NEWS

201/10

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Red carpet for the new stars

Oscilloscopes from Rohde&Schwarz: with high-speed signal analysis, an innovative digital trigger system and an intelligent user interface

GENERAL PURPOSE

Audio analyzer family: designed not only for production

EMC / FIELD STRENGTH

Compact, modular broadband amplifiers featuring high reliability

BROADCASTING

3D TV test signals in accordance with the HDMI 1.4a interface standard

NEWS

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Cover feature

Oscilloscopes from Rohde&Schwarz: Adding two completely new product families to its portfolio, Europe's largest T&M manufacturer delivers what customers have requested.

The R&S®RTO, in models with bandwidths of 1 GHz and 2 GHz, is a high-performance oscilloscope. The focus here is on high speed and optimum signal fidelity – two hugely important factors in real-life oscilloscope applications. These characteristics, combined with the groundbreaking touch-screen interface for ease of use, enables users to accomplish even complex test and measurement tasks in a minimum of time.

The R&S®RTM family is intended for universal applications wherever electrical signals need to be measured. These oscilloscopes with solid features offer an outstanding price/performance ratio in the midrange segment up to 500 MHz.

The new oscilloscopes are presented on page 16.

Overview
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R&S®UPP200/400/800 audio analyzers.

WIRELESS TECHNOLOGIES

GENERAL PURPOSE

EMC / FIELD STRENGTH

R&S®Series4200 radios.

Measuring radiated RF characteristics of mobile phones right on the lab bench

First-time pass in certification measurements – this is a goal that every developer would like to achieve. The new R&S®DST200 RF diagnostic chamber can make this difficult path much smoother. It allows developers to perform a wide variety of radiated tests and receiver sensitivity measurements on wireless devices (e.g. mobile phones) – and it is available directly on the lab bench.

Vital to high product quality: verification of the air interface

Smart phones integrate a large number of functional units in the tightest of spaces. This high density makes the devices vulnerable to desense effects (self-interference). Desense effects can lower receiver sensitivity on specific channels, so that calls near the edge of a radio cell may become unstable. Developers must therefore take countermeasures early on. The R&S®DST200 RF diagnostic chamber enables developers of high-end mobile phones to measure and optimize devices in the lab during the development phase in order to reduce self-interference to acceptable levels (FIG 1).

Further crucial quality characteristics of wireless devices include the radiation characteristics of the built-in antenna as well as a consistently high receiver sensitivity across the entire band. Various radiated RF measurements ensure that a high quality of service (QoS) is later achieved in the radio cell. The R&S®DST200 supports the following measurements, for example (see also box on pages 8/9):

- Desense (self-interference) testing
- Detection of EMI sources
- Coexistence testing of wireless devices for multiple RF standards
- Verification of over-the-air (OTA) performance
- Measurement of radiated spurious emissions (RSE)

FIG 1 The R&S®DST200 RF diagnostic chamber with 3D positioner (R&S®DST-B150 option). It allows the user to position the EUT in any orientation relative to the test antenna with a turn of the wrist.

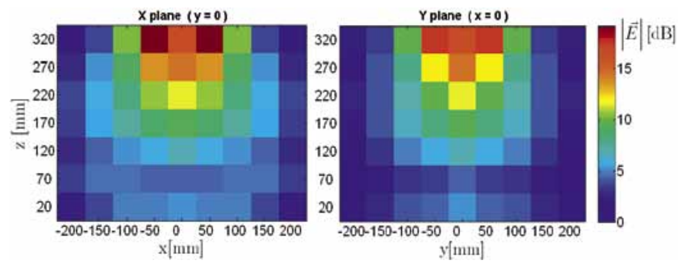


FIG 2 Spatial distribution of the radiated electric field in two vertical planes; R&S®DST200 test antenna at 950 MHz. The origin of the coordinate system is located in the center of the EUT table.

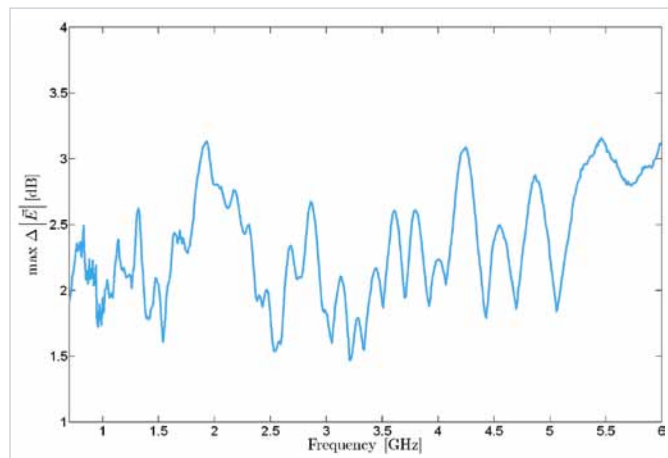


FIG 3 Maximum relative variation of the electric field in a cylindrical EUT volume (D × H = 200 mm × 30 mm) above the EUT table.

Reduced development time – shorter time to market

Wireless devices, e.g. smart phones with numerous air interfaces, require comprehensive testing during the development phase in order to ensure defined product characteristics later during operation. This fast-paced market calls for an efficient development process aimed at achieving first-time pass in certification measurements. Radiated measurements play an important role here and require well-coordinated tools and test environments.

Thanks to its compact size (W × H × D: 770 mm × 760 mm × 695 mm), the R&S®DST200 fits on any lab bench. For product optimization, this means that no continuous access to large EMC test chambers is necessary – which are often not available at short notice. Wait times are eliminated and development time is reduced, resulting in lower cost of ownership.

Free-space conditions ensure outstanding reproducibility of measurements

With a frequency range of 700 MHz to 6 GHz, the R&S®DST200 covers all important wireless standards. The broadband test antenna with circular polarization delivers reliable results throughout the R&S®DST200's frequency range.

Free-space conditions exist within the actual test chamber. This is achieved through the use of high-grade RF absorbers, the geometrical arrangement of the test antenna and the location of the equipment under test (EUT) within the EUT test volume. The RF absorbers minimize parasitic coupling of the EUT as well as detuning of the EUT's built-in antenna caused by conductive parts of the chamber frame.

Sensitivity tests on GPS receivers with input levels <–160 dBm call for perfect RF shielding of the test setup. With its outstanding shielding effectiveness of >110 dB, the R&S®DST200 blocks all interferers present – whether from adjacent test setups or from sources such as base stations or TV transmitters.

The excellent electric field uniformity throughout the EUT volume ensures reproducible test results (FIGs 2 and 3). By contrast, RF test chambers that use near-field couplers demand an intricate, precise fixing of the EUT in the millimeter range because the near-field field strength changes considerably over short distances. The R&S®DST200 ensures stable results even if the position of the EUT is slightly changed.

Manual 3D positioner

The product design process often requires measurements with the EUT placed in a specific orientation, for example in order to test and optimize the radiation characteristics of the integrated antenna. An easy-to-operate 3D positioner with two axes of rotation allows the EUT to be secured in any orientation relative to the test antenna (FIG 1). The positioner's open structure provides access to the EUT's keys, switches or touch screen, making it easy to set the required operating modes. Two angular scales permit accurate positioning for reproducible measurements.

Innovative door mechanism

The clever front door locking mechanism provides excellent shielding effectiveness at low locking force and supports long-term operation. The door, which is hinged in a separate frame, is locked into the groove of the RF chamber main frame with a simple turn of the door handle. In contrast to conventional designs, the locking force is uniformly applied to all RF gaskets of the main frame, which protects the gaskets in continuous use. Pneumatic components are not required. This concept increases availability of the R&S®DST200 and minimizes service costs.

Practical design for customized expansions

Shielded compartments above and below the actual test chamber allow the installation of additional hardware. For example, preamplifiers may be used to extend the dynamic range for radiated spurious emission measurements, or RF switching can be implemented to distribute the test signal to various measuring instruments. This innovative concept does not impair the field characteristics within the EUT volume.

For many measurements, access to external interfaces of the EUT is required. Typical test functions include battery charging, control of the test mode interface, and measurement of the data throughput. For these measurements, up to three RF filters or RF feedthroughs can be installed in the compartment below the actual test chamber. Various options are available:

- 9-pin D-Sub lowpass filter and two fiber-optic feedthrough connectors (R&S®DST-B101 option)
- Two N RF feedthrough connectors (R&S®DST-B102 option)
- USB 2.0 lowpass filter (R&S®DST-B103 option)

Automated measurements with configurable test templates

The powerful R&S®AMS32 system software supports various test applications in the R&S®DST200, for example desense tests, coexistence tests and verification of over-the-air performance. Measurements of radiated spurious emissions are performed with the R&S®EMC32 EMC test software

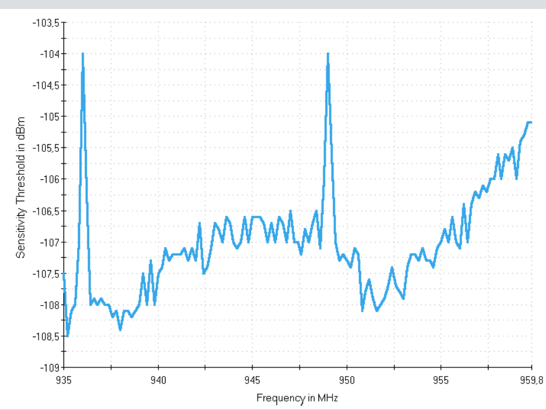


FIG 4 Desense (self-interference) measurement: desense effect in two channels (nos. 5 and 70) in the GSM900 band.

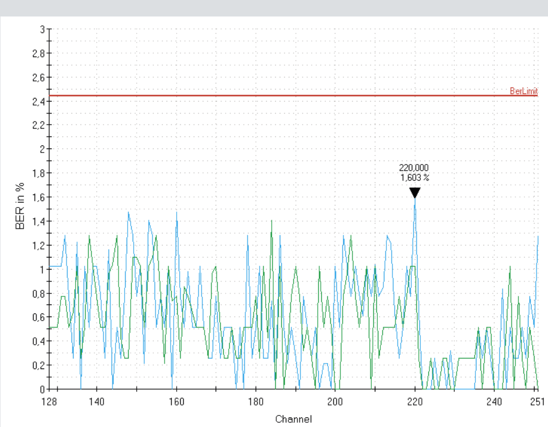


FIG 5 Coexistence measurement: bit error ratios (BER) in the GSM850 band without (green) and with (blue) active Bluetooth™ connection.

Radiated characteristics and receiver sensitivity – the R&S®DST200 supports a wide range of measurements

Desense or desensitization (self-interference)

High-end mobile phones include a large number of components such as RF modules, camera, display, etc. integrated in the smallest possible space. These components can interfere with one another and reduce receiver sensitivity on specific channels. Interference originates from oscillator harmonics or crosstalk on printed board signal paths. It reduces the quality of service (QoS), with the consequence that calls at the edge of a radio cell can become unstable.

Desense measurements (FIG 4) require an active link with a radiocommunications tester (such as the R&S®CMW500). After the link is established, the bit error ratio (BER) or packet error ratio (PER) is measured while a potential interferer is active.

Detection of EMI sources

Oscillator harmonics in the operating band can cause desense effects. For an overview measurement, only a test receiver is required that carries out a frequency sweep. The EUT's RF transceiver remains switched off. To increase sensitivity, the EUT can be moved closer to the test antenna.

Coexistence test

Another important test is to verify the correct functioning of multiple radio services operating simultaneously in a wireless device, such as mobile radio, GPS receiver, Bluetooth™ or WLAN. These can reduce receiver sensitivity. For example, harmonics of specific GSM900 channels are located at 5 GHz in the WLAN range. Errors in data transmission necessitate the repeated transmission of packets and lower data throughput (FIG 5).

For a coexistence test, a link with the possibly affected radio service is set up, and the receiver sensitivity is measured across the entire band. Next, an additional connection with the potential interferer is set up, and the receiver sensitivity for the first radio service is tested again. Alternatively, the data throughput with and without an interferer can be measured.

(a comprehensive article starting on page 32 presents new expansions for this software). R&S®AMS32 and R&S®EMC32 include ready-to-use test templates that require no programming knowledge on the part of the user. The individual test plans and the test report format are easily configured via menus.

Summary

The R&S®DST200 RF diagnostic chamber provides developers of wireless devices with an economical means of performing radiated RF measurements under free-space conditions. The compact test chamber fits on every R&D lab bench. Already at the design stage, developers can measure desense as well as radiated spurious emissions, perform coexistence tests, verify OTA performance and detect harmonics in the operating band. The R&S®DST200 also is a highly valuable tool in production, servicing and qualification measurements in order to monitor and verify product quality.

As a result of the clever design of the R&S®DST200 with shielded compartments above and below the actual test chamber, the R&S®DST200 can be tailored to meet customer's requirements, providing sufficient flexibility for future applications.

Erwin Böhler; Adam Tankielun

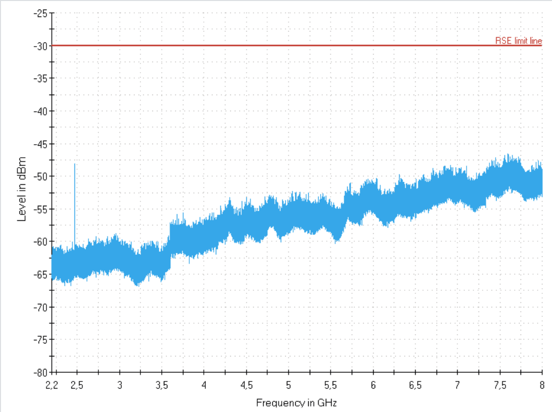


FIG 6 Radiated spurious emission (RSE) measurement: harmonic of the carrier frequency in the GSM850 band.

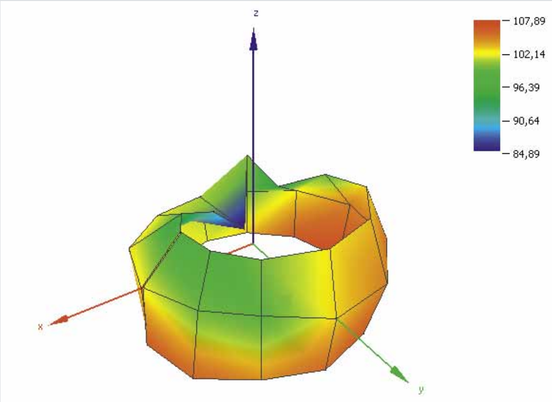


FIG 7 Receiver sensitivity of a mobile phone in the GSM1900 band, measured in three spatial sections.

Radiated spurious emissions (RSE)

The usable frequency spectrum is a valuable resource for network operators. To provide maximum capacity on all channels, radiated spurious emissions of wireless devices must not exceed specified limit values. Radiated harmonics of the carrier frequency and other radiated spurious emissions have to be measured in line with the 3GPP und ETSI test specifications. Further mandatory tests are defined by telecommunications (e.g. R&TTE directive) and government authorities (e.g. FCC). The specified measurements can be performed in the R&S®DST200 with a simple test setup consisting of an R&S®CMW500 universal radio communication tester and a test receiver (FIG 6).

Over-the-air (OTA) performance

CTIA and 3GPP have specified measurements to verify the transmission characteristics of antennas used in wireless devices. Measurements cover the total radiated power (TRP) and the total isotropic sensitivity/total radiated sensitivity (TIS / TRS). These integrated measurement quantities must comply with predefined limit values.

Using the R&S®DST-B150 3D positioner, the RF power and the receiver sensitivity can be measured in the R&S®DST200 in adjustable polar positions (FIG 7). The R&S®AMS32 system software enables semi-automatic measurements with manual positioning and automatic test analysis. Test results are shown both as an azimuth chart with several sections and as a 3D representation.

Powerful software handles nonlinear effects in amplifiers

Today's wireless communications standards place increasingly higher demands on the bandwidth, transmission linearity and power efficiency of the output stages in mobile devices and base stations. Developers must therefore measure, characterize and optimize linear and nonlinear effects of active and passive components. The R&S®FS-K130PC distortion analysis software is a powerful tool for accomplishing these tasks.

In the spotlight: optimizing component characteristics

Wireless communications standards have developed rapidly in recent years. These standards encompass single-carrier methods with constant envelope (e.g. GSM), methods with non-zero crest factors (e.g. EDGE), multicarrier methods (e.g. WLAN or WiMAX™), and the combination of multicarrier methods with high-order modulation at large bandwidths and time duplex (e.g. LTE TDD with 20 MHz bandwidth).

To the same extent, amplifier design requirements with regard to adjacent channel power and signal quality have also increased. Demanding design objectives are becoming more and more difficult to achieve as crest factors increase and higher power efficiency requirements have to be met.

An essential aspect in the development of output stages for mobile devices or base stations is to improve output signal quality. Such an improvement is achieved through linearization during which the input signal of the D/A converter is predistorted at the digital level (see box below). Using this method, linear and nonlinear effects of a component are compensated for by applying the inverse characteristics of the component to the input signal. The algorithms required in each case depend on the various effects in the component to be improved (primarily amplifiers). Such algorithms become more and more complex, since the design objectives to raise energy efficiency are becoming more difficult to achieve. Developers therefore need a comprehensive design and analysis tool with efficient algorithms that cover a wide range of functions.

Battle against nonlinearity

Ideally, the output signal of an amplifier tracks the input signal phase-locked, linearly and with a defined gain. In practice, however, the output power begins to deviate from this linear reference at a certain point. The phase angle between the input and output signal also shifts. All of these nonlinear effects are some of the major drawbacks in power amplifiers because they reduce the quality of the output signal. These effects can increase the adjacent channel power and therefore cause interference in adjacent channels. The signal is also impaired in the transmission band, leading to increased distortion and accordingly a degradation of the signal quality at the receiver.

Therefore, one design objective in the development of amplifiers is to achieve linear behavior between the output signal and the input signal. This is done by attempting to mathematically express the relationship between the two signals ("modeling", "system identification") and to find ways and means to modify the input signal accordingly by means of digital predistortion (DPD) (FIG 1). Numerous university working groups and R&D departments in the industrial sector are addressing this field of research and introduce new or improved modeling methods.

The R&S®FS-K130PC distortion analysis software from Rohde&Schwarz now offers a reference implementation of standard modeling methods that allows users to compare their own results.

AM/AM compression characteristic

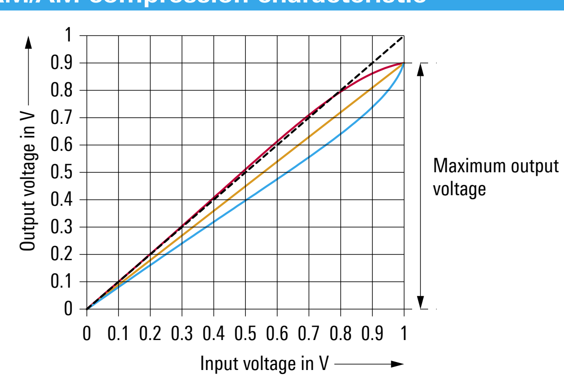


FIG 1 Effect of predistortion (DPD). Black: ideal characteristic; red: output signal without DPD; blue: DPD; orange: characteristic of an amplifier after DPD.

