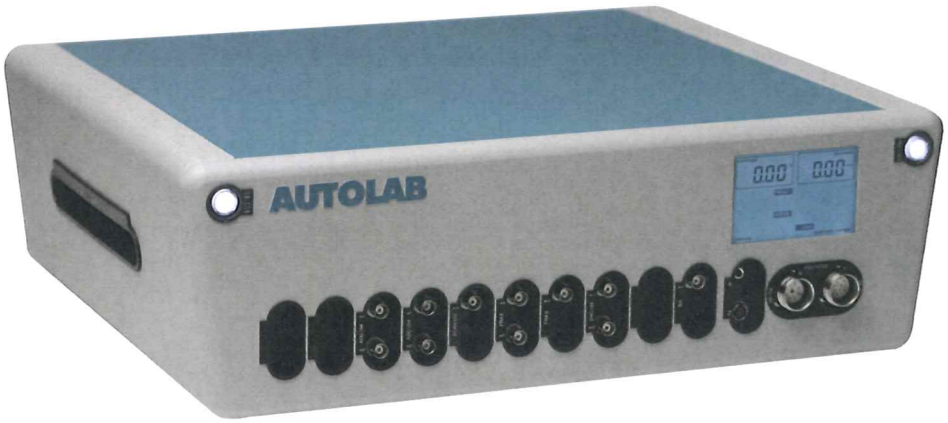
INSERT NEW MODULE FOR THE AUTOLAB 8-SERIES



Editorial
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Table of contents:

Compatibilty table loose modules:

Module	Items	Quantity	Required software	PGSTAT100 possible?
BA	Module label SMB-Coax cable SMB-Coax cable copper SMB-Coax –Banana cable Jumper cable (not used for 8-series) Alligator clip Warning on PGSTAT100	1 3 1 1 1 1 1	GPES 4.9.7 or higher Nova 1.2 or higher	YES, with adjusted DIFFAMP
ECD	Module label SMB-Coax cable	1 1	GPES 4.5 or higher Nova 1.3 or higher	YES
FRA2	Module label SMB-Coax CD with calibration file	2 3 1	FRA 2.4 or higher Nova 1.2 or higher	YES
SCAN250	Module label SCAN250-ADC trigger cable old SCAN250-ADC trigger cable new Analog bus connector cable*	1 1 1 1	GPES 4.9.7 or higher Nova 1.2 or higher	YES
ADC10M	Module label ADC10M-SCAN trigger cable old ADC10M-SCAN trigger cable new Ferrite bead*	1 1 1 1	not supported in GPES Nova 1.2 or higher	YES
PX	Module label Lemo adapter Short circuit BNC plug Analog bus connector Special pX test cable Warning on PGSTAT100	1 1 1 1 1 1	GPES 4.8 or higher FRA 4.9. Nova 1.5 or higher	NO
ECN	Module label Analog bus connector Special ECN cable Warning on PGSTAT100	1 1 1 1	GPES 4.8 or higher FRA 4.9.5 or higher Nova 1.5 or higher	NO
MUX	Module label Digital MUX cable	1 1	GPES 4.7 or higher FRA 4.7 or higher Nova 1.5 or higher	NO
FI20	Module label	1	GPES 4.5 or higher	YES
pX1000	Module label Cover for front connector Lemo to banana cable Analog bus connector Warning on PGSTAT100	1 1 2 1 1	Nova 1.4 or higher	NO
EQCM	Module label Oscillator box DB9 Oscillator connection cable Crystal 6 MHz Au/TiO_2 polished EQCM cell Au counter electrode Reference electrode Ag/AgCl, 3M KCl Driving force adjustment tool Spare O-ring Reference electrode Spare O-ring Counter electrode Spare O-ring Viton Crystal Spare O-ring Cell cover 2.5 mm hex driver Spare EQCM cell screw Warning on PGSTAT100	1 1 1 2 1 1 1 1 1 1 4 1 1 3 1	Nova 1.4 or higher	YES

*delivered if necessary or when the Autolab configuration is unknown.

1. Introduction

The Autolab instrument has 3 different casings, that can be recognized as follows:

1. Old types with serial numbers starting with AUTyynnnn where yy stands for the year of production. These were instruments produced before 1999 (s/n ≤ AUT990789).
2. Autolab cabinets with the blue or green corner pieces with serial number starting with AUT7, produced from 1999 (s/n ≥ AUT70790).
3. Autolab cabinets with serial number starting with AUT8, produced since May 2007 (s/n ≥ AUT83100).

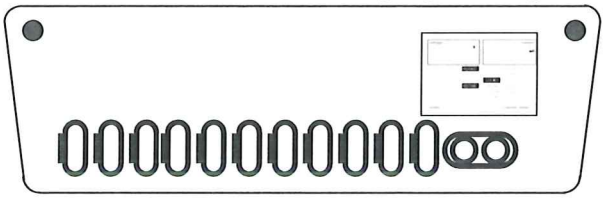
This document pertains to instruments with serial number beginning with AUT8 (point 3 above).

How to use this document:

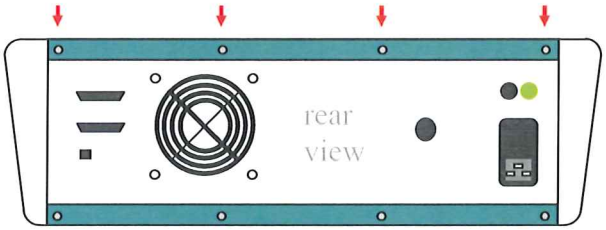
1. Read section 2 about how to open the cabinet,
2. Insert the module as described in section 3,
3. Adjust the Analog bus for ADC10M and BA modules if necessary (sections 5 and 6),
4. Connect the Analog bus wires for the PX, ECN or pX1000 module (section 7 and 8),
5. Close the cabinet,
6. Calibrate the FRA2 module if required (section 9 or section 10),
7. Test the inserted module(s) (section 11).

2. How to open the cabinet

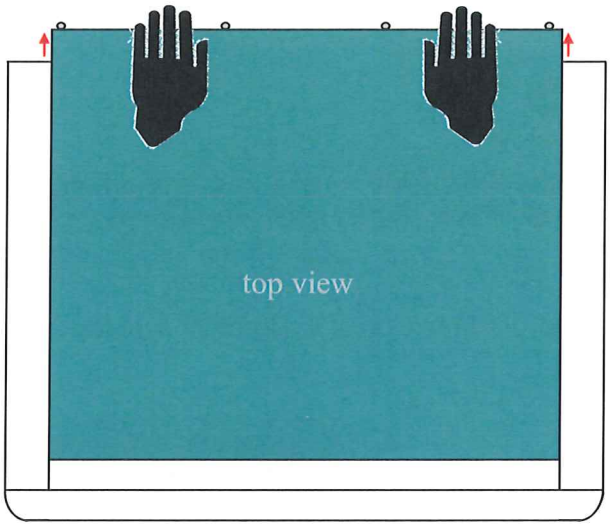
- Switch off the Autolab and unplug mains power.



