

# Getting started with the EmStat3+ module for OEM

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OEM Interface for electrochemical sensors



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## Important before you start unpacking

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Please read this quick start guide carefully before unpacking the boards from their antistatic bags or using the kit, as it contains important information on how to avoid damage to the PCB's.



The EmStat board can be damaged by static electricity (electrostatic discharge or ESD). Please take adequate precautions against static discharge during handling.

## Customer support

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Questions regarding the contents of this document or the products described in this document can be directed to PalmSens BV via:

- the contact form on the website: [www.palmsens.com](http://www.palmsens.com)
- an email to [info@palmsens.com](mailto:info@palmsens.com) ,
- or by telephone: +31 30 2459211



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## 1 Introduction

The EmStat-series are potentiostats with an embedded microcontroller. They provide all the major potentiostatic techniques with automatic current ranging and peripheral control.

### 1.1 EmStat communications

The EmStat is interfaced to a PC or host controller by means of a powered USB bus or serial (TTL) port. The instrument can be used with the Windows program PStouch.



Several Software Development Kits (SDKs) for .NET platforms are available to quickly and easily develop your application for EmStat. The SDK's allow you to:

- easily connect to instruments;
- run measurements;
- store data in PStouch / PStouch compatible format;
- peak detection;
- equivalent circuit fitting;
- manually control the cell;
- and many other things.

SDK's are available for:

- WinForms
- WPF
- Android (Xamarin)
- UWP

All SDK's can be downloaded from [my.palmsens.com](http://my.palmsens.com)

The instrument can also be controlled by using the commands as described in the 'Communications protocol' document.

### 1.2 USB or serial / TTL

EmStat3+ is normally controlled and power via its mini USB port. This requires the PalmSens drivers to be installed (automatically installed with PStouch or the .NET SDK).

Optionally the USB port can be re-programmed to function as a virtual COM port, see appendix A.



Make sure the USB chip is not programmed as VCP (Virtual COM port) when using the Rx/Tx lines on CON2.

EmStat3+ can also be controlled from a host controller by means of Tx and Rx (5V TTL). Use the following pins for TTL communications (see next page for pin locations):

CON2 - pin 12: +5V power supply (500 mA min.)

CON2 - pin 11: GND (or CON2 – pin 6)

CON2 - pin 1: Tx

CON2 - pin 2: Rx



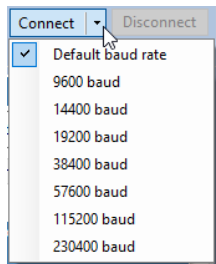
EmStat has a default baud rate of **230400 baud**. This baudrate is generally not supported by the built-in COM port on a regular desktop PC. When using a PC, a USB to serial adapter is recommended.

See also section 1.3

If serial communications is required in order to control the device directly from a PC without using the PalmSens drivers, it is advised to change the EmStat's USB port to function as Virtual COM port. See also appendix A.

### 1.3 Baudrate settings

The EmStat module has been set to a default baudrate of 230400 baud. This baudrate is supported by PSTrace. PSTrace also supports different baudrates. To change the baudrate upon connecting in PSTrace, click the arrow next to the "Connect" button.



The baudrate has influence on the maximum scanrate for measurements;

Baudrate	Max. number of data points / second	Min. interval time
230400	1000	1.00 ms
57600	197	5.07 ms

It is possible to change the baudrate setting of the EmStat module in the firmware (requires firmware v7.0 or higher).

See the EmStat Communications Protocol section 4.6: *Changing the baudrate*.

**The baudrate can also be changed in PSTrace 4.8 or later. See menu: Tools → Instrument settings.**

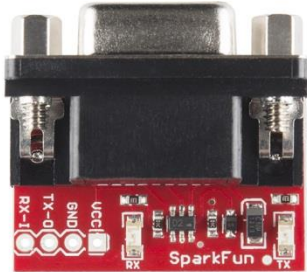
The firmware update program will always be able to update the firmware regardless of the baudrate supported by the firmware.

See section "Firmware" on page 9 in this document on how to update the firmware using a serial connection.

## 1.4 Connecting to PC via RS232 converter

Any TTL to RS232 converter can be used to enable RS232 communications with the EmStat module. These modules all share the same connections; Rx, Tx, VCC and GND.