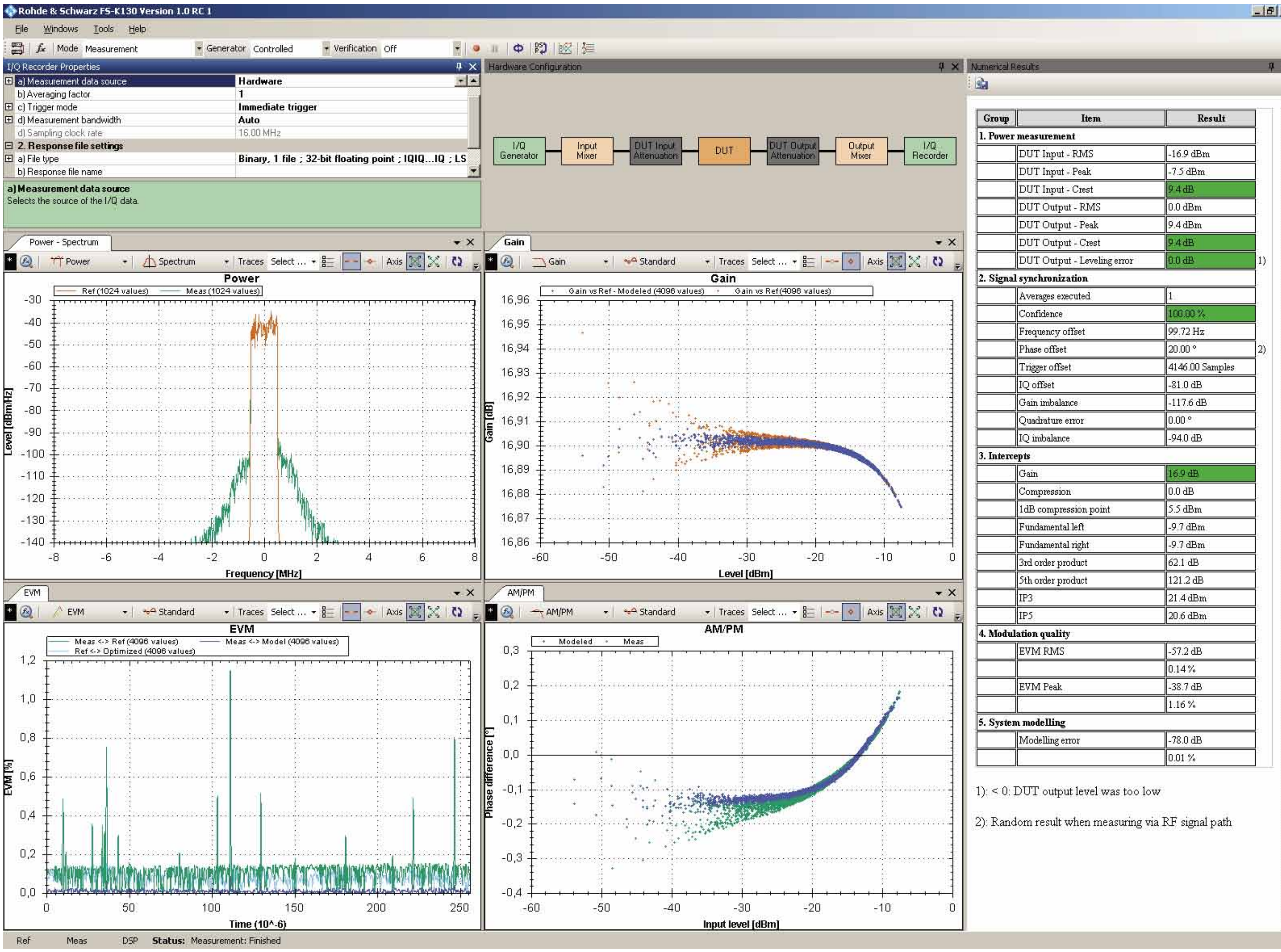


FIG 2 Overview of the R&S®FS-K130PC distortion analysis software.

R&S®FS-K130PC: fully automatic at the press of a button

A powerful tool is now available for performing these complex tasks: the R&S®FS-K130PC distortion analysis software from Rohde&Schwarz (FIG 2) for installation on a PC. It simplifies the workflow and enables the user to focus more on the design tasks at hand. The software automatically performs all necessary steps required to model a component and to improve its output performance (FIG 3):

1. Controls the test hardware (signal generator and signal analyzer)
2. Generates and loads the defined test signals into the signal generator (the software can generate the test signals itself or they are predefined via files); it is also possible to measure the test signal in order to compensate for generator interference effects
3. Sets the component output signal to the desired output power
4. Synchronizes the signals and corrects signal errors (e.g. frequency offset or I/Q modulation error)

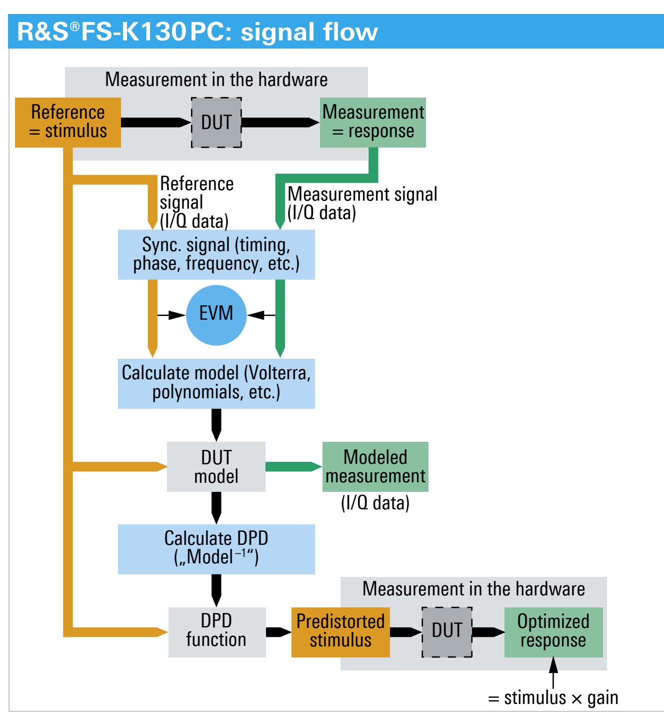


FIG 3 R&S®FS-K130PC can determine all model parameters fully automatically.

5. Calculates the distortion and predistortion models according to the selected method (e.g. polynomial or Volterra series).
6. Generates a predistorted signal, loads it into the signal generator and verifies the improvement by measuring the adjacent-channel power (FIG 4)

The measurement sequence can be parameterized in many aspects. For example, the control of the generator can be switched off so that measurements can be performed when applying user-specific signal sources. The modeling parameters can also be set, for example, to evaluate whether only a few model coefficients are sufficient for characterization.

Selection of interfaces

R&S®FS-K130PC offers all current input and output formats customarily found in the R&D environment:

- The measurement results can be output in any number of graphical displays showing a wide variety of representations
- The measurement results can also be output and exported in tables
- A plain text MATLAB™ function is created (FIG 5) to export the models of the component and the DPD. This MATLAB™ function generates the calculated model coefficients as well as a function for applying the model to a given signal. Any signal can be used with the model function or DPD function, and the effects on the resulting output signal can be observed
- Reference and test signals can be imported into the software in a wide variety of formats (therefore also enabling a measurement with, for example, pure simulation data from other EDA* tools) and also re-exported (e.g. in order to apply the predistortion to the simulation model of other EDA tools)

Summary

The R&S®FS-K130PC distortion analysis software provides developers with all functions for measuring, characterizing and optimizing linear and nonlinear effects of active and passive components. The software fits excellently into development processes owing to its clear and user-configurable interface, its detailed display of results in graphical and numeric form, as well as its wide variety of import and export capabilities.

Martin Weiß

FIG 4 Amplifier output signal without DPD (blue) and with DPD (black). The ACP suppression improves by 20 dB.

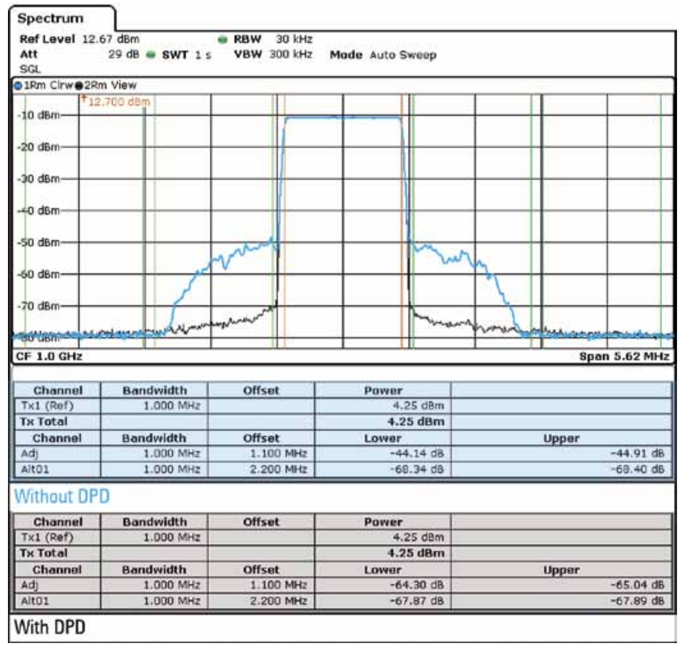
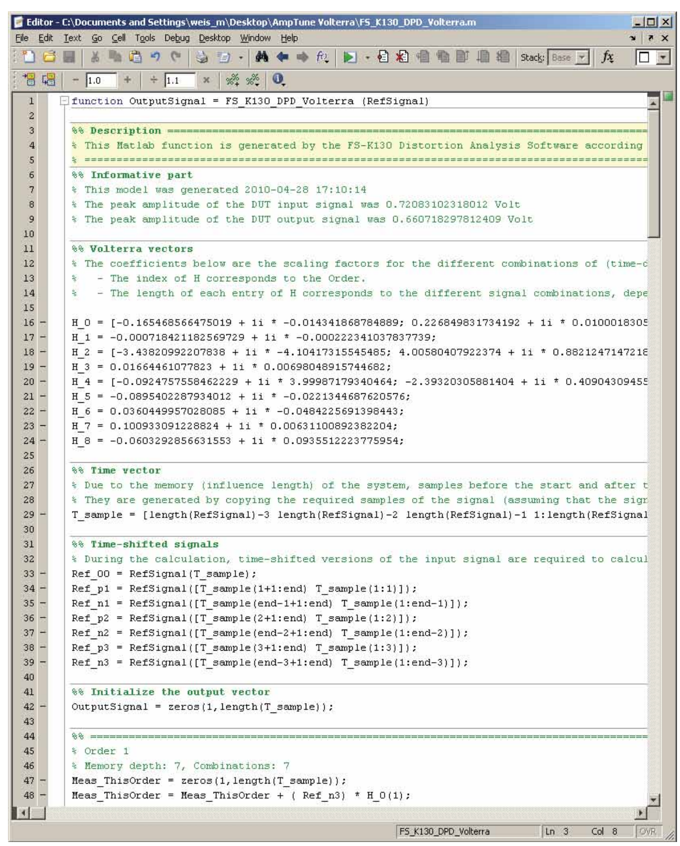


FIG 5 A MATLAB™ model generated by the R&S®FS-K130PC distortion analysis software.



* Electronic design automation.

Compact test setup verifies WiMAX™ MIMO fading performance

Are the various WiMAX™ MIMO schemes implemented correctly in mobile stations? A compact, easy-to-use test setup that handles all fading profiles eliminates any doubt.

MIMO and WiMAX™

Multiple input multiple output (MIMO) antenna systems provide enhanced transmission quality and higher transmission rates via a broadband radio interface. This is achieved through optimum utilization of spatial diversity as well as through spatial multiplexing. Both methods are used in accordance with the mobile version of the IEEE 802.16™ WiMAX™ standard [1].

To improve transmission quality, the standard defines the space time block coding (STBC) method, which requires two transmit antennas on the base station and one receive antenna on the mobile station. This method is referred to as Matrix A MIMO (2 × 1 MIMO) in the standard.

The standard also defines Matrix B MIMO (2 × 2 MIMO). This is a spatial multiplexing scheme in which two independent data streams are transmitted in parallel, which increases the theoretically achievable maximum data rate by a factor of two. This scheme requires two transmit antennas on the base station and two receive antennas on the mobile station.

To verify correct implementation of these two MIMO schemes on WiMAX™ mobile stations, two measurements are vital: On the one hand, receiver performance has to be determined – based on a packet error rate (PER) measurement, for example – in order to verify the gain in transmission reliability. On the other hand, a throughput measurement [2] [3] is required to verify doubling of the transmission rate. Both measurements are supported by the R&S®CMW270 wireless connectivity tester and the R&S®CMW500 wideband radio communication tester.

FIG 1 Powerful yet very compact: The R&S®CMW270 wireless connectivity tester or the R&S®CMW500 wideband radio communication tester, in conjunction with the R&S®AMU200A baseband signal generator and fading simulator.

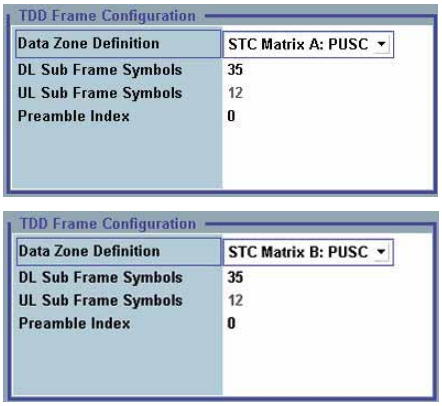


FIG 2 Configuration of MIMO modes: top: Matrix A, bottom: Matrix B.

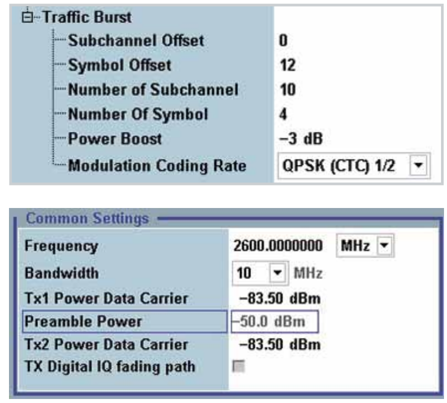


FIG 3 Power settings for MIMO operation. The transmit power can be set separately for the two transmit antennas (bottom).

Reliable and compact WiMAX™ MIMO test setup with the R&S®CMW270 / R&S®CMW500

The R&S®CMW270 wireless connectivity tester, as well as the R&S®CMW500 wideband radio communication tester, are ideal for carrying out complex performance tests under lab conditions. Both instruments combine RF test and MAC layer analysis functions with a Mobile WiMAX™ base station emulator in a single unit to offer maximum flexibility.

To check the proper implementation of the MIMO functionality, the R&S®CMW270, or the R&S®CMW500, emulates a WiMAX™ base station. When equipped with two channels, either instrument can simulate the two transmit antennas of the base station for Matrix A or Matrix B operation (FIG 2). Both the STBC method for Matrix A operation and the spatial multiplex method for Matrix B operation are, of course, implemented in compliance with the standard. The required operating mode can conveniently be set in the tester's configuration menu.

Crucial to successful MIMO operation is the equal distribution of the total signal power between the transmit antennas. In accordance with the standard, only the payload is distributed among and transmitted over two antennas. In contrast, the Mobile WiMAX™ preamble and general broadcast information are emitted only via one antenna. Therefore, the power of the data region must be reduced by 3 dB relative to the remaining transmit signal power on both antennas of the base station so that the total power remains constant. This capability is also provided by the R&S®CMW270 / R&S®CMW500, and the relevant power setting can even be changed for test purposes. The transmit power can, of course, be set individually for each antenna (FIG 3).

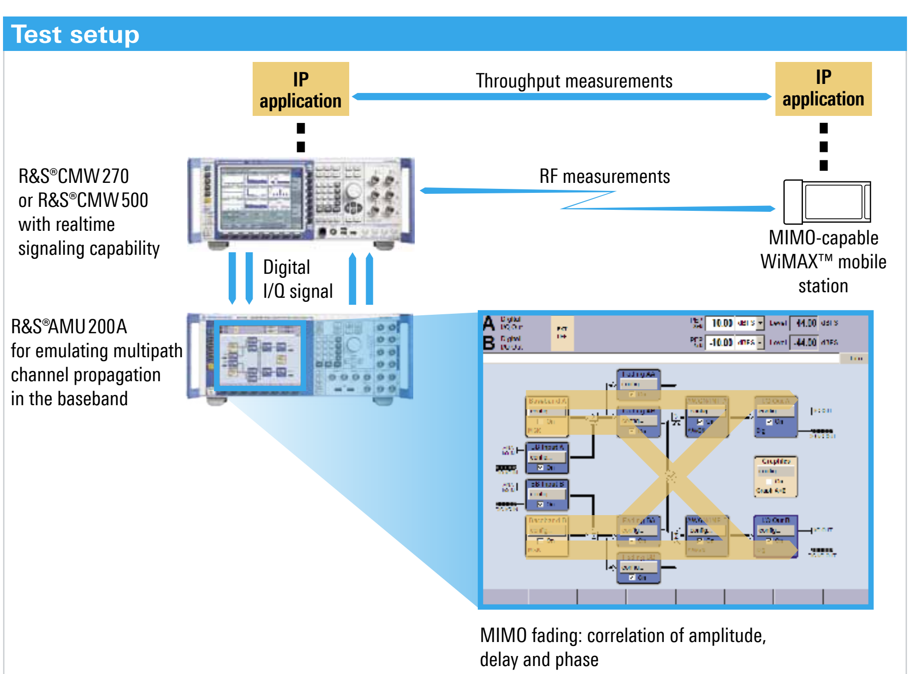


FIG 4 Versatile duo: test setup, consisting of the R&S®CMW270/R&S®CMW500 and the R&S®AMU200A, for verifying MIMO functionality.

Comparison of performance

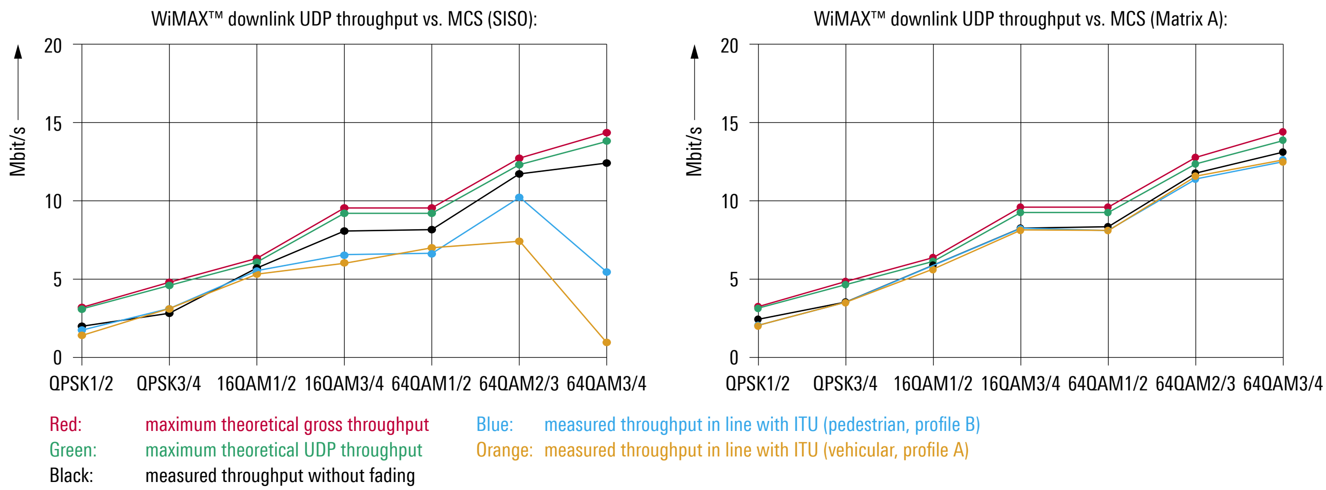


FIG 5 Comparison of performance: MIMO Matrix A versus SISO operation.

Invincible team when fading comes into play

The R&S®CMW270 / R&S®CMW500 can be combined with the R&S®AMU200A baseband signal generator and fading simulator. This yields a compact and reliable test setup that delivers reproducible results for WiMAX™ mobile stations (FIG 4). The R&S®AMU200A signal is looped into the digital baseband of the R&S®CMW270 simply via cabling. Standardized fading profiles in line with ITU and WiMAX Forum™ or user-defined profiles can be applied to the downlink signal of the emulated base station. As a result, a simple and convenient test setup with only two instruments is obtained without additional calibration effort.

Is MIMO correctly implemented in the mobile station?

FIG 5 shows as an example the results of a measurement for verifying the performance gain achieved with Mobile WiMAX™ Matrix A MIMO as opposed to single input single output (SISO) operation. The left-hand diagram shows the results of a user datagram protocol (UDP) throughput measurement [2] [3] performed with the above test setup in SISO operation under static and under various standardized fading conditions in line with ITU [4]. The throughput was measured by applying all modulation and coding schemes (MCS) specified for these conditions in accordance with [1]. As expected, the throughput increases under static conditions with increasing order of modulation. Under fading conditions, however, the throughput sharply declines with increasing sensitivity of the modulation mode. The right-hand diagram shows the gain in transmission reliability and therefore in throughput obtained with MIMO Matrix A operation even for sensitive modulation modes.

Summary

The R&S®CMW270 / R&S®CMW500 and the R&S®AMU200A make it easy to verify implementation of all known WiMAX™ MIMO schemes under fading conditions in the laboratory. The two relevant measurements – receiver sensitivity and throughput – can be carried out without additional calibration effort because the fading profile is applied solely in the digital baseband.

Christian Hof; Heinz Mellein

References
[1] IEEE 802.16-2009™ www.ieee.org.
[2] WiMAX™ throughput measurements using the R&S®CMW270 Application Note 1SP10 (2009) from Rohde&Schwarz.
[3] WiMAX™ data throughput measurements with the R&S®CMW270. NEWS (2010) No. 200, pp. 12–14.
[4] WiMAX Forum™ Radio Certification Test Document, www.wimaxforum.org.

Abbreviations

CTC	Convolutional turbo code
ITU	International Telecommunication Union
MAC	Medium access control
MCS	Modulation and coding scheme
MIMO	Multiple input multiple output (multiple transmit and receive antennas)
PUSC	Partial usage of subchannels
QAM	Quadrature amplitude modulation
QPSK	Quadrature phase shift keying
SISO	Single input single output (one transmit and one receive antenna)
STBC	Space time block coding
TDD	Time division duplex
UDP	User datagram protocol
WiMAX™	Worldwide interoperability for microwave access

Scope of the Art: digital oscillosco

High-speed signal analysis, an innovative digital trigger system and a clever user interface are the highlights of the Rohde & Schwarz oscilloscopes. When debugging, users receive more data significantly faster. The compact instruments are superbly engineered and fun to use.

