

# User guide to EA Power Control

**Version: 2.17**

## **Requirements for installation and operation:**

- PC with min. 2GHz and 1GB RAM
- Windows 7 (32bit/64bit) or newer
- Microsoft .NET Framework 4.5.2 (included in the installer)
- This software is compatible to these device series:
  - » EL 3000 B
  - » EL 9000 B / EL 9000 B HP / EL 9000 B 2Q
  - » EL 9000 DT / EL 9000 T
  - » ELM 5000
  - » ELR 9000 / ELR 9000 HP
  - » ELR 10000
  - » PS 3000 C
  - » PS 5000
  - » PS 9000 1U
  - » PS 9000 2U
  - » PS 9000 3U
  - » PS 9000 T
  - » PSB 9000 / PSB 9000 Slave
  - » PSB 10000
  - » PSE 9000 3U
  - » PSI 5000
  - » PSI 9000 2U
  - » PSI 9000 3U / PSI 9000 3U Slave
  - » PSI 9000 15U/24U
  - » PSI 9000 DT
  - » PSI 9000 T
  - » PSI 9000 WR / PSI 9000 WR Slave
  - » PSI 10000
- This software is compatible to these interface types:
  - » USB (virtual COM port)
  - » Ethernet/LAN

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## 1. Copyright and legal notice

This software is only compatible to power supply and electronic load devices of the above listed series and to the listed interfaces. Any changes to the software and its documentation are prohibited. Exceptions require permission of the owner. Resale or rent are prohibited. Dissemination to third parties is permitted, if software and documentation remain unaltered.

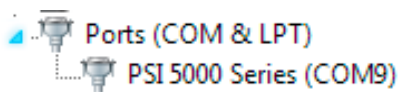
## 2. Introduction

**EA Power Control** is a Windows™ software to remotely control one or multiple units of compatible power supplies and/or electronic loads. This happens via digital interfaces only. Currently supported are USB and Ethernet.

This software is based upon the programming language Visual C# and requires the Microsoft .NET Framework with a certain minimum version which is probably already installed on the PC system or will be installed by the installer of the software product, if selected by the user.

## 3. Preparation

Before you start using **EA Power Control**, at least one compatible device should be connected to the PC. If the device is connected via USB cable, it requires a USB driver to be correctly installed and running. The installed USB device can be found in the Windows Device Manager, in section "Ports (COM & LPT)". Example:



*The driver file is usually installed on the system only once. In case a new device is connected the first time or a known device is connected to a different USB port of the PC, the device will be installed again. New devices will be assigned an unused and unreserved COM port.*

### 3.1 Installation of the software

The installation of the software is done via a standard installer setup. The installation requires administrator permissions. During installation you can select additional packages, if not already installed, which are required by the software to run correctly:

- Microsoft .NET Framework 4.5.2 or newer
- USB driver (not needed for devices which are used via Ethernet only)



*If there is trouble running or even starting the software, it's recommended to repeat the installation with the packages of Microsoft .NET and Visual C++ Runtime marked.*

After the installation you can start the software from desktop or via the Windows start menu in path:

**Windows 7: Start -> All programs -> EA Power Control**

**Windows 10: Start -> E -> EA Power Control**

## 4. Very first start

After the installation and the very first start of the software, the GUI language is set to English as default. This setting can be changed to German, Russian or Chinese.

## 5. Software start / Search for devices

After the start of the software it can automatically search for connected, compatible devices on COM and Ethernet ports. Which of both are included in the search can be defined in "Configuration". This makes it possible to spare searching for COM port devices if only Ethernet connection is used or vice versa.

The search can be repeated anytime with by double-clicking the „Search for devices“ icon, as long as the access to the main window isn't blocked

After the search, detected and compatible devices are listed in the device list ("Devices") as icons. The icons are captioned with the series name and the COM port resp. assigned IP they are connected to, as well as the user text (if not empty).

Example with 1 detected device:

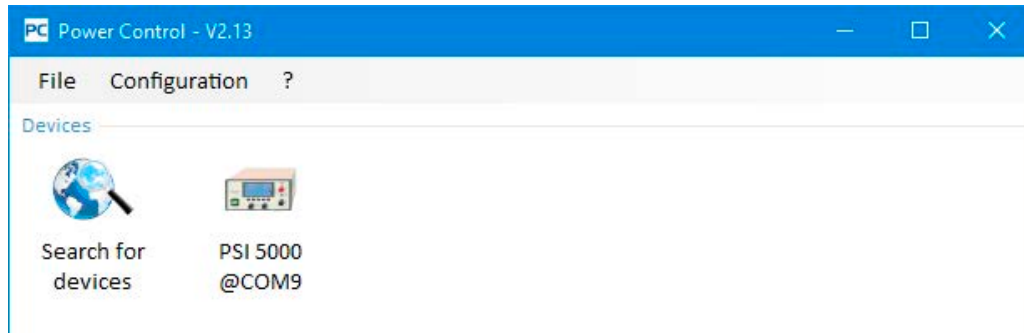


Figure 1



*In case a device is connected to the PC with two interfaces at the same time, USB has priority. The device is then listed only once as connected via COM port.*

If there are no devices found, the device list will be empty:

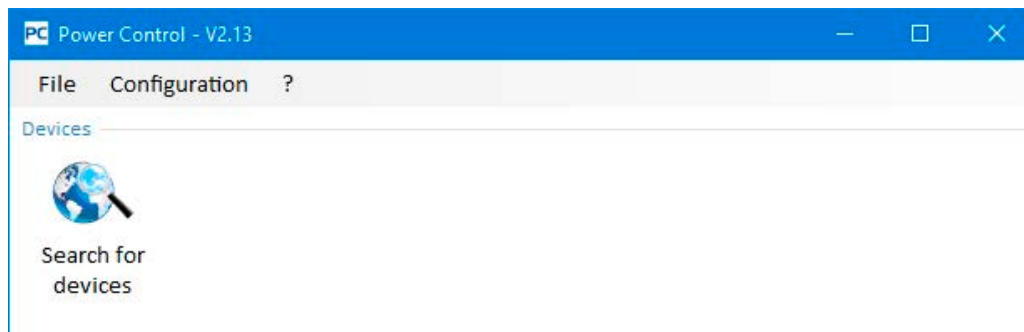


Figure 2

There are several reasons why a device isn't detected by the search:

- If the device shall be controlled via USB cable:
  - a. The device is connected via USB, but the USB driver isn't or not correctly installed (see section 3. Preparation).
  - b. The USB cable isn't plugged at all or not plugged correctly.
  - c. You have a device of a brand-new series and the currently installed version of **EA Power Control** doesn't support it yet. Updating the software can help here.
- If the device shall be controlled via Ethernet:
  - a. The Ethernet port which is set on the device doesn't match the one in "Configuration".
  - b. One or more double IPs have been assigned or the default IP of the device has not yet been changed to meet the local requirements (all devices are shipped with the same standard IP).
  - c. The IP which has been assigned to the device manually or by DHCP isn't within the search range as defined in "Configuration".
  - d. The PC's network adapter can't access the device's IP due to wrong settings

## 6. Conditions for remote control

The device you intend to use in remote control can be in different control states:

- 1) It's currently controlled by the analogue interface (where featured) and thus not controllable via digital interface.
- 2) It's in local state (display shows "Local") and thus locked from remote control in terms of writing to it.
- 3) It's freely accessible. Then the PC can take over remote control.
- 4) It's currently controlled via another digital interface or it's in MENU mode

If the situation is according to 3), the device will accept remote control commands (write access). Otherwise, only the actual values of voltage, current and power are read and displayed (resistance is calculated). In order to set the device into remote control, any other external control or local state has to be canceled manually at the device. Afterwards, it can be set to remote control with button "Remote on" in the app "Terminal" (see below). Details about device states can be found in the user manual of the device.

### 6.1 Controlling multiple units at once

Since version 1.52 of this software there are two separate ways to control and monitor multiple devices:

- Control and monitoring in separate windows, one for each unit (feature included)
- Control and monitoring in one window ("Multi control") (not free of charge, optional)

Both ways work differently. The separate handling in single windows for each unit is only recommended for a small number of devices, let's say up to 5. When wanting to control and/or monitor more units, the overview would be lost with that many windows open at the same time. This is what to use "**Multi control**" for, which offers the option to have up to 20 units of different devices in a clear overview in a single window. One of the primary functions of "**Multi control**" is to set values or status of output/input on the selected device at the same.



*The feature "**Multi control**" is included in **EA Power Control** from version 1.52, but can't be used without prior installation of a license code which isn't free of charge. For more information refer to 12. License management and 13. App „Multi Control“. For test and preview of the Multi Control app and other features you may request a trial license. See 12.1 Trial license.*

Single window operation mode allows for up to 10 devices at once. This can be achieved by opening the control app "Terminal" for every unit and switch between the windows. Those windows can be arranged at will on the PC screen. All units and windows work separately, there is no interconnection. More details below.



*Remote control or even just monitoring devices on their actual values requires constant communication. The more devices are controlled/monitored, the more communication traffic will be generated and depending on the overall load of the PC with background tasks and other software running, **EA Power Control** might slow down because of too little CPU time. This can result in delayed response to buttons clicks or delayed refreshing of actual values and status.*

## 7. Graphical user interface (GUI)

### 7.1 Main window

After the start and search for devices (if search on start is activated), the main window will appear:

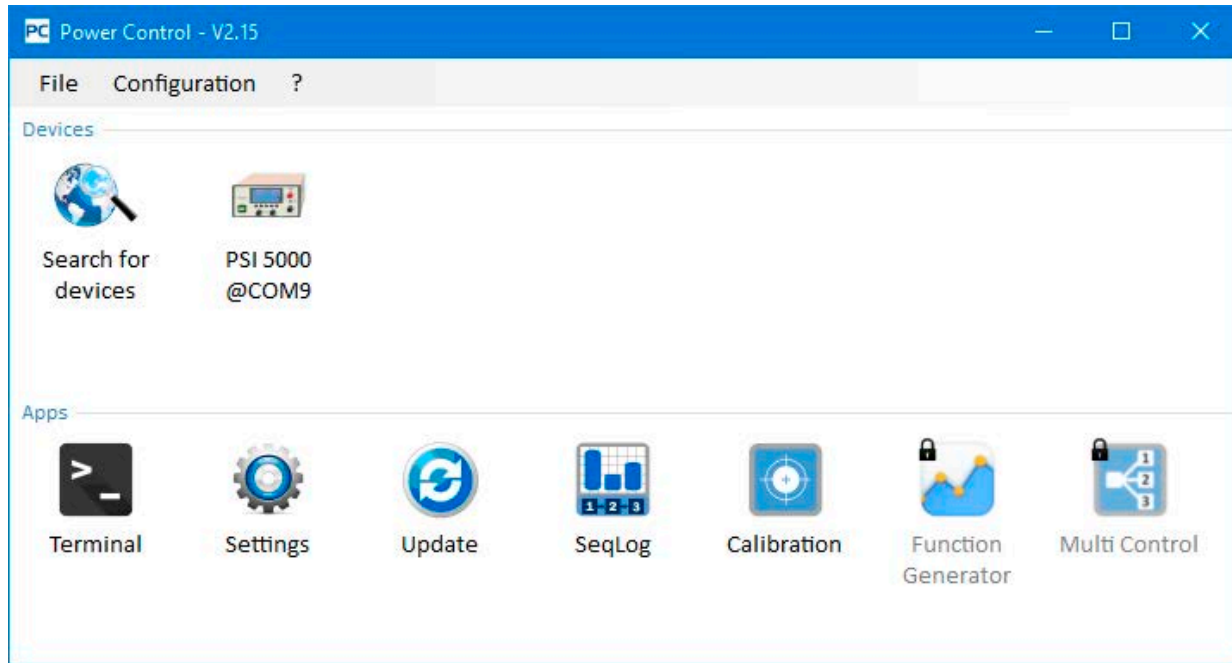


Figure 3

The windows is separated into two parts:

<b>Devices</b>	This part will list the detected devices as icons. In case more devices were detected than would fit in one row, the window will be expanded. The max. number of devices in the list can be 20. The software supervises the devices and in case the connection to a device is lost, probably due to a removed cable, the device will also be removed from the list after a short time. After re-establishing the connection again, the device list isn't automatically refreshed.
<b>Apps</b>	This part will show the available apps (short for: application). Every app offers a set of distinct features. More apps can be installed for use within this software, once available.

App overview:

App name	Functional description	Multiple instances?
<b>Search for devices</b>	After double-click, it will start searching for compatible devices on the selected interfaces. This is also used to refresh the device list. During the search a small windows is opened in front.	-
<b>Terminal</b>	This app is the control application for the devices. It opens a window in which actual values, set values, protection thresholds and status are shown. It can be opened up to 10 times for any 10 devices from the device list. Furthermore, there is direct access to almost every device feature by using commands in SCPI language (except for PS 5000 series) or ModBus protocol.	Yes, up to 10
<b>Settings</b>	Opens a window for comfortable access to device settings as they can be set up in the MENU of the devices. For series which don't have a setup menu, like PS 5000 and PSI 5000, this is the only way to access certain settings related to the device operation.	Yes, up to 10
<b>Update</b>	Opens a window in which device firmware can be comfortably updated. Updates require to load a special update file (*.upd), which can be obtained from the manufacturers website or upon request.	No
<b>SeqLog</b>	Opens the sequencing and logging window. See 9. App „SeqLog“ (Sequencing and Logging) for more information.	Yes, up to 10
<b>Calibration</b>	Opens a windows which guides the user through a process of re-adjustment as part of a calibration. This can be come necessary for several reasons. Further utilities are required to perform the re-adjustment. See 15. App “Calibration” for details.	
<b>Function Generator</b>	Unlockable feature (license with costs). Opens a window for devices of series which feature a function generator or sequence generator. More details in 14. App „Function Generator“.	Yes, up to 10
<b>Multi Control</b>	Unlockable feature (license with costs). See 13. App „Multi Control“. Allows for the control and monitor of up to 20 devices of same or different type at the same time and in one window, along with synchronous setting of values and status	No

## 7.2 Handling in the main window

The handling of the software, concerning the use of the device icons and app icons, can be done in two ways:

- By double-click
- By drag 'n drop

### 7.2.1 Handling by double-click

If you double-click an app icon it displays a device list in form of a context menu from which you can select a device to start the app for.

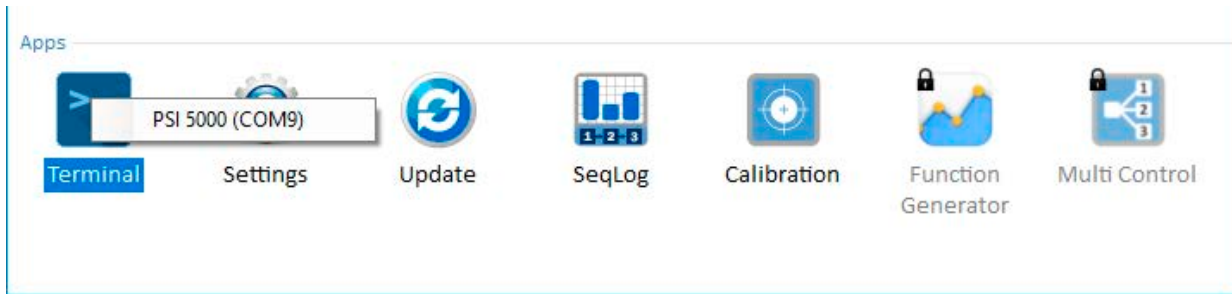


Figure 4 - Open apps by double-click

### 7.2.2 Handling by drag & drop

In order to open an app for a device from the device list, you can simply click the device icon, hold the mouse button and drag the icon onto the wanted app and then drop it. Unless the current situation disallows opening the app, it will be started. Otherwise it should pop up a message about why the app couldn't be started.

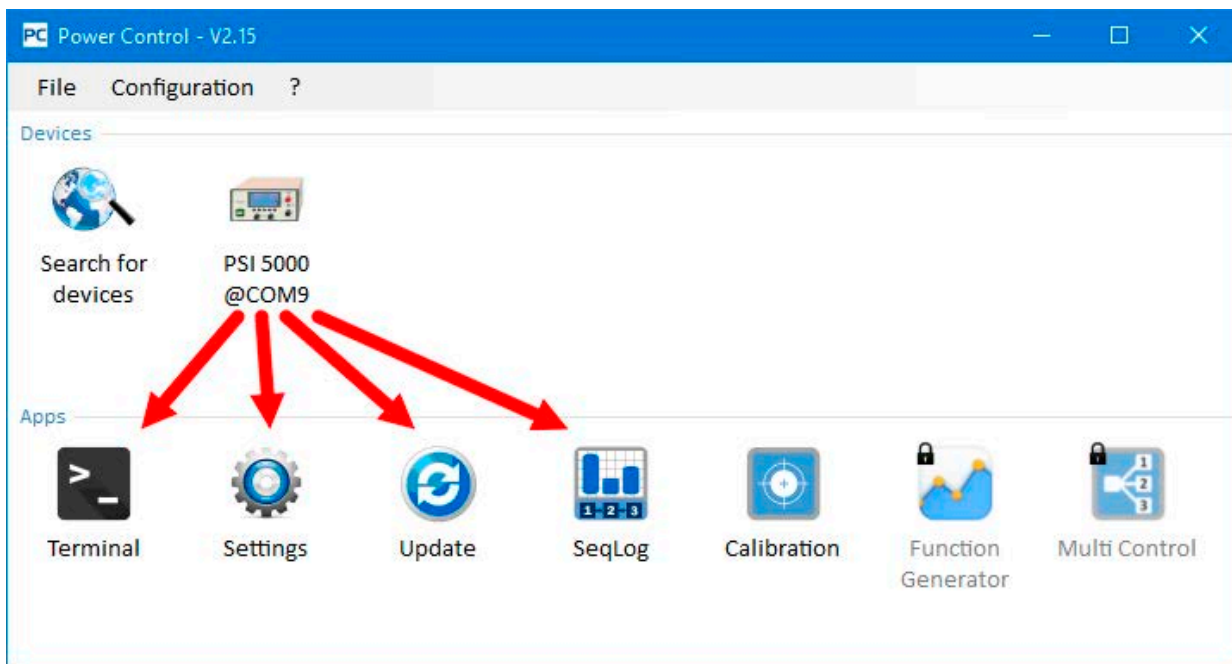
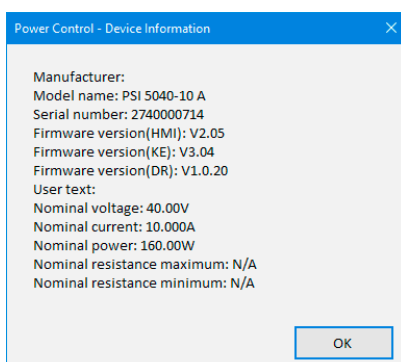


Figure 5 - Open an app by drag & drop

## 7.3 Show device related information

In the device list you can right-click the device icons one to make a window pop up with device information.

