NEWS

205/12

ROHDE&SCHWARZ

Tracking down interference – with a handheld device

The new portable direction finder leaves no signal undetected – whether in vehicles or on foot

WIRELESS TECHNOLOGIES

Analog handheld tester for routine tests on FM radios

WIRELESS TECHNOLOGIES

Cost-efficient MIMO OTA measurements: reference test system demonstrates feasibility

STUDIO TECHNOLOGY

File-based workflows in TV studios with digital video servers and storage systems

NEWS

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Mühldorfstrasse 15 · 81671 München

Customer Support
Europe, Africa, Middle East | +49 89 4129 123 45
customersupport@rohde-schwarz.com
North America | 1 888 837 87 72 (1 888 TEST RSA)
customer.support@rsa.rohde-schwarz.com
Latin America | +1 410 910 79 88
customersupport.la@rohde-schwarz.com
Asia/Pacific | +65 65 13 04 88
customersupport.asia@rohde-schwarz.com

www.rohde-schwarz.com

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Cover feature

Locating the sources of interference and other signals requires the greatest possible mobility and flexibility – especially in applications involving coarse location tracking from a vehicle, followed by fine tracking on foot up to the location of a signal source, such as in buildings. This difficult task can be made a lot easier by a small, portable, high-performance direction finder. And now, one is finally available.

The new R&S®DDF007 portable direction finder is the first of its kind. It turns any vehicle into a high-precision mobile direction finder in just a few minutes. On foot, for example inside buildings or in difficult terrain, this highly compact, easy-to-carry instrument helps operators pinpoint the location of a signal source. With its integrated wideband receiver and compact DF antennas, this small giant is unique on the global market. Designed for flexibility and a wide range of applications, the R&S®DDF007 redefines what modern direction finding can do.

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The new MIMO OTA reference test chamber at the Rohde&Schwarz plant in Memmingen. It demonstrates the feasibility of inexpensive MIMO OTA measurements (page 14).

High-end systems from DVS Digital Video Systems GmbH, a Rohde&Schwarz subsidary, are used at all strategic positions in the new production chain of TeleZüri (page 35).

Versatile and handy portable analog tester

When field personnel have to rely on secure radiocommunications, they make sure that their radios are routinely tested for proper functioning – either in the depot or in the field. An easy task with the R&S®CTH handheld tester. No expert knowledge is needed – simply connect the radio to the tester, and transmitter and receiver measurements start immediately.

The "Swiss army knife" of analog radio testers

The compact, robust, battery-operated R&S®CTH (Fig. 1) is a versatile functional tester for analog FM radios. The easy-to-use tester with its clearly displayed measurements results is an indispensable field tool. Its small size (10 cm × 20 cm × 3.7 cm) and low weight (530 g) make it easy to stow and carry. The handy R&S®CTH also features a perfect mix of functions. It provides everything users need to test analog radios in the field – from transmitter and receiver measurements to distance-to-fault measurements to field strength measurements. Its low power consumption ensures long operating and standby times.

Fig. 1 The R&S®CTH performing measurements on a radio.

Key features of the R&S®CTH

Extensive measurement capabilities

- Transmitter frequency
- Transmit power and antenna matching
- Cableless transmitter test (R&S®CTH200A)
- Cable fault finder (R&S®CTH200A)
- Voice reporting (R&S®CTH200A)

Handy and ergonomic

- Well lit display
- Handy dimensions
- Long operating and standby times
- Ergonomic operation
- Transit case

Rugged and all-weatherproof

- Robust and shockproof
- Splashproof
- Wide temperature range

Fig. 2 The R&S®CTH with transit case and accessories.

Testing of all basic radio functions

During transmitter measurements, the R&S®CTH determines the transmitter frequency and the radiated power. It can measure power between 0.1 W and 50 W in the 30 MHz to 512 MHz frequency range. The reflected power measurement allows the antenna matching to be determined. For receiver measurements, the R&S®CTH generates an FM signal that includes an audible test sound as well as a sound that is below the audible spectrum which is used for the squelch function. For sensitivity measurements, users can vary the generated signal level in 0.5 dB steps. The R&S®CTH tests all basic radio functions needed for error-free operation. It is immediately ready to use and performs the required measurements within seconds.

The tester can measure transmitter frequency over the air interface and displays the field strength as a bargraph. This functional test is very useful since it also allows users to test radios that are installed in a vehicle, for example. The user simply switches on the radio and pushes the talk key. The R&S®CTH will then check the transmit path and can detect a transmitter failure, an incorrect transmitter frequency or even an improperly connected antenna.

The tester's cable fault finder is designed for coaxial cables with lengths of up to 480 m and can be adapted to different types of cables using the adjustable velocity factor. This measurement helps to locate any cable faults between the radio and distant antennas.

Easy operation and robust design

With a minimum of keystrokes, the user can navigate through the tester menu, make settings or start measurements. If the display cannot be read, e.g. when the R&S®CTH is in a location that is difficult to look into, the tester can transmit the measurement results via the RF connection to the radio for voice reporting. Its mechanical and electrical robustness make it ideal for use in the field, even under harsh environmental conditions.

Well-protected in practical transit case

A robust, watertight transit case in line with MIL-STD-810F (Fig. 2) is available for the R&S®CTH. The transit case features an automatic air pressure equalizing valve to make sure that the case opens easily even if air pressure conditions have changed. The tester and its accessories are protected by perfectly fitting foam material and are immediately ready for use. Another optional accessory consists of a 50 W load resistor, cables and BNC adapters.

The R&S®CTH comes in two models; Fig. 3 shows the various functions.

Markus Hendeli; Gottfried Holzmann

Fig. 3 Scope of functions of the two models.

	R&S®CTH100A	R&S®CTH200A
Transmitter measurements		
Forward power	•	•
Reflected power	•	•
Frequency counter	•	•
Receiver measurements	fixed RF level	adjustable RF level
Squelch	•	•
Demodulation	•	•
Additional measurements		
Over the air	–	•
Distance to fault	–	•
Voice reporting	–	•

RF test applications for the early development phase of mobile stations

The higher spectral efficiency, extended bandwidth and MIMO concepts used in the LTE wireless standard mean that tests for the relevant chipsets and mobile stations become more complex. The R&S®CONTEST software platform efficiently reduces test time and expense. Using the convenient user interface, predefined R&D test applications can be easily combined to set up reconfigurable, customer-specific RF test scenarios.

A wide range of special tests in each development phase

The requirements for the many tests performed during the development of mobile stations (MS) until certification vary widely. In the beginning, the emphasis is on customer-specific tests. As development progresses, the focus shifts to tests in line with the 3GPP TS 36.521-1 specification [1]. Test cases specific to network operators are becoming more important and are often a modified form derived from TS 36.521-1.

In the first phase of MS development, for example, individual transmitter and receiver building blocks need to be tested in non-signaling mode. For this purpose, downlink signals are generated in line with the LTE test specification, the measurement values from the MS are read out, and the uplink signals transmitted by the MS are analyzed.

Measurement of transmitter characteristics includes checking the signal power, the signal quality and the radiated frequency spectrum. Transmission quality depends on many factors. Satisfactory transmitter optimization requires precise measurement analysis under various conditions, including in particular different types of modulation (QPSK, 16QAM, 64QAM) and different numbers and offsets of resource blocks.

Initial receiver measurements, such as ACK/NACK throughput ratio and discontinuous transmission (DTX), are also conducted in non-signaling mode. The number of samples is preset and the receive quality is analyzed on the basis of the ACK/NACK information in the MS. Propagation conditions such as interference and noise must be generated in realtime, e.g. using the R&S®SMU200A vector signal generator.

Automation using the R&S®CONTEST software platform and predefined R&D test applications

It is possible to get a quick handle on the basic characteristics of an MS with a few manually performed initial measurements. But when it comes to recording long, complex measurement sequences or reproducibly repeating single measurements, users often feel the need for automation.

Rohde&Schwarz addresses this need with the R&S®CONTEST software platform and its convenient graphical user interface. Users can select from a wide range of currently 60 R&D test applications – from simple instrument settings to complete test cases. The parameter sets have been tailored to the respective test application for ease of use. The test and stimulus scenarios mentioned above can be quickly set up by combining test applications from the LTE signaling, measurement, interferer and miscellaneous groups (Fig. 1).

The built-in intuitive test plan editor allows users to combine test applications in a specific order and also to control the test flow. Graphical programming tools let users add loops, conditions and comments. Each test plan saves parameters that can be declared globally and exchanged between test applications. It is also possible to add small C# code blocks, for even more flexibility. Test plans can be stored, copied and rerun at any time.

Perfect combination: the R&S®CONTEST software platform and scalable test systems

The R&S®CONTEST software platform with its numerous instrument drivers supports a broad range of T&M instruments (see box on page 9), making it the ideal solution for controlling scalable test systems. Since these T&M instruments are also used for conformance test cases, there is a high degree of consistency in all phases – from R&D to pre-compliance to conformance testing.

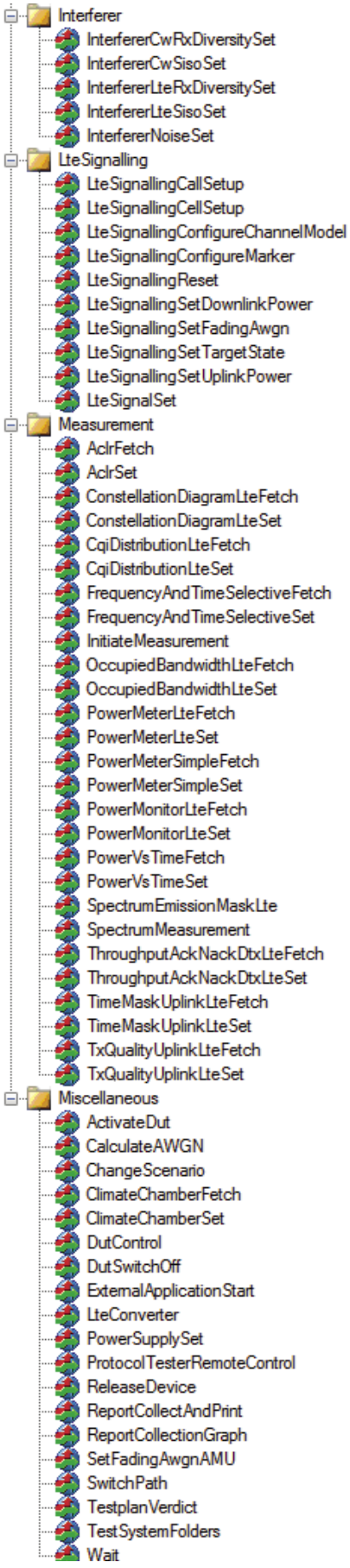


Fig. 1 Quick and easy setup of test scenarios using the R&S®CONTEST software platform's predefined test applications.