The right model …

What customers have often requested is finally available: oscilloscopes from Rohde & Schwarz – a welcome addition to the company's comprehensive T&M portfolio. Users benefit from the high quality and in-depth development and production expertise at Rohde & Schwarz: Analog and digital integration, software and hardware development, production from printed board to finished product all take place in-house. This is the background which resulted in two new oscilloscope families covering bandwidths from 500 MHz to 2 GHz.

Base unit	Bandwidth	Channels
R&S®RTO 1024	2 GHz	4
R&S®RTO 1022	2 GHz	2
R&S®RTO 1014	1 GHz	4
R&S®RTO 1012	1 GHz	2

FIG 2 R&S®RTO digital oscilloscope model overview.

Base unit	Bandwidth	Channels
R&S®RTM1054	500 MHz	4
R&S®RTM1052	500 MHz	2

FIG 3 R&S®RTM digital oscilloscope model overview.

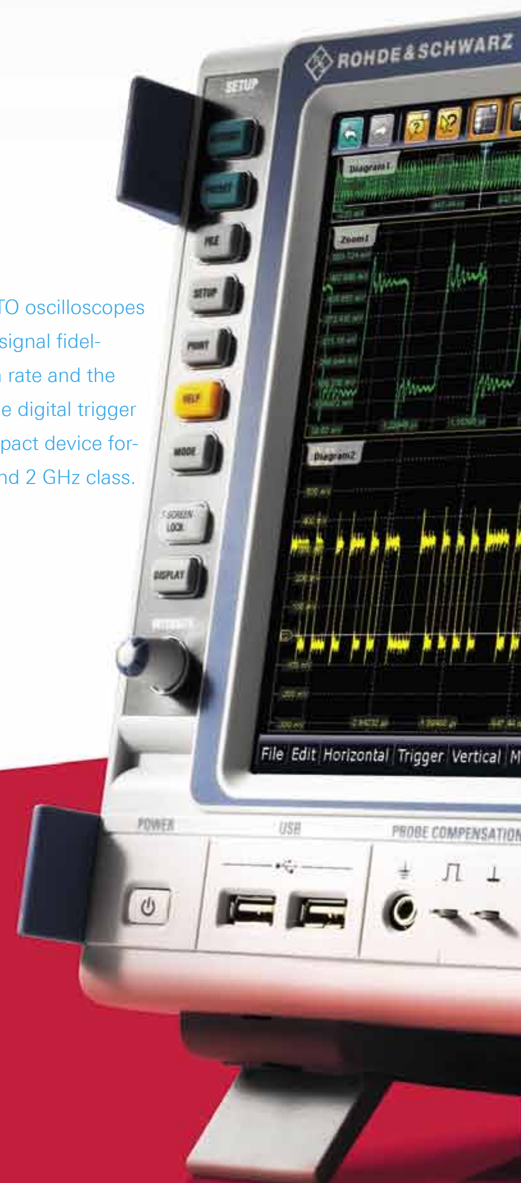


FIG 1 The R&S®RTO oscilloscopes combine excellent signal fidelity, high acquisition rate and the world's first realtime digital trigger system with a compact device format in the 1 GHz and 2 GHz class.

The main advantages of the R&S®RTO oscilloscopes at a glance

- **The fastest acquisition rate of 1 million waveforms per second makes even rare errors immediately visible**
- **Hardware-accelerated analysis displays results immediately on the screen**
- **The digital trigger system displays signals with minimum trigger jitter**
- **User interface and touch screen provide new functions, improving efficiency and ease of use**

pes from Rohde & Schwarz

The oscilloscopes are available as two-channel and four-channel models with either 500 MHz bandwidth (R&S®RTM, FIG 3) or 1 GHz and 2 GHz bandwidths (R&S®RTO, FIG 2). A high-speed ASIC, a deep acquisition memory and a single-core A/D converter are the basis of the high-speed analysis capability of the R&S®RTO family. The low-noise frontends of all the Rohde & Schwarz oscilloscopes enable precise measurements even at the lowest vertical setting.

The R&S®RTM family (page 21) includes a two-channel and four-channel model with 500 MHz bandwidth. The solid T&M characteristics and wide variety of practical functions simplify day-to-day work. The compact dimensions, simple operation and brilliant display make these oscilloscopes the first choice for everyday test and measurement tasks.

The R&S®RTO family includes two-channel and four-channel models with 1 GHz and 2 GHz bandwidths that fulfill the highest performance requirements (FIG 1). The compact instruments have outstanding signal fidelity, high acquisition rates and the world's first realtime digital trigger system. They offer hardware-accelerated measurement and analysis functions as well as an intelligent user interface that makes these instruments really fun to use.

… and probes with control functions

Rohde&Schwarz has developed high-performance active probes (page 23) that are the first to incorporate a micro button to control the various oscilloscope functions. Now, users will never again be in the situation where they need to position two probes and no longer have a hand free to operate the oscilloscope.

The R&S®RTO family

Analyze faster, see more

With their acquisition rate of one million waveforms per second – the highest rate available on the market – the R&S®RTO oscilloscopes find signal faults quickly. They even capture and analyze rare signal details that, until now, have often gone undetected. The world's first realtime digital trigger system precisely relates the trigger event to the measurement signal. In this way, it not only helps to detect errors with extreme reliability, but also to accurately locate them.

When measuring signals in the millivolt range, oscilloscope sensitivity is essential. The low-noise input amplifier and the A/D converter with its excellent dynamic range of more than seven effective bits add only very low noise to the measurement waveform. Furthermore, the active probes – with their low inherent noise, wide dynamic range and low offset drift – ensure that this high level of sensitivity and accuracy is also maintained directly at the test point.

Despite the wide variety of measurement and analysis functions, the oscilloscopes are easy and intuitive to operate. Flat menu structures and signal flow diagrams simplify navigation. Transparent operating menus do not hide any of the measurement diagrams, and signal icons with realtime preview clearly show what is currently happening.

Find signal faults fast

Conventional digital oscilloscopes: long blind time with serious consequences

A digital oscilloscope acquires signals in two steps. First, it samples the measurement signal for a defined period of time and stores the samples. In a second step, it processes these samples and displays the waveform. During this period, the

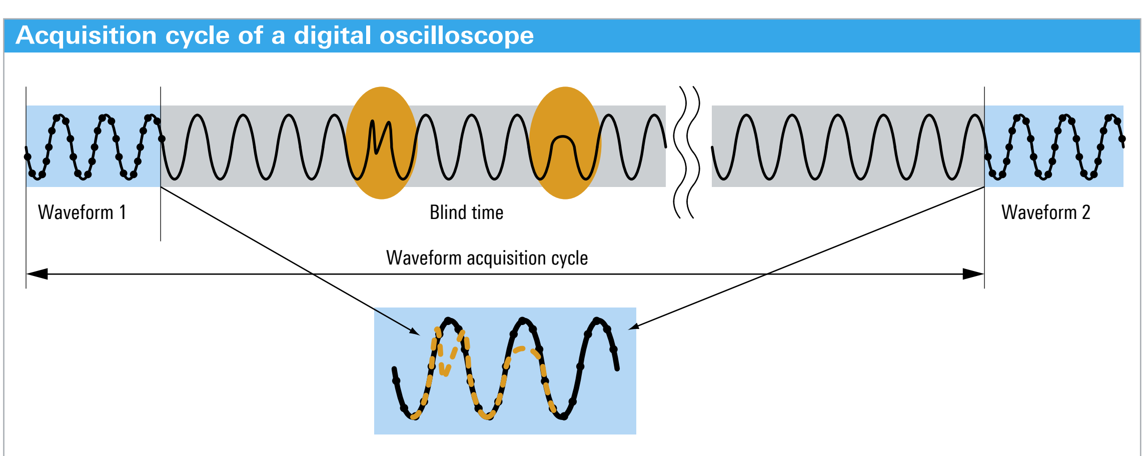


FIG 4 A digital oscilloscope is not able to acquire signal faults that occur during the blind time.

FIG 5 Average measurement time required until a signal fault is displayed (as a function of error rate and acquisition rate). Due to the high acquisition rate of one million waveforms per second, the R&S®RTO oscilloscopes are significantly faster at finding errors.

Error rate	Acquisition rate [waveforms/s]			
	100	10 000	100 000	1 000 000
100/s	1 h : 55 min : 08 s	1 min : 09 s	6.9 s	0.7 s
10/s	19 h : 11 min : 17 s	11 min : 31 s	1 min : 09 s	6.9 s
1/s	7 d : 23 h : 52 min : 55 s	1 h : 55 min : 08 s	11 min : 31 s	1 min : 09 s
0.1/s	79 d : 22 h : 49 min : 15 s	19 h : 11 min : 17 s	1 h : 55 min : 08 s	11 min : 31 s
10 Gsample/s, 1 ksample recording length, 10 ns/div, 99.9 % probability of detecting the error.				

oscilloscope is "blind" to the measurement signal. When conventional digital oscilloscopes operate at their maximum sampling rate, this blind time (FIG 4) exceeds 99.5 % of the overall acquisition time. As a result, measurements only take place during less than 0.5 % of the time. This has serious consequences: Signal faults that occur during this blind time remain hidden to the user, and the less often they occur, the less likely it is that they will be detected.

The R&S®RTO oscilloscopes continuously acquire waveforms, up to 1 million times per second. In contrast to conventional oscilloscopes, they also analyze the waveforms at this speed (FIG 5). The resulting short blind time (FIG 6) is unique for digital oscilloscopes and helps users quickly find even the rarest of errors.

Blind time: R&S®RTO and conventional oscilloscopes

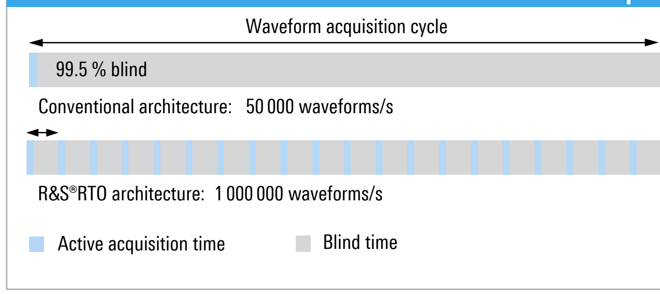


FIG 6 Due to their very short blind time, the R&S®RTO oscilloscopes look at the measured signal over 20 times more often.

The computing processes run in parallel and ensure, for the first time, high acquisition rates, even when analysis functions are active (FIG 7).

Hardware-accelerated analysis

An ASIC in the R&S®RTO oscilloscopes employs 20-fold parallel signal processing which ensures high acquisition rates, even for complex signal analysis. The results are available quickly and are based on a large number of waveforms that provide statistically meaningful information.

High measurement speed, even for complex analysis functions

Standard functions such as mathematical operations, mask tests, histograms, spectrum display or automatic measurements require additional computing time. If they are implemented in software, the blind time increases considerably. Moreover, the oscilloscope responds slowly to changes in the settings and requires a lot of time to deliver conclusive measurement results. Users of the R&S®RTO oscilloscopes do not have to bother with such limitations, because many of the oscilloscope analysis functions are hardware-implemented:

- Histogram
- Spectrum display
- Mask test
- Cursor measurements
- Automatic amplitude and time measurement functions
- Selected mathematical operations

FFT-based spectrum analysis: powerful and user-friendly

The many years of experience that Rohde & Schwarz has gained in the development of spectrum analyzers also benefit the spectrum display for the R&S®RTO oscilloscopes. The FFT function is much faster than with other oscilloscopes available on the market. This is due to the hardware-assisted fast Fourier transform and the preceding frequency conversion into the baseband. On the screen, the high acquisition rate conveys the impression of a live spectrum. Using the persistence mode, rapid signal changes, sporadic signal interference or weak superimposed signals can easily be made visible.

The low-noise frontends and the A/D converter's high effective number of bits (> 7) provide an outstanding dynamic range for an oscilloscope, which even enables identification of weak signal interferences. The possibility of overlapping the FFT means that the R&S®RTO oscilloscopes are also able to correctly display intermittent signals such as pulse-type

FIG 7 Max. acquisition rates depending on analysis functions.

Analysis function	Maximum acquisition rate
None	> 1 000 000
Histogram	> 1 000 000
Mask test	> 600 000
Cursor measurements	> 1 000 000

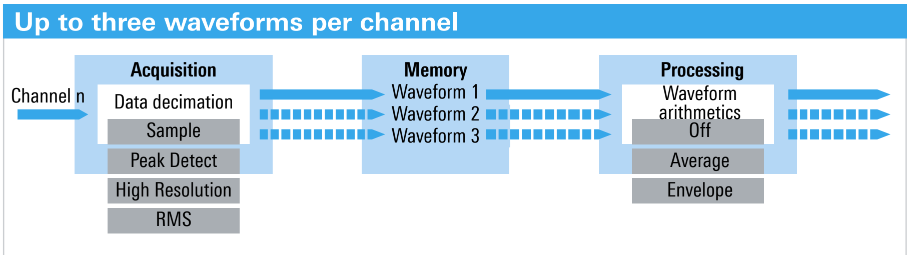


FIG 8 The R&S®RTO oscilloscopes enable users for the first time to configure the type of data decimation and the waveform arithmetics and to display up to three waveforms simultaneously.

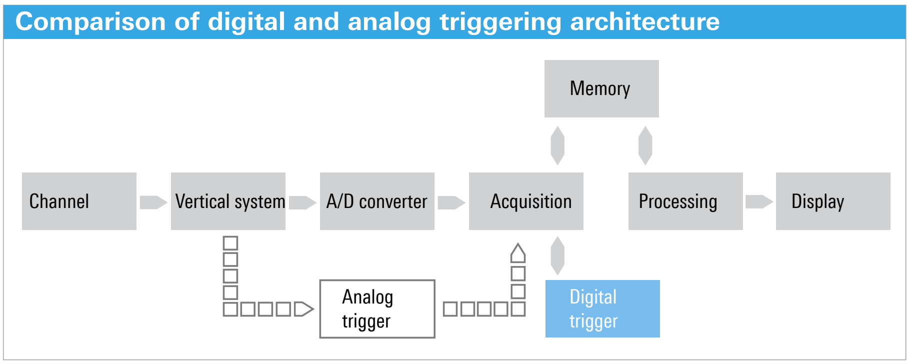


FIG 9 The Rohde&Schwarz oscilloscopes measure extremely accurately because measurement signal and trigger share the same path.

interferers. Particularly when operating the oscilloscope in persistence mode, users can see what is really happening in the measured signal.

Sophisticated analysis with up to three simultaneous waveforms per channel

The different methods for reducing the number of samples, such as Sample, Peak Detect, High Res, or RMS, as well as the waveform arithmetics such as Envelope and Average are important tools for signal analysis and debugging. The R&S®RTO oscilloscopes are the first to simultaneously display up to three waveforms per channel in different ways (FIG 8). The type of data decimation and the waveform arithmetics can be combined flexibly. As a result, users can, for example, compare the original sample points directly with the averaged waveform and the envelope for effective debugging.

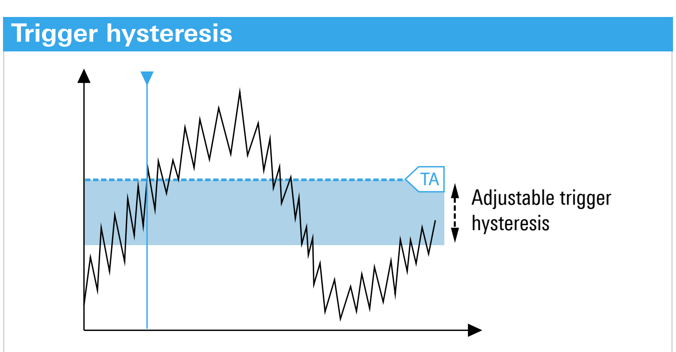


FIG 10 The hysteresis of the digital trigger can be set automatically or manually from 0.1 div to 5 div.

Highly accurate digital trigger system

Due to the use of hardware-based signal processing, the digital trigger system used in the R&S®RTO oscilloscopes is the first to operate in realtime. It increases trigger sensitivity, decreases trigger jitter and allows new functions, such as flexible filter configuration or triggering on mathematically combined input signals.

Precise measurements due to low trigger jitter

Conventional oscilloscopes use an analog triggering architecture. They divide the analog measurement signal in the frontend and process it in separate trigger and acquisition paths. However, these different signal paths cause time and amplitude offset. This results in measurement inaccuracies that cannot be completely corrected by postprocessing.

The Rohde&Schwarz oscilloscopes eliminate such inaccuracies, because the measurement signal and the trigger share the same path (FIG 9). The instrument determines if the trigger condition has been met by direct analysis of the digitized signal. As a result, the R&S®RTO oscilloscopes are able to keep trigger jitter at very low levels and open up new options for trigger conditions.

With the optional oven-controlled crystal oscillator, time stability can be improved for deep memory acquisition and acquisition with high trigger offset.

High trigger sensitivity at full bandwidth

The digital trigger can validate every acquired sample against the trigger definition. For this reason, the R&S®RTO oscilloscopes are able to trigger on even the smallest signal amplitudes. In order to achieve stable triggering regardless of signal noise levels, the user can set a trigger hysteresis for the oscilloscopes (FIG 10). And due to the low-noise front-ends, the oscilloscopes can also trigger on signals with vertical input sensitivities of < 10 mV/div at full measurement bandwidth.

Full measurement bandwidth, even for input sensitivity ranges ≤ 10 mV/div

Typical probes have a voltage divider ratio of 10:1, which reduces the signal amplitude to one tenth of the source. When using such probes for measurements on a low-voltage differential signaling (LVDS) signal with an amplitude of 350 mV, only 35 mV arrive at the oscilloscope's input. To optimally display the signal in this example, the vertical scaling should be 4 mV/div.

This is no problem for the Rohde & Schwarz oscilloscopes because they offer high input sensitivity of up to 1 mV/div. They nevertheless operate with high measurement accuracy because their sensitivity levels are not merely implemented using a software-based zoom, but rather with switchable amplifiers in the frontend. Another special characteristic is that they enable high-precision measurements at full measurement bandwidth in all voltage ranges below 10 mV/div.

The R&S®RTM family

Compact, precise, versatile

The R&S®RTM oscilloscopes (FIG 11) offer 500 MHz bandwidth, a maximum sampling rate of 5 Gsample/s and 8 Msample maximum memory depth. As a result, they can display signals accurately, right down to the details, as well as provide high time resolution, even for long sequences. Furthermore, their very low inherent noise level and good channel-to-channel isolation ensure that the R&S®RTM oscilloscopes deliver precise and reliable measurement results.

Besides the customary measurement and analysis tools, these oscilloscopes feature several special highlights that help users to achieve the desired results quickly during debugging and signal analysis. At the push of a button, for example, the "QuickMeas" function graphically displays the key measurement values for the signal that is currently active and updates them continuously. For cursor measurements, too, these oscilloscopes offer more than the conventional vertical and horizontal cursors. For instance, they provide functions for measuring peak voltages or for automatically counting the number of pulses.

Although the R&S®RTM oscilloscopes feature a wide variety of measurement functions, they are easy and straightforward

FIG 11 Due to their excellent measurement properties and wide variety of practical functions, the R&S®RTM oscilloscopes facilitate daily work, whether in product development or service. Their compact dimensions, simple operation and brilliant display make them the first choice for everyday test and measurement tasks.

to use. Their brilliant and very sharp 8.4" color XGA TFT display with high resolution makes even the smallest signal details visible. Despite the large display, these instruments are among the smallest and most lightweight in their class. All this makes them attractive, universal oscilloscopes suitable for versatile and portable use.

Tools for fast signal analysis

Frequently, measurement signals need to be analyzed in detail, and their properties (e.g. frequency or rise and fall times) have to be determined. The R&S®RTM oscilloscopes offer various powerful tools that facilitate signal analysis and deliver precise results.

Detailed analysis made easy: with zoom function and event marker

The R&S®RTM oscilloscopes' sampling rate of up to 5 Gsample/s enables them to achieve a high time resolution. In combination with the zoom function, this allows the signal to be expanded up to 200000:1 in order to investigate interesting events in detail.

The memory depth of max. 8 Msample makes it possible to capture long sequences. Normally, scrolling to a specific point in the signal using the position knob would therefore be very tedious. The R&S®RTM oscilloscopes are different: They offer eight user-definable event markers that can be used to highlight any points in the signal. Users can then navigate between the markers conveniently using the "Next" and "Prev" buttons.

QuickMeas – key results at the push of a button

The "QuickMeas" measurement function offered by the R&S®RTM oscilloscopes is unique (FIG 12). At the push of a button, it displays the key measurement values for a currently active signal simultaneously on the waveform using auxiliary lines and markers and also updates these values continuously.

Furthermore, the oscilloscopes also provide the customary automatic measurement functions such as measurement of the peak-to-peak voltage or the signal frequency. In addition to the QuickMeas results, four measurements can be displayed simultaneously in tabular form.