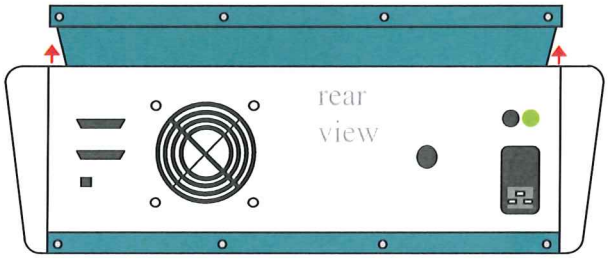
- Unscrew the four indicated screws on the rear of the Autolab. Leave the screws in the top cover:



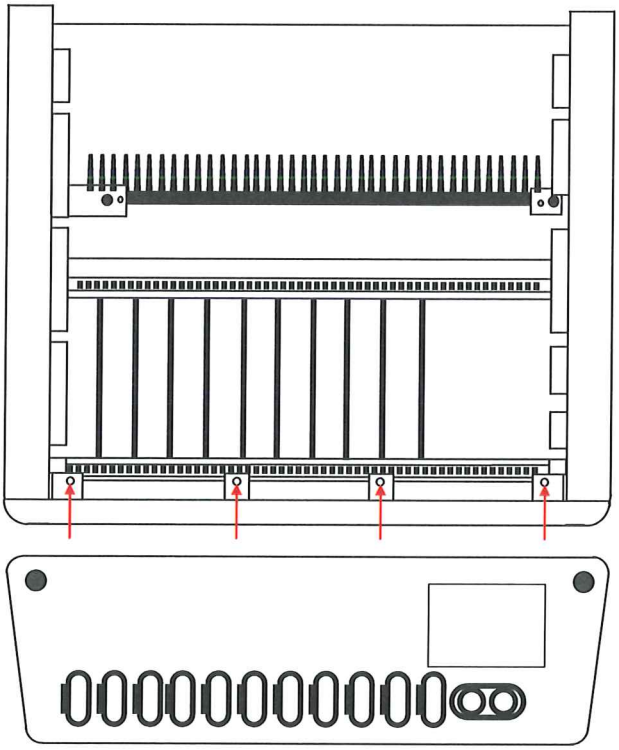
- Remove the top cover by sliding it from the front to the rear. The best way to do this is to stand in front of the instrument, put your both hands at the rear part of the top cover and press with your fingers on the rear panel, while pressing on the top cover. Now the top cover will slide off easily.



- Remove the top cover from the instrument and disconnect the earth cable. Now the analog bus can be reached from the top. If you don't have to install a module, it is unnecessary to remove the front panel of the instrument.

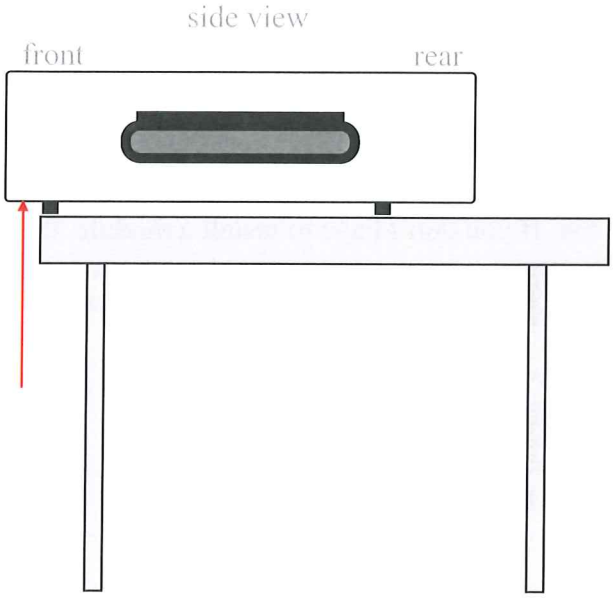


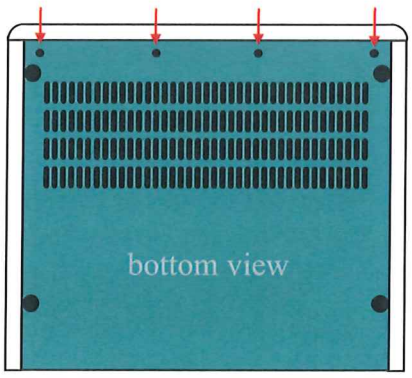
- If installing a new module, the frontpanel must be removed. When the top cover is removed the frame is visible. Remove the four indicated screws from the mounting tags.



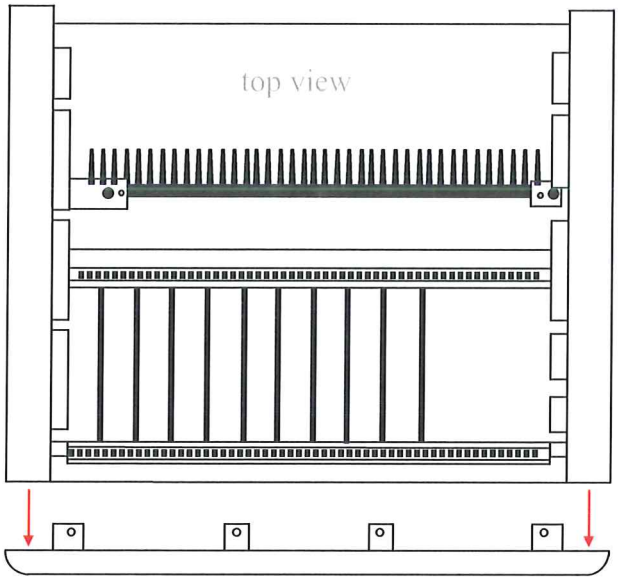
- At the bottom of the front panel the same construction is used. The screws can be reached through holes in the bottom cover. These screws must be removed <u>without turning the Autolab upside down</u>.

- Remove the four screws from the bottom of the front panel. Do NOT turn the Autolab upside down.



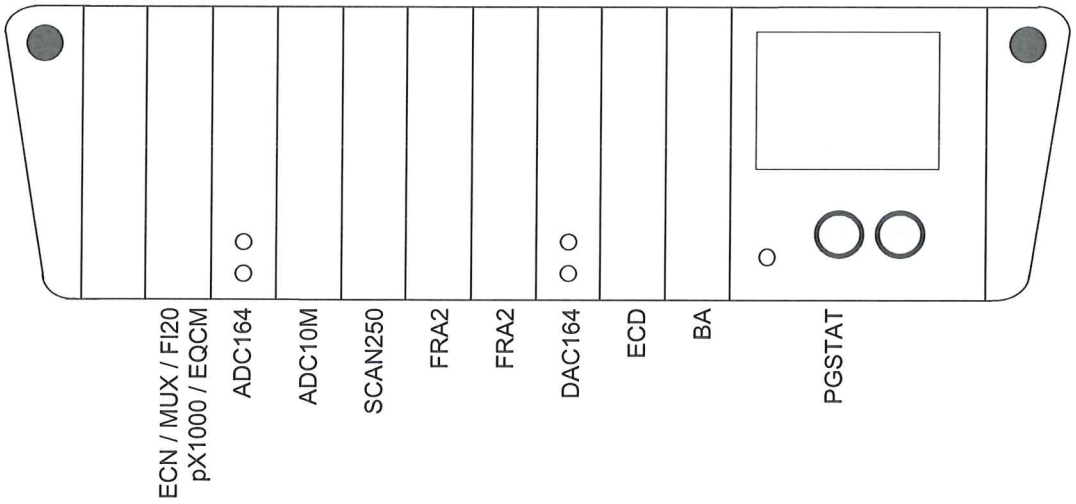


Now the front panel can be shifted smoothly to the front and taken off. Take care not to damage the LCD display.

