User Manual

REFUset V3

REFU Elektronik GmbH

REFUset V3

Table of Contents

1 About this User Manual

These operating instructions form part of the product.

⇒ Read the User Manual carefully before installing and using the product.

⇒ Keep the operating instructions readily available with the device for the entire service life of the product.

⇒ Provide all future users of the device access to the operating instructions.

⇒ For more information on the device, troubleshooting, and options under: www.refu-sol.com

1.1 Symbols and Markup

☑	Prerequisite
⇒	One-step instruction
1.	Multiple-step instruction
•	Bulleted list
Highlighting	Highlighting within a text
↳	Result

1.2 Warning Notices

1.2.1 Layout of a Warning Notice

 WARNING TEXT	**The type and source of danger are described here.** ⇒ Measures for avoiding the danger are shown here.
Example	
 DANGER	**Death or severe injury due to high discharge current when opening the device.** ⇒ It is essential to ensure an earthing connection has been established prior to connection to the supply current circuit.

1.2.2 Categories of Warning Notices

There are three categories of warning notices.

 DANGER	"DANGER" designates a safety notice, the disregarding of which will lead directly to death or severe injury!
 WARNING	"WARNING" designates a safety notice, the disregarding of which can lead to death or severe injury!
 CAUTION	"CAUTION" designates a safety notice, the disregarding of which can lead to property damage or minor injury!

1.3 Information

Note:

A **notice** describes information which is important for the optimum and cost-effective operation of the equipment.

2 Safety Information

2.1 Qualified personnel

The product/system related to this documentation may only be handled by **qualified personnel** for the respective scope of tasks in compliance with the documentation related to the respective scope of tasks, in particular the safety and warning notices contained in it. Qualified personnel is competent on the basis of their training and experience to detect risks and prevent potential threats while handling these products/systems.

2.2 Proper use of REFUsol-Products

Please take note of the following:

 WARNING	**Death or severe bodily injury** ⇒ REFUsol Products may only be used for the applications specified in the catalog and in the related technical documentation. If third party products and components are used, they must be recommended or approved by REFUsol. Flawless and secure operation of the products requires proper transportation, storage, set-up, assembly, installation, start-up, operation and maintenance. The approved ambient conditions must be maintained. Notices in the related documentation must be observed.

2.3 Disclaimer

We have tested that the printed text's content matches the hardware and software described. Nevertheless, deviations cannot be ruled out, and as a result, we do not assume any warranty for it matching completely. The information in this printed text will be reviewed regularly, and necessary corrections will be contained in the subsequent editions.

3 Compatibility Overview

3.1 Inverter type compatibility

This software is compatible with the following products:

REFUsol 08K ... 23K (867 series)

REFUsol 40K / 46K (840, 842 series)

REFUsol 24K-UL (874, 876 series)

REFUsol 48K-UL (843, 844 series)

REFUsol 22K-JP (875 series)

4 Configuration with REFUset

Note

for configuring AE 3TL inverter, use AE SetUp tool from the website www.advanced-energy.com

Note

Depending on the active country code the displays can be different.

4.1 System Prerequisites

The following minimum prerequisites apply for the installation and use of REFUset:

- Windows XP SP3 or higher
- Microsoft .NET Framework 4.0

4.2 Preparatory Measures

Double click on the file that ends with ".exe" to install REFUset. The installation will then be executed.

A shortcut will be saved in the program list. You can start the program via this shortcut (Start → Program → REFUset).

4.3 Description of Functions

REFUset is a Microsoft® Windows® software to support the easy configuration of your REFUsol inverter.

It can be used to change the grid code settings or country-specific parameters of REFUsol inverters. Additionally, functions like sensor configuration, monitoring settings and firmware update are supported. The functions in detail:

4.3.1 Grid-Interactive Functions

- Startup conditions
  - Frequency, voltage range
- Start-up behaviour
  - Restart waiting time
  - Power ramp
- Grid monitoring
  - Actual voltage monitoring
  - Actual frequency monitoring
  - Phase voltage monitoring

- Average voltage monitoring

- Active power control
  - Permanent power limitation
  - Power reduction at over-frequency
  - Power reduction by external signal
  - Inverter remote stop signal at sensor input
- Reactive power control
  - Static voltage support: fixed Cos Phi
  - Dynamic voltage support by characteristic: Q (U), Volt/Var, Cos Phi (P)
  - Dynamic voltage support by external control of Q or Cos Phi
- Fault Ride Through
  - Overvoltage Ride Through
  - Undervoltage Ride Through
- ROCOF (Anti-Islanding method)

4.3.2 Other functions

- Firmware Update
- Sensor configuration
- Monitoring protocol
- Datalogging settings
- Saving / Loading of inverter settings

Note

Only the parameters enabled in the country code set for the inverter may be set. Unused parameters, e. g. additional levels of phase voltage monitoring or an under-voltage average value, are shown in grey and cannot be changed.

The values you should use will be preset by your distribution grid operator. If you set other values, the grid operator may take away your system's operating permit!

4.4 Connection Set-Up Ethernet and RS485

4.4.1 Ethernet

1. Set your PC's network settings to the following values: (TCP/IP)
   - IP address: 192.168.130.100
   - Subnet mask: 255.255.255.0
   - Standard gateway: 192.168.130.1
2. Set up an Ethernet connection between your computer and the inverter
3. Start REFUset from the Windows start menu.

Here is how you access the inverter:

- via the Ethernet interface with the factory-set standard:
    - IP Address 192.168.130.30
    - Port Number: 21062
    - USS Address: 0

If you have set the inverter to another IP adress, you have to change your PC into the same address range, and use this address to connect.

4.4.2 RS485

Connect the Inverter to the PC using an RS485-USB converter. Select the correct COM-port of the converter and type the USS address of the inverter. The inverter is factory-set to a baud rate 57600.

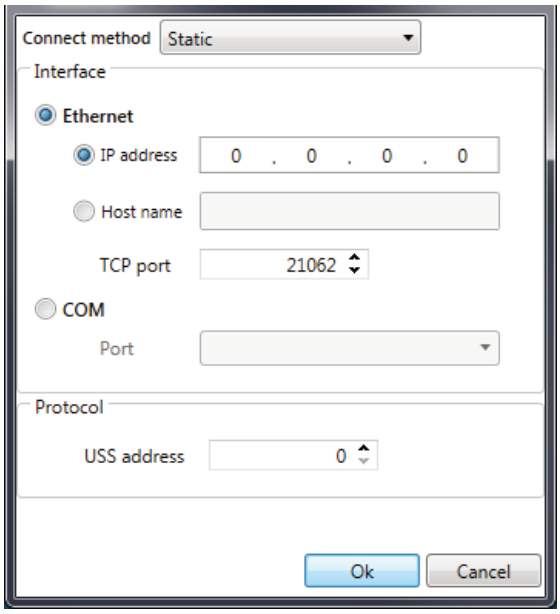


Fig. 1: Selecting the communication interface

The main window will open automatically after a connection is successfully set up and the inverter's parameter values are automatically read.

Automatically scanning a network IP range

If you do not know the IP address of an inverter, it is possible to scan IP ranges (e.g. If DHCP is used), subnets or entire networks for inverters.

Note

It is recommended to scan within the smallest possible IP range to minimize the duration of the search

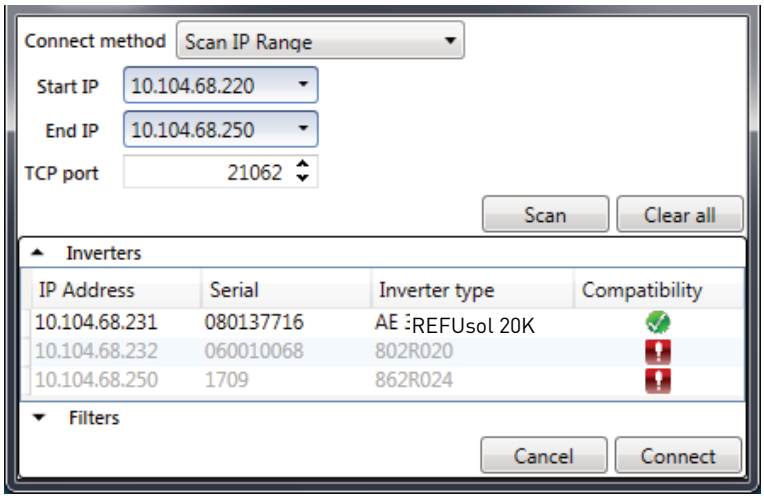


Fig. 2: Selecting the communication interface

After completing the scan all found inverters are shown in a list. You also see incompatible inverters; they are displayed in grey and with an exclamation mark in the compatibility column. With this version of REFUset connections with incompatible inverters are not possible. For this, download the corresponding REFUset version in the download section of the REFUsol website.

Clicking "Filter" unfolds the filter area, where a specific serial number or inverter-type can be filted.

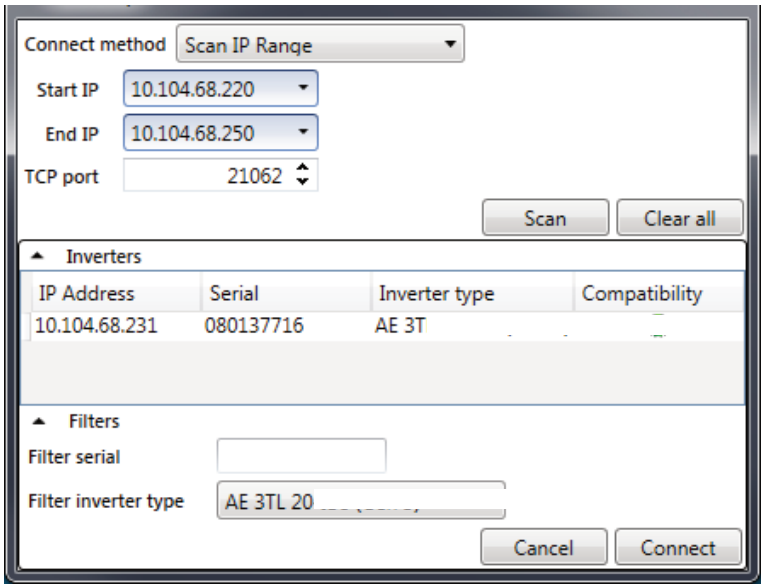


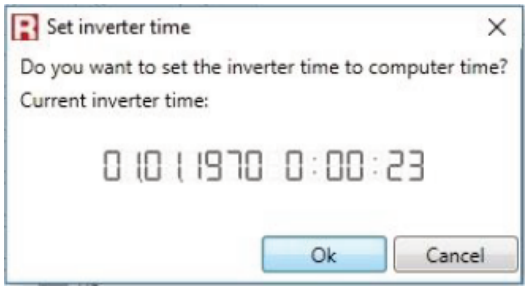
Fig. 3: Result of the scan by using the filter function

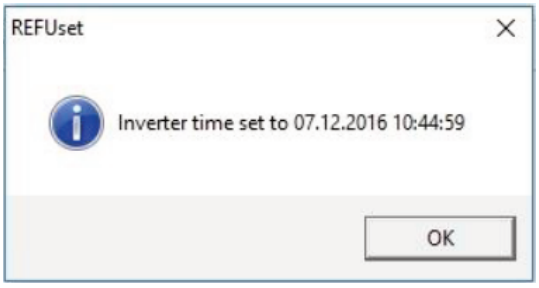
The connection to a particular inverter is carried out by double-clicking on the corresponding line or clicking the button "Connect".

