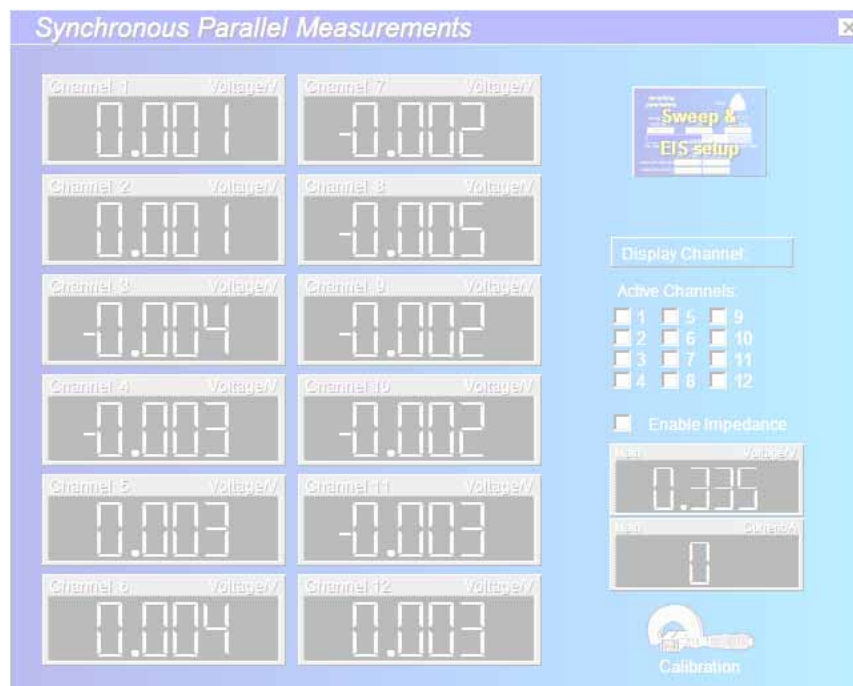


# PAD4

## Parallel AD Converter Plug'n Play Card for Synchronous Parallel Measurements





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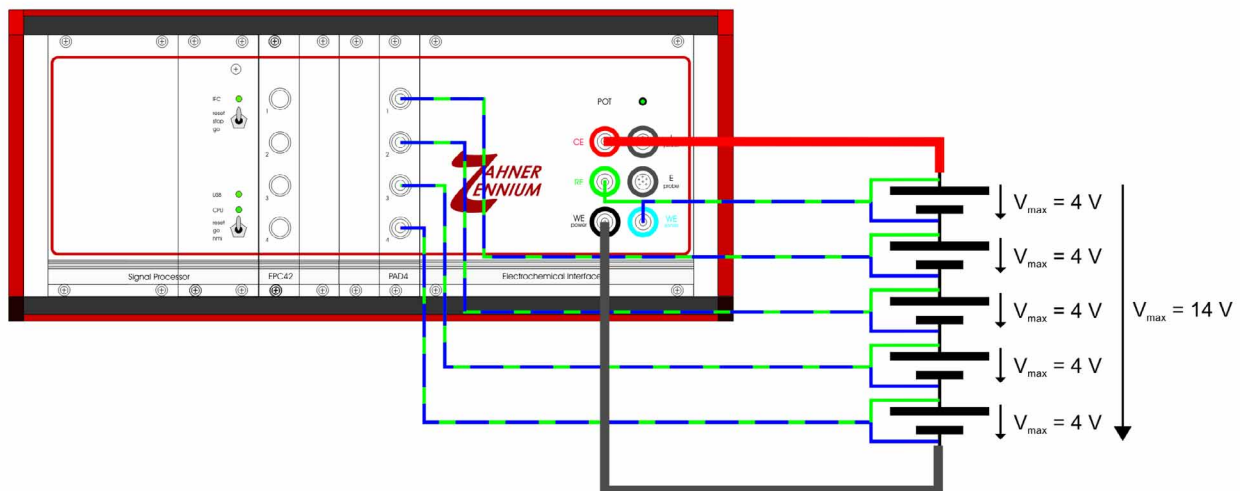
# 1. Introduction

The PAD4 was designed for the investigation of stacked objects like batteries and fuel cells, where the impedance, defined by one common current through the object, but several voltages accessible on several taps must be acquired in parallel. Compared to the usual solution with multiplexers like the PMUX series, the PAD4 has the advantage of real parallel acquisition, saving measurement time and avoiding time lags between the acquisition of different channels.

