

# R&S® ZVA-Z90E / -Z110E Converters WR12 / WR10 with Electronic Attenuators Quick Start Guide



1307.7197.62 – 03

This Quick Start Guide describes the following converter types:

- R&S® ZVA-Z90E, Converter WR12, stock no. 1307.7600.02
- R&S® ZVA-Z110E, Converter WR10, stock no. 1307.7000.40

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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.

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# 1 Safety Instructions

This frequency converter has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

## **NOTICE**

### **Risk of instrument damage**

To prevent instrument damage make sure to read through and observe the following safety instructions.

### **ESD protective measures**

To protect the frequency converter against damage due to Electrostatic Discharge (ESD) use the wrist strap and grounding cord supplied with the network analyzer and connect yourself to the GND connector at the front panel of the analyzer. For details refer to the Quick Start Guide of your analyzer.

### **Input powers RF IN and LO IN**

The RF input power at the connectors RF IN and LO IN must not exceed the maximum values quoted in the data sheet. The maximum values are below the maximum RF source power of the network analyzer. The frequency converter mode ensures compatible source powers.

Before you connect your converter to the network analyzer, always activate the frequency converter mode using the Frequency Converter dialog (see [chapter 3.3, "Activating the Frequency Converter Mode"](#), on page 18) and select the proper converter type and connecting diagram.

### **Protection of waveguide flanges**

The waveguide flanges of the converter and of the test port adapters must be protected against mechanical damage. Furthermore the waveguides must be shielded from dust.

Protect the waveguide flange of the converter by leaving a test port adapter mounted. When the converter is not in use attach one of the included protective caps to the adapter. Also attach protective caps to the second test port adapter. Avoid scratching the contact surfaces of the waveguide flanges.

### **Avoid heavy shocks**

Heavy shocks can damage inner parts of the instrument. Shock-proof packing should therefore be used for storing or dispatching the frequency converter.

### **Opening the instrument**

Do not open the instrument. Repair of the converter can only be done at the manufacturer's servicing department.

## 2 Preparing for Use

This chapter gives an overview of the controls and connectors of the frequency converter and provides all information that is required to put the converter into operation and connect external devices.

Chapter 3 provides an introduction to the operation of the frequency converter. For a list of (additional) required equipment see [chapter 3.1, "Required Equipment"](#), on page 17.

### 2.1 Test Port Adapter (Waveguide Flange)

The test port with a mounted test port adapter is located at the front of the instrument. The device under test (DUT) has to be connected to the test port adapter.



*Fig. 2-1: Front of the instrument R&S ZVA-Z110E (the other model is similar in design)*

The precision waveguide flange of the test port adapter is equipped with two alignment pins and two holes receiving the alignment pins of the DUT (see [figure 2-2](#)). Two additional holes in the middle allow to insert additional alignment pins (delivered with the instrument). Additional pins should be used if the flange of the DUT also has holes for receiving these pins and the accuracy of the connection shall be enhanced.

The R&S ZVA-Z110E converter is delivered with a standard adapter plus an alternative adapter. The two adapters differ in the size of the holes receiving the alignment pins of the flange of the DUT. The standard test port adapter has holes with a diameter of 1.565 mm at both ends. The alternative adapter has holes with a diameter of 1.605 mm at the DUT side. The DUT side is marked by the label "HP/A", indicating that this side is HP/A compatible (i.e. supports thicker pins).

The R&S ZVA-Z90E converter is delivered with the HP/A compatible adapter.

