Microwave Signal Generators R&S®SMR

Universal sweep generators for network analysis

The Microwave Signal Generators R&S®SMR are popular signal sources for the frequency range up to 60 GHz. With their outstanding technical characteristics, small dimensions and unparalleled price/performance ratio, they are crucial in research, development and production. Owing to a special interface, all generators can be combined with the Spectrum Analyzers R&S®FSP or R&S®FSU to form a tracking system for scalar network analysis that satisfies all requirements for frequency range, dynamic range and sweep time.

Tracking systems for all purposes

By combining a Microwave Signal Generator R&S®SMR with one of the Spectrum Analyzers R&S®FSP or R&S®FSU, you can obtain a tracking system for scalar network analysis (FIG 1). This system also allows you to perform measurements on frequency-converting two-ports such as mixers, frequency multipliers or dividers, since the frequency sweep settings of generator and analyzer can be offset. All models of the R&S®SMR family of generators come equipped with the necessary interface, making it easy to upgrade the spectrum analyzers with the option R&S®FSP-B10. And that's not all: The special interface of the generators also permits operation

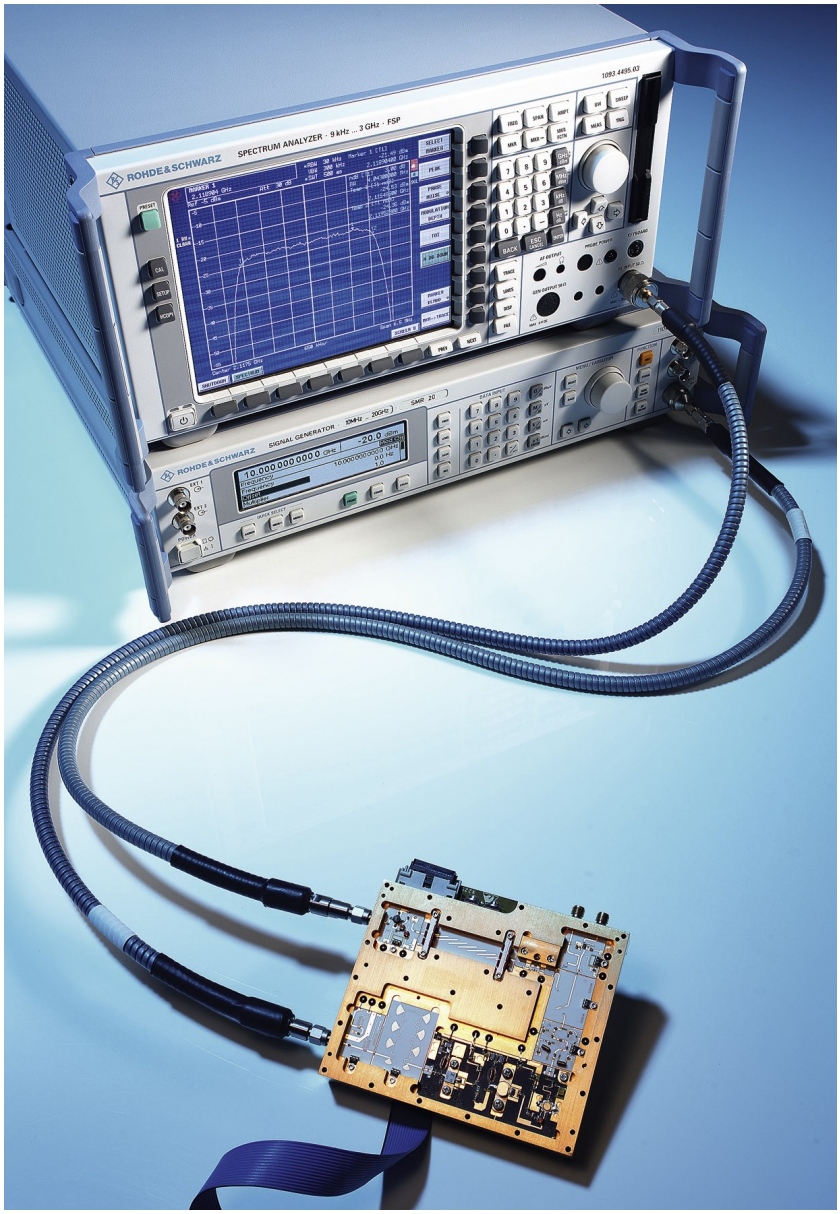

FIG 1
A perfect match: Combined, the R&S®SMR generators and the R&S®FSP or R&S®FSU analyzers form a powerful tracking system for scalar network analysis.

with the Vector Network Analyzers R&S®ZVR, ZVC, ZVM and ZVK which cover the frequency range up to 40 GHz, depending on the model. Measuring frequency-converting DUTs thus becomes child's play (FIG 3).

