

Recording and Converting of R&S I/Q Data Files

Application Note

Products:

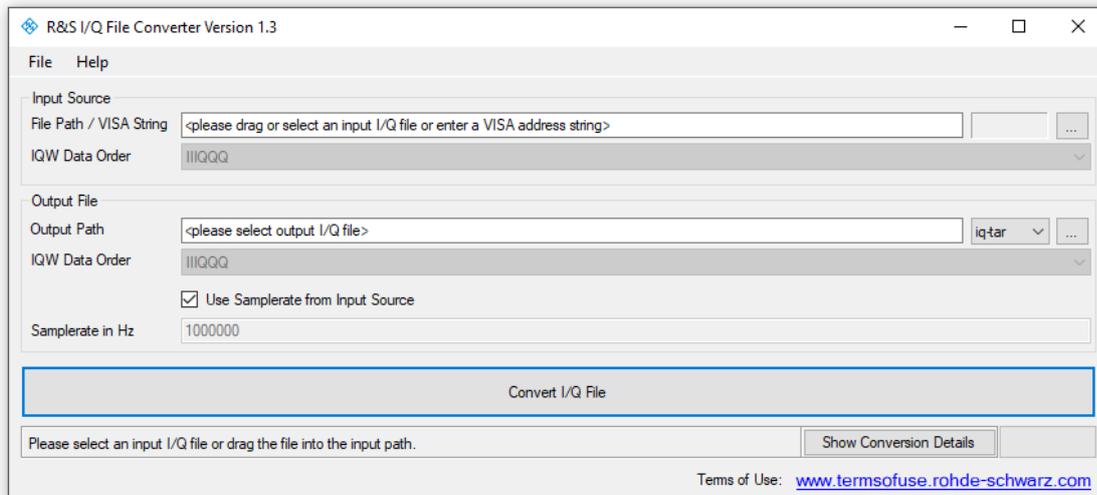
- | R&S®SMx
- | R&S®FSx
- | R&S®RTO
- | R&S FS-Kx
- | R&S VSE

This application note explains how to convert different Rohde&Schwarz I/Q file formats among each other using the supplied software tool. In addition, the tool offers the possibility to capture I/Q data from a connected R&S FSW.

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1 Introduction



The R&S I/Q File Converter is a simple tool to convert the Rohde&Schwarz specific I/Q file formats “*.wv”, “*.iqw” and “*.iq.tar” among each other. Besides that, it is also possible to convert I/Q files to “*.mat”-files that can easily be imported to Mathworks Matlab or to human readable ASCII files. In addition, the tool is capable of capturing I/Q data from a Rohde&Schwarz FSW signal & spectrum analyzer via LAN and write the data directly into an I/Q file.

The software can either be used via its graphical interface or it can be used via command line call.

2 Software Installation

2.1 Required Components

The supplied I/Q conversion software runs on Microsoft Windows and requires the Microsoft .NET-Framework version 2.0 or higher. If .NET is not installed on the system, it can be downloaded from <http://www.microsoft.com>.

The optional functionality of capturing I/Q data directly from a connected R&S FSW requires a VISA library (= Virtual Instrument Software Architecture). The R&S Visa Library can be downloaded from <https://www.rohde-schwarz.com/1DC02>

2.2 I/Q File Converter

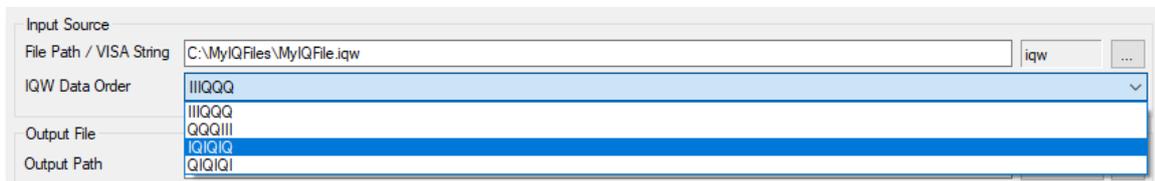
The I/Q File Converter consists of a single executable file and does not require any installation. Just copy the file to a location on your hard disc and double click on it to start the program.