Example:



In the example with a PSI 5000 series power supply it becomes clear, that this device doesn't feature resistance mode (R mode). You can also see that the unit has no user text assigned (yet). The user text is intended to be used to distinguish multiple identical devices.



## 7.4 Menu & configuration

Menu item	Description
<b>File</b>	
Close	Closes the software immediately, no matter what other windows are still open yet.
<b>Configuration</b>	Opens the „ <b>Configuration</b> “ window where you can set device communication related settings and/or settings for the software itself
Tab „General“	The checkmarks in this tab enable or disable the support of device connection via USB or LAN interface in this software. When using either one of them, disabling the other can have positive impact on the performance of the software. Default setting: both enabled <i>Note: as long as both are disabled, search for devices can't find anything!</i>
Tab „USB“	Here you can choose to include (=checkmark set) the search for USB devices during the startup of the software. If no USB shall be used, it's recommended to turn off both, this settings and the global interface USB setting in tab "General". This decreases search time. In case the global interface USB setting is enabled and this parameter is disabled, you can still start searching for USB devices with app "Search for devices". Default setting: enabled
Tab „LAN“	This tab is used to define the IP search range and the port for devices connected via Ethernet. The search range is limited to the last octet. The default port 5025, such as it's default on the devices with Ethernet socket, can be changed at will, but only devices matching this port settings can be found within the IP range. You can furthermore choose to include (=checkmark set) the search for Ethernet devices during the startup of the software. If no Ethernet shall be used, it's recommended to turn off both, this settings and the global interface Ethernet setting in tab "General". This decreases search time. In case the global interface Ethernet setting is enabled and this parameter is disabled, you can still start searching for Ethernet devices with app "Search for devices". Default setting „Search at startup“: disabled Default port: 5025 (also see device manual) Default IP range: 192.168.0.2 ... 192.168.0.100
Tab „Language“	Switch GUI language between English, German, Russian and Chinese
Tab „Format“	Settings for the read/write format of the various log files and sequence files: US = CSV file format (comma as column separator) as commonly used in US American Excel or similar tools Standard = CSV format (semicolon as column separator) as commonly used in Europe In this windows you can also deactivate the recording of physical units in the log files (default is: "Activated") in order to have MS Excel (or similar tools) to interpret the values in the CSV as numbers and not as text.
Tab "Other"	Further software related settings: "Connection attempts" = Number of attempts to reconnect to a device to which the connection seems lost before it's actually removed from the list of devices "Device ping (ms)" = Interval to ping a device for presence
?	
Help	Opens this help file (PDF)
About	Opens a small windows with information about the software and manufacturer details
Enable debug log	For internal use only. Do not enable debug mode, as this will slow down the software more or less, depending on the number of devices used in parallel.
Load patch file	This is used to load updates for <b>EA Power Control</b> itself, such as new and other example sequence files or a newer version of this help document. Such patches will be available as download from the manufacturer's website once they become available or are sent via email upon request.
License Management	This window is used to give an overview about installed licenses and unlocked, extended features. It can also be used to order a license or renew it, as well as install a license code to unlock new functions. See 12. License management.
Enable Demo mode	Switches demo mode on and off. In demo mode the software emulates two non-existing devices (1x ELR 9000, 1x PSB 9000) which you can use to open the different app windows and have a preview.

### 7.4.1 GUI language

In tab "Language" you can switch the language of the GUI between English, German, Russian and Chinese. The change is applied immediately after closing the Configuration window.

## 8. App „Terminal“

The app “Terminal” is the main control application window for devices. It can be opened several times for up to 10 devices, in order to control the device separately and sort of in parallel. There is no link or connection between these windows.

The window is used to control the device state (remote, on/off) by mouse clicks, while values have to be entered via keyboard. Copy and paste is possible.

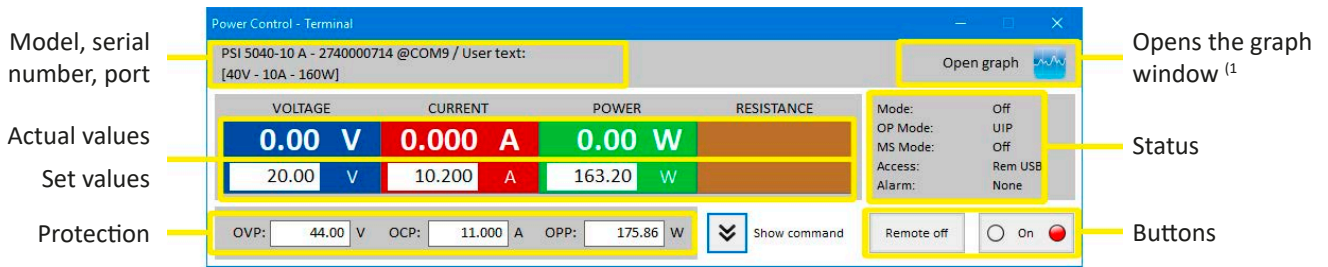
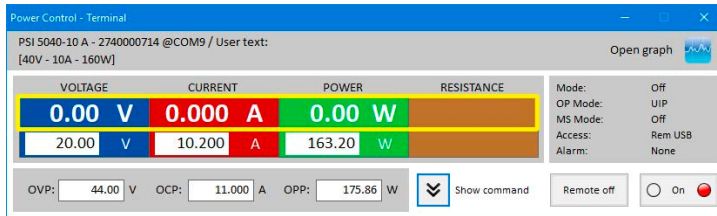


Figure 6

The upper part of the windows is for actual values, set values, protection thresholds and status.

In order to remote control any other function of the particular device, the upper part can be revealed by clicking the “Show command” button. The tabs for SCPI command language (except for PS 5000 series) and ModBus protocol offer predefined selections of commands which can be sent to the device by clicking the “Send” button.

### 8.1 Actual values



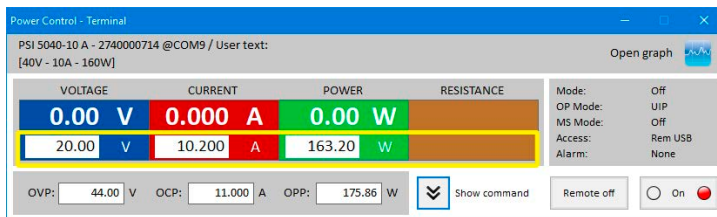
Similar to the value coloring on the devices with color TFT display, the actual values are separated from each other. In the single fields, they are located at the top (big digits). The colored area always shows at least three actual values. With electronic loads, it also shows actual resistance.

Refreshing of actual values is cyclic. High CPU load can, however, delay cyclic refreshing. Especially if there are multiple Terminal windows open. The value format doesn’t always match the format on the display of your device(s), primarily regarding decimal places. Due to the internal translation from per cent values to real values the last digit can be different. This also applies for data recording (i.e. logging, see below).



*Actual values are only read from the device(s) and are influenced by any operation on the device (manual or via analog interface). They are always available, even if the device isn’t in remote control by EA Power Control.*

### 8.2 Set values



The lower parts of the colored areas show the set values (smaller digits). Those are input boxes, which are enabled for putting in values via keyboard after the device has been switched to remote control via any digital interface. This can happen from within the Terminal window by using button “Remote on” or the corresponding command.

After the input boxes have been enabled, they turn white and you can enter values either by typing or by copy & paste.

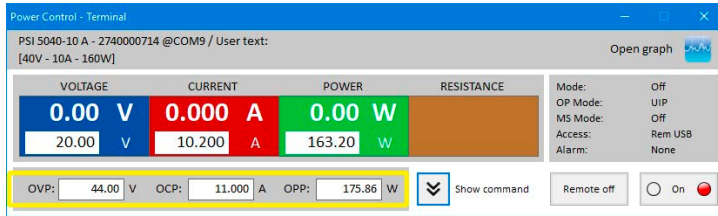
The allowed range of value per input box is identical to what the device allows on the front panel for manual use. The adjustment range of a set value is by default 0...102%, which can be narrowed by the so-called adjustment limits (here short: Limits). These can be defined manually in the MENU of the device or via EA Power Control in app “Settings”. In case, any value you enter is too high or too low, it’s not accepted and the former value will be displayed again.



*Set values are only submitted to the device after pressing key ENTER or RETURN as confirmation.*

1) Only available with app „Multi Control“ unlocked. Also see 13. App „Multi Control“ and 12. License management

### 8.3 Protection thresholds



The so-called protection thresholds are display boxes and input boxes. There are only enabled for entering values while the device is in remote control via digital interface.

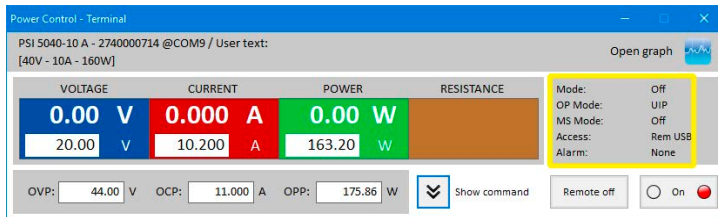
Remote control condition is displayed in the status area by parameter "Access:". After the input boxes have been enabled, you can enter values either by typing or by copy & paste.

The allowed value range per input box is identical to what the device allows to adjust on the front panel for manual use. The adjustment range of a protection threshold always is 0...110% of the related nominal value. In case, any value you enter is too high or too low, it's not accepted and the former value will be displayed again.



*Set values are only submitted to the device after pressing key ENTER or RETURN as confirmation.*

### 8.4 Status



The status area shows a copy of the device status as indicated on the device's display. There can be slight differences. For example, a PSI 5000 device only shows "Remote" in the display, no matter if remotely controlled via analog or digital interface. The status area clearly shows the type of interface in charge (see below).

Status indicators:

**Mode:** Displays the condition of the DC output/input as "OFF" while it's off and while it's switched on, the actual regulation mode (CC, CV, CP, CR) is indicated here. For details about regulation modes please refer to the device manual.

**OP Mode:** Indicates with "UIR" that resistance mode (where featured) or normal mode with "OP Mode = UIP" is active.

**MS Mode:** Shows the status of master-slave mode (where featured) with:

**N/A** = Device doesn't feature „Master-Slave“

**Off** = Master-Slave (MS) is available, but deactivated at the moment

**Slave** = Master-Slave (MS) is available, device is set as Slave (remote control not possible)

**Master** = Master-Slave (MS) is available, device is set as Master (remote control possible)

**Access:** Shows the access to the device via interface as available for remote control with "free" or while the device is in remote control, the type of interface in charge ("rem" = remote control).

**Alarm:** Shows the last device alarm of the device. Some device alarms switch off the DC output/input and have to be acknowledged before the device can be used again. In such a situation, the button ON/OFF below the status area changes to "ACK alarm". It has be used to clear the alarm condition and to enable the ON/OFF button again, but only after there is no alarm present anymore.



*Statuses are only read from the device(s) and are influenced by any operation (manual or via analog interface). They are always indicated, even if the device isn't in remote control by EA Power Control.*

## 8.5 Commands

The app window can reveal an extra part by clicking on the “Show command” button. This allows the user to directly access the device with commands in either ModBus or SCPI (where featured) protocol/language format, in order to query other information from the device or to access functions which are not available in the upper window part.

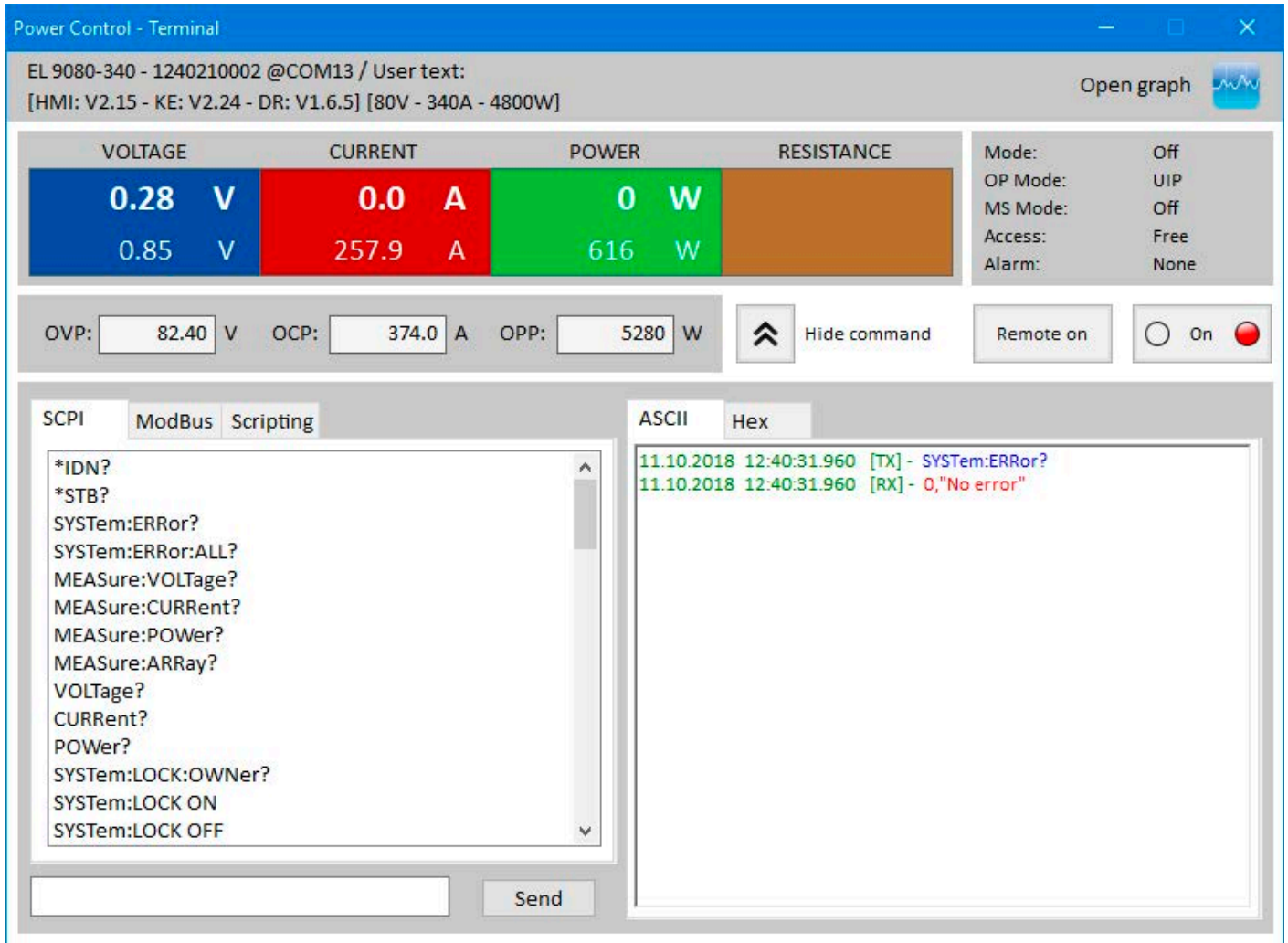


Figure 7 - Direct commands

The tabs “SCPI” and “ModBus” both offer a selected set of commands to choose from and send by click on the “Send” button. Further SCPI commands can be directly typed into the input box (see external documentation “Programming ModBus & SCPI”, which is also delivered with the device on CD or USB stick), while further ModBus commands can be created in tab “Custom” by selecting registers and function codes according to ModBus RTU standard.

