NOVA

Booster Tutorial

Version 1.11.0

1 – The Booster10A and Booster20A

The Booster10A and Booster20A are additional modules that can be interfaced with the PGSTAT128N, 30, 302, 302N, 100 and 100N. The boosters provide an additional current range to the user, 10 A and 20 A, respectively. The extra current range can be used with all the measurement commands and allows high current measurements[1].

Table 1 provides an overview of the compatible instruments.

Instrument	Booster10A	Booster20A
PGSTAT12	×	×
PGSTAT128N	✓	×
PGSTAT20	✓	×
PGSTAT30/302/302N	✓	✓
PGSTAT302F	×	×
PGSTAT100/100N	✓	×
PGSTAT100/100N 'floating option'	×	×
PGSTAT101/M101	×	×
PGSTAT204/M204	×	×
PGSTAT10	×	×
µAutolabII/III	×	×

Table 1 – Overview of the compatible instruments (✓– Booster available; × – Booster not available)

Scope of the tutorial

The aim of this tutorial is to explain how to use the current boosters to perform high current measurements with the Autolab. Information is provided on how to activate the booster during a measurement and on the safety features of the instrument.

[1] In the rest of this section, both the Booster10A and the Booster20A will be referred to as Booster.

2 – Hardware installation

The Booster instruments are external devices that are connected to the Autolab PGSTAT using a dedicated set of cables.

2.1 – Setting up the Booster 10 A

The Booster10A can be connected to one of the DIO connectors on the rear of the PGSTAT by means of the provided cable (see Figure 1).

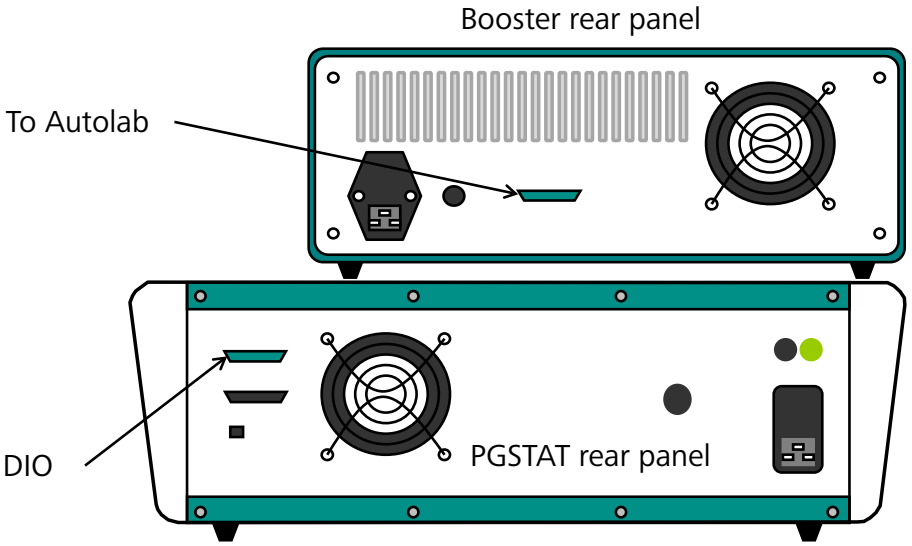

Figure 1 – Connecting the Booster10A to the PGSTAT

An additional connection, between the CE/WE connector on the front panel of the PGSTAT and the Booster10A is required. This is achieved using the provide cable (see Figure 2).

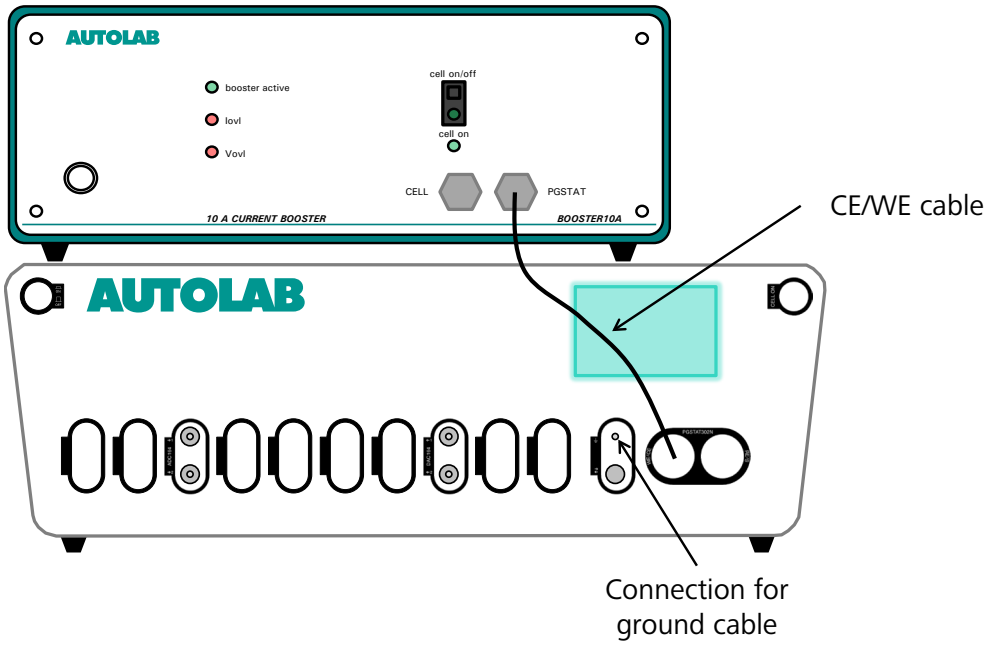

Figure 2 – Connecting the Booster10A to the PGSTAT, through the WE/CE cable

Note

A separate green ground cable is supplied with the Booster in order to provide a connection for a Faraday cage.

