LOGGING AND CHARTING TOOL FOR POWER SUPPLIES R&S®NGX

Products:

► R&S®NGU401

► R&S®NGU201

► R&S®NGM200

► R&S®NGL200

► R&S®NGP800

ROHDE&SCHWARZ

Make ideas real

Contents

1 Background

1.1 Power supplies R&S®NGM201 and R&S®NGM202

Power Supplies R&S®NGM201 and R&S®NGM202, further herein below called "NGM", are high-precision sources and sinks with standard and high-speed voltage and current logging capability.

R&S®NGM201 provides one channel and R&S®NGM202 features two independent channels.

1.2 Power supplies R&S®NGL201 and R&S®NGL202

Power Supplies R&S®NGL201 and R&S®NGL202, further herein below called "NGL", provide the same standard logging functionality as NGM, but not the fast logging.

R&S®NGL201 provides one channel and R&S®NGL202 features two independent channels.

1.3 Power supplies R&S®NGP802, R&S®NGP804, R&S®NGP814, R&S®NGP822 and R&S®NGP824

The R&S®NGP800 DC power supply series, further herein below called "NGP", comprising five models with 400 W or 800 W, provides maximum power at a variety of operating points. The two or four 200 W outputs can each supply up to 64 V or up to 20 A. Electrically equivalent and galvanically isolated outputs can be wired in series or parallel for up to 250 V or 80 A.

These DC power supplies provide the same standard logging functionality as NGL, albeit with improved temporal resolution of 8 ms.

1.4 Source measure units R&S®NGU201 and R&S®NGU401

The source measure units R&S®NGU201 and R&S®NGU401, further herein below called "NGU", offer standard logging and fast logging functionality similar to NGM, albeit with greatly improved resolution and accuracy of the current measurement. Like the NGM, the NGU201 can source and sink currents on positive voltages (2-quadrant operation). The NGU401 can source and sink currents on positive and negative voltages (4-quadrant operation).

1.5 Standard logging

Standard logging records timestamps together with readings for voltage, current and power for each available channel. Standard logging is always global for all available channels of the power supply.

On NGL, NGM and NGU the measurement interval can be set in the range between 0.1 second and 600 seconds. NGP offers intervals between 8 ms and 600 seconds. The start of the logging can be triggered either by an internal event or by an external trigger signal.

Standard logging data is stored locally, either on internal memory or to a USB stick connected to the power supply.

1.6 Fast logging

Fast logging is only available on the NGM and the NGU. It records voltage and current readings versus time, but without time stamps. Fast logging is always individual to each channel of the power supply. It can be configured, started and stopped in each channel independently. The data is collected in separate files.

Available sample rates for fast logging are 100, 1000, 10000, 50000, 250000 and 500000 values per second.

Fast logging data is stored in floating-point raw format. If started manually, it is stored to a USB memory stick connected to the NGM or NGU. The external memory must support the resulting data rate. After termination of the logging, the data can be converted offline to a character-separated ASCII format. In remote control, the logging data must be collected via the remote-control interface every time the status system reports data to be available. The interface used for the remote connection must support the resulting data rate.

1.7 What is new in version 1.1 of the application software?

Version 1.1 of the NGM and NGL logging tool brings about a number of changes and new functionalities:

► Improved chart layout with innovative automatic scaling of the two possible vertical axes. Voltage and current axes share the same grid for better readability.

► Scrolling and zooming within a chart.

► Two cursors are available with optional value labels.

► Calculation of maximum, minimum, average, RMS and AC RMS value on the data between the two cursors.

► Live chart for fast logging. A view of the logged values within a fix interval are shown in a rolling chart strip. The live chart function is limited to sample rates below 10 kS/s.

► It is now possible to open and display log files and fast log files stored on NGM or NGL locally.

► For compression of displayed curve data there is the choice between positive peak, average and negative peak.

► Support for standard logging with the R&S®NGP800 series

► Data folder as location for logging files can be specified separately from the working folder which holds program settings and program log.

► For details on the new functionality, please see the description in the sections below.

1.8 What is new in version 1.2 of the application software?

► This version adds support for the new source measure units NGU201 and NGU401.

► Time resolution of 8 ms is supported with standard logging on the NGP.

2 Prerequisites

2.1 Configuration of the NGU, NGM, NGL or NGP

For standard logging this application allows to choose the channels. With NGU, NGM201 and NGL201 only one channel is available for the logging. No further options are required.

Fast logging is only available on the NGU and the NGM.

2.2 Requirements to Controlling PC and Software Installation

For the instrument remote control, the controlling PC must have a compatible VISA library installed. A free VISA library is available from the R&S® web site [1].

The application program requires .NET runtime 4.0 or higher. Make sure that .NET runtime 4.0 or higher is installed on the controlling PC. A compatible version 4.5 is available for download from [2]

The system partition of the hard disk must have approximately 800 Mbyte of free space to store the log data.

Copy installer "1GP122_xyz.msi" to the local hard drive of the PC and start it. Follow the instructions on the screen.

2.3 Remote Control Connection

For remote control, either a USB connection, LAN connection or GPIB connection is required between the controlling PC and the NGU, NGM NGL or NGP, respectively. See section 3.1.1 for details.