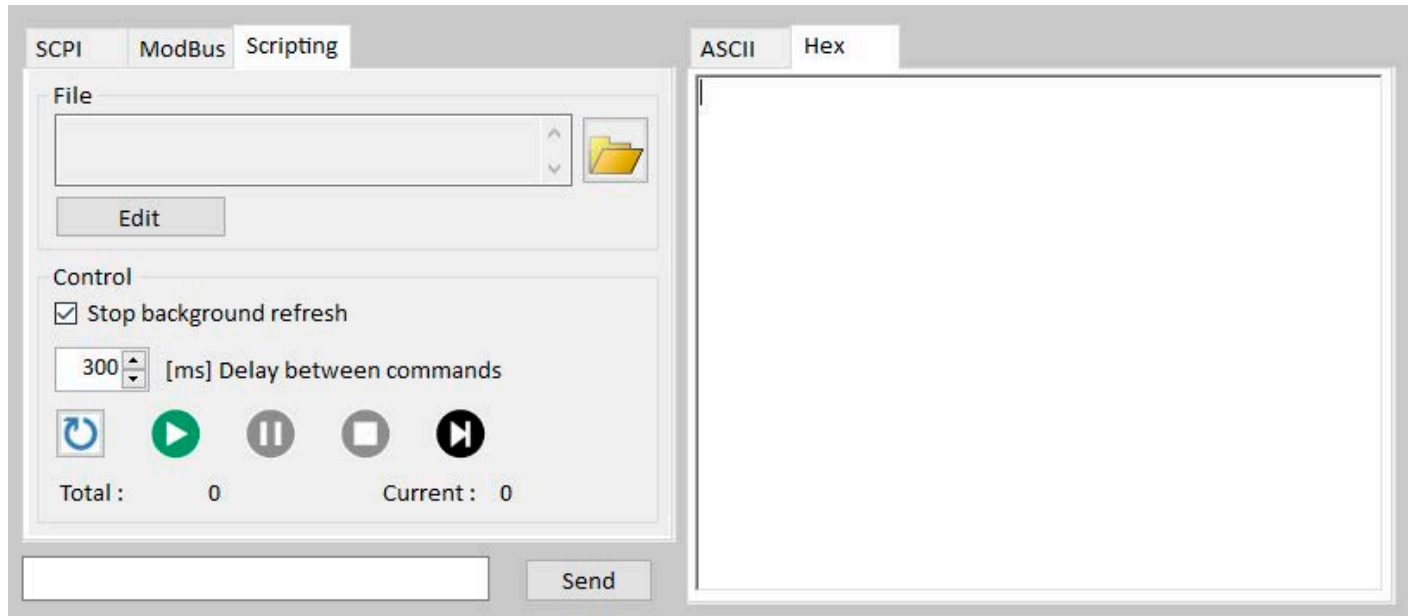
All commands sent and answers received in the selected mode are logged with time stamp in the window part on the right-hand side. The example screenshot above shows that SCPI command \*IDN? has been sent to a PSI 5000 device and the device responded after a few milliseconds.

While SCPI is a text based command language it’s logged in the ASCII tab, ModBus is a binary format and thus logged in the Hex tab.

### 8.5.1 Limitations

- The log doesn’t record all commands in parallel in ASCII and Hex tabs
- When switching between tab “SCPI” and tab “ModBus”, the input mode for the command input box also changes, meaning that typing a SCPI command while ModBus mode is selected won’t result in correct transfer and execution and vice versa, if SCPI mode is active

## 8.6 Scripting



New since version 2.09 is a scripting processor feature in the **Terminal app** window (lower part). It allows to run simple script files (CSV format), containing either SCPI (ASCII text) or ModBus RTU message (binary format written as ASCII text). Mixing of both protocols isn't allowed. The scripted commands plus all responses from the device under control will be written into the log window. The log history can be exported (CSV file) for later analysis (right-click into log window).

Following restrictions and specifications apply:

- The script file isn't checked for plausibility of values or commands, i. e. if any command would try to set a voltage which the device could not set or if a specific command isn't supported
- The adjustable **"Delay between commands"** (4 - 1000 ms), applies for all script lines (global delay); in order to extend the global delay beyond its limit, a WAIT xxxx command can be inserted (see below)
- The script would stop after the last processed line, unless repetition has been activated which runs until manually stopped. Device alarms or connection drops won't stop the script run.
- The script file can't contain mixed commands in SCPI and ModBus RTU protocol format
- The delay of WAIT commands adds to the global delay , i. e. WAIT 1000 with a global delay of 500 would result in ~1500 ms delay for the step
- The global delay can't be adjusted while scripting is running, only in PAUSE or STOP
- The timing isn't 100% correct; the deviation can vary and is system dependent

### 8.6.1 Script file format

The script file is required to be in CSV format, either US or standard european, depending on the format setting in "Configuration" and also the selected GUI language. It basically consists of two columns: one for the command and one for optional comments.

#### 8.6.1.1 Example for a script with SCPI commands

In MS Excel or similar the separator is invisible, but when viewing the file in a text editor, it would look like this:

```
*IDN?;"Query device type and serial number"
```

```
SYST:LOCK ON;"Activate remote control"
```

```
VOLT?;"Query voltage setting"
```

The scripting, when started, would execute one set command and two queries. All three commands plus the responses would show up in the log window. Due to the script containing all SCPI commands, the software would detect ASCII format and automatically switch to the ASCII tab.

#### 8.6.1.2 Example for a script with ModBus RTU commands

In MS Excel or similar the separator is invisible, but when viewing the file in a text editor, it would look like this:

```
00 03 00 01 00 14 15 D4;"Query device type"
```

```
00 05 01 92 FF 00 2D FA;"Activate remote control"
```

```
00 03 01 F4 00 01 C5 D5;"Query voltage setting"
```

The bytes in the ModBus message must be separated with a blank (space), else the script is denied. The script, when run, would execute one set command and two queries. All three commands plus the responses would show up in the log windows. Due to the script containing all ModBus commands, the software would detect binary format and automatically switch to the Hex tab of the log window.

### 8.6.1.3 The WAIT command

Apart from regular SCPI commands or ModBus RTU messages in the script, an extra command **WAIT xxx** command can be inserted as step at any position and as often as required. It serves to extend the global delay. The xxx is for 0 to  $2^{32}$  milliseconds.

### 8.6.2 Options

Since version 2.10 there is one option to check or uncheck: "Stop background refresh". It halts the usually running background communication, which fetches actual values and status for the displays in the upper window part, as soon as the scripting is started. This can be useful to achieve a more accurate timing when using a short global delay of less than 10 ms.

### 8.6.3 Display and control

The scripting tab only has two displays:

**Total:** the total number of step (i. e. lines) in the script file

**Current:** the currently processed step number

The controls use familiar symbols for



Start/run the script processing (after a valid script file has been found)



Pauses the scripting run after the current step; the scripting can be continued later with the next step



Stops scripting after the current step; when starting again with Start button, the scripting will be processed from the beginning



Allows to perform single (manual) steps, either directly from the start of the script (this button is clicked instead of play button) or when paused; after manual steps, the script could be continued automatically with the Start button



Activates/deactivates script repetition after last step; with this setting activated, the script would never stop automatically

## 9. App „SeqLog“ (Sequencing and Logging)

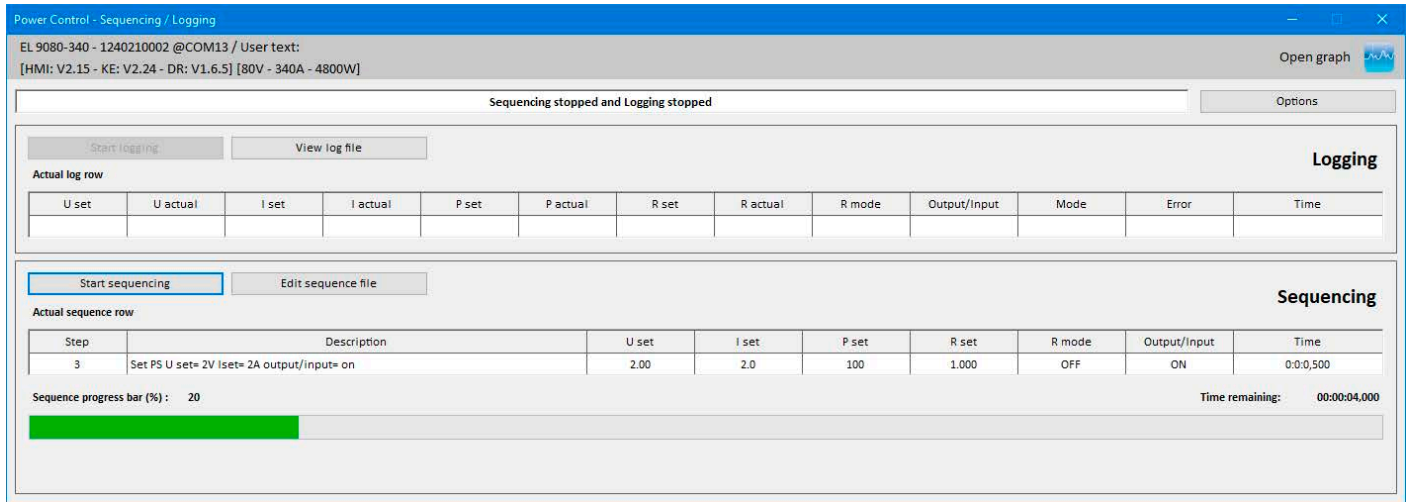


Figure 8

A very important feature of **EA Power Control** is the ability to process sequence files (here: Sequencing) and to record device data (here: Logging). A sequence is a set of rows with set values and a time  $x$ , which are stored in a text file of type CSV.

The software reads these sequence files row by row and send the values and status from the currently processed row to the device, then waits for a certain time to achieve the period until the next step is processed. The period range is 100 ms...99 h:59 m:59 s with a step width of 100 ms.

Logging works similar, but vice versa. In selectable intervals (same definition as for sequencing), the software reads actual values and statuses from the device and writes them step by step into a log file of CSV format. The total recording time and number of recorded entries is limited to a max. number of continuous log files of 1000.



*Since version 2.03 of this software you can select the CSV file format in "Configuration". The default setting is "Standard" and lets the software accept/create CSV with semicolon as separator and as used in Germany and Europe. US user should thus select "US" to use CSV files which are compatible to american standards. The setting applies to both, sequencing and logging. It means, that with setting "US" and when trying to load a CSV file with european format, a format error would pop up.*



**Important!** Sequencing of **EA Power Control** is different to what you can do with the sequences of the arbitrary generator as featured in series ELR 9000, EL 9000 B and PSI 9000s. Sequence file processing always sends the next values as entered in the sequence file and thus the device can't generate ramps to have a linear rise or fall between two set values.

Logging and sequencing are configured in the **"Options"** window, which can be accessed from the **"SeqLog"** app window. For both features it's required to select a separate file for **EA Power Control** to work with. Both, the sequencing and the logging file, are also set separately for every unit used with sequencing & logging. It's not possible to record data of multiple devices into one log file at this point. Doing so is only possible in 13. App „Multi Control“.

The log file doesn't contain information to uniquely identify for what device it was created. Thus it's very important to use file names which clearly assign a file to a device, perhaps by including the same user text in the file name.

For Sequencing you have to select an existing sequence file, which is checked for validity after every selection. The sequence file format is defined (see below) and shown by an example file which is included in the installation and which is the default sequence file when opening the SeqLog app the first time. Sequence file in arbitrary number can be created outside of **EA Power Control**, with popular tools like Excel, other CSV tools or even text editors.

## 9.1 Sequencing

Sequencing requires to select a sequence file for a device, which is tested for compatibility. In case there are errors in the file they are pointed out in a pop-up window. The installation of this software includes an example sequence file (attention, european CSV format!) in path "C:\Users\Public\Documents\EAPowerControl\seqlog\example\_sequence\_file.csv" which is preselected after in the software. You can use this file as a start and edit it according to your requirements.

Editing can be done outside of **EA Power Control** or started from within the app window "SeqLog" or the "Options" window.

Before the start of sequencing the file is checked again in order to cover unnoticed external editing. Basic rules:

- All set values (U, I, P and R <sup>(2)</sup>) must match the nominal values of the device for which the sequence file is going to be opened. If you just open a sequence which was originally made for a 200 V model for an 80 V model, a single voltage value in any row which exceeds 80 V will cause rejection of the file.
- Time values have a recommended minimum of **200 ms**. **It's possible to use lower values, but stable operation can then not be assured anymore**. It depends on many factors, like number of devices running sequencing in parallel or what interfaces are in use. What will work properly can only be elaborated by the user with the on-location setup. The maximum time value is 99h 59m 59s 999ms.
- A single sequence file can be opened for multiple identical devices to have parallel sequencing, as long as the nominal values match. This is true for models PS 9080-170 and PSI 9080-170, even if the PS model doesn't feature resistance mode, but would not be true for ELR 9080-170 and PSI 9080-170, because they have a different nominal power.
- The app "**SeqLog**" can be started multiple times for up to 10 devices. For every device, a separate sequence file can be selected. It's not possible to start Sequencing in all open SeqLog windows at once. For this, app "**Multi Control**" can be used. See 13. App „Multi Control“.
- After a valid sequence file has been opened and the device is in remote control, sequencing can be started in the app window "**SeqLog**". The current processed step is copied from the sequence file to the lower part of the window. The progress bar indicates progression of one cycle of the sequence file. A countdown shows the remaining time of the sequence (number of repetitions x total time of all rows in the sequence file), while a repetition counter counts the number of repetitions, unless repetition was set to "Endless loop".

Following applies additionally:

- Sequencing either stops automatically at the end of a sequence resp. if the desired number of repetitions has been reached or because of device alarms like OV.
- Sequencing can't be paused. Every start after a stop, no matter if manually or due to a device alarm, will start the sequence file all over
- Logging can be started and also stopped automatically with sequencing. There are separate settings in the "Options" window, in tab "Logging".
- Logging can only be started, no matter if manually or automatically, if a log file has been defined, which must be completely accessible for the software, i.e. not locked.
- Paths and file names of sequence and logging files, once selected and assigned for a specific device, are stored in an INI file and recalled the next time the device is detected by search for devices.
- When opening a sequence file for a device which doesn't feature resistance mode, the entries in columns "R set" and "R mode" are shown as "N/A" (not available)

Tips for sequenced operation:

- With the start of sequencing, the DC output/input of the device can be switched on or off and values are set as defined by the 1st sequence row. This can lead to unexpected voltage steps on the DC output of a power supply. To avoid this you might want to add another row as 1st row where the voltage set value is 0 and the DC input/output is set to off.
- With power supplies only: the voltage setting of in a sequence row can be very different to the voltage setting of the previous or next row. In such a case, where the voltage has been set in the previous row to much higher than in the current row, the voltage would have to sink first, which can take more time than defined for the current row, depending on the load. This can even result in the next row not working as expected regarding voltage level and period of step.

2) Adjustable resistance, also called R mode, isn't available with every device series. In order to find out if your device features R mode, refer to the device manual.



### 9.1.1 Settings for Sequencing



The settings for sequencing are per device. It means, the software distinguished devices by their serial number and restores the settings after the next start.

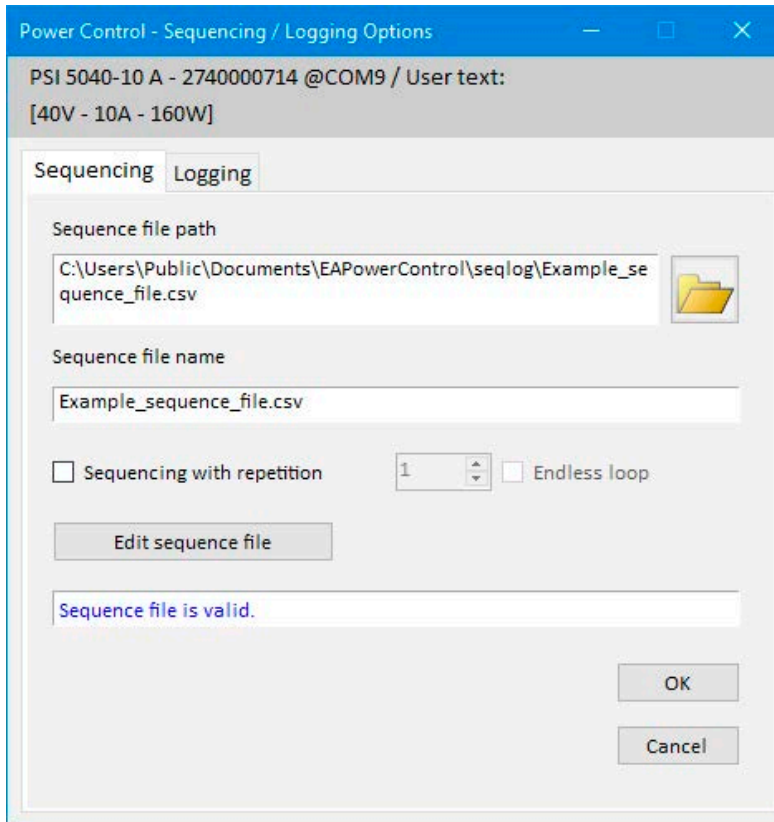


Figure 9



In case this windows shows “Sequence file is invalid” (in red), even if all values in your loaded CSV are correct for the device, it may have to other reasons:

1. Wrong CSV format used in the file (the format regarding comma or semicolon as column separator must match the setting in the configuration, see section 7.4, setting “Format”).
2. The sequence requires a different number of columns. For example, the sequence file for a PSB 9000 series device requires more columns with values than for every other series. Also see the example sequence files which were installed along the software installation in the public user folder

Element	Description
<b>Sequence file path</b>	The button with the folder icon opens a dialog to select a sequence file of type CSV, which must contain data in a certain format, as explained below. By default, an example sequence file is given here. Default selection: example_sequence_file.csv
<b>Sequence file name</b>	Separately shows the name of the sequence file
<b>Sequencing with repetition</b>	Enables repetition of the entire sequence after it has been completely processed. You can set a certain number of extra rounds. Range: 1...65500. The additional option “Endless loop” will repeat the sequence infinitely, until manually stopped or due to a device alarm. Default setting: both disabled
<b>Edit sequence file</b>	Tries to start the application (if there is any) which is assigned to open CSV files, in order to open the sequence file in edit mode. It’s required to save the changes and close the file in the external application to be able to use the file for Sequencing.

### 9.1.2 The sequence file format

The sequence file has to be in file format CSV, which determines a specific value separator format. This format can be selected in the “**Configuration**” window between “US” (separator = comma) or “Standard” (separator = semicolon). Files with the opposite format would then be neglected.