Step sweep

The interaction of an R&S®SMR with a spectrum or vector network analyzer depends on a function that has been a standard feature in all Rohde & Schwarz generators right from the start, i.e. the List mode. In this operating mode, first a list with frequency values and their assigned level values is created. The generator can now work through this list step by step via Auto mode or external trigger. If the list contains ascending frequency values at a constant level, a crystal-controlled digital step sweep is performed that may be very fast.

Basically, these lists can be created either manually or via remote control. When the R&S®SMR is used as a tracking generator, the spectrum or vector network analyzer automatically generates the required list and loads it into the generator via the IEC/IEEE bus, without involving the user. Next, the analyzer activates the List mode in the generator via remote control. After the generator has processed a frequency point, it sends a BLANK signal as an acknowledgement, which prompts the analyzer to issue a new trigger, and so forth. This ensures that both the generator and the analyzer are on the correct frequency before the analyzer initiates a measurement. Of course, these frequencies are identical for DUTs that are not frequency-converting (attenuators, amplifiers, filters, etc); for frequency-converting DUTs (frequency dividers or multipliers, mixers, and so on), an appropriate frequency offset has been set.

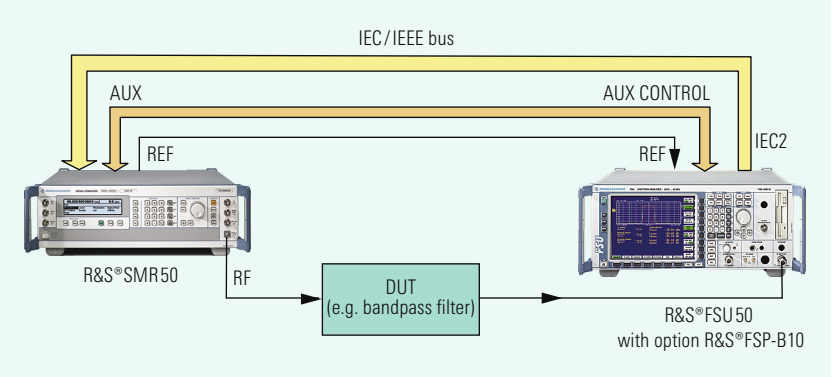

FIG 2 Transmission measurement with the R&S®SMR50 and the Spectrum Analyzer R&S®FSU50.

FIG 2 shows a transmission measurement (magnitude of S_{21}) with an R&S®SMR50 and an R&S®FSU50 as an example. This combination of instruments allows measurements up to 50 GHz without any difficulties. All measurement parameters (start and stop frequency, RF level, sweep time, etc) are set only on the spectrum analyzer. In addition to the transmission value measurements on twoports of any kind, harmonics and spurious suppression can be determined.

The outstanding selectivity and linearity characteristics of the spectrum ana-

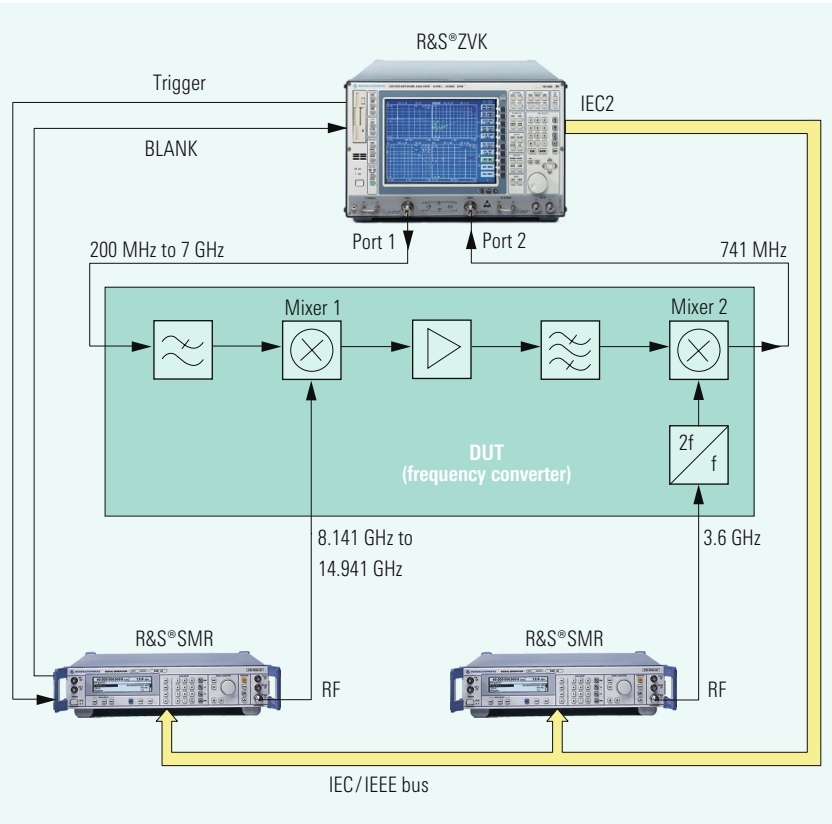

FIG 3 Measurement of a double frequency-converting receiver frontend using the R&S®SMR and R&S®ZVK.