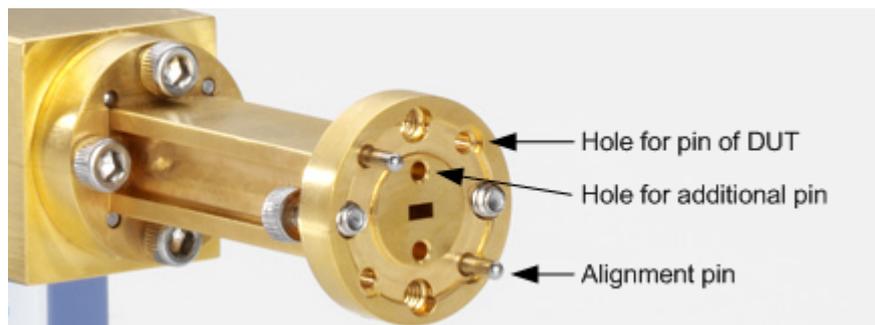


Fig. 2-2: Test port adapter of R&S ZVA-Z110E

### NOTICE

#### Risk of damaging waveguide flanges

The waveguide flanges of the converter and of the test port adapters must be protected against mechanical damage. Furthermore the waveguides must be shielded from dust.

Protect the waveguide flange of the converter by leaving a test port adapter mounted.

When the converter is not in use attach one of the included protective caps to the adapter.

Also attach protective caps to the second test port adapter. Avoid scratching the contact surfaces of the waveguide flanges.

## 2.2 Rear Panel

The rear panel of the frequency converter provides the connectors and control elements described below:

- [Standby Switch](#)
- [Power Supply Connector](#)
- [Fuse Holder](#)
- [RF Connectors – Input](#)
- [IF Connectors – Output](#)
- [Control Connector](#)



Fig. 2-3: Rear view of the frequency converter

### 2.2.1 Standby Switch

The standby toggle switch connects (ready state) or disconnects (standby state) the internal modules of the frequency converter from the power supply.

A green light-emitting diode (LED) next to the switch indicates that the instrument is in ready state. An orange LED further to the right indicates that the instrument is in standby state. These LEDs are only lit when the converter is properly connected to the power supply and the fuse of the instrument is intact.



Fig. 2-4: Standby switch and LEDs

### 2.2.2 Power Supply Connector



To supply the frequency converter, connect the external DC power supply provided with the converter to the 9 V / 0.8 A DC input. For details see [chapter 2.3.7, "Connecting the Converter to the DC Supply"](#), on page 14.

Always switch the instrument to standby state before removing the power supply.

### NOTICE

#### Risk of instrument damage

The input voltage and current must not exceed the maximum values according to the rear panel labeling or the data sheet.

Always use the DC power supply included in the delivery to power your frequency converter.

### 2.2.3 Fuse Holder



The power supply connector at the rear panel is protected by a fuse of type IEC60127 T1 L/H. For fuse replacement see [chapter 2.3.10, "Replacing Fuses"](#), on page 15.

### 2.2.4 RF Connectors – Input



Two input connectors of type 3.5 mm are available:

- RF IN (RF source signal input)
- LO IN (local oscillator signal input)

For correct cabling please refer to [chapter 2.3.6, "Connecting RF Cables"](#), on page 13.

### NOTICE

#### Risk of instrument damage

The RF input power at the connectors RF IN and LO IN must not exceed the maximum values quoted in the data sheet. The maximum values are below the maximum RF source power of the network analyzer. The frequency converter mode ensures compatible source powers.

Before you connect your converter to the network analyzer, always activate the frequency converter mode using the Frequency Converter dialog (see [chapter 3.3, "Activating the Frequency Converter Mode"](#), on page 18) and select the proper converter type and connecting diagram.

### 2.2.5 IF Connectors – Output

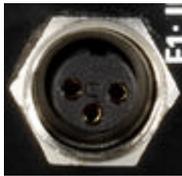


Two SMA connectors are available:

- MEAS OUT (measurement signal output)
- REF OUT (reference signal output)

For correct cabling please refer to [chapter 2.3.6, "Connecting RF Cables"](#), on page 13.

### 2.2.6 Control Connector



The three-pin control connector receives the control signal for the source power of the frequency converter.

For correct connection read [chapter 2.3.5, "Connecting the Control Cable"](#), on page 12.

## 2.3 Putting the Converter into Operation

This section describes the basic steps to be taken when setting up the frequency converter for the first time.