2.2 – Setting up the Booster20A

The Booster20A can be connected to one of the DIO connectors on the rear of the PGSTAT by means of the provided cable (see **Error! Reference source not found.**).

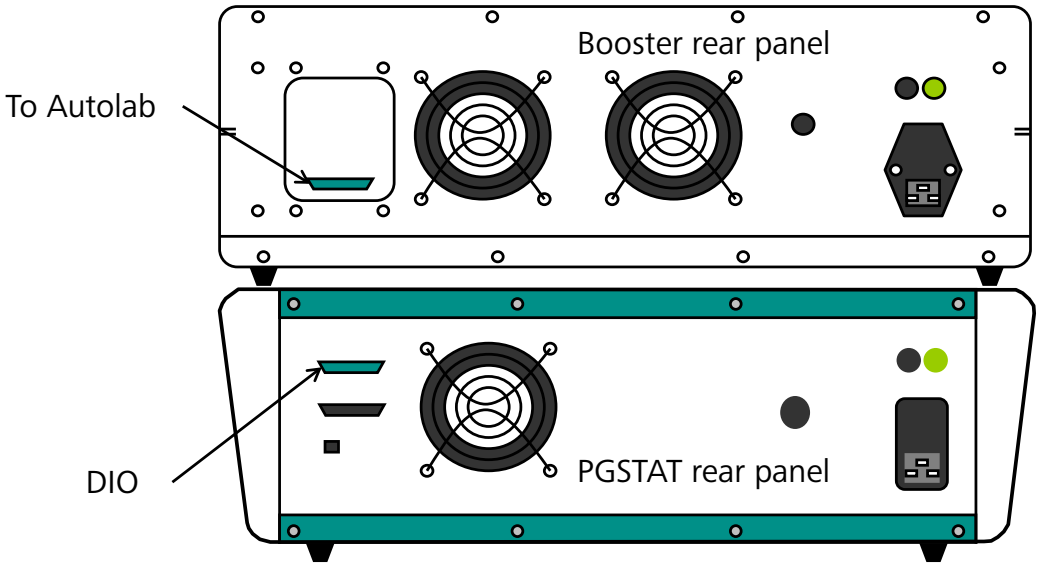

Figure 3 – Connecting the Booster20A to the PGSTAT

An additional connection, between the CE/WE connector on the front panel of the PGSTAT and the Booster20A is required. This is achieved using the provide cable (see Error! Reference source not found.).

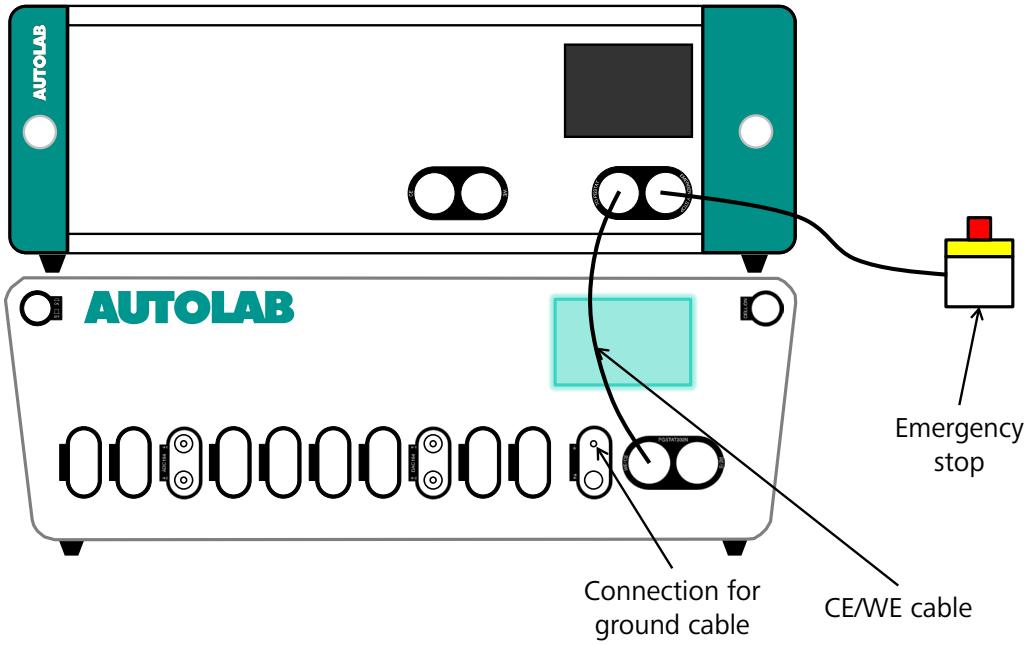

Figure 4 – Connecting the Booster20A to the PGSTAT, through the WE/CE cable

Note

A separate green ground cable is supplied with the Booster in order to provide a connection for a Faraday cage.

In order to use the Booster in NOVA, the hardware setup must be configured accordingly (see Figure 5).