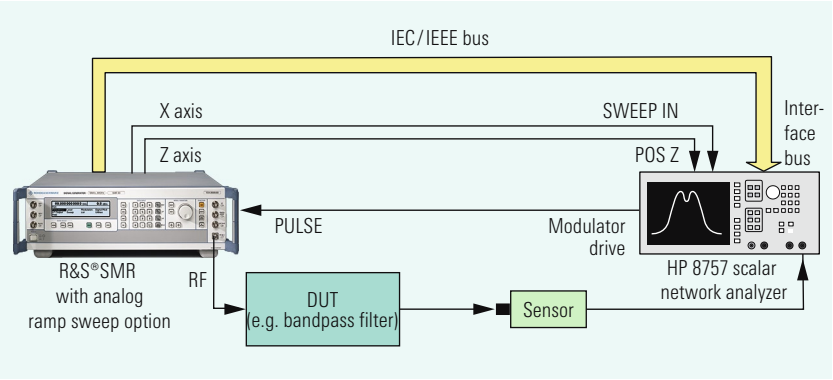

FIG 4 Transmission measurement with the R&S®SMR and the HP 8757 scalar network analyzer.

lyzers yield a dynamic range of up to 80 dB. This is a huge advantage compared to the use of conventional scalar network analyzers which are extremely broadband at the high-frequency end. To obtain a minimum dynamic range of approx. 60 dB with conventional scalar network analyzers, considerable filtering is required at the low-frequency end; this, however, significantly reduces the measurement speed, e.g. to several seconds per sweep. Again, the test setup shown in FIG 2 is clearly superior; depending on the selected setting, up to three frequency sweeps per second are feasible.

FIG 3 shows measurements on a frequency converter with an input range from 200 MHz to 7 GHz. The fixed intermediate frequency at the output is 741 MHz. This test setup allows you to determine the conversion gain versus the frequency, which is a standard measurement on receiving components. The frequency must be set as follows:

- R&S®SMR on mixer 2 fixed at 3.6 GHz
- Receive frequency of the R&S®ZVK fixed at 741 MHz
- Generator of the R&S®ZVK set to a frequency sweep from 200 MHz to 7 GHz
- R&S®SMR on mixer 1 set to a frequency sweep from 8.141 GHz to 14.941 GHz

The levels must be set in such a way that the converter can function properly. All settings, including those of the two generators, are made via the convenient user interface of the R&S®ZVx.

Analog ramp sweep

The R&S®SMR-B4 analog ramp sweep option adds a function to the microwave signal generators of the R&S®SMR family that corresponds to the analog frequency sweep of traditional sweep generators. The frequency sweep generated with this option is thus fully suitable for the operation of conventional scalar network analyzers such as the well-known HP 8757. Depending on the setting, up to ten complete sweeps per second can be achieved. Large numbers of such network analyzers with diode sensors are still used in the upper microwave region because they are a favorably-priced alternative to vector network analyzers or systems with spectrum analyzers. Due to the broadband nature of diode sensors, however, strict requirements are specified for harmonics, subharmonics and spurious suppression in order to keep measurement errors to a minimum. All members of the R&S®SMR family fully satisfy these requirements.

FIG 4 shows a setup for transmission measurements (magnitude of S_{21}) on a twoport. In instrument combinations with spectrum or vector network analyzers, the generators are controlled by the analyzers; if you use the HP 8757, it's just the other way round. All major parameters such as start and stop frequency, frequency markers, sweep time and RF level are set on the R&S®SMR. Each time new values are set, the generator transmits both the start and the stop frequency via the IEC/IEEE bus to the HP 8757, which then displays the values. In a next step, the R&S®SMR assumes control of the entire sweep. The tasks of the HP 8757 are limited to measuring and displaying; only basic settings need to be made on the analyzer.

The HP 8757 can be operated in DC or AC mode. The AC mode setup is shown in FIG 4. During DC mode operation, the connecting line from the modulator drive output of the HP 8757 to the PULSE input of the R&S®SMR may be omitted. Sensitivity in DC mode is limited to approx. –55 dBm, depending on the sensor used, while in AC mode it may be better by 3 dB to 4 dB.

Wilhelm Kraemer

More information about the individual instruments and data sheets at www.rohde-schwarz.com (search term: type designation)