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Vector Analyzers Ease Test Process To 8 GHz

These compact instruments allow complex multiport and balanced measurements to be conducted easily and accurately to 8 GHz in both lab and production environments.

Vector analyzers are part of every major microwave test laboratory and production environment, but ease of use has never been one of their key selling points. The ZVB Series of vector network analyzers (VNAs) from Rohde & Schwarz (Columbia, MD) changes all this, however, by incorporating a user interface with measurement and calibration "wizards" and other software-based features to simplify vector analysis through 8 GHz.

The ZVB Series comprises two models, each available with either two or four ports. The model ZVB 4 covers 300 kHz to 4 GHz, while the model ZVB 8 covers 300 kHz to 8 GHz **(Fig. 1)**. Both instruments employ fundamental mixing as used in the company's ZVR Series VNAs, for dynamic range to 123 dB and trace noise of less than 0.01 dB. The instruments also provide at least +13 dBm test source power, with levels to +16 dBm typical to 4 GHz. The instruments do not use attenuators to vary output power, so they can quickly sweep RF power over a range of –40 to +13 dBm with reduced error and without wearing out attenuators or switches. Intermediate-frequency (IF) bandwidths range from 1 Hz to 500 kHz. The measurement sweep time for 201 points with a bandwidth of 500 kHz is less than 8 ms **(see table)**.

The ZVB Series instruments include a stable signal generator as well as reference and measurement receivers for each port, essentially producing the equivalent of four one-port instruments in a single box. This configuration has several advantages. It allows equal power (to the full +16 dBm) to be delivered to each port. Also, with a generator at each port, there is no need for RF switches for signal routing and control. Elimination of the switches increases accuracy, since switches can impact measurement repeatability. It also allows parallel one- and two-port measurements to be made on several devices under test (DUTs) simultaneously, reducing test time.

Network analyzers make calibrations and measurements at a specific number of points over a given frequency span, and use an interpolation algorithm to determine the calibration data if the user has changed the measurement grid.

1. The ZVB Series of VNAs includes the four-port model ZVB 8 with frequency coverage of 300 kHz to 8 GHz.

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Obviously, the greater the number of measurement points per trace during calibration, the less the instrument must rely on interpolation. In the ZVB Series, the number of test points has been increased from the total of 2001 used in earlier instruments to 20,001 per trace, which not only allows much more data to be collected and analyzed, but greatly reduces reliance on interpolated calibration data.

ZVB Series instruments define a channel as a complete measurement configuration that contains all settings employed to measure the device under test. The channel consists of sweep type (including frequency range and level), number of test points, power level, IF bandwidth, calibration and other parameters. Several traces can be assigned to each channel, which allows the instrument to simultaneously display S-parameters, impedances, admittances, output power, DC power consumption, or various stability factors under various operating conditions. The number of diagrams, channels and traces is limited only by the instrument's memory **(Fig. 2)**.

It would be difficult to fully utilize this level of analysis without an effective user interface, and the ZVB Series addresses this challenge in several ways. Like every current network analyzer, the ZVB Series can be operated both from front-panel hard keys and soft keys, as well as with a mouse and keyboard. However, unlike many other analyzers, functions available by either method are identical, since they are mapped the same way in both pull-down and key-based menus **(Fig. 3)**. Dialog boxes are used where advantageous, so that especially complex configurations of measurement ports, parameters, and traces can be easily manipulated. The instrument also makes extensive use of "wizards" that automate complex operations. The display can also be configured by arbitrarily assigning traces to specific diagrams and channels with only a few keystrokes and without annoying menu changes. To erase the inevitable mistake, the instruments have an "undo" button that reverses the effect of up to seven commands, including those implemented by presets.

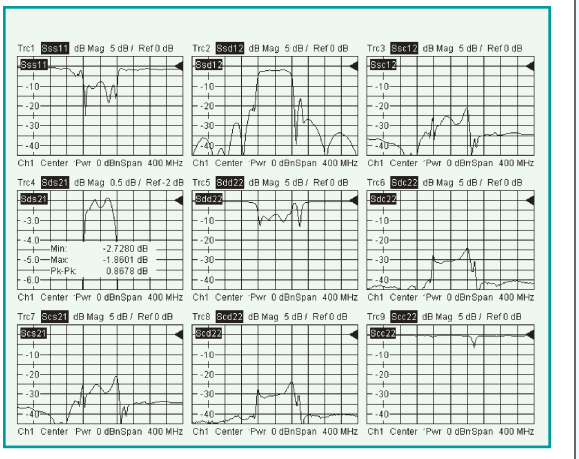
The simplicity of the ZVB Series user interface is particularly useful when making differential S-parameter measurements on balanced devices. Since network analyzers have single-ended ports, baluns and matching circuits are typically used to generate and measure differential signals.