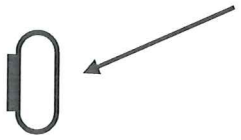


3. How to insert the new module(s)

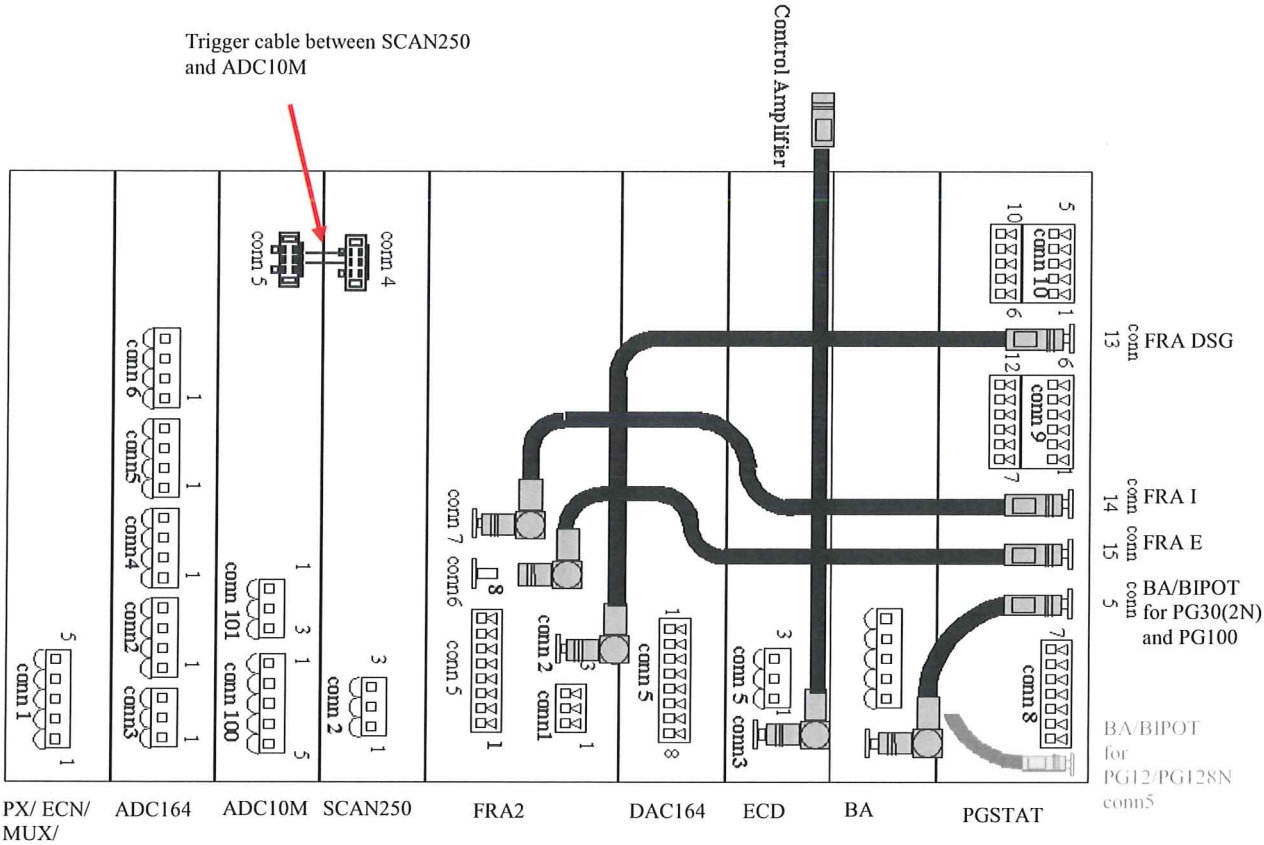
Sequence of modules:

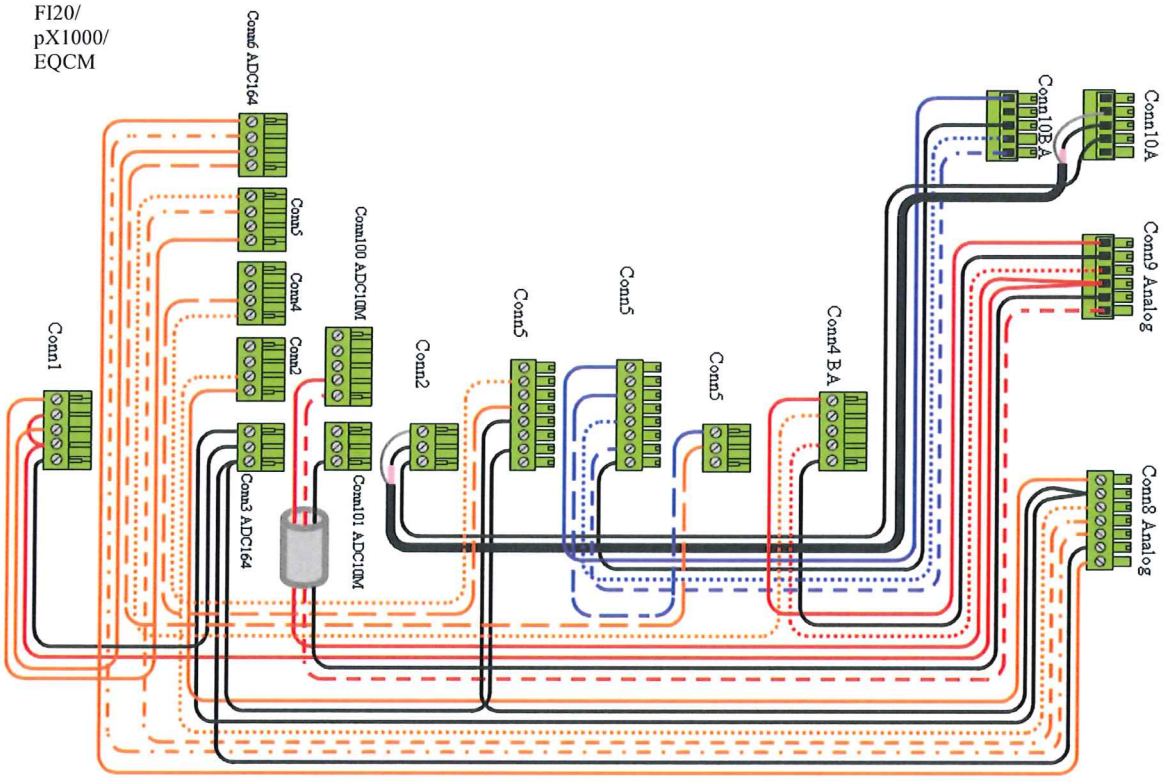


- Note that every module has a fixed position. Find the position of the module to insert. Unscrew the front(s) black plates and place the new module into the appropriate slot.
- Insert the analog bus (Green connector) on top of the module. The **BA**, **ECD** and **FRA2** modules need extra SMB-Coax-cables to be connected on top of the modules (see section 4 and 6).
- The **FRA2** module needs to be calibrated (section 9 with FRA software or section 10 with Nova software).
- The **PX, ECN and pX1000** modules have an extra analog bus connector delivered with the module, which need to be connected to the ADC164. If the reserved slot is already occupied by an **FI20** or **MUX** module, the **PX**, **ECN** or **pX1000** module can be placed in another free slot (section 5).
- The **MUX** and **EQCM** modules does not need any analog bus connections and can be placed in any other free slot in the event that the reserved slot is occupied by an **FI20**, **PX**, **ECN** or **pX1000** module. The combination of the **pX1000** and **ECN** is not possible.
- When the **ADC10M** and **SCAN250** combination is inserted, a trigger cable is needed to connect the **ADC10M** with the **SCAN250** module (see section 4).
- After insertion of the new module, tighten the screws at the front of the new modules.
- Reattach the front plate (take care with the LCD display) with the 4 screws on the top and the 4 screws on the bottom.
- Reattach the earth cable to the top cover.
- Slide the top cover back into place and tighten the 4 screws at the rear.
- Replace the black label at the front of the Autolab with the appropriate label:



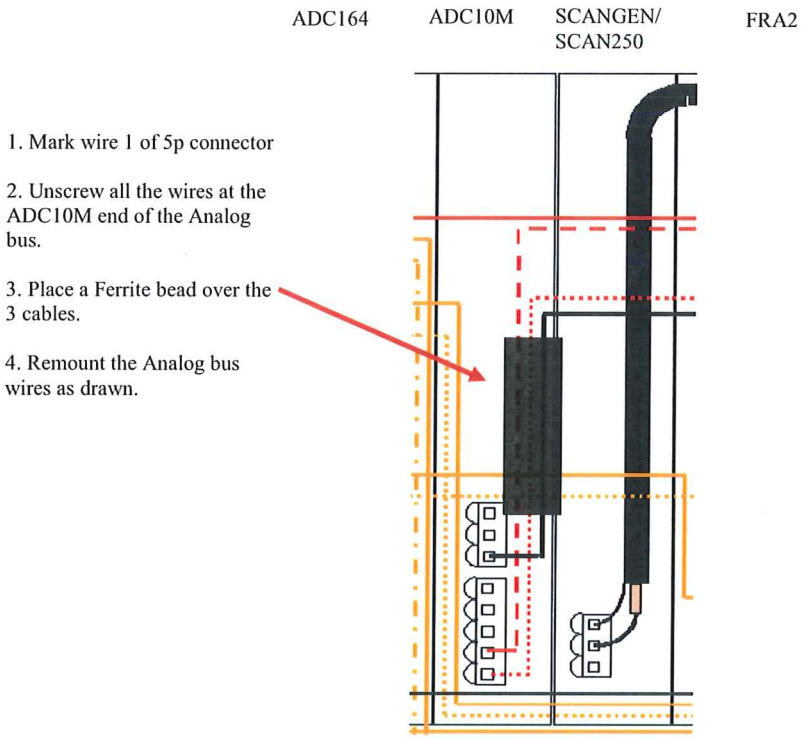
4. Analog bus for the 8-series





5. Analog bus adjustment for the ADC10M module

For the ADC10M modules, a ferrite bead should be placed in the Analog bus. For instruments with serial numbers ≥ AUT8**3340** this adjustment is not necessary. It is standard in the Analog bus with revision number ≥ 5.1.

