Software Utility
R&S®ZVA Frequency Converter Leveling Tool
Getting Started

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ROHDE & SCHWARZ

The following abbreviations are used throughout this guide: R&S®ZVA-Z90E / -Z110E as R&S ZVA-Z90E / -Z110E, R&S®ZV-WR10 / -WR12 as R&S ZVA-WR10 / -WR12, R&S®ZVA as R&S ZVA and R&S®ZVT as R&S ZVT. The "R&S®ZVA Frequency Converter Leveling Tool" is abbreviated as "Leveling Tool".

Contents

1 R&S ZVA Frequency Converter Leveling Tool

This short guide describes the installation, configuration and use of the "R&S ZVA Frequency Converter Leveling Tool". The Leveling Tool is a free software utility for vector network analyzers (NWAs) R&S ZVA and R&S ZVT which are operated in combination with frequency converters R&S ZVA-Z90E or R&S ZVA-Z110E. The tool simplifies and improves the determination of correction values which the analyzers can use to control the RF output power at the converter test ports.

● For a complete list of required equipment and possible combinations refer to chapter 1.1, "Required Equipment", on page 5.

● For an introduction to the tool and its operation refer to chapter 1.4, "Working with the Leveling Tool", on page 8.

● For detailed information about frequency converters and their use refer to the application notes and manuals quoted in chapter 1.6, "Additional Information", on page 12.

ⓘ **Compatibility with network analyzer firmware versions**

The present version of the Leveling Tool requires a network analyzer firmware version V2.78 or higher. Free firmware updates are available for download on the R&S ZVA product pages (http://www.rohde-schwarz.com/product/zva). Refer to the R&S ZVA help system for installation instructions.

ⓘ The "R&S ZVA Frequency Converter Leveling Tool" is provided under the terms and conditions for royalty-free products. For details see "Terms & Conditions" on the Rohde & Schwarz home page, section "Terms and Conditions for Royalty-Free Products".

1.1 Required Equipment

The Leveling Tool is suitable for vector network analyzers R&S ZVA24/40/50/67 or R&S ZVT20 in combination with one or more frequency converters R&S ZVA-Z90E or R&S ZVA-Z110E; see R&S ZVA/ZVT with Frequency Converter(s). An additional power meter is required to measure the RF output powers; see Power Meter.

The Leveling Tool is available for download on the R&S ZVA product pages (http://www.rohde-schwarz.com/product/zva). Notice the compatibility information in "Compatibility with network analyzer firmware versions" on page 5.

1.1.1 R&S ZVA/ZVT with Frequency Converter(s)

A test system which is based on a network analyzer/frequency converter combination comprises the following equipment:

● An R&S ZVA or R&S ZVT vector network analyzer (NWA) with a maximum frequency ≥ 20 GHz.

The four-port instruments R&S ZVA24 / 40 / 50 / 67 or an R&S ZVT20 with a minimum of four ports provide the full functionality. It is also possible to operate the frequency converters with R&S ZVA24, R&S ZVA40, or R&S ZVA50 two-port instruments, but this requires an additional R&S®SMF100A Microwave Signal Generator (see reference [1] in for details).

On R&S ZVA67 analyzers, each test port is driven by its own, independent source. R&S ZVA67 two-port instruments may be operated either with a single frequency converter or with two converters, if an external R&S®SMF100A signal generator is used. On four-port instruments R&S ZVA67, an external signal generator is necessary to realize setups with 4 ports.

The R&S ZVT20 can be operated with up to four frequency converters (depending on the number of installed ports). With an additional R&S®SMF100A signal generator, up to 6 frequency converters are supported for frequency leveling.

- One or more frequency converters R&S ZVA-Z90E or R&S ZVA-Z110E plus all the necessary cabling to connect the converters to the NWA. Frequency converters without electronic attenuators are not recommended, although the Leveling Tool will also perform the calibration steps with these converters.