4.5 REFUset Main Window

4.5.1 Initial Settings

On successful connection to the inverter, the date and time can be set according to the PC's local time. Press OK to set the time:





If the inverter has no country setting, the following screen appears. Please select the appropriate country code and press Save.

4.5.2 Password

To change the inverter's limit values of the country a password is needed. This is available after completing the Confidentiality Agreement (found in the downloadable zip file on the REFUsol website) on request to the REFUsol Services.

To set the password click on "File → Settings → Passwords".

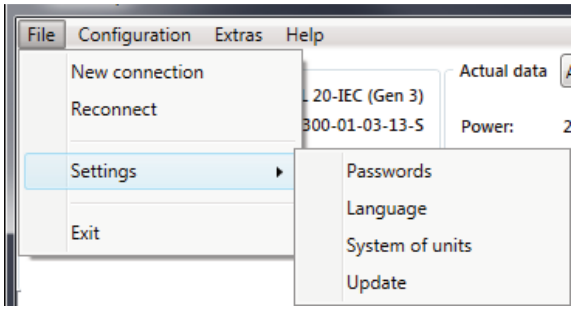


Fig. 4: Selection settings

Note

Changed values in all screens described below are only active when the Save button is pressed.

Note

Voltage and frequency limits are always shown relative to the nominal value. Voltage values are shown as a percentage of the nominal voltage, frequency values as the difference to the nominal value.

Fig. 5: Input password

4.5.3 Main Screen

Using the menu bar (File, Configuration, Extras and Help), you can select several functions offered by the software, which are explained below in detail.

The device information is shown in the upper part of the main window, as well as current measurement values such as line voltage and DC current in the corresponding categories. Via a pull-down menu it can be selected what actual data is displayed: AC, DC, sensors (temperature and irradiation), energy and feed-in (reactive power requirements and power reduction set-points).

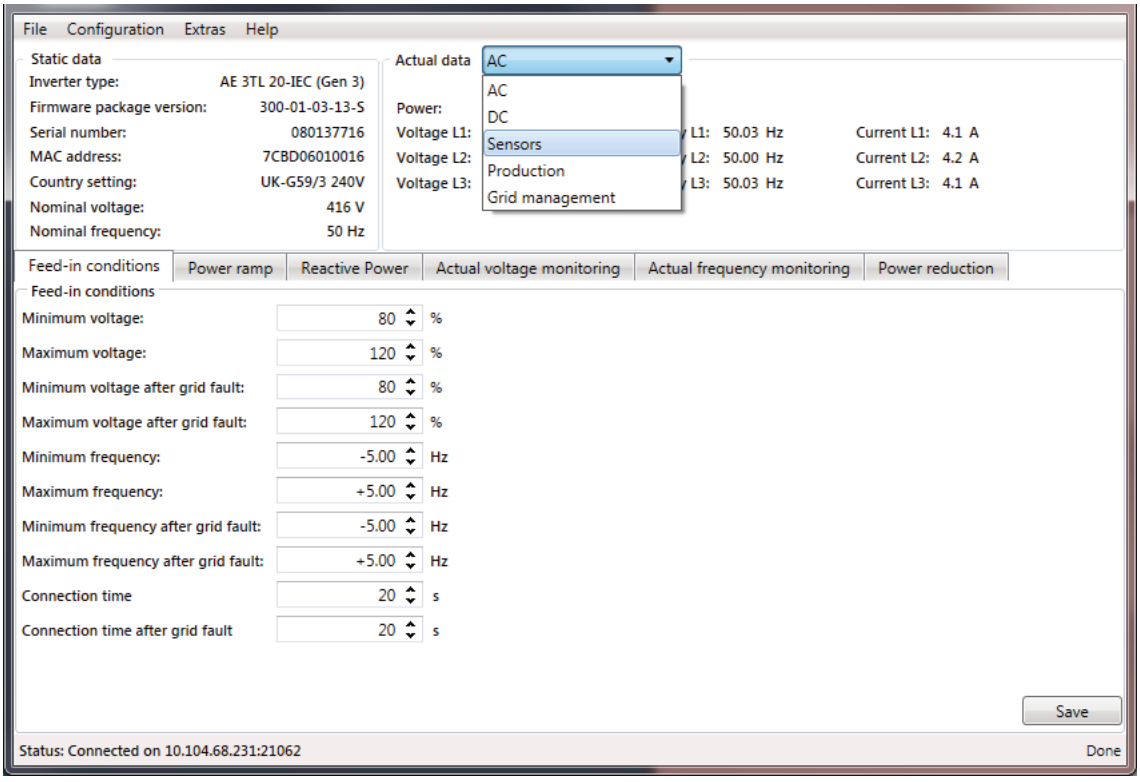


Fig. 6: Main window REFUset

In the lower part, the settings are organized in tabs. Different tabs are selectable depending on the country configuration. All settings are explained in separate chapters.

4.6 File Menu

In the **File** menu, you can establish an inverter connection without closing the program, create a new connection or terminate the program.

The passwords for changing the country-specific settings can be set.

In addition, a language can be set and the Anglo-American or Metric unit systems can be selected.

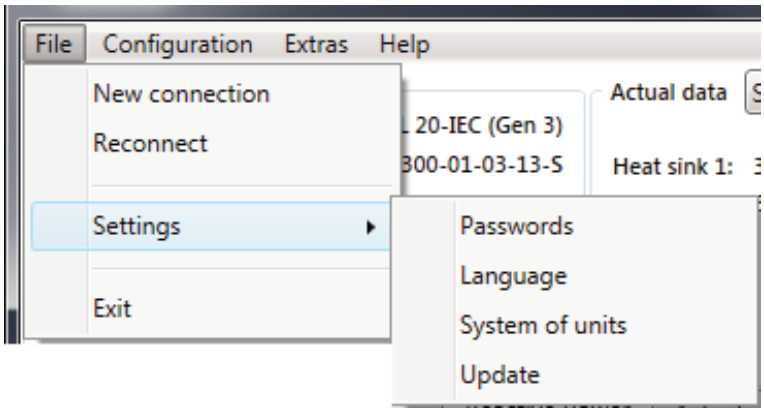


Fig. 7: File Dropdown Menu

4.7 Configuration Menu

The following functions can be found in the **configuration** menu: **Communication**, **Data logger, Analog input configuration, REFUlog** and **Set time to computer time.**

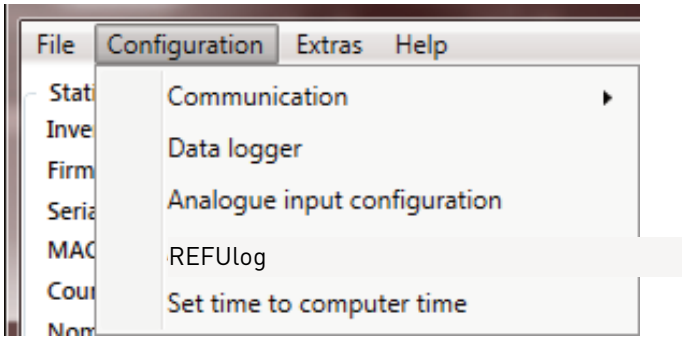


Fig. 8: Inverter Configuration Dropdown Menu

4.7.1 Ethernet-Configuration

In the menu item **Communication → Ethernet-Configuration** you can see the IP-Configuration of the inverter and change it.

Notice

IP configuration and RS485 settings will not be effective until after restarting.
You can only restart directly via the inverter thus far.

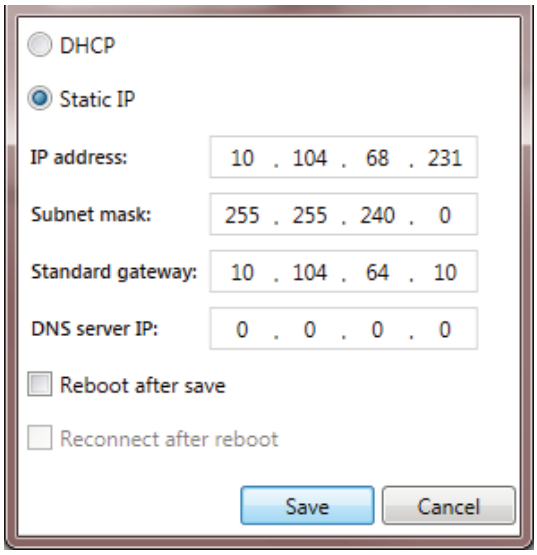


Fig. 9: Connection Settings

4.7.2 RS485

You can set the baud rate and the USS address in the **Communication → RS485** menu item.

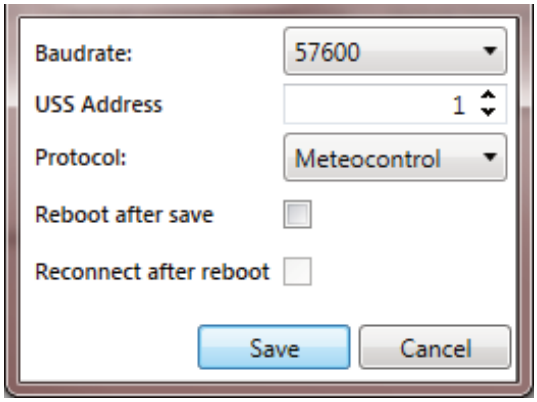


Fig. 10: RS485 Settings

4.7.3 Data logger

You can set the data logger's time interval in the **Configuration → Data logger** menu item.

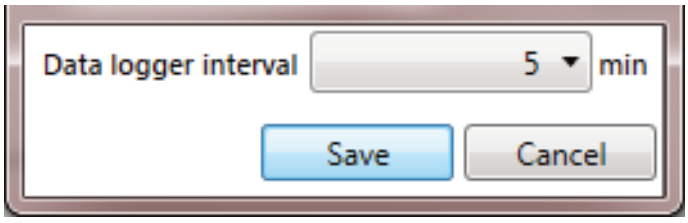


Fig. 11: Data Logger Configuration

4.7.4 Analog Inputs

You can configure analog sensor inputs in the **Configuration → Analog Inputs** menu item. This is the insolation sensor and the temperature sensor.

