Last document update: October 5, 2022

Application Note

1 Description

This Application note shows the differences between our older and latest EmStat modules which are relevant when switching your software and electronics design to work with the EmStat4 LR or HR.

2 Specifications summary

	EmStat2	EmStat3	EmStat3+	EmStat4 LR	EmStat4 HR
Output potentials	-2 V to +2 V	-3 V to +3 V	-4 V to +4 V	-3 V to +3 V	-6 V to +6 V
Compliance potentials	-4.5V to +4.5V	-5 V to +5 V	-8 V to +8 V	-5 V to +5 V	-8 V to +8 V
Max current	20 mA	20 mA	100 mA	30 mA	200 mA
Potentiostat loop bandwidth	1.7 kHz	1.7 kHz	1.7 kHz	320 Hz, 3.2 kHz, 30 kHz or 570 kHz	320 Hz, 3.2 kHz, 30 kHz or 570 kHz
Applied dc-potential resolution	60 µV	100 µV	125 µV	100 µV	183 µV
Applied potential accuracy	≤ 0.2 % ±2 mV offset	≤ 0.2% ±2 mV offset	≤ 0.2% ±3 mV offset	≤ 0.2% ±1 mV offset	≤ 0.2% ±1 mV offset
Measured dc-potential resolution	1 mV	1 mV	1 mV	96 µV 48 µV 19.2 µV 9.6 µV 4.8 µV	193 µV 96.5 µV 38.5 µV 19.3 µV 9.65 µV
measured dc-potential accuracy	Not specified	Not specified	Not specified	≤ 0.2% ±1 mV offset	≤ 0.2% ±1 mV offset
Measured current accuracy	≤ 0.2% to 1% at Full Scale Range	≤ 0.2% to 1% at Full Scale Range	≤ 0.2% to 1% at Full Scale Range	≤ 0.2% at Full Scale Range	≤ 0.2% at Full Scale Range
Current ranges	1 nA to 10 mA (8 ranges)	1 nA to 10 mA (8 ranges)	1 nA to 10 mA (9 ranges)	1 nA to 10 mA (8 ranges)	100 nA to 100 mA (7 ranges)
CR Bandwidth					
1 nA	159 Hz	159 Hz	159 Hz	23.4 Hz	N/A
10 nA	159 Hz	159 Hz	159 Hz	23.4 Hz	N/A
100 nA	482 Hz	1600 Hz	1600 Hz	2.34 kHz	2.34 kHz
1 uA	482 Hz	1600 Hz	1600 Hz	2.34 kHz	2.34 kHz

10 uA	723 Hz	1600 Hz	1600 Hz	234 kHz	234 kHz
100 uA	723 Hz	1600 Hz	1600 Hz	234 kHz	234 kHz
1 mA	723 Hz	1600 Hz	1600 Hz	772 kHz	772 kHz
10 mA	723 Hz	1600 Hz	1600 Hz	772 kHz	772 kHz
100 mA	N/A	N/A	1600 Hz	N/A	664 kHz

3 EmStat4-only features

- Galvanostat
- EIS technique
- MethodSCRIPT support
- Potential ranging
- Onboard measurement storage

4 Connector differences

This section briefly lays out the connector differences between the EmStat series devices. For more information please check the specific device documentation. Pins that are the same across all versions show a '-'.

4.1 CON1

	EmStat2	EmStat3	EmStat3+	EmStat4 LR	EmStat4 HR
Pin 1, Digital IO3	5V	5V	5V	3.3V	3.3V
Pin 2, Digital IO2	5V	5V	5V	3.3V	3.3V
Pin 3, Digital IO1	5V	5V	5V	3.3V	3.3V
Pin 4, Digital IO0	5V	5V	5V	3.3V	3.3V
Pin 5, 5V	-	-	-	-	-
Pin 6, GND	-	-	-	-	-
Pin 7	+VPstat (5V)	+VPstat (5V)	+VPstat (10V)	Digital out4	Digital out4
Pin 8	-VPstat (-5V)	-VPstat (-5V)	Sense (SE)	Reserved	Sense (SE)
Pin 9, GND	-	-	-	-	-
Pin 10, WE	-	-	-	-	-
Pin 11, RE	-	-	-	-	-
Pin 12, CE	-	-	-	-	-

Sense signal is only required for EmStat3+ and EmStat4 HR.