- Option R&S ZVA<n>-B16, "Direct Generator/Receiver Access" at each NWA port

- Option R&S ZVA-K8, "Converter Control"

- Option R&S ZVA-B8 (to establish the power control connection between the NWA and the frequency converters with electronic attenuators)

1.1.2 Power Meter

The frequency range and waveguide interface of the power meter must be in accordance with the used frequency converter. The following power meters are recommended:

- Agilent E4419B with power sensor W8486A or V8486A, depending on the calibrated frequency range.

- Anritsu ML2438A power meter with an adapter MA2497A, used to adapt the power meter either to Agilent W8486A or V8486A.

In all test setups, the USB-to-IEC/IEEE adapter R&S®ZVAB-B44 is necessary. Option R&S ZVAB-B44 consists of an adapter and a driver software for controlling external devices which are equipped with a GPIB bus interface but do not provide a USB interface. The driver software is installed on the network analyzer. Connect the USB port of the adapter to any of the master USB connectors on the front or rear panel of the analyzer. Connect the GPIB port of the adapter to the power meter.

For test systems including an R&S ZVA-Z90E converter, an adequate waveguide transition WR12 to WR 10 or WR12 to WR15 is required in addition to adapt the power sensors to the converter's WR12 waveguide.

1.2 Installation

The Leveling Tool has been designed to run under the Windows® XP Embedded operating system of an R&S ZVA/T network analyzer. To install the program, copy it to any

storage medium accessible from the analyzer and double-click `ZVA-ConvLev Tool.msi`. This is analogous to the NWA firmware installation.

1.3 Program Start and Configuration

When you start the Leveling Tool for the first time, you have to establish a connection to the NWA firmware.

1. To start the Leveling Tool, click the icon named `ZVAConvLevTool.exe` on the desktop of your network analyzer. This is also the program file name.

2. In the menu bar of the main dialog opened (see Main application window of the Leveling Tool), click "Device".

    The "Device" dialog is opened.
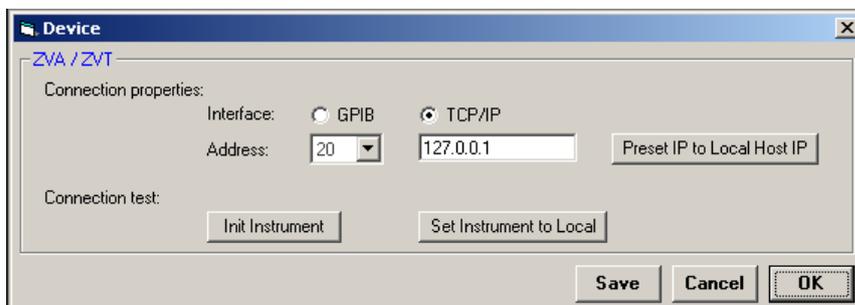
Fig. 1-1: Device configuration dialog

The "Device" dialog is pre-configured for a local host connection to the NWA firmware. That means that the tool and the firmware (running both on the R&S ZVA or R&S ZVT) will communicate using the loopback IP address 127.0.0.1. Installation on an external computer or communication via GPIB interface is not recommended, and Rohde & Schwarz does not guarantee error-free operation for this connection type.

3. Click "Init Instrument" and "Set Instrument to Local" to test the communication between the Leveling Tool and the NWA firmware.

    "Init Instrument" sets the analyzer to remote state; "Set Instrument to Local" causes it to return to the local state.

4. If desired, click "Save" to save the current settings for later sessions.

The "Device" dialog can be re-opened from the main application window using the "Device" menu.

1.4 Working with the Leveling Tool

Before you start the Leveling Tool, ensure that you have carried out all the preparative steps described in Preparing the Analyzer and the Test Setup. Use the Leveling Tool as described in Operating the Leveling Tool.