3 Test Setup

3.1 Remote control

3.1.1 Interfaces

R&S® instruments can usually be remote controlled via GPIB, LAN and USB. NGM and NGL also allow WLAN connection.

For the current task there are some prerequisites to observe, as the fast logging of the source measure units NGU and the DC power supply NGM requires a certain minimum data rate, depending on the sample rate of the logging function.

The data rate of GPIB is sufficient only for the lower sample rates of the fast logging function. Therefore, GPIB is not recommended as connection to the NGM for this application.

The USB interface in the NGM, NGL and NGP supports two different USB classes. "CDC" emulates a serial interface via USB-to-serial converter and has the advantage of compatibility with older remote-control systems. The data rate of the "CDC" class is not sufficient for fast logging. Therefore "USB Class" in submenu "Device → Interfaces" has to be set to "TMC".

3.1.2 VISA Ident Strings

The NGU/NGM/NGL/NGP VISA ident string for USB has the format "USB0::0x0AAD::0x0197::1234.5678k02-123456::INSTR". The black digits and characters are invariant for all individuals of NGM, NGL and NGP, and specify interface type, manufacturer and instrument type. The violet digits are "3639.3763" for NGU401 and NGU201, "3638.4472" for NGM, "3638.3376" for NGL and "5601.4007" for NGP. The blue digit is part of the NGx type number. It is "2" for NGU201, NGM201, NGL 201 and NGP804, "3" for NGU401, NGM202, NGL 202 and NGP842, "4" for NGP824, "5" for NGP802 and "6" for NGP822. The green digits represent the serial number of the individual instrument. The type number and serial number are shown in menu item "Device → Device Information".

The ident string for the IP LAN connection to the NGM/NGL/NGP has the format "TCPIP0::aaa.bbb.ccc.ddd::inst0::INSTR". The black part is common for most instruments and for all NGM and NGL. The green part represents the IPv4 address which can be read with NGM in menu item "LAN" of sub-menu "Device → Interfaces → Network". "aaa" can have two or three digits. All other numbers in the string can have between one and three digits.

The "IP" button enters the template shown above in the resource combobox which then has to be completed with the actual IP address.

It is recommended to use the "Find" button (see below) for discovering the instruments on USB and GPIB interfaces and obtaining their VISA ident strings. The LAN interface is not searched with the "Find" button.

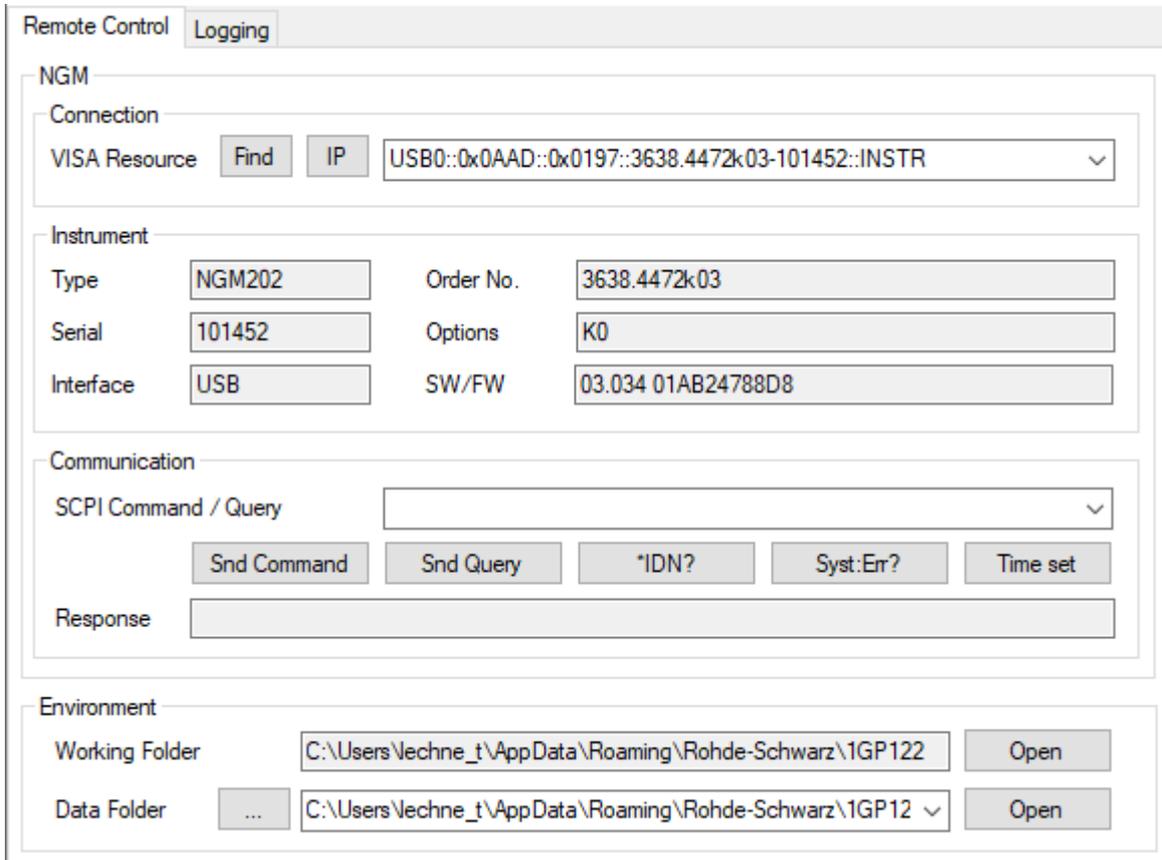# 4 User Interface of the Application Software

4.1 Remote Control Tab

Fig. 4-1: Remote Control tab of the NGx Logging & Charting Tool

The remote-control tab allows configuration and test of the remote-control connection to the connected DC power supply.

