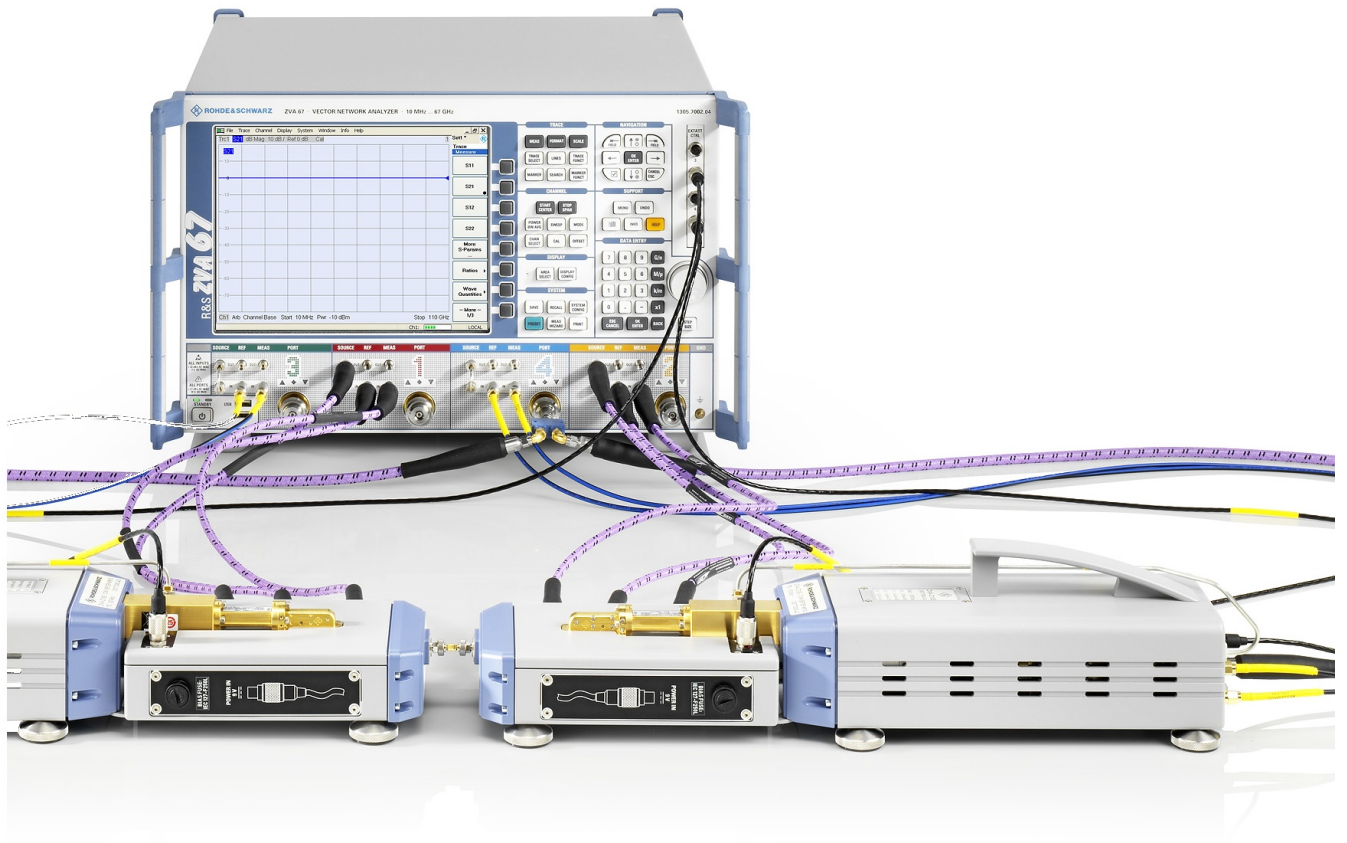


# R&S® ZVA110

## Basic Operation

### Application Sheet



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The following abbreviations are used throughout this guide: R&S®ZVAxx as R&S ZVAxx, R&S®ZVTxx as R&S ZVTxx, R&S®ZVA-BU as R&S ZVA-BU, R&S®ZVA-ZDxx as R&S ZVA-ZDxx, R&S®ZVA-Zxxx as R&S ZVA-Zxxx, R&S®ZV-Zxxx as R&S ZV-Zxxx, R&S®ZV-WRxx as R&S ZV-WRxx.

# 1 Basic Operation

This application sheet describes the use of an R&S ZVA110 vector network analyzer with two external test sets for 2-port transmission measurements.

One-port reflection measurements can be performed in a similar way using a single external test set.

## 1.1 Required Equipment

The R&S ZVA110 system is delivered with all measurement equipment needed. An additional 1 mm calibration kit is required for system error correction (calibration).

