.
5. If liquid may have entered the housing, the SPE Connection Module or the

USB-C port, do not use the instrument. Contact PalmSens BV and state which substance was spilled.

8.1.3. Breakage of containers, cells or sensors

If a sample container, electrochemical cell, vial or sensor breaks:

1. Follow the general actions above.
2. Do not pick up broken glass or ceramic fragments with your hands. Use tongs, tweezers, or a brush and dustpan.
3. Dispose of the fragments in a puncture-resistant sharps container, and treat them and any spilled contents as hazardous waste. See Section 9.7.
4. Handle any spilled contents as described under *Spills on or into the instrument*.
5. If fragments of an SPE are left in the SPE Connection Module, carefully remove them with plastic tweezers while the instrument is switched off. Do not use force. If fragments cannot be removed, contact PalmSens BV.

8.1.4. Lock-up of the instrument

If the EmStat4T does not respond to the touch display, the power button or the software, the cell may still be switched on and may still apply a potential or current to the sensor or cell.

1. Immediately remove the SPE from the SPE Connection Module, or disconnect the cell cable from the cell, to stop any current through the cell.
2. Try to stop the measurement from PSTrace or PStouch, if the instrument is connected.
3. Touch and hold the power button for three seconds to switch the instrument off.
4. If the instrument cannot be switched off, disconnect the USB cable, open the battery compartment and disconnect the battery as described in Chapter 7. Wait at least 10 seconds before you reconnect the battery.
5. Switch the instrument on again. If the firmware does not start correctly, see Section 8.5.
6. If the lock-up occurs again, stop using the instrument and contact PalmSens BV.

8.1.5. Overheating, a swollen battery, smoke or a burning smell



A damaged or defective Lithium-Polymer battery may overheat, release hazardous gases or catch fire.

1. If it is safe to do so, disconnect the USB cable and remove the SPE or cell connection. Do not switch the instrument on again.
2. Move the instrument away from flammable materials, and place it on a non-flammable surface in a well-ventilated area. Do not touch the instrument if it is hot.
3. Do not charge, open, puncture or press on the instrument or the battery.
4. In case of fire, leave the area if needed and follow the fire safety procedures of your organization. Use a fire extinguisher that is suitable for electrical equipment and lithium batteries.
5. Do not use the instrument again. Contact PalmSens BV, and dispose of a damaged battery as described in Section 9.7.

8.1.6. Mechanical damage

If the instrument has been dropped, or if the housing, the touch display, the Connection Module or a cable is damaged:

1. Follow the general actions above.
2. Do not touch sharp edges of a cracked display or damaged housing.
3. Do not use the instrument if the housing or the touch display is cracked, if the battery lid does not close, or if internal parts are exposed. Contact PalmSens BV.
4. Replace a damaged USB cable or cell cable with an original cable from PalmSens BV.
5. If no damage is visible, verify that the instrument works correctly before further use. See Section 8.3.

8.2. MethodSCRIPT error codes

If the MethodSCRIPT of your EmStat4T app contains an error, a message in red will appear at the bottom of the screen (see figure below).

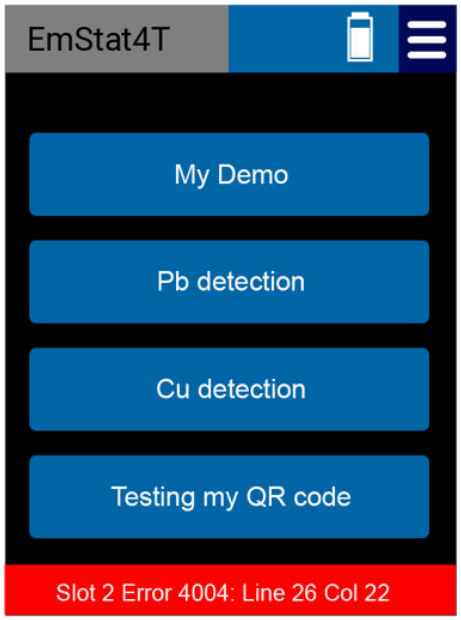


Figure 25. Example of an error message when trying to run an app

The error code refers to a MethodSCRIPT error code which can be found in appendix A “Error code lookup table“ in the MethodSCRIPT documentation. The 'Line' number refers to the MethodSCRIPT line number and the 'Col' to the position on the line which triggers the error. This could be a missing or faulty argument for example.

See for more information the webpage: palmsens.com/methodscript

8.3. Verifying your potentiostat

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

8.3.1. Connecting the dummy cell to the EmStat4T SNS

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+Sense leads are connected to one side and both RE and CE to the other side of the resistor.