Enter the VISA resource string of the power supply as described in section 3.1.2 into the Visa Resource text box.

Clicking the "Find" button starts a search on the USB and GPIB interfaces and displays found NGU, NGM, NGL or NGP instruments in a new remote-control window. If multiple devices are detected, one on each interface can be selected in the comboboxes showing the resource strings, and the interface to be used can be selected with the radio buttons on top.
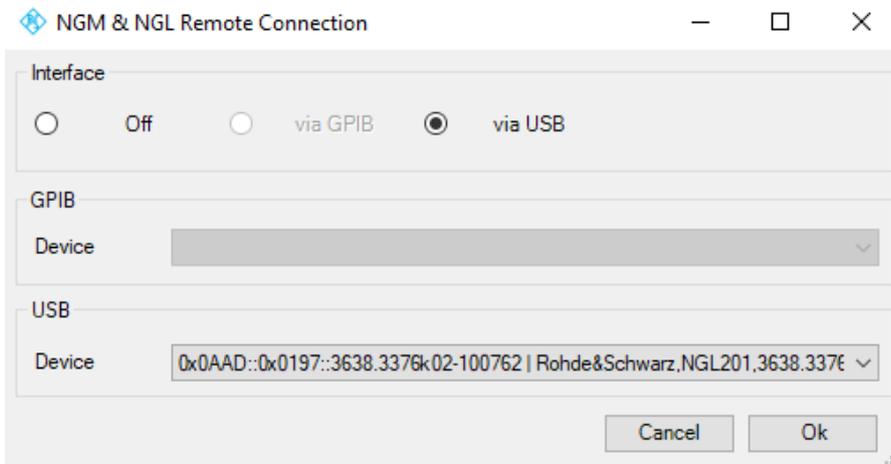
Fig. 4-2: Remote connection window

Clicking the "IP" button enters the resource string template for IP connections into the resource combobox.

Fig. 4-3: resource string template for IP connections

Enter the actual IP address of the DC power supply in the places marked with "aaa.bbb.ccc.ddd".

Any resource which had been connected successfully in the past, is stored with the settings of the user interface and appears in the resource combobox after the next start of the program. Upon start of the application software, it tries to reconnect this instrument. If it is not found, a warning is displayed.

The function of the remote connection can be checked with the buttons below the resource combobox. It is recommended to check the remote-control connection before using the functionality of the "Logging" tab.

"Snd Command" sends a SCPI command entered in the "SCPI Command / Query" combobox to the instrument.

"Snd Query" sends a SCPI command entered in the "SCPI Command / Query" combobox to the instrument, reads the response from the interface and displays it in the "Response" textbox.

The "SCPI Command / Query" combobox remembers the last 20 commands which have been sent successfully. To send one of these commands again, open the combobox with the small arrow on the right side and select the desired command before clicking the "Snd Command" or "Snd Query" button.

"*IDN?" displays the identification returned from the instrument in the response textbox.

Note: It is recommended to execute the "*IDN?" function before proceeding with the logging setup. This ensures that the instrument can be reached by remote control. Based on the identity reported by the instrument, fast logging and further channels are enabled in the logging tab, if supported by the type of the connected power supply.

"Syst:Err?" reads one entry from the error queue and displays it in the response textbox. The error queue can be regarded as a first-in-first-out buffer to which SCPI errors caused by remote commands are written by the instrument and picked up by the "SYST:ERR?" command.

"Time set" sets the real-time clock of the instrument to that of the controlling PC.

The "Instrument" field has no operable controls. It displays information about the connected instrument once a remote control connection has been successfully established.

The "Working Folder" textbox displays the path of the working folder on the controlling PC used by the application program. This folder contains a file "trace.log" where error messages from the application

program are written, and a file "settings.sup" memorizing the settings of the user interface at the time the application program was terminated last time. The "Open" button opens a file explorer in the application folder.

The "Data Folder" Combobox displays the path of the data folder on the controlling PC used by the application program. This folder is the target for log data from the NGM or NGL. Initially the data folder is the same as the working folder, but a different location can be selected by clicking the "…" button.

Note: The selected file location has to support the data rate and access speed required for the fast logging operation. "Jumps" with portions of fastlog traces missing may be due to inappropriate storage media.

The "Open" button opens a file explorer in the data folder.

The combobox on bottom of the window shows the last 64 messages on the remote-control interface in use. While the combobox is closed, it shows the last message. To see the last 64 messages, click on the arrow on the right side.