3 How to convert an I/Q File

3.1 Selecting the Input File

There are two different ways to define the input file. Either you can select the file using the file dialog, which comes up when you press the  -button or you can just drag a file into the program window using the cursor.

“*.iqw”-Files can contain the I/Q data in two different ways. The first one is “paired”. In this case the I/Q samples are stored to the file alternating (“I,Q,I,Q,I,Q...” or “Q,I,Q,I,Q,I...”). The second one is “blockwise”. In this case the first part of the file contains all I-samples and the second part of the file contains all Q-samples (“I,I,I,...Q,Q,Q,...” or “Q,Q,Q,...I,I,I,...”). Since the extension of the file format does not contain the information which format has been used the I/Q Converter offers the possibility to configure the format in the graphical user interface by selecting the “IQW Data Order”:

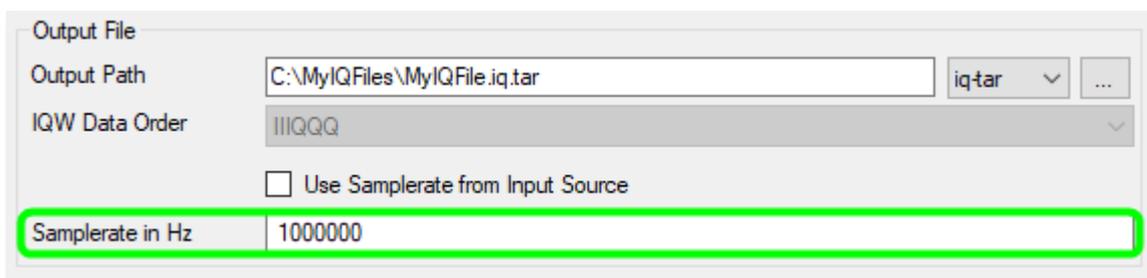


Note that encrypted “*.wv”-files are not supported by the R&S I/Q File Converter.

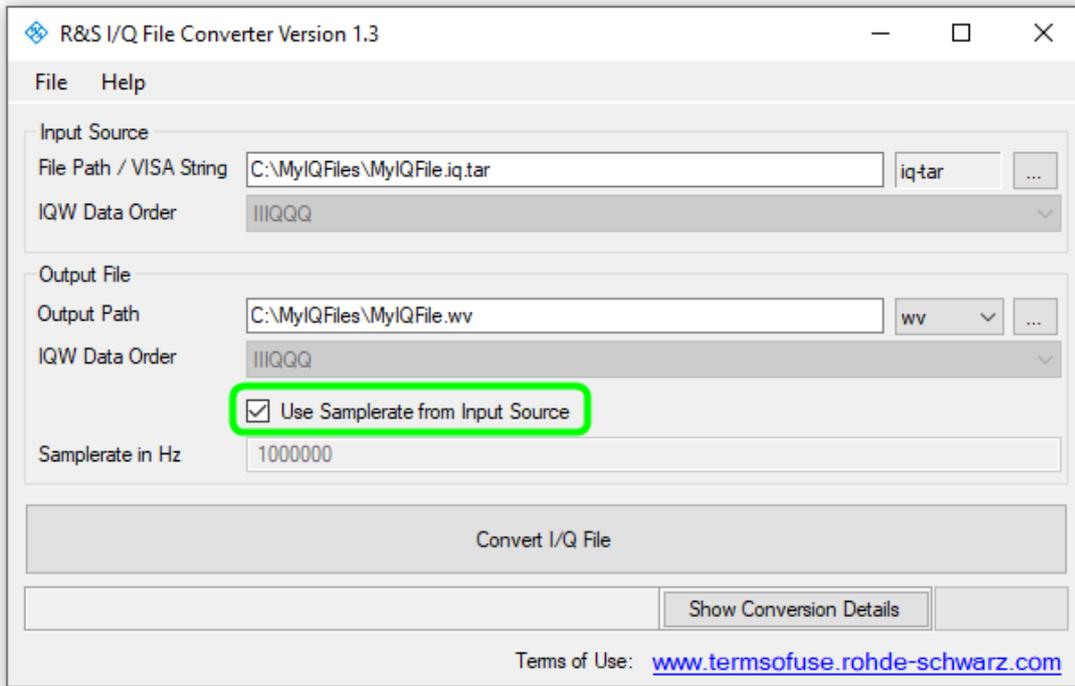
3.2 Defining the Output File

Whenever an input file has been selected, the I/Q Converter software will automatically propose a default path for the output file. To customize the output file path, you can either enter the file path manually into the “Output Path”-textbox or use the  -button to select a file-path from a file dialog.