One task that continually recurs when combining test applications for test systems is interconnecting the instruments. The resulting path transmissions have to be measured and taken into consideration during signal stimulation and measurement. The platform also provides applications for calibration and functional testing of the system.

Complexly interconnected instruments and RF components are easily handled with the R&S®CONTEST platform. Modeling of RF components and their connections ensures that the correct paths are selected and that the connected instruments are operated in the proper range based on the path properties. The software continually checks the feasibility of the requirements placed on the test system.

As the development of an MS progresses, measurements are performed in signaling mode, i.e. after a connection has been established between the simulated base station and the MS. Developers have more flexibility when performing measurements because they do not need to follow the LTE specifications exactly. They can adapt test scenarios to the current development phase of a DUT, e.g. with respect to the support

The R&S®CONTEST software platform supports the following instruments:

Signal generators
R&S®SMU200A, R&S®SMBV100A, R&S®SMF100A, R&S®SMP

Fading simulators
R&S®AMU200A

Signal / spectrum analyzers
R&S®FSQ, R&S®FSG, R&S®FSU, R&S®FSP

Network analyzers
R&S®ZVK, R&S®ZVA

Communications testers
R&S®CMW500

Power supplies
R&S®NGMO, R&S®NGSM

Power meters
R&S®NRP-Z, R&S®NRVD

RF combining units
R&S®TS-CONN, R&S®CMW-Z24

RF switch platforms
R&S®OSP, R&S®ISSCU, R&S®WSSCU, R&S®SSCU-MIMO

Climatic chambers
Vötsch, Espec, Thermotron, TestEquity

of the 3A test mode or signaling characteristics. A convenient feature is the easy parameterization of R&D test applications as shown in Fig. 2. In this scenario, the signal-to-noise ratio (SNR) is decreased until the ACK/NACK throughput ratio is less than 95 %.

The R&S®CONTEST test report has been specially designed to meet R&D requirements. The standard report contains a sequential description of test sequences and conclusive graphs. Users can add comments to the report and, using the intuitive report navigation, they can zoom in to view waveforms in detail and add comments (Fig. 3).

When development of the MS nears completion, precompliance tests in line with 3GPP TS 36.521 [1] need to be performed. During these tests, more test conditions are simulated, e.g. different fading models and environmental influences such as temperature, humidity and power supply. The R&S®CONTEST test cases are based on the same measurement functions as the R&D test applications, ensuring easy comparison of measurement results. An MS is one step closer to certification when it has passed a number of tests in line with TS 36.521. The Global Certification Forum (GCF) and the PCS Type Certification Board (PTCRB) stipulate which tests have to be performed.

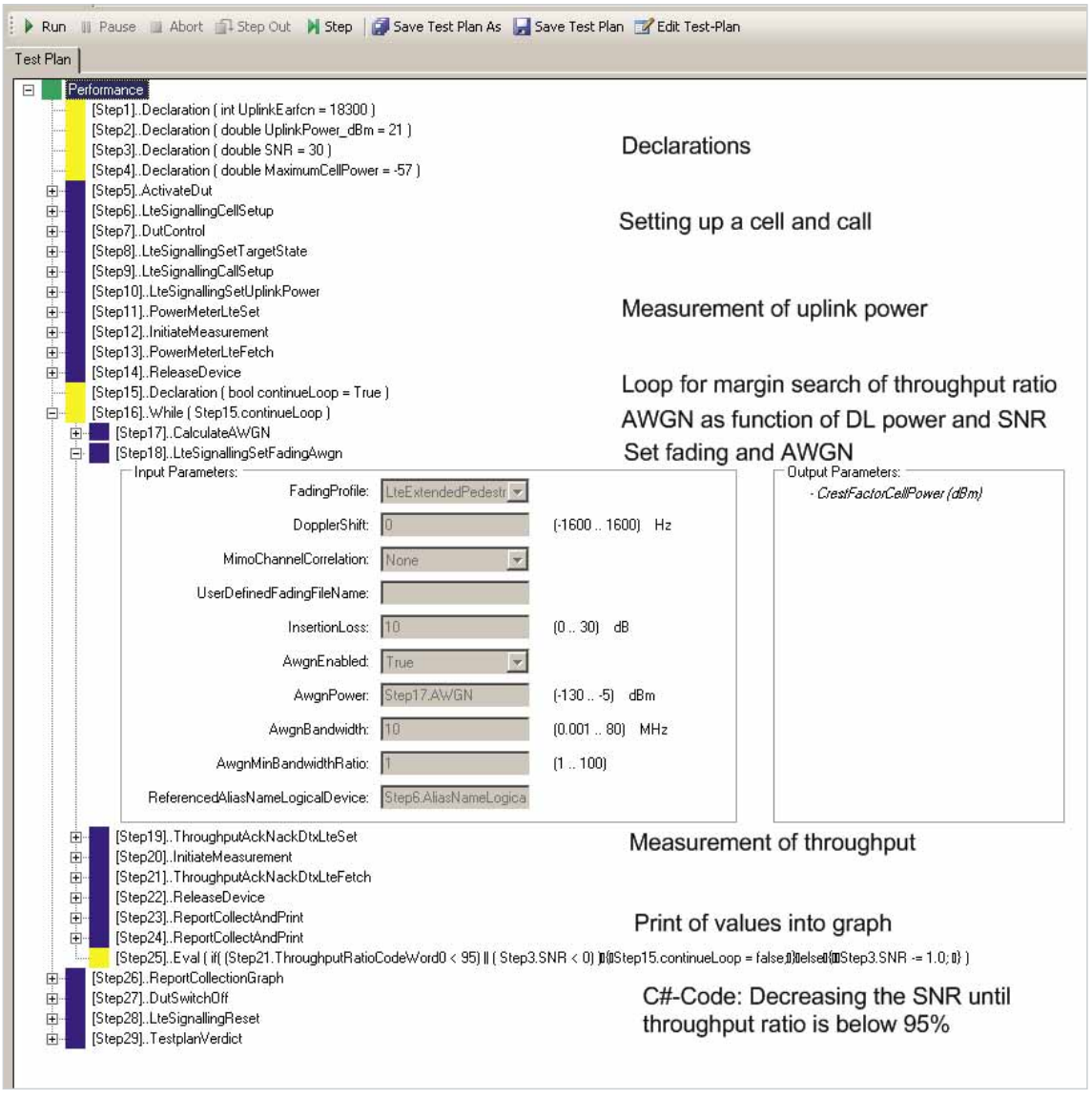


Fig. 2 Throughput measurement test scenario.

Summary

Simple operation, flexibility in test applications and automated test sequences that are easy to combine enhance the efficiency of tests in the early development phase of an MS. The R&S®CONTEST software platform can be used for scalable test systems all the way through certification testing. The software platform can also be used for simultaneous voice and data LTE (SVDLTE) measurements. It works perfectly together with the R&S®TS8980 test system family, which consists of the R&S®TS-RRM radio resource management, R&S®TS8980L1 layer 1 RF tester, R&S®TS8980LBS location based services and R&S®CMW-PQA performance quality analysis test systems [2].

Stefan Ballmann; Detlef Wiese

References

[1] 3GPP 36.521-1 V9.3.0 test specification, "User equipment (UE) conformance specification; radio transmission and reception, part 1: conformance testing".

[2] R&S®TS8980 RF conformance test system family for LTE and WCDMA/HSPA+. Article available on the internet ("News&Events", "R&S News Magazine", No. 202).

Fig. 3 R&S®CONTEST test report with comments.

Description: #16 Step21 - ACLR Fetch

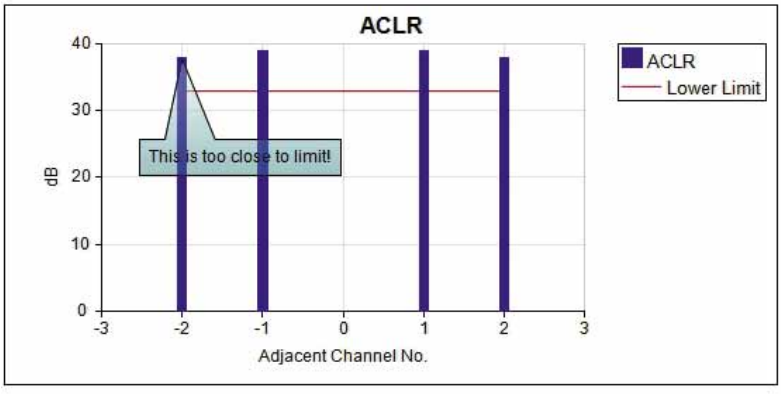
Input Parameter:

Name	Value
LowerLimitAclr	33 dB
Timeout	15 s
ReferencedAliasNameLogicalDevice	Aclr-FSx1

*** Teststep 1 started ***

ACLR Measurements:

Adjacent Channel No.	Center Frequency	Measured Value Relative	Measured Value Absolute	Lower Limit	Evaluation Result
0	1.95 GHz	0 dB	21 dBm	none	Not Evaluated
-2	1.93 GHz	38 dB	-17 dBm	33.000 dB	Inside
-1	1.94 GHz	39 dB	-18 dBm	33.000 dB	Inside
1	1.96 GHz	39 dB	-18 dBm	33.000 dB	Inside
2	1.97 GHz	38 dB	-17 dBm	33.000 dB	Inside



Test-Step Result: Inside

*** Teststep 1 finished ***

Compact system for measuring radiated spurious emissions on LTE devices

The European R&TTE Directive and standardization bodies such as the ITU specify radiated spurious emission (RSE) measurements for wireless communications devices. The conventional approach to measuring RSE uses notch filters to suppress strong wireless carrier signals. However, this approach is impractical for Long Term Evolution (LTE) which uses 258 combinations of frequency bandwidths. Rohde&Schwarz now presents a new test concept that significantly reduces costs and effort.

Strict requirements: high sensitivity …

Regulatory authorities do not make any compromises when it comes to specifications for RSE measurement. And for good reason: If wireless devices radiate outside the specified frequency ranges, they will interfere with other instruments, radio systems or services. Manufacturers, test houses and regulatory authorities use standard-specific RSE tests to check whether wireless devices fulfill these conditions.