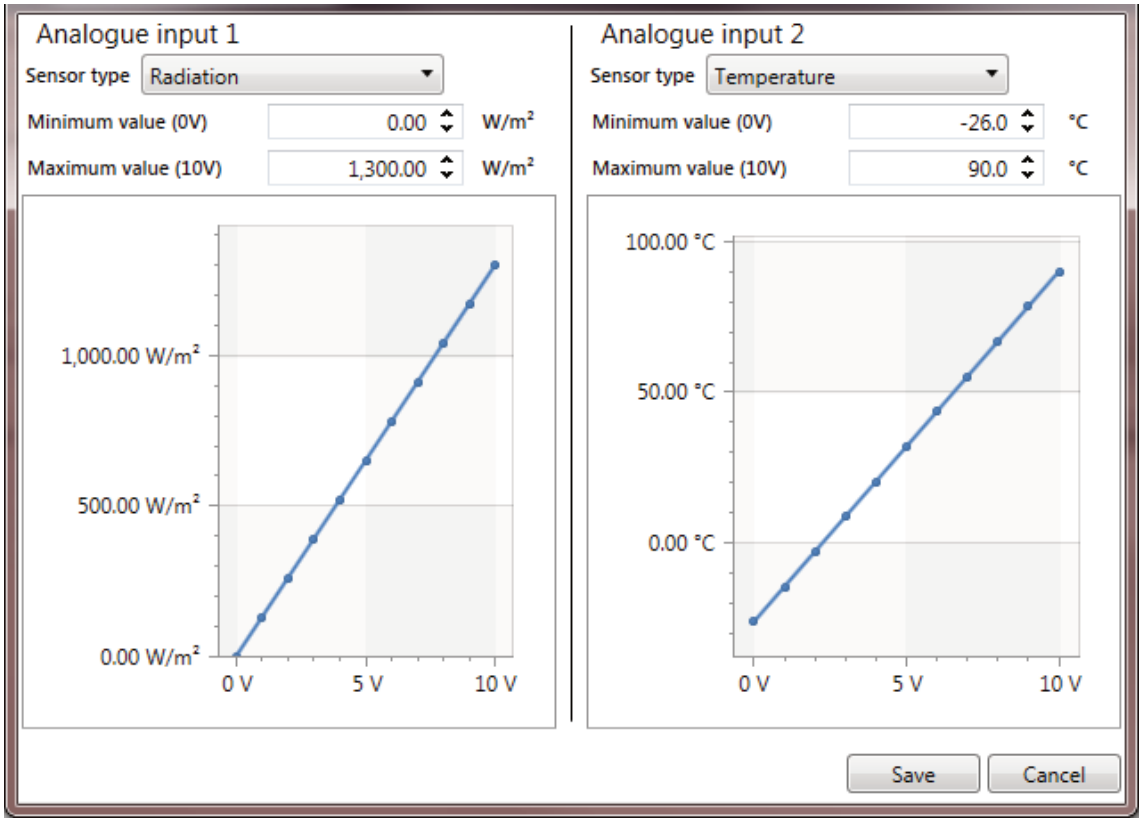


Fig. 12: Radiation and Temperature

If you have connected an external monitor to one of the analog inputs, please select the sensor type "External monitoring". It can be configured in the mask displayed below.

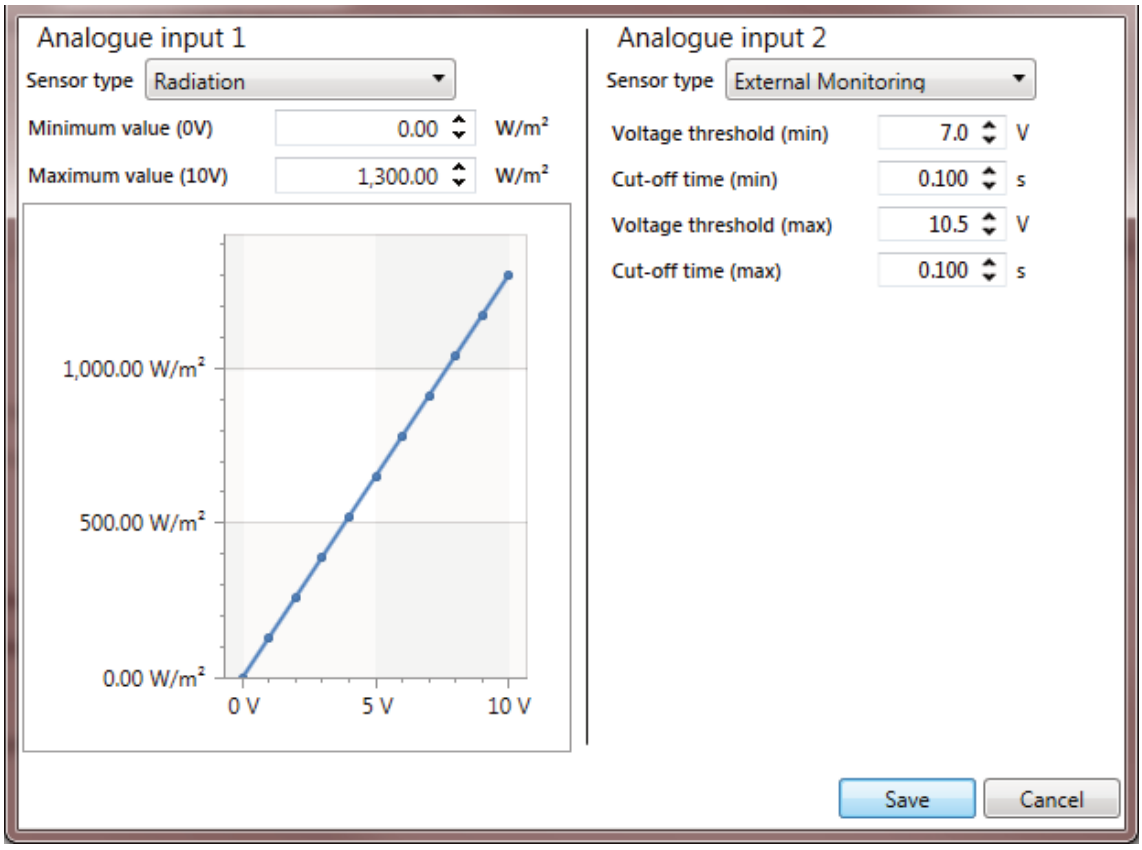


Fig. 13: Radiation and Temperature

4.7.5 REFUlog

You can activate the portal data forwarding function in the **Configuration → REFUlog** menu item. In addition, a test function and the configuration of the inverter can be sent from here.

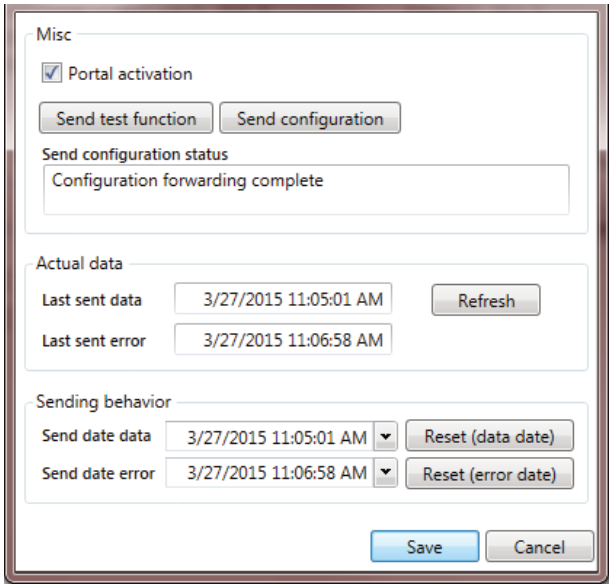


Fig. 14: REFUlog configuration

The date of the last data shipment and delivery of the last error is in the "Current data" visible.

In the area "sending behavior" you can enter a past date from that the data will be transmitted again. By pressing the button "Reset" all data is sent from the beginning of the recording.

4.7.6 Set time to computer time

By pressing configuration **Configuration → Set time to computer time,** the inverter time will be synchronized to the computer time. The following acknowledgment message appears.

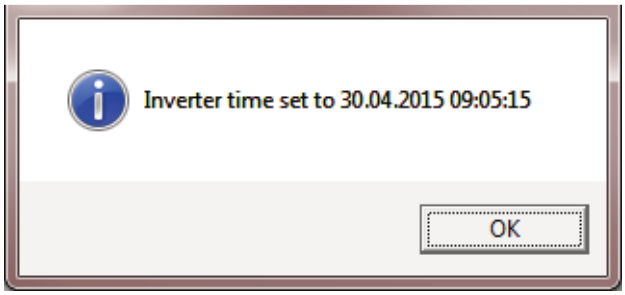


Fig. 15: Message after setting the system time

4.8 Extras Menu

4.8.1 Reboot

You can do a remote controlled restart with Extras → Reboot.

4.8.2 Error and event memory

Clicking the button "Extras Error/event memory" produces on the screen the following list:

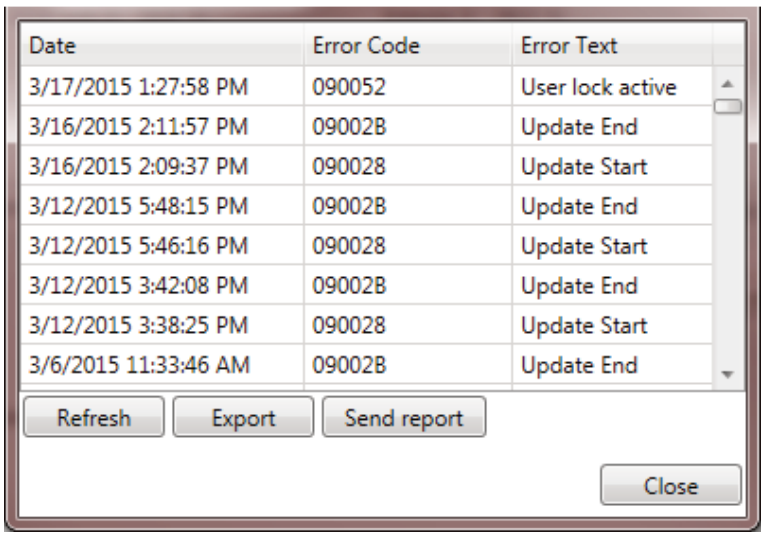


Fig. 16: Error and event memory

By pressing the appropriate buttons, it is possible to update this list, to generate a XML-file or to send the report by email to REFU Elektronik GmbH.

After pressing "Export Parameters", the following screen will appear:

4.8.3 Firmware-Update

CAUTION	**Material damage during interrupt the update process possible.** ⇒ Only perform update when sufficient sunlight is available until the end of the process.

Note

It is not possible to install an older firmware version. If this is necessary, contact the service.

For a firmware update, proceed as follows:

1. Download current firmware package from REFUsol webpage and save it local on your computer.
2. With "Browse" find corresponding .RFWPS file. Make sure the file extension in in capital letters!
3. Click Button „Update“.
   - Update process is displayed on the progress bar.
   - After successful upgrade, a status message appears.