4.2 Logging Tab

The "Logging" tab shows the controls for configuring and starting the standard logging or fast logging, as well as controls for transferring data and displaying data in charts.
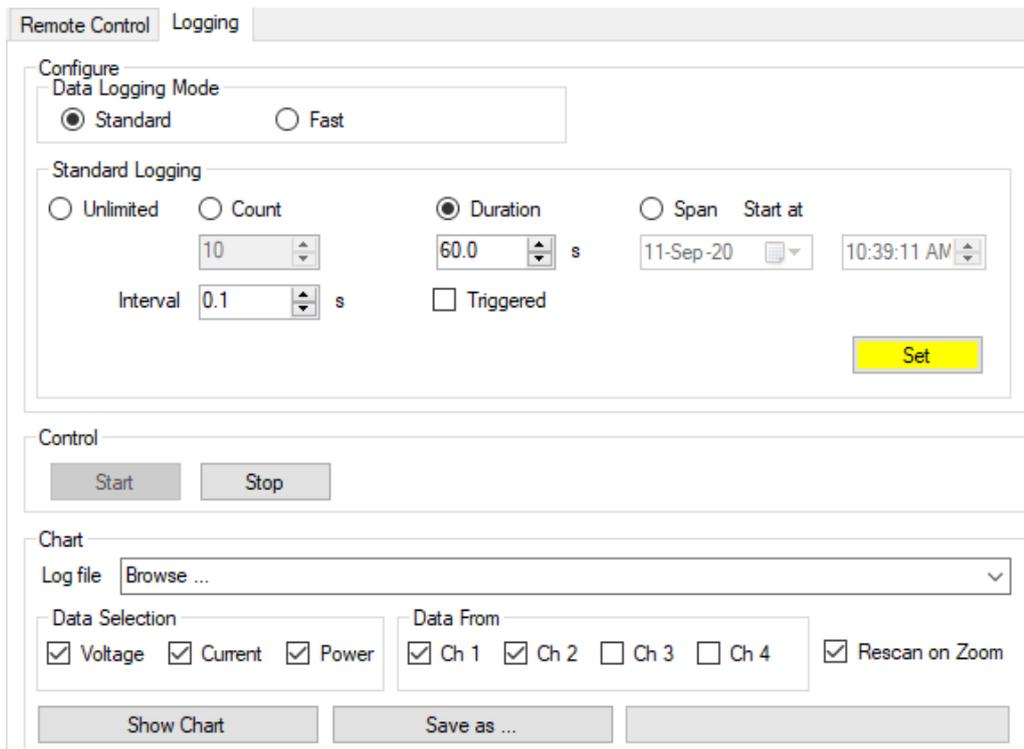

Fig. 4-4: Logging tab of the NGM & NGL Logging & Charting Tool with standard logging
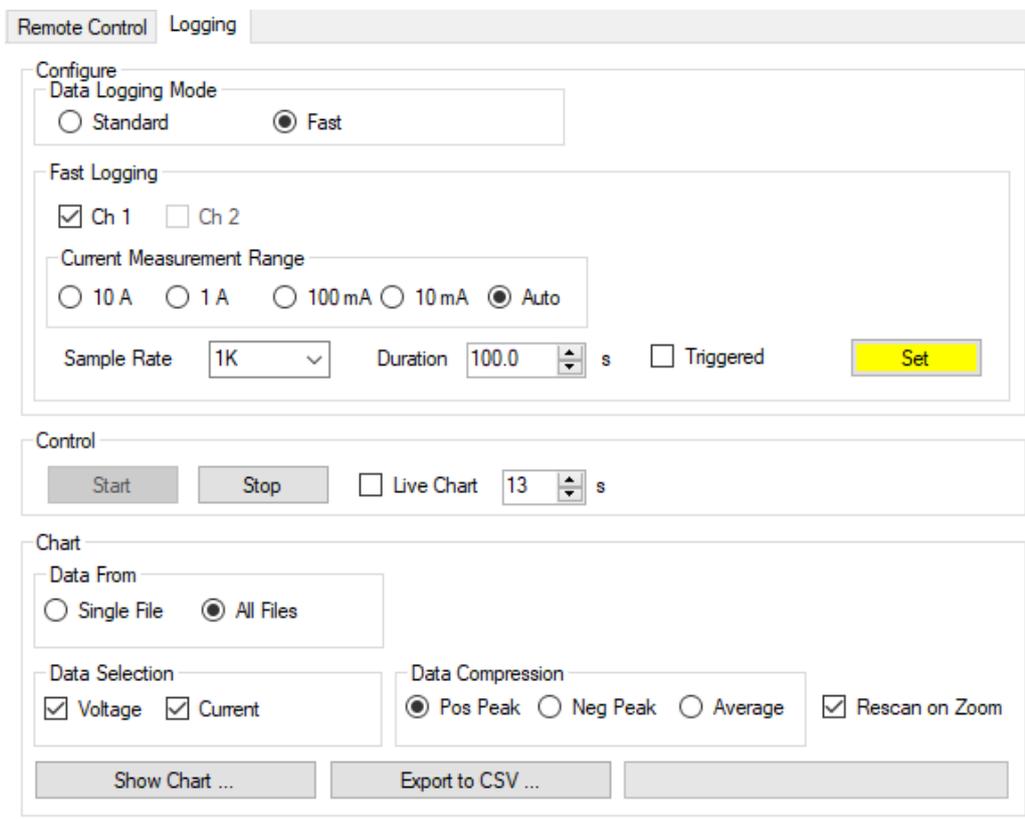
Fig. 4-5: Logging tab of the NGM & NGL Logging & Charting Tool with fast logging

4.2.1 Configuration

The "Logging" tab allows control of the logging in all NGx, and of the fast logging functionality in the NGM and NGU. It also allows display of logging data available on the power supply or on the controlling PC on a chart.

