BAT-FLEX

Manual

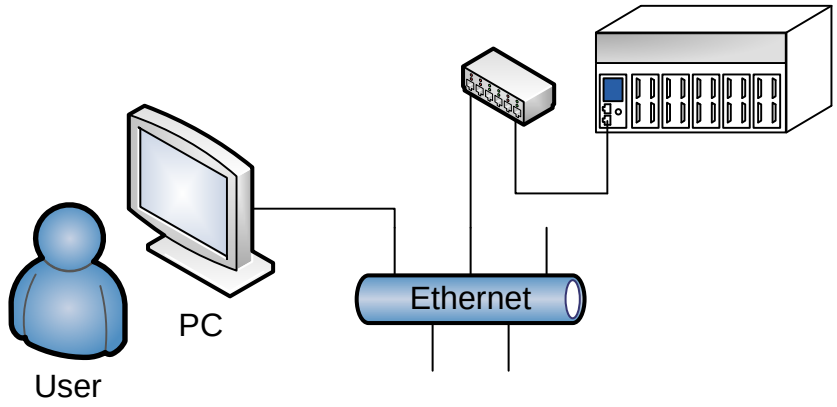
Rev.	Remarks /changes	created		checked		released	
01	Initial, ported	RT	01.03.13	AST	01.03.13	AST	01.03.13
03	Corrected channel specification	DK	21.08.14			DK	21.08.14

Table of Contents

1. Connection Drawing

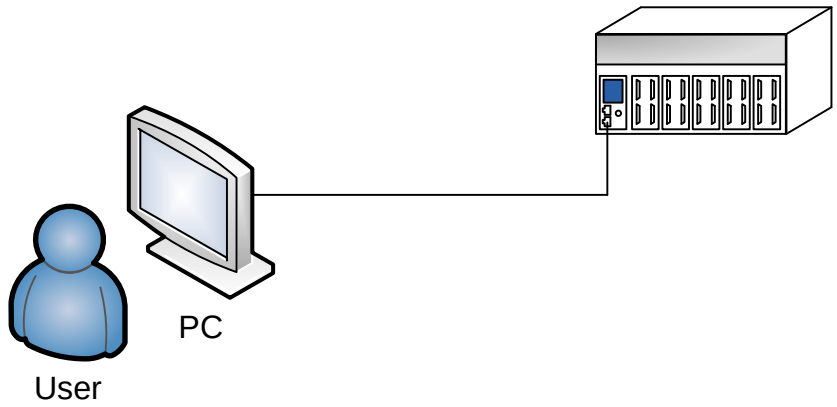
1.1. Connection over Network

The PC usually acquires its IP address from the local DHCP. If there is no DHCP present please read Appendix A: How to set up a static IP. A description how to set the device IP can be found in the BatFlex FPGA Card Menu Guide.



1.2. Direct Connection

Please read Appendix A: How to set up a static IP for further instructions.



2. Hardware Installation

2.1. BatFlex

- Connect a power cord to the device.
- Connect the BatFlex with a RJ-45 cable to the desired network.
- Connect the Computer to the same network as the BatFlex.
- Turn the BatFlex device on, using the main switch on the front side.
- The device is now ready to communicate with the PC.

2.2. Remarks

- Keep in mind that the BatFlex system uses a static IP Version 4 configuration. This requires the user to choose an IP separately for each device.
- The IP is updated as soon as the configuration menu closes. Restarting the device is not necessary.
- Network IPs are usually managed by a DHCP Server. Therefore the BatFlex IP must not be in the specified range of the DHCP. Otherwise IP address collisions may occur. Usually there is a static IP range where one should set up the BatFlex system with.
- It's advised to avoid bigger networks (for example global company networks) especially in case of very long measurements. Unexpected or unavoidable maintenance of the network could cause measurement data loss.

2.3. Card Types

The BatFlex Device is designed as amodular System where measurement cards can be replaced whenever the device is turned off. The onboard microprocessor is able to recognize the new configuration on the next power up.

2.4. Overview

Card Type	Card Function
BatFlex FPGA Card	This card contains the onboard data processing controller and the network adapter.
BatFlex Reference Card	This card contains a high precision, thermally regulated voltage reference which is used periodically to calibrate measurement cards.
BatFlex Small Card	This card is a measurement card for small currents up to 24 mA. The full specification can be found in chapter 2.5.4
BatFlex Small Dual Card	This card is a compound consisting of two stacked BatFlex Small cards. This allows to use up to 8 channels with a single card slot. The full specification can be found in chapter 2.5.4.

2.5. Details

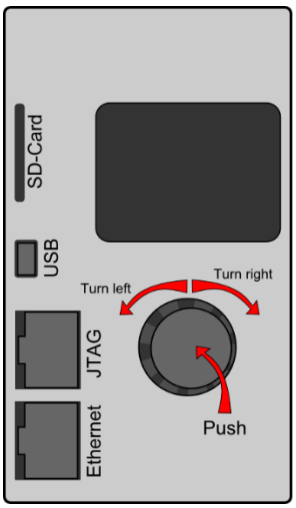
2.5.1. BatFlex Power Supply

Input Specification	*Details*	*Value*	*Unit*
Input voltage	Nominal	85-264	VAC
Frequency		47-63	Hz
Line Safety Switch	Recommendation	5	A