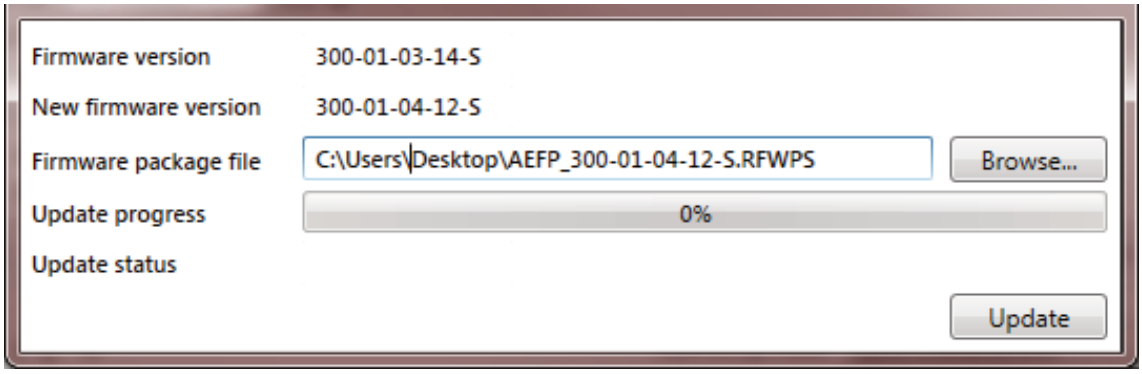


Fig. 17: Firmware-Update

4.9 Help

You will see information about the tool's product version by clicking on the **Help → About** button.

Check for updates

With Help → Check for updates you can find out, whether the newest version of REFUset is installed.

4.10 Feed in conditions

You can set the inverter's feed-in conditions here, i.e. at which line voltage range and line frequency range the inverter will begin to the feed-in. Also the connection time can be adjusted. All these limits can be configured for the first startup (in the morning) or after a grid fault (i.e. grid overvoltage).

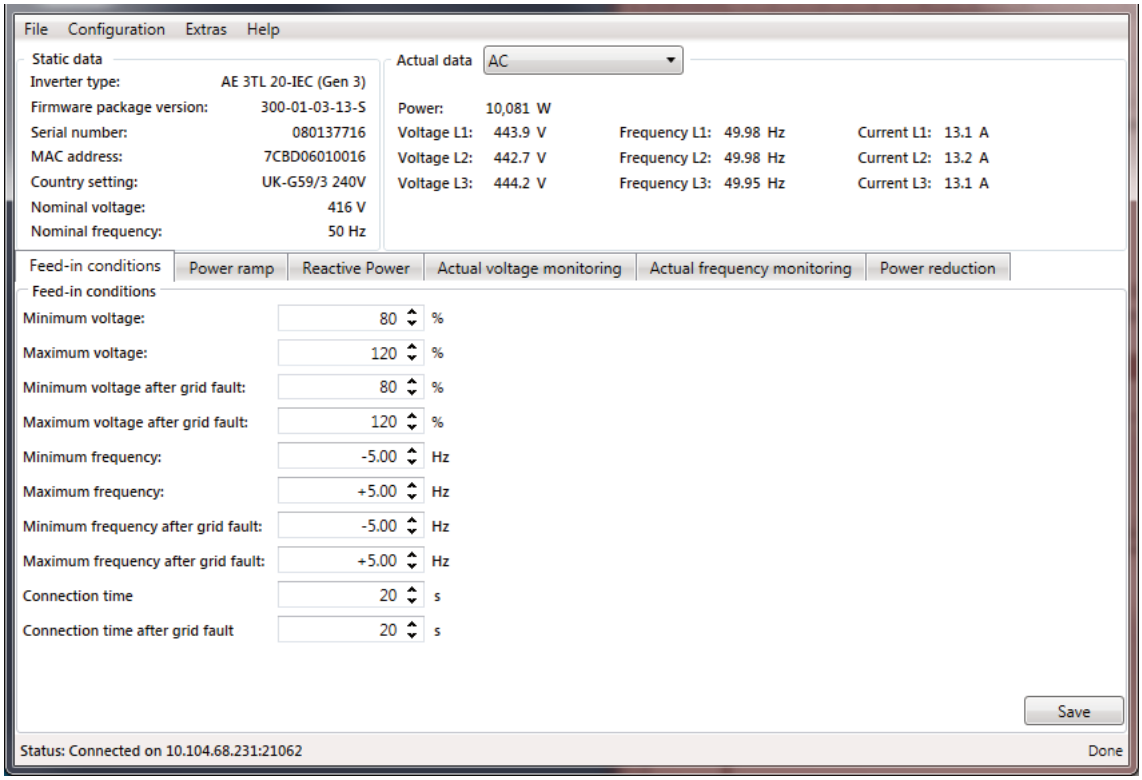


Fig. 18: Feed-in Conditions

4.11 Power Ramp

A power ramp limits the increase of power injection into the grid during startup, or after a grid fault. The ramp is defined as the time in seconds between startup and reaching the nominal power of the inverter. A typical power ramp is 600 seconds.

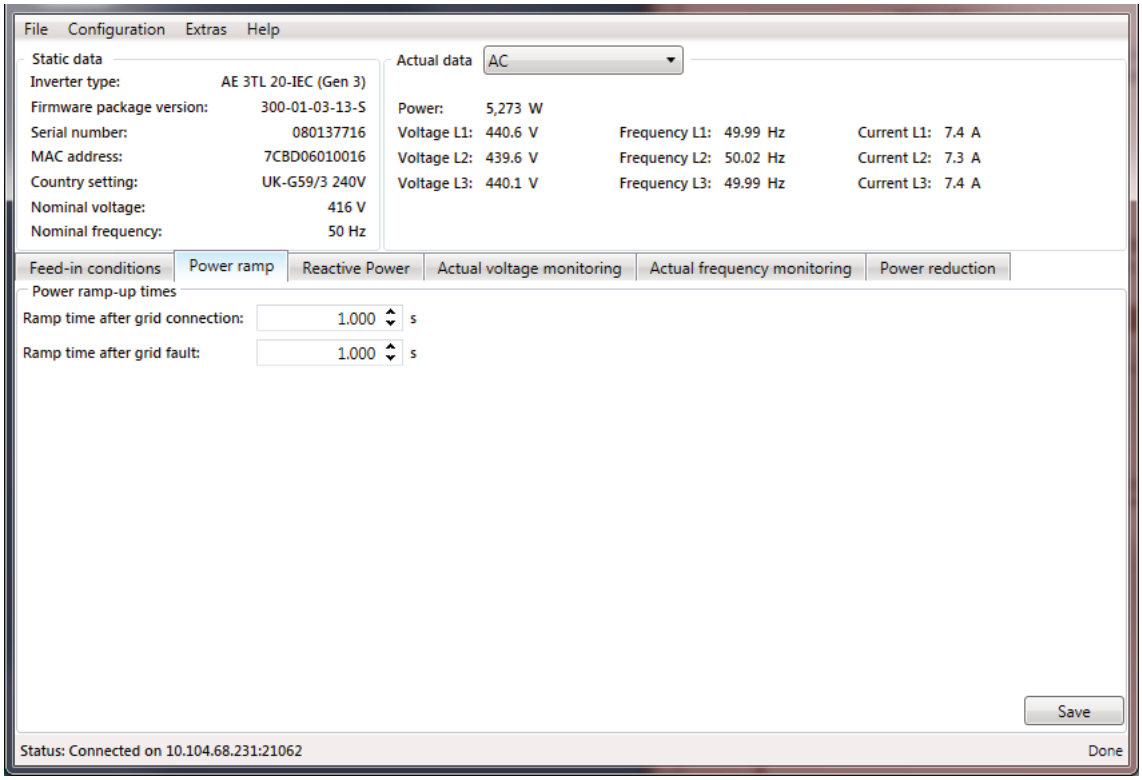


Fig. 19: Power Ramp

4.12 Actual voltage monitoring

Use the actual voltage monitoring tab to set the upper and lower limits of the Y-voltage (phase to neutral) and their corresponding trip times (cut-off time). The voltage limits are configured as percentage to the nominal voltage.

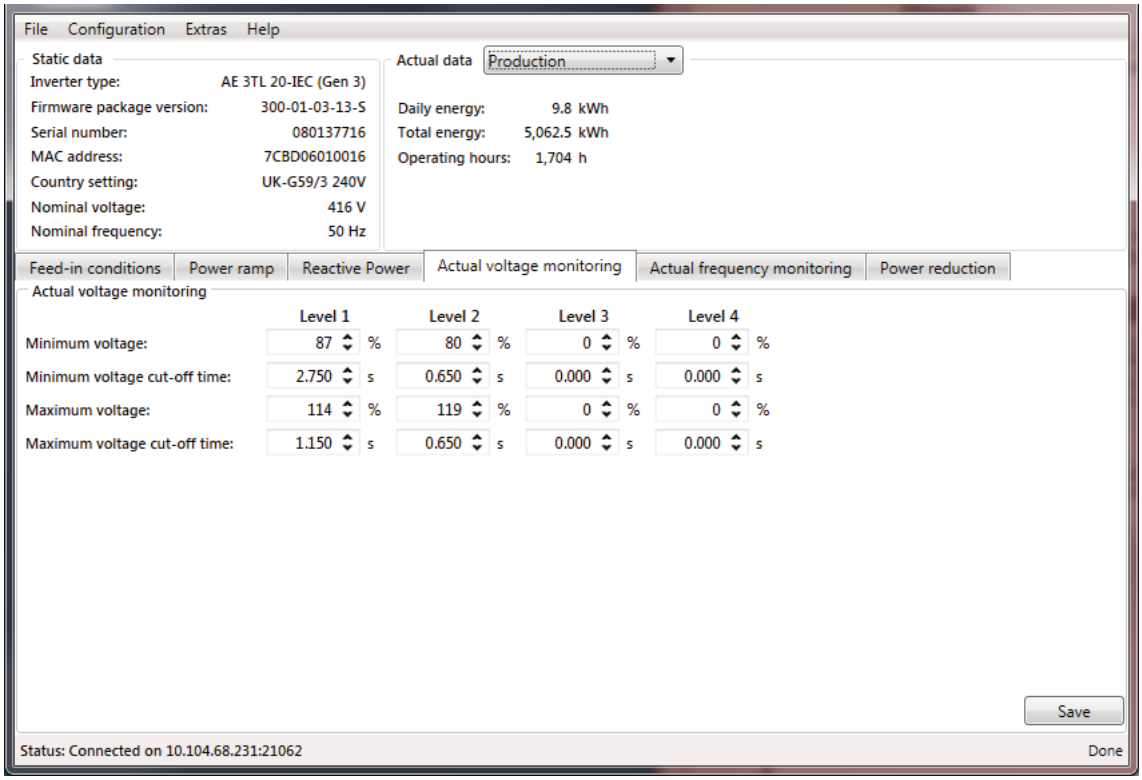


Fig. 20: Actual voltage Monitoring

4.13 Actual frequency monitoring

Use the actual frequency monitoring tab to set the grid frequency limits and their trip times (cut-off time). The frequency is defined as offset to the nominal frequency.

