

Millimeter-wave network analysis with maximum dynamic range

The new R&S®ZVA-Z110 converters from Rohde & Schwarz expand the R&S®ZVA24, R&S®ZVA40, and R&S®ZVT20 vector network analyzers by adding millimeter-wave measurement capability with maximum dynamic range from 75 GHz to 110 GHz (W band).

Perfectly integrated into the analyzer firmware

The R&S®ZVA-Z110 converters (FIG 1) expand the high-end network analyzers from Rohde & Schwarz by adding the frequency range from 75 GHz to 110 GHz, thus covering important frequency bands, e.g. the forthcoming vehicle distance radar (77 GHz), or applications in the defense sector (94 GHz). The converters, which are also intended for use in wafer probes and are appropriately dimensioned for this application, are simply connected to the base unit; no additional hardware is required.

As a unique feature worldwide, the converters are fully integrated into the network analyzer firmware, i.e. the converters can be operated as if they were an integral part of the analyzer. By selecting the appropriate cabling scheme in the analyzer firmware, all the required parameters will be set automatically (FIG 2). These include the frequency limits of the WR10 band, the multiplication factors for the RF and the LO signals, the power values of these signals, and the receiver frequency. The correct setting menus, measured-value indications, frequency limits, etc. will thus always come up, reducing setting errors to a minimum. The network analyzer includes an output power limiting function, which prevents damage to the converters caused by unduly high RF or LO input powers.