Extensive cursor-based measurement functions

Cursor-based measurements are normally limited to horizontal or vertical cursors. Not with the R&S®RTM oscilloscopes: Their cursor menu offers additional features that are familiar from the automatic measurement functions, e.g. measurement of the mean voltage or RMS value, as well as a pulse counter. The advantage here is that users can limit measurements to a specific section of the signal.

Measurement value		Display
Vp_+	Positive peak voltage	Graphical display directly on the waveform
Vp_-	Negative peak voltage	
tr	Rise time	
tf	Fall time	
Mean	Mean voltage	
Vpp	Peak-to-peak voltage	Tabular display on the bottom right of the screen
RMS	RMS value	
T	Time	
f	Frequency	

FIG 12 QuickMeas: key results at the push of a button.

Three cursors are used for measuring ratios. The "Ratio X" measurement, for example, determines the duty cycle of a pulsed signal conveniently and in a single step. Another useful function is "Set to Wave". At the push of a button, this function automatically assigns the cursors to the corresponding signals, without users having to select and position the cursors.

Reliable results for stringent demands

Excellent measurement accuracy due to low-noise frontends

The accuracy of a signal displayed on the screen heavily depends on the oscilloscope's inherent noise. For this reason, the R&S®RTM oscilloscopes have very low-noise frontends and a low-noise A/D converter. As a result, they are able to measure precisely, even at the smallest vertical settings.

Full measurement bandwidth, even at 1 mV/div

With their input sensitivity of up to 1 mV/div, the R&S®RTM oscilloscopes offer high vertical resolution. Some oscilloscopes are only able to reach such a high input sensitivity by employing software-based zooming or by limiting the bandwidth. In contrast, the R&S®RTM oscilloscopes show the signal's real test points, even at 1 mV/div. In addition, their full measurement bandwidth can be used. As a result, they feature high measurement accuracy, even for the smallest signal details.

For detailed information, videos, comprehensive product brochures and much more about the new oscilloscopes, visit:

www.scope-of-the-art.com

The Rohde & Schwarz probe family

Excellent specifications, practical design

The high-quality active probes enable full use of the maximum bandwidths of the oscilloscopes. Besides their excellent specifications, they feature impressive reliability and ease of use.

Besides bandwidth, the crucial parameters for probes are input impedance and dynamic range. With their input impedance of 1 MΩ, the active probes put only a minimum load on a signal source's operating point. And the very large vertical dynamic range, even at high frequencies, prevents signal distortion – for example: 16 V (V_{pp}) at 1 GHz. There are no annoying interruptions of the measurements for compensation processes, because the offset and gain errors of the probes are almost completely independent of the temperature (for example, zero error < 90 μV/°C).

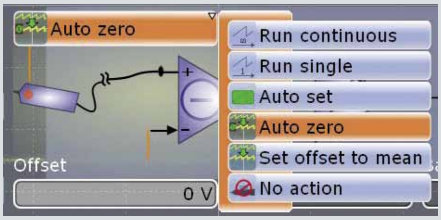


FIG 14 Menu for configuring the micro button.

FIG 15 R&S®ProbeMeter: high DC measurement accuracy, independent of the instrument settings and in parallel with the measurement channel.

Micro button for convenient instrument control

The situation is all too familiar: The user has carefully positioned the probes on the device under test and now wants to start measuring – but doesn't have a free hand. That will not happen with the active probes from Rohde & Schwarz. They are equipped with a micro button on the probe tip. Different functions such as Run / Stop, Autoset or Adjust Offset can be assigned to this button (FIGs 13 and 14).

FIG 13 Practical design: micro button for convenient control of the instrument. Diverse probe tips and ground cables are included in the equipment supplied as standard.

R&S®ProbeMeter: integrated voltmeter for precise DC measurements

Is the supply voltage correct? Is DC voltage superimposed? These questions from everyday practice are answered by the active probes' integrated voltmeter (R&S®ProbeMeter). It always shows the DC value of a measurement signal with the full dynamic range – regardless of the other instrument settings (FIG 15). Compared to a traditional oscilloscope channel, the R&S®ProbeMeter offers higher DC measurement accuracy. Altogether, it offers various advantages that make everyday test and measurement tasks easier:

- Fast verification of supply voltages and signal levels without changing the oscilloscope's settings
- Automatic compensation of the DC component for AC measurements with optimal dynamic range
- The DC value of a measurement signal often provides a good reference point for trigger level setting

For detailed information about the probes, visit **www.scope-of-the-art.com**

New audio analyzer family – designed not only for production

High measurement speed, parallel signal processing in multichannel applications and high reliability in continuous operation are vital requirements to be met by audio analyzers for use in production. If, on top of that, a cost-efficient instrument for system use is needed, the solution is the R&S®UPP200/400/800 audio analyzer.

Universal AF measuring instrument

Audio analyzers have a wide range of applications. Obvious ones are measurements on audio equipment in home entertainment or on professional sound studio equipment. But the audio characteristics of mobile phones must also be measured, and audio analyzers are likewise used in the development and production of hearing aid equipment. Furthermore, these universal audio frequency measuring instruments are frequently used in the development of components, and also in military applications.

The R&S®UPV audio analyzer – the high-end instrument from Rohde&Schwarz – has held a solid position in virtually all audio T&M applications for years. Measurement accuracy and dynamic range at the limits of what is possible, coupled with unique measurement capabilities, make the R&S®UPV ideal primarily for work in research, development and quality assurance.

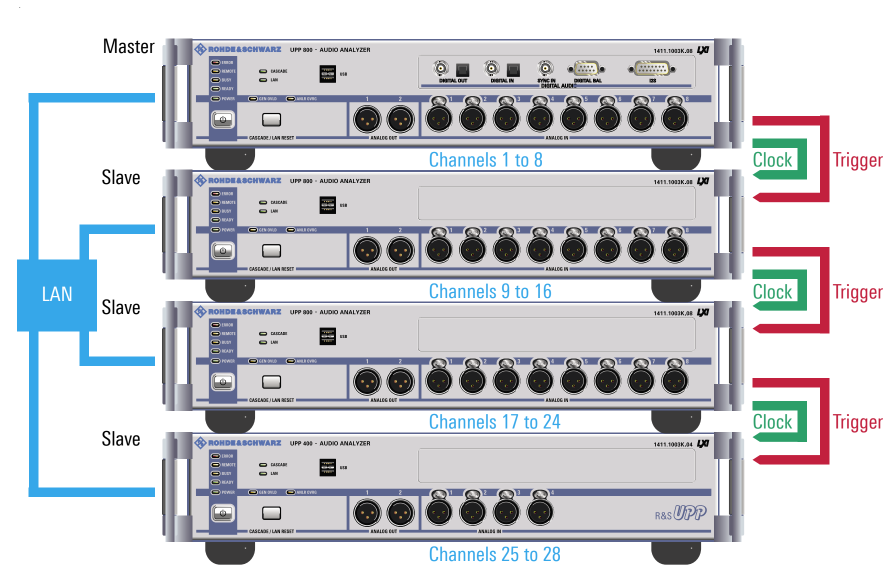
But such versatility is not always required, for example in production applications. Fewer parameters normally need to be measured in production scenarios than in the laboratory, and the focus is on high production throughput. Other applications, in contrast, do not place any extreme demands on the measurement functions. Here, instrument costs play a more important role.

Precisely these cases are the target of the new family of R&S®UPP200/400/800 audio analyzers (FIG 1). Depending on the model, they offer two, four or eight analog channels operating in parallel. If multiple instruments are used in cascaded operation, up to 48 measurement channels are available synchronously, which saves time.

FIG 1 The new R&S®UPP200/400/800 family of instruments: audio analyzers with two, four and eight analog measurement channels for simultaneous and time-saving analysis of multichannel DUTs.

FIG 2 If more than eight channels have to be measured simultaneously, several R&S®UPP200/400/800 audio analyzers can be cascaded. The master, an R&S®UPP800, controls the other audio analyzers, so the entire cascade acts like a single measuring instrument.

Instrument cascade



The R&S®UPP audio analyzers are cost-efficient, compact and designed for system applications. They feature low height, and come without front-panel control elements or integrated display. If a monitor, mouse and keyboard are connected, the result is a full-featured, manually operable measuring instrument for use on the lab bench. It has an integrated control PC, and all required software is already installed, so users can start taking measurements right away.

The R&S®UPP audio analyzers perform all measurements frequently needed in the audio world: frequency response measurements, total harmonic distortion measurements and intermodulation measurements, detailed spectral diagram, and more. The generator is equally multifaceted. It generates all required signals, ranging from sine wave to noise signals and multi-sine wave. Measurements must often be performed on analog and digital interfaces; the new audio analyzers are designed for both.

Powerful and fast for use in production

Measuring instruments for use in production must meet numerous requirements. The instruments are designed for continuous operation and feature an impressively low failure rate. Their long calibration intervals mean high availability. Furthermore, they offer simple remote-control operation via all conventional interfaces (IEC/IEEE bus, USB, LAN); these are all facts for which measuring instruments from Rohde&Schwarz have long been known. Yet the new R&S®UPP audio analyzers deliver even more highlights.

Parallel measurements for high production throughput

The R&S®UPP performs all measurements, including FFT analysis with maximum resolution, on all channels simultaneously. With multichannel measurements, this considerably reduces the overall measurement time compared with instruments that can only process two channels at a time using an audio switcher, for example.

In measurements on surround-sound systems for home entertainment, but above all in the production of sound systems for motor vehicles, this advantage really pays off. Even in mid-class cars, the two stereo channels are split between the front and rear passengers to up to eight loudspeakers and the corresponding number of amplifier channels. The objective is to offer high-quality sound despite the (somewhat) difficult acoustics and the little amount of space for accommodating the sound transducers.

Elaborate sound systems in automobiles use amplifiers with 16 or more channels to transmit surround-sound in the best possible quality via numerous loudspeakers. For applications of this kind, in which the R&S®UPP800's eight measurement channels do not suffice, several audio analyzers can be cascaded to measure all channels simultaneously, which saves time (FIG 2).

The R&S®UPP-K800 control software turns one of the R&S®UPP800 audio analyzers into the master of the cascade. Up to five other R&S®UPP200/400/800 analyzers can be combined with this instrument as slaves. In remote-control mode, for example in a production system, the entire cascade acts as a single measuring instrument with the required number of measurement channels. Therefore, only the master is remote-controlled; it triggers all participating measurement channels simultaneously, controls the measurement sequence in all participating slaves of the cascade and returns all the results to the controller. For this purpose, the individual audio analyzers are interconnected via a control line, and the system clock and the trigger signals are transmitted from the master to the slaves.

Up to 48 analog channels can be measured in parallel in this way. Since all measurement channels operate synchronously, phase measurements between all participating channels are also possible. The greatest advantage of a cascade is that it saves a significant amount of time when measuring multichannel DUTs and simplifies programming within the system.

High measurement speed throughout the system

When the R&S®UPP audio analyzer was being designed, special attention was paid to maximizing the speed of the overall measurement system:

- Time-critical and computation-intensive process steps are carried out directly in the R&S®UPP audio analyzer by digital signal processors and the integrated PC. Raw data does not have to be exported to the test system's controller for analysis, so neither unnecessary transmission time nor additional computing time accumulates.
- The measurements are digitally implemented and optimally adapt the measurement time to the measurement task. For example, the measurement time is adjusted to the frequency of the test signal – not only with level measurements but also with complex analyses such as the THD+N measurement – so that the measurement can be performed in the shortest time possible.
- The internal setting and settling times in the generator and the analyzer are optimized using digital signal processing; they are also taken into account in the measurement routines. This yields stable results without the need to activate a settling function, which means repeating the measurement until a result within a tolerance band is obtained.

FIG 3 The new R&S®UPP audio analyzers have a built-in control PC. If a commercially available keyboard, mouse and monitor are connected, the instrument becomes a manually operable measuring instrument for use on the lab bench.

FIG 4 The R&S®UPP-B2 digital audio interface option expands the instruments for connecting audio components with standardized interfaces for the AES/EBU and S/P-DIF formats. In addition, I^{2}S interfaces for measurements on audio ICs are included.

Integrated control PC

The R&S®UPP audio analyzers are compact instruments that already contain an integrated PC. This yields a number of advantages – both in remote-controlled system operation and in manual operation on the lab bench. For example, limit checks or S/N measurements can be performed in the audio analyzer, eliminating the need to program such routines in the controller.

Since all measurements, including multichannel FFT analyses, are performed by the analyzer's PC, the test system's controller does not have to provide any additional performance. Data transfer is limited to measurement results without large amounts of raw data having to be transmitted, as is the case with other audio measuring instruments. Moreover, the operating and control software programs of other audio analyzers do not have to be integrated into the test system's controller.

The R&S®UPP audio analyzers also show their strengths in standalone operation, for example in service or in quality assurance. Manual operation requires only an external monitor, mouse and keyboard, all of which are commercially available PC peripherals (FIG 3). The instrument is operated via the Windows™ user interface. All settings are carried out via panels that contain all related functions and settings.

Teamwork is the key

Featuring the same operating philosophy and remote control, the R&S®UPV and R&S®UPP audio analyzers are a strong team. The two series of models provide the optimal solution for R&D and production, respectively. Instrument settings for the same functions can be exchanged between the two analyzer types. This makes it easier to operate these instruments in parallel. Plus, solutions to problems can be found quickly if, for example, employees in production need to coordinate measurement tasks with the R&D department.

Optional digital audio interfaces

In addition to the standard analog, balanced inputs and outputs, the audio analyzers from Rohde&Schwarz can be equipped with numerous digital audio interfaces (FIG 4). Digital audio equipment can be interconnected via standardized interfaces. In the professional sector, the AES/EBU format is used. Consumer instruments are equipped with the S/P-DIF interface. The R&S®UPP-B2 option supports both sectors.

A close look at how the various modules and ICs are interconnected inside audio equipment reveals primarily serial digital data interfaces. Here, the inter-IC sound bus (I^{2}S bus) is widely used. The I^{2}S interface for generator and analyzer are likewise included in the R&S®UPP-B2 option, which is integrated on the front panel of the base unit.

All digital audio interfaces operate with sampling rates up to 200 kHz, which covers all requirements typically encountered today. The I^{2}S interfaces make it possible to use word widths of up to 32 bit. Internal (master) or external (slave) synchronization of the transmit IC and user-configurable parameters such as word offset and Fsync polarity open the door to less frequently used applications.

Summary

By introducing the new R&S®UPP200/400/800 audio analyzers, Rohde&Schwarz is expanding its portfolio of audio test equipment to include favorably priced two-channel to eight-channel models. Although the new analyzers primarily address the production sector, their outstanding price/performance ratio also paves the way to many applications in development, service and quality assurance. The instruments are already available. A wide range of information, detailed specifications, etc., can be found on the Rohde&Schwarz Internet site: www.rohde-schwarz.com

Klaus Schiffner

Compact, modular broadband amplifiers featuring high reliability

The R&S®BBA100 is a new family of broadband amplifiers from Rohde&Schwarz – an in-house development that has many outstanding features and whose compact size, optimum scalability and high reliability sets it apart. The flexibility of the amplifiers makes them suitable for EMC applications in test houses, in the electronics and automotive industries, and for numerous applications in research institutes and development labs, and radiocommunications.

Amplifiers that meet customers' needs

Complete EMC systems built using only in-house components: Rohde&Schwarz is very close to this ambitious goal. The new R&S®BBA100 broadband amplifiers round out a comprehensive portfolio that already covers all important EMC requirements, from antennas to T&M equipment to control applications. It makes sense to complete this portfolio and Rohde&Schwarz, as the worldwide leading manufacturer of transmitters, is ideally suited to develop such sophisticated amplifiers.

That's how the market's most flexible and advanced broadband amplifier system came about. The amplifiers are completely modular; users select the frequency range and power class that they need:

9 kHz to 250 MHz	125 W, 250 W, 500 W
80 MHz to 400 MHz	125 W, 250 W, 500 W
250 MHz to 1 GHz	70 W, 125 W

FIG 1 Example of an R&S®BBA100 compact desktop model with three frequency ranges:
9 kHz to 250 MHz at **250 W**, 80 MHz to 400 MHz at **125 W** and 250 MHz to 1 GHz at **70 W.**

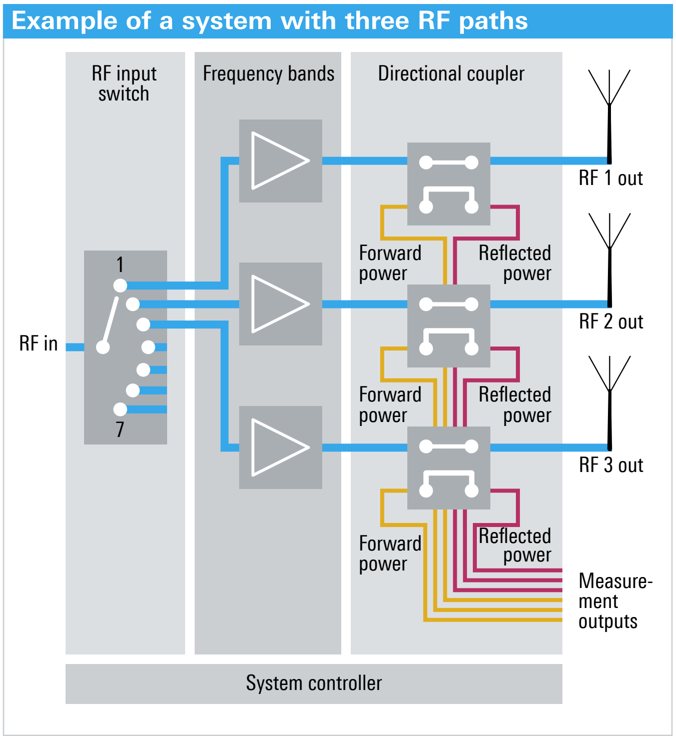


FIG 2 Example of an R&S®BBA100 system with three RF paths.

FIG 3 Example of a rackmounted R&S®BBA100 system with high power and various frequency ranges. The top five height units in this system provide room for application-specific components.

Each amplifier system is assembled according to customer requirements and installed in 19", 5 HU rackmounts. Smaller systems are configured as desktop models (FIG 1); for larger systems, one or more extension units are added to the base unit and mounted in a rack (FIG 3).

The amplifiers are ideal for amplitude, frequency, phase and pulse modulation and are extremely tolerant to mismatch. The wide-range power supply (90 V to 264 V AC) can handle widely varying voltage sources.

All in one box – no external control components

What all the systems have in common is the powerful system controller that is an integral part of an R&S®BBA100 amplifier system. It is used to control and monitor the amplifier modules and also offers numerous interfaces and switching functions making it possible to design compact amplifiers for multiple frequency bands. No other external control components are required.

The 19" basic unit already has room for several independent RF paths for different frequency bands, each covering the complete signal path starting from the input switch and continuing through the preamplifier to the power amplifier to the directional coupler (FIG 2). The input switch sets the amplifier's RF input signal to the desired RF path. Outputs for the RF forward and reflected signals of each path offer the user numerous measurement options.

Interlocks

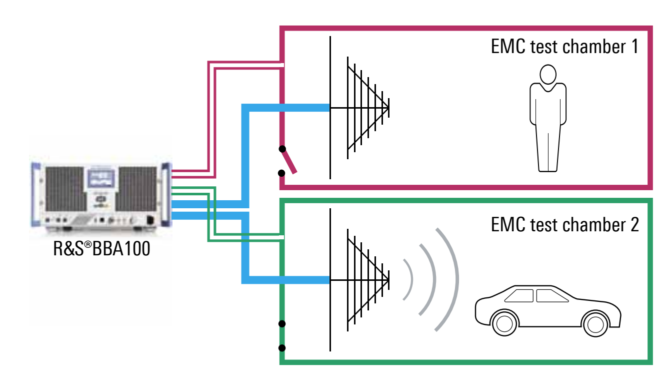


FIG 4 The interlock in the first EMC test chamber is interrupted (red); simultaneously, the second chamber (green) can continue regular operation.

Class AB amplifiers have the advantage

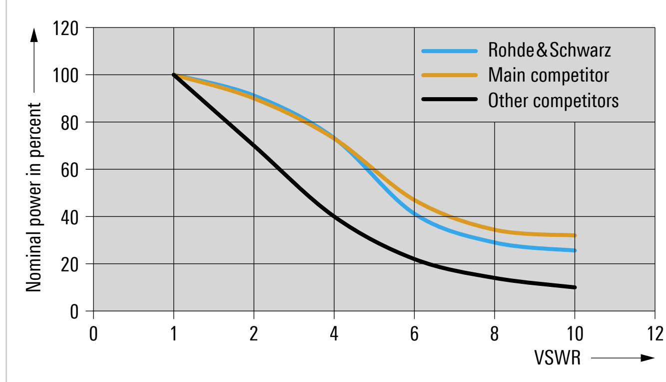


FIG 5 Advantage with no disadvantage: Even with high VSWR, the advanced design of the class AB amplifiers delivers RF output power comparable to class A amplifiers.