### NOTICE

#### Risk of instrument damage

Before turning on the converter, please make sure that the following conditions are fulfilled:

- Converter covers are in place and all fasteners are tightened.
- Ventilation openings are unobstructed.
- The converter is dry and shows no condensation.

Non-observance may cause damage to the converter!

### 2.3.1 Unpacking the Unit and Checking the Shipment

1. Unpack the converter and the other contents of the shipping container.
2. Check the shipment against the list of accessories to ensure that all items are included.
3. Remove the protective cap from the test port adapter at the front of the instrument and carefully inspect the frequency converter to make sure that it was not damaged during shipment.

Should the converter be damaged, immediately notify the forwarder who shipped the converter to you and keep the container and packing material.

Equipment returned or sent in for repair must be packed in the original container or packing.

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**NOTICE****Risk of damaging waveguide flanges**

The waveguide flanges of the converter and of the test port adapters must be protected against mechanical damage. Furthermore the waveguides must be shielded from dust.

Protect the waveguide flange of the converter by leaving a test port adapter mounted. When the converter is not in use attach one of the included protective caps to the adapter. Also attach protective caps to the second test port adapter.

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The wooden box should be kept and used for storage of the instrument and the accessories.

### 2.3.2 Setting up the Converter

The frequency converter is designed for use under laboratory conditions on a bench top. The surface of the bench top should be flat. The converter must be used in horizontal position.

The general ambient conditions required at the operating site are as follows:

- The ambient temperature must be in the ranges specified for operation and for compliance with specifications (see data sheet).
  - All ventilation openings must be unobstructed.
- 

**NOTICE****Risk of instrument and DUT damage**

To avoid damage of electronic components of the DUT and the frequency converter, the operating site must be protected against electrostatic discharge (ESD).

To prevent ESD damage use the wrist strap and grounding cord supplied with the network analyzer and connect yourself to the GND connector at the front panel of the analyzer. For details refer to the Quick Start Guide of your analyzer.

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### 2.3.3 Adjusting the Feet of the Instrument

The instrument can be used with three or four feet attached to the bottom side. It is recommended to use three feet: two in the front and one in the middle of the rear. In most cases a suitable start setup for instrument alignment is as follows: Screw the front feet into the instrument as far as possible and use the rear foot to align the instrument parallel to the surface of the bench top. When you mount a DUT to two instruments (see [chapter 2.3.9, "Mounting a DUT"](#), on page 15) use the feet for further alignment.



Fig. 2-5: Setup with three feet (left) and four feet (right)

### 2.3.4 Selecting and Mounting a Test Port Adapter

Depending on the instrument model one or two test port adapters are available (see [chapter 2.1, "Test Port Adapter \(Waveguide Flange\)"](#), on page 6). Select the appropriate adapter depending on the DUTs to be measured:

- Standard adapter (R&S R&S ZVA-Z110E):  
Use this adapter if you want to measure DUTs with thin pins only.
- HP/A compatible adapter (R&S ZVA-Z90 and R&S ZVA-Z110E):  
Use this adapter if you want to measure DUTs with thick pins.

DUTs with thin pins can also be connected to the HP/A adapter (useful if you have both types of DUT). But the connection of DUTs with small pins is more accurate if the standard adapter is used. The reduced alignment condition can typically be compensated using two additional pins above and below the waveguide cross-section.

Mount the selected adapter to the waveguide flange of the instrument using the delivered screws and the included hex ball driver. A tight and accurate connection is very important to ensure precise calibration and measurement results.

### 2.3.5 Connecting the Control Cable

The source power of the frequency converter is controlled from the R&S ZVA vector network analyzer. Connect the 3-pin control connector at the rear panel of the converter to the output connector of option R&S ZVA-B8 (EXTATT CTRL) at the top right of the R&S ZVA front panel using the control cable supplied with the converter.



The numbers below the EXTATT CTRL connectors denote the controlled analyzer ports. Control connector numbers and analyzer port numbers must always be the same.

For an upgrade of your network analyzer with option R&S ZVA-B8, contact your Rohde & Schwarz service representative.