Since the implementation for support of series PSB 9000 exists an extended file formats which must be loaded for PSB 9000 series devices. Standard sequence files would be rejected as “invalid”. There are example files for both, standard and extended format, installed in the public user folder of Windows (in c:\users\public\documents\EAPowerControl\seqlog) when installing a new version of **EA Power Control**. They’re named example\_sequence\_file.csv (standard) and example\_sequence\_file\_psb.csv (extended). They depict the required layout of the sequence file. It’s recommended to store the example sequence file as template for any new sequence file to be made.

The sequence file is built like this (example shows the extended format):

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Step	Description	U set (V)	I set (A)	P set (W)	Output/Input	Hour	Minute	Second	Millisecond	R mode	R set	I set EL (A)	P set EL (W)	R set EL
2	1		0	1,2	101	ON	0	0	0	900	ON	1	1	100	10
3	2		1	1,3	102	OFF	0	0	0	900	OFF	2	2	200	20
4	3		2	1,4	103	ON	0	0	0	900	ON	1	3	300	30
5	4		3	1,5	104	OFF	0	0	0	900	OFF	2	4	400	40
6	5		4	1,6	105	ON	0	0	0	900	ON	1	5	500	50
7	6		5	1,7	106	OFF	0	0	0	900	OFF	2,2	6	600	60
8	7		6	1,8	107	ON	0	0	0	900	ON	2,4	7	700	70
9	8		7	1,9	108	OFF	0	0	0	900	OFF	2,6	8	800	80

The sequence file format has to follow these rules (with format extension changes from 02/2018):

- Row 1 is used as headline and must not be used as 1st sequence step.
- The texts in columns A and B are not required, but are intended to help describing (column B) and counting (column A) the steps
- All values in columns C thru E, unless left empty - which is allowed -, must not exceed the corresponding nominal values of the device which the file is opened for, else the sequence is rejected and the software will pop up an error list. Example: you create a sequence file for an 80 V model and in one row you define 50 V. This sequence file could not be loaded for a 40 V model.
- Columns G thru J must only not be empty and must only contains number.
- Column K is only checked for validity if the sequence is loaded for a device which features resistance mode. Entries in this column can be empty or contain the string OFF (=resistance mode UIR not active) or ON.
- Column L is only checked for validity if the sequence is loaded for a device which features resistance mode. Entries in this column can be empty or if they’re not empty, they must contain a value which has to be within the minimum and maximum resistance definition for the particular device model.
- Extended format: Columns M thru O (red frame) are only required for any PSB 9000 and PSB 10000 series device, they belong to sink operation mode, which is additional for this series

## 9.2 Logging

Device data can be recorded at almost any time, also while the device isn't in remote control. It means, it's possible to control a device via its analog interface (except for PS 5000 series) and record data through a digital interface in **EA Power Control**, to do logging that is.

Logging can be started manually by pressing a button or automatically along with Sequencing, if this option is enabled and a log file has been defined. The "Options" windows offers the necessary settings.

Following generally applies for Logging:

- Logging can be started anytime if a log file has been defined and set up for the particular device.
- In case Logging is started automatically with Sequencing, it also can be stopped anytime manually or it stops automatically once Sequencing stops or if "Stop Logging on error" is enabled and an error occurs.
- The "Options" window gives the choice to either create a new log file or open one for reuse.
  - » *Attention! Be careful with the record mode "Overwrite" when opening existing files from disk! Previously recorded data is lost if the setting is "Overwrite" and Logging is started the next time.*
- If Logging is automatically started with Sequencing and the log interval matches the time values in the sequence file, the device has to receive and set the values of the current sequence row first. Afterwards, the device can be read by Logging to record the updated values. This will cause the log file to have at least one row offset regarding the set values and related actual values. The bigger the log interval, the bigger the time difference between sequence file row and corresponding log file row.
  - » Example: the time values in the sequence file are all 1 s, the log interval also is 1 s. Sequencing and Logging are started simultaneously. In row 5 it defines a voltage value of 30, which will cause a power supply to set 30 V as soon as row 5 is processed. In the same moment, the log file receives an entry in row 5, but probably a different actual value, because the 30 V are not yet set. So the log file will record the actual value corresponding to 30 V at least one row later.
- Older Excel versions which might still be in use and probably also similar tools can have a max. row limit of 65536 per sheet. In order to record beyond this limit, the software will create an overflow file once 65500 rows have been reached. The overflow file will be added \_001 in the file name. This number is a counter which can go up 999, so that after recording 1000 log files, logging will automatically stop and the software will pop up a message.

### 9.2.1 Settings for Logging

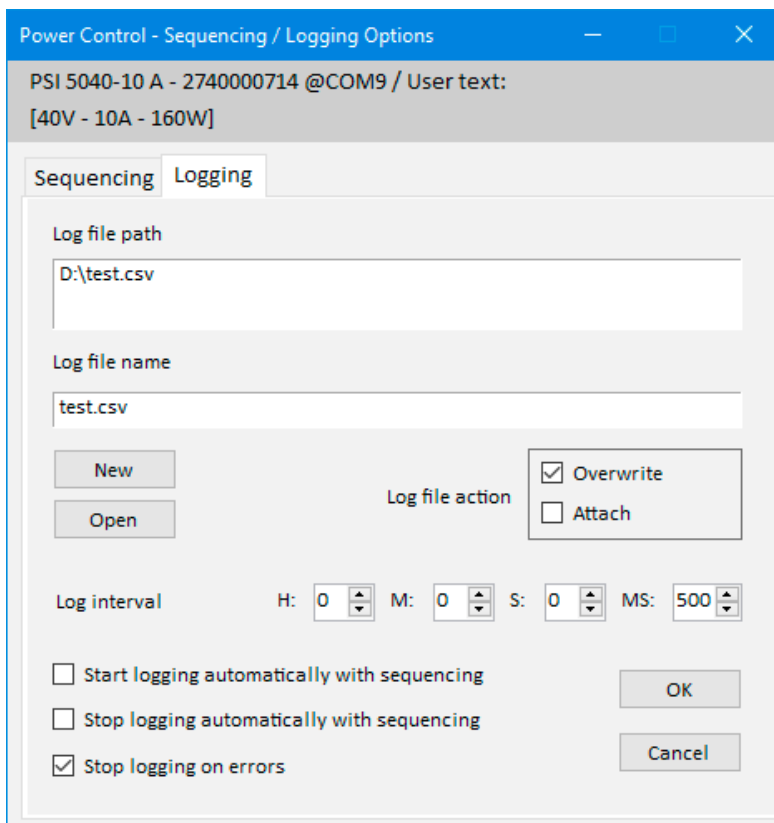


Figure 10

Element	Description
Log file path Log file name Button „New“ Button „Open“	These are used to define path and file name of the log file. You can either create a new file with “New” button or open an existing one with “Open”. Mind the option “Log file action”, especially when opening existing log files where data shall be attached at the end!
Log file action	Selects the record mode for the log file between “Overwrite” and “Attached”. Caution! With “Overwrite” chosen, previously recorded data is overwritten every time you start Logging again, no matter if manually or automatically with Sequencing. Default setting: “Overwrite”
Log interval	Defines the time between two log file entries of a logging session. This value can’t be changed while logging is running. Adjustable range: 100 ms...99 h 59 m 59 s in 100 ms steps or a multiple of it. Default value: 500 ms
Start logging automatically with sequencing	If this setting is enabled and there is a log file defined, a new logging session is started automatically every time sequencing is started with the corresponding button. The selected log file action also applies! You may stop logging manually at any time else it will continue until stopped by an event, or automatically if the other setting „Stop logging automatically with sequencing“ is enabled, too. Default setting: disabled
Stop logging automatically with sequencing	If this setting is enabled and logging has been started either manually or automatically with sequencing (see other setting „Start logging automatically with sequencing“), it can stop automatically with sequencing, no matter what reason made sequencing stop (reached end of sequence file, end of repetitions, device alarm). Default setting: disabled
Stop logging on error	Normally, logging would continue logging during device alarm situations where the DC input/output of the device is switched off and the actual values are all zero (except for voltage on an electronic load). Then the log file would be filled with zeros. You can enable this settings to avoid logging to continue recording values during errors/alarms. Default setting: disabled

## 10. App „Settings“

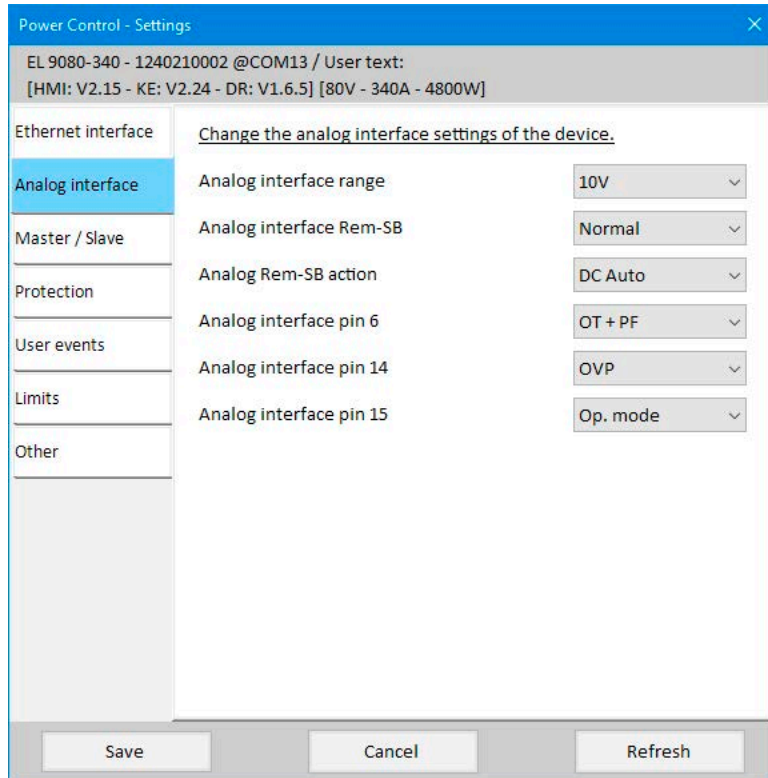


Figure 11

The app “Settings” offers you to adjust device related parameters and settings as they are also available in the setup menu of your device. Contrary to manual operation on the front panel (i.e. HMI) of the device, the app requires remote control. In case the app can’t switch the device into remote control, it won’t open the window.

Some device series do not even have a setup menu, such as PS/PSI 5000. For these, this settings window is the only way to access some extra settings, such as the effective voltage range (0...5 V or 0...10 V) of the analog interface (PSI 5000 only). Not all available setting is supported by all device series. Those will be greyed out.

Details about the settings in this window can be found in the device manuals, as they are identical to those described there.

## 11. App „Update“

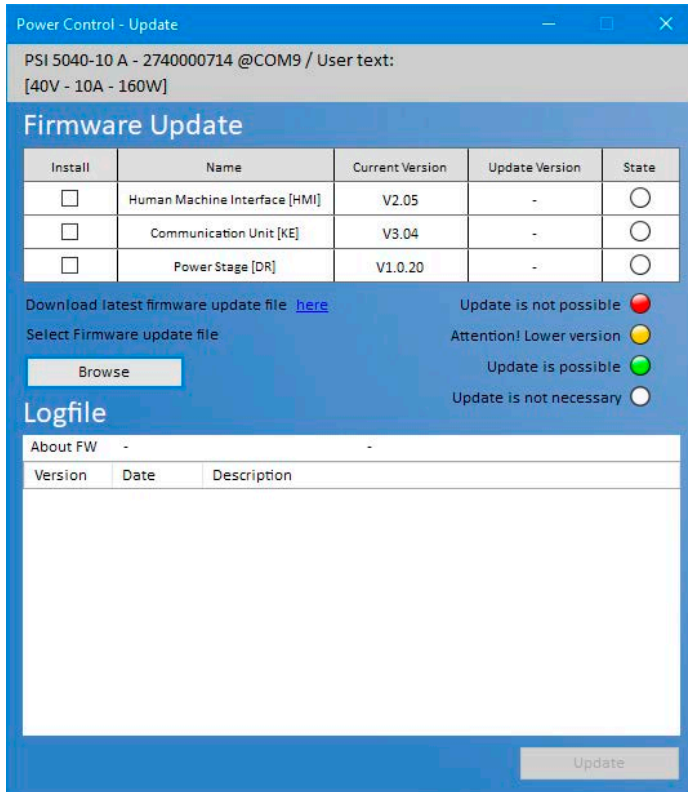


Figure 12

This app is used to update firmware of micro-controllers inside a device, as well as the firmware of the CAN interface module IF-AB-CAN, which is supported since **EA Power Control** version 2.15. This part of the software is considered as an update tool for current device series. In order to update any compatible and supported device, you need to first download an update file (\*.upd) from our website or obtain it from us upon request. The file will always contain the most recent firmware versions.

Rule of thumb:

**Only install updates on your device if absolutely necessary or after you have been requested to do so!**

### Further facts you should be aware of before installing firmware updates:

- Firmware updates can only be done via USB line
- Installing updates can fail due to several reasons, for example because of a supply blackout. Depending on which component was being updated while the interruption occurred, the device can be recovered or has become unusable. Recovery is partly possible, but not in every situation. In such a case contact our support staff.
- Do not downgrade your device, i.e. install an older version than currently installed, unless you are definitely requested by us. The software will ask for permission to do the downgrade. Upgrading to a newer version after a downgrade should be possible without restrictions.
- It might happen, that particular models of a compatible device series or a device of a series yet unknown to your currently installed version of **EA Power Control** can't be updated by this app. In such a conflict situation, the software should pop up a message.

In the window of the "Update" app you can open the update file with button "Browse". The file is checked for validity and later it will show some information in the log file box. The information is per component. It means, if you select any of the max. three components (HMI, KE or DR) in the list "Firmware Update", the display history information changes.

Along with the information in the log window the list also displays the firmware versions, as installed in the device, and the update versions, as contained in the update file. There is furthermore a traffic light telling you if an update is

- recommended (green)
- not required (white)
- refused (red)
- possible, but not recommended, i. e. downgrade (yellow)

Normally, you should only install updates on components with **green** light.

The user can decide to update every component or just one. The selection is done by manually setting a checkmark in the list view, in column "Install". Components not check-marked here will be skipped during the update process.

After enabling at least one component for update and clicking button "Update", the update will start and do the rest automatically until finished. This can take a couple of minutes. Make sure the device is permanently powered during this time.

## 12. License management

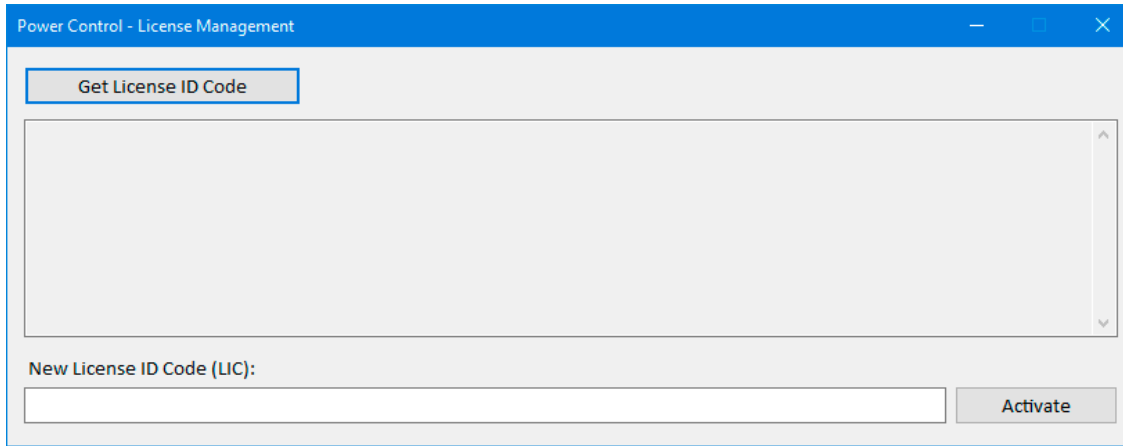


Figure 11 - License manager

The software contains a license manager. It's used to install optionally obtainable license codes to unlock extended features in the software. Those extended features are not free of charge. The license code can be purchased together with a device (which is supported by this software) or later.

The license is tied to the PC on which it shall be installed.

### Questions & answers:

#### What to do before requesting a license code?

First, gather information about the unlockable features by calling our sales department or visiting our website or reading this document. If one or multiple of these features are of interest for you, download the most recent version of **EA Power Control** from our website and install it. In the help menu there is an option to enable the demo mode which allows to have a view into every app. If you want to test the software first, there is a free 14-day trial option available for which you can request a trial license. See section 12.1 Trial license.

If you have decided to order the full license, you can request a quote from our sales department before actually starting to obtain the license code.

With date 12/2019 following features can be unlocked (all at once, not separately):

Feature name	Included since version	Short description
Multi Control App	1.52	App for parallel and synchronous control and monitoring of up to 20 devices in one window. For details about this feature refer to 13. App „Multi Control“. Note: the license for this app includes the Function Generator app and the Graph
Function Generator App	2.03	App for the remote control of the function generator as featured by some series or the sequence generator of ELR 5000 series. Once the license code for Multi Control is installed, this app is automatically unlocked. For more details about this app refer to 14. App “Function Generator”.
Graph App	2.03	App with a graphical visualization of set values and actual values, screenshot feature and data recording. Once the license code for Multi Control is installed, this app is automatically unlocked. For more details about this app refer to 15. The Graph. The app can't be started directly from the main window, but only from within other windows, such as Terminal.

#### How to obtain a license?

Open the license manager in **EA Power Control** via menu “? -> License Management” and in the manager click on “Get License ID code”. This will open another window with some information. Click on the displayed e-mail address (blue link) to open your default e-mail software and to send a request mail for a quote and/or other information. In case you want to obtain the 14-day trial license code please explicitly say so in the e-mail, otherwise it's assumed you want to obtain the full license. For this, you must also add the proof of purchase by attaching the receipt to the request e-mail.