For the LTE wireless standard, these measurements are not easy to implement. Test systems must have a high dynamic range. The relevant RSE tests have a defined measurement range from 30 MHz to 12.75 GHz, with an equivalent transmit power of –30 dBm. The inherent noise of test systems must be as low as possible to have a sufficient measurement safety margin at the stipulated limit of –30 dBm. This can only be realized with a built-in low noise amplifier (LNA), especially because of the relatively high and frequency-dependent free-space path loss at a measurement distance of three meters. Cable attenuation has an impact, too, even if it is partially compensated by the antenna gain.

… combined with high signal levels

High signal levels represent a further difficulty for RSE measurements. A transmitting wireless device radiates the LTE carrier signal. In the worst case it has a low frequency of 800 MHz in power class 3, i.e. at the maximum output power of 23 dBm plus/minus tolerances. These strong signals must not interfere with the measurement.

For conventional wireless standards such as GSM and WCDMA, wireless devices are tested using notch filters in front of the LNA to suppress these signals. The passband of these filters features very steep slopes to permit accurate measurements at carrier offsets of ±2 channels. However, this conventional measurement approach has several disadvantages:

- Each frequency band and bandwidth requires a separate filter
- Only one carrier frequency measurement per filter can be performed without time-consuming retuning
- Steep-sloped filters are bulky and need a lot of space
- The many signal paths and RF relays reduce the mean time between failures (MTBF)
- Calibration is time-consuming and costly

For GSM, this measurement approach typically requires four notch filters. The WCDMA standard with its overlapping frequency bands requires nine filters – and a corresponding amount of space.

This measurement method is impractical for LTE which has 43 defined frequency bands, each with six bandwidths. 258 notch filters would be needed to cover all frequency bandwidth combinations, a space-consuming and costly solution.

The compact solution from Rohde&Schwarz

That is why Rohde&Schwarz has developed a new test concept for radiated spurious emission measurements on LTE devices. First, it takes advantage of the fact that LTE operates at a lower output power than GSM and WCDMA. Second, Rohde&Schwarz has the right receiver for this application: the R&S®ESU EMI test receiver which offers an exceptionally high sensitivity of typically –155 dBm/Hz and a high dynamic range of 80 dB in the relevant frequency range.

Fig. 1 Extremely compact: Equipped with the new R&S®OSP-B155 plug-in filter module, the 2 HU R&S®OSP130 open switch and control platform covers all LTE bands.

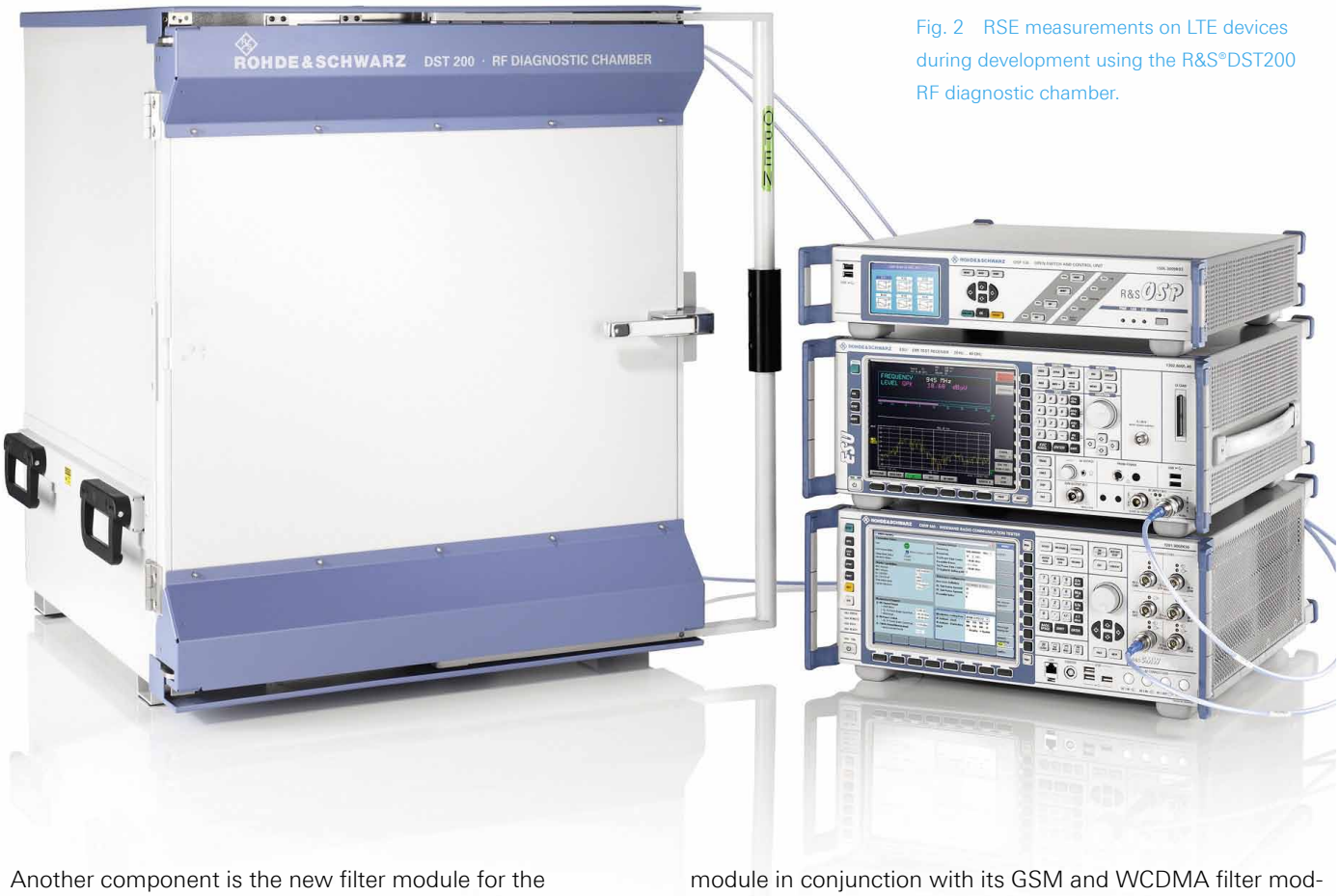


Fig. 2 RSE measurements on LTE devices during development using the R&S®DST200 RF diagnostic chamber.

Another component is the new filter module for the R&S®OSP130 open switch and control platform (Fig. 1). The R&S®OSP-B155 filter module shifts the received signal spectrum into the optimum power range to allow full use of the dynamic range of the connected R&S®ESU EMI test receiver. RSE measurements can be performed with sufficient sensitivity without any notch filters.

The R&S®OSP-B155 has a built-in LNA to amplify small signals and can simultaneously receive high-level signals. The result is higher sensitivity and lower noise floor. A highpass filter prevents the harmonics of the built-in LNA from distorting measurement results. The module takes up two of the three slots on the R&S®OSP130. To expand an existing filter matrix to cover LTE signaling, the module can simply be connected to a free filter path. The rest of the matrix is set to through. The R&S®OSP-B155 option features an additional signal path which can be used to expand the filter matrix. The R&S®OSP130 open switch and control platform processes the signals.

The R&S®EMC32 EMC measurement software adjusts the level during measurement to prevent overloading. In combination with the R&S®CMW500 wideband radio communication tester, it also controls LTE signaling.

The R&S®OSP-B155 filter module is also included in the R&S®TS8996 RSE test system. This system uses the filter module in conjunction with its GSM and WCDMA filter modules to test wireless devices for compliance with the GSM, WCDMA and LTE standards. Plus, the R&S®OSP-B155 can be used for measuring RSE on LTE devices during development, using a test setup with the R&S®DST200 compact RF diagnostic chamber (Fig. 2).

Summary

The R&S®OSP-B155 filter module option for the R&S®OSP130 open switch and control platform is designed to be used in combination with the R&S®EMC32 EMC measurement software and the R&S®ESU EMI test receiver from Rohde&Schwarz. All RSE measurements specified for LTE devices can be performed using this compact and cost-efficient test setup which seamlessly integrates into existing RSE filter matrices. In combination with the R&S®CMW500 wideband radio communication tester, which provides LTE signaling, the setup can be integrated into an LTE test system as an independent RSE measurement system.

Per Isacsson

The article starting on page 16 shows OTA and RSE measurements using the R&S®DST200 RF diagnostic chamber. The article starting on page 21 presents other new modules for the R&S®OSP120 open switch and control platform.

MIMO OTA reference test system at the Rohde&Schwarz plant in Memmingen

MIMO OTA testing has not yet been fully standardized. The CTIA in the USA and the 3GPP RAN4 working group are in the process of reviewing a range of proposals. Rohde&Schwarz has suggested to both bodies an inexpensive method of MIMO OTA testing that centers on 3D evaluation. Its feasibility has been demonstrated in the new reference test chamber at the Rohde&Schwarz plant in Memmingen. Customers are invited to have their wireless devices tested by Rohde&Schwarz so that they can compare the results with those obtained using other test methods*.