Option R&S ZVA-B8 replaces the 3.5" disk drive of the analyzer. If you keep cal kit data or other network analyzer data files on a 3.5" disk, you may want to save them to another storage medium, e.g. a USB memory stick before you have the disk drive replaced.

### 2.3.6 Connecting RF Cables

The connectors RF IN, LO IN, MEAS OUT and REF OUT have to be connected to a network analyzer (LO IN is alternatively connected to an external generator).

#### NOTICE

##### Risk of instrument damage

The RF input power at the connectors RF IN and LO IN must not exceed the maximum values quoted in the data sheet. The maximum values are below the maximum RF source power of the network analyzer. The frequency converter mode ensures compatible source powers.

Before you connect your converter to the network analyzer, always activate the frequency converter mode using the "Frequency Converter" dialog (see [chapter 3.3, "Activating the Frequency Converter Mode"](#), on page 18) and select the proper converter type and connecting diagram.

#### NOTICE

##### Risk of connector and cable damage

Tightening the cables overly may damage cables and connectors. Tightening them not enough yields inaccurate measurement results.

For these reasons always use an appropriate torque wrench, suitable for the type of connector.

#### Connecting the input connectors (RF IN, LO IN)

The type of cable required for connecting the input connectors depends on the type of the network analyzer/external generator: Different instruments may require different connectors. At the converter side 3.5 mm connectors are used.

For a complete test setup for a 2-port transmission measurement as shown in the figure below, a cable length of 1 m is recommended. For a setup with only one converter shorter cables may be sufficient. Always use cables with low attenuation and excellent phase stability.

1. Ensure that the converter is in standby state or disconnected from the power supply.
2. Ensure that the frequency converter mode is activated at the network analyzer (see [chapter 3.3, "Activating the Frequency Converter Mode"](#), on page 18).
3. Connect port 1 or port 2 of the analyzer to RF IN of the converter.
4. Connect port 3 or port 4 of the analyzer to LO IN of the converter.

Alternative: Connect an external generator signal to LO IN.

### Connecting the output connectors (MEAS OUT, REF OUT)

Suitable cables for connecting the output connectors to the network analyzer are included in the delivery. The ends of these cables are labeled accordingly. Depending on the type of the analyzer an additional adapter kit may be required to connect the cables.

1. Ensure that the converter is in standby state or disconnected from the power supply.
2. Ensure that the frequency converter mode is activated at the network analyzer (see [chapter 3.3, "Activating the Frequency Converter Mode"](#), on page 18).
3. Connect MEAS OUT of the converter to the MEAS IN connector of the analyzer, using the port providing the RF source signal (port 1 or port 2 connected to RF IN).
4. Connect REF OUT of the converter to the REF IN connector of the same analyzer port.



*Fig. 2-6: Test setup for 2-port transmission measurement with R&S ZVA-Z110E*

### 2.3.7 Connecting the Converter to the DC Supply

An external DC power supply and several plug adapters are provided with the instrument. Select the appropriate adapter and attach it to the power supply. To remove a mounted adapter press the small button next to the adapter and push the adapter away from the button.

Connect the power supply to the 9 V / 0.8 A DC input at the rear panel (see [chapter 2.2.2, "Power Supply Connector"](#), on page 8) and to a power outlet. The power supply supports input AC voltages between 100 V and 240 V and frequencies between 47 Hz and 63 Hz.

A lit LED next to the standby switch indicates that the power supply operates appropriately. If neither of the two LEDs is lit, check the fuse of the instrument (see [chapter 2.3.10, "Replacing Fuses"](#), on page 15).

### 2.3.8 Switching on the Instrument

The standby toggle switch is located at the rear panel (see [chapter 2.2.1, "Standby Switch"](#), on page 8). To switch the instrument to ready state, press the key. The green LED next to the switch must be lit now.

After switching the instrument to the ready state a warm-up time of one hour is required to ensure accurate measurements. The instrument is only warmed-up in ready state, not in standby state.