The file formats “.wv” and “*.iq.tar” also contain information about the sample rate that was used when the I/Q data was recorded. In order to supply this information to the target file, the user interface offers the possibility to enter the sample rate value manually or, if available, to use the same sample rate as the input file:



When using “*.wv” or “*.iq.tar” files as input, the sample rate can be read directly from the input file. You can choose if you want to use the sample rate from input file or if you want to enter it manually by checking or unchecking the “Use Samplerate from Input File”-checkbox:



3.3 Performing the Conversion

When an input file path and an output file path have both been selected a click on the “Convert”-button will perform the conversion.

3.4 Supported File Formats

3.4.1 Input File

The following file formats are supported as input file:

- iq-tar (default I/Q file format for R&S analyzers)
- iqw (deprecated default I/Q file format for R&S analyzers)
- wv (default I/Q file format for R&S generators, only unencrypted WV files are supported)

3.4.2 Output File

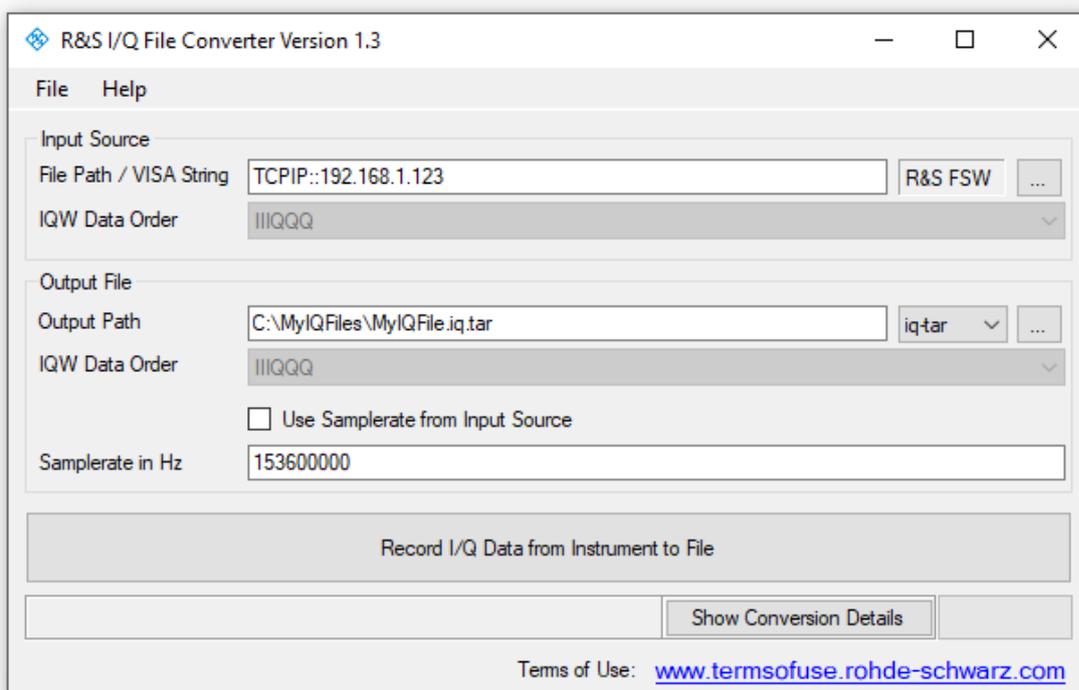
The following file formats are supported as output file:

- iq-tar (default I/Q file format for R&S analyzers, see <https://www.rohde-schwarz.com/de/software/iq-tar/> for details about the file format)
- iqw (deprecated default I/Q file format for R&S analyzers)
- wv (default I/Q file format for R&S generators)
- mat (default file format for Mathworks Matlab)
- txt (ASCII file containing comma-separated values, one I/Q sample per line)