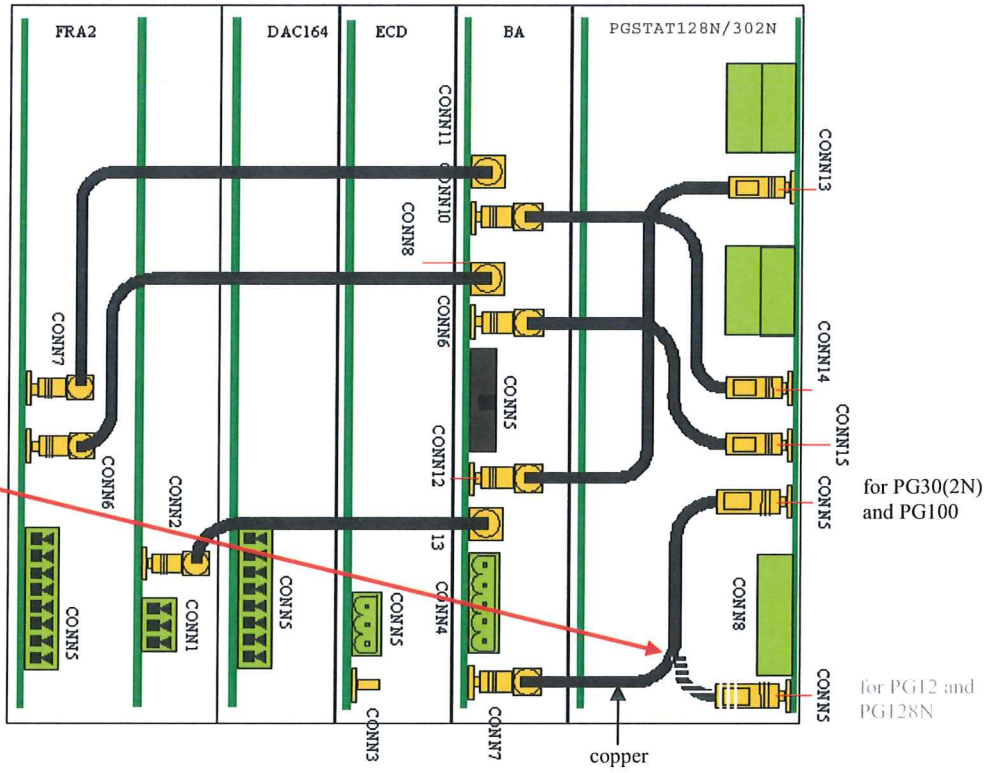


The ADC10M installation can be tested using Nova, see Section 11 of this document. The ADC10M is not supported in the GPES 4.9 software.

6. Analog bus adjustments for the **BA** module

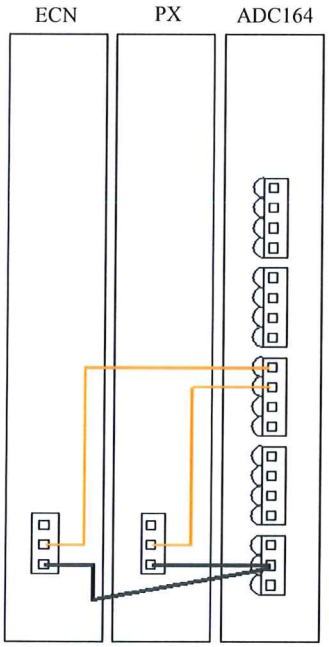
For the BA module the SMB coaxial cables should be connected.
Place the delivered SMB coax cables between the PGSTAT and BA module as drawn in the following picture. If the FRA2 module is present connect the FRA2 coaxial cables to the BA module as drawn.

In addition to the 3 SMB cables a special copper wire is necessary to minimize loss of current due to cable resistance. The copper coax has a lower resistance than the regular coaxial cable. For the same reason, the WE(2) cable connected to the Diffamp is also made of this special copper coaxial cable. The special cables are labeled.



Note: The supplied jumper cable is NOT used for the BA module in an 8-series instrument!

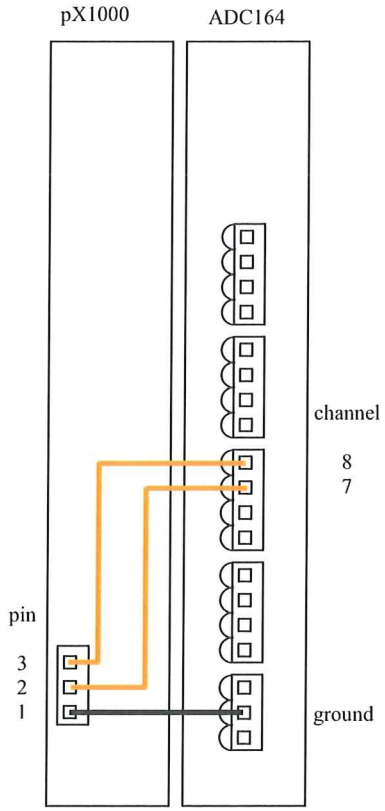
7. Connect the **PX** or **ECN** module



- These connections are not for the pX1000 module. For installation of the pX1000 module see section 8.
- The PX module is connected to ADC channel 7.
- The ECN module is connected to ADC channel 8.
- For GPES 4.9, open the C:\Autolab\Sysdef40.inp file in Notepad and verify the correct configuration:

```
15:  …
16:  11,9,16,15,1
17: 7,8,,,
18: &HE,&HF,&H3,,
19:  10,-10, 65536, 50, 10000
20:  …
```

8. Connect the **pX1000** module



- Pin 1 of the pX1000 connector must be connected to one of the 3 pins of the ground connector of the ADC164.
- Pin 2 must be connected to ADC channel 7.
- Pin 3 must be connected to ADC channel 8.

The pX1000 installation can be tested using Nova, see Section 11 of this document. The pX1000 is not supported in the GPES 4.9 software.

9. Calibration of **FRA2** module with FRA software

The procedure described below is explained for the Autolab 4.9 software. It is possible to calibrate C1 and C2 with the Nova software. This is explained in chapter 10 of this document.

- First install the FRA software by re-installing the Autolab software from the original CD. Select the FRA software to be installed,
- The calibration file FRA2CAL.INI is delivered with the new FRA2-module.
- Copy this file into the c:\autolab folder (do NOT use the 'Load calibration file' option from the 'File menu'),
- The file must be changed for the specific Autolab. Open the file with Notepad,

Fragment of the FRA2CAL.INI file, bold zeros must be adapted:

```
.....
FRA2 Channel 2= .9637107

[CFCalib]
C1=0
C2=0

[System]
Autolab number=AUT00000
Calibration revision=1.0
Calibration Serial Number=1
NofRegions=7

[CalibRegion1]
BeginFreq=
.....
```

- The Autolab number must be changed to the serial number of the connected Autolab (i.e. AUT**83185**, see rear side of Autolab),
- Save FRA2CAL.INI file and exit Notepad,
- C1 and C2 must be measured. The Autolab dummy cell and a Faraday cage are needed for accurate measurements. If you do not have a Faraday cage or if you are not able to calibrate, you can fill in the typical values for C1 and C2 given in the table. This will however affect the accuracy of the measurement.