### 2.3.9 Mounting a DUT

The DUT has to be screwed to the test port adapter at the front of the instrument. Mount the DUT using the delivered screws and the included hex ball driver. A tight and accurate connection is very important to ensure precise results of calibration and measurements. Depending on the type of waveguide flange of the DUT it may be required to exchange the test port adapter (see [chapter 2.3.4, "Selecting and Mounting a Test Port Adapter"](#), on page 12).

For a test setup involving two frequency converters connected to one DUT the converters and the DUT have to be aligned accurately, using the adjustable instrument feet.

### 2.3.10 Replacing Fuses

The power supply connector at the rear panel is protected by a fuse of type IEC60127 T1 L/H.

To replace the fuse open the fuse holder by slightly turning the lid counter-clockwise, preferably using a small coin. A replacement fuse is provided with the instrument.

## 2.4 Maintenance

The frequency converter does not require any special maintenance. Make sure that the air vents are not obstructed. The outside of the instrument is suitably cleaned using a soft, line-free dust cloth.

**NOTICE****Risk of instrument damage**

Cleaning agents contain substances that may damage the instrument, e.g. solvent-containing cleaning agents may damage the front panel labeling or plastic parts.

Never use cleaning agents such as solvents (thinners, acetone etc.), acids, bases or other substances.

For our support center address and a list of useful R&S contact addresses refer to the pages at the beginning of this document.

**2.4.1 Storing and Packing**

The converter can be stored at the temperature range quoted in the data sheet. When it is stored for a longer period of time the instrument should be protected against dust.

When the instrument is to be transported or dispatched, the original packing should be used, particularly the protective cap and the wooden box (see also [chapter 2.3.1, "Unpacking the Unit and Checking the Shipment"](#), on page 10).

## 3 Basic Operation

This chapter describes the use of an R&S ZVA vector analyzer and two R&S ZVA-Z110E frequency converters for 2-port transmission measurements.

Measurements using other converter types are performed in an analogous way.

### 3.1 Required Equipment

Measurements with frequency converters can be carried out with the following equipment:

- Network analyzer (NWA) R&S ZVA with an upper frequency limit of 20 GHz or higher (R&S ZVA 24, R&S ZVA40 ...).  
The required firmware version depends on the frequency converter model:
  - R&S ZVA-Z110E: at least version V2.61
  - R&S ZVA-Z90E: at least version V2.70
- Two NWA ports per frequency converter port.  
Alternatively: One NWA port per frequency converter plus a common external generator for the LO signals. The R&S SMF100A signal generator with suitable options is recommended.
- N frequency converters for an N-port measurement
- Option R&S ZVA<n>-B16, "Direct Generator/Receiver Access" at each port
- Option R&S ZVA-K8, "Converter Control"
- Option R&S ZVA-B8 to establish the control connection between the NWA and the frequency converters
- a suitable set of calibration standards

### 3.2 Measurement Principle

The frequency converters use frequency multipliers to transform the RF source signal from one of the network analyzer ports into a high-frequency stimulus signal. A second signal (Local Oscillator, LO) is used for down-conversion of the reference and measurement channels. The LO signal can be provided either by a second analyzer port or by an external generator.

The measurement involves the following steps:

1. Selection of the converter and test setup, activation of the converter mode
2. Entry of power coefficients (when a converter is used for the first time or assigned to a new analyzer port).
3. Connection of the frequency converters
4. Power and frequency settings

5. Power calibration using an appropriate external waveguide power meter
6. Calibration using a suitable waveguide calibration kit
7. Connection of the DUT and measurement

### 3.3 Activating the Frequency Converter Mode

To activate the converter mode for a setup without external generator,

1. Click "System > System Config ..." and open the "Frequency Converter" tab of the "System Configuration" dialog.
2. Select correct "Type": R&S ZVA-Z90E or R&S ZVA-Z110E.
3. If you use your frequency converter for the first time, click "Coefficients" to enter the power coefficients; see [chapter 3.4, "Entering Power Coefficients"](#), on page 19.
4. Click "Apply" to activate the frequency converter mode and "Close".