## 1.2 Measurement Principle

The principle of the measurement with external test sets is described at the beginning of the R&S ZVA110 Quick Start Guide, stock no 1314.4502.62.

The measurement involves the following steps:

1. Activation of the "ZVA110-BU" mode for measurements with external test set
2. Entry of power coefficients (when an external test set is used for the first time).
3. Connection of the external test sets
4. Power and frequency settings
5. Power calibration using an appropriate external power meter
6. System error correction (calibration) using a suitable calibration kit
7. Connection of the DUT and measurement

## 1.3 Activating the ZVA110-BU Measurement Mode

After a factory preset, the R&S ZVA67 is configured for measurements using the internal test sets. You have to activate the "ZVA110-BU" mode explicitly before you connect the external test sets.

To (re-)activate the "ZVA110-BU" mode,

1. Click "System > System Config ..." and open the "Frequency Converter" tab of the "System Configuration" dialog.
2. Select "Type : ZVA110-BU".
3. Click "Apply" to activate the mode.

4. If you use your vector network analyzer for the first time, click "Coefficients" to enter the power coefficients; see [chapter 1.4, "Entering Power Coefficients"](#), on page 4.
5. "Close" the "System Configuration" dialog.



#### Analyzer settings with active "ZVA110-BU" mode

In "ZVA110-BU" mode, the frequency and level settings of the network analyzer are automatically set to be compatible with the external test sets. "Low Phase Noise" is enabled, Automatic Level Control (ALC) is disabled. The frequency and levels of all ports are displayed in the "Port Configuration" dialog ("Channel > Mode > Port Config ...").

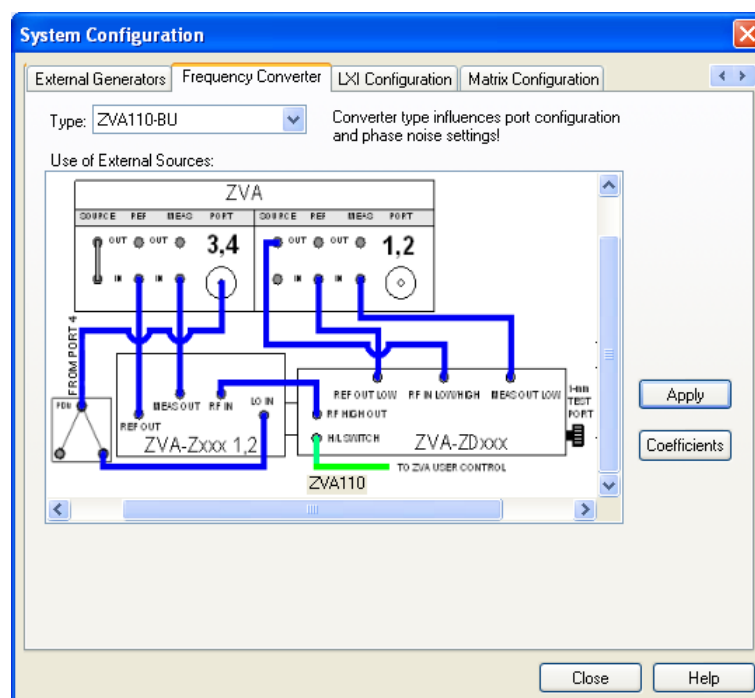


Fig. 1-1: Frequency Converter dialog

## 1.4 Entering Power Coefficients

For accurate control of the converter output power, the R&S ZVA67 analyzer must know the (non-linear) current-power characteristic of the frequency converters. The characteristic is sufficiently described by a third-order polynomial. A label with the four polynomial coefficients  $c_0$ ,  $c_1$ ,  $c_2$ , and  $c_3$  is affixed to each converter.

When the R&S ZVA110 is used for the first time, it is recommended to check whether the power coefficients on the converter labels correspond to the entries in the analyzer dialog. Proceed as follows:

1. Activate the "ZVA110-BU" mode following the first steps in [chapter 1.3, "Activating the ZVA110-BU Measurement Mode"](#), on page 3.
2. In the "Frequency Converter" dialog, press "Coefficients".
3. In the "Power Coefficients" dialog opened, clear "Use default coefficients". Adjust the coefficients in the dialog to the converter coefficients, if necessary.

The numbers of the table rows in the dialog denote the analyzer ports for the converters.