3D evaluation method indispensable for realistic test results

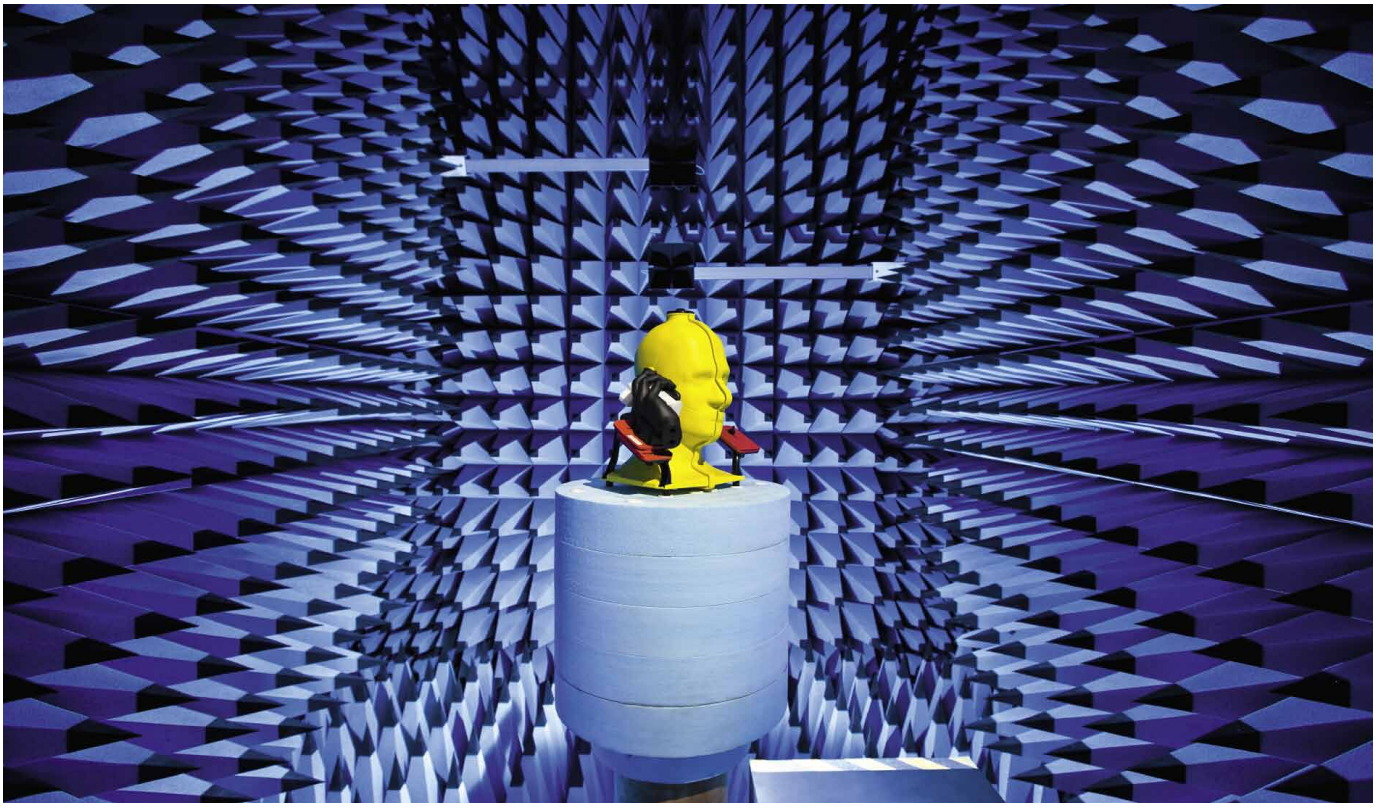
In real-life situations, wireless devices are operated in any orientation. Due to differences in propagation conditions, the signals received by devices may come from any direction. In order to be able to assess the devices' antenna properties in connection with multipath reception at any receive angle, 3D evaluation is essential. To simulate real-life operating conditions, it must be possible to position both transmit test antennas at any point in a spherical space around the device under test.

R&S®TS8991 MIMO OTA performance test system

The R&S®TS8991 (Figs. 2 and 3) also supports MIMO OTA testing. It requires a test chamber based on a conventional SISO OTA test chamber with one conical cut positioner. A second dual-polarized test antenna with associated positioner for the elevation supplies a second downlink signal. The test antennas can be moved independently of each other, allowing a wide angle of arrival spread for the generated signals. The DUT is attached to an azimuth positioner containing a communications antenna for the uplink.

* Register at customersupport@rohde-schwarz.com or call Tel. +49 89 41 29 12 345

Fig. 1 The new MIMO OTA reference test chamber at the Rohde&Schwarz plant in Memmingen.



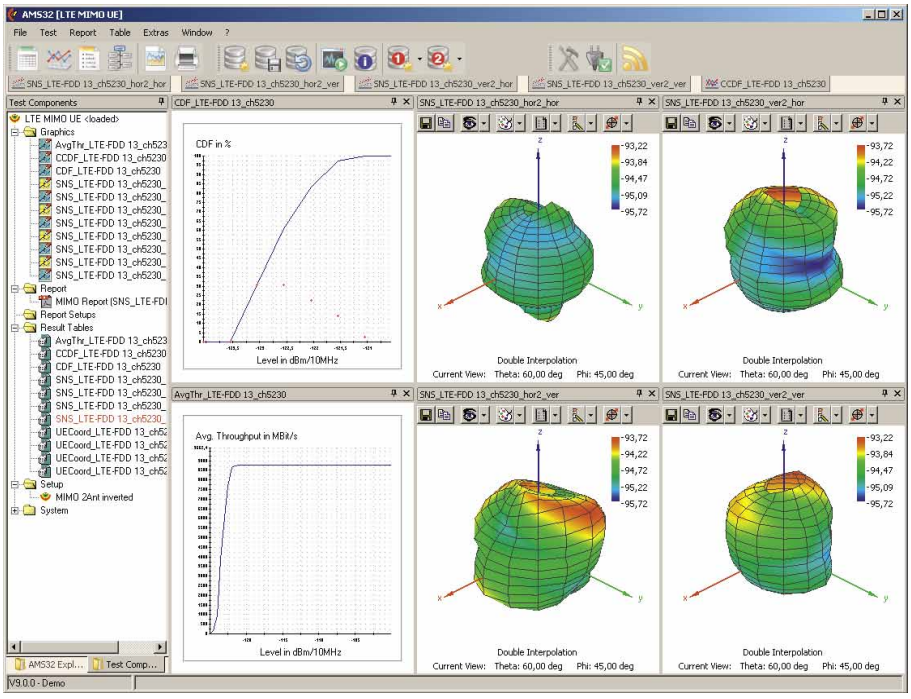


Fig. 2 Results of a MIMO OTA test using the R&S®AMS32 system software.

Fig. 3 The R&S®TS8991 test system for MIMO OTA tests.

New reference test chamber

The Rohde&Schwarz MIMO OTA test method was originally checked and optimized in a first-generation test chamber measuring 5 m × 5 m × 5 m. Numerous test series were conducted to verify the stability of the test results and to compare different MIMO devices. Rohde&Schwarz took part in a round robin test organized by the 3GPP RAN4 working group, in which each participant was provided with five different LTE USB modems. The purpose of the test was to obtain results for identical DUTs using different MIMO OTA test methods. The results provided valuable input for the 3GPP MIMO OTA test standard.

In late 2011, Rohde&Schwarz commissioned a new reference test chamber (Fig. 1), located in a separate building. The anechoic chamber is specified for the frequency range from 400 MHz to 6 GHz, making it also suitable for tests in the field of broadcasting standards.

Summary

The new MIMO OTA reference test chamber is a permanent facility, set up to optimize the Rohde&Schwarz MIMO OTA test method. Customers are invited to have their wireless devices tested there. The results allow comparisons with other test methods proposed to the CTIA or 3GPP.

Erwin Böhler; Adam Tankielun

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[1] Cost-effective OTA performance testing of MIMO-enabled LTE devices. NEWS (2011) No. 203, pp. 14–17.
[2] OTA performance measurements of MIMO-enabled devices. Rohde&Schwarz application brochure: www.rohde-schwarz.com (search term: TS8991).
[3] Rohde&Schwarz White Paper 1SP12; Two-Channel Method for OTA Performance Measurements of MIMO-Enabled Devices; www.rohde-schwarz.com (search term: 1SP12).

R&S®DST200 RF diagnostic chamber for automated OTA and RSE measurements

An automated 3D positioner is now available for the R&S®DST200 RF diagnostic chamber. This opens the door to automated OTA and RSE measurements in R&D and quality assurance. The test chamber is the most compact on the market and allows users to perform measurements directly on the lab bench. Users will especially like the excellent correlation of results achieved with the R&S®DST200 with those obtained with larger OTA test chambers.

Over-the-air (OTA) measurements

Every wireless device has to undergo OTA testing before it is put on the market. Tests have been specified by CTIA, and similarly by 3GPP, for the three-dimensional, angle-dependent measurement of key parameters such as total radiated power (TRP) and total isotropic sensitivity (TIS). These tests are usually carried out in an RF shielded environment. They deliver conclusive information about how a wireless device will behave in a network and are therefore required by network operators.

Radiated measurements with the R&S®DST200 – in a minimum of space

The R&S®DST200 RF diagnostic chamber allows for extremely compact test setups. It fits on any lab bench – together with the test equipment and a PC – and is easy to transport and install (Fig. 1). The RF frontend of the R&S®CMW500 wideband radio communication tester contains several RF connectors for transmit and receive signals. In the simplest scenario, no RF switching matrix is required; all that needs to be done is connect the RF cables between the tester and the R&S®DST200. Users can then perform a wide range of measurements (Fig. 2).

Fig. 1 OTA measurements requiring a minimum of lab space: the R&S®DST200 RF diagnostic chamber with automated 3D positioner, R&S®OSP130 open switch and control platform, R&S®ESU EMI test receiver and R&S®CMW500 wideband radio communication tester.

Key component: the automatic 3D positioner

The new, optional R&S®DST-B160 automated 3D positioner (Fig. 3), for which Rohde&Schwarz has a patent pending, is the automatic version of the existing R&S®DST-B150 manual 3D positioner. The equipment under test (EUT) is attached to a removable support at the center of the positioner and is rotated by two servomotors about the azimuth and the elevation axes. An optical sensor ensures high positioning accuracy, allowing both axes of rotation to be automatically reset to a defined start position. The automated 3D positioner is remotely controlled via its RS-232-C interface. The R&S®AMS32 OTA performance measurement software and the R&S®EMC32 EMC measurement software include drivers for this interface.

The servomotors and the motor control unit are accommodated in the RF shielded bottom compartment of the R&S®DST200, preventing EMI leakage to the outside which could affect receiver sensitivity measurements. The positioner is made of a very low relative permittivity material to minimize field perturbation in the EUT quiet zone.

New, cross-polarized test antenna

In OTA and RSE measurements, a series of tests are performed during which the EUT transmits or receives ϕ and θ orthogonally polarized fields. Rohde&Schwarz now offers an antenna suitable for performing these measurements: the new R&S®DST-B210 cross-polarized test antenna. It has two sections arranged at right angles and connected to two RF ports. The compact antenna achieves broadband radiation characteristics in the frequency range from 70 MHz to 12 GHz and features a high cross-polarization ratio. The measurement distance between the center of the 3D positioner and the test antenna is approx. 280 mm. Path loss calibration tables for all test antennas compatible with the R&S®DST200 can be found on the Rohde&Schwarz website. These tables can be used to carry out high-precision absolute-level measurements. Test antennas are easily interchanged after opening the top cover of the R&S®DST200.