The "Ch …" checkboxes allow to select the channels for logging and fast logging. With fast logging, the channels are selected in the configuration. The checkbox for higher channels only enabled after a successful remote connection to a power supply with respective channel count.

Standard logging always collects data from all available channels.

The radiobuttons in the "Data Logging Mode" groupbox allow to select one of standard logging or fast logging and enable the respectively available controls. Fast logging can only be selected when a NGM200 is connected.

4.2.1.1 Parameters for Standard Logging

The sample rate and duration of standard logging can be specified in four modes:

1. Unlimited mode
    When started, the logging runs until it is stopped. In this mode the interval (sample period) can be specified.

2. Count mode
    When started, the logging collects the specified number of values and then stops. In this mode the interval (sample period) and the number of sampled values can be specified.

3. Duration mode
    When started, the logging runs for the specified duration. In this mode the interval (sample period) and the duration of the logging can be specified.

4. Span
    Logging starts at the specified date and time and runs for the specified duration. In this mode the start time, the interval (sample period) and the duration of the logging can be specified.

5. If the "Triggered" checkbox is enabled, logging starts with a trigger event which must be configured locally in the menu of the NGM or NGL. For details see the R&S®NGL200/NGM200 user manual [3] or R&S®NGL200/NGM200 user manual [4].

6. Data from standard logging is originally stored on the NGM or NGL, respectively. The location of the log file (internal storage or USB drive) must be selected locally in the menu of the NGM or NGL.

7. Note: Make sure to set the location to "/int/logging" if no USB memory is connected,

8. Note: To transfer the settings to the NGM or NGL, the "Set" button must be clicked. If any setting is changed, the "Set" button turns yellow and the "Start" button is disabled. By clicking the "Set", all settings are transferred to the connected instrument, the "Set" button turns gray again, and the "Start" button is enabled.

4.2.1.2 Parameters for Fast Logging

Fast logging is only available on the NGM and NGU.

For fast logging, a sample rate has to be selected out of an available set. The "Sample Rate" combobox offers the sample rates which are available on the connected instrument.

The fast logging runs for the specified duration after it has started.

Like the standard logging, also the fast logging can be started by a trigger event configured locally in the menu of the NGM or NGU, respectively, if the "Triggered" checkbox is checked.

For fast logging it is recommended to select a fix current measurement range if the maximum expected current is known beforehand. This ensures that logging data is continuously available.

Note: To transfer the settings to the NGM, the "Set" button must be clicked. If any setting is changed, the "Set" button turns yellow and the "Start" button is disabled. By clicking the "Set", all settings are transferred to the connected instrument, the "Set" button turns gray again, and the "Start" button is enabled.

During fast logging, data is transferred from the NGM to the controlling PC and stored in a new file in the data folder every 0.5 seconds. Thus, two new raw data files are generated per second.

4.2.2 Control

Only for fast logging and only for sample rates of 10 kS/s and below, a live chart can be enabled in the "Control" groupbox, and the length of the time axis of this live chart can be chosen. The time range can be set between 1 second and 100 seconds. If the duration of the fast logging is longer than the set time range of the live chart, the curve will roll through the chart. After the fast logging has finished, the chart can display the complete curve if desired (see section 4.3 below). For the live chart the data selection and data compression settings from the Chart field apply (see section 4.2.3.2 below).

Note that the live chart requires a certain minimum processing power of the controlling PC. If the chart update is too slow, malfunction of the live chart and the fast logging may occur.

The "Start" button starts a logging or fast logging process, respectively. The "Stop" button ends a running logging or fast logging process. Note that unlimited logging always has to be stopped with this button. All

other modes of the logging, as well as fast logging, end automatically after a specified time span or number of logged values.

While a logging or fast logging is running, control of the user interface is not possible with the exception of the "Stop" button.

When a triggered logging or fast logging has been started with the "Start" button, the following window is displayed until the logging has been triggered:

Fig. 4-6: "Waiting for Trigger" window

The logging can be aborted with the "Cancel" button in this window.

4.2.3 Charts and data transfer

The buttons in the "Chart" groupbox allow to store logging data locally to files, and to display the data in charts.