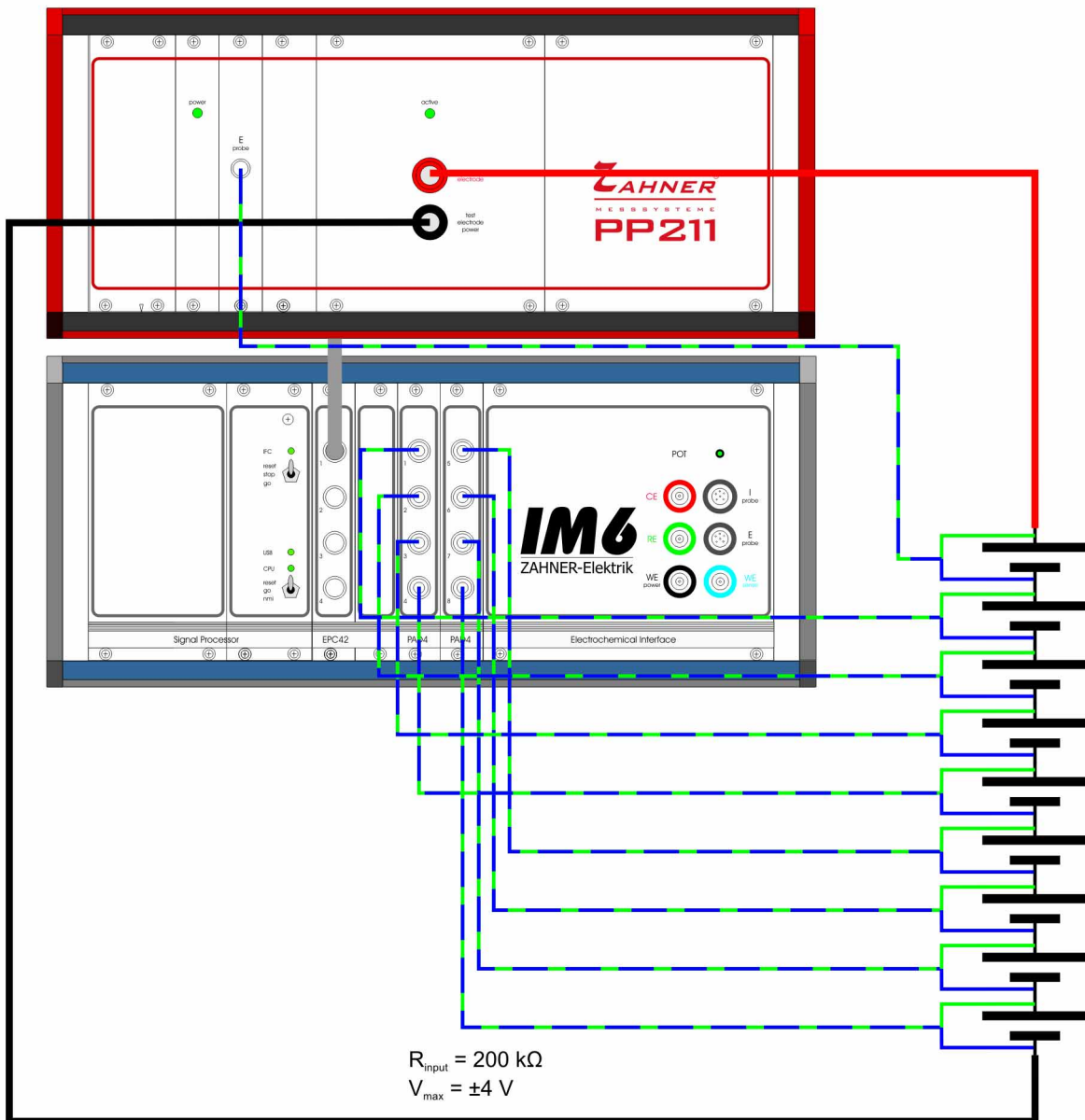
PAD4 is a plug-and-play card for an extension slot of the *IM6/Zennium*. It allows to connect four different potential sense inputs for parallel impedance measurements.