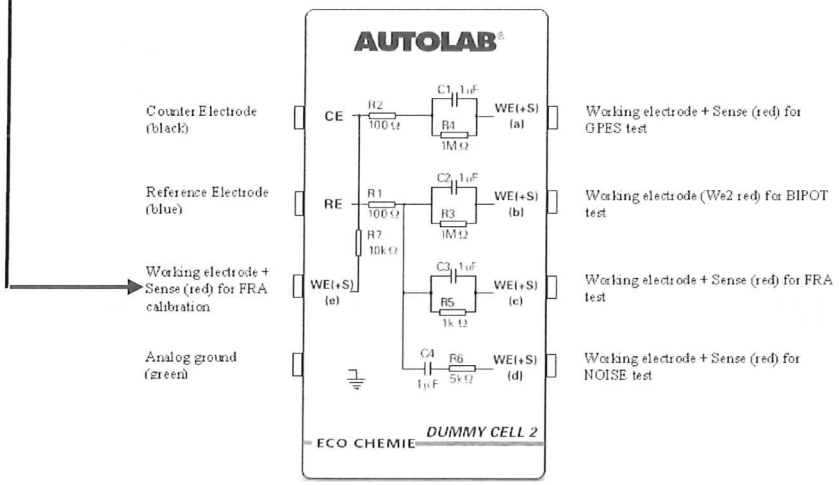
Table 1. Typical values for C1 and C2

Type	**C1**	**C2**	
PGSTAT302N	16.0	0.3	If **0.0** observed specify **0.1!**
PGSTAT128N	26.0	1.0	
PGSTAT128N	16.0	1.0	for instruments with s/n > AUT84180

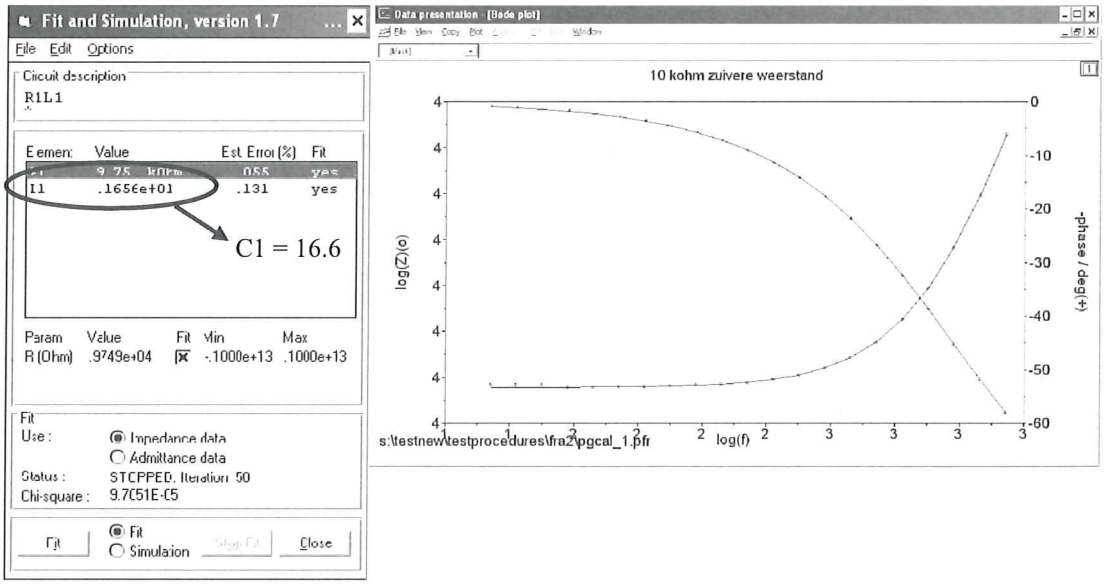
Measure C1 and C2 with FRA software

- Note: Follow this procedure strictly in order to retrieve proper results,
- Close FRA-software (when active),
- Be sure C1 and C2 are set initially to zero in the FRA2CAL.INI file,
- Start up FRA-software,
- Load the procedure 'PGCAL_1.pfr' from the delivered CD,

- Connect the dummy cell (e) (10k Ohm) and place the dummy cell inside a Faraday cage. Connect the green ground lead to the Faraday cage. Do NOT connect the ground lead to the dummy cell,



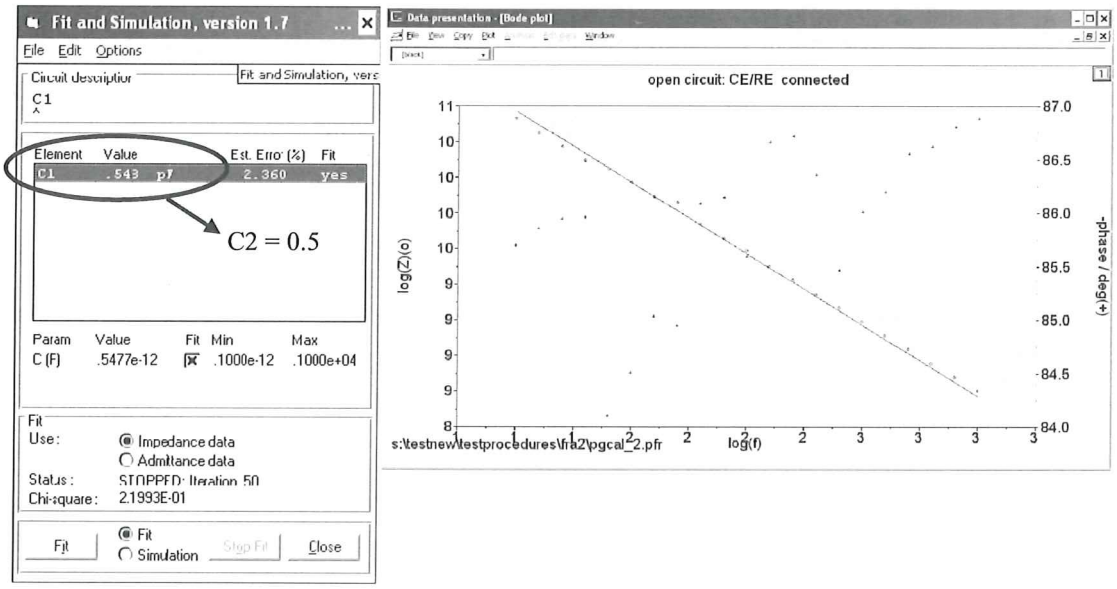
- Start the measurement and wait until it has been finished. Ignore the message 'current range is too low for the frequency',
- Select 'Fit and Simulation' (Data presentation, Analysis) and open the circuit-file 'PGCAL_1.ecc',
- Start the fit. After the fit, the Bode plot should be similar to the example below,



- Determine C1: C1= (Value of Element L1) * 10, so if L1 gives 0.1656e+01, C1=16.6. Round value to one decimal place. Check if the value is close to the typical value given in table 1,
- Exit 'Fit and Simulation' and exit the FRA-software,

- Edit FRA2CAL.INI and adjust C1 to the measured value,
- Save FRA2CAL.INI and exit Notepad,

- Start up FRA-software again,
- Load the procedure 'PGCAL_2.pfr' from the delivered CD,
- Disconnect the dummy cell and leave the leads open in the Faraday cage. CE and RE must be connected together as well as WE and S. Be sure RE/CE and WE/S are not connected together,
- Start the measurement and wait until it has been finished,
- Select 'Fit and Simulation' (Data presentation, Analysis) and open the circuit-file 'PGCAL_2.ecc',
- Start the fit,



- The fitted value for the (Element C1) is equal to the value for C2. Round this value to one decimal place. If the (Value of Element C1) is .548 pF, C2=0.5. Verify that the value is close to the typical value given in table 1,
- Exit 'Fit and Simulation' and exit the FRA-software,
- Edit FRA2CAL.INI and adjust C2 to the measured value,
- Save FRA2CAL.INI and exit Notepad,

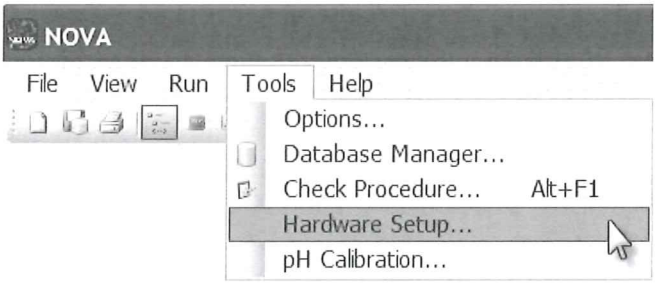
Test FRA calibration with FRA software

- To verify that the FRA has been calibrated properly run the FRATEST procedure on the dummy cell (c), explained in the 'Installation and Diagnostics guide'. Fit the data with the circuit-file 'FRATEST.ecc':
- Wait until measurement has been finished,
- Open 'Fit and Simulation' (Data presentation, Analysis),
- Load circuit-file 'Fratest.ecc' from delivered CD,
- Press 'Fit'-button
- When the fit is ready chi-square should read about 1e-4 (typical)
- R1 should be approximately 100 Ohm with a maximum error of .100 %
- R2 should be approximately 1 kOhm with a maximum error of .100 %
- C1 should be approximately 1 µF with a maximum error of .100 %
- If the values are out of range, something is wrong with the installation or with the calibration. Please check the complete installation procedure. If re-calibration is necessary, please remember to set C1 and C2 back to zero.