4.2 CON2

	EmStat2	EmStat3	EmStat3+	EmStat4 LR	EmStat4 HR
Pin 1, UART TX	5V	5V	5V	3.3V	3.3V
Pin 2, UART RX	5V	5V	5V	3.3V	3.3V
Pin 3	Reserved	VFOUT	VFOUT	E_UNIPOLAR	E_UNIPOLAR
Pin 4	Reserved	VREF	VREF	I_BIPOLAR	I_BIPOLAR
Pin 5, Digital IO	Reserved	INT, 5V	INT, 5V	Digital IO5, WAKE, 3.3V	Digital IO5, WAKE, 3.3V
Pin 6, GND	-	-	-	-	-
Pin 7, RESET	RESET, 5V active high	RESET, 5V active high	RESET, 5V active high	nRESET, 3.3V active low	nRESET, 3.3V active low
Pin 8, nDWNLD	nDWNLD, 5V active low	nDWNLD, 5V active low	nDWNLD, 5V active low	nDWNLD, 3.3V active low	nDWNLD, 3.3V active low
Pin 9 Analog In	0 V – 4.095 V	0 V – 4.095 V	0 V – 4.095 V	0V – 3V	0V – 3V
Pin 10 Analog Out	0 V – 4.095 V	0 V – 4.095 V	0 V – 4.095 V	0V – 3V	0V – 3V
Pin 11, GND	-	-	-	-	-
Pin 12, 5V	-	-	-	-	-

- The EmStat2 has an optional hardware feature that allows RS232 level communication. This is not discussed here.
- VFOUT, VREF, E_UNIPOLAR, and I_BIPOLAR are analog voltage outputs and should be left unconnected in most cases.
- The INT and WAKE pins are both digital input pins. They can also be used as output.

4.3 CON3 (ES4 only)

	EmStat4 LR	EmStat4 HR
Pin 1, UART CTS	-	-
Pin 2, UART RTS	-	-
Pin 3, I2C SDA	-	-
Pin 4, I2C SCL	-	-
Pin 5, Reserved	-	-
Pin 6, Reserved	-	-
Pin 7, EXT_SETP	+/- 5V	+/- 8V
Pin 8, nSHDN	-	-
Pin 9, Digital IO6	-	-
Pin 10, 3.3V_D	-	-
Pin 11, -VRAIL	-7.5V	-10V
Pin 12, +VRAIL	7.5V	10V

- All digital voltages are 3.3V.
- This connector is optional, but it is recommended to use the UART CTS and RTS pins when using UART.

4.4 Other connectors

	EmStat2	EmStat3	EmStat4
Cell	5 Pin Triad	4 Pin Lemo	5 Pin Lemo
USB	USB Mini	USB Mini + Alternate connector	USB C + DNP alternate connector

4.5

4.6 Software

EmStat2 and EmStat3 support the same firmware, and are compatible. The EmStat2 and EmStat3 will require different conversions from ADC and DAC values to currents or voltages. Both the “Embedded SDK” and .NET SDKs handle this automatically.
The EmStat4 protocol is not compatible with the EmStat2 and EmStat3. It uses the MethodSCRIPT protocol. This means the EmStat4 is not compatible with the “Embedded SDK”. When using an up-to-date version of the .NET SDK, this is handled automatically.
The EmStat4 uses standard USBCDC drivers for USB, not the FTDI drivers used by earlier EmStat modules.

More information about the EmStat4 protocol can be found here:
https://www.palmsens.com/product/emstat4m/#downloads

The EmStat4 has parsing libraries and examples available at:
https://github.com/PalmSens/MethodSCRIPT_Examples

More information about MethodSCRIPT can be found here:
https://www.palmsens.com/methopdscript

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