With four PAD4 add-on cards up to 16 channels synchronous measurements can be done in parallel to the main channel.

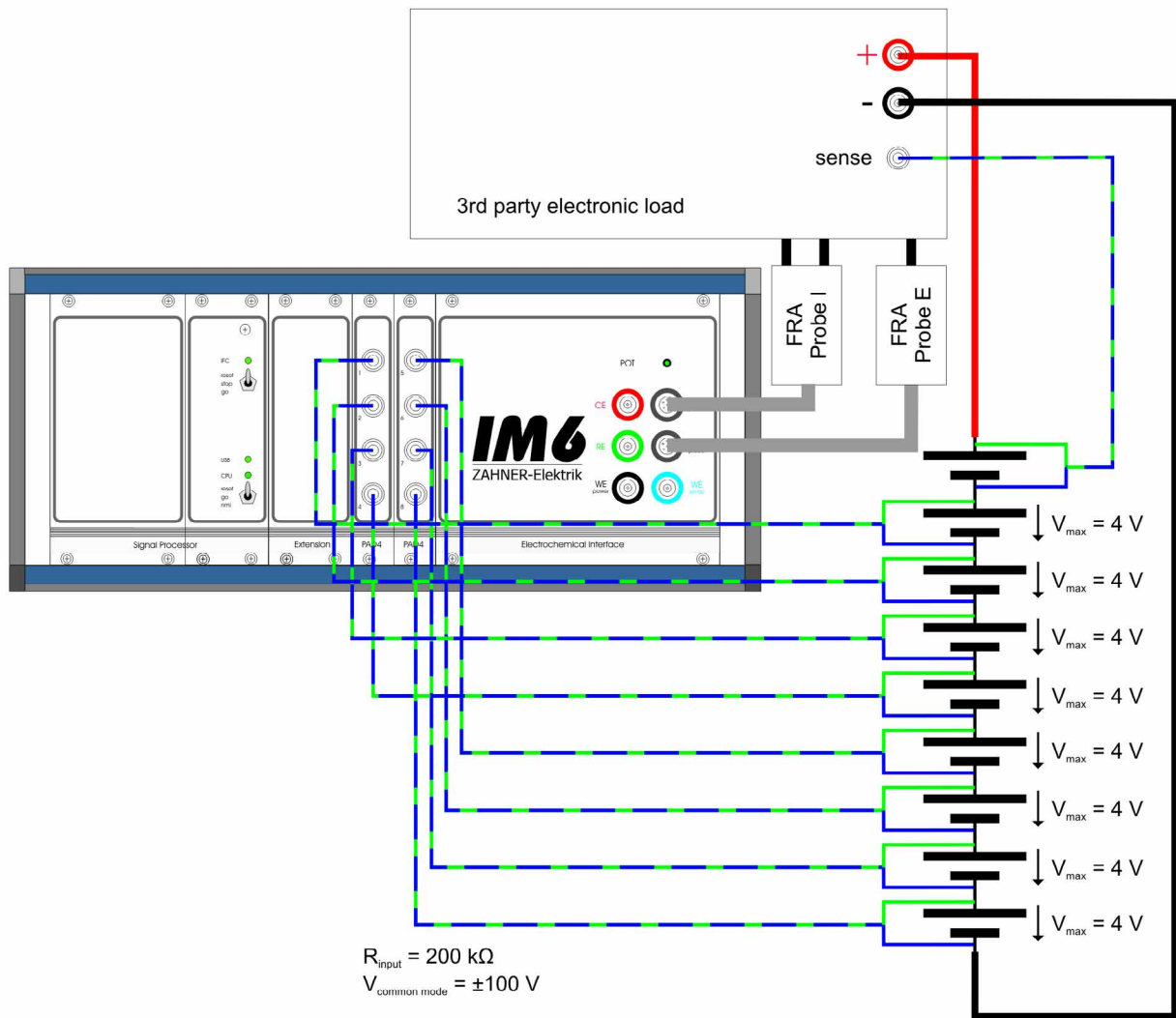
The *Zennium* can control one PAD4 add-on card with 4 additional parallel sense channels. The *IM6* can control up to four PAD4 add-on cards with up to 16 additional parallel sense channels.