Connect the SparkFun TTL-RS232 converter or any other similar converter as following:



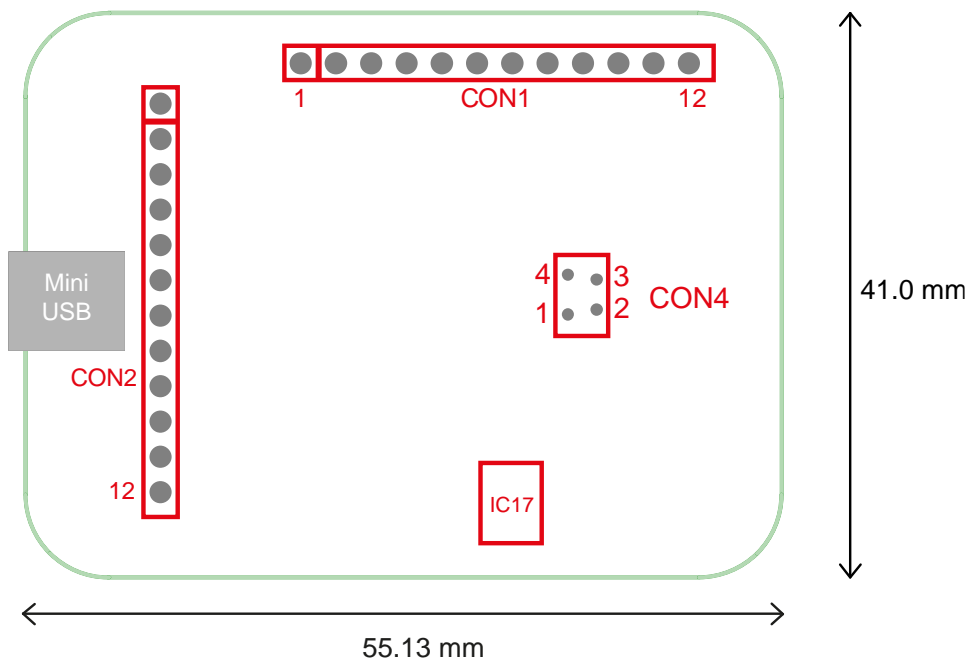
If using a null modem cable between EmStat and PC/controller:

EmStat:  
 Rx: CON2 – PIN2  
 Tx: CON2 – PIN1  
 VCC: CON1 – PIN5  
 GND: CON1 – PIN6

If connecting directly to PC/controller:

EmStat:  
 Rx: CON2 – PIN1  
 Tx: CON2 – PIN2  
 VCC: CON1 – PIN5  
 GND: CON1 – PIN6

## 2 Printed Circuit Board Layout



*EmSta3+ PCB layout*

The board has two pin headers: CON1 and CON2

**CON1** is used to connect for instance the MUX multiplexer or any other peripheral.

**CON2** is used when serial TTL communications is used and provides also an external analog input and analog output line, with a range of 0 - 4.095 V.

## CON1 description

Pin	Function
1	Digital outputline d3 or can function as digital input line 0
2	Digital outputline d2
3	Digital outputline d1 reserved for switch box: 1 = off 0 = on
4	Digital outputline d0 reserved for switch box: 0 = off 1 = on
5	Output: 5 V digital (max. 30 mA when powered from USB), or input (if not powered from USB): 5 V power supply (100 mA min.),
6	DGND
7	10 V analog (advised max. 50 mA)
8	Sense
9	AGND (connect to metal housing / cable shielding)
10	WE
11	RE
12	CE

The digital I/O lines are at 5V.

## 2.1 CON2 description

Pin	Function
1	Tx (serial port) at 5V
2	Rx (serial port) at 5V
3	Reserved (DO NOT CONNECT THIS PIN)
4	Voltage reference (4.096 V)
5	Reserved for use with external interrupt signal
6	DGND
7	Reset (active high)
8	Download (active low)
9	ADC ch.2 (range 0 – 4.095 V)
10	DAC ch.1 (range 0 – 4.095 V) The load must have an impedance of at least 5 kohm.
11	DGND
12	5 V power supply (500 mA min.), if not powered from USB



## 2.2 Heat transfer

IC17 which is used for the 100 mA range, may dissipate about 1 Watt or even higher when the output current limit is set higher.

It is therefore required to make a thermal connection from the bottom side of the PCB to something which can absorb heat, for instance using the thermal pad WX-3009-0227-6 from 3M.

Suggested heatsinks:



Heatsink 24-pin DIP Glue-On BLK (508500B00000G) available on [Digikey](#)



An adhesive heat sink like BGA-STD-015 is available from Farnell (2084425).



When using the 100 mA range, it is required to make a thermal connection from the bottom side of the PCB to something which can absorb heat like a housing or heat sink.

## 2.3 Pinout of sensor plug

See CON4 on page 5.

Front view of socket

1 • • 4  
2 • • 3

Solder side of socket

4 • • 1  
3 • • 2

1. RE: blue connector or reference electrode
2. CE: black connector or counter electrode
3. S: red female/male connector or sense
4. WE: red connector is working electrode

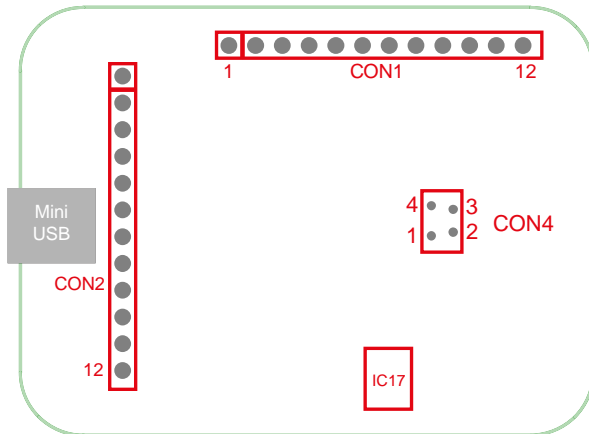


The shield of the cable must make contact with the metal case of the sensor connector or AGND.

