Quick guide

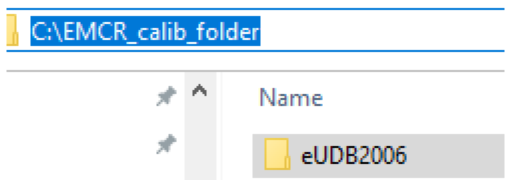
eNPR-10MHz Manual Calibration

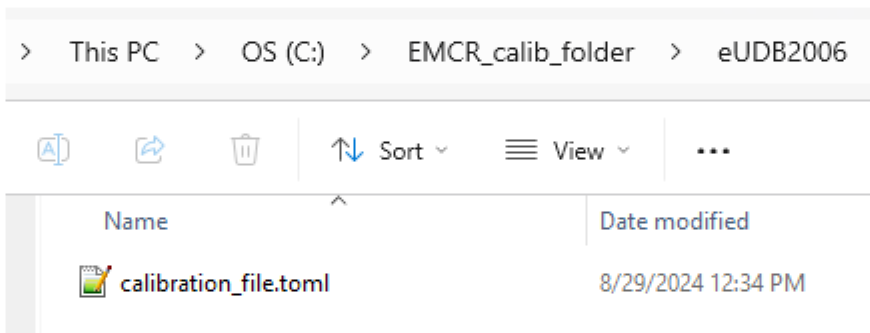
Revision History

Date	Version	Description
17/02/2025	2.0	Handled new toml calibration files
23/07/2024	1.0	First version of document

Calibration file

The calibration file must be placed in a folder with the same name as the device's serial number. This folder must be placed in the path C:\EMCR_calib_folder. Example for device eUDB2006:





The calibration file has the following structure:

Unset

```
[[sampling_rates]]
name = "slow"
id = 0
values = [ 40.0, 20.0, 10.0, 5.0, 2.5, 1.25,]

[[boards]]
board_number = 0
current_dac = []
voltage_adc = []
shunt_resistance = []
rs_correction = []
[[boards.current_adc]]
range_name = "100nA"
range_id = 0
[[boards.current_adc.sampling_rates]]
```

```
sr_id = 0

[boards.current_adc.sampling_rates.calibrations]
gains = [ 1,]
offsets = [ 0,]

[[boards.voltage_dac]]
range_name = "1600mV"
range_id = 0
[[boards.voltage_dac.sampling_rates]]
sr_id = 0

[boards.voltage_dac.sampling_rates.calibrations]
gains = [ 1,]
offsets = [ 0,]
```

The first line which starts with “gains” contains within brackets the current gain.

The first line which starts with “offsets” contains within brackets the current offset in A.

The second line which starts with “gains” contains within brackets the voltage gain.

The second line which starts with “offsets” contains within brackets the voltage offset in V.

You can start by copying the example above into a file called calibration_file.toml placed in C:\EMCR_calib_folder\<SERIAL_NUMBER>

Procedure

The acquired current (I_a) is corrected via a calibration procedure to return the calibrated current (I_c) via the following formula: $I_c = I_a$ * I_G + I_O. The same happens for the voltage[1]

Current gain

- Open the software
- Click the connect

[1] The stimulus gain calibration is not performed for the eNPR-10MHz, since a calibrated off-the-shelf DAC is used

- Insert the provided model cell (10M // 2.5p)
- Close the lid
- Set the smallest sampling rate (1.25MHz)
- Apply the constant voltage protocol with 100mV
- Take note of the corresponding mean current I1 in the Measurement overview widget (9.518408nA in the example below)

Measurements Overview

Channel index	Mean Voltage	Unit	Voltage RMS	Unit	Mean Current	Unit	Current RMS	Unit	Conductivity	Unit
1	100.000000	mV	0.000000	mV	9.518408	nA	0.018666	nA	0.095184	uS

extract

- Apply the constant voltage protocol with -100mV
- Take note of the corresponding mean current I2 in the Measurement overview widget (-9.340171nA in the example below)

Measurements Overview

Channel index	Mean Voltage	Unit	Voltage RMS	Unit	Mean Current	Unit	Current RMS	Unit	Conductivity	Unit
1	-100.000000	mV	0.000000	mV	-9.340171	nA	0.019115	nA	0.093402	uS

extract

- The current gain I_G is obtained with the following formula: G = DV/DI/R, where DV = 100mV-(-100mV) = 200mV, DI = I1-!2, 9.518408nA-(-9.340171nA) = 18.858579nA, and R = 10MOhm (calibration resistance). So in this example I_G = 1.06052529196
- Click disconnect
- Update and save the calibration data file by changing the current gain, e.g.:

Unset

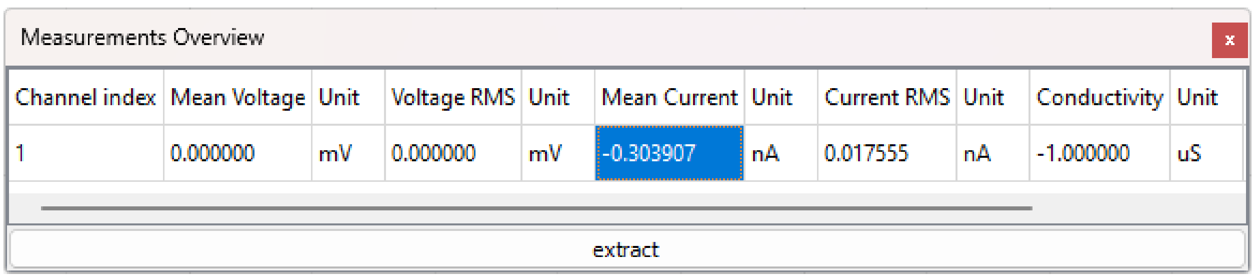
```
[[boards.current_adc]]
range_name = "100nA"
range_id = 0
[[boards.current_adc.sampling_rates]]
sr_id = 0

[boards.current_adc.sampling_rates.calibrations]
```

```
gains = [ 1.06052529196,]
offsets = [ 0,]
```

Current offset

- Click connect
- Remove the model cell
- Close the lid
- Set the smallest sampling rate (1.25MHz)
- Apply the constant protocol with 0mV
- Take note of the corresponding mean current I0 in the Measurement overview widget (-0.303907nA in the example below)


Measurements Overview

Channel index	Mean Voltage	Unit	Voltage RMS	Unit	Mean Current	Unit	Current RMS	Unit	Conductivity	Unit
1	0.000000	mV	0.000000	mV	-0.303907	nA	0.017555	nA	-1.000000	uS

extract

- The current offset I_O equals -I0, so in this example I_O = 0.303907e-9
- Update and save the calibration data file by changing the current offset, e.g.:

Unset

```
[[boards.current_adc]]
range_name = "100nA"
range_id = 0
[[boards.current_adc.sampling_rates]]
sr_id = 0

[boards.current_adc.sampling_rates.calibrations]
gains = [ 1.06052529196,]
offsets = [ 0.303907e-9,]
```

Voltage offset

- Click connect
- Insert the provided model cell (10M // 2.5p)
- Close the lid
- Set the smallest sampling rate (1.25MHz)
- Apply the constant protocol with 0mV
- Take note of the corresponding mean current I0 in the Measurement overview widget (-0.303907nA in the example below)

Measurements Overview

Channel index	Mean Voltage	Unit	Voltage RMS	Unit	Mean Current	Unit	Current RMS	Unit	Conductivity	Unit
1	0.000000	mV	0.000000	mV	0.440217	nA	0.019935	nA	-1.000000	uS

extract

- The voltage offset V_O equals -I0*R, so in this example V_O = -4.440217e-3
- Update and save the calibration data file by changing the voltage offset, e.g.:

Unset

```
[[boards.voltage_dac]]
range_name = "1600mV"
range_id = 0
[[boards.voltage_dac.sampling_rates]]
sr_id = 0

[boards.voltage_dac.sampling_rates.calibrations]
gains = [ 1,]
offsets = [ -4.440217e-3,]
```

The final calibration file will look like this:

```
Unset
[[sampling_rates]]
name = "slow"
id = 0
values = [ 40.0, 20.0, 10.0, 5.0, 2.5, 1.25,]

[[boards]]
board_number = 0
current_dac = []
voltage_adc = []
shunt_resistance = []
rs_correction = []
[[boards.current_adc]]
range_name = "100nA"
range_id = 0
[[boards.current_adc.sampling_rates]]
sr_id = 0

[boards.current_adc.sampling_rates.calibrations]
gains = [ 1.06052529196,]
offsets = [ 0.303907e-9,]

[[boards.voltage_dac]]
range_name = "1600mV"
range_id = 0
[[boards.voltage_dac.sampling_rates]]
sr_id = 0

[boards.voltage_dac.sampling_rates.calibrations]
gains = [ 1,]
offsets = [ -4.440217e-3,]
```