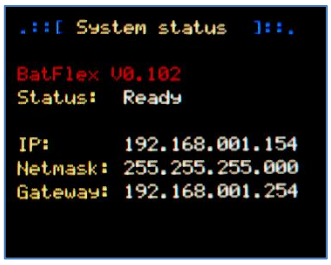
2.5.2. BatFlex FPGA Card

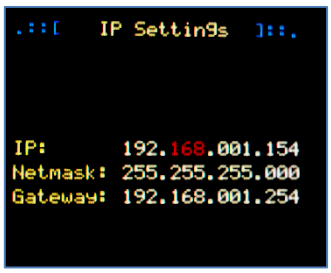
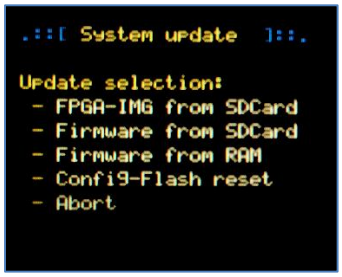
2.5.2.1. Controls

The Bat Flex Control panel is very simple to use. One can navigate through menu entries by turning the wheel to the left or to the right. Selections are confirmed by pressing the wheel. The SD card slot can be used to upgrade the firmware of the device. USB and JTAG are for service and debugging only.



2.5.2.2. Menu Guide

	Startup Screen: This image appears when the device is booting. The BatFlex system is started up and shut down with the power switch on the front side. No additional actions are required.
	This screen is displayed after starting up the device. It's only informative which means that no settings can be adjusted here. The status label indicates if there are any errors or complications detected

	This screen is used to update the BatFlex network configuration. To enter the dialogue, push the button once. Parameters can be adjusted by rotating the wheel. To advance to the next parameter, press the button once again. The active field will light up in red.
	This page is used to keep the system up to date. All device users will be notified if an important update is available.**WARNING**: This section is reserved for experienced users, wrong updating could damage the device. **FPGA-IMG from SD**: A new FPGA image will be transferred from the SD card to the device. This is a major update, which means that the entire software is renewed. **Firmware from SDCard**: The FPGA boots up several soft cores during runtime. This section updates the soft core firmware. The FPGA programming will remain. **Firmware from RAM** Code can be loaded dynamically to the device RAM. This function will copy the running code into persistent memory. Please note that this section should be used by developers only. **Config-Flash reset** Configuration is set to default and will be rebuilt.IP address and Port will be set back.

2.5.2.3. Warnings

- Do not plug the Ethernet cable into the JTAG connector. The connectors have different pin counts, however, because of the RJ standard, they look very similar.

2.5.3. BatFlex Reference Card

2.5.3.1. Specification

Channels	*Details*	*Value*	*Unit*
Number of channels	-	10	Pcs.

2.5.3.2. Warnings

- The output cables must not touch the case in any way. Connecting the reference output to the case will lead to wrong calibration of the device.

2.5.4. BatFlex Small Dual Card

For informations about the output connector please read Appendix B: BAT FLEX Small Connection Designation

2.5.4.1. Specification

Channels	*Details*	*Value*	*Unit*
Number of channels	-	8	Pcs.

Current measurement	*Details*	*Value*	*Unit*
Resolution	± 188 uA,	100	pA
	± 750 uA	400	pA
	± 3 mA	1.5	nA
	± 24 mA	12	nA
Accuracy	full scale	±0.05	%
Long term drift		~30	ppm / day

Current output	*Details*	*Value*	*Unit*
Output Range	Resolution: 50 nA	±24	mA
Voltage Range	Current = 24mA	± 10	V

Voltage Measurement	*Details*	*Value*	*Unit*
Range		± 12.5	V
Resolution		6	µV
Accuracy	full scale	± 0.01	%
Long term drift		~10	ppm / day

2.5.4.2. Warnings

- Do not short circuit different guard pins. This can cause permanent damage to the card.
- The reference output cable must not touch the case in any way. Connecting the reference output to the case will lead to wrong calibration of the device.

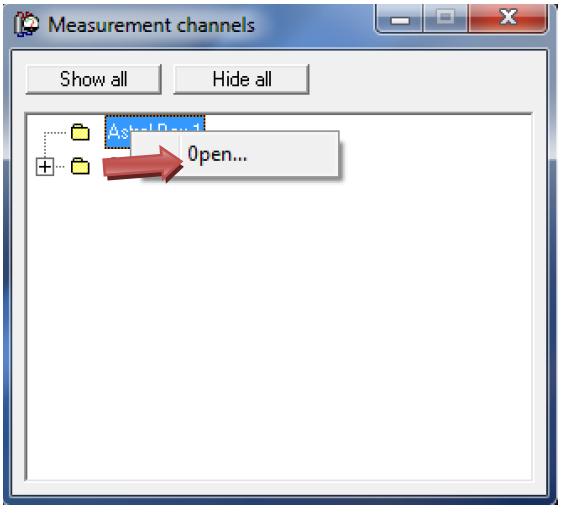
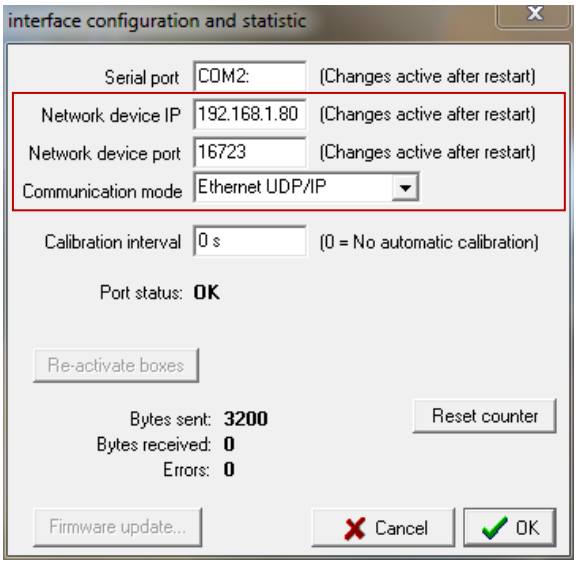
3. CCCC Setup

3.1. Preparation

First of all the CCCC-Folder needs to be moved from CD to the local hard drive. From there the application can be started by executing „cccc.exe“. No additional installation is required.