4. Repeat the last step for both frequency converters/external test sets.

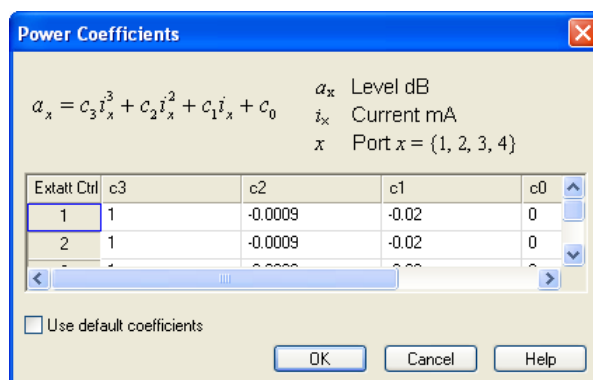


Fig. 1-2: Entry of power coefficients for analyzer port 1

## 1.5 Connecting the External Test Sets

Each of the external test sets must be connected to the R&S ZVA110 base unit, the power supply and the DUT.

- Power control connection: Connect the 3-pin control connector at the rear panel of the converter to the output connector of option R&S ZVA-B8 (EXT ATT CTRL) at the top right of the R&S ZVA front panel using the control cable supplied with the converter.
- Control connection: Connect "H/L Switch" cable between the USER CONTROL connector on the rear panel of the R&S ZVA110 base unit and the H/L SWITCH connector on the top side of each diplexer.
- Analyzer ports: Connect each of the two external test sets as shown in the "Frequency Converter" tab of the "System Configuration" dialog using the cables supplied with the instrument.
- Power supply: Connect the external DC power supply provided with the external test sets to the "9 V / 0.5 A" DC inputs.
- DUT (usually connected after calibration): Screw on the 1 mm test port connectors at the front of the diplexers.

The title page of this application sheet shows an R&S ZVA110 with all necessary connections. Refer to the Quick Start Guide R&S ZVA110, "Broadband Measurements using 1 mm External Test Sets", stock no. 1312.6808.62 for details.

## 1.6 Power and Frequency Settings

While the "ZVA110-BU" mode is active, the "Channel > Stimulus" settings of the network analyzer control the frequency and power range of the converters. The "Channel > Mode > Port Configuration" dialog shows an additional row for each converter. The "Power" and "Frequency" settings in the "Source" section of the dialog serve different purposes:

- The "Power" setting defines the output power for each external test set. After a source power calibration of the converter ports 1 and 2, the analyzer will generate the selected source powers at the 1 mm test port connectors of the external test sets; see [chapter 1.7, "Calibration"](#), on page 7.  
Port 4 provides the local oscillator signal for the converters. The default source power setting ensures a suitable input level of approx. 7 dBm at the LO IN connectors.
- The source frequencies at the 1 mm test ports are essentially determined by the port frequencies of the analyzer: The "Port 1" and "Port 2" source frequencies define the source frequencies of the left and right external test sets, respectively.  
The "Converter Port 1" and "Converter Port 2" frequency settings in the "Port Configuration" dialog define the frequency axes for the source power calibrations, but do not affect the source frequencies at the 1 mm test ports. For best accuracy, ensure that the correct converter frequencies are set, especially if the test setup contains additional frequency-converting components.

### Example:

In the example below, the frequency at the NWA "Port 1" has been increased by 1 GHz offset. The same offset has been entered for "Converter Port 1". This ensures a correct frequency axis during the power calibration.

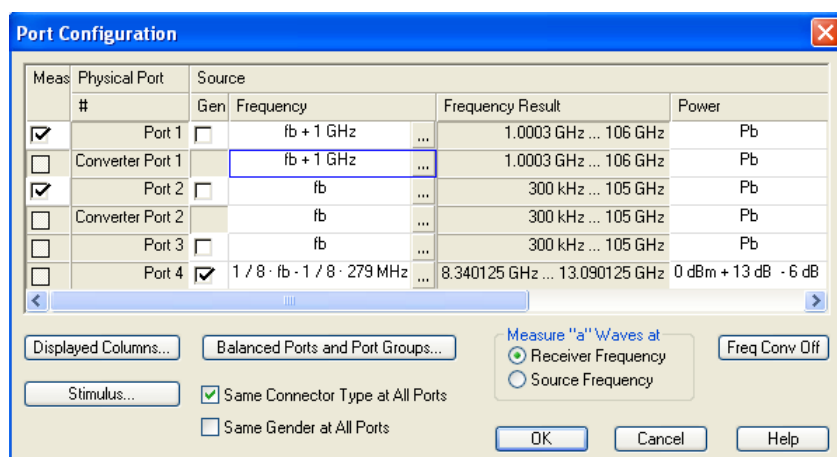


Fig. 1-3: Converter frequency and power settings

## 1.7 Calibration

A source power calibration for an external test set requires an appropriate external power meter, to be connected to the converter's 1 mm test port connector. The power meter is configured in the ordinary way using the "System Configuration > External Power Meters" tab.