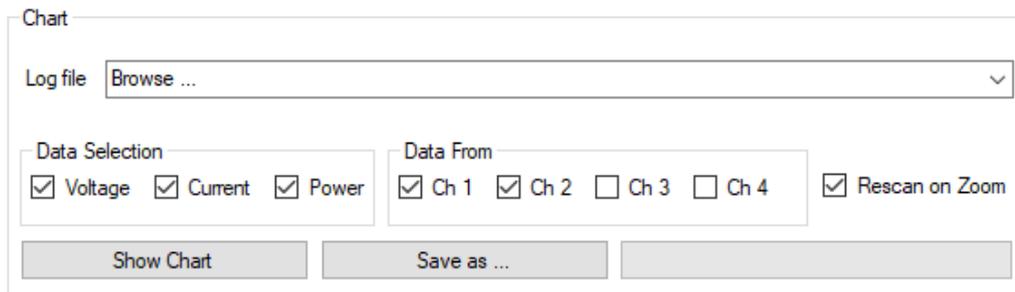### 4.2.3.1 Standard Logging

Fig. 4-7: Chart groupbox for standard logging

When the small arrow on the log file combobox is clicked, the application program queries the names of the available log files from the connected NGx and lists them in the combobox. The file names contain the date and time of acquisition start. Select one of the available files in order to perform one of the available actions.

Standard logging files contain voltage, current and power readings for one to four channels. The checkboxes in the "Data Selection" groupbox can be used to select the type of data to be displayed in a diagram, the checkboxes in the "Data From" groupbox allow to select the channel from which the data should originate.

Clicking the "Diagram" button opens diagrams with the selected content. If the "Browse…" entry is shown in the log file combobox at this time, a file selector box opens to browse to a log file, e.g. stored on an external USB drive.

If voltage and current are both checked, the respective data is displayed in one diagram per channel. If it is desired to display voltage and current data in separate diagrams, enable only one of the checkboxes at a time and open the diagrams one after the other. Power data is always displayed separately, two channels per diagram at maximum.

Before diagrams can be displayed from data stored locally on the NGx, the data has to be transferred from the power supply to the controlling PC over the remote-control interface. With large files, this may take some time during which the following window is shown:

Regarding the "Rescan on Zoom" checkbox, see section 4.2.3.3 below.

Clicking the button "Save as …" transfers the selected data to a comma-separated file on the controlling PC, specified in a file selector box.
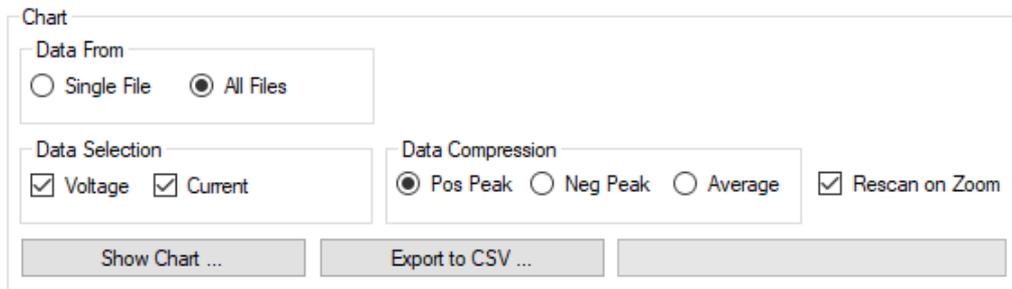
4.2.3.2 Fast Logging

Fig. 4-9: Chart groupbox for fast logging

Fast logging data is transferred from the power supply to the transferring PC in real-time and stored in the data folder of the application program. A new file is created every 0.5 seconds. The file size depends largely on the sample rate of the fast logging. The file name consists of date and time, sample rate, channel number and a sequential number.

In addition to the "*.raw" files containing the fast logging data there is also one "*.inf" ASCII file containing the time of the start and the sample rate of the fast logging.

The groupbox "Data From" allows to select whether just data from the selected file, or data from the complete fast log to which the selected file belongs, is to be displayed or exported, respectively.

The checkboxes in the "Data Selection" groupbox can be used to select the type of data to be displayed in a diagram. If both voltage and current are selected, they are displayed in the same diagram. If it is desired to display voltage and current data in separate diagrams, enable only one of the checkboxes at a time and open the diagrams one after the other.

The Choice in the "Data Compression" groupbox decides how data from multiple single samples is combined into each point of the displayed curve. With "Pos Peak" the maximum of all combined sample values is displayed, and with "Neg Peak" the minimum. "Average" displays the average of all original sample values within the time interval which is combined into one curve point.

Clicking the "Diagram" button opens a file selector. If a valid raw file is selected, the log data of the selected file or of the complete fast log to which the selected file belongs, is displayed, depending on the "Data From" settings.

Clicking the "Export to CSV …" button opens a file selector. If a valid raw file is selected, the log data of the selected file or of the complete fast log to which the selected file belongs, is exported, depending on the "Data From" settings.

4.2.3.3 Rescanning

The selected files may contain more data points than can be displayed in a diagram. Therefore, data has to be compressed for showing a long portion of a curve or an entire curve. On the other hand, if a small section of a curve is viewed, not all data outside the visible time axis range will be loaded from the files.

For this reason, it may be necessary to re-load data from the files during zooming or scrolling operation. If a diagram is zoomed in, more details are desired to be displayed, which requires less severe data compression. If a diagram is zoomed out or scrolled, the time axis may comprise regions where no data has been available in the previous view.