Unique safety concept

The R&S®BBA100 broadband amplifier has three independently configurable interlocks; each RF path can be separately assigned to an interlock (FIG 4). This provides maximum flexibility when configuring a system while still ensuring the highest operator safety. For example, when used with two EMC test chambers, it is possible to change the test setup of one chamber while simultaneously transmitting RF power in the other chamber.

High reliability and simple maintenance

In the industrial environment, the reliable R&S®BBA100 broadband amplifiers have high uptimes and are fast and easy to service. Here, the advantages of their modular design also pay off: If an amplifier module malfunctions, users can replace it themselves within minutes. The front of the instrument can be easily removed; the amplifier module's contacts and interfaces are designed for simple plug-in. The modules are calibrated during production, so the amplifier is quickly ready to be used again. And all other service work can usually take place on site; the amplifier does not have to be sent in.

VSWR-proof, even with high mismatch

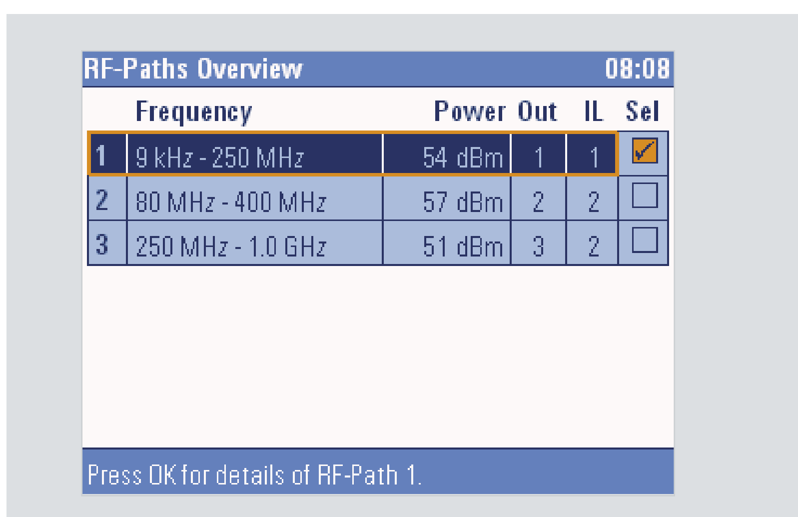
The R&S®BBA100 amplifier family works in the AB mode with optimized quiescent current for high linearity. Compared to amplifiers in the conventional A mode, this advanced concept proves to have many advantages: Class AB amplifiers are not only perfectly stable under all mismatch conditions, they are also immune to parasitic oscillation (FIG 5). In addition, compared to class A amplifiers with the same output power, the operating point can be set such that the power transistors have a higher efficiency and a lower junction temperature – which is repaid in the form of a substantially higher life expectancy.

Configuration of amplifier systems has never been so easy

The operating concept of the R&S®BBA100 broadband amplifiers is flexible and well-thought-out: Setup of the basic unit is intuitive and efficient on the color display (FIG 6). Important system parameters can be easily entered; configuration of amplifier systems has never been so easy. The R&S®BBA100 can also be controlled via a web browser allowing the user to benefit from the higher resolution on a PC or laptop and see even more clearly presented information at a glance.

The R&S®BBA100 family is also well suited to automated environments: Its numerous remote-control interfaces such as GPIB, Ethernet and optical Ethernet allow it to be easily

FIG 6 Three different views of the user interface.



integrated into various network topologies. Its extensive set of control commands makes it simple to execute automatic test and measurement sequences.

Another invaluable advantage: The new amplifier family is fully supported by the proven R&S®EMC32* EMC measurement software that is continuously being enhanced. The software allows users to manually or automatically operate the systems used for EMI and EMS measurements in accordance with CISPR, IEC, ISO, EN, ETSI, VDE, FCC and ANSI.

Ready for the future and always up to date

The complete modularity of the R&S®BBA100 provides high investment protection and makes it ready for the future. The system's output power and frequency range can be expanded at a later point in time; already existing components are retained. New EMC test standards or changing customer requirements are not a problem; the amplifier grows to keep pace. The user can upgrade the integrated system controller using a software update; new functions can be easily added on site.

Efficient and environmentally friendly

Class A amplifiers dissipate power even when there is no input. In the case of Rohde&Schwarz class AB amplifiers, the power dissipation only increases with rising input signal level. The high operating efficiency contributes to the overall efficiency, making it possible to use energy-saving cooling systems, which in turn protects resources and the environment.

The most advanced production processes and lead-free electronics help protect the environment. And at the end of the product life cycle, the modular design means that most of the raw materials can be recycled.

Summary and future developments

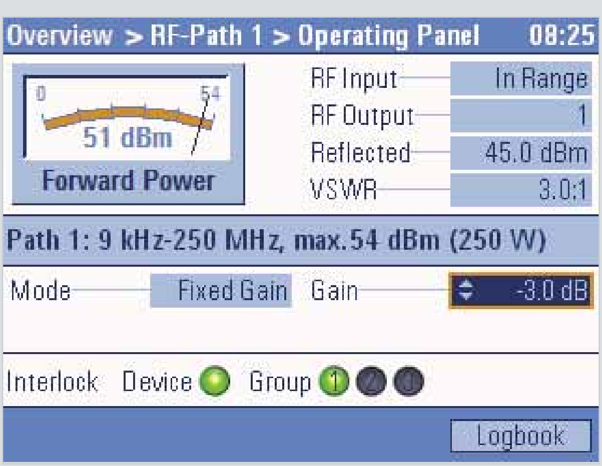
The new R&S®BBA100 broadband amplifiers from Rohde&Schwarz are the most advanced and versatile systems on the market. Numerous control and switching functions, together with high reliability and scalability, provide users with compact systems that exactly meet their requirements.

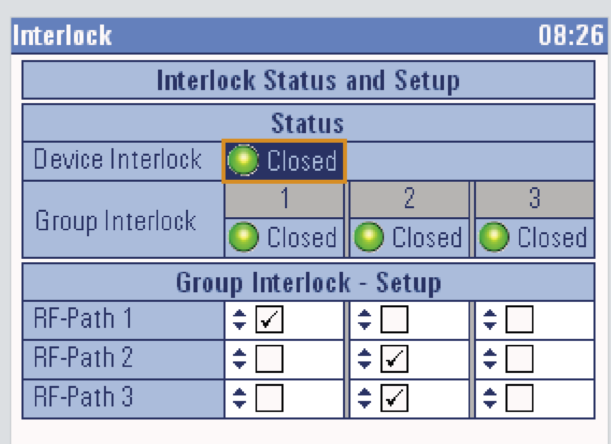
The comprehensive operating and remote-control options make it easy to integrate the amplifiers into various environments. The systems are almost always up and running due to their high reliability and the fact that users are able to perform typical service work on site themselves.

The R&S®BBA100 is completely ready for future requirements; it can be upgraded later and offers maximum investment protection – which is why renowned customers have already decided in its favor. Rohde&Schwarz will continue to expand the modular concept and develop even more functions. The standard long-term warranty period promotes the trust and confidence of customers.

Sandro Wenzel

* See article on page 32.





More effective than ever: R&S®EMC32 EMC measurement software with new enhancements

New options for increasing the automation and flexibility of test sequences, for measuring antenna radiation patterns and for integrating the software into laboratory management systems make the R&S®EMC32 EMC measurement software even more versatile. It is therefore no surprise that this powerful tool for electromagnetic interference (EMI) and susceptibility (EMS) measurements, with more than 2000 licenses sold worldwide, is the market leader for automatic EMC testing in all relevant sectors and standardization fields.

Greater efficiency in the EMC test lab

EMC test labs have to face major challenges if they are to prevail against their competitors now and in the future. It is not enough to merely reduce costs, for this may result in a deterioration of the service provided. It makes much more sense to free up unused resources through higher measurement automation and by integrating the tests into the overall laboratory workflows. This is the only way to fully utilize test stations, improve the quality of work and respond flexibly to customers' wishes.

The new options for the R&S®EMC32 software make users ideally prepared to meet these requirements:

- R&S®EMC32-K11 Test plan generation and automatic test sequence control with test sequencer
- R&S®EMC32-K21 Automation of additional measurement tasks using macro language
- R&S®EMC32-K22 Measurement of RF radiation patterns of antennas and EUTs
- R&S®EMC32-K8 Interface to laboratory management systems

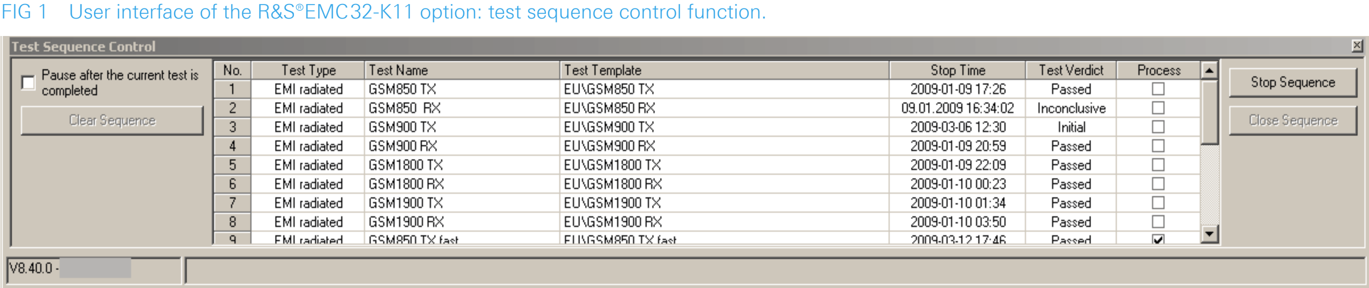
Automated testing with the R&S®EMC32-K11 EMC test sequencer

The R&S®EMC32-K11 option increases efficiency and measurement throughput. It adds a test sequencer to the R&S®EMC32-S (EMS) and R&S®EMC32-EB (EMI) basic packages and offers the following functions:

Improved automation through sequential execution of measurements

The test sequencer (FIG 1) increases the productivity of a test system by combining individual EMC measurements into a test sequence, which yields an automated flow of measurements. It covers all types of tests ranging from EMI to EMS and also includes the new test methods, i.e. measurement of RF radiation patterns and automation of additional measurement tasks using macro language. The EUT can automatically be switched to the desired operating status by actions at the beginning and end of a test, e.g. starting the call setup in the respective communications band (GSM900, GSM1800, WCDMA, etc.).

FIG 1 User interface of the R&S®EMC32-K11 option: test sequence control function.



Test plans for different EUT categories

The test sequencer allows individual tests in a sequence to be repeated or skipped, providing the necessary flexibility to save test plans for different EUT categories in R&S®EMC32. This results in a higher standardization of test sequences in the lab and improves throughput. The test sequencer is integrated into the operating concept of R&S®EMC32's virtual instrument, giving the user an overview of the current measurement, of test results (PASS/FAIL) already obtained, and of the tests in the sequence still to be completed.

Individual test reports and test reports covering multiple measurements

The software is also versatile when it comes to generating test reports: For a test sequence, it automatically creates test reports for individual measurements as well as a comprehensive test report covering all or selected measurements. The content of the reports can be visualized as desired by including graphics and tables.

Automation of additional measurement tasks with the R&S®EMC32-K21 option

Development labs often have to carry out measurement tasks in addition to the actual EMC measurements. In most cases, the T&M equipment required for these measurements is already integrated in the EMC test system. The R&S®EMC32-K21 software option makes it possible to automate these measurements with little effort, increasing the speed and reproducibility of the test sequence.

Seamless integration of additional measurement tasks into the R&S®EMC32 operating concept

The test sequences created with the integrated macro language are available as test templates and fit seamlessly into the general R&S®EMC32 operating concept for test execution and test report generation. Measurement results are stored in the EUT-specific R&S®EMC32 data structure. As a result, the execution and documentation of these additional test sequences can also be standardized. The R&S®EMC32-K11 option makes it possible to combine these test sequences into an overall test program sequence.

Intuitive macro language for test sequence control

For the creation of program sequences, the integrated macro language (FIG 2) provides the basic functions of a programming language as well as high-level functions to perform the following tasks:

- Branching and looping
- Use of variables
- Mathematical operations
- Generation and editing of result tables
- Generation of graphics and representation of results
- Call of subroutines

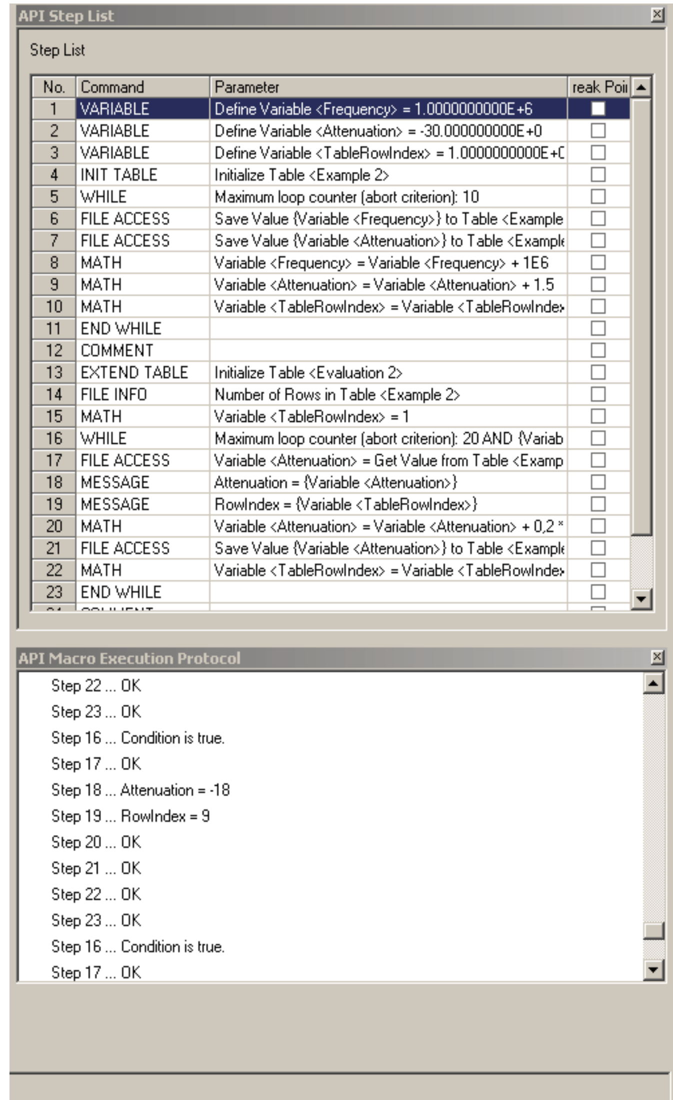


FIG 2 The macro editor in the R&S®EMC32-K21 software option provides the basic functions of a programming language as well as high-level functions for numerous tasks.

- Interactive user dialogs
- Communicating with T&M equipment and external programs via IEC/IEEE bus, or serial or LAN interface

Wide range of actions during EMC measurements

The created macros can not only be used for performing independent tests, they can also be executed as actions during an EMC test, for example at the start or end of a measurement or when EUT errors occur. The transfer of parameters to the macro makes it possible, for example, to switch EUTs to a specific operating status or reset them to a defined status after an error has occurred. Of course, these actions can also be used for a variety of other tasks, such as processing of measured data in order to generate additional result graphics.

Versatile use

The macro language opens the door to a wide range of T&M applications. Typical applications include:

- Setup of communications link with the EUT
- Monitoring of transmission signal with a spectrum analyzer in Max Hold mode
- Analysis of occupied band on spectrum analyzer
- Measurement of total harmonic distortion (THD) on FM receivers of mobile phones while GSM and UMTS transmitters are active at the same time
- Measurement of additional EUT and environmental parameters

Measurement of RF radiation patterns with the R&S®EMC32-K22 option

In combination with the R&S®EMC32-EB basic package for EMI measurements, the R&S®EMC32-K22 software option makes it possible to measure the RF radiation patterns of antennas and EUTs (FIG 3). The EMC measurement system can therefore also be used for antenna measurements. The following types of measurements are available:

Measurement of passive and integrated antennas

When measuring the RF radiation pattern of passive antennas, the transmit antenna is fed by a generator controlled by

FIG 3 Display of the RF radiation pattern of an antenna (azimuth pattern).

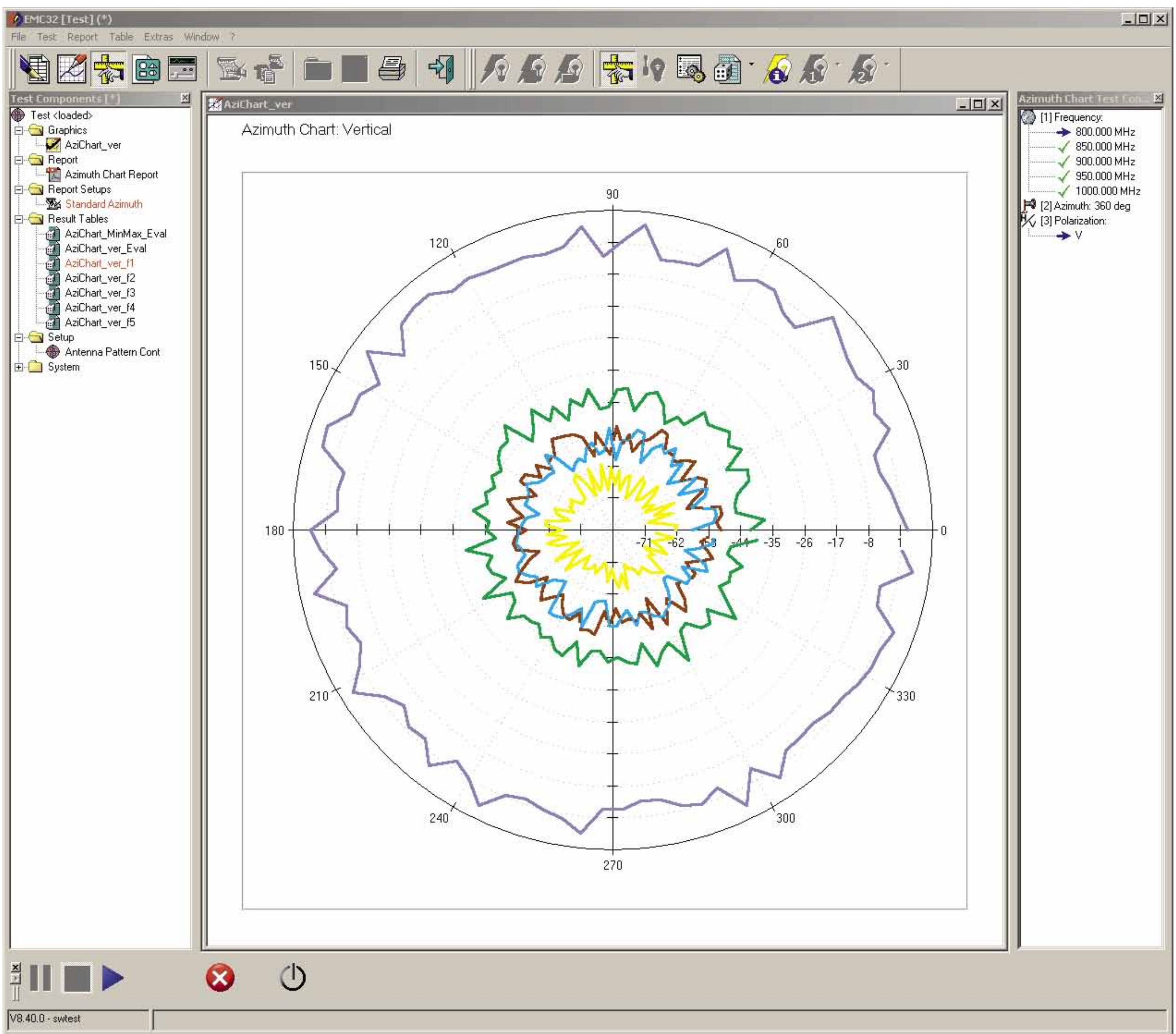
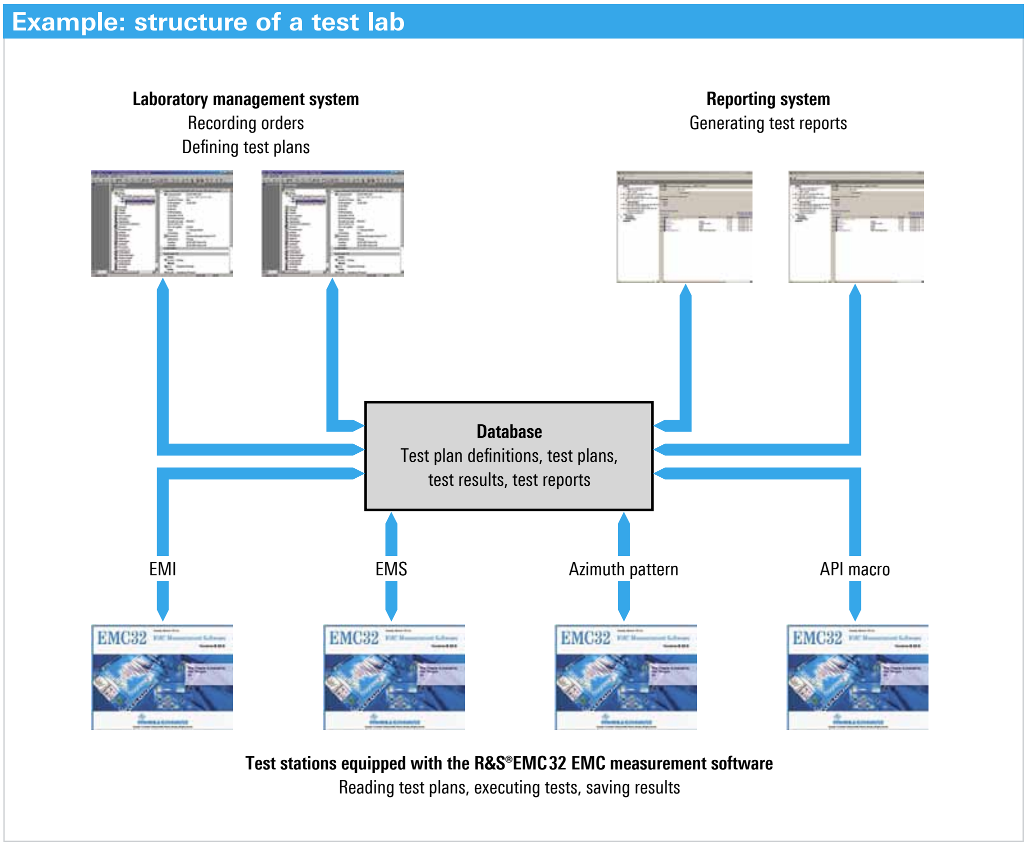


FIG 4 Typical network structure of a test lab in which R&S®EMC32 and a laboratory management system (LMS) are used.