Connection scheme for 4 channel PAD4 with a 5 cell battery stack. The maximum input voltage of each PAD4 channel is limited to  $\pm 4$  V with a compliance voltage range of  $\pm 100$  V. The output voltage and current is limited by the electrochemical workstation. For example the *Zennium* has a compliance voltage of  $\pm 14$  V.

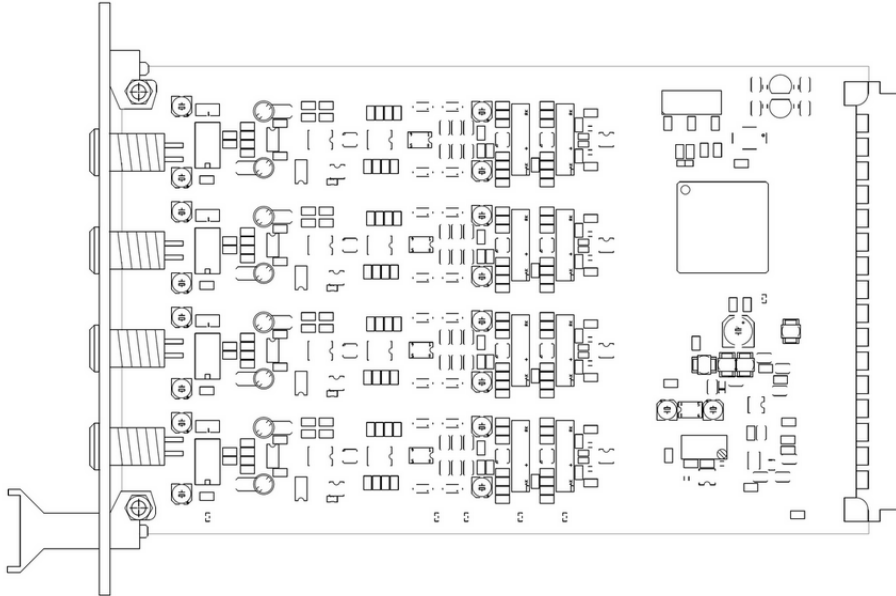


Connection scheme for 8 channel PAD4 with an external power potentiostat **PP211** (20 V / 10 A) connected via EPC42 to an IM6.



The PAD4 AD converter card is also compatible with a 3<sup>rd</sup> party electronic load interfaced from the *IM6/Zennium* by means of the **FRA-Probe**.

## 2. Installation



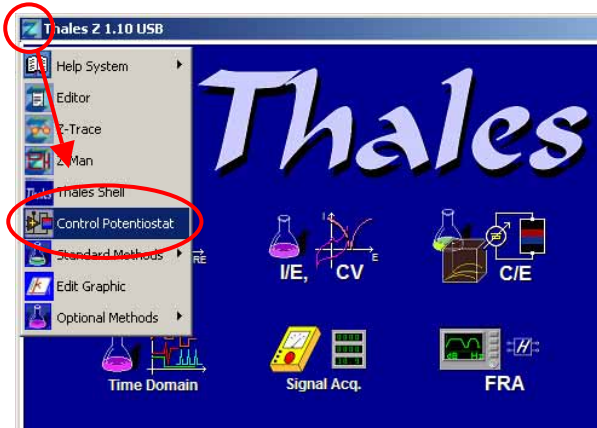
Contents of package	
1	PAD4 four channel parallel AD-converter (plug-in card for <i>IM6/Zennium</i> )
4	sense cables (Lemosa/open end - blue/green)

For the installation of the PAD4:

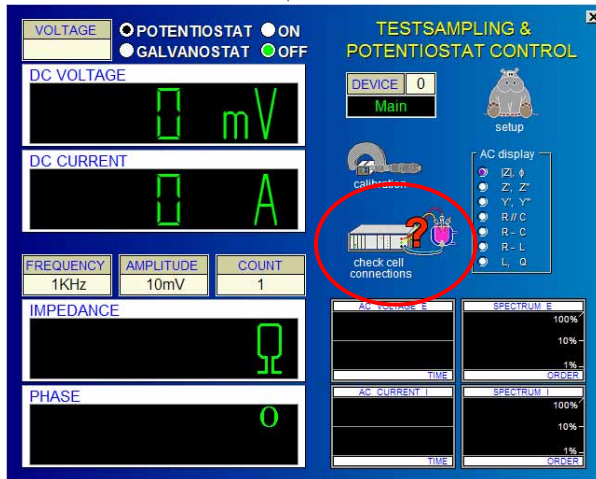
- Switch off the *IM6/Zennium* and disconnect it from mains
- Remove one of the empty slot front panels named *Extension* by twisting the four screws at the top and the bottom
- Plug in the PAD4 cards and fasten the two screws at the top and the bottom of its front panel (from left to right: channel 1-4, 5-8, 9-12, 13-16)
- Connect the *IM6/Zennium* to mains and switch it on

The hardware installation is finished now. The Thales software (Z 1.20 and higher) will detect the PAD4 cards automatically when started.

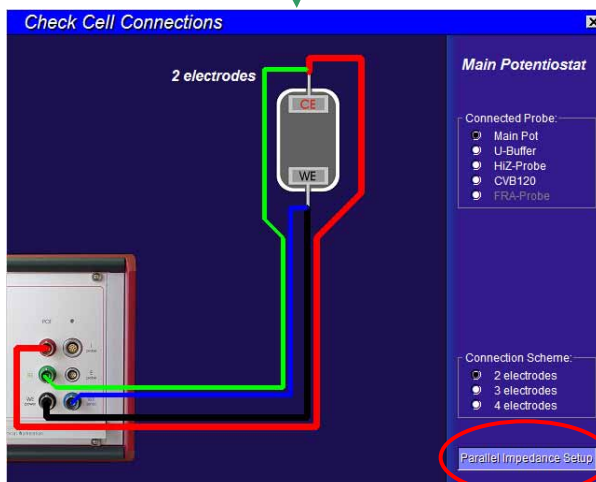
### 3. Configuration



Click on the Z icon at the upper left edge of the Thales software window and switch to **Control Potentiostat** page.



Click on **Check Cell Connections**.



The **Thales** software detects the PAD4 cards automatically and shows the button **Parallel Impedance Setup**. Click on that button to switch to **Synchronous Parallel Measurements** page.



**Synchronous Parallel Measurements**

- DC voltage displays
- Switch to **Control Potentiostat** page.
- Select channel for AC display.
- Activate/deactivate PAD4 channels.
- Enable activated channels for **EIS**.
- PAD4 DC calibration. AC calibration only for service (needs calibration elements).

### 3.1 Select PAD4 channel for AC voltage display

Select channel for **EIS** AC voltage display

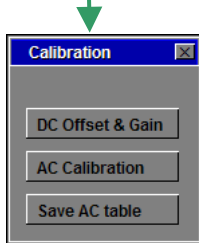
green: main potentiostat  
red: selected PAD4 channel

### 3.2 Select PAD4 channels for EIS measurements

Activate PAD4 channels for **EIS** measurements and enable impedance measurement.

**!** **Note:** PAD4 channels are only measured when impedance is enabled.

### 3.3 PAD4 DC calibration



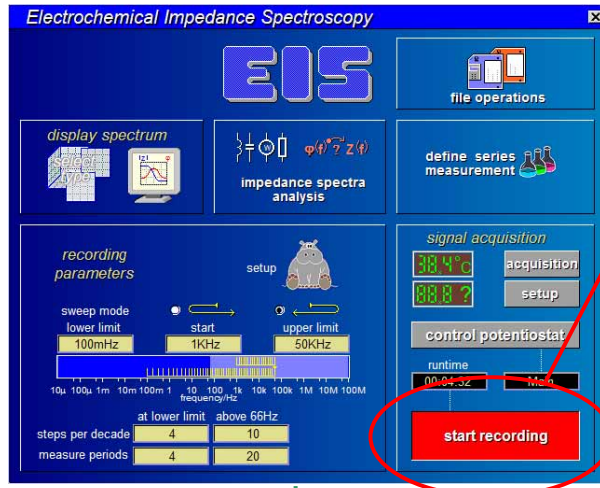
Perform a DC calibration. The offset voltages and the gains can slightly drift when the system warms up.