4 How to capture an I/Q File directly from a connected R&S FSW via Remote Connection

4.1 Configuring the Analyzer Connection

Besides converting existing I/Q files, the R&S I/Q File Converter (v1.3 or higher) also offers the possibility to capture I/Q data from a connected R&S FSW Signal and Spectrum Analyzer and store the data into an I/Q file. Instead of entering a file-path as input source, you can enter a VISA instrument string (e.g. "TCPIP::192.168.1.234"). Whenever a VISA address has been entered, the field on the right of the textbox will show "R&S FSW" to indicate that the input source is an instrument instead of a file (please note that only the R&S FSW Signal and Spectrum Analyzer is supported by this functionality).



When capturing I/Q data directly from an analyzer, the "Samplerate in Hz" textbox can be used to configure the sample rate that is used to record the I/Q data. If "Use Samplerate from Input Source" is checked, the R&S I/Q File Converter will check if an I/Q Analyzer channel is active on the R&S FSW. If yes, the sample rate of this channel will be used for the recording. If not, the default value of 10000 Hz will be used.

The number of samples to be captured can be configured in the "Advanced File Conversion Settings" (see chapter 6 Advanced File Conversion Settings).

4.2 Recording I/Q Data

After a VISA string has been entered in the "File Path / VISA String" textbox, the I/Q File Converter will not attempt to convert an existing I/Q file but instead it will connect to the configured instrument and capture a new set of I/Q data.

Per default the I/Q File Converter uses the current settings of the connected R&S FSW for the capture. Thus, prior to the I/Q capture, the spectrum analyzer needs to be configured accordingly. To do so, open an "IQ Analyzer" channel on the R&S FSW manually (Keys: "MODE → IQ Analyzer"). Afterwards, configure the desired settings in the "Data Acquisition" dialog (Keys: MEAS CONFIG → Data Acquisition").

Once the "IQ Analyzer" on the R&S FSW has been configured and an output file has been specified, you can press the "Record I/Q Data from Instrument to File"-button in the R&S I/Q File Converter to start the data recording.

5 Using the R&S I/Q File Converter from the Command Line

In some applications, it might be more suitable to perform the conversion directly via command line without the graphical user interface. The following syntax can be used for that purpose:

ConvertIQ.exe <InputFile> <OutputFile> <SampleRate>

<InputFile>: Path of the input file. (e.g. "C:\InputFile.wv")

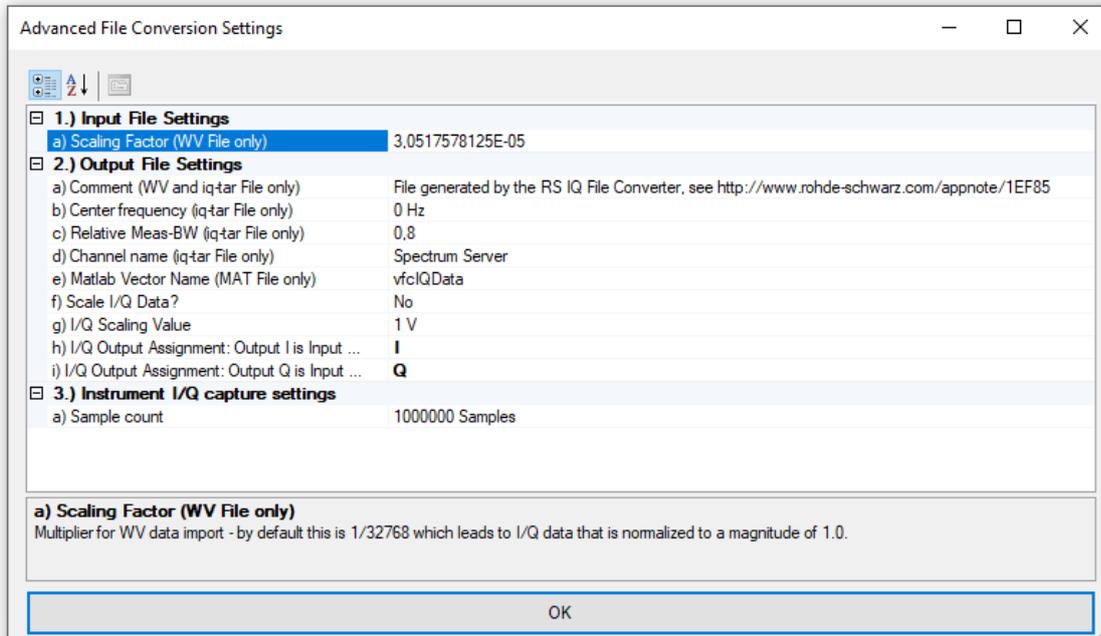
<OutputFile>: Path of the output file. (e.g. "C:\OutputFile.iq.tar")