If the checkbox "Rescan on Zoom" is checked, the diagram will in these cases automatically rescan the data from the log files in order to obtain appropriate trace data. This automatic mode is recommended, unless the rescanning process takes too much time and therefore unduly slows down the zooming or scrolling progress. In this case, the checkbox can be unchecked, and the rescanning can be started with the rescan button in the diagram when required or desired.
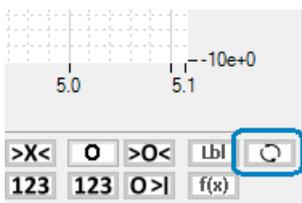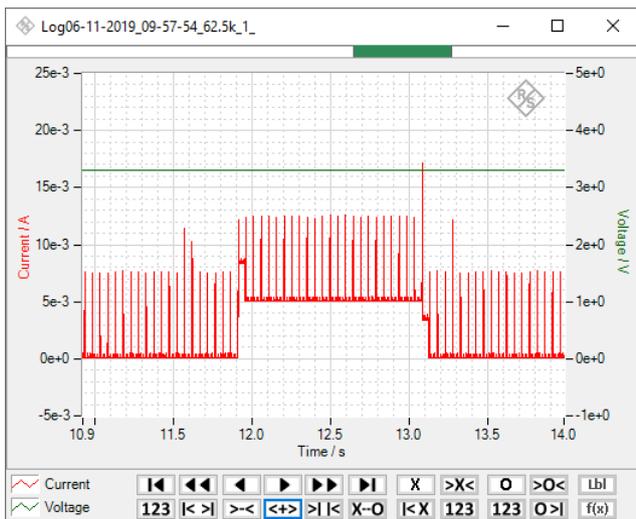

Fig. 4-10: Rescan button

4.3 Chart Forms

Fig. 4-11: Chart with logging data

4.3.1 Zooming and scrolling

Clicking with the left mouse button into the chart with the "Shift" key depressed and drawing a rectangle with the left mouse button depressed, zooms the abscissa of the chart into the marked rectangle when the left mouse button is released.

Alternatively, the time axis section can be zoomed in an out by clicking and holding the zoom buttons. In addition, the complete curve or the interval between two cursors can be displayed, or a standard interval can be restored by clicking the respective buttons.

Note that the ordinates (current, voltage and power axes) are always auto-scaled to the value range present in the visible section of the time axis.

The time axis can be scrolled by rolling the mouse wheel or by clicking and holding the scroll buttons. In addition, the visible section of the curve can be moved to the start or the end of the trace by clicking the respective buttons.
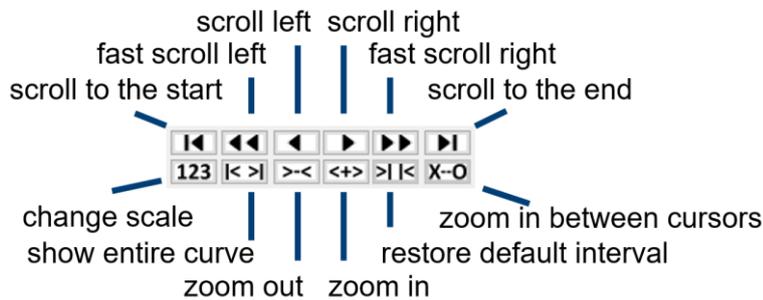

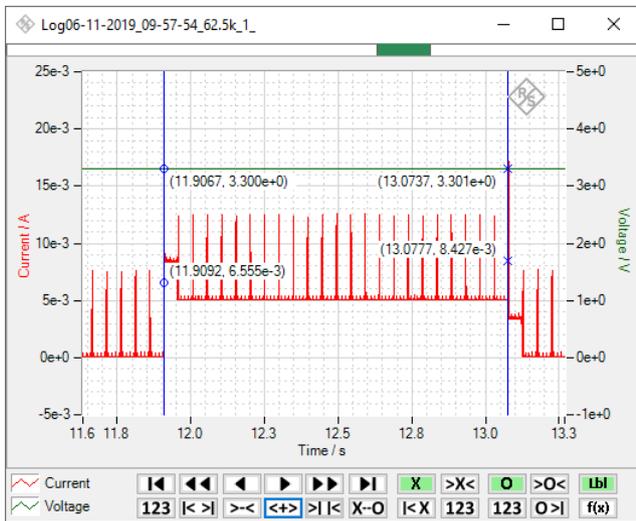Fig. 4-12: Zooming and scrolling controls

4.3.2 Cursors

Fig. 4-13: Chart with cursors and labels

Each chart features two cursors. The visibility of the cursors can be toggled as well as the visibility of the labels showing the curve values belonging to the cursors.