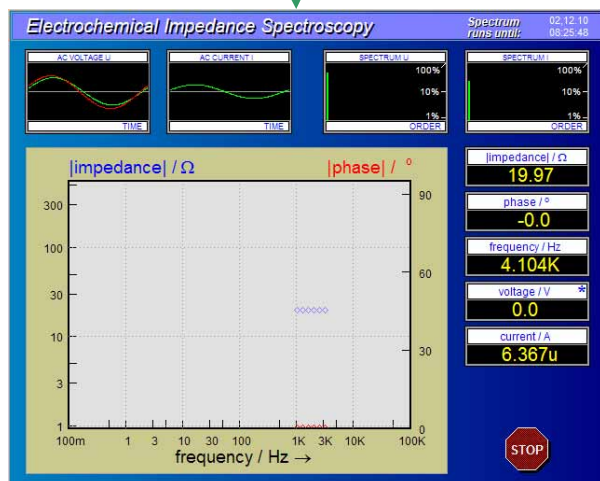
**Note:** AC calibration is only allowed for service personal.

To activate Calibration button press button **2** (number two) of your keyboard to highlight the calibration icon and press **ENTER** to show the Calibration menu. Select DC Offset & Gain to perform a DC calibration.

## 4. Parallel Impedance Measurements

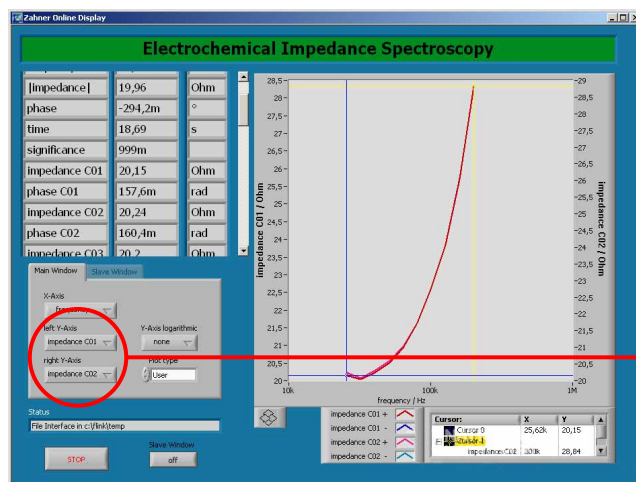


If PAD4 channels are activated and impedance is enabled **EIS** and **FRA** measurements are automatically done for all activated channels. For detailed information refer to [EIS manual](#).



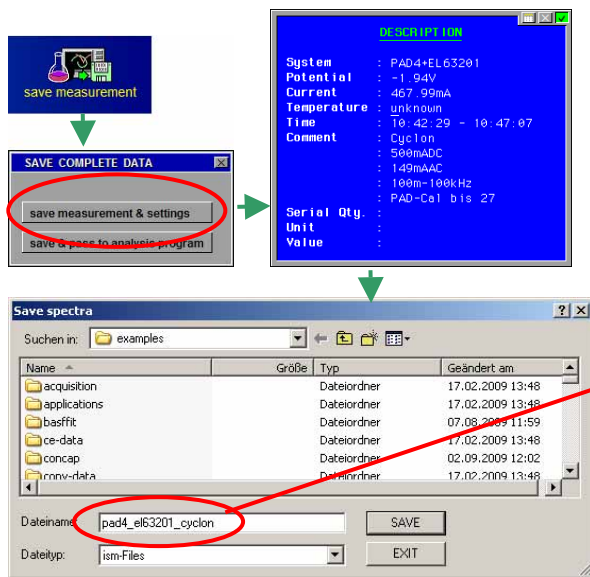
Realtime AC voltage display  
**green**: main potentiostat  
**red**: selected PAD4 channel

Data display, realtime frequency domain displays and numerical displays only show measure data of the main potentiostat channel.