### How to install a license code?

After reception of the license (as e-mail, text form), which is tied to a specific PC and its unique computer ID number (short: CID), compare the CID of the PC you are going to install the license on with the CID in the license code e-mail. The CID of the current PC is displayed in the “**Get License ID code**” window. Access it via menu “? -> **License Management** -> **Get License ID code**”. In case the compared CIDs didn’t match, the PC may be the wrong one or the CID has changed in between. Then read below at “What to do if the license should suddenly become invalid?”.

After successful comparison, close the window and either type the license code into the text box “**New License ID Code (LIC)**” or copy & paste it from the e-mail. If the license code is accepted, the license will be installed and the corresponding features unlocked. The license manager windows will show the status as often as you open it. One license code can unlock multiple extended features.



Save the e-mail with the license code for later use at a secure and easy to find location or print it.

### Can a license be transferred to a different PC?

No. But there is a multi-license package available. Please contact our sales team for advice on how to proceed or a quote. This is especially required in case a PC with an installed license suddenly fails and becomes unusable or the license was only installed on the PC for temporary use and test and that PC is going to be forwarded to the end user.

### What to do if the license should suddenly become invalid?

It may happen that a license suddenly becomes invalid, for example because the PC configuration has changed and its computer ID (short: CID) too. In such a case, please first compare the current CID with the one in the e-mail you should have received after purchasing the license. The current CID is shown to you when accessing the menu “? -> **License Management**” and then by clicking on “**Get License ID Code**”.

- a. If both CIDs are identical, simply install the license again. See above at “How to install a license code?”
- b. If the CID has changed, please request a new license code. You can do this by sending us an e-mail which should contain the new and old CID and the proof of purchase. We will then generate a new code and mail it to you

## **12.1 Trial license**

For previewing and testing purposes there is the option to request a 14 day trial license. It unlocks the full functionality.

Getting and installing the trial license is done the same way as with the full license, but the trial will expire 14 calendar days after being created (not 14 days after being installed). Within the test period the program will notify you upon every start. Once it’s expired, the software will notify a last time and after that the apps “**Multi Control**”, “**Function generator**” and the graph are locked again. Installation of a full license during the trial period or after will overwrite the trial license.

You may request a trial license once for every PC. The procedure is the same, via the license manager window and the “**Get License ID code**” button. In the small window which shows the CID there will be a blue link that when clicked generates an e-mail to send the CID. Add your trial license request there.



## 13. App „Multi Control“

Figure 12 - Multi Control main view

Since version 1.52 of **EA Power Control** the app “**Multi Control**” is featured. After the first installation of this software, the app is locked. To unlock it, an optionally purchasable license has to be installed. For more information about getting a license and unlocking the app refer to .

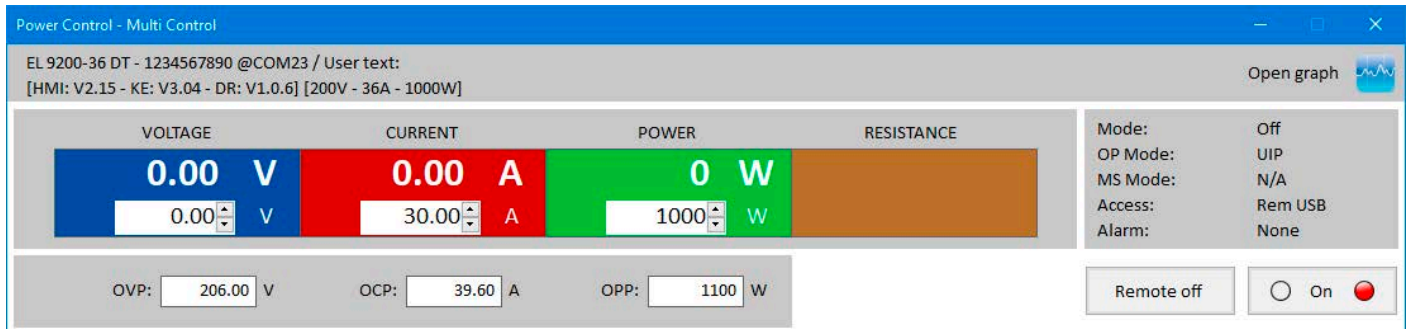
This app can be used to control and monitor up to 20 devices of identical or different model and type at once and in one window. All devices recognized by **EA Power Control** are listed in this window to access them for remote control without the need to switch to app “**Terminal**”. The device list can be managed by deleting devices from it resp. insert them again, as long as they are still connected to the PC.

### 13.1 Limitations

- The app can manage, access and control up to 20 devices. In case a higher number is directly connected to the PC or accessible via a network, a rule applies to first list USB devices according to their incrementing COM port number, then list Ethernet devices according to their incrementing IP
- Sequencing can only be done in one instance and only for the selected devices. Furthermore, it can only be started if the set values in the loaded sequence don't exceed the ratings of the selected units.
- The function generator remote control feature can be used for one or multiple selected units which feature a function generator or sequence generator. In case the selected units
  - » are of different type, not all function can be used for all units.
  - » have different ratings, the input boxes for values are limited to the lowest rating from all of the selected units.
  - » don't all feature a function generator, loading a function will be aborted with an error message.
- Devices to which the connection has been lost can't be inserted automatically into the device list again
- A configuration via app “**Settings**” can't be written to multiple devices at once

## 13.2 Functions in the app window

### 13.2.1 Upper window area



The upper window area always show the actual and set values, as well as status of one currently selected device from the device list (blue, single device selection). This window part is identical to the upper window part of app “Terminal” (see 8. App „Terminal“).

### 13.2.2 Middle window area



The middle part of the window is used to manage groups of devices. Every of the max. 20 devices can be assigned to any of the four groups, while every group can have a max. of 20 devices. The actual assignment to a group is done in the device list (see below at Tab “Devices”). The buttons are used to select devices which are assigned to a particular group. “Select” here means to put the checkmark next to the devices in column 1 of the device list. It works the same way the other way round when deselecting groups.

All actions after group selection, like setting status (input/output on/off) or values, are applied to the selected devices only. It means you can assign different set values to every group. General rules:

- A device from the device list can only be assigned to one of the four group or none
- The group configuration isn’t stored automatically, but you can do this manually (button “Save config.”) and then let the software load the last save configuration automatically when opening the app
- Devices, which have been stored in a group configuration but are now disconnected, are listed in the device, but are greyed out and can be deleted manually or are cleaned up when using button “Show all devices”

#### Area “Group settings”

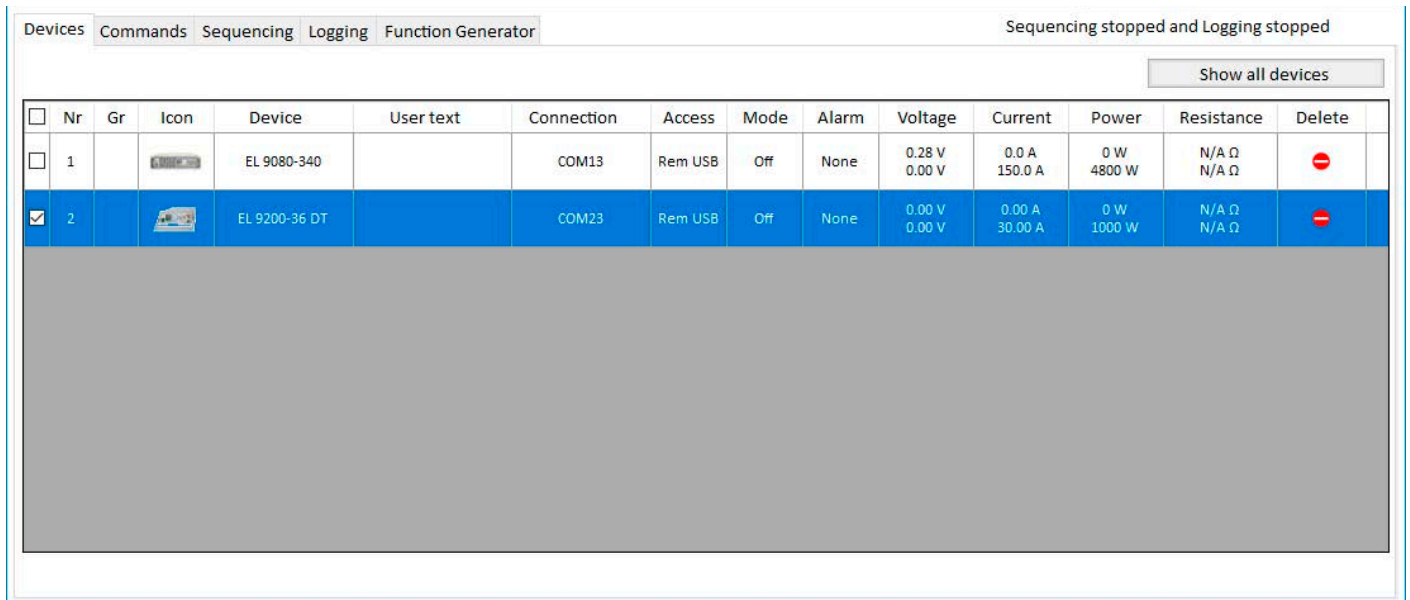
Buttons <b>G1 – G4</b>	Select/deselect one or multiple device groups
Button <b>Reset groups</b>	Deletes all device assignments to all groups, deselects all groups
Group names	The text next to the group buttons <b>G1 - G4</b> , the group name, can be changed to your custom name when double-clicking on them

#### Area “Configuration”

Button <b>Save config.</b>	Saves the current group configuration into a configurations file (*.ini). Different groups configurations can be loaded and saved this way, while the most recently used configuration could be loaded automatically at app start-up by ticking the option “Load config. at app startup”
Button <b>Load config.</b>	Loads any formerly save group configurations file (*.ini) from storage and also set the most recently loaded file to load for option “Load config. at app startup”
Option <b>Load config at app startup</b>	When activated, this option will try to load the most recently saved or loaded group configurations file from storage when starting this app

### 13.2.3 Lower windows area

#### Tab „Devices“



When starting the app “Multi Control”, EA Power Control will list all known devices here. This list can later be modified by deleting unnecessary units. General rules for this list:

- In case the connection to any device on the list drops, it will be detected and greyed out, but can also be cleared from the list by clicking “Show all devices”
- Devices, which have been deleted from the list with a button click into column “Delete”, but are still connected and online can be put into the list again by clicking on “Show all devices” or by repeating the search for devices

In the device list you can...

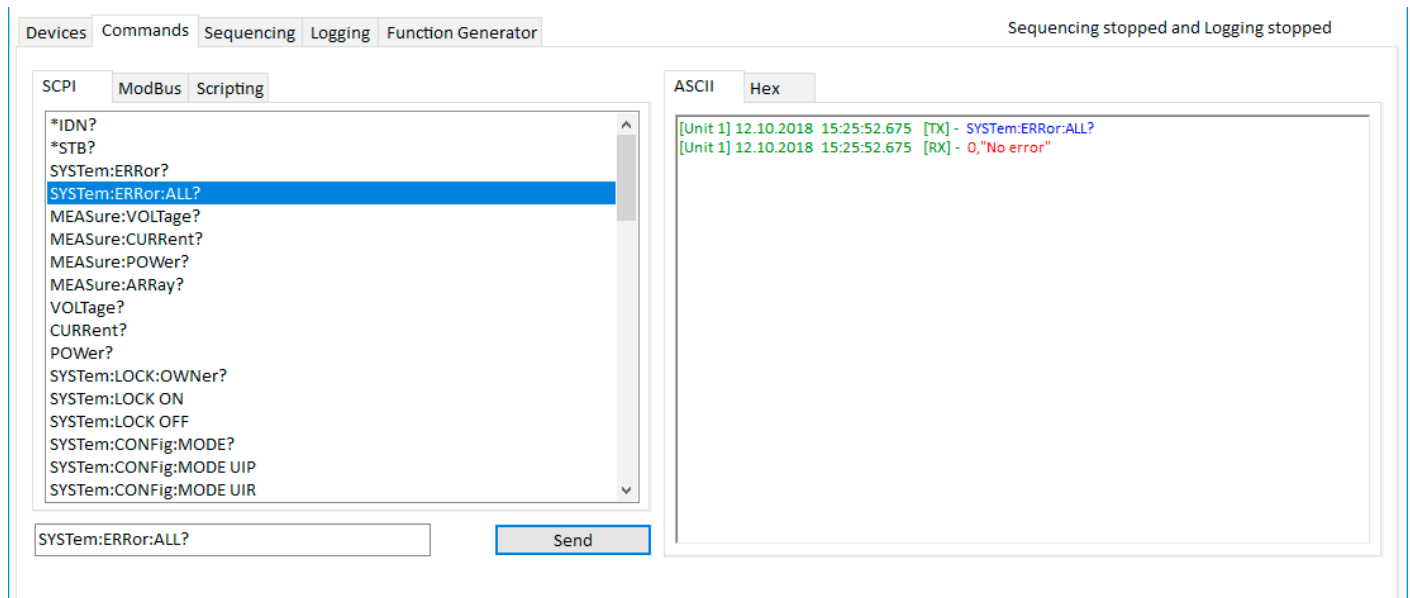
- select one device (one row marked blue), in order to have the upper window show its values and status
- select one or multiple devices by setting the checkmark in order to
  - » send values and/or status almost<sup>3</sup> synchronously to these devices
  - » run parallel Sequencing on them
  - » run parallel functions on them or at least configure functions
- assign one or multiple devices to device groups, in order to
  - » quicker select certain device types
  - » send different settings (values, status) to different groups
- delete (hide) devices from the device list
- undelete (unhide) formerly deleted devices again
- run the app “Settings” for the selected device, in order to adjust operation parameters

In the device list, at least one device row is selected and marked blue. The values and status of this device will be shown in the upper part of the window for direct access. Clicking another device switches the display. The device list show a lot of information in compact view:

Column	Column title	Information in the column
1	-	Checkmark for selection of single or multiple device for group action
2	Nr	Incrementing position number for the device in the list
3	Gr	Group assignment (G1 - G4, empty when no group)
4	Icon	Device icon like in the main window, used for easier device type recognition
5	Device	Device name
6	User text	Show the user text you probably have given the device
7	Connection	Interface identifier (COM port or IP)
8	Access	Status of remote control: free/local = not in remote control, remote = in remote control
9	Mode	Status of the DC input/output of the device
10	Alarm	Last alarm (copy from device display)
11-14	U, I, P, R	The three resp. four actual values (upper) and the set values (lower) which are currently in effect on the selected device
15	Delete	This column is used to delete, i. e. hide a device from the list

3) Due to the nature of the supported interfaces (USB, Ethernet) it’s physically not possible to send a command to all units at once. Instead the same command is sent to all selected devices subsequently, with the shortest possible delay

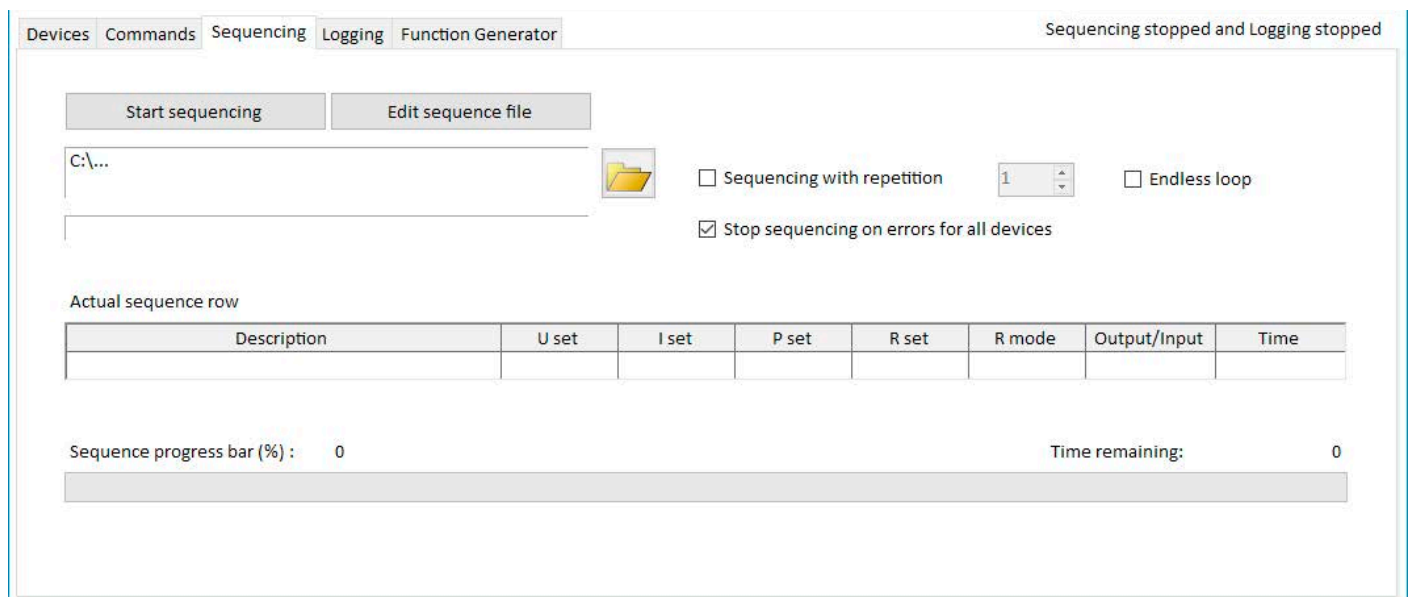
## Tab „Commands“



Similar to single device control in the app **“Terminal”** (refer to 8.5 Commands), you can control further functions or query information which are not available in the device list or upper window part.