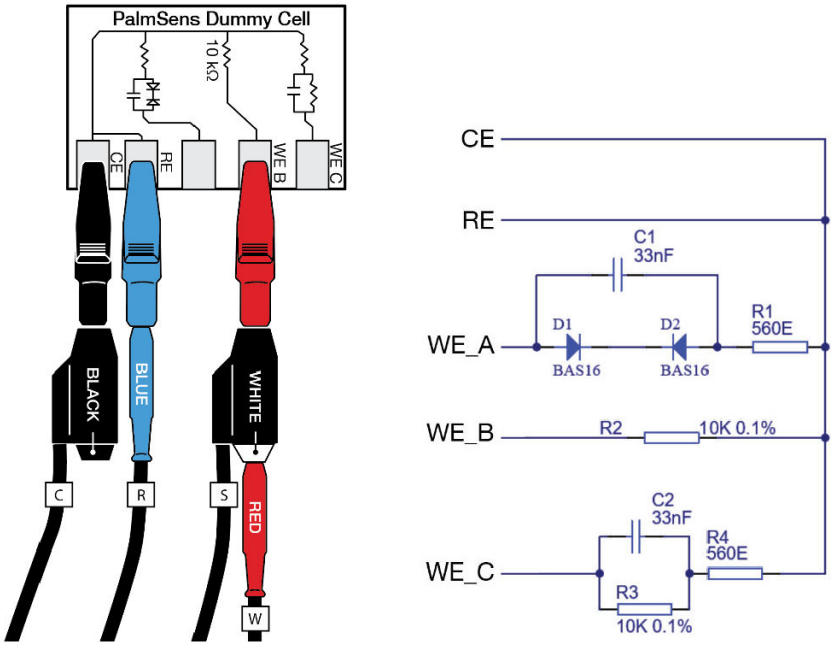


Figure 26. PalmSens Dummy Cell supplied with the EmStat4T SNS version

8.3.2. Connecting the dummy cell to the EmStat4T SPE

In case you are using the EmStat4T SPE version, connect the SPE dummy cell. Keep in mind that this SPE has a simplified Randles Circuit with an extra 560 Ω resistor in series with the 10 kΩ resistor.



Figure 27. The SPE dummy cell supplied with the EmStat4T SPE version

8.3.3. Running a test measurement on the dummy cell

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 in as much detail as possible.

8.4. Noise troubleshooting

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"** in the PSTrace Manual.

8.4.1. 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 (50 Hz or 60 Hz).

8.4.2. 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. Nearby RF transmitters (Wi-Fi routers, mobile phones, industrial radios) may be interpreted by the instrument as valid electrochemical signals. Measurements performed near such sources may therefore deviate from stated specifications. 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 instrument has an inbuilt shield and should protect your signal outside the Faraday cage. This is one of the most effective methods to reduce noise.

8.4.3. Cables

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

8.4.4. Contacts

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

8.5. Firmware updates

The regular firmware update tool of PSTrace cannot be used for firmware updates to the EmStat4T. Use the tab 'Firmware Update' in the EmStat4T Configurator Tool instead.

For more information see Section 5.2 on Configuring the style and behavior.

8.5.1. Bootloader emergency button

If the EmStat4T firmware does not start correctly, it is impossible to remotely enter the bootloader to upload new firmware. In this case, a special button in the battery compartment can be used.



Figure 28. EmStat4T bootloader emergency button

To use this function, open the battery compartment of the EmStat4T and remove the battery. Hold the bootloader button down while connecting the USB cable, and the device will appear as “STM32 Bootloader” for reprogramming.

Chapter 9. Maintenance and compliance

9.1. Lithium-Polymer batteries

The typical estimated life of a Lithium-Polymer battery is about two to three years or 300 to 500 charge cycles, whichever occurs first. One charge cycle is a period of use from fully charged, to fully discharged, and fully recharged again. Consider a two- to three-year life expectancy for batteries that do not run through complete charge cycles.

Rechargeable Lithium-Polymer batteries have a limited life and will gradually lose their capacity to hold a charge. This loss of capacity (aging) is irreversible. As the battery loses capacity, the length of time it will power the product (run time) decreases. Lithium-Ion batteries continue to slowly discharge (self-discharge) when not in use or while in storage.

Detailed instructions for battery replacement can be found in this document.

The new battery or battery pack must be obtained from PalmSens BV. Lithium-ion batteries have specific voltage operation and temperature control requirements, so using the wrong model may lead to overheating and fire.



The use of an unauthorized battery may compromise safety, pose a risk of fire, and result in irreversible damage to the device.