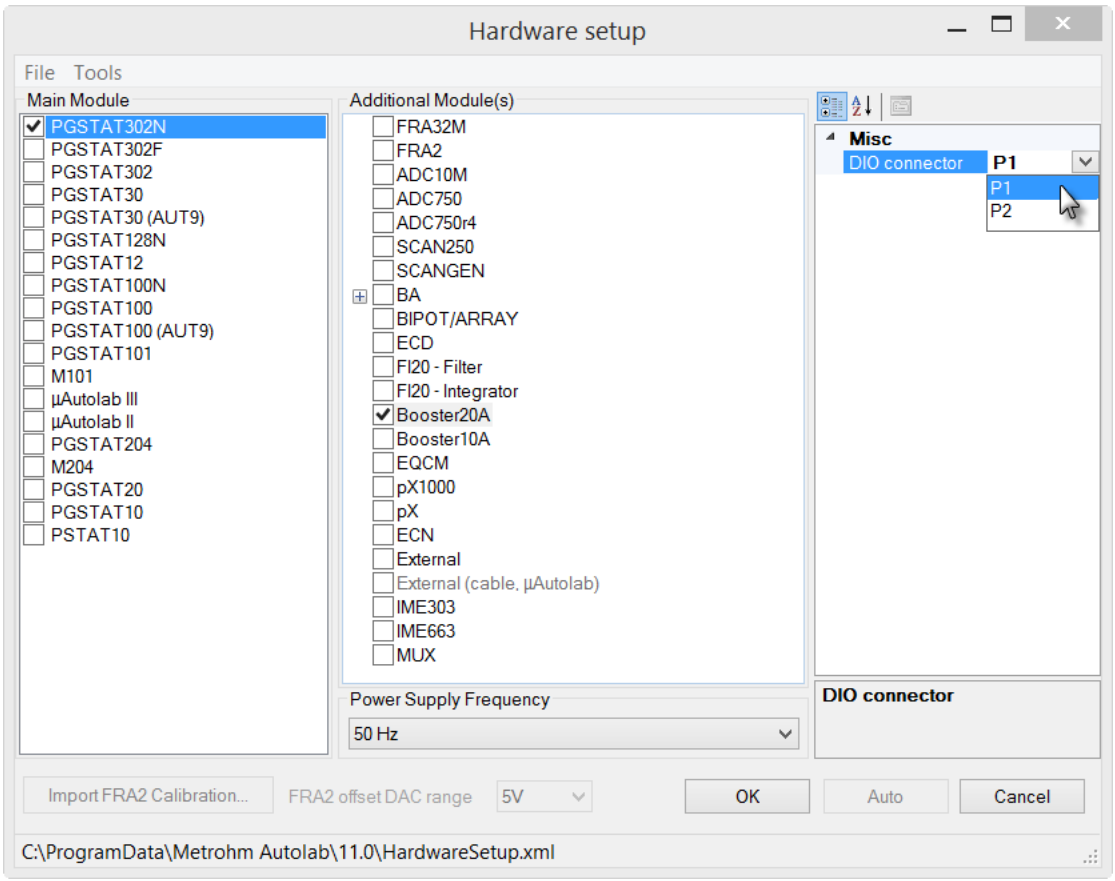

Figure 5 – Selecting the Booster20A in the hardware setup

The DIO connector used to control the Booster is defined on the right-hand side of the Hardware setup window (the default connector is P1).

After the selection of the Booster in the hardware setup, an additional current range is available (see Figure 7). This current range can be selected manually, using the Autolab display or during a procedure.

Note

If a Booster is declared in the hardware setup, but is not connected to the Autolab, or if the DIO cable is missing or is not properly connected, a warning message will be displayed when NOVA is started (see Figure 6).

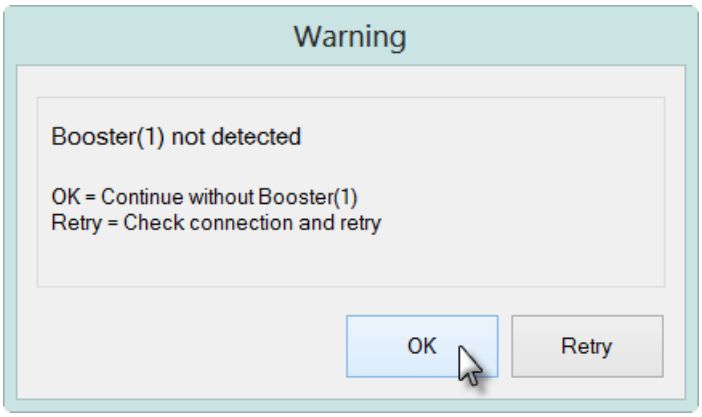

Figure 6 – A message is displayed when the Booster is not detected

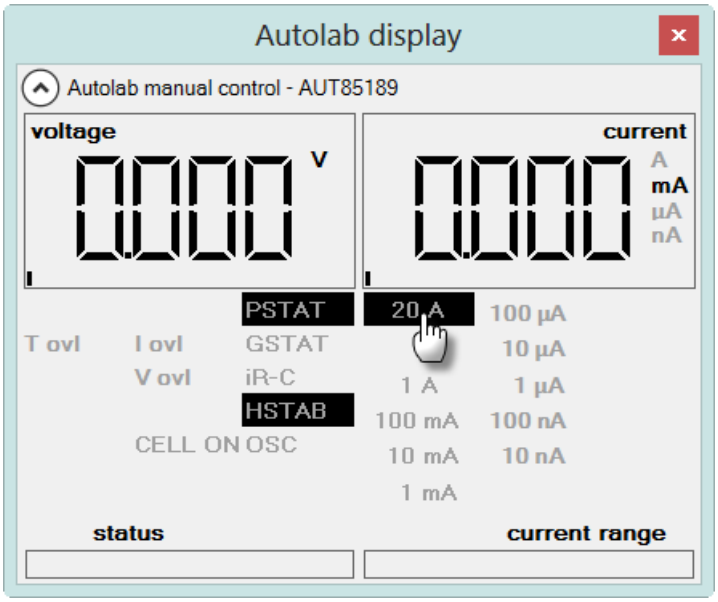

Figure 7 – The 20 A current range is available in the Autolab display window

Note

To avoid damage to the working electrode, a safety feature automatically switches the cell OFF when then instrument activates or deactivates the 20 A current range (or the 10 A current range in the case of the Booster10A).