The difference here is that the selected command can be sent **to one device or groups**, resulting in as much responses as devices are currently selected when querying something. In order to connect responses in the log window to devices, the entries are **prefixed** with the device’s user text (unless not given). See example above, with “Unit 1” as user text.

## Tab „Sequencing“



The sequencing action in this tab is very much the same as in the app **“SeqLog”** for single device control (refer to 9. App „SeqLog“ (Sequencing and Logging)), but with some differences:

- The sequence file will be applied to all currently selected devices at once
- The sequence file will be checked for compatibility to all currently selected devices

## Tab „Logging“

Logging in “Multi Control” is available since version 2.02. The logging is basically the same as with the app “SeqLog” for single units. Also see 9. App „SeqLog” (Sequencing and Logging).

The only difference is the log mode, which makes it possible to decide whether the log data of the devices is recorded into separate log files or one:

Option	Effect
One file for all devices	For each selected device from the device list there will be one row of data recorded with every logging interval. Thus there can be up to 20 rows with the same time stamp. The data in the log file can be filtered and analyzed using either the serial number or user text (unless empty), which both are also recorded for every unit.
One file for each device	This option will either automatically create a new log file for every selected device in the folder set in “Log file path” or use existing one(s). The files have a specific naming scheme like <serial_number>_<user_text>_log_<counter>.csv. Explanation: <user_text>: the user definable text which is stored in the device <serial_number>: of the device <counter>: 001...999, will be counted up as soon as the number of rows in a log file exceeds 65500, like when logging with app “SeqLog”

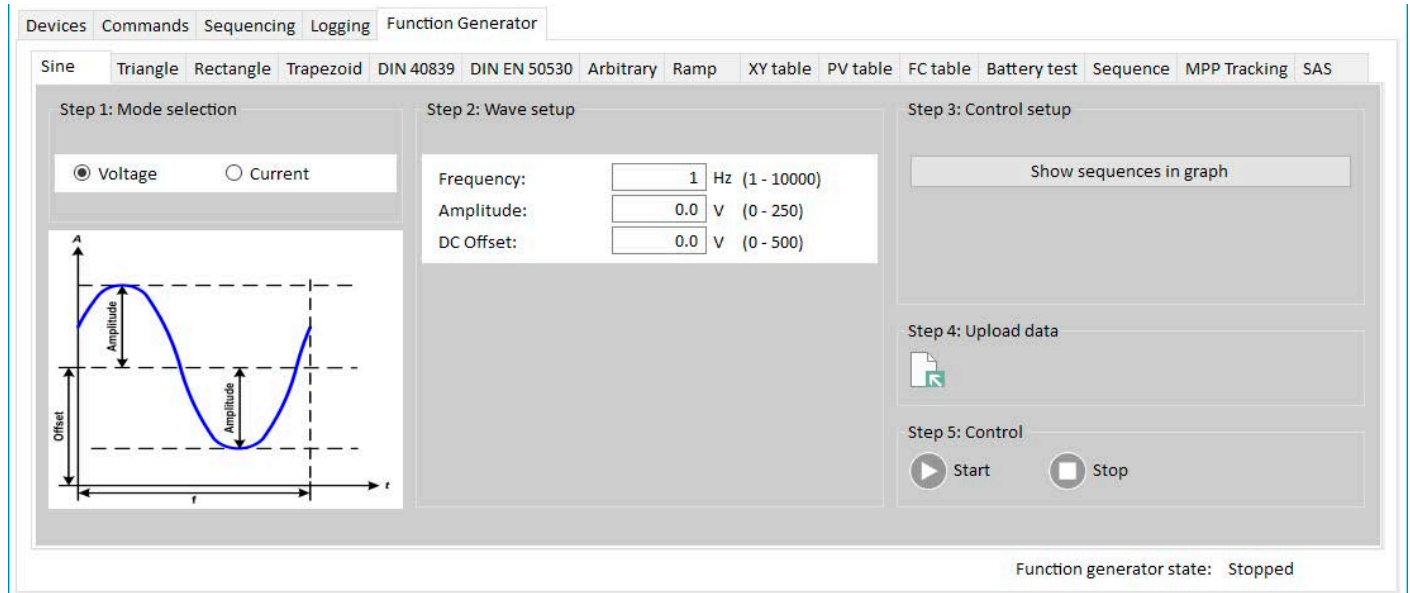
For log mode “One file for each device” it furthermore applies:

- If the user text of a device is empty, the log file name will be shorter
- The selected log file path folder is checked for file already existing from previous log actions and in case they match the selected devices from the list, they are used for logging and with the selected log file action, instead of creating new ones
- When selecting one or multiple additional units in the device list while logging is running, the logging isn’t started subsequently for these units
- When deselecting one or multiple additional units in the device list while logging is running, the logging is stopped immediately for these units, while it keeps running for the other units
- In case the connection to one or multiple units drops while logging is running, the logging is stopped for those while it keeps running for the rest

For log mode “One file for all devices” it furthermore applies:

- When selecting one or multiple additional units in the device list while logging is running, the logging is started subsequently for these units. The log data is then added in the log from that moment on
- When deselecting one or multiple additional units in the device list while logging is running, the logging is stopped resp. paused immediately for these units
- In case the connection to one or multiple units drops while logging is running, the logging is stopped for those while it keeps running for the rest
- The log file format isn’t identical to the log files created by those device series featuring a front USB port with USB logging feature

## Tab “Function Generator”



Most functions in this tab are set and handled the same way as in the app “**Function Generator**”. Also see 14. App „Function Generator“. But there are a few additional features only available in the function generator in **Multi Control**, because they require multiple units to run. These are:

- **SAS** (Solar Array Simulation, available since version **EA Power Control 2.12**, see section 13.3)
- **MPPT Flow Control** (available since version **EA Power Control 2.11**, see section 13.4)

There are also a few additional rules for the use of the function generator in **Multi Control**:

- The tabs of the single functions are always accessible, even if only one device is currently selected and that one device doesn't feature a function generator
- When selecting different device types at the same time, the tab will show all functions which would be available on the control panels of the single devices. Every function could be configured, but only loaded if it was one which is featured by all selected devices. Otherwise loading is aborted with an error message. For example, the battery test isn't supported by power supply devices. Hence it's recommend to group only devices of same type and also check what functions are featured by the device series
- Values, as you can enter them in the various input boxes and which are related to set values (U, I, P) on the devices, are limited to lowest of the ratings of the selected device. Example: you selected two devices, one with 60 V rating and one with 40 V. Then all input boxes related to voltage would only accept to enter max. 40.

### 13.2.3.1 Context menu

There is a context menu (right-click) in the device list to perform extra actions for a single device or multiple selected devices:

Menu item	Parameter	Effect
Open in	Settings	Opens app „ <b>Settings</b> “ for the device in the selected row. Also see 10. App „Settings“
Set group	G1, G2, G3, G4, None	Assigns the device in the selected row to a group (G1...G4) resp. revokes an assignment (none).
Send command	ACK alarm	Alternative method to clear an alarm (row marked red)
Set group for all marked devices	G1, G2, G3, G4, None	Assign devices with checkmark to a group resp. revoke assignment
Set values for all marked devices		Set values of U, I, P and R to all devices with checkmark
Try to connect		Tries to re-connect with a disconnected device (greyed out). If successful, the device can be used again.
Start/stop sequencing for all marked devices		Starts or stops Sequencing, depending on the current status, the same was as when using button „ <b>Start Sequencing</b> “ in tab „Sequencing“. Also see Tab „Sequencing“.
Start/stop logging for all marked devices		Starts or stops Logging, depending on the current status, the same was as when using button „ <b>Start Logging</b> “ in tab „Logging“. Also see Tab „Logging“.

### 13.3 Function “SAS” (Solar Array Simulation)

#### 13.3.1 Introduction

This function is implemented since version **2.12** of **EA Power Control**. It extends the feature set of the simple PV simulation by the definitions of norm paper EN 50530. Together with a set of power supplies (single units or masters of master-slave systems), it can simulate an array of various solar modules/panels with different characteristics. Thus it's possible to configure the test setup differently for each power supply. The sum of settings can be save with the **“Save config.”** feature and loaded again after the next start.

**The sole purpose of SAS is to measure data about the MPP tracking of solar inverters and to rate their tracking efficiency.**

Further information about what SAS is, does and what's its benefit is can usually be found in external documentation, such as application notes.

#### 13.3.2 Series supporting SAS

- PSI 9000 2U-24U
- PSI 9000 WR, PSI 9000 WR Slave
- PSI 9000 3U Slave
- PSI 10000
- PSB 9000 (from firmware KE 2.25)
- PSB 10000

#### 13.3.3 Control elements in the SAS window

The screenshot shows the SAS control interface. Callout 1 points to the device selection dropdown (EL 9080-340 / 1240210002). Callout 2 points to the configuration tabs (EN50530 Static, EN50530 Dynamic, Options). Callout 3 points to the PV Technology dropdown (Manual). Callout 4 points to the device test status section (Estimated time, Elapsed time, Status, Progress). Callout 5 points to the device measurements section (Meas. U, Meas. I, Meas. P, Meas. E). Callout 6 points to the Start button. Callout 7 points to the Create Report button.

Nr.	Description
1	<b>Device selection.</b> Lists all devices you selected in the device list, excluding incompatible ones. Every device can be selected one by one from the drop-down field to configure it or, after the configuration is done, the settings of any device can be applied to all other units as well, if option “Apply same settings for all devices” is enabled.
2	<b>XY curves windows.</b> Opens up to three different pop-up windows with an XY graph showing real-time calculated an UI, UP or efficiency curve of the currently selected unit. The efficiency curve would thus only all results after the test has finished. When switching to a different unit, these pop-up windows don’t switch as well. They must be reopened manually to show the curve of the next unit etc.
3	<b>Configuration tabs.</b> The test can basically run in two parts, static and dynamic tracking, whereas static runs first. In the tabs, the test steps can be enabled and disabled, so that static and dynamic tests can also run standalone. More details below.
4	<b>Device test status.</b> Show test run status in form of a time counter and a progress bar.
5	<b>Device measurements.</b> Shows some measured and calculated data related to the MPP (maximum power point), as comparison. The ratio between calculated MPP and measured MPP determines the tracking efficiency.
6	<b>Run control.</b> Starts the function run or manually stops it, contrary to the default, when it would stop automatically at the end. After any form of stop, the function can only be repeated from the very beginning
7	<b>Create report.</b> After the function has stopped, this button can save a report in form of a CSV file on PC. It will contain an overview about all devices (models, serial numbers etc.) involved in the last test, plus the results from the static and dynamic test part for every device.

### 13.3.4 How it works

The SAS function always works in two parts, a static test and a dynamic tracking test (MPPT). Both use checkmark buttons to enable or disable a test part, so that only static, only dynamic or both are possible, whereas when using both parts, static will always run first. During the test run the windows refreshes data shown in area (5) and after it has stopped, a report can be created for every unit in the drop-down list. The last result data is furthermore stored automatically for every device, so that when opening **Multi Control** again and going into **SAS**, the last data is still available. As an additional feature, one of the options allows for automatic saving of extra result data from every unit to PC.



*Only specific series support the SAS function (see section 13.3.2). Unsupported series are filtered, so that the drop-down list in the SAS window may not contain all devices you selected in the device list tab.*

Setup and run of the SAS function always follows the same steps:

- 1) Selection of any number of compatible units from the device list tab by putting a checkmark
- 2) Switch to “**Function Generator**” tab and in there, to “**SAS**” tab.
- 3) Select a device from the drop-down list to configure it for the static, dynamic or static + dynamic test (further explanations below)
- 4) Repeat the same for all other devices OR choose to use the same settings for all by putting a checkmark in the “**Options**” tab. This will use the settings applied for the currently selected device for all other devices in the drop-down.
- 5) Run the function (6).
- 6) If favored, create a test report file (7). This file will summarize the result data from the tables in the static and dynamic test of all involved devices. This file is saved in the same public user folder where other files will also be stored in.

### 13.3.5 Configuring the test parts

SAS has two test parts, a static test part called “EN 50530 Static” and a dynamic test part called “EN 50530 Dynamic”. Both are configured separately.

#### 13.3.5.1 Configuration for “EN50530 Static”

The static test part only tests one fixed MPP (maximum power point) which is defined by the values Umpp (min, nom, max) and Imp, plus the panel technology. Value Umpp requires two edge values and a regular which should be close to each other. The defined MPP is then shifted by applying varying irradiance in selectable per cent steps (see image above). This goes along a new PV table calculation for every step which also calculates the next MPP. After shifting the MPP, the solar inverter would start to track and find a new MPP, which is measured and displayed together with the calculated MPP on the right side in area “Device measurement results”. The ratio between calculated MPP and the measured MPP is then used to rate the inverter efficiency, which is depicted in per cent in table for every Umpp.

The technologies “cSI” and “Thin film” have no adjustable parameters which are thus only shown. The settling and testing times are adjustable, but set to default value from the norm. Definition:

**Settling time:** time to wait before every step. A step is, for example, to go from Umpp (min) to Umpp (nom)

**Testing time:** total time to dwell on the next MPP (step). It adds to the settling time.

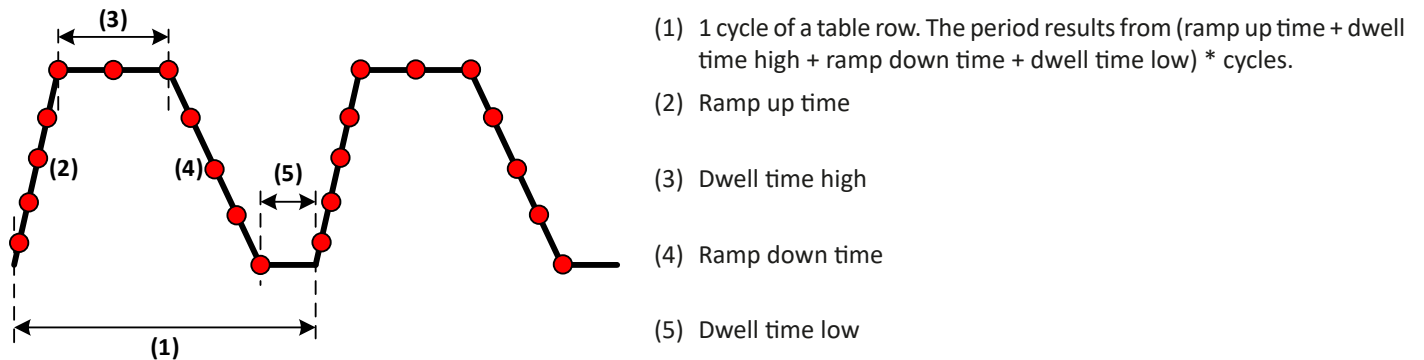
Example: let’s say rows 5%, 25%, 75% and 100% in the table are activated. Every row would process three MPP settings for Umpp(min), Umpp(nom) and Umpp(max), with the selected irradiance. The settling time is 300 seconds, the dwell time is 600 seconds. The total test time for the static test part would then be  $4 \times 3 \times (300 + 600) = 10800$  seconds or 3 hours.



### 13.3.5.2 Configuration for “EN50530 Dynamic”

The dynamic part has extended features compared to the static part. It runs similar to the day trend ET curve in the EN 50530 PV function (see user manual of series supporting this function). It requires to load a CSV file from hard drive, which can hold up to 50 rows of configuration data. This data is then listed in the table (see figure above). Any number of rows loaded from the file can be activated to be used in this test part. In this windows, you would also define an MPP, which would later be shifted in the test run by the factors in the table, such as irradiation (in W/m<sup>2</sup>), ramp up time, dwell time etc. The temperature, like used in simulation modes ET and DAY ET, can't be varied here.

The total time required by the dynamic part is determined from the number of cycles and time values in the table. Visualization of the MPP trend in the dynamic test part:



Format of the configuration file:

- Text format (CSV), columns separated either by comma or semicolon (the file format must match the selection in the global configuration of **EA Power Control** in configuration window, tab “Format”)
- Up to 50 rows plus 1 header row
- 7 columns, defined as this from left to right:

Column header	Description	Value range
<b>Irr From (W/m<sup>2</sup>)</b>	Irradiation trend over time (rising/falling ramp, shown in combined form in the table in the SAS app window)	1...1500
<b>Irr To (W/m<sup>2</sup>)</b>		
<b>Cycles</b>	Number of cycles to process the same row. A value > 1 causes the test to repeat the trend defined by ramp and dwell times and by the irradiation	1...2 <sup>32</sup>
<b>Ramp up (s)</b>	Ramp up time in seconds in which the irradiation changes in the defined range “from-to”	1...1500
<b>Dwell high (s)</b>	Dwell time at the end of the rising ramp (defined by the “to” value of irradiation”)	1...2 <sup>32</sup>
<b>Ramp down (s)</b>	Ramp down time in seconds in which the irradiation changes in the defined range “from-to”	1...1500
<b>Dwell low (s)</b>	Dwell time at the end of the falling ramp (defined by the “from” value of irradiation”)	1...2 <sup>32</sup>

### 13.3.6 Options

All options are not activated by default. They are saved automatically and apply for all units involved in the SAS test.

Option	Meaning
<b>Stop test for all devices upon error</b>	In case of an error, such as a device alarm (OT, OVP) or connection drop, the test would automatically stop for the particular device. This option can be used to stop the test for the other device as well.
<b>Save raw test data for all devices</b>	The test run gathers a lot of data, partly displayed on screen, partly available for save as a file by clicking a button ("Create report"), as kind of a summary. This option enables to save more and raw data for every device in separate files, sort of as a log, which allows for deeper analysis
<b>Apply setting to all devices</b>	The test setup, i. e. configuration in the tabs "EN 50530 Static" and "EN 50530 Dynamic", is by default done for every device separately and will be automatically stored. But this option allows to submit the configuration of any unit for all others, which makes the most sense when having a strain of identical units with identical E.U.T/D.U.T.