3.2. Communication Setup

After setting the IP address correctly the application needs to be restarted.

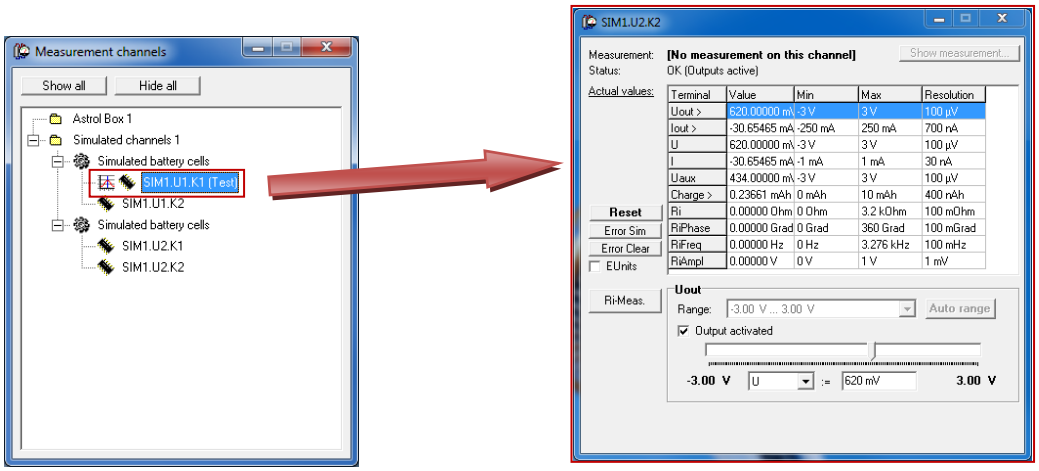
	On startup the application searches for a viable device on the Network. If the device is not yet configured, the first action after the main window shows up is to get into the communication setup by right-clicking on „Astrol Box <x>“.
	Devices can be connected troughSerial Port (BatSmall Series) or Ethernet (BatFlex Series). This Manual focuses on the Ethernet Version. The important parameters are marked red: • IP Address: The device IP address, can be configured on the small device screen. • Network device port: Communication port ,default port is 16723 • Communication mode has to be set to „Ethernet UDP/IP“.

3.3. CCCC Overview

After restarting the application with the communication set up correctly, the devices on the bus should be identified and displayed in the device list similar to the screenshot on the right side.

By right click on a channel in the list, the channel window can be opened.

In that window all measurement values for the selected channel are displayed. Additionally a constant current or a constant voltage can be set to the output of the channel for testing purposes.



Care should be taken to the measured current in this window because the current measurement range doesn't switch automatically to constant current mode. The range can be chosen by clicking on „I“ and selecting the appropriate range in the dropdown menu.

Output Modes
Constant voltage: By clicking on „Uout >“ a slider shows up. By enabling the checkbox the value chosen with the slider is sent to the device.The device then tries to reach the defined voltage. Please note that the voltage is regulated with the device software because the BatFlex Small card outputs are current channels. This may lead to a pulsating output waveform when used with inadequate loads.
Constant current: Same procedure as with constant voltage. One can click on „Iout >“ and then set the desired output current.

By right-clicking on the „Astrol-Box“ in the channel-list a window appears with some additional information about the selected device. There are also some buttons to calibrate, reset, search for new devices and update the firmware.

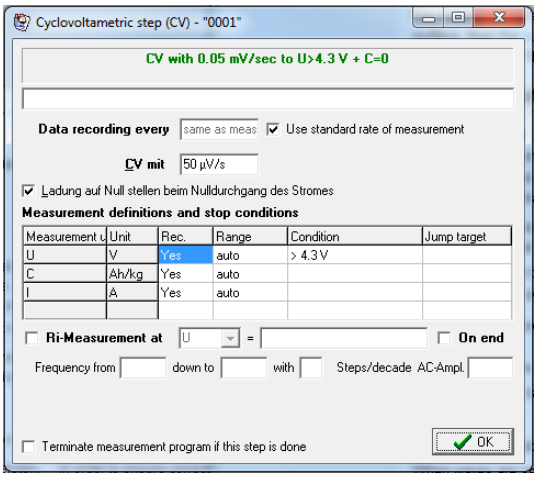
4. Set up the Measurement Program

4.1. Introduction

Each measurement consists of 3 different files. All files are readable with a text editor.

Type	Function
Measurement Program File (*.mpr)	This file contains the general structure of the measurement. It can be created with the Editor Tool (CCCC Tool). If one wants to implement a custom software or script to create measurement flows,one should refer to the step syntax documentation.
Data File(*.dat)	The Data File is created by the CCCC Software during a measurement. It contains the measurement data recorded by the device.
Log File (*.log)	This File contains all the events that took place during the measurement. For example if the measurement was canceled or if a counter was set to a specific value during the data recording.