Typical measurements

A-GPS testing

Compared to standalone GPS, assisted GPS (A-GPS) reduces the time needed to calculate the position of a wireless device. In addition to satellite information, A-GPS uses information from the base station, such as accurate coordinates of the cell base stations and precise time information. A-GPS capability is a key requirement in order to meet the US Federal Communications Commission (FCC) wireless 911 rules requiring service providers to deliver fast and reliable location information even under poor signal conditions.

The new R&S®DST-B160 automated 3D positioner and the R&S®DST-B210 cross-polarized test antenna are mandatory options for performing A-GPS measurements with the R&S®DST200. The R&S®SMU200 vector signal generator simulates eight satellites, whose downlink signals are applied to the test antenna in the R&S®DST200 in the ϕ and θ polarization planes (Fig. 4, example 3). The EUT extracts information such as position data and received signal level from the satellite data and sends it to the R&S®CMU200 universal radio communication tester via a cellular link.

A-GPS measurements in line with CTIA 3.1 can be very time-consuming. Testing multistandard smartphones takes several

Measurement	Description
OTA SISO	Over-the-air performance test in line with CTIA 3.1 TRP and TIS, GSM, WCDMA, CDMA2000®, LTE
OTA MIMO	Over-the-air performance test: transmit diversity, spatial multiplexing modes
A-GPS	Assisted GPS performance test in line with CTIA 3.1
Coexistence	Simultaneous operation of two cellular or wireless services (e.g. GSM and WLAN)
Desense	Verification of OTA sensitivity degradation caused by internal EUT EMI sources (self-interference)
EMI scan	Quick detection of EMI sources within the RF operating band (in-band emissions)
RSE	Radiated spurious emissions measurement, e.g. to verify compliance with specified limits in line with ETSI EN 301908 (WCDMA) or similar standards

Fig. 2 The R&S®DST200 RF diagnostic chamber enables a wide range of measurements in R&D, quality assurance and product qualification.

Fig. 3 The R&S®DST-B160 automated 3D positioner.

hours, for example. The compact R&S®DST200 makes it possible to perform such measurements right on the lab bench. Product optimization takes place in the lab, and developers no longer require constant access to large OTA test chambers, which are often not available at short notice.

RSE measurements – mandatory for all wireless devices

All wireless devices need to be tested for radiated harmonics of the carrier frequency or other spurious emissions (radiated spurious emissions, RSE). Measured values must comply with specified limits in line with 3GPP, ETSI or FCC standards, for example. RSE measurements can be made using a simple test setup with the R&S®DST200, an R&S®CMW500 and an R&S®ESU EMI test receiver (Fig. 4, example 4). The R&S®OSP130 open switch and control platform connects the ϕ or θ polarization plane of the test antenna to the test receiver input.

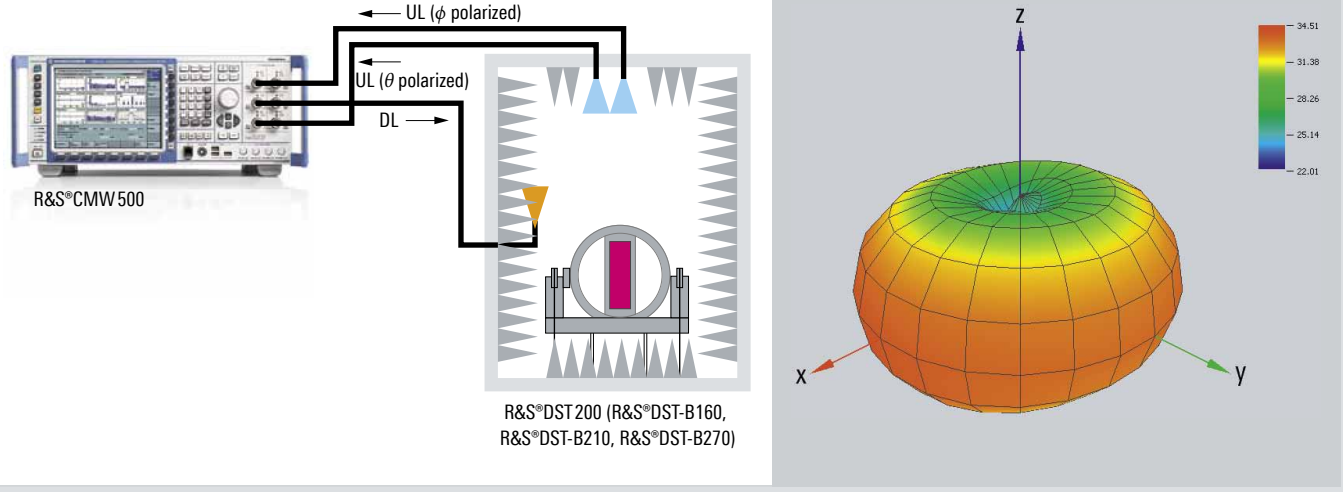
MIMO performance testing made easy

The performance gain achieved with 2×2 MIMO in the downlink – data throughput twice as high as with SISO – has to be verified at various stages in a product's life cycle:

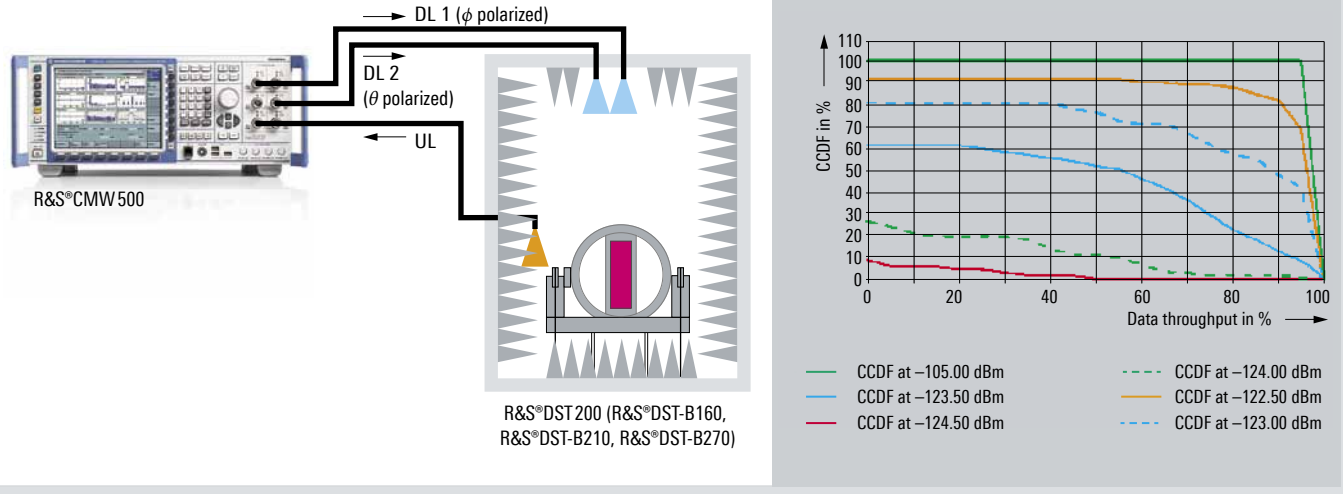
- In R&D, e.g. during antenna design
- In production, for quality assurance
- In servicing, for quality assurance
- In qualification measurements

Fig. 4 Four example test setups and results for various radiated measurements with the R&S®DST200 RF diagnostic chamber.

Example 1: OTA performance test; TRP, GSM900



Example 2: MIMO OTA performance test; transmit diversity, LTE

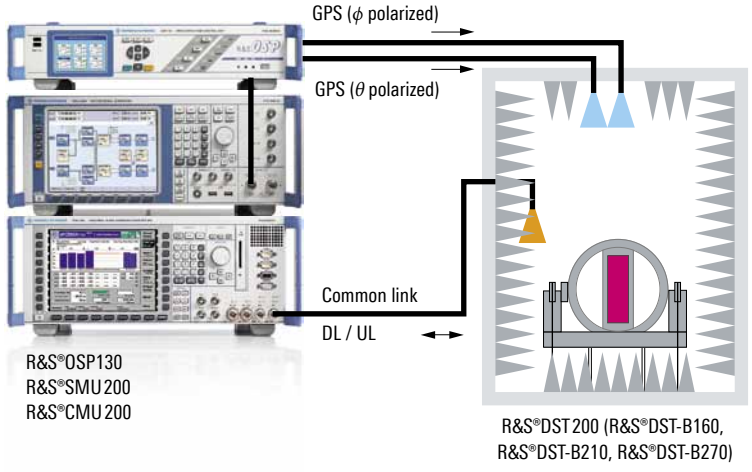


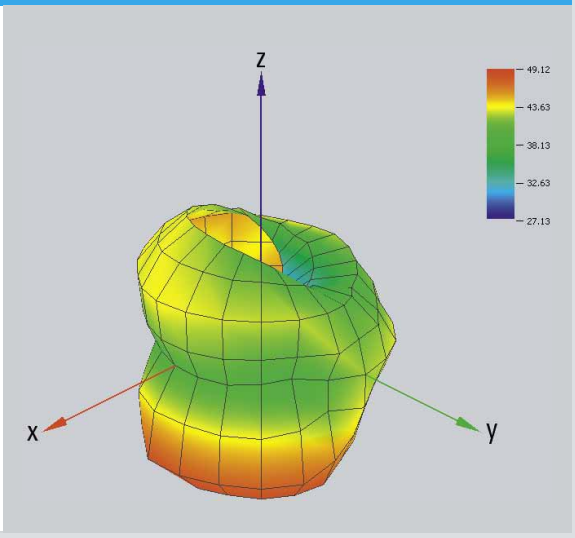
Pass/fail measurements and qualification measurements on MIMO-enabled wireless devices can be performed using a compact and simple test setup with the R&S®DST200 RF diagnostic chamber (Fig. 4, example 2). All LTE parameters can be configured with the R&S®AMS32 measurement software and the R&S®AMS32-K31 option (Fig. 5). The two downlink signals from the R&S®CMW500, which simulates the base station, are connected to the R&S®DST-B210 cross-polarized test antenna. The automated 3D positioner aligns the EUT in any desired orientation in the polar coordinate system to provide a complete picture of the spatial MIMO characteristics. Receiver sensitivity is plotted in a 3D diagram that reveals any sensitivity degradation in partial areas. The average data throughput is plotted versus the received signal level.