### 13.3.7 Function run, control and analysis

After the configuration is complete or when Multi Control has been started for a set of already **SAS** configured devices which would load the last configuration automatically, the test can be started (6). It runs in parallel for all devices, always consisting of the static and dynamic test part. Due to different device types and configurations the test time can vary pretty much from unit to unit.

The **SAS** window would always show the measured data and test status of the device currently selected in the drop-down list. In order to see data and status of other units, it requires manual switching.

The test would usually stop after a determined time which results from the sum of settings in the configuration, but could also be stopped by an error (alarm, connection lost) or manually anytime (stop button, (6)). The latter means to stop the test for all devices at once.

At the end of the test, i. e. when all devices have run through, the test results can be read from the **SAS** window or be saved as a summary to a file ("Create report", (7)). The file would then contain the same results as shown in the tabs "EN 50530 Static" and "EN 50530 Dynamic", but for all SAS test involved devices at all.

## 13.4 MPPT Flow Control



In order to basically use MPP tracking your device must support this function and may require a firmware update.

**MPP Tracking** is one of functions recently added to some device series and supported in **EA Power Control** since version 2.10. It has been extended in version 2.11 by a feature called **“MPPT Flow Control”**. The extension is only available in **Multi Control**’s function generator. This extension is configured in an extra tab labeled **“Options”**, under the **“MPP Tracking”** function tab in the function generator.

The purpose of the flow control is have two MPP tracking test, i. e. **MPP3** and **MPP4**, run automatically after each other in an infinite loop. This automated run comes with some extra rules:

- The flow control feature has to be activated in the “Options” tab (put checkmark)
- In order to correctly run this extended MPP tracking, it’s required to...
  - » Configure mode MPP3 completely and correctly in tab **“MPP3 (Fast track)”**
  - » Configure mode MPP4 completely and correctly in tab **“MPP4 (User curve)”**
- Mode MPP3 always runs first, followed by MPP4
- The extended test is started with the control elements in the MPP3 tab. Once MPP3 is done, **EA Power Control** will automatically load the configuration data for MPP4 into the device and start the MPP4 test part.
- Mode MPP3 requires to setup a max. running time
- The flow control of MPP3->MPP4 repeats infinitely until stopped, but can be paused at a specific time of day and for a specific duration

### 13.4.1 Flow control settings

Nr.	Description
1	<b>Activate/deactivate flow control.</b> This activates or deactivates flow control. In deactivated state, modes MPP3 and MPP4 run as usual, i. e. separately. This setting isn’t saved automatically, but can be saved manually in the global configuration using the “Save config.” button. When activating flow control a special situation is in effect which requires a specific sequence of steps. See 13.4.2.
2	<b>Step 1 period.</b> Step 1 will always be MPP3. This mode normally runs without a time limit until manually or otherwise (alarm) stopped. This period setting defines how long MPP3 will run in every cycle.
3	<b>Pause Flow control and Logging.</b> The flow of MPP3->MPP4 repeats infinitely until manually or otherwise stopped, so it could run for a very long time. In order to have a nightly rest period or a time window to reconfigure something, a pause can be defined for a specific time of day and a specific period. This causes the test to stop immediately memorizing the current mode and elapsed time of MPP3 to continue after the pause. If the current mode before the pause was MPP4, it will restart after the pause, because it can’t continue from somewhere in the middle. Logging will also pause.
4	<b>Disable logging for MPP4.</b> By default, an activated logging would run in the background logging data all the time, even if nothing happens. Since mode MPP4 gathers its own result data and saves it to a file, the logged data during MPP4 may be useless or double, so you may decide to deactivate logging for the MPP4 cycle.
5	<b>Save MPP4 results automatically.</b> Same as when using the “normal” MPP tracking function, where you run MPP4 once and receive a full set of result data, this can be done here as well. When activated (put checkmark), the result data would then be saved automatically to the given path, except for the drive being full. There are, however, differences: <ul style="list-style-type: none"> <li>• Every repetition of MPP4 creates one file with result data for all involved devices in it. In order to distinguish the blocks of result data inside the file from each other, the serial number of the particular device is inserted above the result data</li> <li>• Every finished cycle of MPP4 will create a new result data file with date and time in the file name</li> </ul>

### 13.4.2 Procedure

Using the flow control extension requires a specific procedure for configuration and control. Given that all devices are correctly set up on their DC inputs/outputs, do the following:

- 7) In tab "Options" activate flow control and configure all related settings according the test requirements or load a configuration file.
- 8) In tab "MPP4 (User curve)" configure the test part for MPP4
- 9) In tab "MPP3 (Fast track)" configure the test part for MPP3
- 10) Start the tracking function (tab of MPP3)
- 11) Stop the test when finished

The test would not stop automatically, except for device alarms or connection drops.

### 13.5 Function "Sandia"

This function was already available in the function generator app since version 2.12, but now since 2.13 it's also available in Multi Control. It means, it can now configure and run the PV simulation according to "Sandia" on multiple units at once. Configuration and use of the function is the same as for a single device. For details about Sandia refer to section 14.1 Function "Sandia" on page 38.

It's recommended to only use and select identical device models for Sandia, i. e. ones with same voltage and current rating.

Differences in the simulation run with multiple units:

- After the start, the simulation runs on every selected device in parallel, but autonomously. The control in the Sandia windows is merely for start and stop.
- If any device experiences an alarm situation, it will stop the test, but the other devices will continue. The alarm condition can be read from the status area in the Multi Control window and in the device list you can find the particular device.
- Once an alarm has been cleared from any unit, the simulation can be restarted by selecting the particular device and run the simulation from the Sandia window. Later, when the simulation shall be stopped for all units at once, they have to reselected in the device list before.
- The simulation is only started after all selected devices have received the table data. Depending on the number of units, there can be a noticeable delay.

## 14. App „Function Generator“

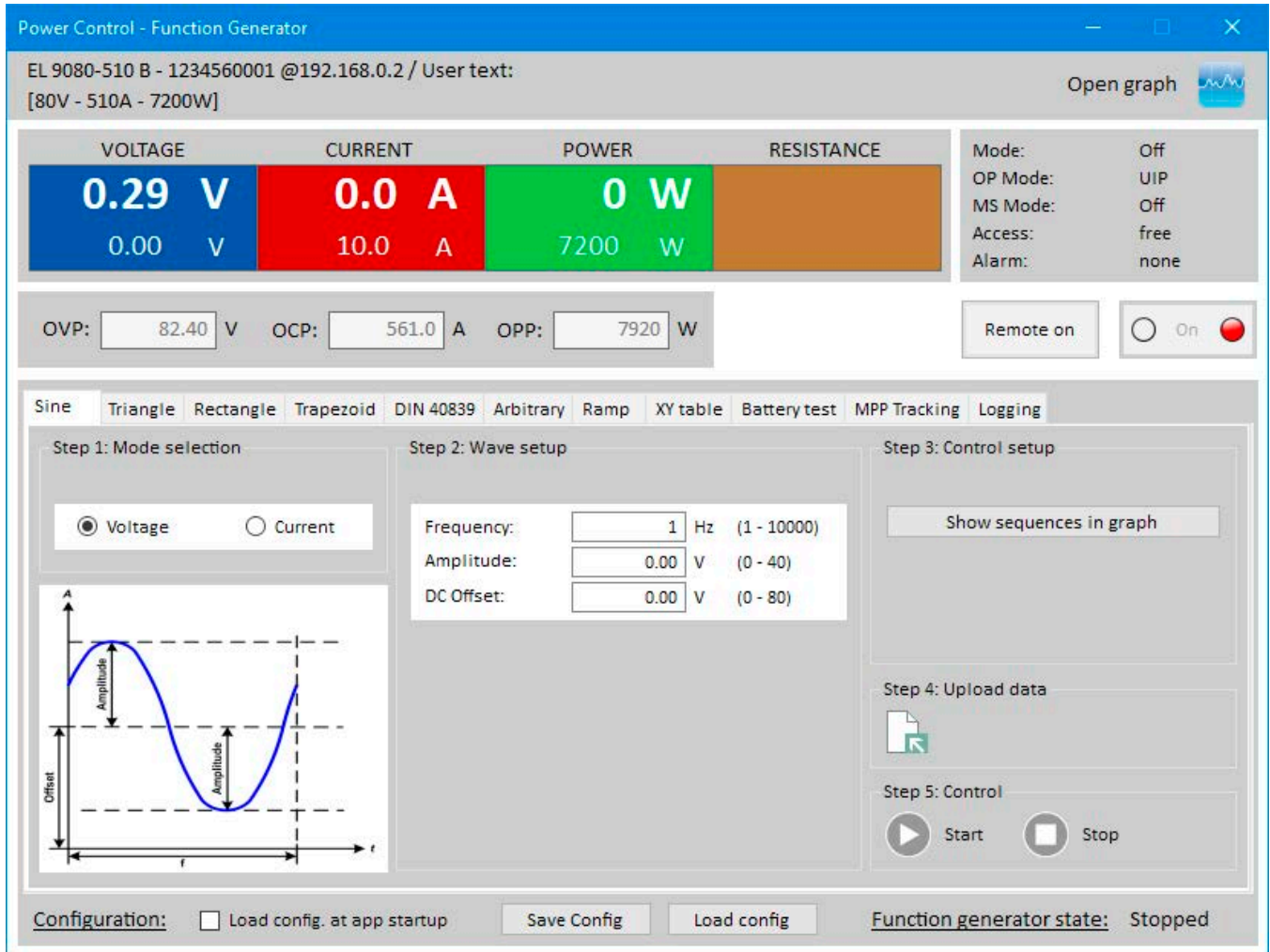


Figure 13 - Function generator app window

After the first installation of the software the app is locked. To unlock it, an optionally purchasable license has to be installed. For more information about how and where to get a license and unlocking the app refer to 12. License management. In case you already have a valid license for app “Multi Control” installed, the “Function Generator” app is automatically unlocked.

The “Function Generator” app is a representation of the manual operation of the function generator on the control panel (HMI) of those device series featuring a function generator or sequence generator, which currently are:

- ELR 9000 / ELR 9000 HP / ELR 10000
- EL 9000 B / EL 9000 B HP / EL 9000 B 2Q
- EL 9000 T / EL 9000 DT
- ELM 5000 (ELR 5000)
- PSB 9000 / PSB 10000
- PSI 9000 (including all sub series) / PSI 10000

For unsupported series the app won’t start or pop up a notification.

The single functions and their parameters etc. are described in the device manual and are not explained further herein. The following things are different or additional to manual control on the HMI:

- When starting the app, the set values of voltage and current are reset to zero for safety reasons. In order to run the function correctly, you need to set these values, plus power, as required for the application
- The setting for functions Sine, Triangle, Rectangle, Trapezoid, DIN 40839, Battery test, PV table, FC table and Ramp can’t be loaded from the device into the app window
- All parameters in any of the functions are not saved automatically by the app nor transmitted automatically to the device. You need use the “Save config.” button in order to save the settings or load them into the device with the button in area “Step x: Upload data”
- The app ignores activated resistance mode (“UIR” in status area) at first, but automatically switches it off when eventually loading the configured function data into the device

## 14.1 Function “Sandia”

The name “Sandia” comes from the US american institution “Sandia National Laboratories”. It developed a photovoltaics test function similar to the one from european norm EN 50530. It works with less factors and thus less options to play around with, but at the same time it’s simpler and easier to handle.

This Sandia function is pure software, embedded into **EA Power Control** since version 2.12. Contrary to the purpose of EN 50530, Sandia isn’t intended to measure and rate the tracking efficiency of solar inverters, but to rate the overall efficiency of energy generation in solar plants, i. e. the combined system of solar module(s) and inverter. Further information about Sandia and its test mechanism can be found in official documentation from Sandia National Laboratories.

### 14.1.1 Overview and control elements

Nr.	Description
1	<b>Configurations tabs.</b> These are used to enter the test parameters from which the PV curve will be calculated. Variation of the fill factor (FF) is optional, else the Sandia defaults it to 0.78. If FF use is activated, the software will ignore Uoc and Isc parameters and instead calculate both from Umpp, Impp and the FF. Tab “Advanced” even allows for the integration and variation of additional factors into the table calculation, such as temperature. All these affect the resulting PV curve. See section 14.1.2.
2	<b>Calculate table.</b> After entering all parameters, the PV table data, which represents the PV curve, is calculated by clicking this button. This doesn’t happen automatically and may take a few seconds.
3	<b>Show the table.</b> After the calculation, in order to verify the curve results as expected, it can be visualized in an XY diagram.
4	<b>Save table to file.</b> This is an option to save the calculated table data to a CSV file on a storage media for later analysis or visualization in a different software.
5	<b>Upload.</b> Before the test can actually start, it’s required to upload the table data to the device. This is done by clicking this button
6	<b>Start/Stop.</b> Manual start or stop of the function run. An XY generator based function would not stop automatically, only in case of a device alarm.

### 14.1.2 Configuration

By default, only 4 parameters are required to set up this PV function (tab “Basic”): Uoc (open circuit voltage), Isc (short-circuit current), Umpp/Impp (voltage/current in the maximum power point). Additionally, there is a fill factor which can be activated and which defines the ratio of Uoc to Umpp, as well as of Isc to Impp. In case it’s activated, only Umpp and Impp are required to be defined and the rest is calculated. The resulting Uoc, Isc and Pmpp are displayed in tab “Calculated results”.

Tab “Advanced” offers some additional parameters to enable and configure. Definitions and ranges:

Name	Located in tab	Range	Default value	Unit
Uoc / Umpp (panel voltage)	Basic	0... $U_{Nom}$ of the device	-	V
Isc / Impp (panel current)	Basic	0... $I_{Nom}$ of the device	-	A
Fill factor	Basic	>0...1	0.78	-
Irradiance reference value	Advanced	>0...1500	1500	W/m <sup>2</sup>
Irradiance	Advanced	>0...1500	1500	W/m <sup>2</sup>
Temperature reference value	Advanced	-40...80	50	°C
Temperature	Advanced	-40...80	50	°C
Beta (temperature coefficient)	Advanced	-1...<0	-0.38	-

### 14.1.3 Control

After configuring all necessary parameters the table has to be calculated before it can be uploaded to the device. Table calculation doesn't happen automatically, so you have to trigger it by clicking the corresponding button. Calculation can fail and will then be reported on screen. One possible reason to fail could be a voltage value which is too low, even if the adjustable range starts at 0. The same value could lead to a positive result with a different device model. So it can't be predetermined which values would be OK and which wouldn't. To verify the calculated PV curve is OK it's recommended to view it in the XY diagram.

After the calculation, the table can either be directly uploaded to the device (button in Step 3) in order to start the test, or the curve resulting from the table data can be viewed or the table data could be stored to a file for other purposes. Once the table has been uploaded, the control button Start/Stop will be unlocked and the PV simulation can be started immediately.

During the test run only output voltage and power set values are adjustable, which are global limits able to affect test results, so it's recommended to set the output voltage to at least as high as  $U_{oc}$ , ideally before the test is started, and the output power to at least the calculated power of the MPP, but better to the product of  $U_{oc} * I_{sc}$ .

## 14.2 Function "DIN EN 50530"

This function is mostly identical to the equally named function as available on the HMI of select series. For details about this function, its setup and use please refer to the user manual of the device. This section is only intended to describe additional features.

### 14.2.1 Simulation mode "U/P"

Additionally to the simulation modes as also available on the HMI of your device, **EA Power Control** features this mode since version 2.17. It allows for a different method to impact on the MPP compared to simulation mode U/I. With U/P mode, the user only enters a per cent value which is factor for the current in the MPP. Input example:

The screenshot displays two steps of the configuration process. Step 2, titled 'Step 2: Input mode', features a dropdown menu set to 'MPP'. Below it, two input fields are shown: 'Umpp:' with a value of '60.00' and unit 'V', and 'Imp:' with a value of '30.0' and unit 'A'. Step 3, titled 'Step 3: Simulation mode', features a dropdown menu set to 'U/P'. Below it, two input fields are shown: 'Calculated Pmpp (100%):' with a value of '1800' and unit 'W', and 'Imp percentage:' with a value of '75.00' and unit '%'. The interface has a light grey background with white input boxes and labels.

The value "Calculated Pmpp" comes from the given MPP values,  $U_{mpp}$  and  $I_{mpp}$  and can't be changed anymore once the simulation is started. Value "Imp percentage" is variable during simulation and moves the MPP on the Y axis of the PV curve. The per cent value in the example would result in an  $I_{mpp}$  of 22.5 A during the simulation, until changed.

## 14.3 Function "Battery test"

This function is mostly identical to the equally named function as available on the HMI of select series. For details about this function, its setup and use please refer to the user manual of the device. This section is only intended to describe additional features.

### 14.3.1 Mode "CP" (constant power)

Contrary to the HMI of the device where the battery test can either run in constant current mode (CC) or in constant resistance mode (CR) here constant power (CP) is additionally activated. This mode is limited to the so-called "Dynamic test" which in the current version of this software is only available with series PSB 9000 and PSB 10000. CP has to be activated explicitly, same like CR, and also separately for the test parts "Charging" and "Discharging". After activation the power set values becomes accessible, also separately for both test parts.

When running the dynamic battery test in CP, the software will permanently calculate the charging/discharging current from the battery voltage and the given power set value to keep the power constant. It means, that the values "Discharging current" and "Charging current" have to be overridden, so they're not accessible anymore once CP has been activated.

#### 14.3.1.1 Limitations

- The power may not be held constant anymore if the calculated would exceed the maximum current as rated for the particular device or there is an adjustment limit ( $I_{max}$ ) which is lower than the rated current.