The files should not be separated from each other during a measurement. Otherwise the CCCC Software will not recognize preexisting data and is going to create a new Data File in the folder of the Measurement Program File.

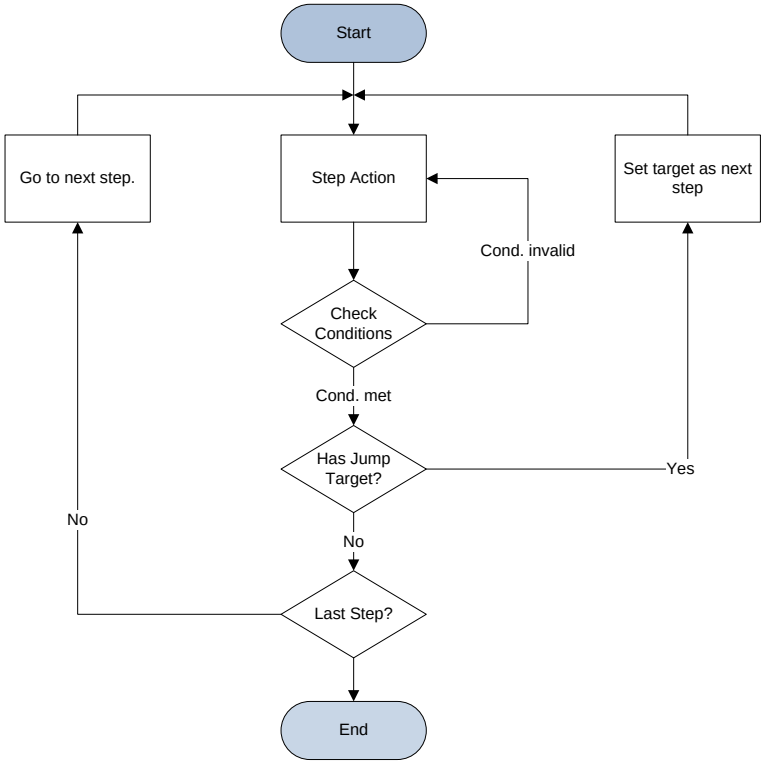


This window shows the configuration page of a cyclovoltametric step

However if one likes to share the data after a recording, it is sufficient to pass just the Data File because it contains all the essential information to visualize the results.

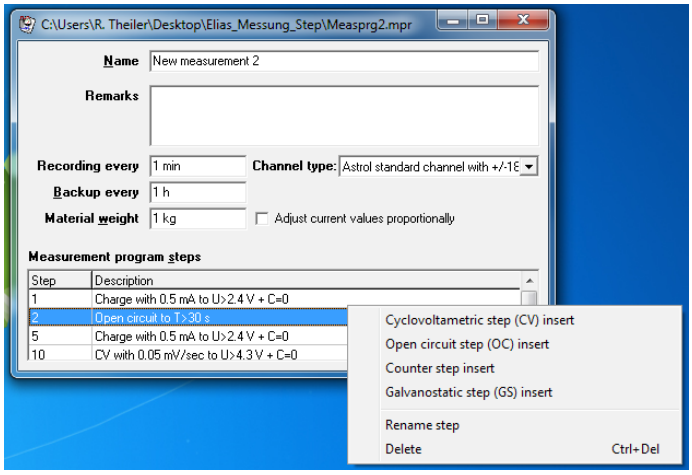
4.2. Measurement Flow

Each measurement is defined as a sequence of different steps. The execution pointer will then move from position to position during the execution. Each step has its unique ID and can be configured with individual parameters. It's also possible to jump between the steps by setting conditions to these parameters (for example if U > 1.5V jump to ID 20) to offer maximum flexibility to the user.



4.3. Available Steps

Step	Function
Counter Step	The Software offers 3 counters that can be incremented, decremented or set to a specific value with this step. It's also one of the most obvious points to initiate a jump to another step. Counters are normally used if one wants to iterate a program n times.
Galvanostatic Step	This step implements a galvanostat (or current source). Its main purpose is to keep the current through the cell constant, disregarding changes in the load itself. This step offers a conditional reduction of the current depending on another parameter (voltage, auxiliary current, ...)
Cyclovoltametric Step	This steps purpose is to implement a cyclic voltametry. It's capable to run a predefined voltage ramp on the output.
Open Circuit Step	This step opens the output for a specific amount of time.



The measurement editor overview: Inserting new steps to the program can be simply achieved by right-clicking at the desired position

4.4. Assignment

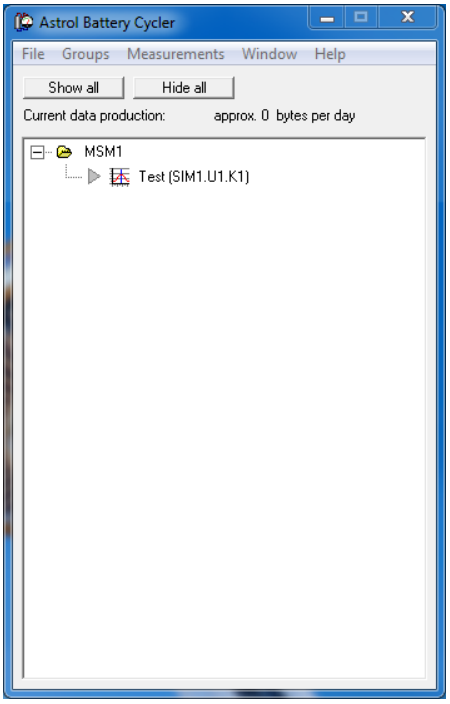
To assign a data file to a channel one has to switch from CCCC Tool to the CCCC main software.