However, baluns and matching circuits add measurement error, and baluns are effective only at relatively low frequencies. In addition, no calibration standards are available. To circumvent these problems, a balanced two-port is analyzed as a single-ended four port with a four-port network analyzer. Two physical ports of the instrument form a logical balanced port, and the resulting mixed-mode S parameters are calculated from the unbalanced S-parameters. The ZVB Series instruments simplify this process with wizards that guide the user, step by step, through the configuration of the

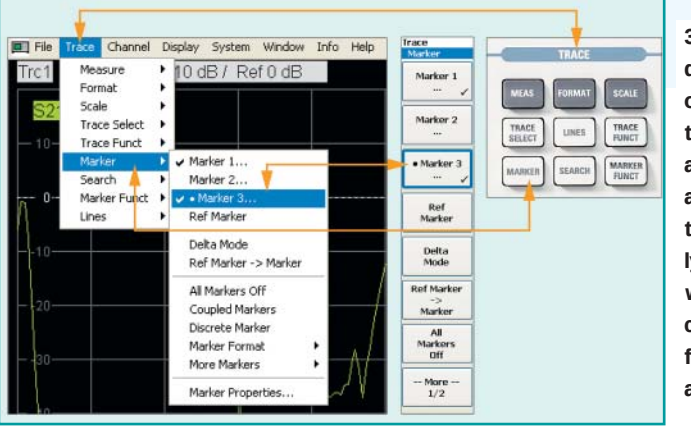
ZVB specifications at a glance

Frequency range	
ZVB 4	300 kHz to 4 GHz
ZVB 8	300 kHz to 8 GHz
Number of test ports	2 or 4
Measurement types	Balanced (mixed-mode S parameters), multiport, parallel two-port
Measurement time[1]	Less than 8 ms
Dynamic range	At least 123 dB
Trace noise	Less than 0.01 dB
Continuous RF power sweep range	–40 to +13 dBm (+16 dBm typical)
IF bandwidth	1 Hz to 500 kHz
Measurement points per trace	20,001 maximum
Number of traces, diagrams, channels, and set-ups than can be loaded into RAM	Limited only by instrument memory
Switching time between display channels	Less than 1 ms
Operating system	Windows XP
Control	Hard keys and soft keys, keyboard and mouse, online help, measurement wizards
Interfaces	Ethernet (2), USB (4), IEC-Bus, DC measurement inputs, bias (1 each, 4 ports), VGA monitor, foot switch, external trigger
Removable storage	Diskette
Calibration types	TOSM, TRL/LRL, TOM, TRM, TNA
Weight	44 lb.
Dimensions	17 × 9 × 14 in.
Options	Time domain, external time base, electronic calibration (via USB)

1. 201 points, 1 GHz to 1.2 GHz, 500 kHz measurement bandwidth



2. Display capabilities are limited only by the internal memory.



3. The Windows-based operating system of the ZVB analyzers allows them to be run locally or remotely, with identical commands for each approach.

measurement, and offer a suitable calibration method if desired. All 16 mixed-mode S parameters can be configured in less than 30 s.

For amplifier measurements, the ZVB Series determines output power, stability factors, power consumption, power-added efficiency, impedances and Z-parameters as a function of frequency or level, as well as S-parameters. Two DC inputs are available that measure supply current and voltage so that the DUT's efficiency and power consumption can be evaluated at various frequencies and power levels.

4. This electronic calibration unit allows VNA calibrations to be performed in about 20 s.

Measurement data can be exported as MATLAB-files, as *.snp- files or as *.csv-files. Data using these file formats can also be imported into memory traces so that current measurements can be compared with data from simulations. An on-screen math editor allows measurement traces to be linked with math functions, and the resulting expressions can be stored and transferred to other instruments.

An electronic calibration unit is available that allows the calibration process to be performed in about 20 s **(Fig. 4)** after the unit has been connected to each port and to one of the two front-panel or two rear-panel USB ports. A wide array of calibration kits is installed at the factory.

A quick look at the front panel of the four-port versions shows that the ports are not arranged in the standard 1-through-4 configuration, but rather are ordered from left to right as 3, 1, 4, and 2. The instruments' designers chose this arrangement because while unorthodox in appearance, it better reflects the actual measurement environment. For traditional coaxial or single-ended measurements, this layout increases the mechanical distance of the two ports typically in use, which reduces crosstalk and eliminates the need to bend cables tightly when connected to the analyzer. When making differential measurements, logical ports are mapped to the physical ports on the analyzer. Logical port 1 is created by ports 1 and 3, and logical port 2 is created by ports 2 and 4. As a result, the user needs to remember only that odd numbers reflect port 1 and even numbers reflect port 2.

The ZVB Series instruments, which are available with a time-domain option, measure 17 × 9 × 14 in. and weigh 44 lb. P&A: from $32,200 (ZVB 4) and from $40,300 (ZVB 8); 6 wks.

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