LTE parameter	Settings for LTE link
LTE band	1 to 41, FDD, TDD, depending on EUT capabilities
Radio channels	e.g. 5180 to 5279 for LTE FDD 13
Modulation	QSPK, 16QAM, 64QAM
Resource blocks	1 to 100
Start of resource block	0 to 99
Transport block size index	0 to 26
Bandwidth	1.4 / 3 / 5 / 10 / 15 / 20 MHz
MIMO mode	transmit diversity, open and closed loop spatial multiplexing

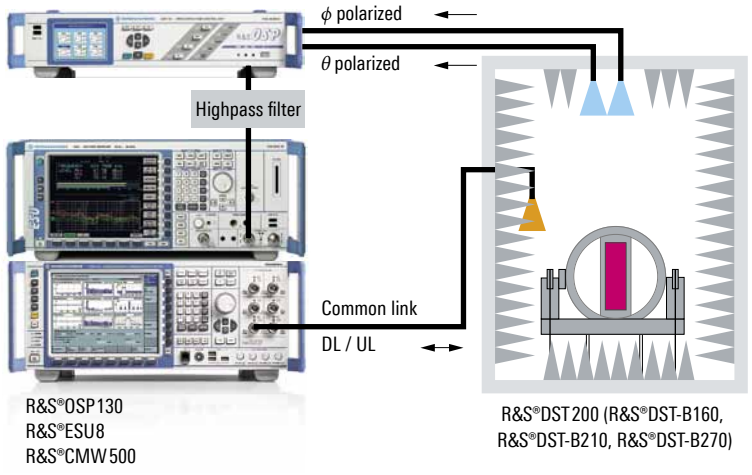
Fig. 5 Configuration of MIMO measurements using the R&S®AMS32 OTA performance measurement software and the R&S®AMS32-K31 option.

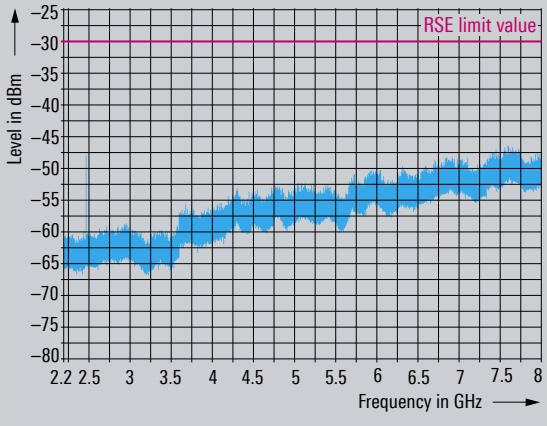
Example 3: A-GPS test





Example 4: RSE test





Excellent correlation of results between the R&S®DST200 and larger OTA test chambers

Fig. 6 reveals statistical performance, showing the cumulative distribution functions (CDF) for the results obtained with three different test chambers. The EUT was operated in LTE MIMO transmit diversity mode, and receiver sensitivity was measured with the EUT set to six spatial orientations. The measurements made with the R&S®DST200 RF diagnostic chamber were repeated in order to verify reproducibility of results obtained with the test chamber.

The best statistical sensitivity was obtained with the OTA reference test chamber (5 m × 5 m × 5 m), with 50 % of all antenna constellations yielding at least 90 % of the maximum data throughput at a downlink power density of $P_{iso} \approx -127$ dBm/15 kHz referenced to an ideal isotropic radiator. The R&S®R-Line compact test chamber (1.7 m × 1.6 m × 2.2 m) and the R&S®DST200 delivered sensitivity 1 dB and 2 dB lower, respectively, for the same test parameters. The measurements also exhibited a high level of reproducibility for the tests performed with the R&S®DST200, with resulting CDF graphs differing by no more than 0.5 dB.

Summary

The R&S®DST200 RF diagnostic chamber together with its new options enables a wide range of automated OTA and RSE test capabilities, while offering the most compact size on the market. The R&S®DST-B160 automated 3D positioner and the test equipment are controlled using the R&S®AMS32 and R&S®EMC32 measurement software. Results are generated in the same way as with large OTA or EMC test chambers. These features combine to open up new applications in R&D and quality assurance in production and subsequent servicing by network operators. Rohde&Schwarz will continue to create new options and add-ons to make the R&S®DST200 even more flexible.

Erwin Böhler; Adam Tankielun

The article starting on page 12 discusses typical RSE measurements on LTE wireless devices during development using the R&S®DST200 RF diagnostic chamber.

Result correlation for three test chambers

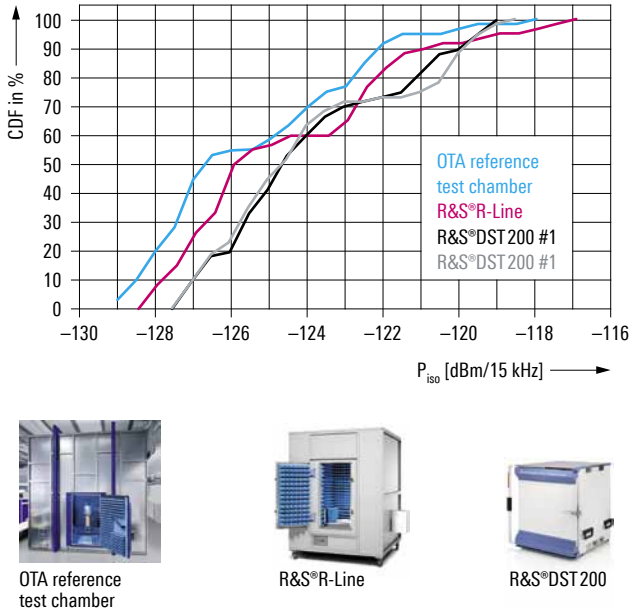


Fig. 6 CDF results obtained with three different RF test chambers for receiver performance tests in LTE transmit diversity mode.

Abbreviations

3GPP	3rd Generation Partnership Project
A-GPS	Assisted global positioning system
CDF	Cumulative distribution function
CTIA	Cellular Telecommunications Industry Association
DL	Downlink
EMI	Electromagnetic interference
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FDD	Frequency division duplex
MIMO	Multiple input multiple output
OTA	Over-the-air
RSE	Radiated spurious emissions
SISO	Single input single output
TD	Transmit diversity
TDD	Time division duplex
TIS	Total isotropic sensitivity
TRP	Total radiated power
UL	Uplink
WCDMA	Wideband code divison multiple access

R&S®OSP120 now even more versatile: easy setup of small RF test systems

The new R&S®OSP120 open switch and control platform offers two front module slots that facilitate cabling in the lab. Together with coaxial N relays in new modules, small RF systems can be very easily set up for test and measurement instruments with front-panel RF connectors. A new EMC module and modules with terminated semiconductor and N relays allow easy configuration of small EMS systems.

R&S®OSP120 now with front module slots

The new model of the R&S®OSP120 open switch and control platform (Fig. 1) opens up even more versatile configuration options. While the existing R&S®OSP120 and R&S®OSP130 base units and the R&S®OSP150 extension unit offer three slots on the rear for the different modules, the new model of the R&S®OSP120 additionally includes two slots on the front that can be optionally equipped with single- and double-width modules or RF feedthroughs. This is useful for small test and measurement systems in the lab, for example, when the connection lines of a matrix wired on the rear panel are to be routed forward to the device under test or the measuring instrument. Or when the R&S®OSP120 is used in racks, where the front-panel cabling can now be implemented with short RF lines.

Depending on the configuration, four to twelve SMA connectors, four N connectors or combinations thereof can be implemented (Fig. 3). When combining SMA and N connectors, the limitations with respect to the lower power rating of the SMA connectors have to be taken into account.

The RF feedthroughs between the front and rear panels of the R&S®OSP120 are implemented by combining module panels with N and SMA connectors and with the appropriate cable sets (Fig. 2).

As in the past, up to three modules or a combination of modules with a total of three control buses are supported. This makes it possible to combine an R&S®OSP-B125 triple-width module (two control buses) on the rear panel with another module on the front panel, for example.

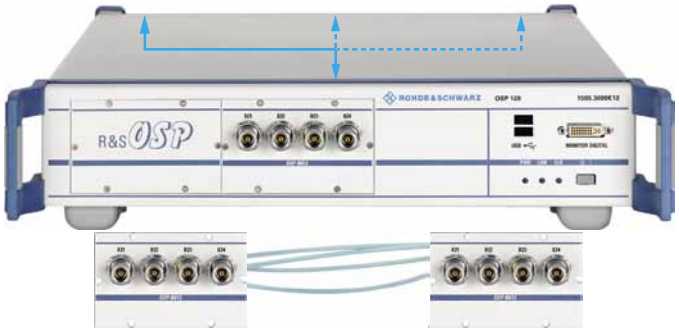


Fig. 2 Configuration example: The R&S®OSP120 base unit with RF feedthrough with N connectors, consisting of two R&S®OSP-B012 module panels and one R&S®OSP-Z010 RF cable set.

The R&S®OSP open switch and control platform was presented in NEWS (2008) No. 195, pp. 28–31. Another article appeared in NEWS (2008) No. 197, pp. 27–29, describing the new R&S®OSP130 base unit and the expanded range of modules. In NEWS (2010) No. 202, pp. 24–25, new modules with terminated RF relays were presented.

The expansion continues: The new R&S®OSP120 model is now equipped with two additional front module slots in addition to new RF modules with N relays, new semiconductor relays and an EMS module.

The article starting on page 12 describes how to perform RSE measurements for the R&S®OSP130 base unit without bandstop filters by using the new R&S®OSP-B155 filter module.

Fig. 1 The new R&S®OSP120 base unit with two additional front module slots (here with an R&S®OSP-B131 RF switch module).

Examples of RF feedthroughs

SMA to SMA
4 × SMA to 4 × SMA
(2 × R&S®OSP-B011, 1 × R&S®OSP-Z012)

or (shown below)
12 × SMA to 12 × SMA
(2 × R&S®OSP-B011, 3 × R&S®OSP-Z012)

N to SMA
2 × 4 N to 8 × SMA
(1 × R&S®OSP-B011, 2 × R&S®OSP-B012, 2 × R&S®OSP-Z011)

or (shown below)
4 × N to 4 × SMA
(1 × R&S®OSP-B011, 1 × R&S®OSP-B012, 1 × R&S®OSP-Z011)

N to N
4 × N to 4 × N
(2 × R&S®OSP-B012, 1 × R&S®OSP-Z010)

Fig. 3 Configuration examples of RF feedthroughs. Depending on the configuration, four to twelve SMA connectors, four N connectors or combinations thereof can be implemented (R&S®OSP-B011 and R&S®OSP-B012: module panels; R&S®OSP-Z010 / -Z011 / -Z012: RF cable sets).