Each channel can contain a single measurement file at the same time.

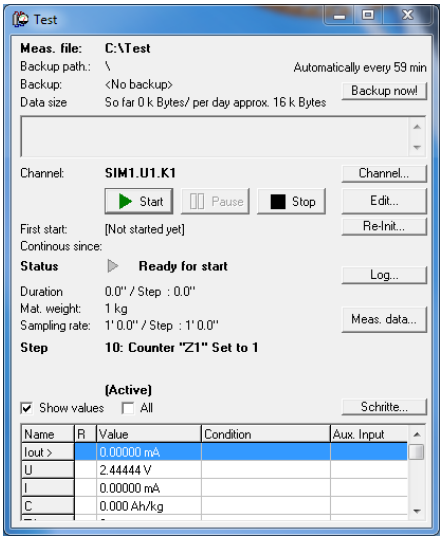
A new measurement has to be started trough the assignment dialog in the CCCC main window (or with the shortcut Ctrl + N). One can select the predefined Measurement Program File here. The dialog asks here for an optional backup path to avoid loss of data during longer measurements. In a last step an available channel has to be selected.

After that the measurement window can be opened.

The measurement window contains control elements to start stop and pause the data recording as well as a table with the current measurement values for each active recording.



Active measurements are listed in the CCCC main window. It's possible to add different category folders here.



Each measurement has its own control window

The recorded data can be exported to a file or displayed in a graph by clicking on the „meas. data" button. For further details please refer to the Data Analysis chapter.

The measurement file can also be changed this way (even during a running measurement) by pressing the „Edit..." button.

It's possible to track the previously mentioned execution pointer during a measurement by opening the „Schritte (Steps)" window.

5. Measurement-Program Example

5.1. Example File

There is an example file on the CD with the name test.mpr. This file can be opened with the CCCC-Tool. This file contains only the program flow which describes the measurement behavior. The recorded data are saved in a separate file with the ending *.dat.

5.2. Program Description

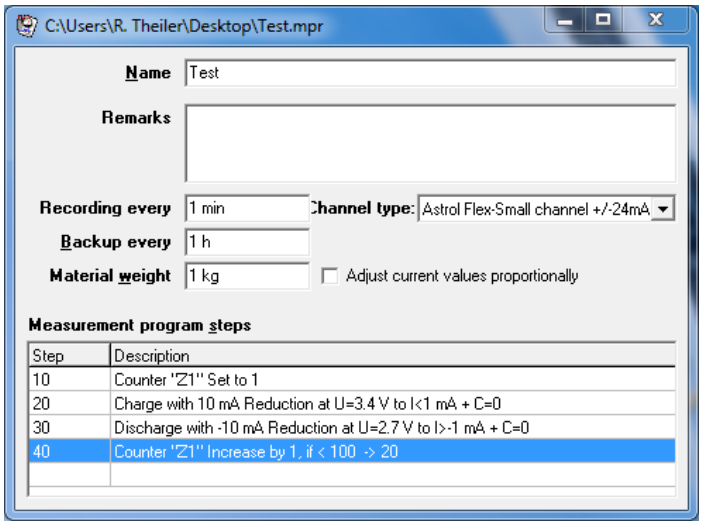
The following chapter explains the example file test.mpr which contains a program for 100 GS-cycles from 2.7-3.4V with 10mA.

If the file is opened with CCCC-Tool there is a window with all program steps listed. Every step has a unique number which acts as a reference for conditional jumps from other steps.

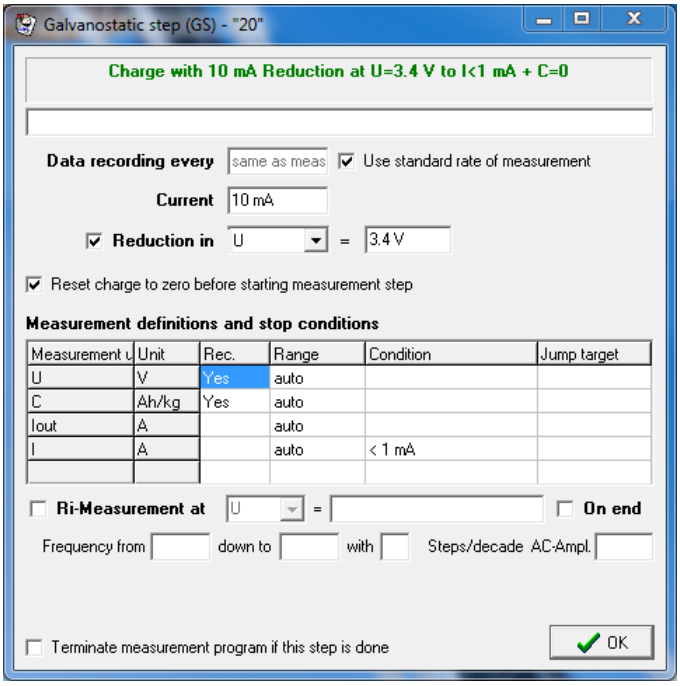
The first step is a **counter step** which sets the cycle counter to one.