#### **Analyzer settings with active frequency converter**

In frequency converter mode, the frequency and level settings of the network analyzer are automatically set to be compatible with the selected frequency converters. "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 ...").

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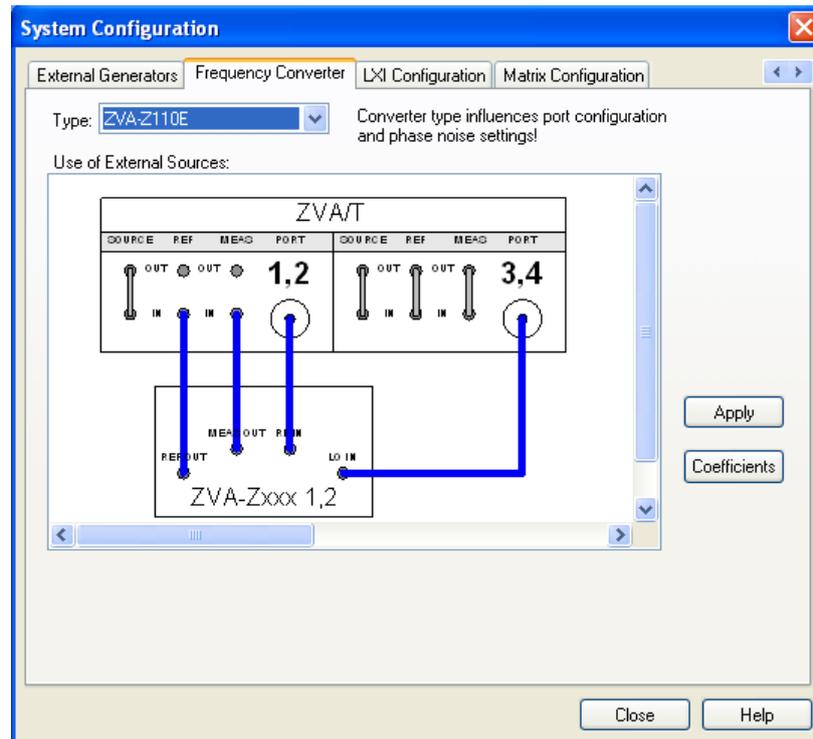


Fig. 3-1: Frequency Converter dialog (example: R&S ZVA-Z110E)

### 3.4 Entering Power Coefficients

For accurate control of the converter output power, the R&S ZVA analyzer must know the (non-linear) current-power characteristic of the 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.

The power coefficients must be adjusted whenever a new converter is connected to an analyzer port. To enter the coefficients, proceed as follows:

1. Activate the frequency converter mode following the first steps in [chapter 3.3, "Activating the Frequency Converter Mode"](#), on page 18.
2. In the "Frequency Converter" dialog, press "Coefficients".
3. In the "Power Coefficients" dialog opened, clear "Use default coefficients" and enter your coefficients into the appropriate table row.

The numbers of the table rows denote the analyzer port for the converter.

4. Repeat the last step for all frequency converters in the test setup.

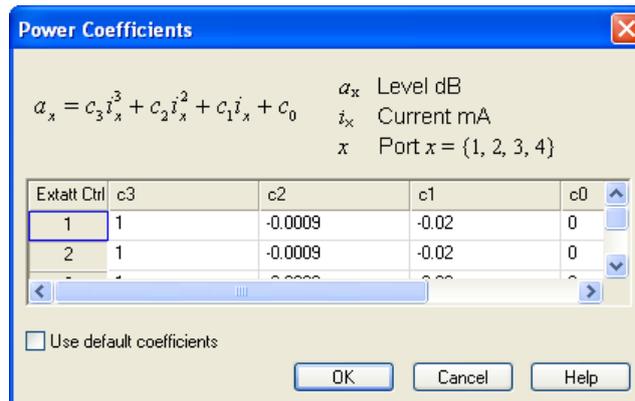


Fig. 3-2: Entry of power coefficients for analyzer port 1

### 3.5 Connecting the Frequency Converters

Each frequency converter must be connected to the analyzer, the power supply and the DUT. Please refer to the following sections for details.