R&S®EMC32. To measure the RF radiation pattern of an EUT in a specific plane, the EUT is rotated and the emission values are determined. The user can individually define the test sequence order (frequency loop, turntable position, polarization). Measured values are displayed for each polarization in a separate polar diagram; a result trace is generated for each test frequency across the turntable's range of rotation. The EUT can be set to the desired azimuth position either in steps or continuously.

Measurement at critical frequencies in an EMI test

R&S®EMC32-K22 enables users to measure frequencies at a defined spacing, or process user-defined frequency lists. In EMI measurements, therefore, it helps users make a detailed spatial analysis of the RF radiation patterns of an EUT at predetermined interference frequencies.

Optimized test methods for measurements on mobile phones

In combination with the R&S®EMC32-K2 option, the following additional functionality is available for RF radiation pattern measurements:

- Automatic setup of a communications link by a network simulator (e.g. the R&S®CMU200 universal radio communication tester)
- Monitoring of communications during the measurement and call cleardown at the end of the measurement
- Additional measurement loop for the mobile phone's elevation positioning
- Measurement loop either across all harmonics of the carrier or across selected communications channels

Automatic analysis of measured data

The integrated analysis functions provide the following result tables at the end of a measurement:

- The minimum / maximum / average level over a rotation is calculated for each polar diagram and each test frequency
- The position of the radiation minimum and maximum is determined for each test frequency of the entire measurement

These tables can be automatically included in the test report.

Seamless integration into the test lab workflow with the R&S®EMC32-K8 option

Test houses often use laboratory management systems (LMS). These include software packages for mapping, structuring and standardizing all workflows in the lab. The R&S®EMC32-K8 option developed by Rohde&Schwarz for the R&S®EMC32 measurement software is an interface to the most important LMS software packages. It allows EMC measurements to be seamlessly integrated into the overall test plan of an EUT and simplifies the acquisition, analysis and transfer of measured data.

Integration of test plan and test result structure into R&S®EMC32

The interface makes it possible to transfer all relevant test plan and EUT data from the LMS to the R&S®EMC32 measurement software, to display the test result structure of the LMS software in the R&S®EMC32 Explorer and to save the R&S®EMC32 test data in the LMS software. As a result, all LMS data relevant to EMC testing is available on the appropriate test station. R&S®EMC32 users can work in the local test structure with subdirectories and tests as well as in the LMS test structure. From both environments, tests can be called up, redefined and saved.

Transfer of test results for report generation in the LMS

By providing test result components such as graphics and tables for report generation in the LMS, lab management and test tasks can be ideally combined. Users benefit from the reliable, error-free transfer of measured data to the LMS test report, the acceleration of processes, and easier comparison of measured data.

Test plan and data flow in an EMC lab

FIG 4 shows the typical network structure of a test lab in which R&S®EMC32 and an LMS are used. The information and data flow between the LMS and R&S®EMC32 is shown in FIG 5.

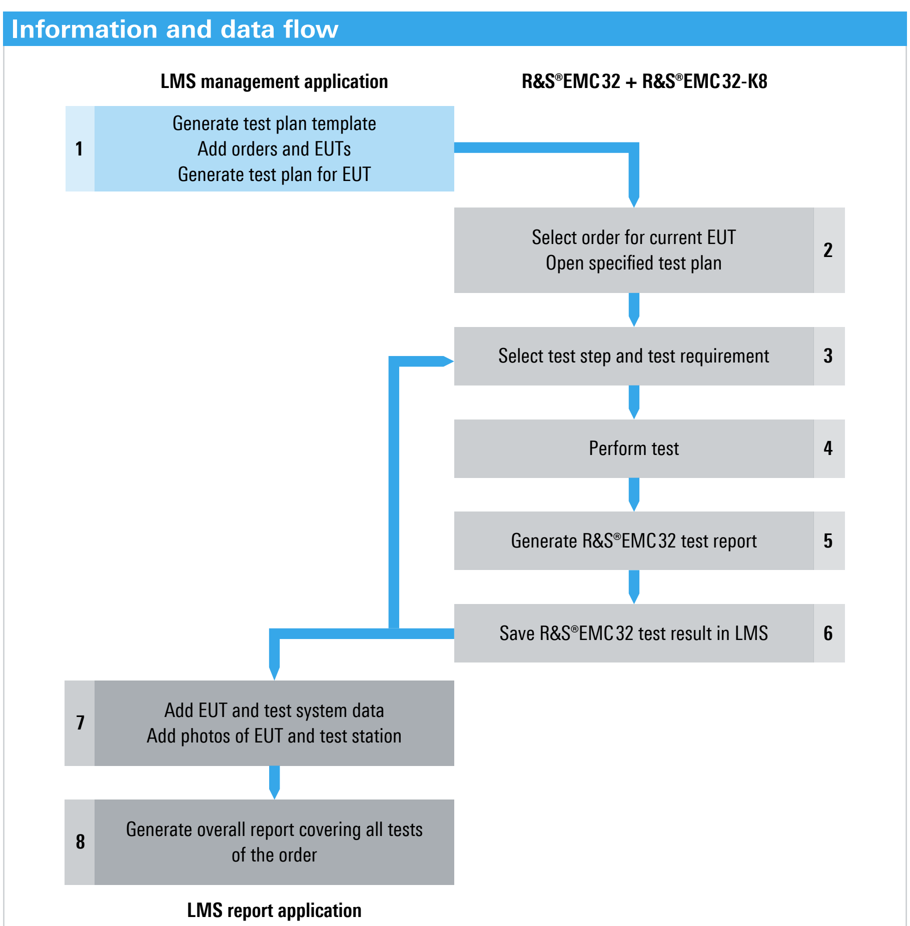


FIG 5 Information and data flow between the laboratory management system (LMS) and the R&S®EMC32 EMC measurement software.

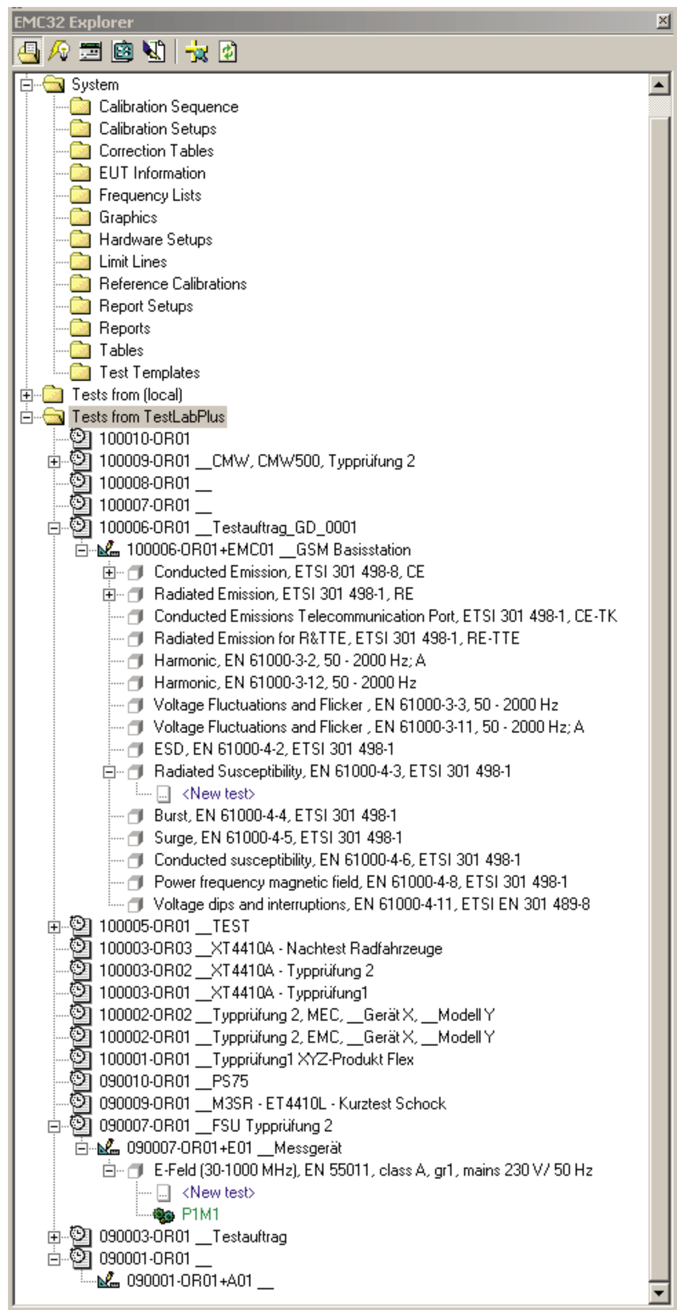
Type	Application
R&S®EMC32-S	Basic package for EMS measurements
R&S®EMC32-K1	Enhanced EMS functionality for automotive / MIL measurements
R&S®EMC32-K2	Measurement of audio breakthrough and spurious emissions in wireless communications sector
R&S®EMC32-K3	EMS measurements in reverberation chambers in line with EN 61000-4-21 (requires R&S®EMC32-K4)
R&S®EMC32-K4	EMS auto test functionality
R&S®EMC32-K6	Measurements in line with MIL-STD-461E CS103 / 4 / 5
R&S®EMC32-K7	Generic drivers for RF generators, power meters and oscilloscopes
R&S®EMC32-K8	Database interface to lab management systems
R&S®EMC32-EB	Basic package for EMI measurements
R&S®EMC32-K10	EMI auto test functionality
R&S®EMC32-K11	Test plan generation and automatic test sequence control with test sequencer
R&S®EMC32-K21	Automation of additional measurement tasks using macro language
R&S®EMC32-K22	Measurement of RF radiation patterns of antennas and EUTs

FIG 6 The R&S®EMC32 software has a modular structure, providing a wide range of capabilities to individually tailor the software to the tasks at hand.

R&S®EMC32 Explorer with display of the LMS data structure

If the R&S®EMC32-K8 option has been installed and there is a network connection to the LMS database, the R&S®EMC32 Explorer displays, in addition to the local test directory, a test directory with the LMS data structure (FIG 7).

FIG 7 The R&S®EMC32 Explorer can display a test directory with the LMS data structure in addition to the local test directory.



Summary

Owing to its intuitive operating concept, the R&S®EMC32 EMC measurement software makes it easy to perform EMC measurements in all relevant sectors. This applies to measurements during development as well as to acceptance tests and certification measurements – from simple lab applications to complex test sequences in EMC test chambers.

The tried-and-tested modular concept implemented by the R&S®EMC32 options provides extensive capabilities for tailoring the software to various requirements, reducing costs and allowing future-oriented expansion (FIG 6).

Special options make it possible to maximize automation while integrating the measured data into a test house's overall workflow. The resulting increase in throughput contributes to cost efficiency in the lab and the test house.

Robert Gratzl; Xaver Sutter

Realistic simulation: cable TV networks for J.83/B and DOCSIS 3.0

Despite faults and interference in cable networks, set-top boxes and cable modems always have to provide perfect reception. Therefore, they are thoroughly tested during development and production to make sure they fulfill this requirement. Rohde & Schwarz offers a system that, for the first time, can realistically simulate cable TV networks. The system consists of the R&S®SFU broadcast test system and several R&S®SFE100 test transmitters.

Interference affecting the path to the set-top box

Both the less-than-ideal modulation at the cable headend, e.g. due to phase noise, and the transmission path affect the signal quality. Amplifier stages ensure a sufficient signal level, but they also increase the noise component, superimpose AC hum, and the nonlinearities cause intermodulation products such as composite second order (CSO) and composite triple beat (CTB). The transmission path starts at the modulator output of the cable headend and ends at the real load, i.e. at the cable tuner of the set-top box or the TV set. Ideally, the characteristic impedance of cable TV distribution network should remain constant at every point along the transmission path. In the real world, however, differing impedances at terminals and connections lead to mismatches in the overall system. A part of the signal energy fed into the cable returns to the source. This type of micro-reflection causes amplitude and phase ripple in the transmitted signals.

"Breathtaking: It is small in size and fail-safe, consumes minimum power, provides high signal quality for all relevant broadcasting standards and is favorably priced …" This is how the R&S®SFE100 test transmitter was presented in NEWS 198, (pp. 62–64).

This article shows how the R&S®SFE100, together with the R&S®SFU broadcast test system, realistically simulates cable networks.

Rack with several R&S®SFE100 for use in production.

The most crucial components in the transmission chain are the TV receivers or set-top boxes. They should not produce additional interference and have to work perfectly outside the lab environment in various cable TV networks, even if the interferences described above are present. The large number of signals present in the cable network, primarily analog and digital adjacent channels, is also very critical. Electromagnetic interference from 3G/4G wireless communications signals in the upper frequency bands formerly used for terrestrial TV also increasingly causes problems for cable TV reception.

Simulation of cable TV networks in the lab

Up until now, in order to simulate a cable TV network in the lab, each channel needed its own generator. Although this enables a good simulation of analog TV signals with a CW signal, a large number of units are needed. Simulation is more efficient with a combination of arbitrary waveform generators and broadcast signal generators from Rohde & Schwarz (FIG 1). When simulating cable TV networks, there are three types of channels: the useful signal that is received by the set-top box under test, its two direct adjacent channels, and all other channels (also referred to as load). In addition to the simulation of a fully occupied cable network, the above-mentioned interference such as AC hum, micro-reflection and phase noise as well as white noise and pulse-like noise should be applied to the useful signal.

The R&S®SFU broadcast test system generates such useful signals in a reproducible way and in high quality. With its interferer management option, the R&S®SFU also generates the useful signal's two direct adjacent channels and allows interference from 3G / 4G wireless communications signals to be simulated. The R&S®SFE100 test transmitter makes it much easier to simulate the other TV channels in the cable network, as compared to conventional systems which need a large number of units. Each R&S®SFE100 generates several adjacent analog or digital TV signals using a multichannel arbitrary waveform from the R&S®SFU-K356 waveform

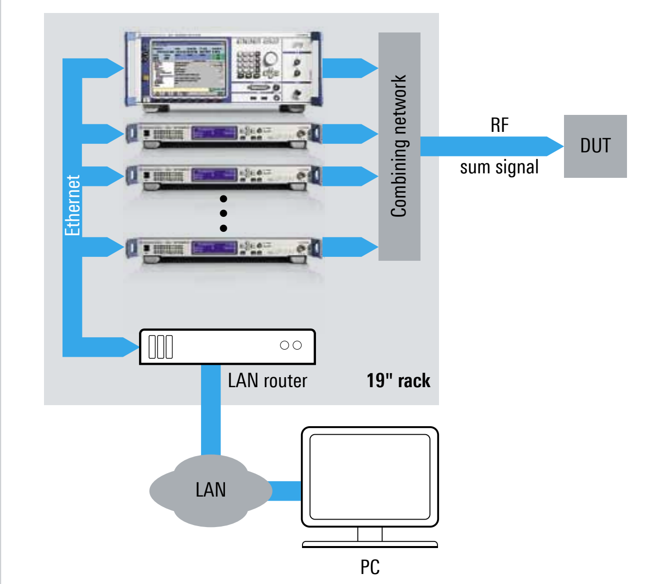


FIG 1 Signal-generation principle for simulation of a cable TV network.

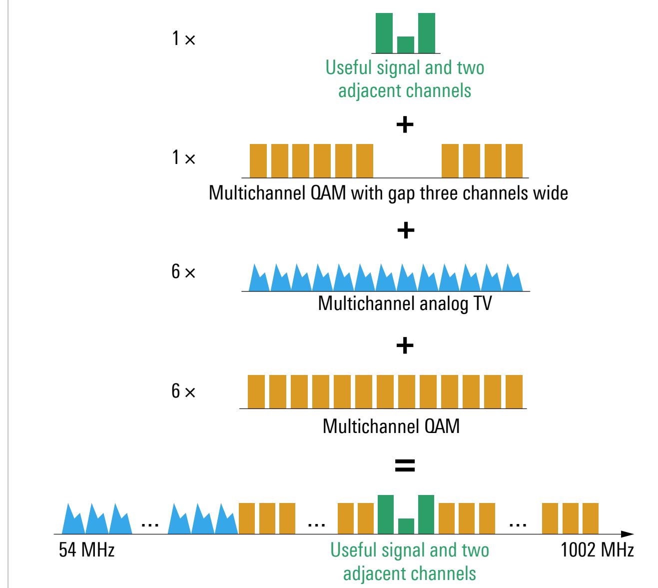


FIG 2 The total spectrum results from superimposing the useful signal, its adjacent channels and the load channels.

library. For example, an R&S®SFE100 test transmitter can generate 13 channels with 6 MHz channel bandwidth for the USA television. Only 13 R&S®SFE100 test transmitters are required for the entire 54 MHz to 1002 MHz (158 channels) frequency range used in the USA.

Seamless spectrum over 158 TV channels

The partial signals from each R&S®SFE100 test transmitter and from the R&S®SFU broadcast test system have to be superimposed. The R&S®SFU-K356 waveform library contains fully occupied multichannel signals and also a variety of multichannel waveforms with a gap three channels wide in which the R&S®SFU inserts the useful signal and the two adjacent channels. There is a suitable waveform for each possible position of the gap. Using a broadband combining network, all the signals can be superimposed and added together to form a seamless single-output sum signal (FIG 2). The signal generators and the combining network are mounted in a 19" rack, together with a power distributor and a fan unit. A LAN router, also integrated in the rack, connects the Ethernet interface of the units so that the entire system can be remotely controlled by a PC. This is a very compact solution and, compared to conventional solutions, the low number of units also reduces power consumption considerably. This conserves our environment and considerably reduces the operating costs.

Measurements in line with the USA ANSI/SCTE 40 standard

ANSI/SCTE 40* defines the minimum requirements based on the above scenario for cable TV networks and their components and receivers. In the USA, cable network operators always require proof from their suppliers that they meet this specification. Similar test specifications, adapted to local conditions, are used in Europe and Asia. The Rohde&Schwarz system makes it possible to simulate all common measurement scenarios in a universal and reproducible manner. Manufacturers can test their cable receivers in accordance with the highest quality requirements.

Harald Gsödl; Peter Lampel

* ANSI/SCTE 40 conformance testing using the R&S®SFU, R&S®SFE and R&S®SFE100. Application Note 7BM68 from Rohde&Schwarz.

3D TV test signals in accordance with the HDMI 1.4a interface standard

3D, the runaway hit in cinemas, can now be enjoyed at home. The 3D sensation requires state-of-the-art TV sets that are able to process the corresponding pictures and provide suitable panels. As a result, R&D departments and quality assurance are going to face new challenging tasks. The R&S®DVSG digital video signal generator, which already creates all the required signals, is the ideal tool to meet such requirements.

Depth perception through a second perspective

3D TV is a technology that makes motion pictures or television images appear to be three-dimensional. Two perspectives of the same scene are offset by the distance between one's eyes and reproduced on the screen in a defined sequence. Today's TV sets are unable to show these images, which is why new 3D TV sets are being developed. The content intended for each eye is delivered synchronously either via active shutter glasses with alternating frame replay or via passive polarization glasses with alternating polarized picture information. As a result, a three-dimensional effect is produced.

The latest high-definition multimedia interface (HDMI) standard, 1.4a, defines new picture formats and timings that transmit the stereoscopic picture information to TV sets using players or set-top boxes.