The following two steps are **galvanostatic-steps** which charge/discharge with a constant current until the defined end voltage is reached. With the reduction condition the voltage is being held constant until the current drops below the defined current limit of 1mA.

After these two cycles a counter step increases the counter and jumps to the next charge step if the cycle counter hasn't reached the limit of 100 cycles.



At the end there is a charge cycle to charge the cell to a specific charge condition for storage.In the **GS-Step window** there are many options available. The important ones are the charge current and the reduction condition where one can choose the measurement source.



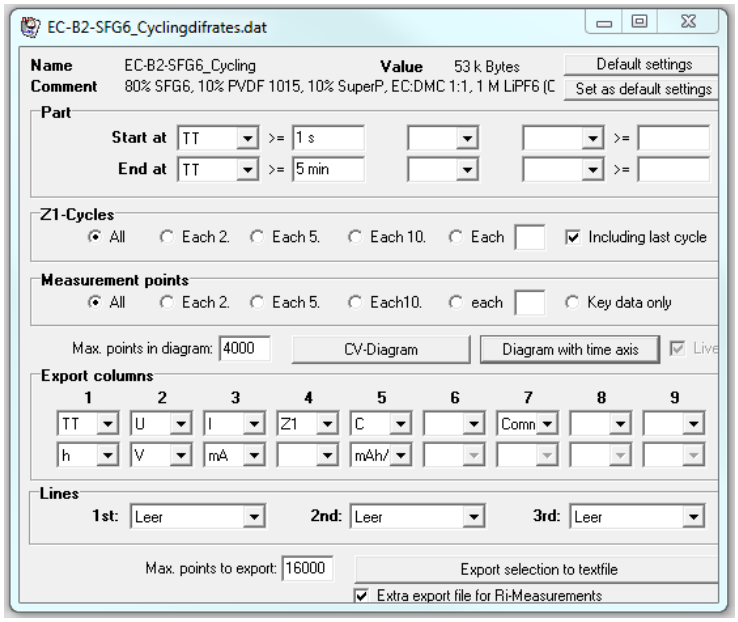
In the conditions table multiple conditions on which the step needs to stop or jump to a predefined step number can be defined.

After saving the program one can proceed with the measurement and data analysis.

6. Data Analysis

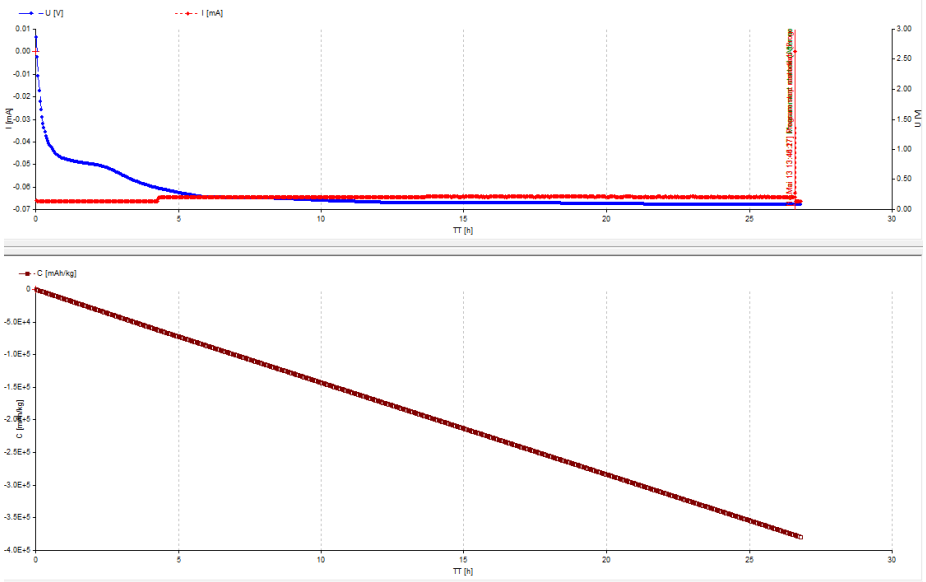
One can view a plot of the data at any time during a running measurement. After the process is done, the Data File can be opened with the CCCC Tool software to display and filter the results. To filter the results one has to define conditions in the data analysis dialog. CCCC Tool offers two main methods to display the data, as a CV - diagram (Current – Voltage) or as a time dependent diagram.

There are many customizable parameters to get the best view on the desired data:



7. Export and Printing

Recorded data can be exported to a text file (similar to the CSV standard, space separated values). There is also an option to print out the plots directly from the CCCC Tool software.