- Control connection: [chapter 2.3.5, "Connecting the Control Cable"](#), on page 12
- Analyzer ports: [chapter 2.3.6, "Connecting RF Cables"](#), on page 13
- Power supply: [chapter 2.3.7, "Connecting the Converter to the DC Supply"](#), on page 14
- DUT (usually connected after calibration): [chapter 2.3.9, "Mounting a DUT"](#), on page 15

### 3.6 Power and Frequency Settings

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

- The output power for each converter can be selected in the "Power" column. A source power calibration of the converter port ensures that the analyzer will generate the selected source power; see [chapter 3.7, "Calibration"](#), on page 21.
- The source frequency at the converter ports is essentially determined by the port frequency of the analyzer. The converter frequency settings in the "Port Configuration" dialog define the frequency axes for the source power calibrations, however, they do not actually affect the converter output frequencies. 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 a 50 MHz offset. The converter source frequency six times the NWA source frequency, therefore a 300 MHz offset has been entered for "Converter Port 1". This ensures a correct frequency axis during the power calibration.

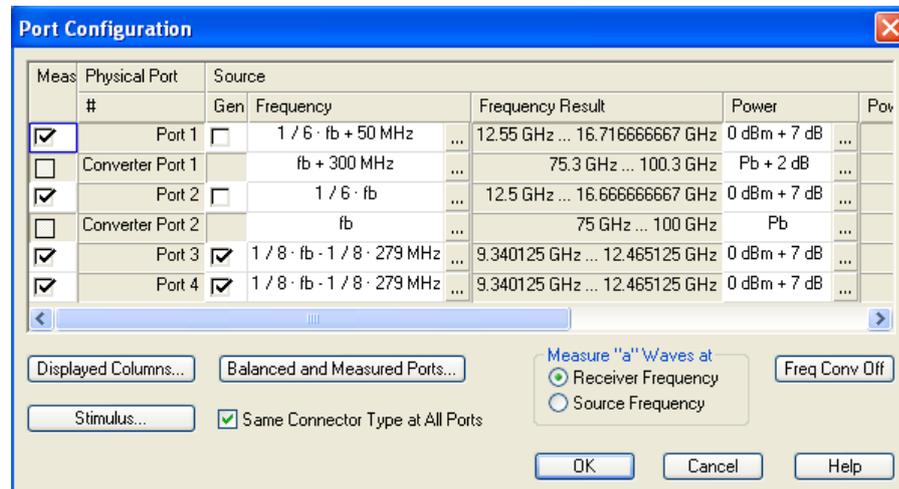


Fig. 3-3: Converter frequency and power settings (example: R&S ZVA-Z110E)

## 3.7 Calibration

A source power calibration for a frequency converter requires an appropriate external power meter, to be connected to the converter's waveguide flange; see [chapter 2.1, "Test Port Adapter \(Waveguide Flange\)"](#), on page 6. Waveguide power meters are 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 waveguide 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 a frequency converter connected to NWA port 1).
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 3.7, "Calibration"](#), on page 21.

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. Due to the physical properties of the mm-waves and the waveguides, measurements with frequency converters require a special calibration kit for system error correction. Rohde & Schwarz offers kits for this purpose, e.g. the calibration kits R&S ZV-WR10 and R&S ZV-WR12. The standards in the calibration kit allow all one-port and two-port calibration types supported by the network analyzer except TNA. Refer to the documentation of the calibration kit or the help system of your network analyzer for details.

### 3.8 Measurement

After power calibration and system error correction, the mm-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 the transmission and reflection coefficients of a bandpass filter in the frequency range between 75 GHz and 110 GHz, which is covered by the frequency converter R&S ZVA-Z110E.