9.2. Temperature compliance

Our instruments are designed for indoor use at ambient temperatures between 0 °C and 45 °C. The battery of the EmStat4T is rated from -20 °C to +60 °C when discharging and from 0 °C to +45 °C when charging.

9.3. 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.

9.4. 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.

9.5. 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.

9.6. Cleaning and decontamination

This section describes how to clean and decontaminate the EmStat4T and its accessories. Clean the instrument regularly and whenever it is visibly dirty. Decontaminate it whenever it may have been exposed to hazardous substances, and always before it is stored for a long period, disposed of, or returned to PalmSens BV for service or repair.



Before cleaning or decontamination, switch off the EmStat4T and disconnect it from the cell, the USB cable and any other power source. Do not immerse the instrument, its Connection Modules or its cables in any liquid, and prevent fluids from entering the housing, the connectors or the Connection Module slot. Fluids inside the instrument may cause damage and create a safety hazard.

9.6.1. Recommended materials

Material	Use
Soft, lint-free cloth or wipe	For all cleaning. Lightly dampen it; never use a wet cloth.
Clean (demineralized) water, optionally with a mild, neutral detergent	Routine cleaning of the housing, the touch display and the cables.
Isopropyl alcohol (70% or higher)	Removing grease and fingerprints, and disinfecting the housing, the touch display, the cables and the connector contacts.
Ethanol (70%)	Disinfecting the housing, the touch display and the cables.
Dry, soft brush or clean, dry compressed air	Removing dust and debris from the Connection Module slot and the SPE Connection Module.



Do not use abrasive cleaners, scouring pads, acetone or other

strong solvents, bleach concentrates, or strongly acidic or alkaline agents. Do not spray any liquid directly onto the instrument, and do not autoclave, heat-sterilize or immerse any part of the instrument. These may damage the housing, the touch display, the labels and the electrical contacts. If you intend to use a cleaning or decontamination agent that is not listed above, contact PalmSens BV to confirm that it is compatible.

9.6.2. Cleaning procedure

1. Switch off the EmStat4T and disconnect all cables.
2. Wipe the housing with a cloth lightly dampened with water or with water containing a mild detergent.
3. Clean the touch display with a soft cloth that is lightly dampened with water or isopropyl alcohol. Do not press hard on the display.
4. Wipe the cell cable and the USB cable with a lightly dampened cloth. Do not let fluids enter the connectors.
5. Remove dust from the Connection Module slot and the SPE Connection Module with a dry, soft brush or with dry compressed air. Do not insert objects into the connectors.
6. If needed, clean the cell cable clips with a cloth or cotton swab lightly dampened with isopropyl alcohol.
7. Wipe off any detergent residue with a cloth dampened with clean water.
8. Let all parts dry completely before you reconnect them or switch on the instrument.

9.6.3. Decontamination procedure

If the instrument, its Connection Modules or its cables have come into contact with a hazardous substance, such as a spilled sample, reagent or electrolyte:

1. Wear suitable personal protective equipment (PPE), such as gloves and safety glasses.
2. Switch off the EmStat4T and disconnect all cables.
3. Consult the Safety Data Sheet (SDS) of the substance for the correct decontamination method and agent.
4. Absorb any liquid with a disposable absorbent wipe, without spreading it or pushing it into the openings of the instrument.
5. Wipe all contaminated surfaces with a cloth lightly dampened with water or

with a suitable agent from the table above. Repeat with a clean cloth until no residue remains.

6. Wipe the surfaces once more with a cloth lightly dampened with clean water and let them dry completely.
7. Dispose of the used wipes, cloths and gloves as described in Section 9.7.

If the instrument cannot be decontaminated, or you are not sure that decontamination was successful, do not return it for service. Contact PalmSens BV first.

9.7. Disposal of hazardous waste

This section describes how to safely handle and dispose of waste that may be hazardous and that is created while using the EmStat4T. The operator is responsible for identifying the hazards of the samples, reagents and electrodes used, and for complying with all applicable local, regional and national regulations for hazardous waste.



Used electrodes, sensors, samples, reagents, electrolyte solutions and cleaning materials may be contaminated with toxic, corrosive, flammable or otherwise hazardous substances. Do not dispose of this waste with general household waste or pour it down the drain unless local regulations explicitly allow this.

9.7.1. Chemical waste

- Consult the Safety Data Sheet (SDS) of every chemical, reagent and electrolyte used for its hazards and disposal requirements.
- Wear suitable personal protective equipment (PPE), such as gloves and safety glasses, when handling measurement waste.
- Collect liquid waste in closed, chemically resistant containers that are clearly labeled with their contents and hazards. Do not mix incompatible waste streams.
- Collect used electrodes, Screen-Printed Electrodes (SPEs), sensors and contaminated wipes or tissues separately from non-hazardous waste.
- Have hazardous waste disposed of by an authorized waste handling service.