3 – Using the Booster in the procedure setup

With the Booster correctly installed and defined in the hardware setup, it is possible to use it in the procedure setup. The Booster can be activated and deactivated at any time during a measurement. This requires the use of the Autolab control command.

To activate the Booster during a measurement, the *20 A (Booster on)* current range must be selected from the current range drop-down list in the Autolab control window (see Figure 8).

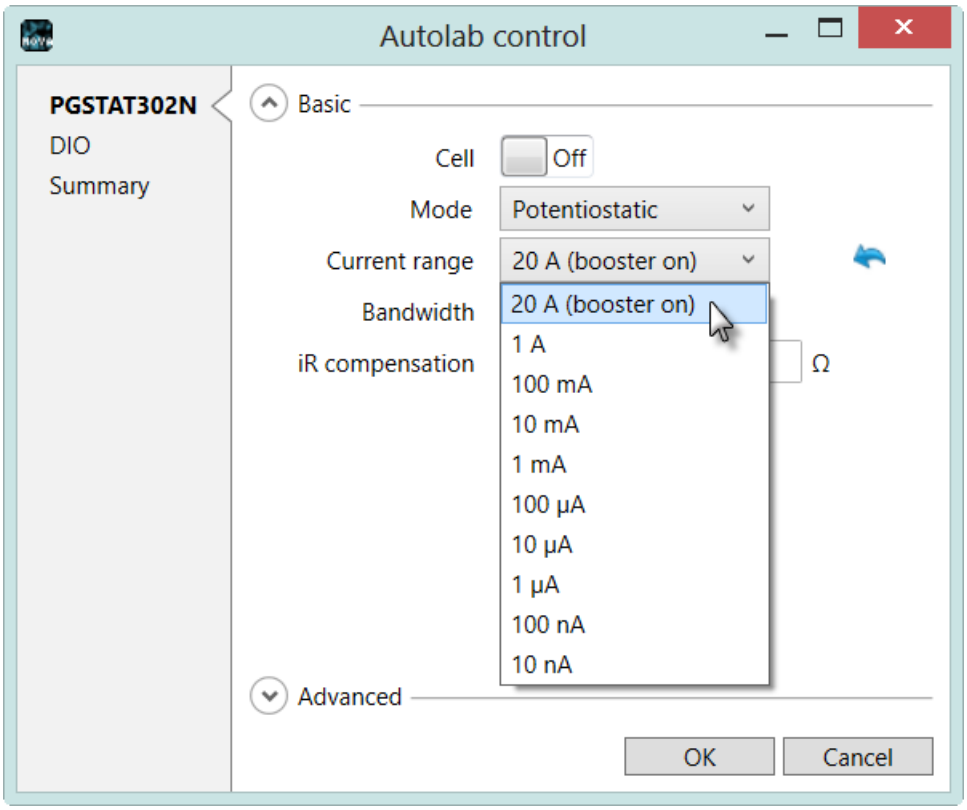

Figure 8 – Activating the Booster is performed by selecting the additional current range from the drop-down list

Note

Activating the 20 A current range forces the cell to be switched off. In order to perform a measurement, the cell must be switched on again manually.

The Booster is deactivated by selecting any other current range in the Autolab control window.

4 – Automatic current ranging restriction

The automatic current ranging option, including the high current range provided by the Booster is only available during a **FRA frequency scan**. For all the other measurement techniques, it is **not** possible to include the current range provided by the Booster in the automatic current ranging option (see Figure 9).

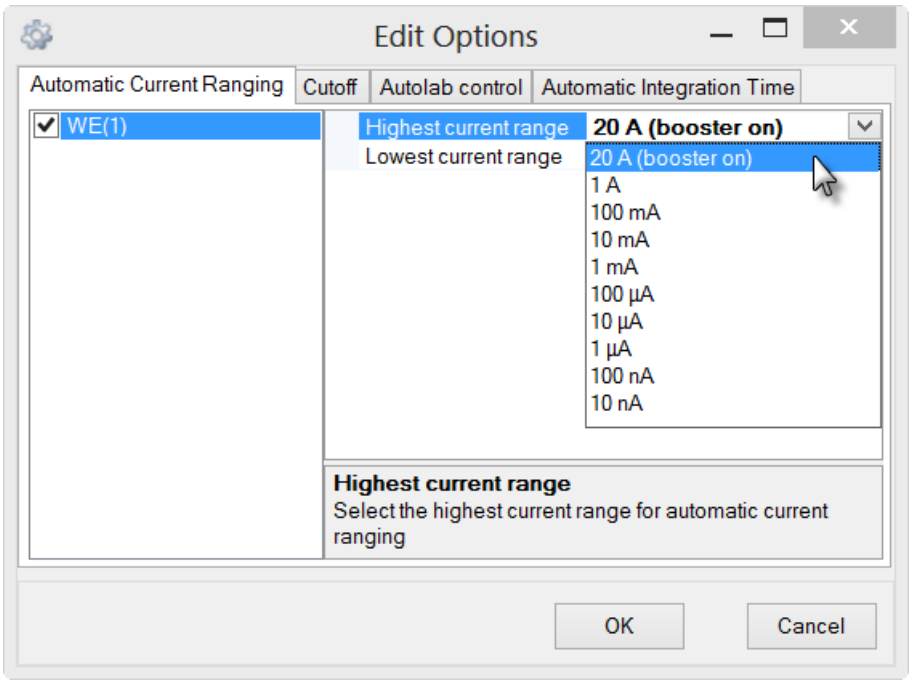

Figure 9 – The automatic current ranging settings for WE(1), including the 20 A (booster on) current range, is only available for the FRA frequency scan command