Frame-compatible formats are based on conventional picture resolutions. The two perspectives share the resolution horizontally (side by side) or vertically (top and bottom) (FIG 1). These picture formats are used primarily in the TV transmission of 3D content. In this case, the existing infrastructure for high-definition transmission (HD) can be used. Yet, the resulting resolution is a drawback, since the individual picture sections are simply scaled up to the entire display area.

In contrast, frame-packing formats offer sequential pictures in full resolution. These formats are used primarily in combination with Blu-ray disc players and – compared to frame-compatible formats – offer optimum picture quality.

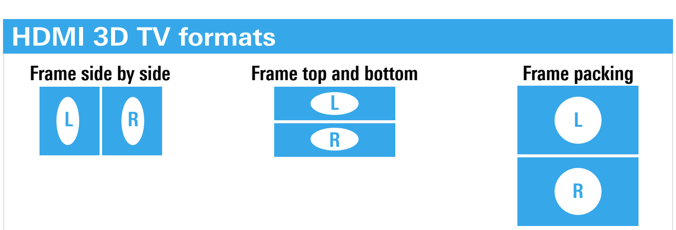


FIG 1 3D TV video formats in accordance with HDMI 1.4a.

New T&M challenges

The first 3D TV sets are mainly systems with active shutter glasses. Faulty synchronization mechanisms in such glasses might cause ghosting effects, i.e. crosstalk of the picture information for the left eye to the right and vice versa. If the exposure time per eye is too low, brightness will be drastically reduced. This means that R&D as well as production have to face new challenging T&M tasks.

Suitable signal generators and T&M instruments are required to provide precise and reproducible test results. When equipped with the R&S®DVSG-K10 AV signal generator option, the R&S®DVSG is able to create all common primary 2D and 3D video formats, uncompressed and without interfering compression artifacts, in accordance with HDMI 1.4a. Using the R&S®DVSG-B10 AV signal generator extension (hardware expansion), long 3D sequences can be output, since this option expands the video memory to 4 Gbyte and provides sequences with up to 387 individual RGB pictures at 1080p and 36 bit color depth. At lower resolutions or lower bit depths, the sequence length increases proportionally. A test signal library for the various 2D and 3D picture formats is part of the equipment supplied. The library contains moving sequences for subjective picture quality assessment as well as test sequences, which, together with spectroradiometers, can be used to analyze the luminance or crosstalk (FIG 2).

The AVG pattern import software, which is part of the R&S®DVSG-K10 AV signal generator option, enables users to create their own 3D test scenarios from any uncompressed original picture in the formats BMP, TIFF and YUV10 (FIG 3). The software generates the appropriate AVG files based on picture pairs for the left and right eye. The import function for uncompressed PCM audio files with up to eight channels completes the scope of functions provided by the Windows™ application. It can be run on the signal generator or on a separate PC.

FIG 2 Typical test setup to measure the luminance of 3D TV sets (including a positioning system from Instrument Systems and a spectroradiometer from Konica Minolta).

Display test under real conditions

The R&S®DVSG can be equipped with the R&S®DVSG-B30 AV signal player option. This option lets users check how compressed 3D TV signals occurring in typical broadcast transmissions are processed. Users can play 3D live signals based on MPEG-2 transport streams that contain complex scene cuts and pictures, blocking and other compression artifacts. Supporting both MPEG-2-coded video and MPEG-4 advanced video coding (AVC), the R&S®DVSG is also able to decode all current audio standards.

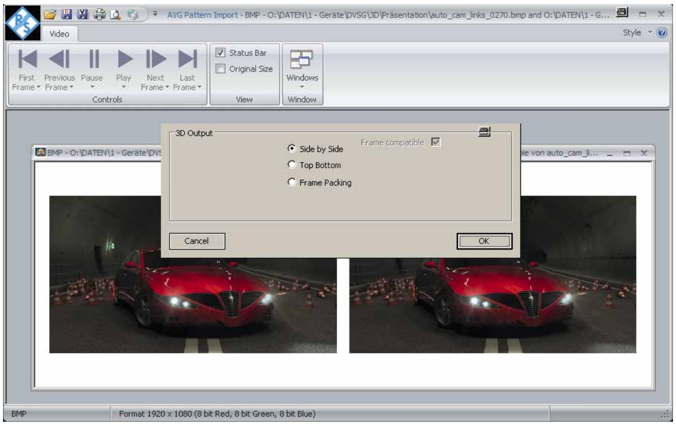


FIG 3 The AVG pattern import software enables users to conveniently configure specific 3D test patterns.

The R&S®DVSG digital video signal generator is an outstanding tool for use in R&D departments and for quality assurance of 3D TV sets. Offering a scope of functions unique on the market, it enables users to reproducibly perform all required measurements to meet highest quality standards.

Harald Gsödl

Europe's air traffic control on the way to voice over IP

Voice communications systems will continue to be absolutely essential for the safe handling of air traffic in Europe in the future. But the rapid technical development opens up completely new opportunities for air traffic control (ATC) organizations. They are subjecting these new methods to thorough tests, for high safety requirements must be met. This careful migration is made possible by the radios of the R&S®Series4200 family, because they support several communications technologies that make migration easier.

Tried and tested in changing times

All flights based on instrument flight rules (IFR) require a constantly available voice connection between pilot and air traffic controller. For this reason, voice communications are one of the most important working bases in air traffic control. The technical basis for voice communications is a radio network that ensures countrywide coverage during all phases of the flight independent of altitude. For this purpose, radio stations with radios and associated RF components, such as transmitter/receiver filters, couplers and antennas, are installed at suitable radio locations, e.g. at airports or on mountaintops. Depending on the operational requirements, a number of radio channels are available for each location, combined with the corresponding number of device installations. To ensure the availability of the radio system in case a component fails, additional devices are installed to provide redundancy.

The radio systems as well as the air traffic controllers with their controller working positions (CWP) are connected with the terrestrial voice communications system (VCS). The VCS connects the controller working positions dynamically or semipermanently with the associated radio systems so that the air traffic controllers can work on the frequency assigned to their respective sectors. The assignment of a CWP to a

radio channel can change depending on the time of day and the traffic volume. From a technical and organizational perspective, it is also possible that sectors are taken over by air traffic controllers who are working at other locations.

The connection of the radio systems and controller working positions or the interconnection of individual voice switching nodes is made using analog telephone lines or via digital transmission lines with 2 Mbit/s in line with the ITU-T G.703 standard. The transmission lines for connecting radio locations are leased by the ATC organization from a telecommunications provider. However, many providers in Europe no longer offer analog landlines, since they can hardly be operated economically anymore. In the near future, the digital transmission technologies that have been used for years, such as plesiochronous digital hierarchy (PDH) and synchronous digital hierarchy (SDH), will also no longer be available for connecting remote radio stations to the voice switching system.

Alternatives are in demand – and also in sight: Voice over IP (VoIP) is an obvious choice, due to its widespread use and the many years of experience with this technology in the classic telecommunications environment. VoIP is not only a replacement for analog or PDH transmission technology; it also offers several significant advantages.

R&S®Series4200 software defined radios

The R&S®Series4200 is the latest generation of digital software defined radios for stationary use in civil and military air traffic control. The possible applications range from small emergency radio systems with only a few channels to nationwide radiocommunications systems with several hundred channels.

- VHF frequency range from 112 MHz to 156 MHz
- UHF frequency range from 225 MHz to 400 MHz
- 50 W transmit power in VHF and UHF range
- Automatic main/standby operation
- USB service interface for configuration and software downloads
- Remote control and remote monitoring via Ethernet interface
- Suitable for data transmission in VDL mode 2 standard
- Connection via E1 interface
- Voice over IP via software upgrade

VoIP: communications technology of the future for air traffic control

VoIP systems no longer transmit voice over a circuit-switched voice network, but over an IP-based packet-switched data network. For this purpose, the voice signal is digitized at the source and divided into IP data packets. The data network consists of routers that handle the routing of the voice packets and the data packets on the basis of the IP address. At the information sink, the digital voice packets are converted back into an analog signal.

Cost savings through integrated voice and data networks

ATC organizations already operate extensive data networks, e.g. for the transmission of radar and flight plan data. Therefore, it seems reasonable to transmit voice and data over a single network in the future, as is possible with VoIP. At remote locations, the integration of voice and data into a common network is particularly advantageous, for it also saves money – only a single network must be planned, installed and operated.

Data networks that should also transmit digital voice information must meet special requirements, for this information must be transmitted in realtime and with absolute reliability. The radios are remote-monitored and remote-controlled via an IP-based data connection. In the future, voice transmission as well as remote monitoring will run via the same IP interface on the radio.

Simple setup

While the technical planning of the data networks as described above is more complex, the installation of the VoIP network components simpler. This is because standard cabling and components, which are already in use for today's LAN technology, are sufficient. All security mechanisms known from the data world, such as Internet protocol security (IPSec), and prioritization techniques, such as differentiated services (DiffServ, RFC 2474, RFC 2475) or multiprotocol label switching (MPLS), can also be used for voice transmission via VoIP.

Shift of routing technology into the IP network

Another advantage of VoIP systems is the possibility of doing without central switching nodes – such as those required in circuit-switched voice networks. For security reasons, today's routing technology is designed redundantly in the voice network – which results in added costs. In an IP-based data network, the data packets are not distributed by a central unit but by routers whose number and performance are determined by the size and requirements of the network. The router decides, based on the IP address of the information sink, where the packet should go. Consequently, the information source only needs to know the IP address of the communications partner. The addresses defined in an address plan that can dynamically be adjusted to the operational conditions. Therefore, the data packets are switched via several routers distributed in the network, and not centrally. The advantage is that existing redundancy mechanisms in the IP network can be utilized.

Implementation of new functions

Speaking in favor of the introduction of VoIP is not only that it replaces transmission methods which are no longer available, but also that new functions can be implemented in the voice communications system – functions that are difficult to implement using today's circuit-switched technology.

One example are the functional airspace blocks (FABs) planned within the framework of the "Single European Sky" initiative, in which several countries are united into one FAB, e.g. the FABEC (FAB Europe Central), comprising France, Belgium, the Netherlands, Luxemburg, Switzerland and Germany. These FABs no longer organize the airspace over Europe according to national borders, but with a view toward achieving the highest possible efficiency in utilizing the airspace so that air traffic can be handled in a more time- and cost-saving way.

One of the many requirements for an FAB is the harmonization of the communications technology to ensure sufficient

VoIP infrastructure

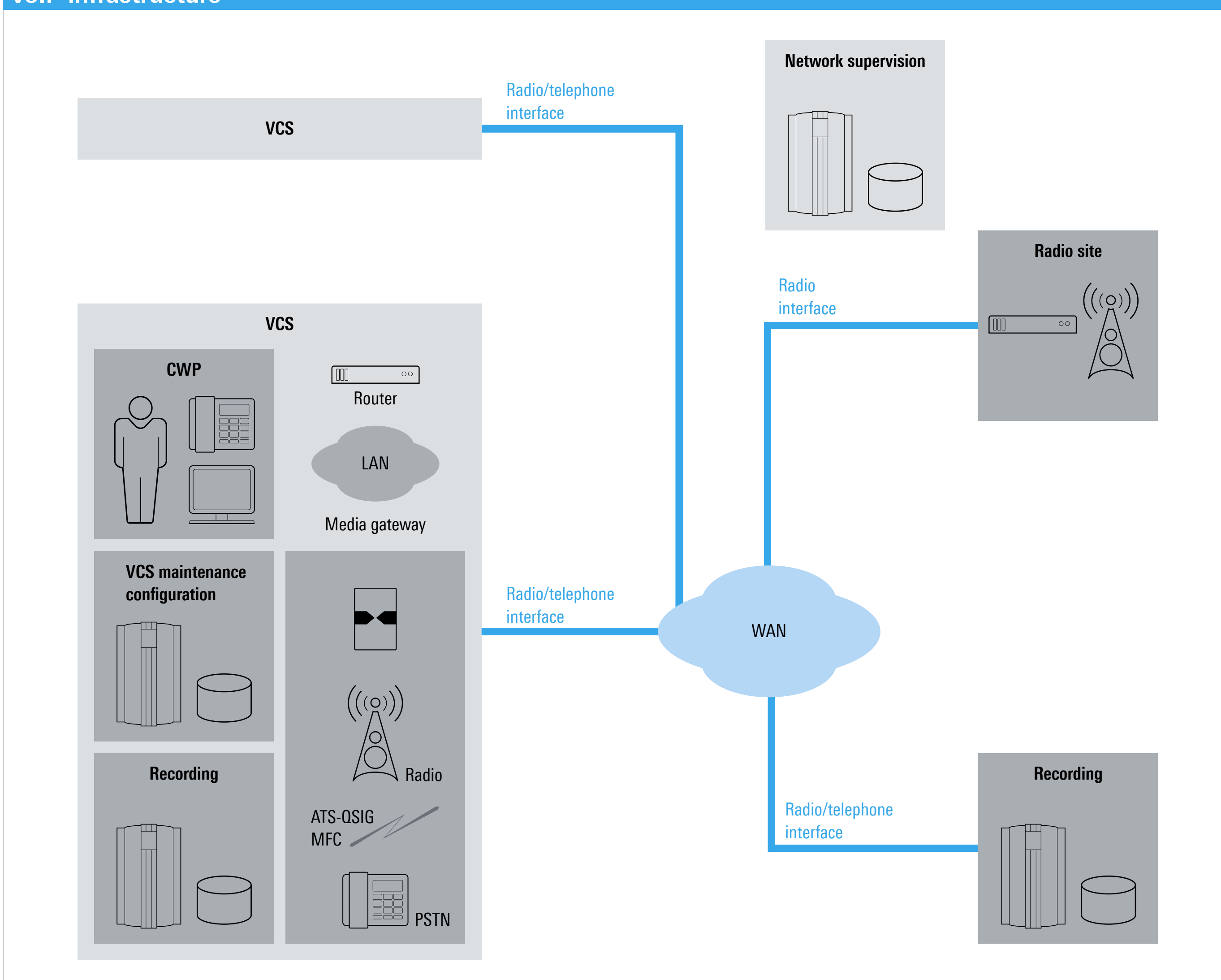


FIG 1 VoIP infrastructure for use in air traffic control (source: EUROCAE ED136).

interoperability. Today, every country has its own operational processes and different communications technology with which the air traffic controllers communicate with each other and with the pilots. Communications between air traffic controllers across borders run via telephone connections. Today, it is not easily possible for an air traffic controller in one country to optionally access the radio infrastructure of another country. But this is necessary if FABs are to be introduced, since an air traffic controller from one country must be able to operate the sector that is covered by the radio infrastructure of another country. Only VoIP technology provides the prerequisites for such functions. Plus, this technology offers the means of introducing additional performance features that make communications between air traffic controllers and pilots easier and more secure.

Standardization

In order to make VoIP usable for ATC applications, the European Organization for Civil Aviation Equipment (EUROCAE) created a working group – the WG67. Based on the existing requests for comments (RFCs), its task is to develop standards that will enable the use of VoIP. These standards allow interconnection of radios, VCS and CWP from different manufacturers. The WG67 consists of representatives from ATC organizations (air navigation service providers, ANSP) and industry. The infrastructure to be standardized is specified in the Vienna Agreement (FIG 1). The necessary requirements and specifications are defined in several documents [1 to 7] which were ratified at the end of 2008 and have been official EUROCAE documents since February 2009.

In April 2008 and March 2009, the specifications were validated in plug tests. For this purpose, the representatives from industry interconnected radios and VCS and performed various tests. Rohde & Schwarz actively participated in the plug tests by providing software defined radios of the R&S®Series4200 (see box on page 43), in which the VoIP functionality can be installed via software upgrade.

The tests showed that the EUROCAE standards are generally suitable for implementing VoIP-based VCS. The test results are also used to improve the interface specifications. In the next few months, new editions of the documents ED137 Part 1 and ED137 Part 2 are expected to be released.

The European Organization for the Safety of Air Navigation (EUROCONTROL) supports the migration of today's communications systems to VoIP systems with recommendations and guidelines to enable a uniform infrastructure across all participating EUROCONTROL countries. Furthermore, the EUROCAE standards are being introduced in the appropriate committees of the International Civil Aviation Organization (ICAO) so that they will be adopted worldwide.

The technology

The basis for the EUROCAE specifications are the RFCs developed by the Internet Engineering Task Force (IETF). The objective of WG67 was to remain as close as possible to the existing standards and expand them only whenever it was necessary to meet the requirements of the ED136 document. The basis for the VoIP-based interface between the VCS / CWP

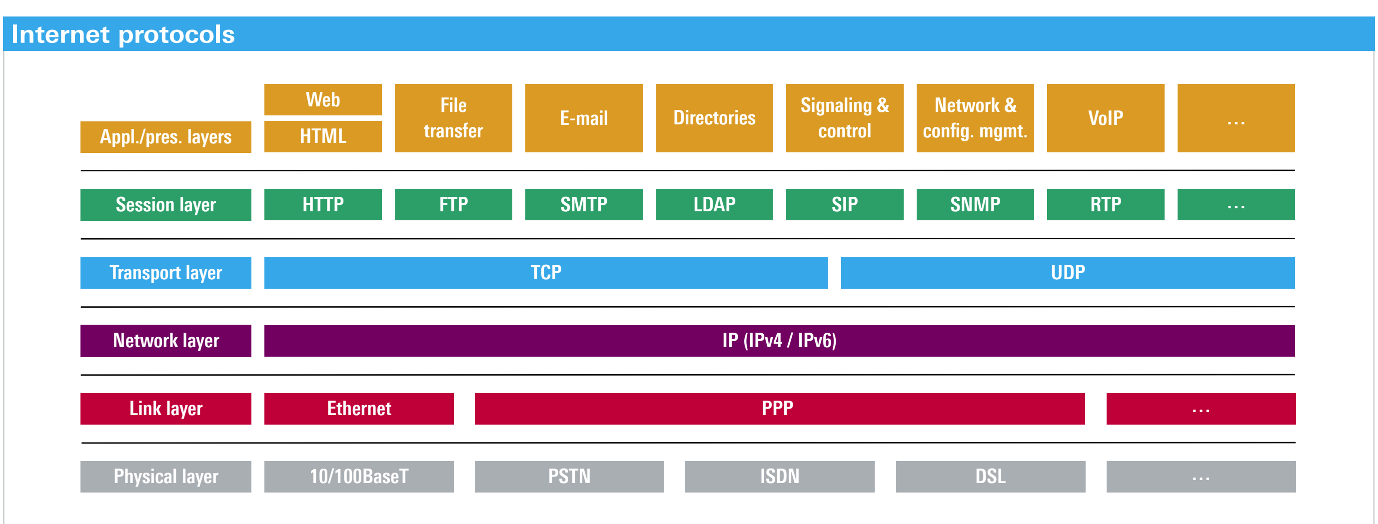


FIG 2 Selection of protocols commonly used in the IP world, presented in line with the ISO/OSI 7-layer model.

and the radios is the session initiation protocol (SIP) RFC 3261 and the realtime transport protocol (RTP) RFC 3550. FIG 2 shows the protocols that are common in the IP world, illustrated using the ISO/OSI 7-layer model.

The call setup is signaled between the radios and the VCS/CWP using SIP. For this purpose, the VCS/CWP sends the connection request to the corresponding radio, together with the parameters required for communications, e.g. the voice codecs to be used. The radio confirms the connection request, possibly with modified parameters, or rejects it with a cause value. Several VCS/CWP can set up an active connection to a radio, where the call setup is always initiated by the VCS/CWP.

After a successful call setup, a bidirectional RTP session is initialized between the radios and the VCS/CWP, where a separate session is set up to every VCS that sent a connection request. These connections transmit the voice packets. The packets are sent even if no voice is to be transmitted (no RF transmission), in this case without content. Besides voice, additional information for signaling is also transmitted in the RTP header. Since additional information must be transmitted together with voice in a VoIP system for ATM applications, the standard RTP header was extended. This extended RTP header transmits the push-to-talk (PTT) and squelch (SQ) signals. The transmitter is keyed with the PTT signal, and the SQ signal indicates the opening of the squelch at the receiver. In addition, signals for displaying the reception quality of the receiver are transmitted that enable the VCS/CWP to switch the best signal among several receivers through to the air traffic controller.

An important function that was implemented in the extended RTP header is the monitoring (keep-alive) of the connection between radio and VCS. For this purpose, the correct reception of the voice information is monitored by both sides. If no voice is transmitted, keep-alive signals are sent in the extended RTP header and their correct reception is monitored. Adjustable keep-alive timers are used to control the tolerance to interruptions and packet loss.

In most cases, the transmitters and receivers are positioned at different locations so that they do not interfere with each other. For this reason, VCS and CWP set up independent SIP/RTP sessions to the respective transmitters and receivers. The suitable audio streams are then combined in the VCS in each case to feed transmit and receive signals of the same radio channel to the headset of the air traffic controller. FIG 3 shows the phases of the VoIP call setup between a VCS and the transmitter or receiver of a radio channel.