A realtime impedance plot of the PAD4 channels during measurement can easily be done with the **Online Display**. For detailed information refer to [Online Display manual](#).

Select PAD4 channels (impedance [C01..C16], phase[C01..C16])



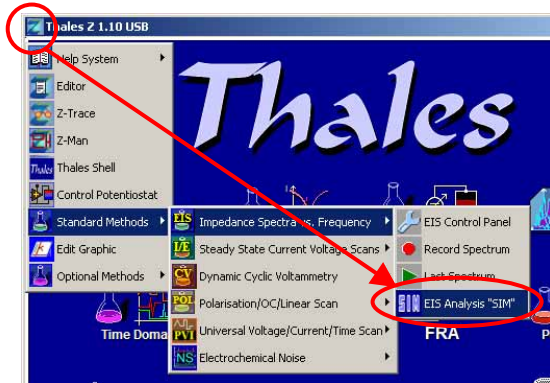
Save measured *EIS* data. Please refer to [EIS manual](#).

Each single spectrum is saved individually so that you may analyse it individually or in the context of the complete parallel measurement.

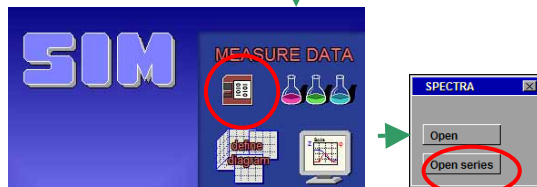
The file name of each spectrum is complemented by a two-digit number which specifies the number of the PAD4 channel (00: main channel).

If any of the file names to be created already exist, you will be asked for overwriting the files or cancel saving.

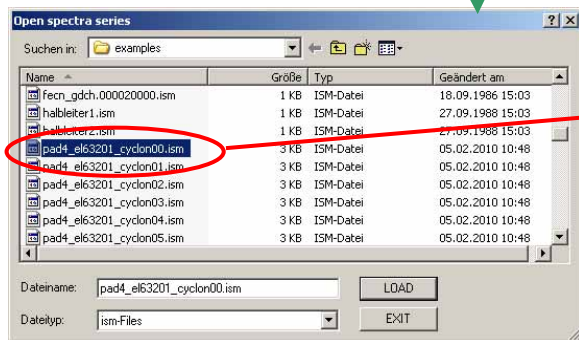
## 5. Parallel Impedance Analysis



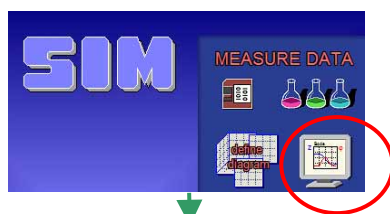
Click on the Z icon at the upper left edge of the Thales software window and navigate to **EIS Analysis "SIM"**.



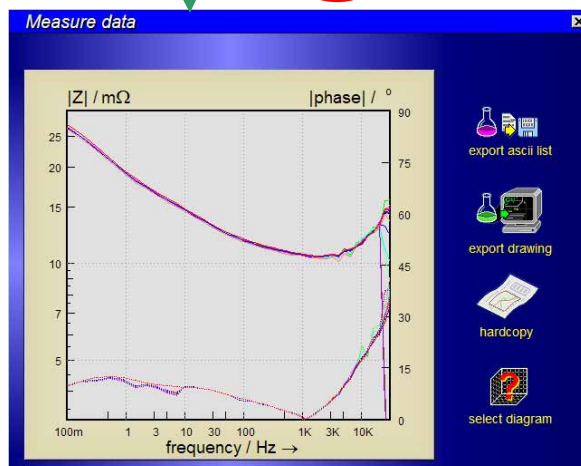
Select open series measurements.



Select first impedance spectra measurement **[filename]00.ism** to open the hole parallel measurement data.



Click on the **Display Diagram** button to display the diagram of the loaded and selected parallel **EIS** data.



For further information on analysis parallel impedance data please refer to [SIM manual](#).