New modules with N relays

N connectors offer the advantage of higher electrical and mechanical power rating compared with modules with SMA connectors (Fig. 4). This is one of the reasons why N connectors are the prime choice especially when it comes to external RF connectors of measuring instruments. If possible, they are also used as output ports on power amplifiers. The new R&S®OSP-B131 and R&S®OSP-B132 options feature two and six N relays (SPDT).

New modules with terminated relays

The R&S®OSP-B129 module extends the range of terminated coaxial relays. The module is equipped with a terminated eight-fold SP8T changeover relay and two non-terminated SPDT relays. In addition to the R&S®OSP-B107 solid-state relay (SSR) module, the portfolio now includes modules with terminated SSRs as SPDT changeover relays (R&S®OSP-B127) and SP6T multiposition relays (R&S®OSP-B128) (Fig. 5). Compared with coaxial mechanical RF relays, SSRs allow faster, wear-free changeover but generally have higher attenuation and lower power rating.

EMS module for small EMC measurement systems

Besides the R&S®OSP-B104 relay driver module for driving external power relays in an electromagnetic susceptibility (EMS) system, the portfolio now also includes the R&S®OSP-B114 module for easy configuration of small EMS systems. It provides the following functions:

Power rating of different RF connectors

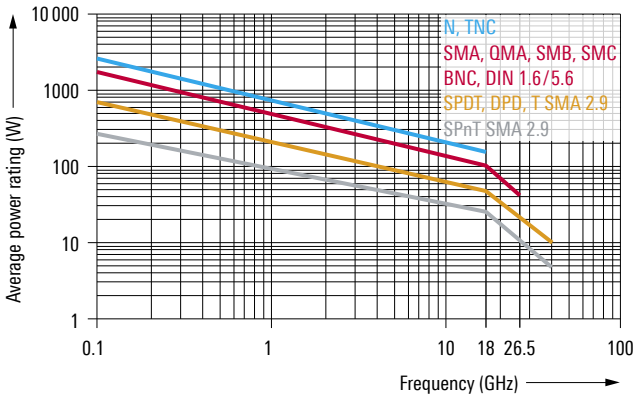


Fig. 4 Comparison of the average RF power rating of different RF connectors. Source: coaxial switching products, Radiall product catalog.

Fig. 5 A selection of new relay modules.

Example of a small EMS system

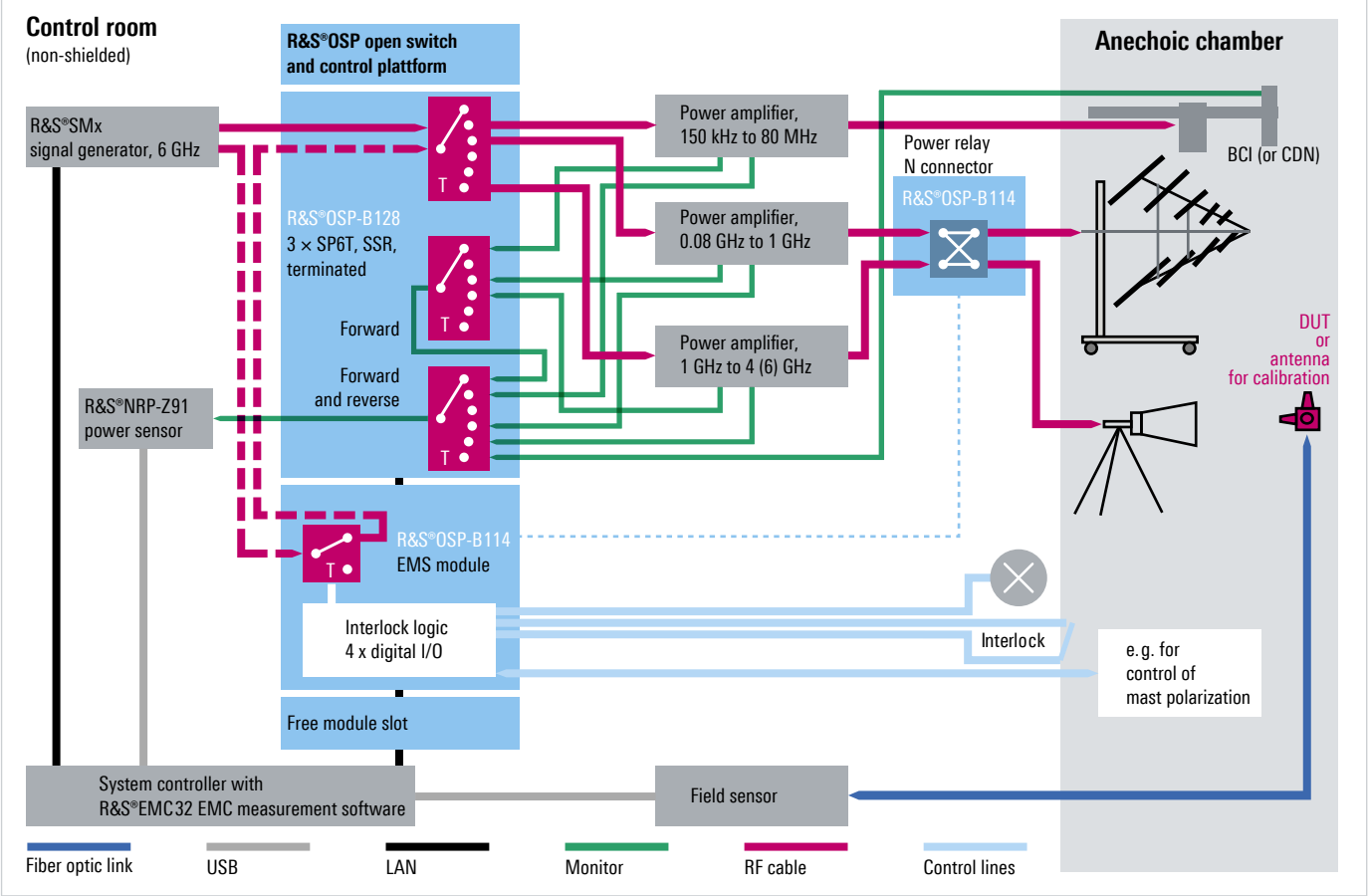


Fig. 6 Example of RF wiring for a small EMS system using the R&S®OSP-B114 ESM module, the R&S®OSP-B102 RF switch module and the R&S®OSP-B128 multiposition relay.

- A transfer relay (DPDT) with N connectors for switching between two amplifiers and two transducers (antenna or coupling network)
- An interlock circuit with an interlock loop, an output for an interlock display, a terminated SSR for separating the signal generator from the amplifier input (safety switch off if interlock loop is open) and digital inputs / outputs for further applications such as controlling antennas

Fig. 6 shows an example of system wiring for testing electromagnetic susceptibility. The combination of the amplifiers' forward and reverse outputs with terminated SSRs of the R&S®OSP-B128 module eliminates the need for a second power sensor. Using the R&S®OSP open switch and control platform and its modules has a major advantage because a configuration can be progressively adapted and expanded into a complex system in order to meet increasing requirements. The EMS test system is controlled by the R&S®EMC32 EMC measurement software.

Summary

The additional front module slots of the R&S®OSP120 open switch and control platform and the new N relay modules are especially useful in lab applications where cabling has to be performed on the front of the instrument. By using special modules, e.g. the EMS module, in combination with general switch modules, an efficient setup of EMC test systems and future customer specific expansions is possible.

An overview of all available modules for the R&S®OSP open switch and control platform is included in the data sheet (www.rohde-schwarz.com, search term: OSP).

Gert Heuer; Bernhard Rohowsky

R&S®UPP audio analyzer: testing HDMI devices

High-resolution digital television signals and top-quality surround sound are the standard in consumer audio and video systems today. Devices communicate and transmit data over a high-definition multimedia interface (HDMI). The interface's numerous features are quite a challenge for test and measurement equipment. Fitted with the R&S®UPP-B4 option, the R&S®UPP audio analyzer meets all the requirements for conducting comprehensive audio measurements on HDMI components.

HDMI – the standard in consumer electronics

With the arrival of advanced CD and DVD players, digital audio connections gradually displaced previous analog solutions. Among professional users, AES/EBU emerged as the dominant interface, whereas in the consumer sector, devices were fitted with the Sony/Philips digital interface (S/PDIF).

The arrival of surround sound (5.1 audio, for instance) created a need for a new, more sophisticated type of interface – ideally one that could combine video and multichannel audio signal transmission over a single cable. This led to the creation of the HDMI standard (see box at right), which enables digital transmission of high-resolution television and top-quality surround sound signals over the same cable. Today's advanced TVs, DVD players, AV receivers and even game consoles all connect with one another via HDMI cables.

This technological advance has created a need for equally capable T&M equipment – a need that the R&S®UPP audio analyzer and the new R&S®UPP-B4 HDMI option fulfill.

HDMI option for the R&S®UPP audio analyzer

Equipped with the R&S®UPP-B4 HDMI option, the R&S®UPP audio analyzer enables product development, quality assurance and production to conduct a comprehensive range of audio measurements on HDMI chips, Blu-ray™ players*, AV receivers, TV monitors and other equipment. The R&S®UPP can conduct measurements on any combination of interfaces: For instance, it can feed I²S signals to a chip and analyze the results at its HDMI port, or it can apply HDMI test signals to the input of an AV receiver and test the audio quality on the receiver's analog loudspeaker outputs. It can even be used to test TV monitors. The R&S®UPP audio analyzer generates test signals in HDMI format and sends them to the DUT. In the simplest scenario, audio functions, such as correct channel assignment, are analyzed by means of listening tests, and video quality is visually analyzed on the TV monitor.

The option can be integrated into each of the three R&S®UPP200, R&S®UPP400 and R&S®UPP800 base units (Fig. 1). This means that all interfaces necessary for audio measurements are included in a single instrument:

Fig. 1 The R&S®UPP800 audio analyzer with the R&S®UPP-B4 option installed. The R&S®UPP family of instruments was covered in detail in NEWS (2010) No. 201, p. 24–27.

* Blu-ray™ is a trademark of the Blu-ray Disc Association.