The procedure validation will generate an error if a measurement using Automatic current ranging in combination with the Booster is started (see Figure 10).

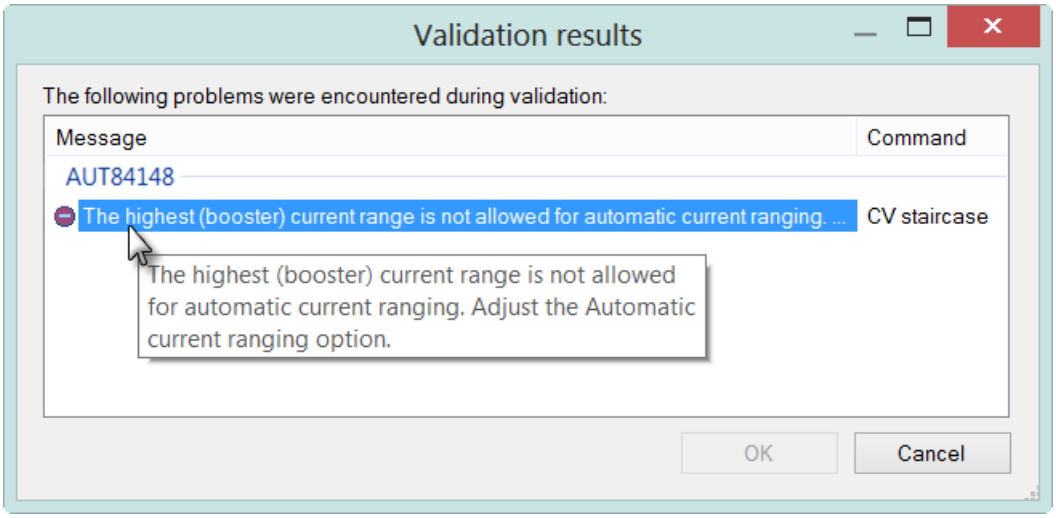

Figure 10 – The procedure validation will generate an error when Automatic current ranging is used in combination with the Booster

Note

This error message is not shown for FRA measurements.

5 – A measurement using the Booster on the special dummy cell

A Booster tutorial folder is located in the **Program Files\Metrohm Autolab\Nova 1.11\Shared Databases\Tutorials** folder (see Figure 11). Using the database manager, set this folder as the Standard database.

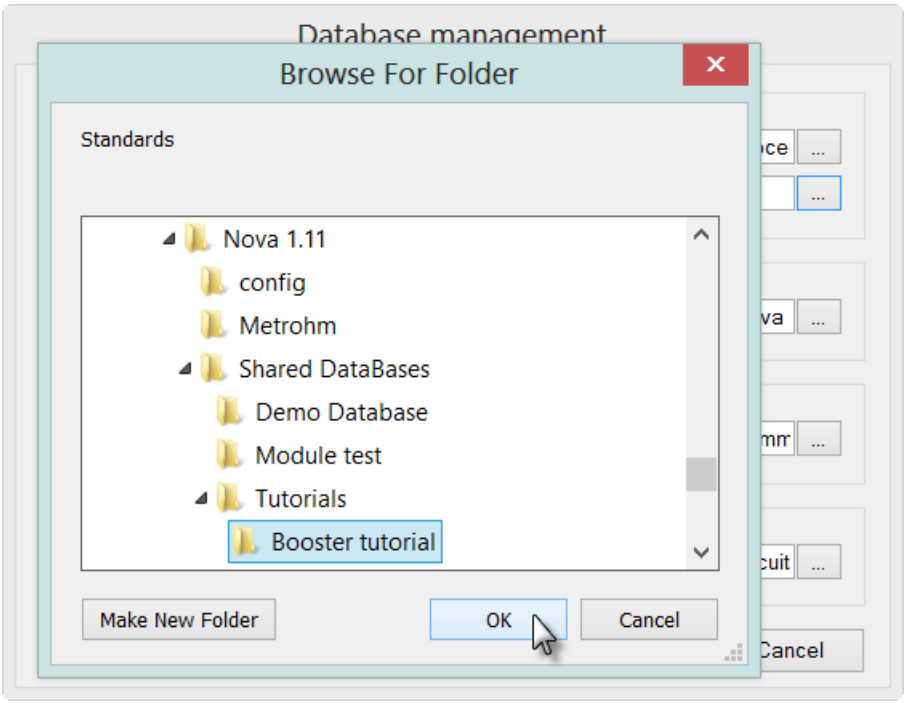

Figure 11 – Loading the Booster tutorial database

Two procedures are included in this tutorial procedure. All the procedures are intended to be used with the special Autolab Booster dummy cell. One procedure is designed for the Booster10A and the other for the Booster20A (see Figure 12).