1.4.1 Preparing the Analyzer and the Test Setup

Before you start using the Leveling Tool, you have you carry out the following steps:

1. Ensure that the frequency converter mode of the NWA is active. Open the "System > System Configuration > Frequency Converter" tab and select the "Type" and "Use of External Sources" according to your frequency converter type and test setup. For details refer to reference no. [2] in chapter 1.6, "Additional Information", on page 12.
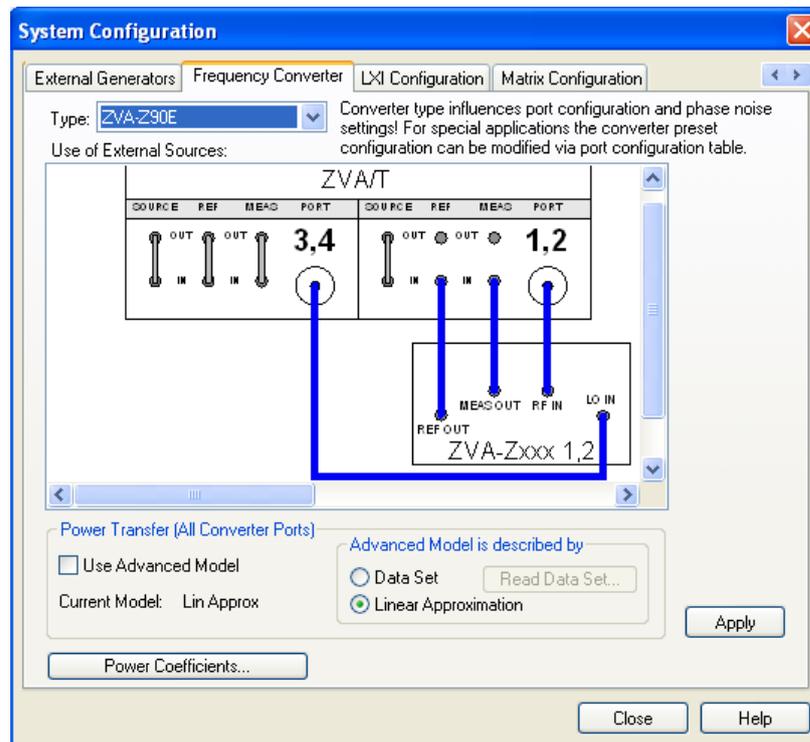
Fig. 1-2: System Configuration > Frequency Converter dialog

In the example above, the NWA is configured for an R&S ZVA-Z90E frequency converter. Both the RF and the LO signals are generated internally by the NWA.

2. Establish all connections (including the power control cable connection, if applicable) between the converters and the network analyzer. For details refer to reference no. [3].

3. Connect the external power meter to the network analyzer using the R&S®ZVAB-Z44 adapter. Make sure the power sensor (including an additional adapter, if necessary) is connected to the power meter and the power meter is ready to operate.

4. Configure the external power meter using the NWA firmware dialog "System > System Config > External Power Meters". For details concerning the usage of external power meters see the relevant manuals of the power meters and power sensors and reference no. [3].

1.4.2 Operating the Leveling Tool

After the preparative steps described in Operating the Leveling Tool, operation of the Leveling Tool is straightforward:

1. Double-click the ZVAConvLevTool.exe icon the Windows® desktop of your analyzer.

   This opens the main application window shown in Main application window of the Leveling Tool.

2. Click the "Identify Converter Setting" button in the lower part of the main window. The tool will remote-control the NWA firmware and read the active instrument configuration (especially the converter type, the start and stop frequency and the number of points). This data serves as a basis for recording the correction values.