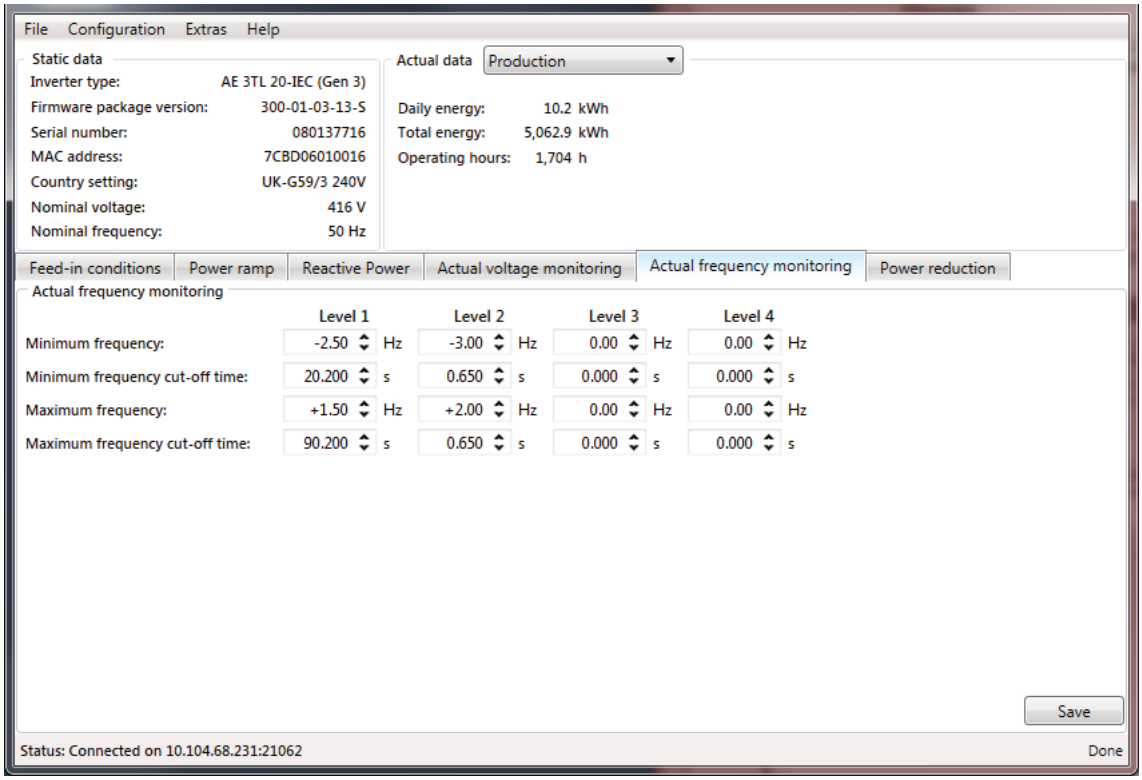


Fig. 21: Actual frequency monitoring

4.14 Power Reduction

Hard power-down of PV systems in conjunction with grid over-frequency can put the grid's stability in jeopardy. This is why the frequency-dependent reduction was introduced. The maximum deliverable power is reduced starting with a certain frequency value depending on the frequency. You can set the start value for the reduction, the reduction factor and the return frequency in the Power reduction tab.

The reduction factor (dP / df) is the power gradient after the start frequency is exceeded. 40% means 40% of nominal power is reduced at 1 Hz over-frequency.

Additionally, a Gradient (dP / dt) can slow down the power change at very fast frequency changes. 10% means the inverter's power is reduced by 10% of its nominal power per second.

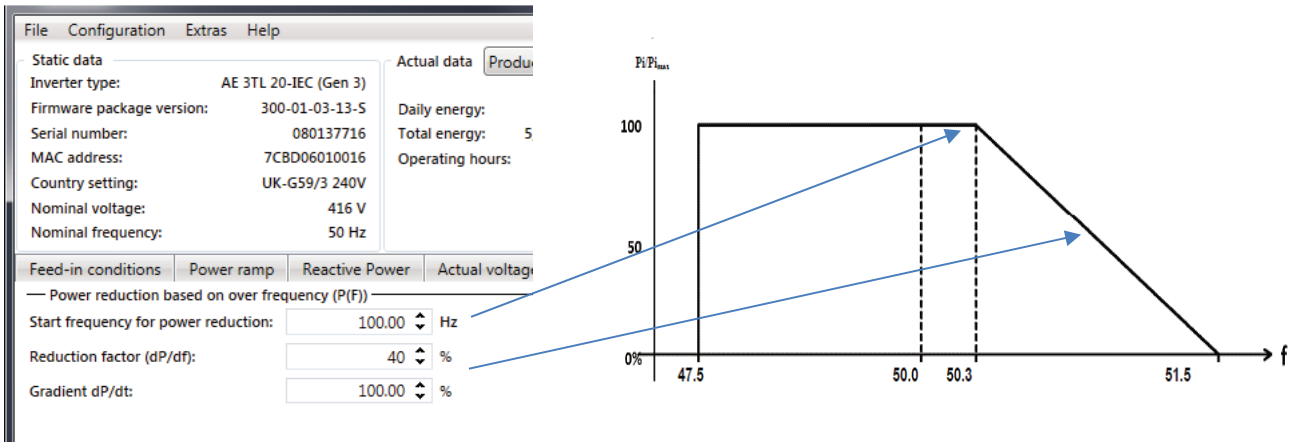


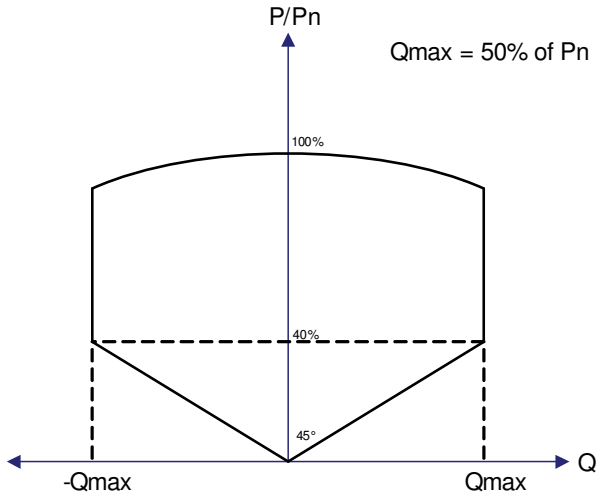
Fig. 22: Configuration for Power Reduction

4.15 Reactive Power

There are different modes of operation available in the Reactive power tab to enable the inverter to play its part in regards to the voltage stability of the electrical grids as required by the electric power company.

A **Capacitive** reactive power supply is specified with a **negative angular offset (over-excited)**. The reactive power supply will accordingly be made **inductive** by setting a **positive angular offset (under-excited)**:

capacitive (-) inductive (+)



The phase offset of the overall system caused by the wiring and external components can be adjusted with the help of the "Device-specific offset". By setting the offset of the reactive power to 1%, it would adjust the capacitive reactive power by 1% of the nominal power of the device.

This function is always active regardless of which mode of operation is selected.

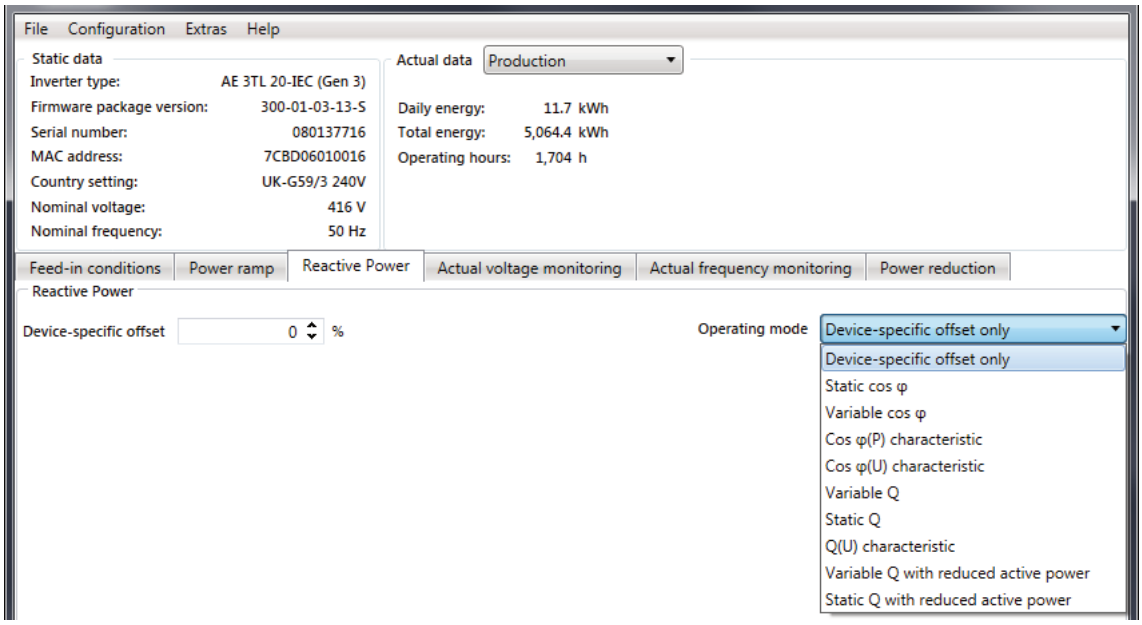


Fig. 23: Different modes of operation

4.15.1 Static cos φ

A permanently applicable phase shift is specified by a static setpoint, either in degrees (°) or as a cos φ value.

The "rate of change of phase offset" indicates how fast the inverter adjusts to the new cos φ-fixed value.

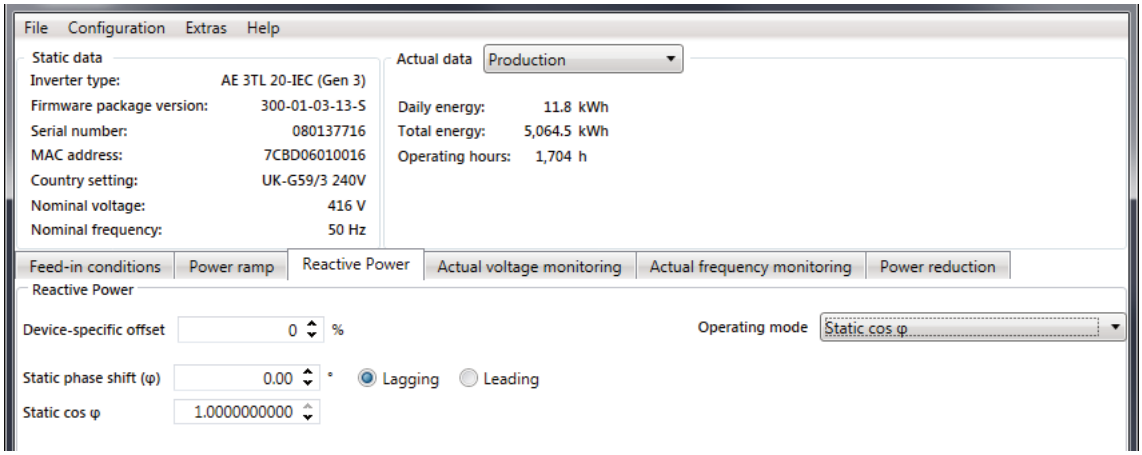


Fig. 24: Static cos φ

4.15.2 Variable cos φ

This mode of operation dynamically controls the cos φ value. It is used together with an external control unit, like REFUcontrol or a 3rd party product. The actual setpoint for the phase shift is shown in the window.