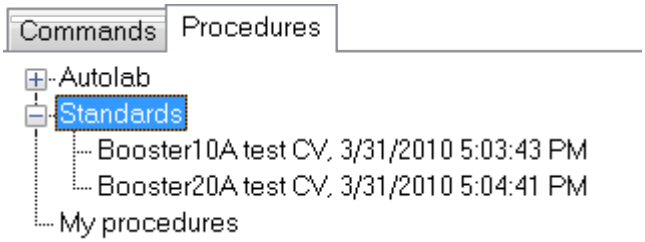

Figure 12 – The two Booster tutorial procedures

This section describes the Booster procedures. Both procedures are designed to perform a standard staircase CV on the special Booster dummy cell. The measured current will reach the maximum possible value during the scan.

5.1 – Booster10A test CV

Select the *Booster20A test CV* procedure from the Standards group. Connect the electrode leads from the PGSTAT to the Booster20A test cell (50 mOhm resistance) shown in Figure 13 and start the measurement.

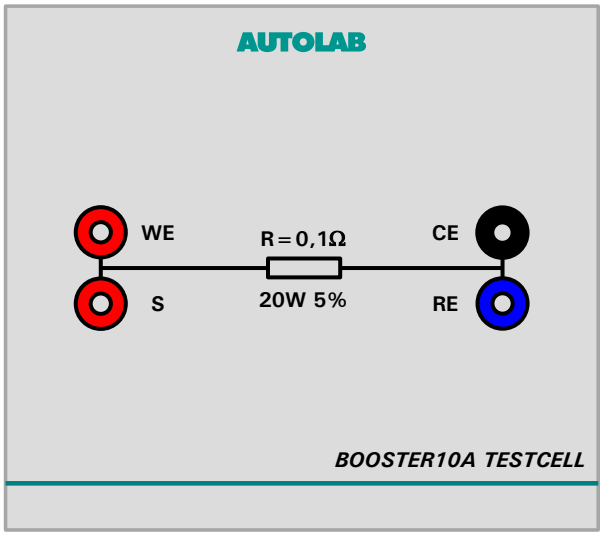

Figure 13 – The Booster10A test cell

This procedure uses the *Autolab control* command to select the 10 A current range at the beginning of the experiment. This activates the Booster during the measurement (see Figure 14).

Commands	Parameters	Links
Booster10A test CV		
Remarks	Test of the Autolab Booster10A	
End status Autolab		
Signal sampler	Time, WE(1).Potential, WE(1).Current	
Options	No Options	
Instrument		
Instrument description		
⊞ Message box		
⊟ Autolab control		
WE(1).Mode	Potentiostatic	
WE(1).Bandwidth	High stability	
WE(1).Current range	10 A (booster on)	
⊞ Set potential	0.000	
⊞ Set cell	On	
⊞ Wait time (s)	5	
⊞ CV staircase	[0.000, 1.200, -1.200, 0.000, 2, 0.1000000]	
⊞ Set cell	Off	
⊟ Autolab control		
WE(1).Current range	1 mA	
<..>		

Figure 14 – The Booster10A is activated at the beginning of the procedure using the *Autolab control* command

Note

Automatic current ranging is not possible with the Booster10A, the measurements are therefore performed in a fixed current range.

After pressing the Start button, a message will be displayed (see Figure 15).

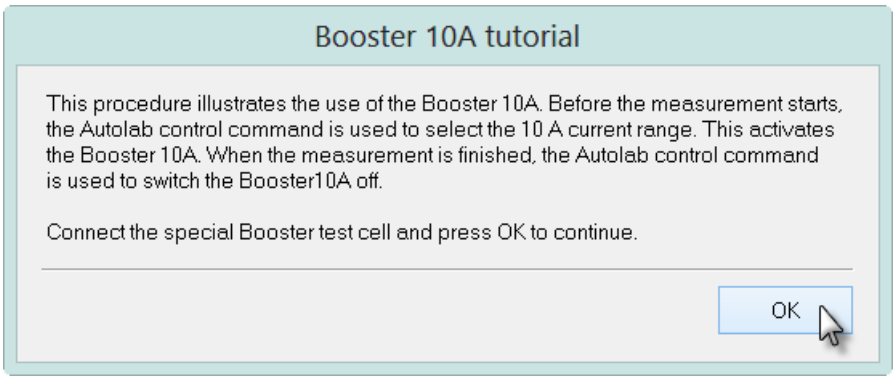

Figure 15 – The message box displayed using the Booster10A

Click the OK button to continue with the measurement. In the first part of the procedure, the Autolab control command is used to set the active current range to 10 A, which activates the Booster10A. With the extra current range selected, the cyclic voltammetry measurement proceeds, starting at 0 V, and scanning between -1.2 and 1.2 V (see Figure 16).