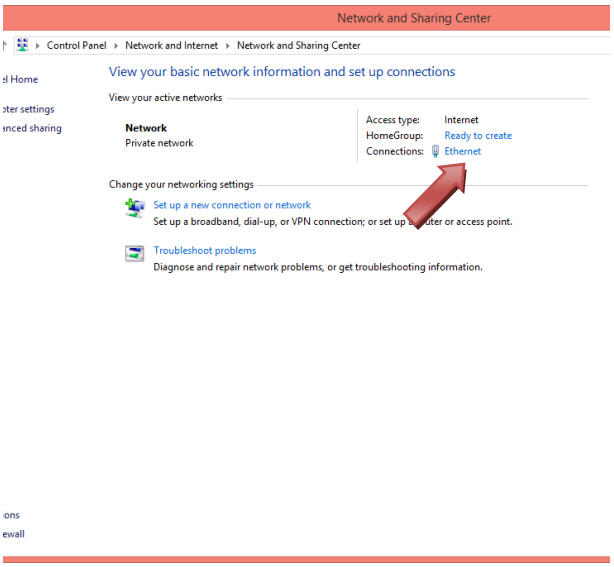
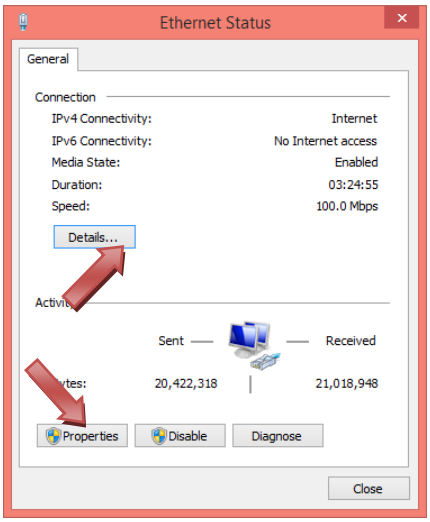
8. Simulation Channels

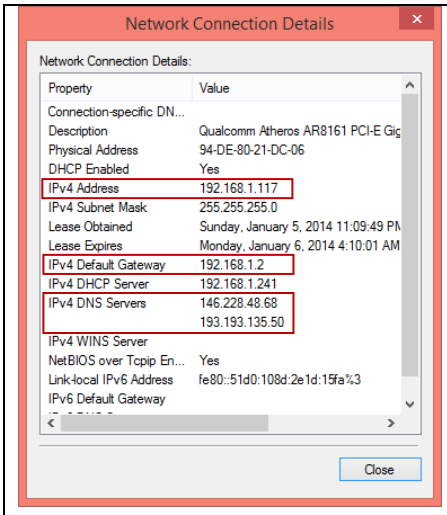
The CCCC Software offers 4 simulation channels. They can be used to test a measurement flow. Keep in mind that these channels may not be completely accurate due to a simpler simulation algorithm.

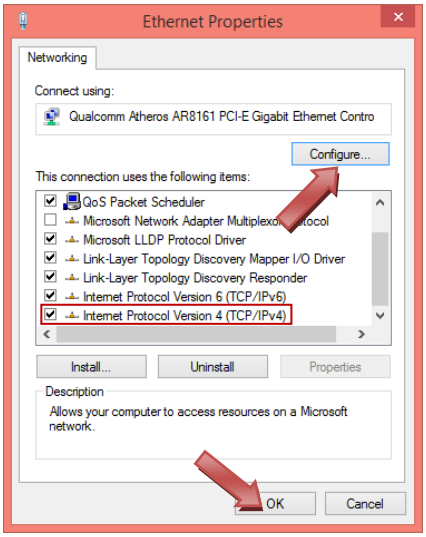
9. Appendix A: How to set up a static IP

9.1. Introduction

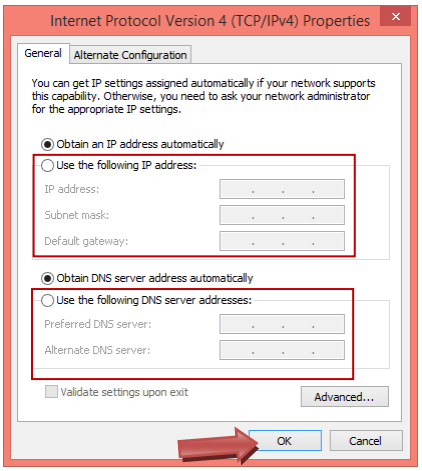
This step-by-step guide describes how one can set up a static IP on a windows computer (Tested with Windows 7 and Windows 8). This requires a running network card with up to date network drivers.

	Open the Network and Sharing Center. This can be found in the Control Panel under Network and Internet. A Control Panel can be opened by pressing “Windows + R”, then type “control panel”. Open the connection by clicking on its blue name.
	Click on Details. A window containing all detailed information about this network adapter will pop up next. The following parameters are essential, it`s recommended to copy it for further use: • IPv4 Subnet Mask • Default Gateway • DNS Servers Click on Properties now.





Click on Internet Protocol Version 4 (TCP/IPv4) and then "Configure" it.



This final configuration form allows the user to enter the desired IP address. Co complete this step, click on "Use the following IP address:" This will activate the input fields. One should use the data obtained in the first step to complete the Subnet mask, Gateway and the DNS server addresses.