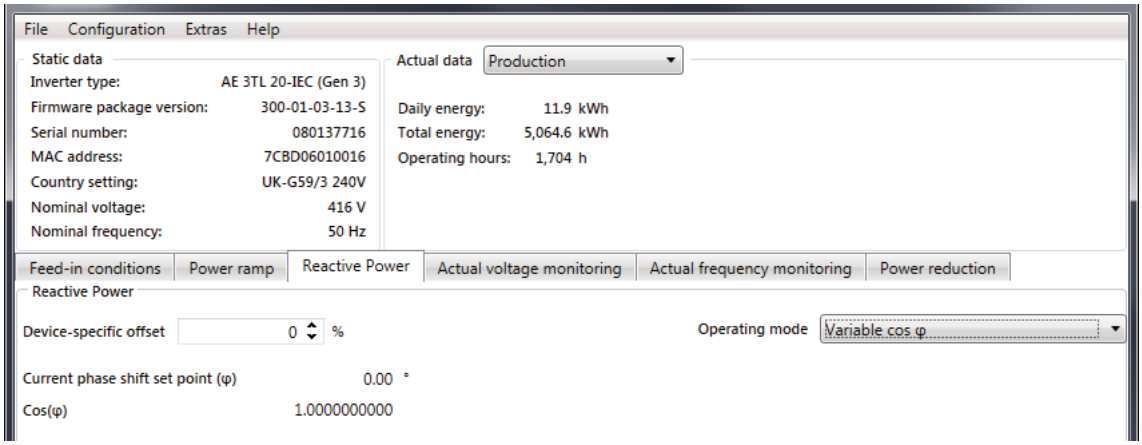


Fig. 25: Variable Cos φ

4.15.3 Cos φ (P) - characteristic

The desired phase shift and reactive power supply can be specified in this function depending on the active power supplied by the inverter.

The settings are available for 0 ... 100% of the rated active power in steps of 10%.

You can enter the reactive power as a phase shift in degrees (°) or as a cos φ value.

The "rate of change of phase offset" indicates how fast the inverter is adjusted to a new value.

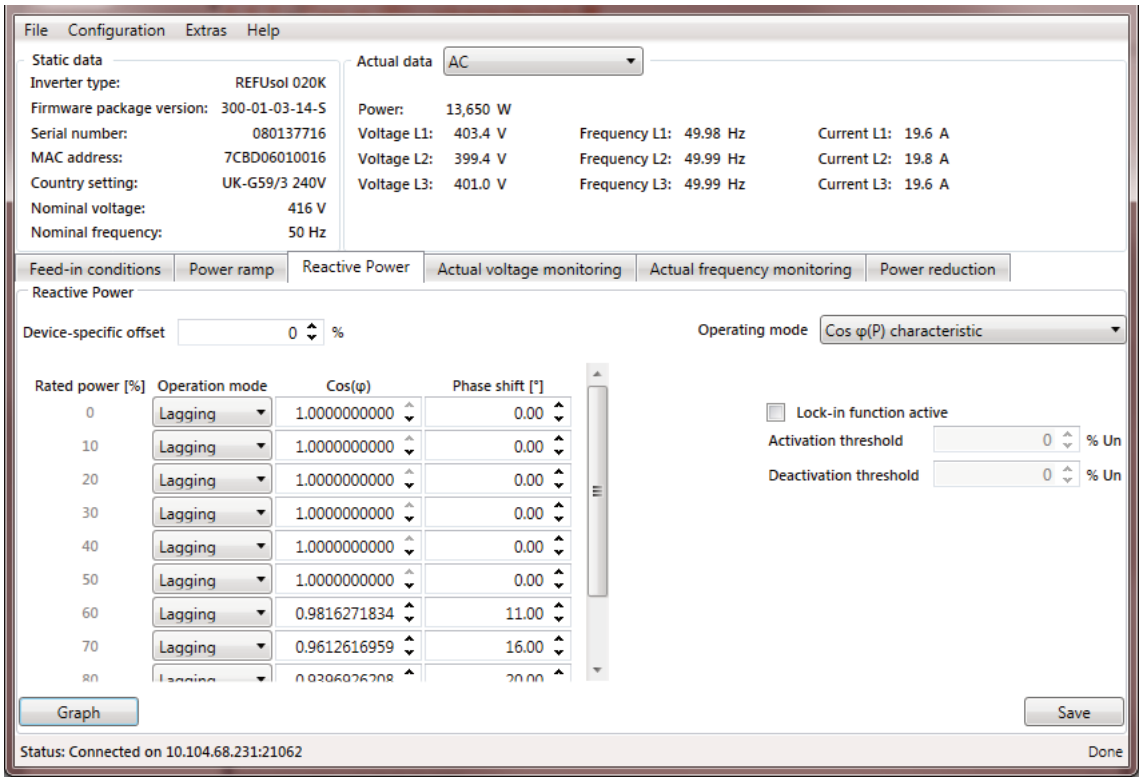


Fig. 26: Cos φ (P) characteristic

You can display the characteristic entered in a chart by pressing the "Graph" button.

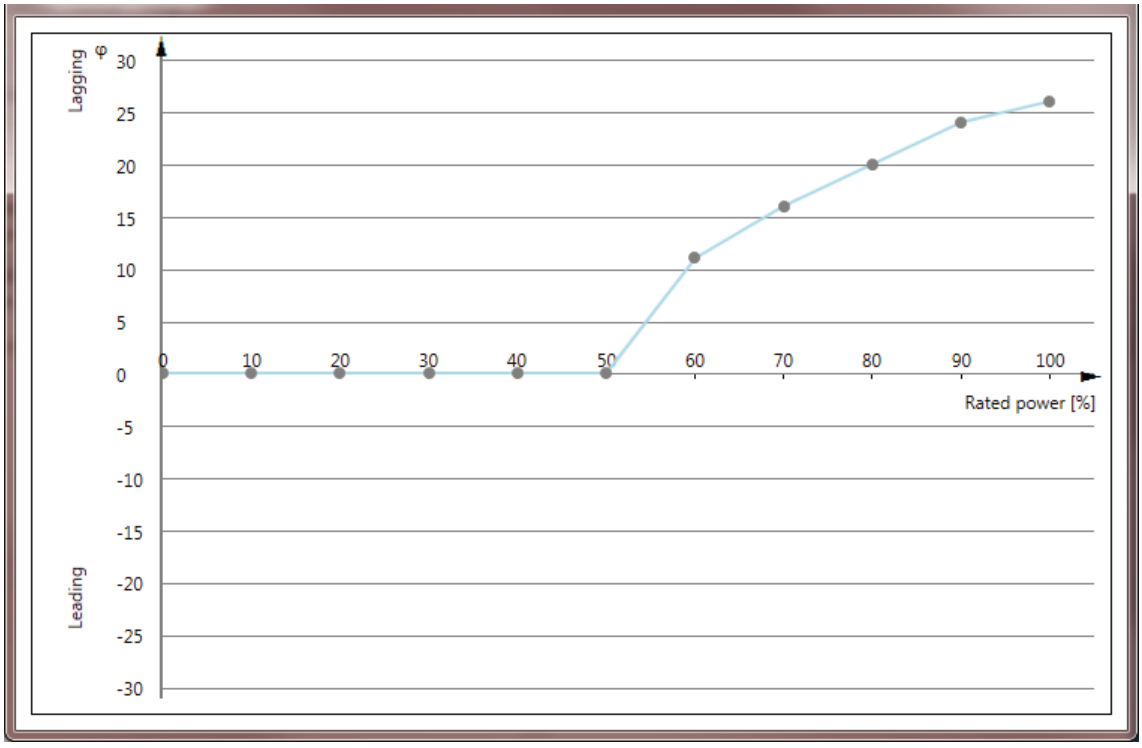


Fig. 27: Cos φ (P) – Characteristic Chart

4.15.4 Cos φ (U) – characteristic

The desired phase shift and reactive power supply can be specified in this function depending on the grid voltage.

The settings are available for 90 ... 110% of the nominal voltage in steps of 2%.

You can either enter the constant via a phase shift in degrees (°) or via cos φ.

The "Time constant for phase shift" factor indicates, how fast the inverter will react to voltage changes with the reactive power supply.

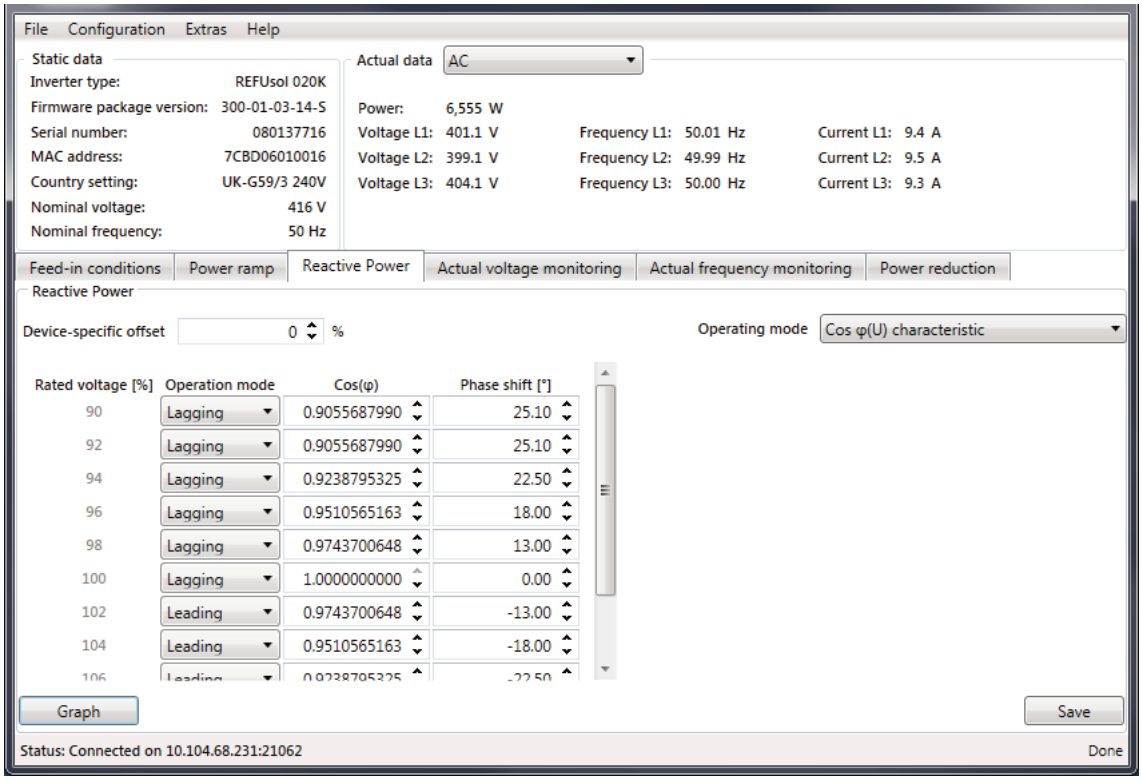


Fig. 28: Cos φ (U) – characteristic

You can display the characteristic entered in a chart by pressing the "Graph" button.