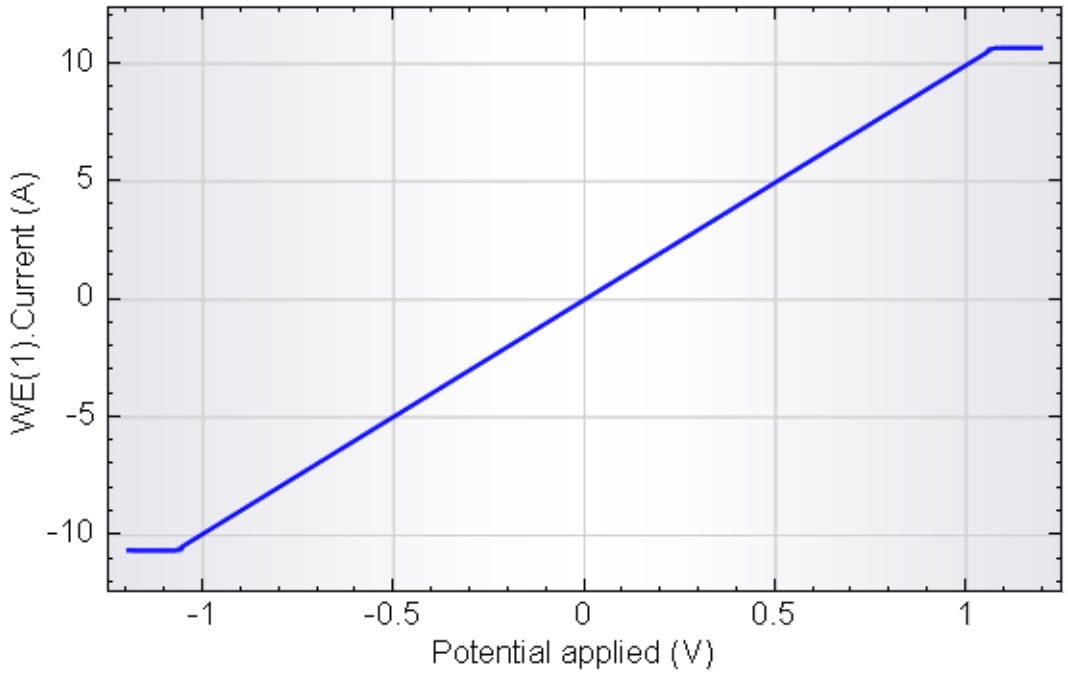

Figure 16 – Booster10A tutorial measured data

Since the resistance of the special Booster dummy cell is 100 mOhm, the WE(1).Current changes from -10 A to 10 A during the cyclic voltammetry measurement. The measured current levels out at the vertices of the scan since the maximum current that can be measured with the Booster10 A is reached.

5.2 – Booster20A test CV

Select the *Booster20A test CV* procedure from the Standards group. Connect the electrode leads from the PGSTAT to the Booster20A test cell (50 mOhm resistance) shown in Figure 17 and start the measurement.

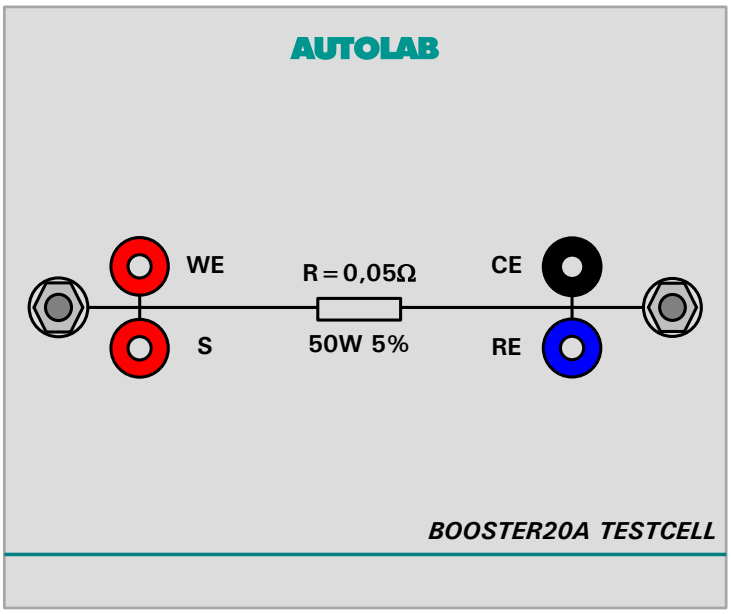

Figure 17 – The Booster20A test cell

This procedure uses the *Autolab control* command to select the 20 A current range at the beginning of the experiment. This activates the Booster during the measurement (see Figure 18).

Commands	Parameters	Links
Booster20A test CV		
Remarks	Test of the Autolab Booster20A	
End status Autolab		
Signal sampler	Time, WE(1).Potential, WE(1).Current	
Options	No Options	
Instrument		
Instrument description		
Message box		
Autolab control		
WE(1).Mode	Potentiostatic	
WE(1).Bandwidth	High stability	
WE(1).Current range	20 A (booster on)	
Set potential	0.000	
Set cell	On	
Wait time (s)	5	
CV staircase	[0.000, 1.200, -1.200, 0.000, 2, 0.1000000]	
Set cell	Off	
Autolab control		
WE(1).Current range	1 mA	
<..>		

Figure 18 – The Booster20A is activated at the beginning of the procedure using the *Autolab control* command

Note

Automatic current ranging is not possible with the Booster20A, the measurements are therefore performed in a fixed current range.

After pressing the Start button, a message will be displayed (see Figure 15).