To move the cursors, drag them with depressed left mouse button. There are also buttons for moving the cursors to the center of the chart or to the start or end of the traces.
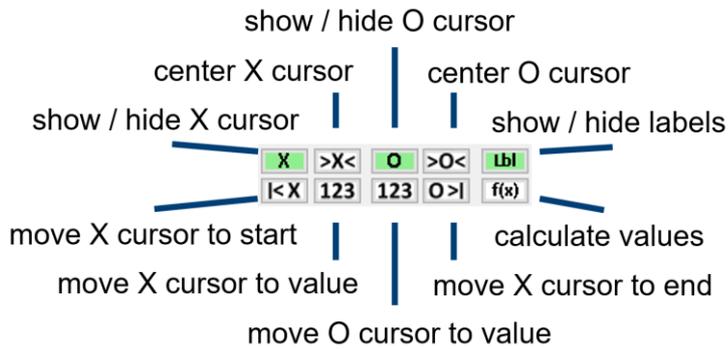
Fig. 4-14: Cursor controls

WaveformGraph: Copyright © 2020 National Instruments Corporation. All Rights Reserved.

4.4 Calculation results

Only if both cursors are visible, the "f(x)" calculation button produces the following results related to the cursor positions:

► Time and, as far as available, current, voltage and / or power at the cursor positions

► The differences between the values at the cursor positions

► Minimum, average and maximum of all sample values between the cursor positions

► Energy and charge as integral of power and current between the cursor positions

► RMS (root mean square) averages of all sample values between the cursor positions

► AC-RMS averages (RMS values without the DC component) between the cursor positions, which can be interpreted as ripple voltage and ripple current in case of otherwise constant DC values. For this calculation, the respective average values are regarded as DC values.

► If the curves are displayed in a data-compressed mode, the calculations are nevertheless done on all sample values in the (fast) log file.
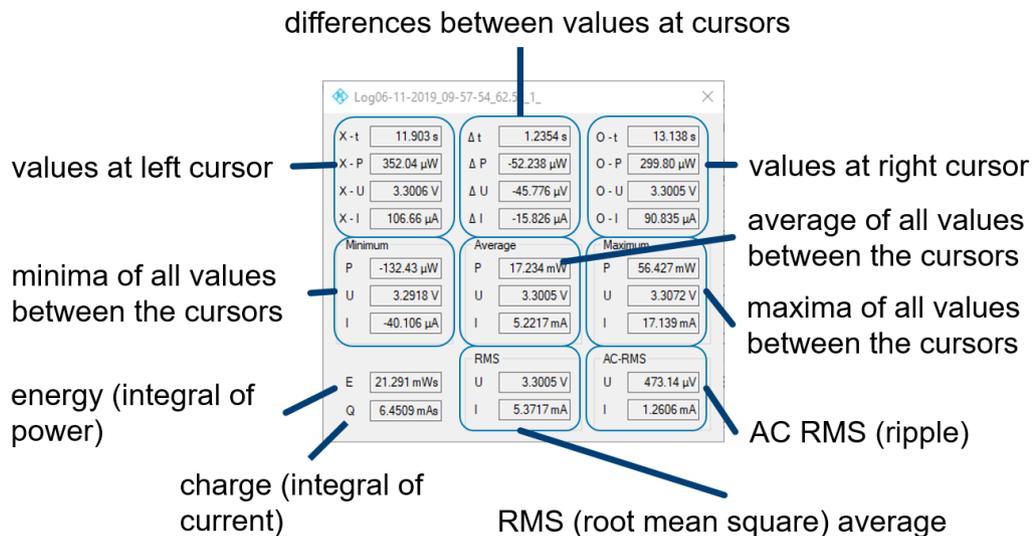

Fig. 4-15: Calculation results

5 Literature

[1] Rohde & Schwarz, "R&S®VISA," Rohde & Schwarz GmbH & Co. KG, 11 May 2018. [Online]. Available: https://www.rohde-schwarz.com/search_63238.html?term=R%26S+VISA+software+library. [Accessed 27 June 2019].

[2] Microsoft, ".Net Framework," Microsoft, 2019. [Online]. Available: https://www.microsoft.com/en-us/search?q=.NET+Framework+4.0. [Accessed 23 October 2019].

[3] Rohde & Schwarz, "R&S®NGL200/NGM200 Power Supply Series User Manual," 13 April 2020a. [Online]. Available: https://www.rohde-schwarz.com/manual/ngl200/.

[4] Rohde & Schwarz, "R&S®NGP800 Power Supply Series User Manual," 19 October 2020b. [Online]. Available: https://www.rohde-schwarz.com/search/search_63238.html?term=Manual+NGP800.

[5] Rohde & Schwarz, "R&S®NGU Source Measure Units User Manual," 16 February 2021. [Online]. Available: https://www.rohde-schwarz.com/manual/ngu/.

6 Ordering Information

Designation	Type	Order No.
Source Measure Unit	R&S®NGU201	3639.3763.02
Source Measure Unit	R&S®NGU401	3639.3763.03
Power Supply	R&S®NGM201	3638.4472.02
Power Supply	R&S®NGM202	3638.4472.03
Power Supply	R&S®NGL201	3638.3376.02
Power Supply	R&S®NGL202	3638.3376.03
Power Supply	R&S®NGP802	5601.4007.05
Power Supply	R&S®NGP804	5601.4007.02
Power Supply	R&S®NGP814	5601.4007.04
Power Supply	R&S®NGP822	5601.4007.06
Power Supply	R&S®NGP824	5601.4007.03

Rohde & Schwarz

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