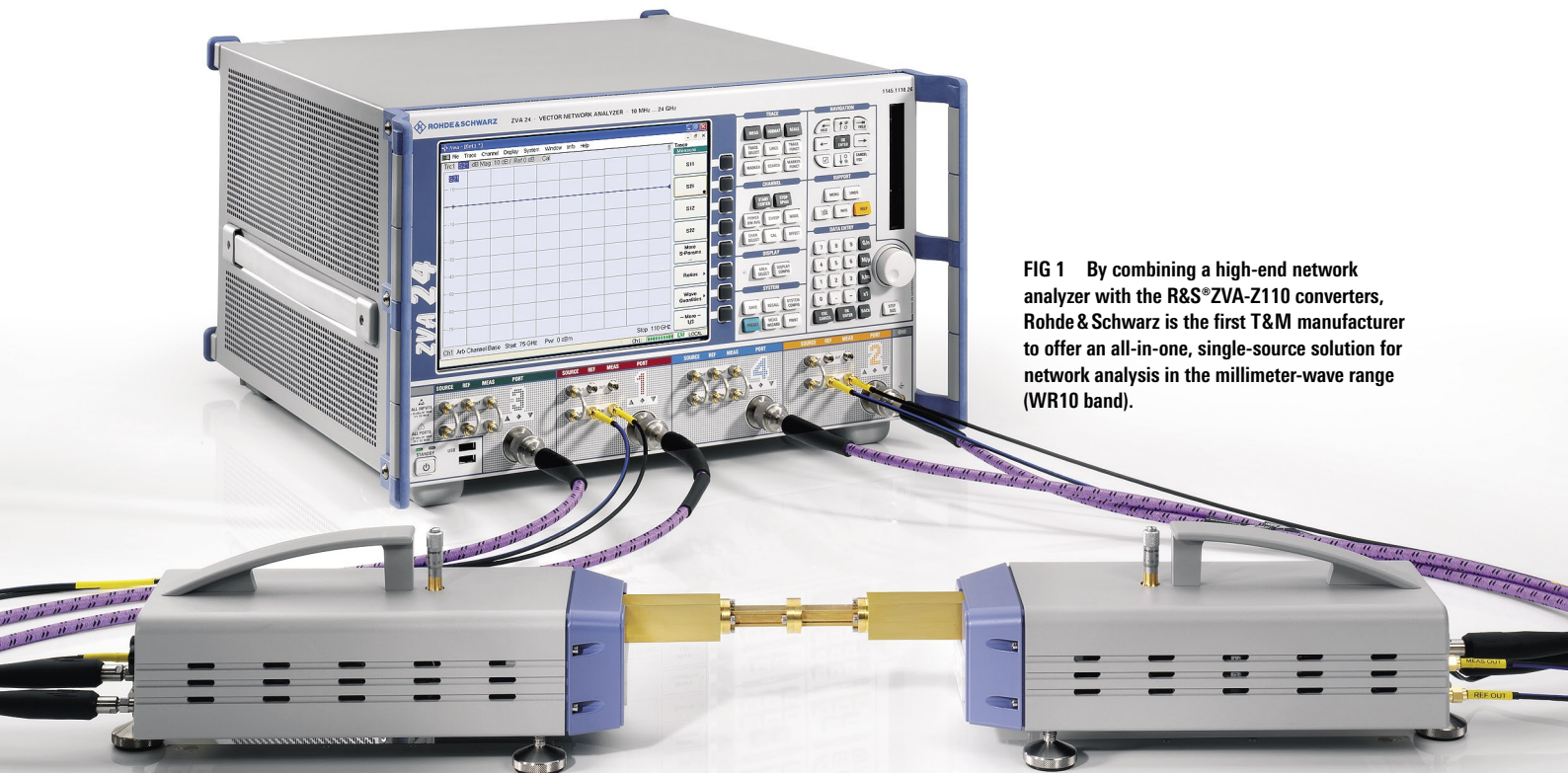


FIG 1 By combining a high-end network analyzer with the R&S®ZVA-Z110 converters, Rohde & Schwarz is the first T&M manufacturer to offer an all-in-one, single-source solution for network analysis in the millimeter-wave range (WR10 band).

43386/1

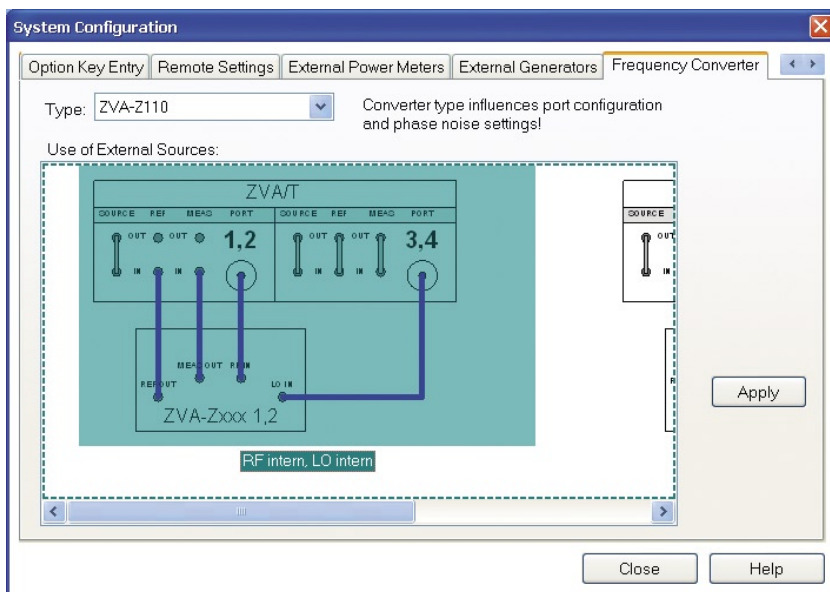


FIG 2 Selection of converter type in the instrument firmware and display of required connections.

► Functional description

The R&S®ZVA-Z110 converters are based on frequency multiplication of the RF and LO input signals. RF signals are generated in the range 12.5 GHz to 18.33 GHz and multiplied by a factor of six to the range 75 GHz to 110 GHz; LO signals are generated in the range 9.34 GHz to 13.71 GHz and multiplied by a factor of eight. Harmonics mixers downconvert the measurement and reference signals to be output by the converters to a fixed IF in the megahertz range and apply them to the network analyzer's MEAS IN and REF IN inputs. Bidirectional measurements are possible as the converters contain directional couplers separating forward and reflected power.

Each converter features an integrated attenuator that allows manual reduction of the converter output power by up to 25 dB, which is necessary for characterizing low-noise amplifiers, for example.

Ultra-wide dynamic range

The converters offer an excellent, unrivaled dynamic range of typically >110 dB. This speeds up measurements, as it enables the use of wider IF bandwidths, and allows high-blocking filters to be analyzed.

Easy to handle

The converters' waveguide test ports are arranged on a bar extending from the converter to provide easy access to the screw-connected flange joints. The converters can be set up on three or four feet that can be separately adjusted in height. Using three feet in particular allows the optimal alignment of the waveguide flanges relative to one another. Differences in height and the cocking of flanges relative to each other can be balanced out with high precision, thus enabling tight and stable screw connections – which is an important prerequisite for correct calibration.

Easy and fast test setup

When using an R&S®ZVA 24 or R&S®ZVA 40 four-port network analyzer or an R&S®ZVT 20 with at least four ports, no external generator is needed for delivering the LO signals required by the converters. Four-port analyzers have two internal signal generators, one generating the RF signals and the other the LO signals. No further hardware is required, which greatly facilitates and, most importantly, speeds up the test setup, since the second internal generator operates in parallel with the first one and need not be remote-controlled via the IEC/IEEE bus.

