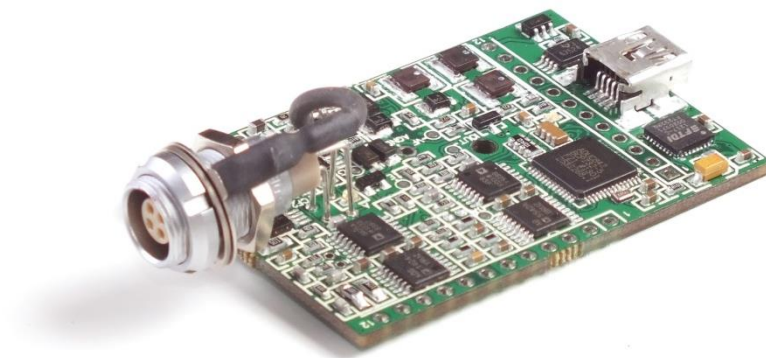


Getting started with the EmStat3 module for OEM

OEM Interface for electrochemical sensors



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Important before you start unpacking

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



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

Customer support

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
- an email to 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 PStTrace.



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 PStTrace / 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

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 PStTrace 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):

- CON1 - pin 5: +5V power supply (100 mA min.)
- CON1 - pin 6: GND (or CON2 – pin 6 or pin 11)
- CON2 - pin 1: Tx
- CON2 - pin 2: Rx

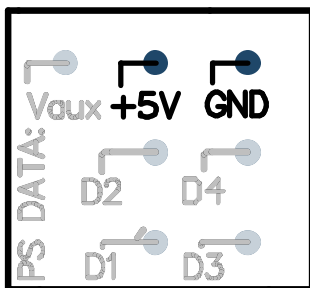


EmStat has a default baud rate of **230400 baud**. This baudrate is generally not supported by the built-in COM port on a regular desktop PC. When using a PC, a USB to serial adapter is recommended.

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.

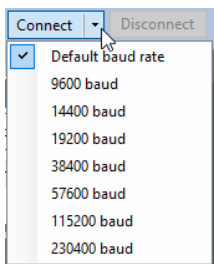
If the EmStat3 PCB is placed on a MUX board, the +5V and GND pins on the MUX board can be used to power both the EmStat3 and MUX board:



Connection pins on MUX board

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).

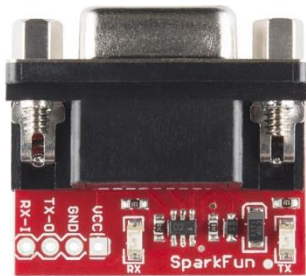
See the EmStat Communications Protocol section 4.6: *Changing the baudrate*.

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 “Updating the EmStat’s firmware via serial connection” on page 6 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:



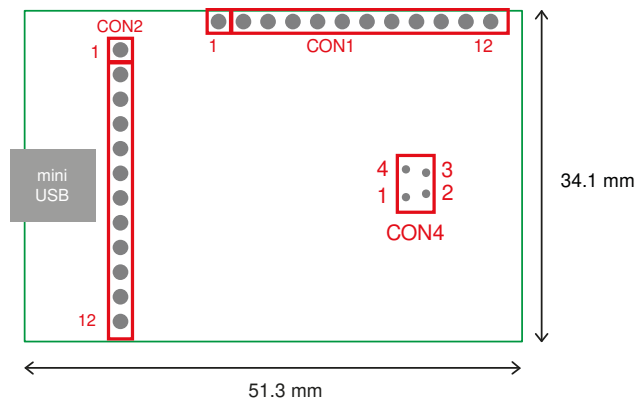
If using a null modem cable between EmStat and PC/controller:

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



EmStat3 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 for serial TTL communications and provides an external analog input and analog output line, with a range of 0 - 4.095 V.

2.1 CON1 description

Pin	Function
1	Digital outputline d3 reserved for Mux16 or can function as digital input line 0
2	Digital outputline d2 reserved for Mux16/8
3	Digital outputline d1 reserved for Mux16/8 and switch box: 1 = off 1 = on
4	Digital outputline d0 reserved for Mux16/8 and 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	5 V analog (max.20 mA when powered from USB)
8	-5 V analog (max. 10 mA)
9	AGND (connect to metal housing / cable shielding)
10	WE
11	RE
12	CE

The digital I/O lines are at 5V.

2.2 CON2 description

Pin	Function
1.	Tx (serial port) at 5V
2.	Rx (serial port) at 5V
3.	Reserved (DO NOT CONNECT)
4.	Voltage reference (4.096 V)
5.	Reserved
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)
11.	DGND
12.	5 V output if powered via USB

2.3 Pinout of sensor plug

See CON4 on page 2.

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. Not connected
4. WE: red connector is working electrode

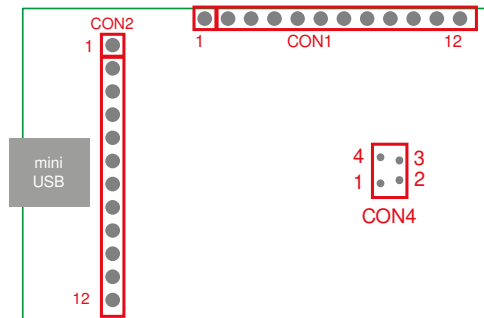


The shield of the cable must make contact with the metal case of the sensor connector or AGND.

Updating the EmStat's firmware via serial connection

When updating the EmStat via USB, the USB chip takes care of toggling the download and reset pins when necessary. This needs to be done manually when updating the EmStat via serial connection.

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.



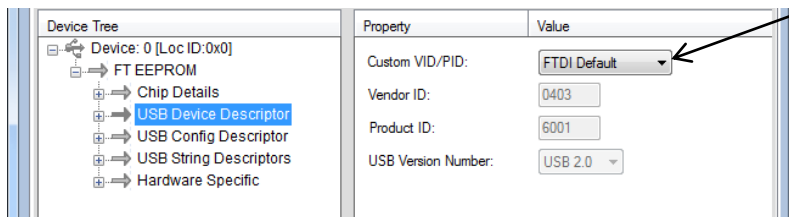
When the EmStat is connected by means of a **serial connection**, it is required to toggle pins on **CON2** manually.

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.

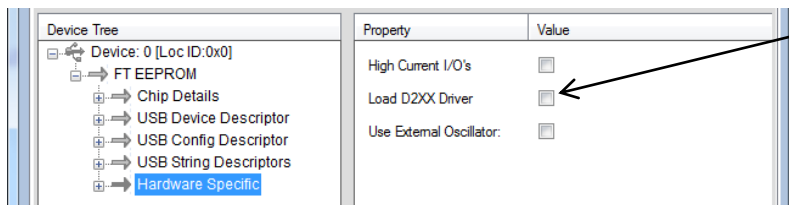
Appendix A: Change EmStat USB connection to virtual COM port

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:



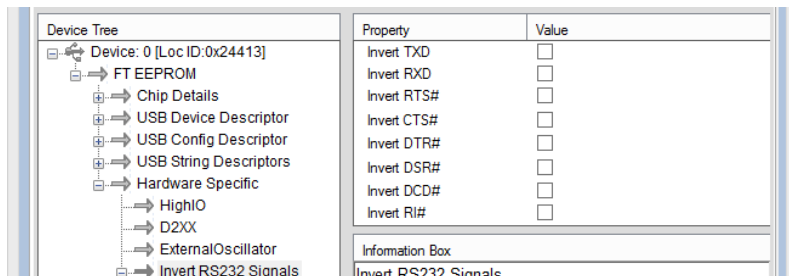
Select FTDI Default



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.