To perform the source power calibration, proceed as follows:

1. Connect the power meter and open the "Channel > Calibration > Start Power Cal > Source Power Cal" dialog.
2. Select your converter and source port from the "Source" pull-down list (e.g. "Conv 1" for the left external test set connected to Ports 1 and Port 3).
3. Click "Modify Settings" and ensure that both "Flatness Cal" and "Reference Receiver Cal" are checked.
4. If your test setup causes strong nonlinear effects, you can choose a "Convergence Factor" different from one.
5. Start the calibration sweep.



To ensure an accurate source power calibration and quick convergence, use the correct power coefficients; see [chapter 1.7, "Calibration"](#), on page 7.

A receiver power calibration of the b-waves (without external power meter, using the "Receiver Power Calibration" dialog) is possible after completed source power calibration.

After the power calibration procedure a system error correction is recommended. Measurements with external test sets require a 1 mm calibration kit for system error correction.

## 1.8 Measurement

After power calibration and system error correction, the millimeter wave measurement can be performed like any other network analyzer measurement. The analyzer may perform a frequency or power sweep. The "Port Configuration" settings (together with the "Stimulus" settings), determine the sweep range of the converted signals (for a frequency sweep, the input and output frequencies at the DUT ports). All measured quantities (S-parameters, wave quantities, ratios etc.) and other trace settings are available.

The following example shows a transmission measurement on a through connection in the frequency range between 10 MHz and 110 GHz.

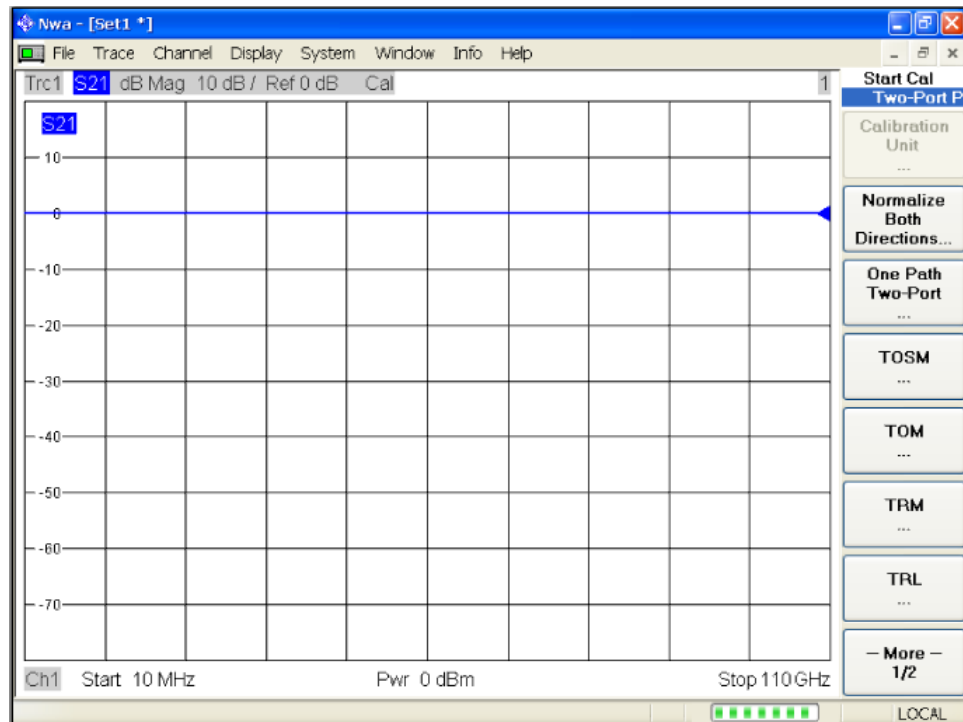


Fig. 1-4: Transmission measurement with an R&S ZVA110



For best measurement accuracy, observe the following rules:

- Enter the correct power coefficients of all frequency converters; see [chapter 1.4, "Entering Power Coefficients"](#), on page 4.
- Perform a source power calibration; see [chapter 1.7, "Calibration"](#), on page 7. Using output powers at the 1 mm connectors outside the calibrated range generally impairs the measurement accuracy. The effect is enhanced if the power coefficients are not correct.
- Perform a system error correction for the power-calibrated test setup using an appropriate calibration kit.

## 1.9 Additional Information

For a comprehensive description of R&S ZVA analyzers including frequency conversion and remote control refer to the R&S ZVA help system or to the printable operating manual, which is available for download at <http://www.rohde-schwarz.com/product/zva>.

For an description of the R&S ZVA110 connectors and safety instructions refer to the R&S ZVA110 Quick Start Guide.

Application notes related to frequency converters are also available for download, see <http://www.rohde-schwarz.com/product/zva-z>.