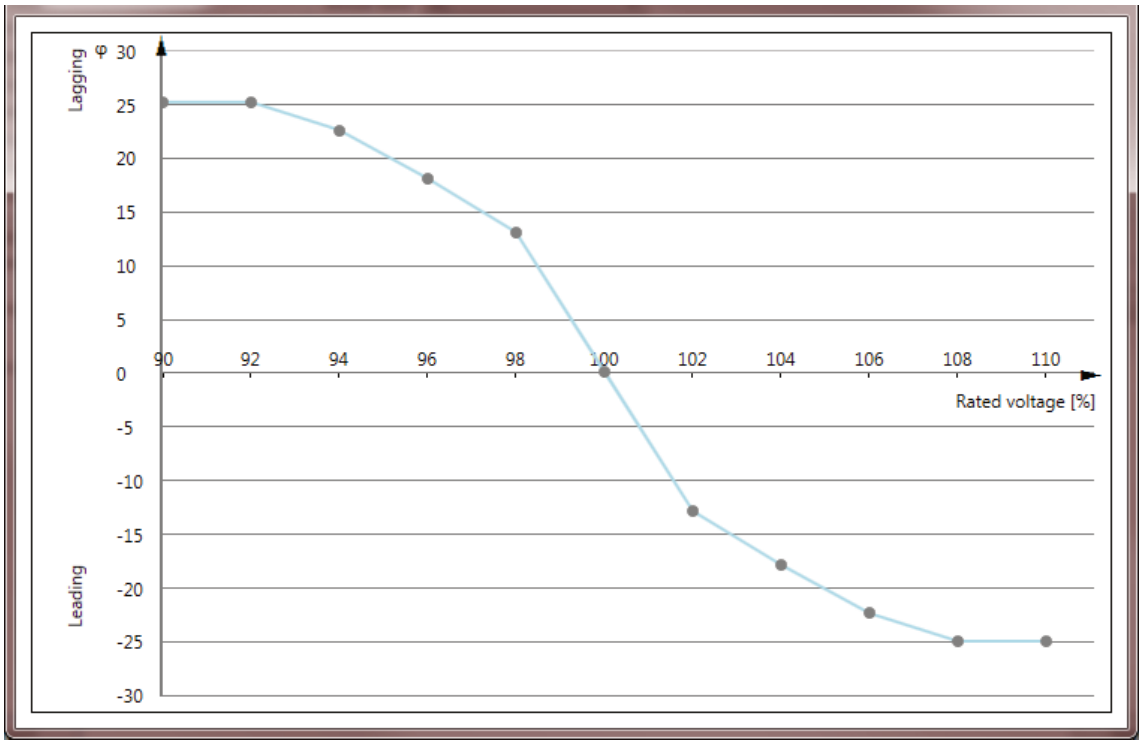


Fig. 29: Chart Cos φ (U) – Characteristic

4.15.5 Variable Q

This mode of operation dynamically controls the reactive power as an absolute or relative setpoint. It is used together with an external control unit, like REFUcontrol or a 3rd party product. The actual setpoint for the phase shift is shown in the window.

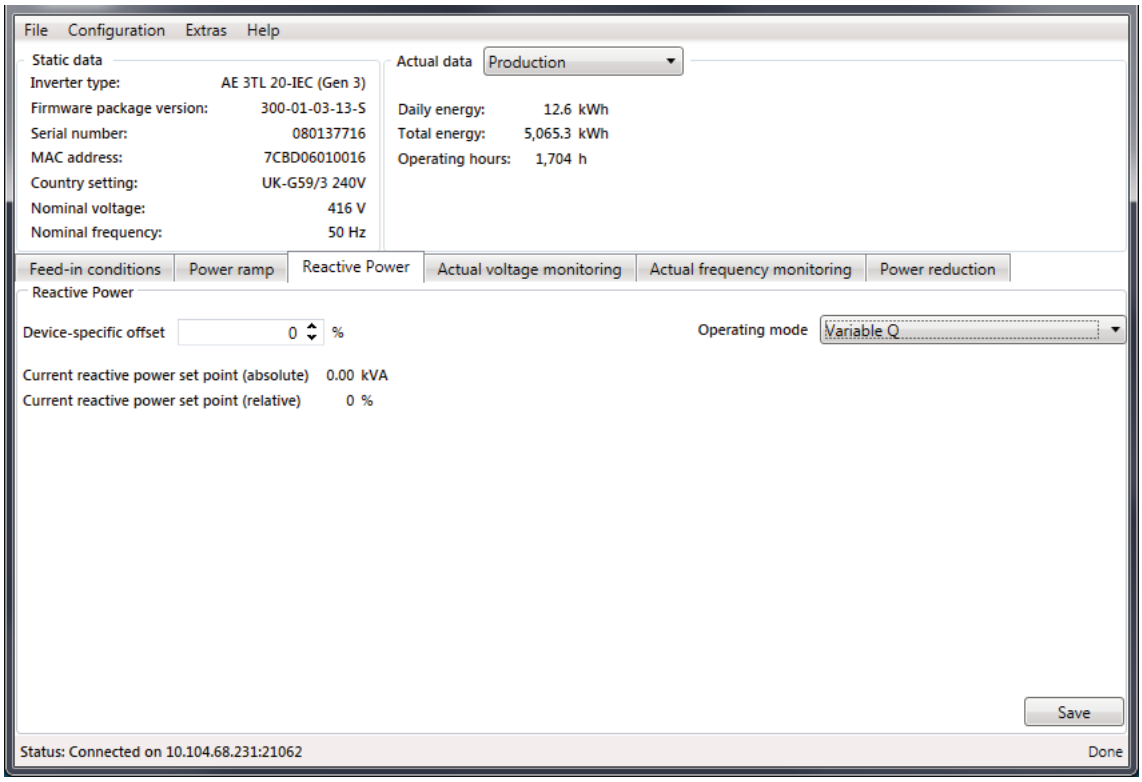


Fig. 30: Variable Q

4.15.6 Static Q

It is possible to enter a certain reactive power as fixed value. The fixed value can be entered absolutely as kVA or relative as %.

A device-specific offset can be specified.

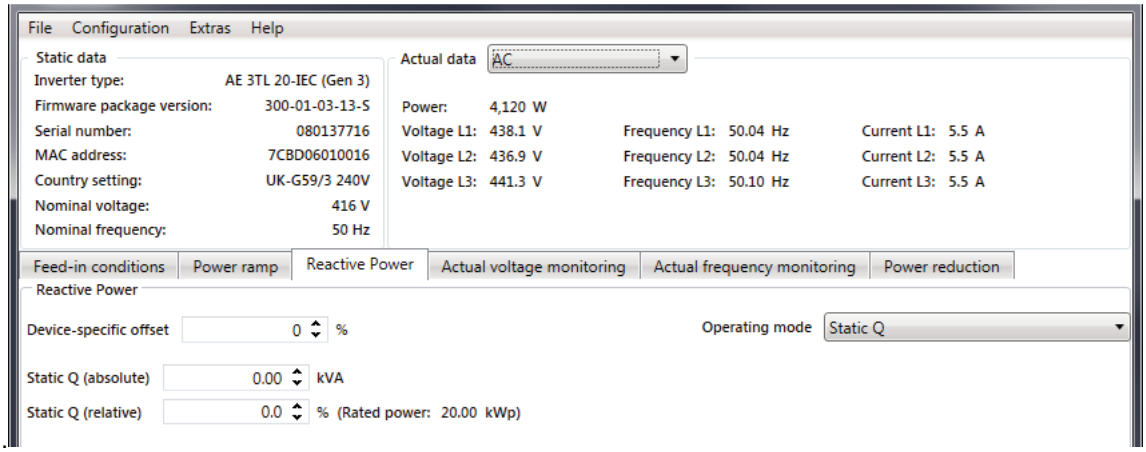


Fig. 31: Static value for reactive power

4.15.7 Q(U) characteristic

Depending on the voltage, a characteristic curve for the reactive power can be defined.

In addition, you can enter an activation, deactivation threshold and the system-specific offset for power supply, for the hysteresis you can also define characteristic points. The resulting curve can be displayed as a graph. As a characteristic type are "linear interpolation" and "Hysteresis" available.

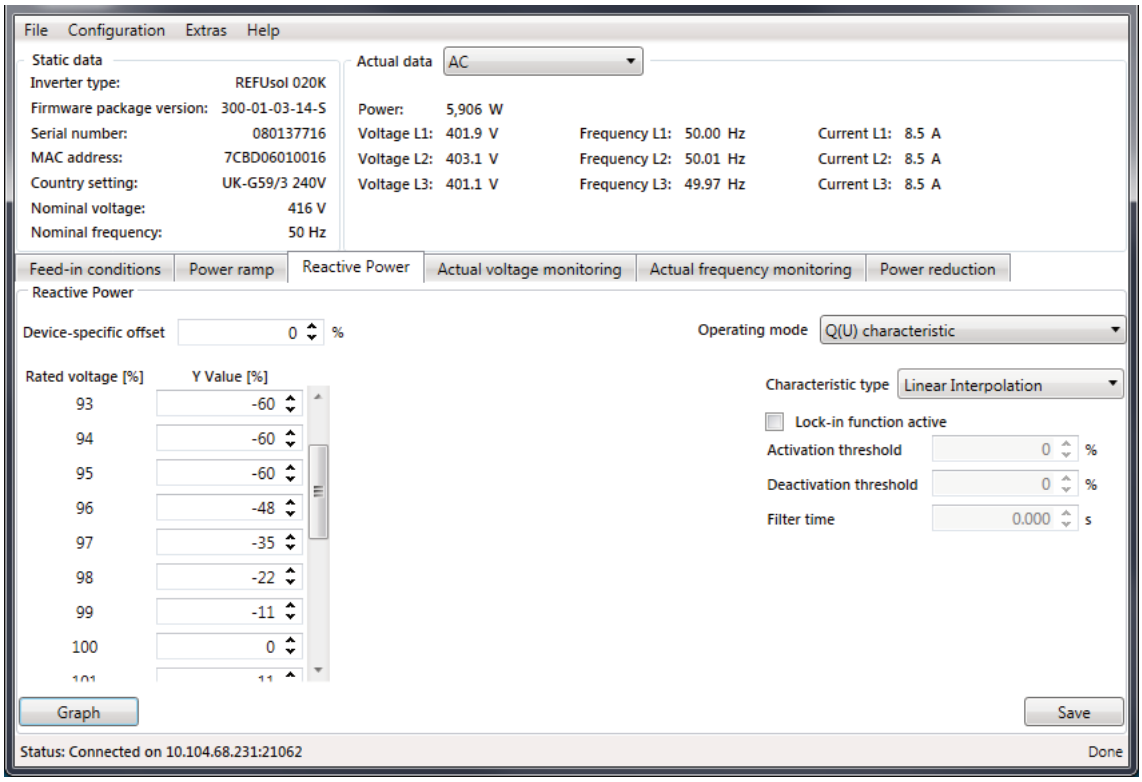


Fig. 32: Determining Reactive Power characteristic depending on voltage

You can display the characteristic entered in a chart by pressing the "Graph" button.