Alternatively, an R&S®ZVA 24, R&S®ZVA 40, or R&S®ZVT 20 two-port network analyzer can be used. In this case, an external R&S®SMF100A signal generator is additionally required to provide the LO signal. The signal generator's output signal is distributed to the two LO inputs of the converters via a suitable power splitter.

FIG 3 R&S®ZV-WR10 calibration kit – version with sliding match.



Calibration

After selecting the converter type, the R&S®ZV-WR10 waveguide calibration kit (FIG 3) is set automatically, and the corresponding calibration data is loaded. Calibration kits from other manufacturers can also be used.

Calibration is performed by means of the short, offset short (consisting of a short and a shim), and match waveguide calibration standards. Alternatively, an optionally available sliding match can be used, which is useful especially when high-precision reflection measurements are to be performed. The through calibration standard is implemented by directly screwing together two waveguide test ports.


Test port adapters, which are supplied as standard with the converters, protect the converters' waveguide connectors against wear and at the same time allow the connection of calibration kits from other manufacturers.

Multiport measurements

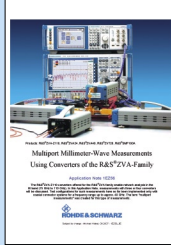
Using an R&S®ZVT20 six-port network analyzer with three internal signal generators, you can perform tests on three-port DUTs without an external generator. This test configuration allows you, for example, to measure all S-parameters of a waveguide directional coupler simultaneously after performing full system error correction. Four-port DUTs can be tested using four R&S®ZVA-Z110 converters, an R&S®ZVA24, R&S®ZVA40, or R&S®ZVT20 four-port network analyzer, and an external generator for delivering the LO signal.

Andreas Henkel

More information at
www.rohde-schwarz.com
 (search term: ZVA-Z110)



Application Note
1EZ55



Application Note
1EZ56

Condensed data of the R&S®ZVA-Z110

Frequency range	75 GHz to 110 GHz (WR10 band)
Output power (with +7 dBm input power from the R&S®ZVA/R&S®ZVT network analyzer)	+2 dBm
Manual power attenuation	0 dB to 25 dB using adjustable power control screw
Dynamic range	>95 dB, typ. >110 dB
Connector	compatible with UG-387 flange

Measurement example

An 80 GHz notch filter is to be measured using two R&S®ZVA-Z110 converters. First, full two-port calibration is performed. Then the filter is connected to the waveguide test ports of the converters. All four S-parameters of the filter can be measured and displayed in one or more diagrams on the analyzer screen (FIG 4). By using multiple measurement channels, it is possible, for example, to display the filter transmission characteristic across the entire WR10 band from 75 GHz to 110 GHz and at the same time the filter pass-band alone.

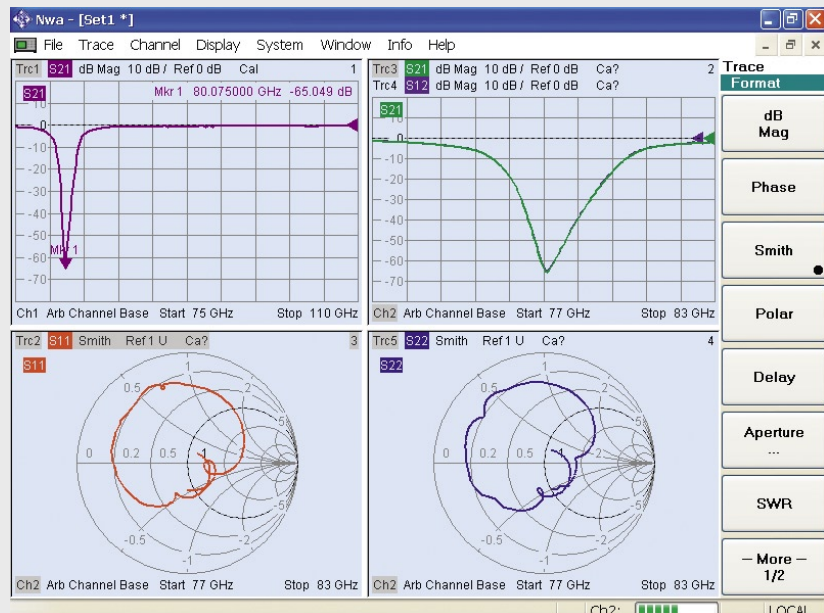


FIG 4 Measurement of an 80 GHz notch filter.