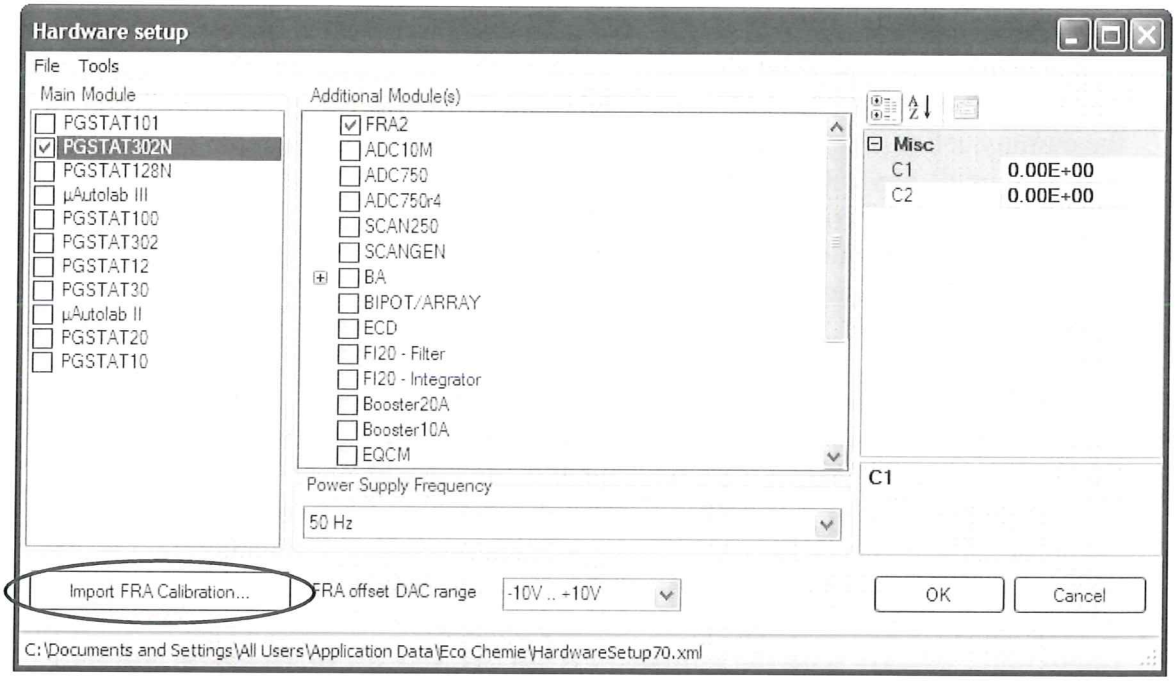
- **Important : Always send the adjusted FRA2CAL.INI file to Metrohm Autolab by Email (**service@metrohm-autolab.com**, subject Autolab serial number). This is important for future service. If not sent back, we are not able to service this instrument properly.**

Include results of FRA2 calibration with FRA software in Nova

To activate the FRA2 calibration in Nova, import the Fra2Cal.ini file in the Hardware setup. This procedure is described in the Getting started manual of the Nova software. With Nova installed, select the Hardware Setup from the tools menu.



This opens the Hardware setup window.



Press the Import Fra Calibration button and browse to the Fra2Cal.ini. After importing the file you have to specify the PGSTAT module present in your Autolab.

The procedure to measure C1 and C2 is explained for the Autolab 4.9 software. It is possible to measure C1 and C2 with the Nova software. This is explained in a separate document present on our website and on the CD delivered with a loose FRA2 module.

10V FRA module configuration in Autolab software (GPES+FRA)

Some applications (i.e. Impedance measurements with a Dynamic load) need a modified FRA module. This 10V version of the FRA modules requires an additional step in the Hardware configuration. Here we explain the modification to the GPES and FRA software. The 10V version can be recognized at the front of the Autolab. The FRA2 module label is marked with "FRA2.V10". The FRA2 is standard delivered with the 10V option.
The 10V FRA module requires a modification of the SYSDEF40.INP file. Open the file using Notepad, and change record 53 from:

53: ,4.8,1,10, (default)

to

53: **1**,4.8,1,10,

Note: This modification of the hardware setup is only required once and must be saved.

10. Calibration of **FRA2** module with Nova software

The procedure described below is explained for the Nova software.

- First install the Nova software,
- The calibration file FRA2CAL.INI is delivered with the new FRA2-module The Autolab number must be changed to the serial number of the connected Autolab (i.e. AUT**83185**, see rear side of Autolab)

Fragment of the FRA2CAL.INI file, bold zeros must be adapted:

```
.....
FRA2 Channel 2= .9637107

[CFCalib]
C1=0
C2=0

[System]
Autolab number=AUT00000
Calibration revision=1.0
Calibration Serial Number=1
NofRegions=7

[CalibRegion1]
BeginFreq=
.....
```

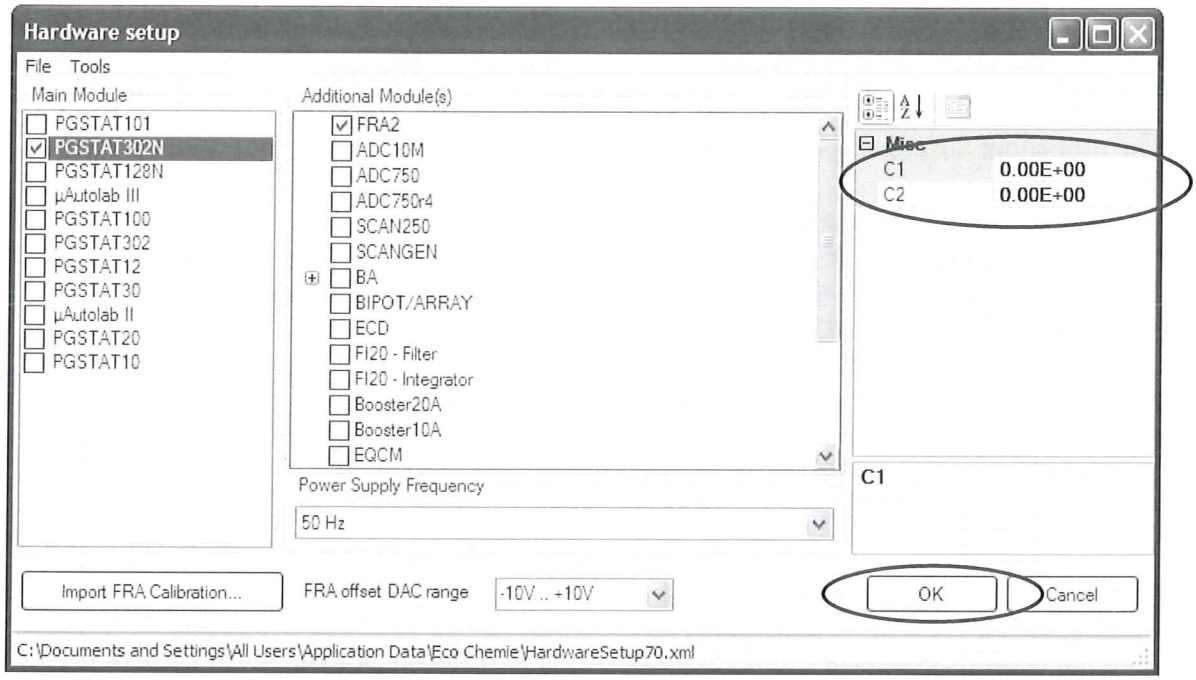
- Save FRA2CAL.INI file and exit Notepad,
- Insert the FRA2CAL.INI file in Nova following the procedure described in chapter 9, *Include results of FRA2 calibration with FRA software in Nova.*
- C1 and C2 must be measured. The Autolab dummy cell and a Faraday cage are needed for accurate measurements. If you do not have a Faraday cage or if you are not able to calibrate, you can fill in the typical values for C1 and C2 given in the table. This will however affect the accuracy of the measurement.