3. Connect the power sensor to the waveguide test port of the converter no. 1.

   The following figure shows a power sensor Agilent W8486A connected to a R&S ZVA-Z90E converter using a waveguide transition WR12 to WR10.
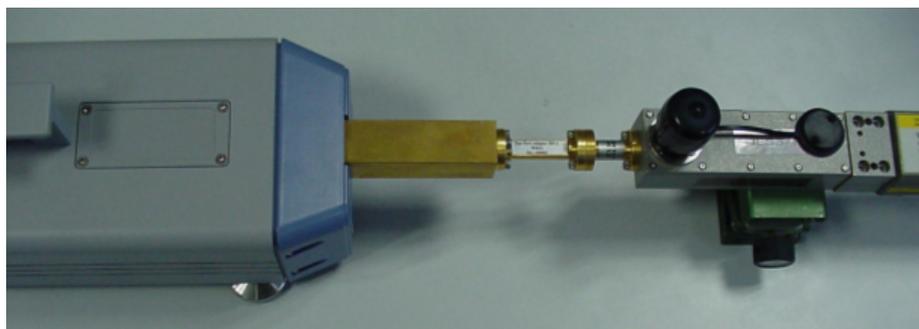
Fig. 1-3: Example of a power sensor connection

4. In the "Run All" column in the lower part of the main window, click the button no. "1" (Converter 1).

   The tool first performs a power calibration of the reference receiver (a-wave). Then this calibration is used to record the dependency between the converter's output power and the power applied to the converter's RF IN connector. If applicable, the tool records the characteristic of the connector's electronic waveguide attenuator.

5. Repeat this calibration for all converters in the test setup.

6. To apply the recorded values click "Activate Cal Data" in the "Finish" panel of the main window.

    This button selects "Use Advanced Model" and "Data Set" in the firmware dialog shown in figure 1-2 and loads the recorded calibration data into the NWA firmware. The data acquired during the reference receiver calibration is also taken into account.

7. Click "Exit Tool" in the "Finish" panel to close the Leveling Tool.

Loading the calibration data manually

You can also load previously generated calibration data manually using the analyzer's user interface. This involves two steps:

●   Open the "Frequency Converter" tab of the "System Configuration" dialog ("System > System Config..."). In the "Power Transfer" panel, select "Use Advanced Model" and "Data Set". Click "Read Data Set" to load the calibration data.

●   Open the "Calibration Manager" dialog ("Channel > Calibration > Calibration Manager..."). Select the recorded receiver calibration from the "Calibration Pool" and apply it to the active channel.

1.4.3   User Interface and Calibration Procedure

The graphical user interface consists of the "Device" configuration dialog described in chapter 1.3, "Program Start and Configuration", on page 7 and the main application window shown below.
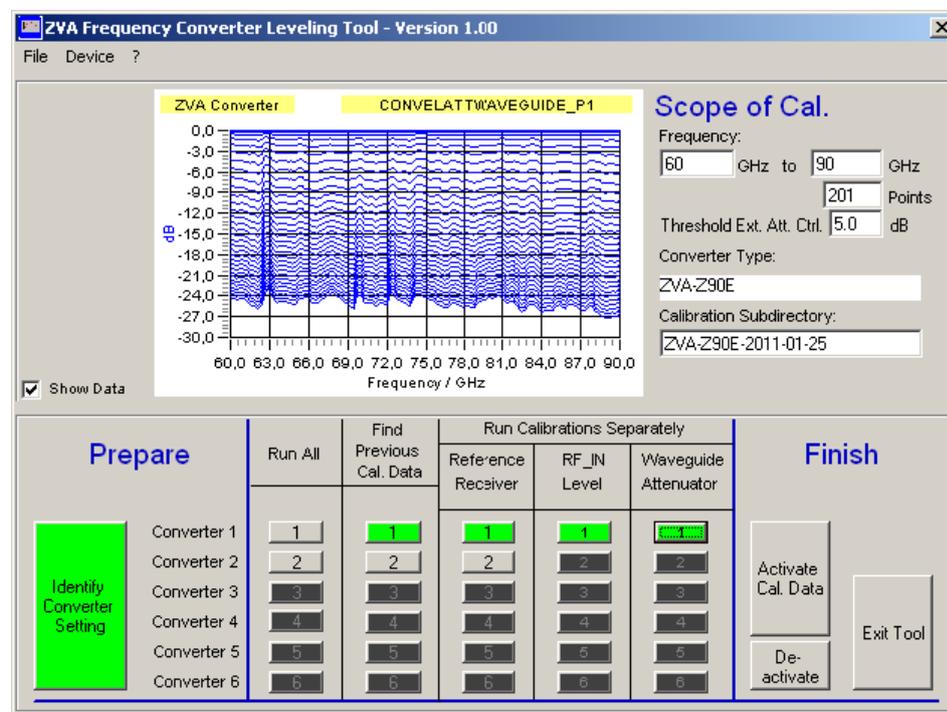
Fig. 1-4: Main application window of the Leveling Tool

Most of the control and display elements in the main application window are self-explanatory. Notice the following general hints about the calibration procedure.