9.7.2. Batteries

The EmStat4T contains a rechargeable Lithium-Polymer battery. Damaged, swollen

or leaking batteries may overheat or catch fire.

- Do not puncture, crush, short-circuit, incinerate or dispose of the battery with household waste.
- Tape the battery terminals or place the battery in a separate bag before disposal to prevent short circuits.
- Take used batteries to a designated battery collection point, or return them to PalmSens BV.

9.7.3. Decontamination of the instrument and accessories

Before the EmStat4T, its Connection Modules or its cables are disposed of, or returned to PalmSens BV for service or repair, decontaminate them from any hazardous chemical or biological substances as described in Section 9.6. Inform PalmSens BV of any hazardous substances that the instrument may have been exposed to. For the disposal of the instrument itself, see Appendix B.

9.8. 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.

9.9. Service and repair

Except for the battery in some models, your PalmSens instrument contains no userserviceable 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 repair

9.10. Removal from use, transport and disposal

The responsible body must take the following actions to eliminate or reduce hazards when the EmStat4T is removed from use, returned to PalmSens BV for service or

repair, transferred to another user, or disposed of:

1. Stop the use of the instrument, switch it off and disconnect the USB cable.
2. Remove any SPE or cell connection, and dispose of used consumables as described in Section 9.7.
3. Clean and decontaminate the instrument and its accessories as described in Section 9.6.
4. Record that the instrument has been decontaminated, which method and agents were used, and which hazardous substances the instrument may have been exposed to. Include this record with the instrument when it is returned for service or transferred to another user.
5. Pack the instrument in its original packaging or in the carrying case. Follow the transport conditions in Section 6.2, and the regulations for the transport of lithium batteries contained in equipment.
6. Dispose of the instrument as described in Appendix B. If the battery is removed separately, dispose of it as described in Section 9.7.

Before you return an instrument, contact PalmSens BV for return instructions:

PalmSens BV
Vleugelboot 22
3991 CL Houten
The Netherlands
info@palmsens.com
www.palmsens.com

9.11. 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 (Restriction of Hazardous Substances) initiative.

Chapter 10. Licenses

This section provides an overview of the open-source software components used in this product, which are licensed under the MIT License. Each component is distributed under its own license terms, which permits the free use, modification, and distribution of the software. Below, you will find the relevant copyright notices and license texts for these components, ensuring compliance with the terms of the MIT License.

By including these licenses, we acknowledge and respect the contributions of the respective authors and maintain transparency about the usage of third-party open-source software.

FreeRTOS (MIT)

www.freertos.org/Documentation/02-Kernel/01-About-the-FreeRTOS-kernel/04-Licensing

eyalroz/printf (MIT)

www.github.com/eyalroz/printf/blob/master/LICENSE

mcufont (MIT)

www.github.com/mcufont/mcufont/blob/master/LICENSE

Appendix A: CE Declaration

PalmSens

EU DECLARATION OF CONFORMITY

CE

Certificate number: PSDOC-ES4T-A

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

This declaration is valid for the following product:

EmStat4T: Portable electrochemical analyser with touch interface.

- USB power and communications
- Battery power
- Bluetooth communication

The object of the declaration described above is in conformity with the Radio Emissions Directive 2014/53/EU (RED) and applicable standards listed below:

Health & Safety

- EN 62479:2010
- EN 61010-1:2010 + A1:2019
- EN 62311:2020

Cybersecurity

- EN 18031-1:2024

EMC

- EN 61326-1:2021
- EN 301 489-1 V2.2.3:2019
- EN 301 489-17 V3.3.1:2024

Efficient Usage of Radio Spectrum

- EN 300 328 V2.2.2: 2019

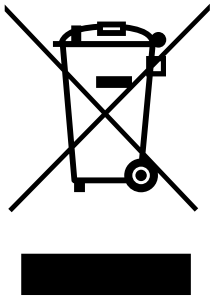
This declaration is issued under the sole responsibility of PalmSens BV.

Date: 1st of August 2025

C.J. van Velzen, CTO

Revision Record Sheet:

Appendix B: EU Waste Electrical and Electronic Equipment (WEEE) Directive



The pictogram shown above, located on the product 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 to designated collection points where it will be accepted free of charge.

Alternatively, in some countries, you may be able to return your product 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.

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The Netherlands

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