Table 1. Typical values for C1 and C2

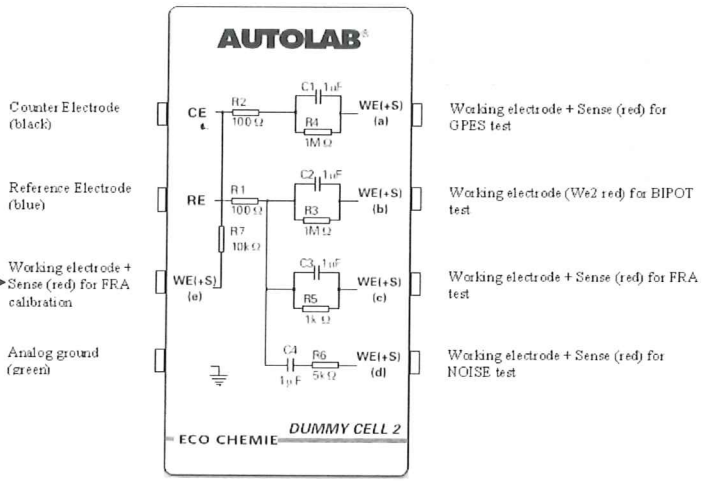
Type	**C1**	**C2**	
PGSTAT302N	16.0	0.3	If **0.0** observed specify **0.1!**
PGSTAT128N	26.0	1.0	
PGSTAT128N	16.0	1.0	for instruments with s/n > AUT84179

Measure C1 and C2 with Nova software

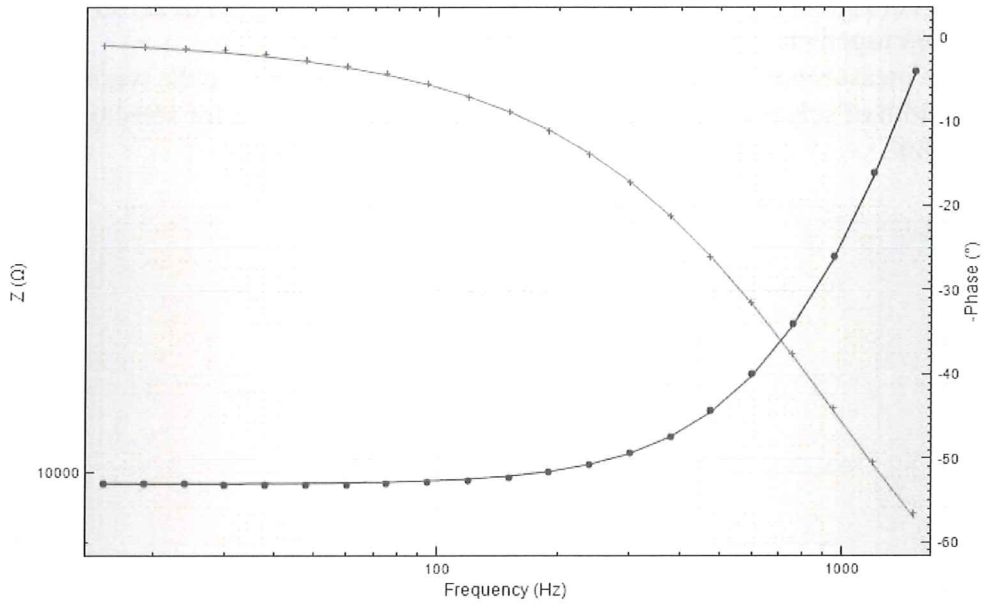
- Note: Follow this procedure strictly in order to retrieve proper results,
- Start the Nova software,
- Be sure C1 and C2 are set initially to zero,



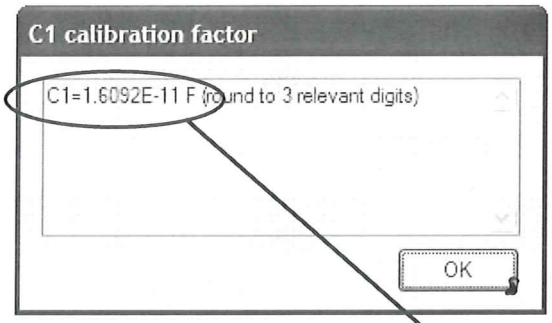
- Import the procedure "PGSTAT C1 calibration.nox" from the delivered CD,
- Connect the dummy cell (e) (10k Ohm) and place the dummy cell inside a Faraday cage. Connect the green ground lead to the Faraday cage. Do NOT connect the ground lead to the dummy cell,



- Start the measurement and wait until it has been finished. Ignore the warning 'Bandwidth of selected current range (100nA) is not sufficient for selected frequency (1500 Hz)',
- After the measurement, the Bode plot should be similar to the example below. The data is automatically fitted,



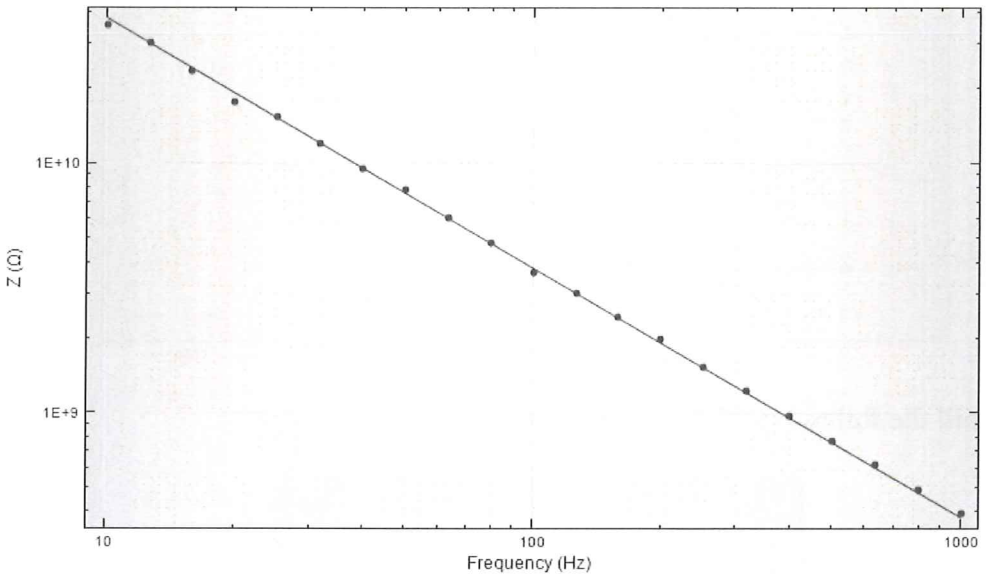
- Wait until the following message appears:



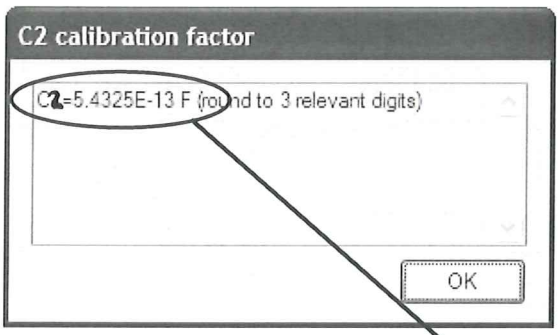
- Fill out the C1 value in the Hardware setup, press OK and save the changes.