## 15. App “Calibration”



With date 02/2020 the Calibration app doesn't yet support series PSB 10000, PSI 10000 and ELR 10000.

### 15.1 Preface

Definition of calibration: *“In measurement technology and metrology, calibration is the comparison of measurement values delivered by a device under test with those of a calibration standard of known accuracy”* (source: Wikipedia).

The calibration app here is a re-adjustment feature **EA Power Control**, used with power supplies and electronic load devices in remote control via a digital interface. Some device series have a calibration feature built into their HMI, but some series don't, such as PSB 9000. The main purpose of the app is to calibrate the set values on the DC terminal of the device, plus also the actual values on display. The advantage of the app over the manual way via the HMI is that the app window can show much more information and literally guide the user through the process.

The purpose of calibration is to find out if a device is still within tolerance or not and in case it's not it's usually re-adjusted right-away to compensate the deviation as far as possible. This can become necessary due to the device and its components aging by more or less heavy use or after a repair. While it's usually not necessary to readjust a device if all values are within tolerance, the user or operator of the device decides when and how often a calibration is considered necessary and also if a re-adjustment is performed or not.

### 15.2 Preparation

For a successful re-adjustment as part of a calibration, a few tools and certain ambient conditions are required:

- For voltage calibration: a measurement device (multimeter) for voltage, with a max. error in the particular measuring ranges of half of the voltage error of the device under calibration (the tolerance or error of a specific model is stated in the user manual, in the technical specifications). That measurement device can also be used to measure the shunt voltage when calibrating the current
- For current calibration: a suitable DC current shunt or current transducer, ideally specified for at least 1.25 times the max. output current of the device under calibration and with a max. error that is half or less than the max. current error of the device under calibration (the tolerance or error of a specific model is stated in the user manual, in the technical specifications)
- Normal ambient temperature of approx. 20-25°C (68-77°F)
- Depending on the of device, power supply or load or bidirectional, an adjustable load or source or both, which are capable of consuming/supplying at least 102% of the max. voltage and current of the device under calibration and which are calibrated and precise

Before you can start calibrating, a few measures have to be taken:

- Let the PSI device warm up for at least 10 minutes under 50% load, in connection with the voltage / current source
- In case the remote sensing input is going to be calibrated, prepare a cable for the remote sensing connector to DC output, but leave it yet unconnected
- Abort any form of remote control, deactivate master-slave mode, deactivate resistance mode
- Install the shunt between PSI device and load and make sure the shunt is cooled somehow
- Connect external measurement device to the DC output or to the shunt, depending on whether the voltage is going to be calibrated first or the current
- Connect the device via USB to the PC, start **EA Power Control** and open the “**Calibration**” app

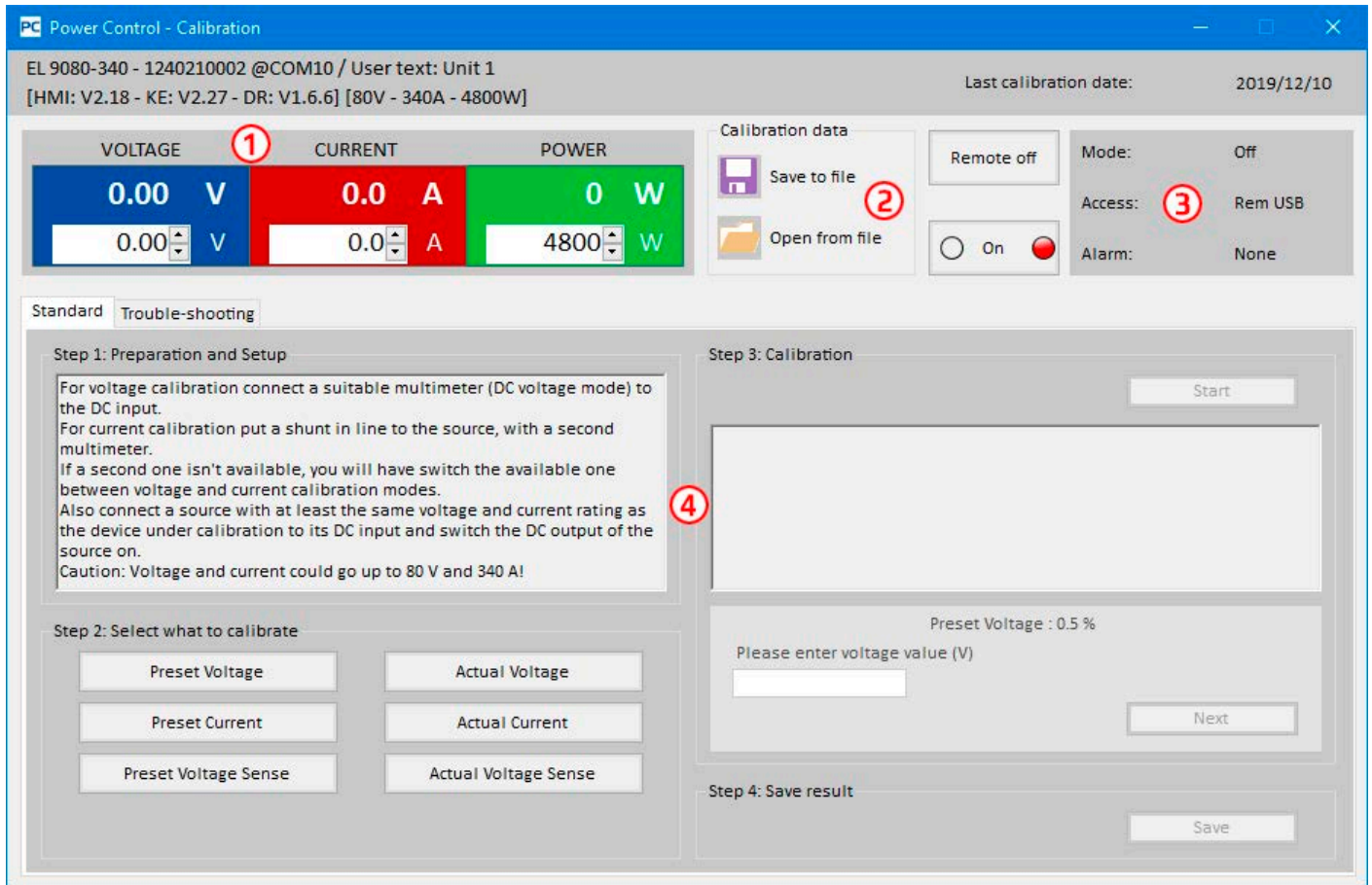
### 15.3 After the app start

The very first step when going to calibrate a device the first time or when repeating the calibration the next is to save the calibration data stored in the device to a file on PC, as a backup. It helps to restore the device to a previous state in case something goes or the device seems to have become worse after the re-adjustment. In order to save the data click on “**Save to file**” button in the window area “**Calibration data**”.

**EA Power Control** supports to calibrate and re-adjust all series it supports in general, but there is a distinction between devices from series PSB 9000 and all other series. The software detects the series and will present you with the proper tab, in which it will start showing instructions. Carefully read and follow them to prepare your setup.



Overview:



Nr.	Description
1	Actual and set values. These value on serve to watch if and what the device is doing. The set values of the device are controlled by the app when running a re-adjustment.
2	Manually save the calibration data stored in the device to a file on PC, also load them from there. This can be considered as a backup feature for calibration data. It's recommended to create a backup every time a re-adjustment is going to executed.
3	Status display, similar to the one in the Terminal app.
4	The tab where the actual re-adjustment takes place. It will instruct the user what to do or request to enter values, which are processed in the calibration procedure.

### 15.4 The re-adjustment procedure

After the start new instructions will be shown. Follow them step by step, as they are guiding you through the process. If everything goes smoothly and no interruption like an alarm interferes the procedure you will come **to the end where you definitely should save the newly collected calibration data to the device** and also to the PC.

Notes about the **“Standard”** tab calibration (all series except for PSB 9000):

- Depending on the series your device is from, you can select from a varying number of options to calibrate. There is no particular order regarding what to do first, voltage or current, however it's required to always re-adjust a preset before the actual, because they are connected
- It's not required to do everything every time. In case the device is OK regarding the current, but not regarding the voltage, it would suffice to re-adjust “Preset Voltage” and then “Actual Voltage”
- In case the result of a first cycle of calibrating and re-adjusting voltage or current isn't to your satisfaction, it can be repeated to get better results

Notes about the **“PSB 9000”** tab calibration:

- After the calibration has been canceled by the user before reaching the final step, it will run from the very beginning when starting it again.

## 16. The Graph

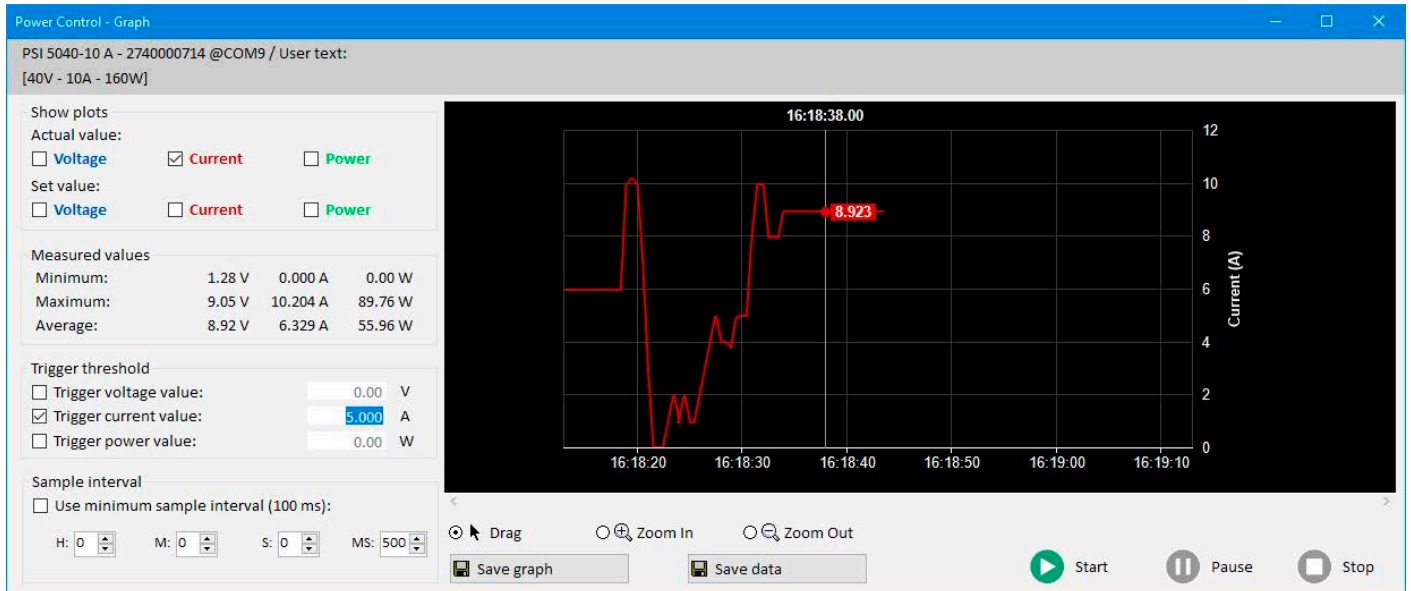


Figure 14 - Graph window (default size)

After the first installation of this software, the app is locked. To unlock it, an [optionally purchasable license](#) has to be installed. For more information about getting a license and unlocking the app refer to 12. License management. In case you already have a valid license for app “Multi Control” installed, the Graph is automatically unlocked.

After unlocking the “Graph” by installing a license there will be a new button available in the app windows “Terminal”, “Seq/Log” and “Function Generator”:



It opens the graph window. The “Graph” records data in the background and visualizes it on the graph screen. It can show **up to 6 plots**. The recorded data (10000 samples with each plot) can be exported into a text file of CSV format (european or US format, can be selected in “Configuration”), similar to the one of the logging feature. Alternatively, the current graph screen can be saved as image.

The graph screen always shows a time range of at least 1 minute and a maximum time range of 10000 x sample interval. It means, with a sample rate of 1 s the zoomable and moveable time range would be 10000 s etc.

### 16.1 Control elements

#### Area “Show plots”

The check boxes enable and disable the 6 available plots. The color here is the same as used for the plots on the graph screen, in order to see which plots represents which physical value. The graph has three vertical axes for U, I and P. The set values and actual values belonging to the same physical value use the same scale. Switching off a plot only makes it invisible on the graph screen, but the data for it's still recorded in the background, so that when switching it back on again, there will be no gaps and the recorded data of the plot is filled into the graph at once.

#### Area “Measured values”

The values in this area update with the every elapsed sampled interval. This area is only of informational value.

#### Area “Trigger threshold”

The check boxes here enable or disable separate trigger thresholds which can make the graph stop when reaching any of the enabled thresholds. It works both ways, either if a value is above the threshold and then falls or if it's below the threshold and then rises. After a stop has been triggered, the software will pop up a message. Once the pop-up is closed, the recording can be continued.

The threshold values only become valid if the entered value is confirmed by ENTER or RETURN key on keyboard or if you click with the mouse somewhere outside of the numeric field.

#### Area “Sample interval”

Defines the sample interval, i. e. the time after which the graph collects the next set of data (=sample) from the device to record it into plots. The default value is 500 ms, the minimum value is 100 ms and the maximum is 99 h 59 m 59 s 999 ms.

For using the **minimum interval of 100 ms** it's sufficient to tick the checkbox. This setting doesn't touch the adjusted sample interval, so that when deselecting the checkbox, the other sample interval instantly becomes effective.

Changing the sample interval while the graph is running will be effective after the momentary interval has elapsed.

### Buttons “Drag”, “Zoom in” and “Zoom out”

These three buttons are for use with the graph screen only. Once a function of those three has been selected by clicking the button, it can be used on the screen. As the button names say, the graph can be zoomed in or out, for instance to analyze a specific part and save images or show the entire record of max. 10000 samples. When zooming, the scales on the Y axes are adapted, so it can happen that plots get out of the visible area. This can be compensated by dragging the visible area or zooming out again.




### Button “Save graph”

This button can be used to save a snapshot of the graph area to an image file (PNG, JPG, GIF, SVG) or PDF on any storage media. It will save the entire graph area, including the scales.

### Button “Save data”

With this button the samples, i. e. data recorded in the background (actual values of U, I, P) can be saved to a file at any time, even while the graph is running. The exported file format is similar to the log file of the logging feature, but only holds the three actual values plus a time stamp. The exported file can contain recorded samples up to the max. number of 10000.

### Buttons “Start”, “Pause” and “Stop”

These are used to control the graph run. After every first start or the next start succeeding a stop, the graph area is initialized according to the last settings of color and will be cleared. The graph then starts to plot the recorded samples. Button  only pauses the graph from plotting, the data record is continued in the background, so that when continuing the plotting with , the graph plots all data recorded in the pause at once into the graph area and jumps ahead to the current time stamp. Stopping with button  causes the plotting to end, with the max. last 10000 samples in memory, which then could be exported.

## 16.2 Context menu

The graph area offers a context menu which becomes accessible when hovering the mouse pointer over it. It's used to change the plot settings:

Menu entry	Function
Auto scale Y	Activates or deactivates the auto-scaling of the Y axes. When activated, the scales of the three vertical axes are dynamically adapted to the plot values in the visible graph area. When using this with very small values, the visual result can look unexpected.
Clear plot	Clears all plots and recorded samples in the memory. It can be considered as a reset. Can be applied during the graph run or in stop mode. Be careful with this function, as all recorded data will be lost.
Select background color	Selects the graph area background color between black and white. The graph grid, scales and captions are adapted as well
Select plot color	You can change the default colors of the plots here. The new color settings are stored and used the next time the graph window is opened.
how cursor value	Additionally to the plots the graph can show a vertical cursor along with a sample point on every of the 6 plots. When hovering the graph area with the mouse pointer, the cursor follows and shows the recorded value of the plot(s) at a certain time stamp.
Select plot type	For the 6 plots you can select the plot type between:  Dot = all recorded samples of the plot are shown in dot like form, with gaps due to the sample interval Line = Default setting, draws straight lines between every sample point in order to achieve the look of a curve, depending on the zoom level Curve fitting = similar to line mode, but rounded so the curve doesn't look so edgy when zooming in very deep

## 16.3 Notes and limitations

- The graph isn't a measuring tool. The displayed and recorded values are read from the device and plotted to the graph area. Long-time recording can be done by setting a very long sample interval.
- The vertical axes of U, I and P are set to auto-scale mode by default. This can lead to weird display when working with very low values which fluctuate only a little so the auto-scaling zooms the scale. In such situations it's recommended to switch off auto-scale function and zoom in manually
- The graph window can't be opened independently, but only from within the app windows “Terminal”, “Seq/Log”, “Multi Control” and “Function Generator” and will also be closed together with them
- When running dynamic operations on the device, for example a function, the graph may not be able to keep up with the value progression on the DC input/output of the device. For example, when running a rectangular function with 1 s pulse and 1 s pause and having a sample interval of 1 s for the graph, the visual result would be a triangle. However, with the minimum setting of 100 ms the result would look like a rectangle showing a few “stairs” here and there. A better visual depiction could only be achieved using an oscilloscope.

## 17. Demo mode

Since version 2.03 of this software includes a demo mode. It allows for the access to all app windows without having a real device of any compatible series connected to the PC, in order to have a look into the GUI especially of the licensed app “Multi Control”. When enabling the demo mode, the software will create two dummy units for app testing. Of course, there are some limitations, such as it can’t show reasonable values and status in the various app windows.

Enabling or disabling the demo mode is done in the help menu (also see 7.4 Menu & configuration). Demo mode is furthermore only temporary until the program is terminated.