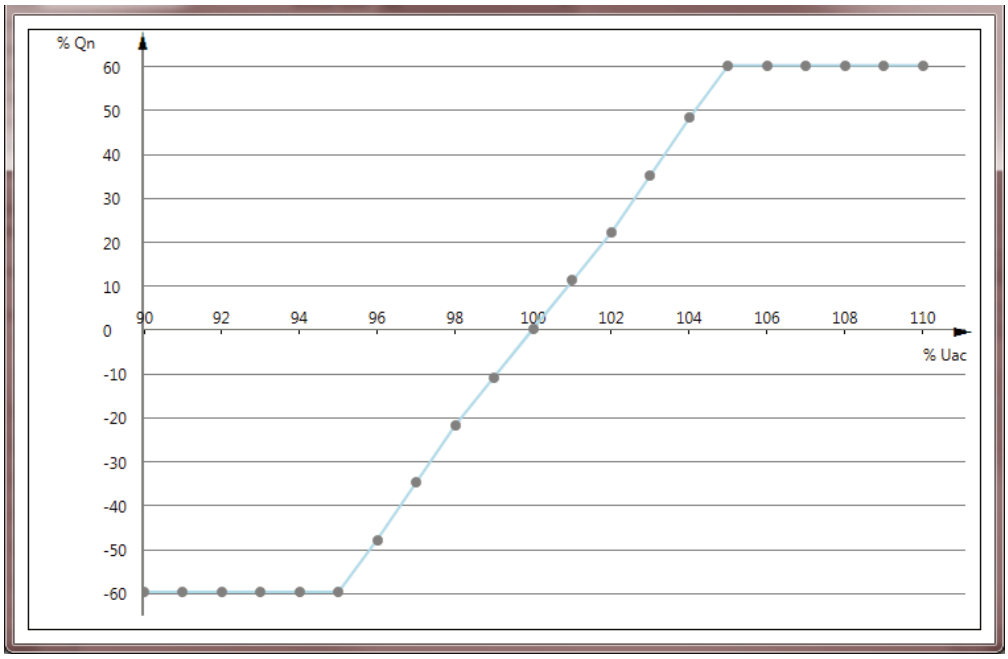


Fig. 33: Chart Characteristic type "linear interpolation"

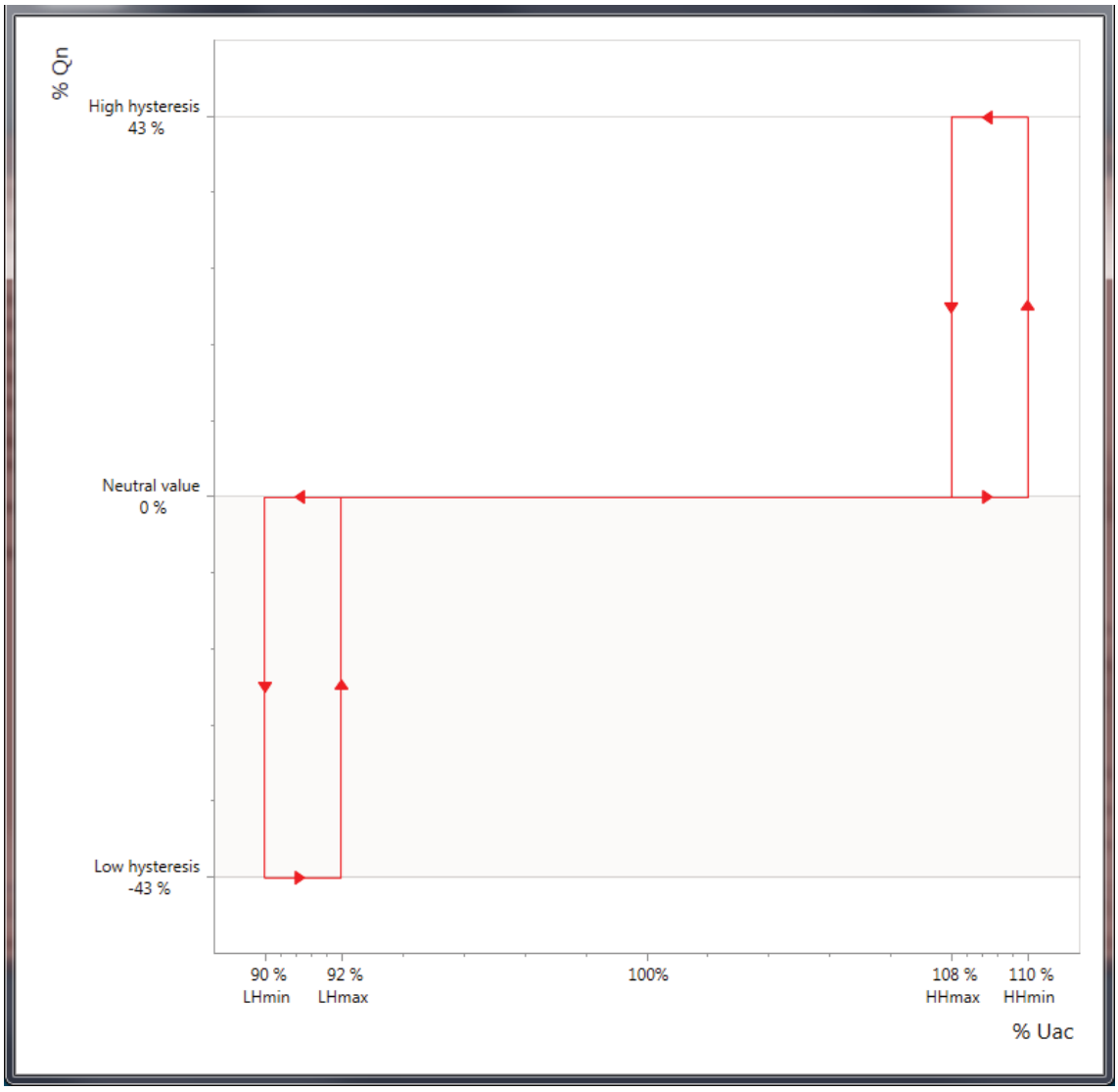


Fig. 34: Chart Characteristic type "Hysteresis"

4.15.8 Variable Q with reduced active power

The mode is used together with an external control unit, like REFUcontrol or 3rd party products. In this screen only the device-specific offset can be adapted.

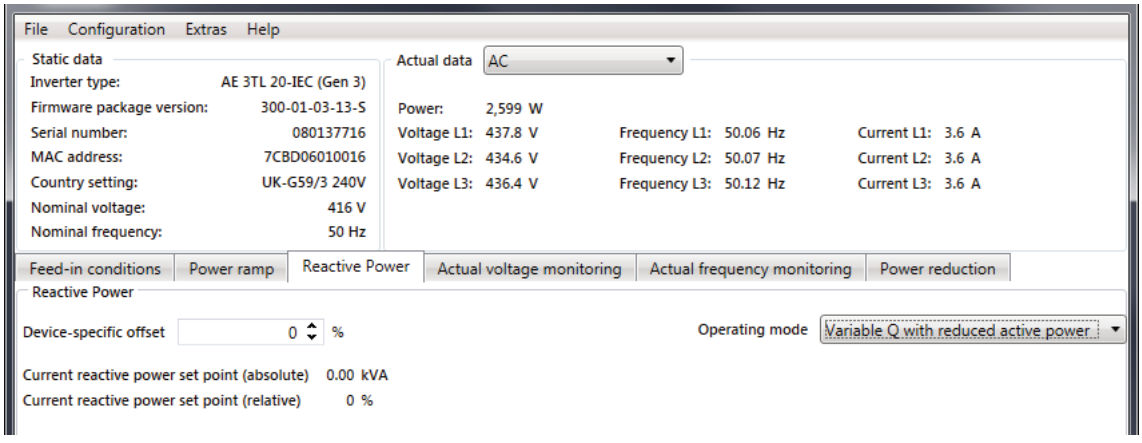


Fig 35: Variable Q with reduced power

4.15.9 Static Q with reduced active power

It is possible to enter a Q-fixed value. This can be expressed in absolute terms as Q-fixed value in kVA or relative in %. The conversion from absolute to relative or vice versa is done automatically. In addition, you can change the device-specific offset.

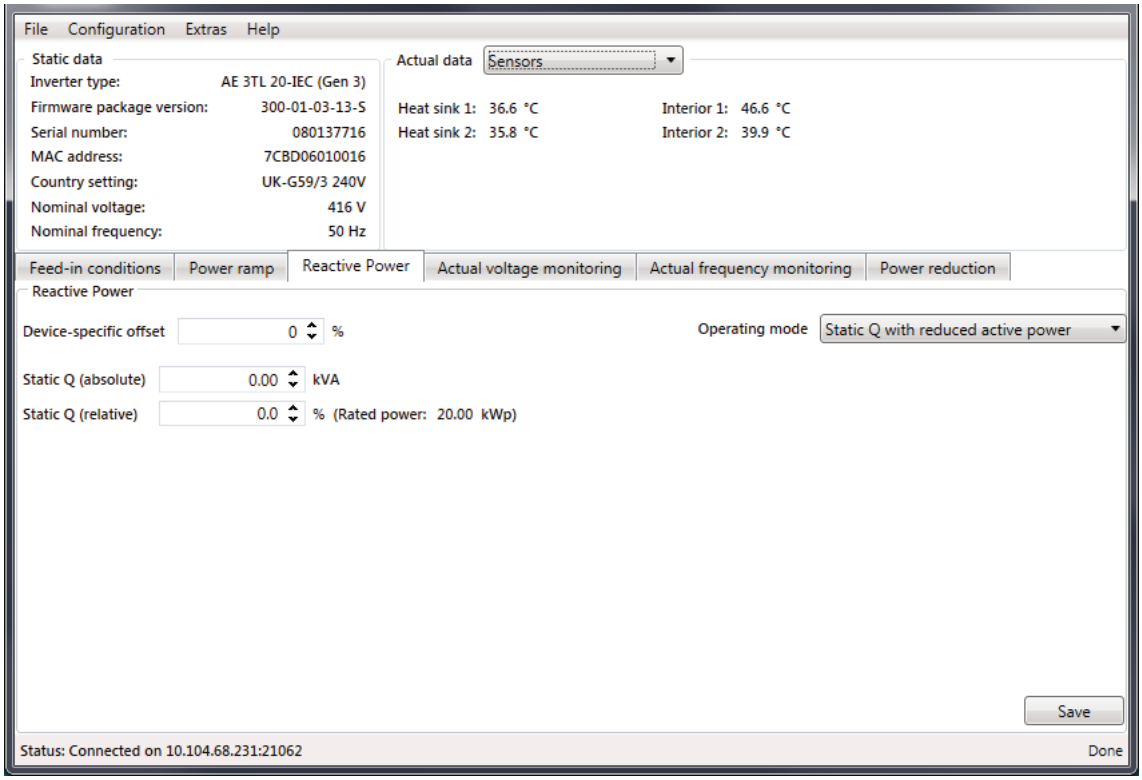


Fig. 36: Q fixed value with reduced power

5 Contact

Please address any questions on malfunctions or technical problems to

Mexico / North America

Service-Hotline: + 1 970-318-2301

(24 hours)

Europe

Service-Hotline: +49 (0)7121 4332 – 333

(Monday - Thursday, 8 am to 5 pm, Friday 8 am to 4 pm)

Online

Email: service.usa@prettl-energy

Website: www.refu-sol.com

Direct Link: www.refu-sol.com/en/accessories/technischer-support/

You should have the following data at hand:

- Exact description of the error with error code.
- Data from the type label, particularly the device type on the top left of the type label.