<SampleRate>: Sample rate of the output file in Hz. (e.g. "15360000")

Examples: "C:\ConvertIQ.exe .\InputFile.wv .\OutputFile.iq.tar 15360000"
"C:\ConvertIQ.exe TCPIP::192.168.1.123 .\OutputFile.iq.tar 15360000"

6 Advanced File Conversion Settings

The “Advanced Settings”-dialog offers some expert settings for the I/Q file conversion. The dialog can be opened by pressing “Advanced File Conversion Settings” in the “File”-menu of the main window.



6.1 Input File Settings

Scaling Factor

When using “*.wv”-files as input source, a configurable multiplier is applied to the I/Q data. The default value is 1/32768, which leads to I/Q data that is normalized to a magnitude of 1.0.

6.2 Output File Settings

The supported file formats iq-tar and wv contain a header that allows multiple entries. The most important one is the sampling rate that has already been described above. Besides that there are other entries that can be used to store additional information about the I/Q data stored in the file. The R&S I/Q File Converter offers the possibility to modify some of these entries by opening the “Advanced File Conversion Settings” in the File menu.

The following entries are supported:

- **Comment**
A general comment about the file content. Can contain any string. This entry is used for iq-tar and wv file format.
- **Center Frequency**
This entry is only relevant for iq-tar-file export. The center frequency specified here can be used as indicator at which frequency the I/Q data contained in the file has originally been recorded.

-
- **Relative Meas-BW**
The “Relative Meas-BW” setting can be used to give an indication on how much of the bandwidth relative to the sampling rate in the I/Q file is usable for a measurement. This can for example be relevant for I/Q files that have been resampled (even when the sampling rate increases by using a resampler the usable bandwidth will not increase).
 - **Channel Name**
An iq-tar file can optionally contain multiple sets of I/Q data vectors (= “channels”). The default setting is “Spectrum Server” because that is also the default value for files that have been generated by a R&S Instrument (e.g. R&S FSW).
 - **Matlab Vector Name**
This setting is only relevant for mat-file export. When loading the mat-file into Matlab the I/Q data will be available in form of a variable in the Matlab workspace. The desired name of this variable can be configured with the “Vector Name”-setting.

The “I/Q Data Scaling” functionality of the R&S I/Q File Converter offers the possibility to rescale the I/Q data contained in an I/Q file to a specified maximum voltage. The following settings are available for this feature:

- **Scale I/Q Data?**
Activates or deactivates the scaling functionality. If activated all I/Q samples contained in the output I/Q file will be rescaled in such a way that the maximum amplitude matches the “Scaling Value” (see below).
- **I/Q Scaling Value**
All I/Q values contained in the output file will be scaled to this given maximum amplitude in Volts. Note that this setting only has an effect when “Scale I/Q Data?” is set to “yes”.
- **I/Q Output Assignment**
Defines how the I data are derived from the input data. This setting may for example be used to invert I and Q.

Once I/Q Scaling has been configured and activated all conversions that are performed afterwards will automatically apply the I/Q Data Scaling to the output file.

6.3 Instrument I/Q Capture Settings

When using the instrument I/Q capture functionality, the amount of I/Q data to be captured from the instrument needs to be specified. If no active “IQ Analyzer” channel is found on the R&S FSW, the R&S I/Q File Converter will automatically open a corresponding channel. In this case the number of samples to be recorded can be configured using the “Sample Count” setting.

- **Sample Count**
Defines the number of samples to be captured if no IQ Analyzer channel was active on the connected R&S FSW.

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system



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