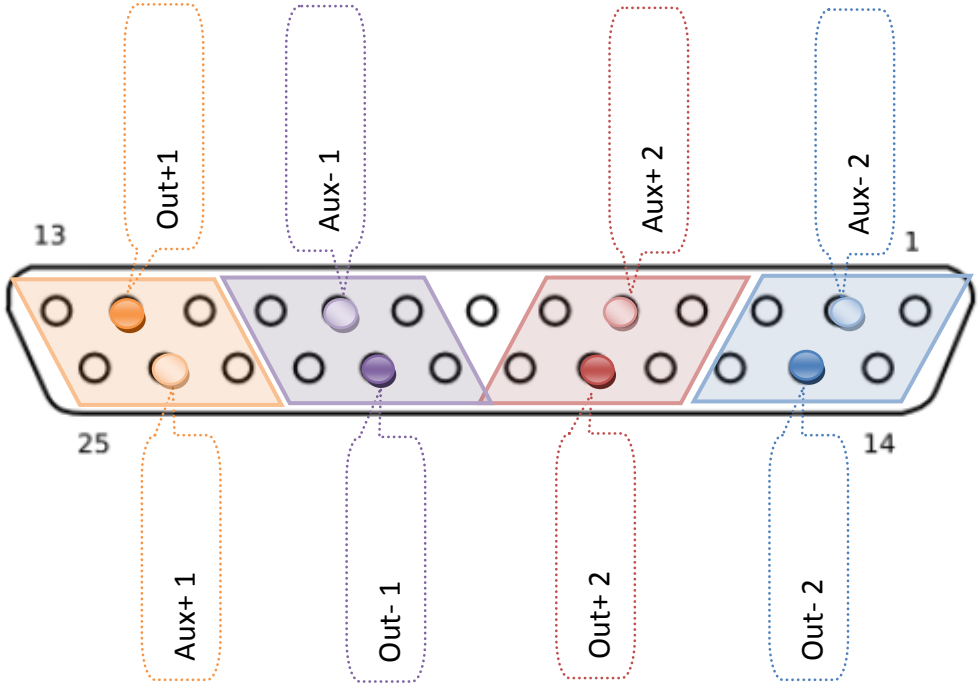
The computer will change the IP address as soon as the dialogue has been confirmed.

Hint: The purpose of a DNS is to resolve a URL to its IP address. In consequence, if one does not enter a valid DNS address, internet sites have to be resolved manually. For example www.google.ch will not show any result, the IP address (http://74.125.224.72/, Date: 6.1.2014) has to be used.

10. Appendix B: BAT FLEX Small Connection Designation

Pin	Function	Comment
1	Guard- 2	
2	Aux- 2	
3	Guard- 2	
4	Guard+ 2	
5	Aux+ 2	
6	Guard+ 2	
7	NC.	Not connected
8	Guard- 1	
9	Aux- 1	
10	Guard- 1	
11	Guard+ 1	
12	Out+ 1	
13	Guard+ 1	
14	Guard- 2	
15	Out- 2	
16	Guard- 2	
17	Guard+ 2	
18	Out+ 2	
19	Guard+ 2	
20	Guard- 1	
21	Out- 1	
22	Guard- 1	
23	Guard+ 1	
24	Aux+ 1	
25	Guard+ 1	

Connector (front view, contact side)



Never connect different guard types, the device could be damaged!

The connector on the device side is a Sub-D 25 female

11. Labels

11.1. Rear side

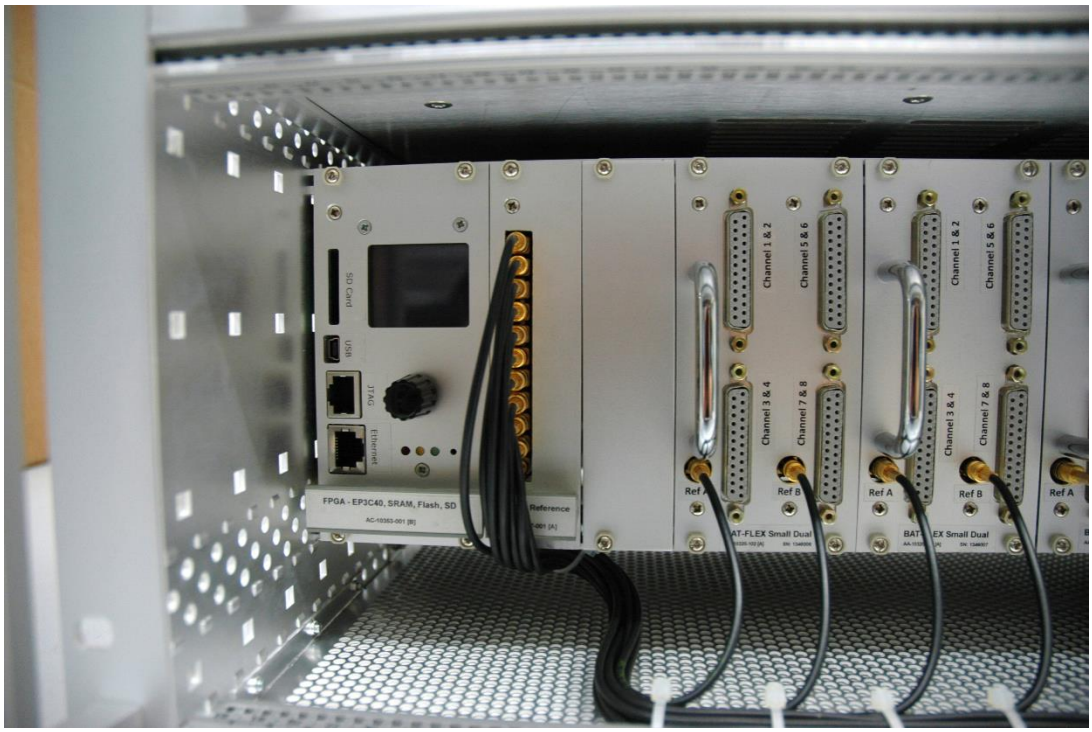
Type label with serial number.

11.2. Inside

Type label with serial number on the left side.

12. Order code

Type	Order Code
BatFlex Base Device with Reference Card	AA-10320-001
Bat Flex Small Dual (8 Channels)	AA-10320-102



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