- The upper part of the dialogs displays all relevant results, e.g. the information gathered with the "Identify Converter Setting" button or the traces measured on the R&S ZVA/ZVT. No information is displayed for the reference receiver calibration.

- The "Scope of Cal." settings show the basic calibration sweep settings of the network analyzer. "Threshold Ext. Att. Ctrl." is a threshold value for the output power at the converter's test port: Below the threshold, part of the power reduction is controlled by the electronic attenuators in the frequency converters. Above the threshold, the power reduction is controlled by the RF signal fed in at RF IN.
  You can change the calibration sweep settings before you start the calibration.

- IN the lower part of the window, only the buttons that are allowed to be used are enabled. All the other buttons are disabled (black color). If an operation step has been performed successfully, the button related to it turns green, otherwise it turns red.

- Additional popup boxes with bar graph and text show the progress of a specific calibration step. A green or red box at the end of an action indicates whether or not it could be successfully completed.
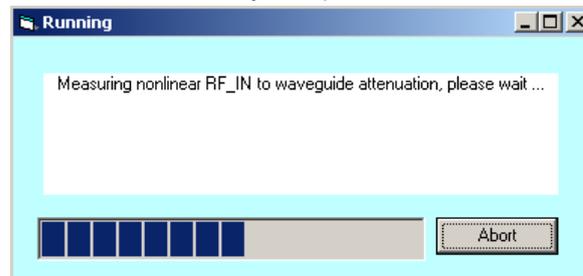
Fig. 1-5: Example of a progress box

- "Run All" triggers all necessary calibration steps for a converter. The calibration is performed automatically and in a single sequence. Alternatively the calibration can be performed step by step using the buttons grouped under "Run Calibrations Separately".

- When a calibration is performed, the power sensor must be connected to the calibrated converter. Therefore the rows of buttons labeled "Converter 1" to "Converter 6" distinguish the different converters.

- All recorded values are collected in a set of files. The files are stored to a subdirectory that is generated below `C:\Rohde&Schwarz\NWA\FrequencyConverter\`. The subdirectory name is automatically generated using the converter type and the current date. It appears in the "Calibration Subdirectory" field where you can change it according to your needs.

1.5 Hints for Most Effective Use

To take full advantage of the Leveling Tool,

- Use the "Calibration Subdirectory" field to define different names for you calibration data sets.

- If necessary, activate the Automatic Level Control (ALC) of the network analyzer to improve the flatness of the output power.
- Use the "Abort" button of the "Running" dialog (see Example of a progress box) to abort the measurements.

1.6 Additional Information

Application notes related to the frequency converters are available for download at http://www.rohde-schwarz.com/product/zva-z. Operating manuals and help systems for network analysis including frequency converters are also available for download; see http://www.rohde-schwarz.com/product/zva.

1. Hiebel, Michael: "Application Note: Multiport Millimeter-Wave Measurements Using Converters of the R&S®ZVA Family", Rohde & Schwarz GmbH & Co. KG, 2007

2. "Operating Manual or Help System: R&S®ZVA/ZVB/ZVT Vector Network Analyzers", Rohde & Schwarz GmbH & Co. KG, current version

3. "Quick Start Guide: R&S®ZVA-Z90E / -Z110E Frequency Converters with Electronic Attenuators", Rohde & Schwarz GmbH & Co. KG, current version

4. Hiebel, Michael: "Fundamentals of Vector Network Analysis", Rohde & Schwarz GmbH & Co. KG, 4th rev. 2008