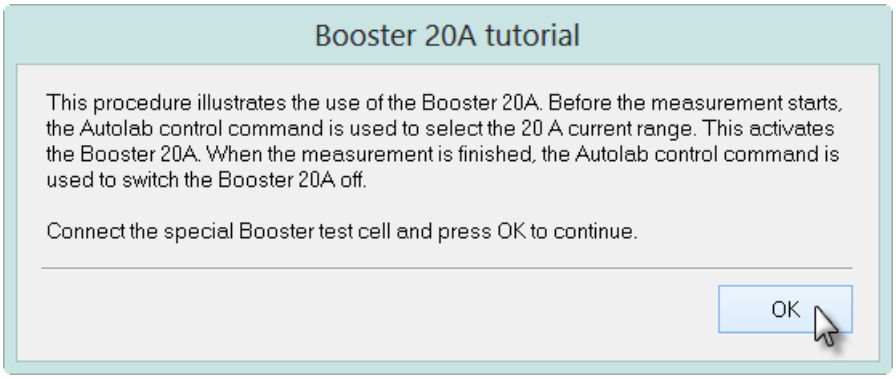

Figure 19 – The message box displayed using the Booster20A

Click the OK button to continue with the measurement. In the first part of the procedure, the Autolab control command is used to set the active current range to 20 A, which activates the Booster20A. With the extra current range selected, the cyclic voltammetry measurement proceeds, starting at 0 V, and scanning between -1.2 and 1.2 V (see Figure 16).

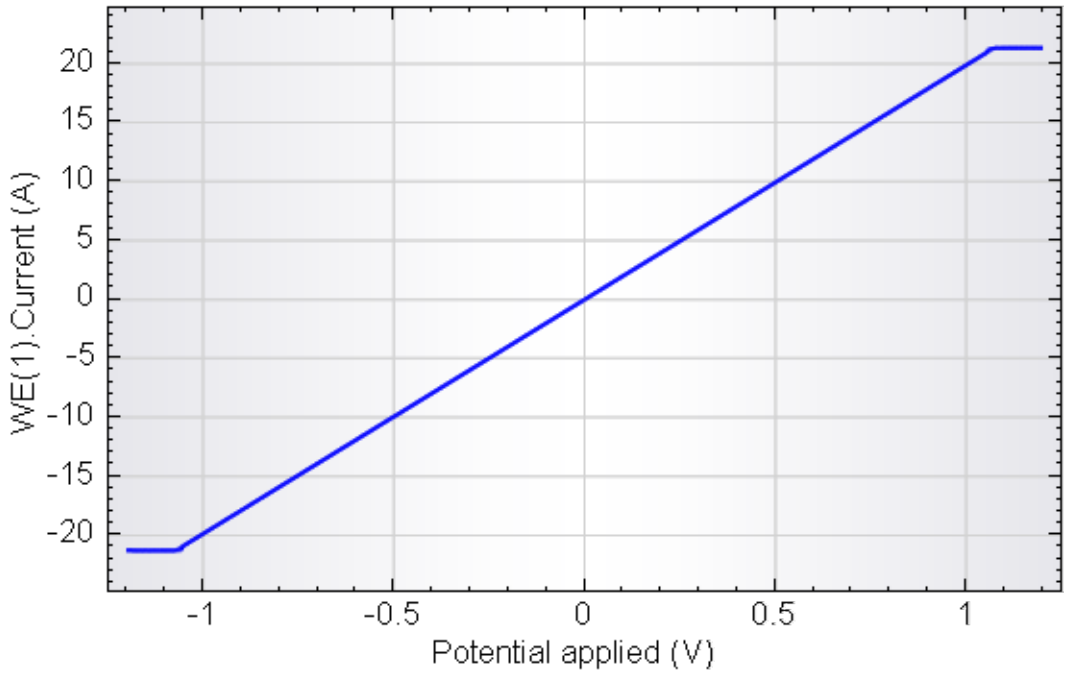

Figure 20 – Booster20A tutorial measured data

Since the resistance of the special Booster dummy cell is 50 mOhm, the WE(1).Current changes from -20 A to 20 A during the cyclic voltammetry measurement. The measured current levels out at the vertices of the scan since the maximum current that can be measured with the Booster20 A is reached.

Hardware specifications

The Booster10 and Booster20A are external high current amplifiers that can be connected to the Autolab PGSTAT instruments. The Booster20A is only available for the PGSTAT30, 302 or 302N, while the Booster10A can be connected to any Autolab PGSTAT, except the PGSTAT101, PGSTAT204, M101 or M204, PGSTAT10, PGSTAT12, µAutolab II and III (see Table 1 at the beginning of this document).

The Boosters are also not compatible with the PGSTAT100/100N fitted with the Floating option and with the PGSTAT302F.

Both Boosters provide one additional current range: 10 A for the Booster10A and 20 A for the Booster20A. The boosters can be used in combination with any electrochemical method supported in NOVA.

Note

Automatic current ranging is **not** possible when the Booster10A or Booster20A is used, except during FRA measurements.

Table 2 provides an overview of some of the Booster10A and Booster20A specifications.

Instrument	Booster10A	Booster20A
Maximum current	10 A	20 A
Compliance voltage	20 V	20 V
Maximum power	150 W	350 W
Current resolution	± 0.0003 %	± 0.0003 %
Current accuracy	± 0.5 % of CR	± 0.2 % of CR
PSTAT bandwidth	4 kHz	18 kHz
GSTAT bandwidth	2.5 kHz	40 kHz

Table 2 – Overview of the specifications of the Boosters

Note

The bandwidth of the Booster10A and Booster20A impose a practical limit for the highest frequency that can be used during FRA measurements. Do not exceed the bandwidth limit provided in Table 2 when performing FRA measurements in combination with the Booster10A or Booster20A.

Warning

The compliance voltage limit of the Booster10A and the Booster20A overrules the compliance voltage limit of the PGSTAT. For example, when a PGSTAT100 or PGSTAT100N is used in combination with a Booster10A, the maximum compliance voltage of the combined system is ± 20 V instead of ± 100 V.