VoIP implementation in the R&S®Series 4200

The R&S®Series4200 is the current generation of VHF and UHF radios for air traffic control and has been in use for about four years. The latest generation of this family of radios offers an additional digital interface in line with ITU-T G.703 as well as significantly higher processor performance and more storage capacity. As a result, the radios can be used not only for analog connections, as is still predominant today; alternatively, they can also be digitally connected to the voice switching system. For the connection via VoIP, the LAN interface that already exists for remote monitoring is used. All R&S®Series4200 radios that are already equipped with the

Connection setup

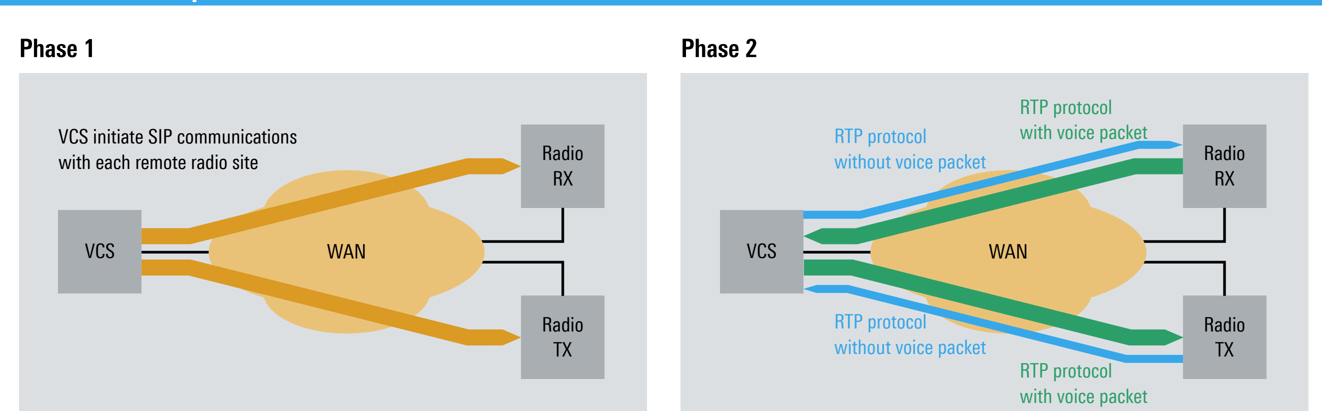


FIG 3 Call setup between VCS and transmitter/receiver of a radio channel via SIP and RTP (source: EUROCAE).

R&S®GB4000V and R&S®GB4000T with R&S®Series4200 via VoIP

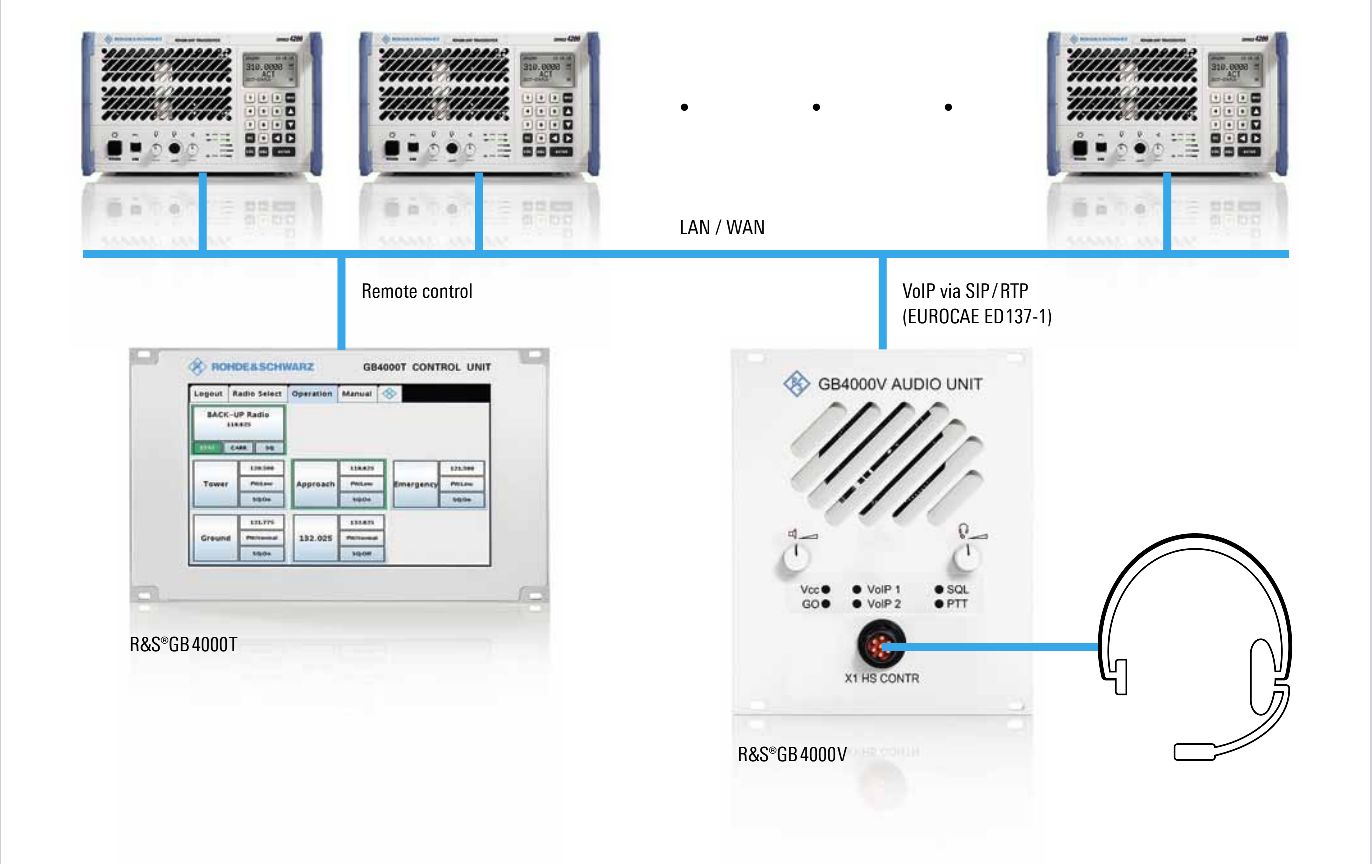


FIG 4 Implementation of a communications system via VoIP.

powerful processor can be upgraded to VoIP operation via software. As a result, they offer high safety of investment and certainty of planning, since they can be subsequently integrated into VoIP systems yet to be deployed.

For small systems with one or only a few controller working positions, Rohde&Schwarz offers additional components for VoIP-capable voice communications: the R&S®GB4000V audio unit and the R&S®GB4000T control unit. These system components make it very easy to implement VoIP-based communications systems, such as those required e.g. in a tower or for the apron check. FIG 4 shows such an application.

Summary

Voice over IP has proven its value in the classic telecommunications sector for several years now. With a few changes, which have been specified by EUROCAE in collaboration with representatives from ATC organizations and industry, VoIP is now ready to be used in ATC applications.

The R&S®Series4200 family provides the right radio for setting up voice communications systems that are open-ended for future needs.

Bernhard Maier

References
[1] ED136 “VoIP ATM System Operational and Technical Requirements”
[2] ED137 “Interoperability Standards for VoIP ATM Components – Part 1: Radio Interface”
[3] ED137 “Interoperability Standards for VoIP ATM Components – Part 2: Telephone Interface”
[4] ED137 “Interoperability Standards for VoIP ATM Components – Part 3: Recording Interface”
[5] ED137 “Interoperability Standards for VoIP ATM Components – Part 4: Supervision”
[6] ED138 “Network Requirements and Performances for VoIP ATM Systems – Part 1: Specification”
[7] ED138 “Network Requirements and Performances for VoIP ATM Systems – Part 2: Design Guideline”

High-precision calibration of EMC test antennas – also as a service

The calibration laboratory of Rohde & Schwarz Messgerätebau GmbH now also performs accreditation measurements of the free space antenna factor. The measurement uncertainty achieved at the Rohde & Schwarz open area test site was verified by Germany's National Metrology Institute (PTB). This test site achieves the highest accuracy among the three laboratories in Germany that are admitted to perform these types of measurements. The service is also available for measurements on customer antennas.

Why calibrate antennas?

Calibrated antennas are primarily required for high-precision field strength measurements that determine the radiated disturbance of communications and T&M products as well as of household electronics and automotive equipment (FIG 1). The measurements verify the electromagnetic compatibility (EMC) of products. All Rohde & Schwarz products undergo EMC testing during development and, by random sampling, also during manufacturing.

The applicable standards are defined in national and international rules and regulations. They include not only the limit values to be observed, but also the relevant test methods. For many electronic products, CISPR standards function as a basis for determining EMC conformity. CISPR 22 and CISPR 11 deserve particular mention here, and most instruments from Rohde & Schwarz are qualified in line with these standards. These CISPR standards stipulate measurement of the free space antenna factor. With this background in mind, Rohde & Schwarz prepared its open area antenna test site in Memmingen to meet the requirements for characterizing test antennas by using the free space antenna factor. The required high-precision T&M equipment was developed, partly also in cooperation with the Ulm University of Applied Sciences [1] [2]. Rohde & Schwarz test antennas and, as a service, also customer antennas can now be calibrated with unsurpassed quality and in line with DKD requirements.

FIG 1 Radiated disturbance measurements with calibrated antennas.

Crucial: the free space antenna factor

The antenna factor describes the relationship between the electric field strength at the antenna site and the voltage at the antenna output (50 Ω). The limit values in radiated disturbance measurements are always expressed as maximum permissible field strengths. Since the field strength can only be determined indirectly from the voltage at the antenna output, a suitable transducer factor – i.e. the antenna factor *K* – is needed to convert the voltage to field strength:

$$K = \frac{E}{V}$$

K: antenna factor
E: electric field strength at antenna site
V: voltage at antenna output (50 Ω)

The interaction between the antenna and its environment complicates the measurements. Environmental influences are generally difficult to determine mathematically and, consequently, difficult to correct. For this reason, the free space antenna factor is defined for ideal conditions, i.e. without interfering environmental influences, and measurements are carried out under special conditions in which environmental influences can theoretically be calculated. Such conditions exist in the half space above an ideally conductive and planar surface, allowing results to be corrected by the systematic environmental effect. Another method is to position the antennas geometrically such that the ground influence can be neglected (see "Test methods" box for more information).

Open area test site with optimum conditions

The Rohde & Schwarz open area test site in Memmingen, at which antenna calibrations are performed, covers an area of 500 m^2 (FIG 2). Its fully metallic surface exhibits a maximum unevenness of ±8 mm. The mobile and remote-controllable masts permit test distances of one to ten meters and antenna heights between one and six meters. For high-precision measurements, the mast drives can be lowered below the ground plane. This and the nearly reflection-free environment around the test site yield excellent conditions for calibrations with utmost accuracy.

FIG 2 The open area antenna test site (20 m × 25 m) of Rohde&Schwarz Messgerätebau GmbH in Memmingen offers optimum conditions for high-precision antenna calibrations.

Unsurpassed accuracy

Crucial to the achievable accuracy (measurement uncertainty) in an antenna calibration is the selection of the appropriate calibration method. For a given geometry of the test platform, this method decisively depends on the antenna type and the frequency range. The smallest measurement uncertainty that can be stated for the Rohde&Schwarz test site – as verified by the PTB – is 0.35 dB. Accredited measurements can be performed in a range from 20 MHz to 18 GHz.

Jürgen Gaßner

References
[1] Master's thesis (in German only): Validierung eines neuen Antennen-Kalibrierplatzes nach CISPR 16-1-5 und Vorbereitung für die Akkreditierung beim DKD (Validation of a new antenna calibration test site in line with CISPR 16-1-5 and preparation for accreditation by the German Calibration Service), Diana Groborsch, 02/2005.
[2] Master's thesis (in German only): Bestimmung von Antennendiagrammen auf dem Freifeldmessplatz „Darast" der Rohde&Schwarz Messgerätebau GmbH (Measurement of antenna patterns on the Darast open area test site of Rohde&Schwarz Messgerätebau GmbH), Josef Breher, 01/2009.

More information
For details, see the accreditation certificate at http://www.dkd.eu/laboratorien/en/pdf/16101.pdf.
Information about the calibration of Rohde&Schwarz and customer antennas is available at http://www.memmingen.rohde-schwarz.com/en/services/DKD calibration.

Test method

The basic method for determining the antenna factor is the three-antenna method, which is employed to measure the antenna factors of three, usually different, antennas. The method relies on solving a system of equations with three unknowns. The three unknown antenna factors are determined using three independent measurements (antenna combinations 1–2, 1–3 and 2–3). The exact application of this method is described in various standards, e.g. in ANSI C63.5, SAE ARP958 or, in future, CISPR 16-1-6.

As to the above method, a basic distinction is made between measurements with ground reflection (FIG 3) for omnidirectional antennas and the classic free space method (FIG 4) for antennas with a pronounced directional pattern. In the case of the free space method, the ground reflection is eliminated through an appropriate arrangement of the test setup and, if necessary, the use of a ground absorber.

Rohde&Schwarz is accredited for both methods. With broadband antennas, the two methods are partly combined to minimize measurement uncertainty in all frequency ranges.

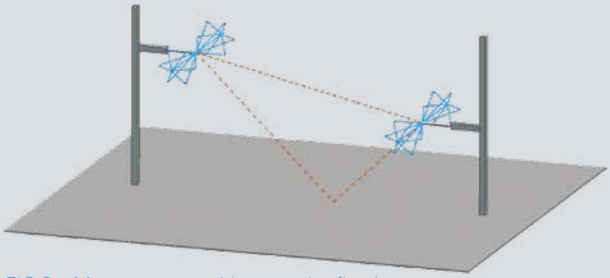


FIG 3 Measurement with ground reflection.

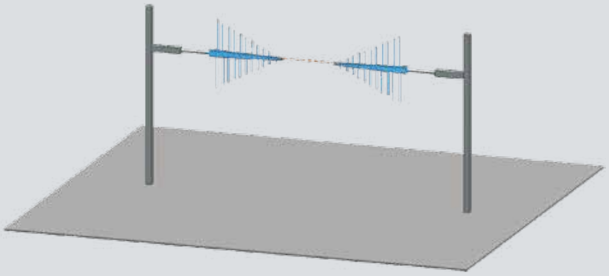


FIG 4 Measurement without ground reflection.

Change at the helm of Rohde&Schwarz: Manfred Fleischmann succeeds Michael Vohrer

After a long career with Rohde&Schwarz spanning 35 years, including seven years on the Executive Board and five years as its Chairman, Michael Vohrer (62) has retired. An electrical engineer by profession, Vohrer played a key role in the company's success throughout the years. One of his major contributions was achieving market leadership in the field of mobile radio test and measurement when he headed that division. The company's entry into the oscilloscope market, which is now underway, marks the end of his long and productive career. On July 1, 2010, his colleague Manfred Fleischmann became President and CEO. Gerhard Geier, previously Head of the Radiomonitoring and Radiolocation Division, has been newly appointed to the Executive Board. Managing partner Christian Leicher remains on the Executive Board.

Michael Vohrer goes into well-earned retirement.

A proven T&M expert, Michael Vohrer mapped out important new paths for Rohde&Schwarz: He launched the R&S®CMU200 universal radio communication tester, one of the company's all-time best selling products. Vohrer is leaving the company for personal reasons: "Now that we have successfully guided the company through the economic crisis and I see that things are back on the right track, I would like to start enjoying my well-earned retirement." At the beginning of the new fiscal year on July 1, 2010, Manfred Fleischmann assumed the role of President and CEO. Fleischmann joined the company 25 years ago, and has been a member of the Executive Board since 2005. In this capacity he was responsible primarily for production, logistics and materials management. Before that, Fleischmann, who is an engineer by profession, held various management positions in quality assurance. "My goal is, together with my colleagues, to maintain the company's economic independence and growth. Driving us toward this goal are both the company's global positioning (for example, our expansion activities in Asia) and its innovative products, such as the newly launched oscilloscopes, which will also open up new markets."

The new Rohde&Schwarz Executive Board: Gerhard Geier, Manfred Fleischmann (Chairman) and Christian Leicher (from left).

Gerhard Geier is now on the Executive Board. Also an engineer, Geier has been with the company since 1968 and has been a member of Corporate Management for 16 years as Head of the Radiomonitoring and Radiolocation Division. Under his leadership, this division advanced to take its place alongside Test&Measurement, Broadcasting and Secure Communications as one of the four main pillars of the company. With Geier in charge, Rohde&Schwarz most recently entered the field of satellite monitoring and established international R&D capacity in France and Singapore to complement the development activities in Germany. With the new Executive Board, comprised of Manfred Fleischmann, Christian Leicher and Gerhard Geier, Rohde&Schwarz will continue to rely on the proven combination of long-standing experience and innovative expertise.

Rohde&Schwarz China launches open lab

Since the beginning of the year, Rohde&Schwarz China has been operating an open lab in Bejing. The lab is accessible to potential customers and partners at no cost. They can perform experiments and validate their test solutions. This enhanced proximity to the customer should also help Rohde&Schwarz identify new applications. Moreover, Rohde&Schwarz offers support and consulting for the users. The lab is equipped with test and measurement equipment and the associated accessories. The main focus is wireless communications, aerospace and defense, audio and video, plus EMC.

The open lab team.

New offices in Asia

Rohde&Schwarz Japan has moved into a new office in Tokyo. Headquarters and the Tokyo Sales Office now occupy 880 rather than 570 sqm. The new, representative site should increase Rohde&Schwarz Japan's brand image.

Rohde&Schwarz Korea has opened another office in Darjeon. The objective is to support customers in central and southwest Korea even better.

Samsung produces USB modems for LTE networks with T&M equipment from Rohde&Schwarz

The Korean electronics manufacturer Samsung is the first company to deliver USB modems for commercial LTE networks. Samsung produces these modems by using the R&S®CMW500 wideband radio communication tester from Rohde&Schwarz. It is the only instrument on the market that simulates a base station in the operating mode, allowing transmitter signal quality and receiver sensitivity to be subjected to high-precision tests in the signaling mode. This helps to ensure that all processes such as registration in the network or connection setup function in compliance with standards. The first LTE networks are planned for launch in 2010.

Rockwell Collins names Rohde&Schwarz as Indirect Commodity Supplier 2010

This was the second time that Rohde&Schwarz USA was awarded this title by the Rockwell Collins electronics group. The Supplier of the Year Award is recognition for significant contributions by suppliers. Quality, delivery, total cost of ownership, delivery time and customer service were evaluated. The award was presented during the Annual Supplier Conference by Jeff Moore, Senior Vice President of Operations at Rockwell Collins.

Tesat-Spacecom awards supplier prize to the Teisnach plant

The Tesat-Spacecom aerospace company in Backnang, Germany, which is a subsidiary of EADS, awarded the 2009 supplier prize to the Teisnach plant. Rohde&Schwarz was selected best among the 500 evaluated suppliers. The decisive factors for this success are the continuous process improvements and the continuous training of employees.

China Central Television (CCTV) uses R&S®DVM400

The national Chinese TV provider CCTV is setting up transport stream monitoring for its headend in its new TV center. To do this, CCTV selected the R&S®DVM400 digital video measurement system from Rohde&Schwarz. The objective is to install a monitoring system for 64 transport streams. Currently, three transport streams are already monitored in realtime at one site by means of various routers. Since 2003, CCTV has been operating 14 program channels, six of which are occupied in trials with pay TV and one channel with an HDTV program. In total, CCTV reaches 90 % of the population via satellite.

Rohde&Schwarz Messgerätebau receives Bavarian Quality Award 2010

Rohde&Schwarz Messgerätebau for the first time won the Bavarian Quality Award, which was established in 1993. Altogether 327 Bavarian production companies from industry had been nominated for their outstanding achievements in the areas of quality and quality management. The Memmingen production plant attained a top ranking. It had to prove its expertise in a number of disciplines, including strategy, market image, procurement, production and order handling.

Rohde&Schwarz receives Frost&Sullivan Award

Frost&Sullivan Asia Pacific has named Rohde&Schwarz as the "Secure Military Communications Vendor of the Year 2010". Rohde&Schwarz achieved excellent results in all evaluation categories. Since 2008, the analyst and consulting group has been issuing this award for best practices in aerospace and defense. Frost&Sullivan evaluates factors such as functionality, quality and complexity, service, support and training, or extra service for the customer. Brand recognition, awards and successes also play a role. Rohde&Schwarz was designated winner from among the 17 competing organizations.

Australian Defence Magazine honors Rohde&Schwarz Australia

The Australian Defence Magazine (ADM) has selected Rohde&Schwarz Australia and its customer Ground Telecommunications Program Office (GTESPO) as award winners. The two companies received the 2009 DMO/Industry Team of the Year Award. In their first joint effort, GTESPO and Rohde&Schwarz formed a tightly cooperative team. The objective was to deliver a transportable ATC system for the Australian Air Force. ADM, Australia's leading magazine for the defense industry, praised especially how the team mastered the challenges of the tight schedule despite long product delivery times.

Paul Barton, Communications Systems Manager at Rohde&Schwarz (2nd from right), with the certificate. (Photo courtesy of Australian Defence Magazine.)