## 3 Firmware

The firmware of EmStat can be updated by using the program 'Update firmware' or using PStTrace for Windows. The EmStat with USB interface is updated automatically.

In order to follow the steps below first solder on two small wires to both pin 6 and pin 8 of CON2 of the EmStat module directly so you can connect the two pins briefly.



When the EmStat is connected by means of a **serial connection**, it is required to toggle pins on **CON2** manually.

Follow these steps:

- Remove the power supply from EmStat
- Connect CON2-Pin 8 (download - active low) to CON2-Pin 6 (GND).
- Connect the power supply
- Run program 'Update firmware'
- Press 'Connect'
- Load firmware file ESx##, where x is the EmStat type and ## the firmware version.
- Make sure the checkbox 'PalmSens or EmStat is on, but does not work property' is checked
- Click button 'Update Firmware'.
- Remove the power supply briefly to force a reset
- Wait until updating has finished.
- Remove the connection between CON2-Pin 8 and CON2-Pin 6.
- Force another reset by briefly interrupting the power supply.

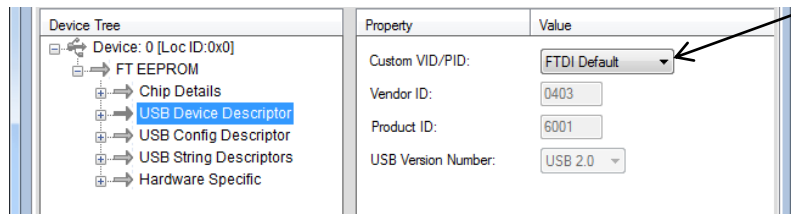
## 4 Power requirements

Power from USB port:

- Cell off 10 mA: 0.220 A
- Cell off 100 mA: 0.257 A
- Cell on 10 mA, with 10 mA output current: 0.277 A
- Cell on 100 mA, with 50 mA output current: 0.440 A

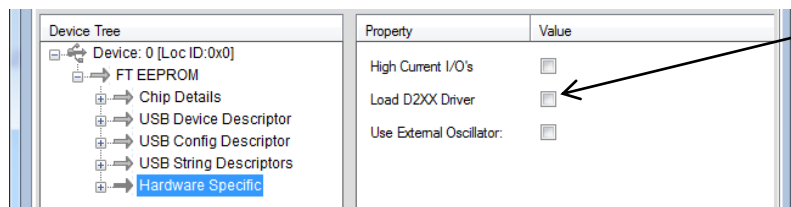
## Appendix A: Change EmStat USB connection to virtual COM port

1. Connect EmStat to the USB port.
2. Open FT\_PROG (see <http://www.ftdichip.com/Support/Utilities.htm>)
3. Click the “Scan and Parse” button 
4. Change the Custom VID/PID to FTDI Default:



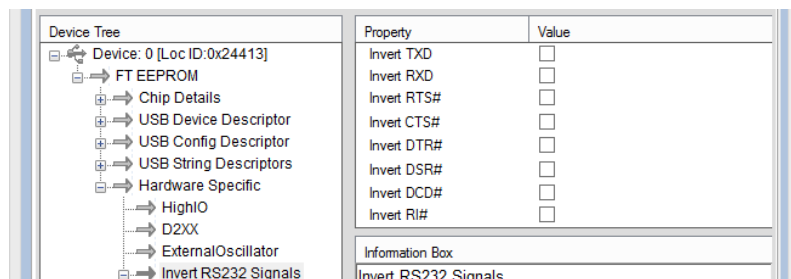
Select FTDI Default



5. Uncheck the checkbox “Load D2XX Driver”:



Uncheck “Load D2XX Driver”

6. Make sure all “Invert RS232 Signals” settings are unchecked:



7. Click the “Program Devices” button 
8. Click the “Scan and Parse” button  again to check if the settings are written correctly, especially the invert DTR# setting. If this setting cannot be changed, please contact us. Your FT\_PROG version might have a bug.
9. Remove the USB cable and insert again.
10. Your PC will now detect a virtual COM port which can be used to communicate with EmStat.
11. The com port number can be found in the Device Manager found in Windows Configuration. You can also press [windows key] + [pause] on your keyboard to find the Device Manager.



Make sure the USB chip is not programmed as VCP (Virtual COM port) when using the Rx/Tx lines on CON2 of the EmStat module.