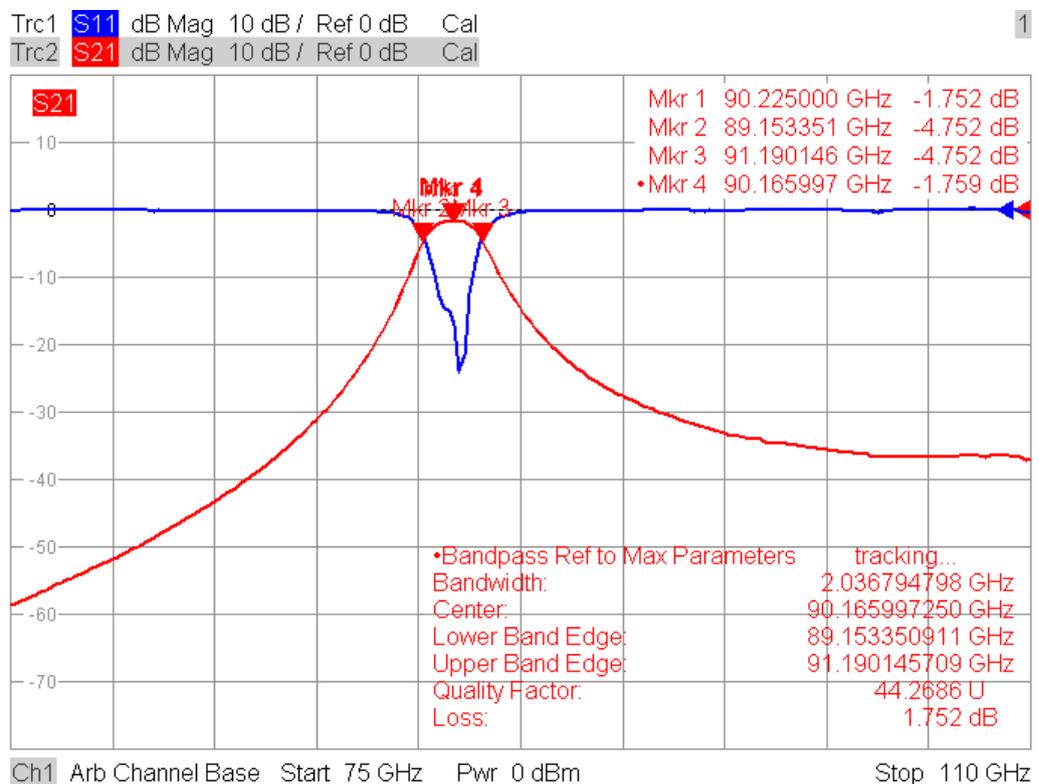


Fig. 3-4: Transmission and reflection of a bandpass filter measured with an R&S ZVA-Z110E



For best measurement accuracy, observe the following rules:

- Enter the correct power coefficients of all frequency converters; see [chapter 3.4, "Entering Power Coefficients"](#), on page 19.
- Perform a source power calibration; see [chapter 3.7, "Calibration"](#), on page 21. Using converter output powers 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 test setup.

## 3.9 Troubleshooting

The table below lists possible errors and remedies.

Error	Possible cause	Remedy
No output signal, LED next to the mains switch on the rear of the converter panel off.	Converter not power-supplied	Check power supply and fuse (see <a href="#">chapter 2.2.3, "Fuse Holder"</a> , on page 9)
Power control fails, frequency converter operates at maximum output power.	Control connection not established	Check connecting cable and port assignment of control connectors.
Inaccurate converter source levels	Insufficient settling time, especially for fast sweep and strong power variations	Increase sweep time ("Channel > Sweep > Sweep Time")
Inaccurate converter source levels, even at reduced speed	Power coefficients entered and converters do not match, e.g. the coefficients of port 1 and port 2 are interchanged	Make sure that all coefficients are correct and assigned to the right analyzer ports (see <a href="#">chapter 3.4, "Entering Power Coefficients"</a> , on page 19)

## 3.10 Additional Information

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

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

The text book "Fundamentals of Vector Network Analysis" by Michael Hiebel is an ideal complement for the information given in the user documentation. The book combines theoretical background and practical measurements on an R&S ZVA network analyzer. In case of interest please contact your local R&S office.

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