- Wait until the Autolab initializes.
- Import the procedure “PGSTAT C2 calibration.nox” from the delivered CD,

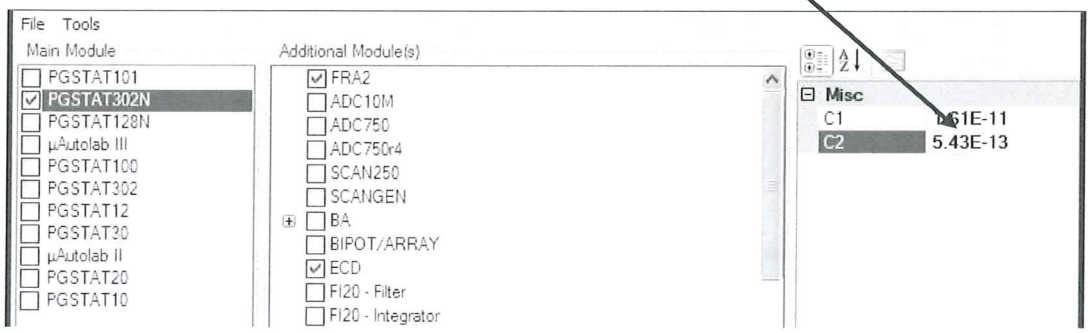
- Disconnect the dummy cell and leave the leads open in the Faraday cage. CE and RE must be connected together as well as WE and S. Be sure RE/CE and WE/S are not connected together,
- Start the measurement and wait until it has been finished. Ignore the warning 'Bandwidth of selected current range (100nA) is not sufficient for selected frequency (1000 Hz)',



- Wait until the following message appears:



- Fill out the C2 value in the Hardware setup, press OK and save the changes.



Test FRA calibration with Nova software

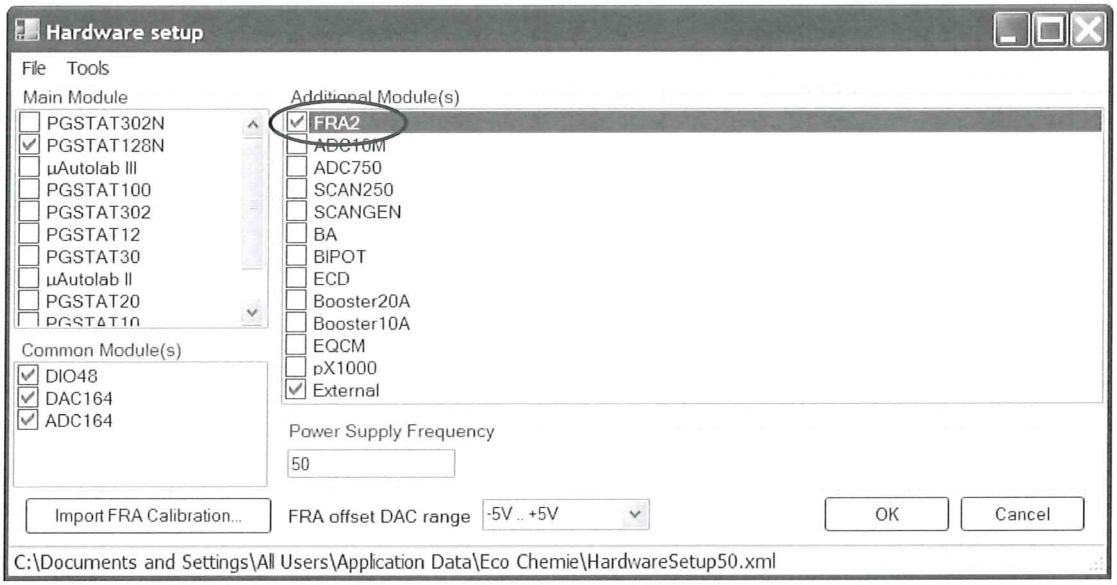
- To verify that the FRA has been calibrated properly, run the TestFRA2 procedure on the dummy cell (c), explained in the Getting started tutorial.
- If the values are out of range, something is wrong with the installation or with the calibration. Please check the complete installation procedure. If re-calibration is necessary, please remember to set C1 and C2 back to zero.

- **Important : Always send the (new) C1 and C2 values to Metrohm Autolab by Email (**service@metrohm-autolab.com**, subject Autolab serial number). This is important for future service. If not sent back, we are not able to service this instrument properly.**

10V FRA module configuration in Nova

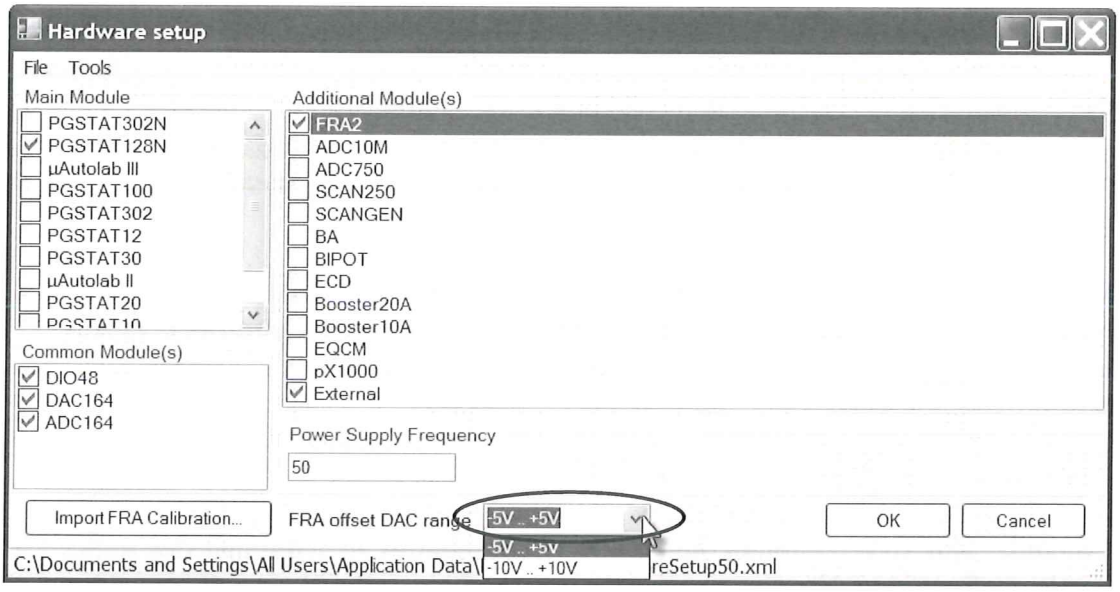
Some applications (i.e. Impedance measurements with a Dynamic load) need a modified FRA module. This 10V version of the FRA modules requires an additional step in the Hardware configuration. Here we explain the modification to the Nova software. The 10V version can be recognized at the front of the Autolab. The FRA2 module label is marked with "FRA2.V10". The FRA2 is standard delivered with the 10V option. The FRA module can be tested and calibrated as described in the previous paragraphs.

With Nova installed, select the Hardware Setup from the tools menu. This opens the Hardware setup window.



Select the FRA2 module.

A drop-down list is located at the bottom of the Hardware setup window. Using this drop-down list, select the correct offset DAC range of the FRA2 module.



Note: if you are unsure what range to choose, contact your local distributor or Metrohm Autolab for more information.

Click the OK button to close the hardware setup. You will be first prompted to save the modification and then to restart the application. Click the Yes button for both questions.

Note: the hardware is now set. This modification of the hardware setup is only required once and must be saved.

11. Module test

- Connect mains power,
- Switch Autolab on,
- Install the delivered software (Autolab 4.9 and/or Nova) if necessary,
- Select Hardware setup and activate inserted module,
- Perform tests as they are described in the Nova Getting Started manual or in the Autolab 4.9 Installation and Diagnostics manual.
- In Nova there is also a separte document about the Module test. This tutorial is available from the Help menu.