HDMI at a glance

HDMI is an interface developed especially for the consumer electronics sector. From the very outset, it fulfilled the consumers' wish for simplified equipment cabling and easier operation of system components as well as the movie industry's need for a means of transmission that afforded protection against illegal copying. The standard has gradually been refined in a number of stages. Higher screen resolutions and the demand for greater color range to allow skin tones and higher-contrast scenes to be rendered better called for higher transmission bandwidths. Users also wanted to be able to operate multiple system components with a single remote control. Currently, HDMI version 1.4 is used. It supports bidirectional data transmission (on the audio return channel), new lossless compressed audio coding methods and Ethernet connection. The data transmission rate has now risen to 10.2 Gbit/s – sufficient to meet tomorrow's needs and requirements. With the definition of the Micro HDMI connector, the interface is gradually finding its way into mobile phones and portable audio devices, and a new locking connector means it can now be used in vehicles too. All these features make HDMI the most successful and versatile connector system ever in the field of audio and video.

Data transmission between HDMI source and HDMI sink

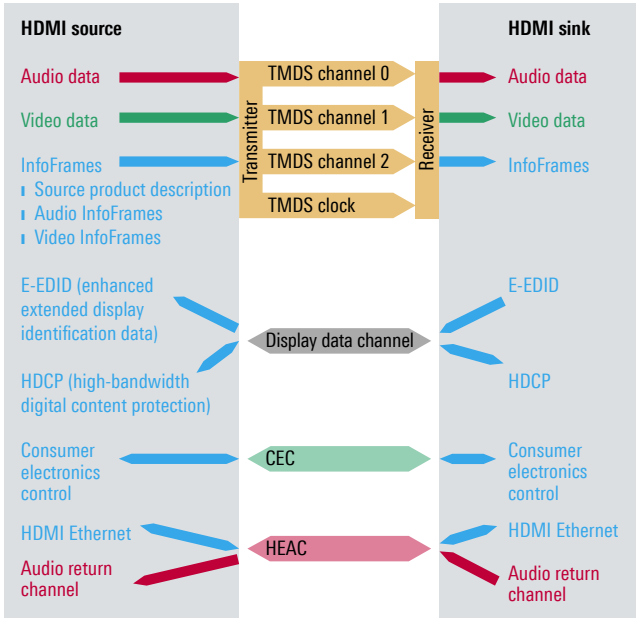


Fig. 2 HDMI transmits data on four separate physical channels.

- Four HDMI ports on the front of the R&S®UPP
- Two-, four- or eight-channel analyzer for parallel and concurrent measurements on analog channels. The inputs are balanced XLR female connectors; a BNC adapter set is available as accessory
- Digital audio interfaces in S/PDIF format with BNC and TOSLINK connectors for two-channel linear PCM audio signals in line with IEC 60958. Compressed audio data streams with up to eight channels in line with IEC 61937 are available for playback and – after Dolby® decoding* (optional) – also analysis
- Digital I²S interfaces for testing audio ICs. There are four data lines each in the transmit and receive directions, allowing signals for up to eight audio channels to be generated and measured in parallel

The data structure in detail – and testing capabilities with the R&S®UPP

Physical data channels

In the HDMI world, there are sources and sinks. An HDMI device can have one or more HDMI inputs and outputs. Every input or output must comply with all requirements for an HDMI sink or HDMI source. There are four separate physical data channels for transmitting the data (Fig. 2):

- Four transition minimized differential signaling (TMDS) line pairs transmit audio and video data as well as InfoFrames
- The display data channel (DDC) is used to exchange information that facilitates the interconnection of various HDMI devices and enables data encryption
- The bidirectional consumer electronics control (CEC) line transmits data that allows all connected HDMI devices to be operated with a remote control
- The HEAC line transmits HDMI Ethernet data and contains the audio return channel

Audio data

HDMI differentiates between a two-channel data structure (stereo) and an eight-channel data structure (surround sound). The digital audio signals are transmitted as linear PCM data with up to 24 bit word length and up to 192 kHz sampling rate. The interface can also transmit encoded data streams, including streams compressed using conventional methods standardized by Dolby.

The R&S®UPP800 audio analyzer can generate up to eight different test signals in HDMI or I²S format at the same time and measure up to eight signals concurrently – in HDMI format, in I²S format and at its analog inputs. Unlike other HDMI T&M equipment, the R&S®UPP offers full, professional audio analyzer functionality:

* Dolby® is a registered trademark of Dolby Laboratories.

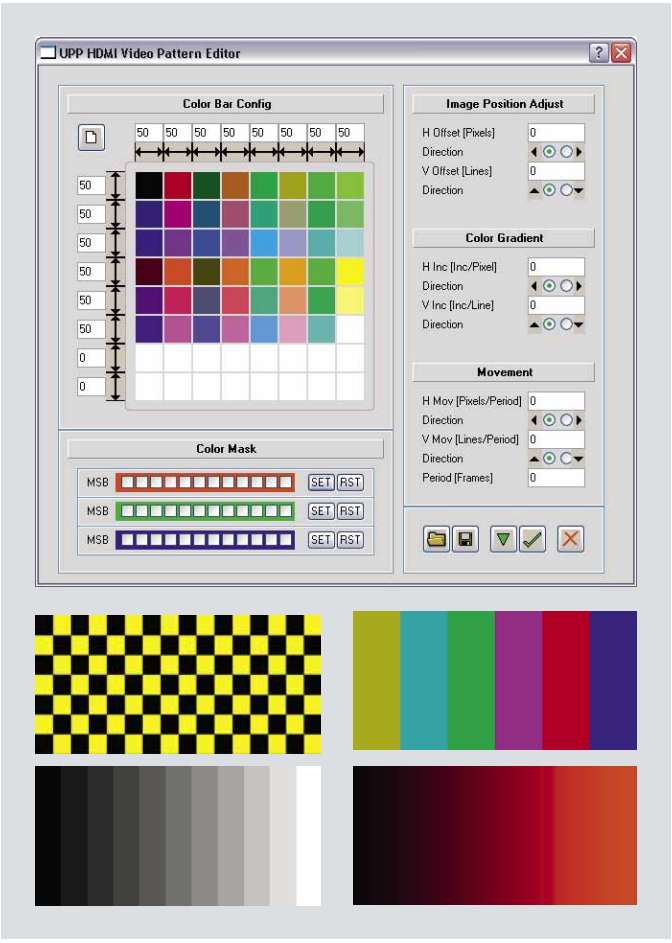


Fig. 3 Multicolor and moving test patterns can be generated with the optional pattern generator.

- Its signal generation capabilities range from generating sine and multitone signals for intermodulation measurements and burst and noise signals to playback of voice and music signals
- It can also play Dolby Digital® and Dolby Digital Plus®* encoded signals and decode them to conduct realtime measurements
- In addition to the basic measurements of level, frequency response, crosstalk, SNR, THD+N and phase, the R&S®UPP provides a number of other measurement functions, including modulation factor, DFD, DC voltage and group delay
- It also offers powerful FFT analysis and can display the trace in the time domain. A 1/n-octave analysis option is available as well

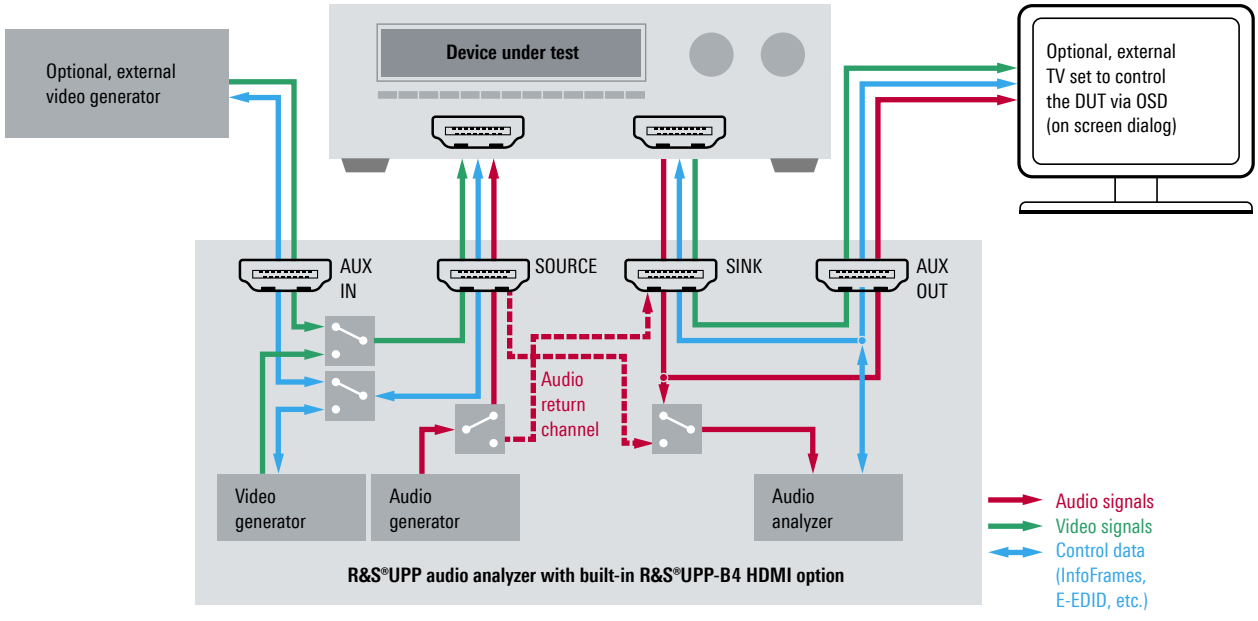
Video data

Audio and video data is combined in a common frame structure. HDMI can transmit all of today's common video formats in the highest quality. With the R&S®UPP-B4 HDMI option, the R&S®UPP audio analyzer can generate both audio and video data. In addition to monochrome test patterns, it can optionally output multicolor and moving test patterns (Fig. 3).

* Dolby®, Dolby Digital® and Dolby Digital Plus® are registered trademarks of Dolby Laboratories.

Fig. 4 The R&S®UPP-B4 option has four HDMI ports for connecting DUTs.

Test setup



Users can choose any colors they wish and set a color depth of 8 bit, 10 bit or 12 bit. The video formats are CEA-861-E standard compliant and are available with resolutions up to 1920 × 1080 pixel.

If users require more complex video signals for test purposes, test patterns and video sequences can be fed in from an external source over another HDMI port on the R&S®UPP (Fig. 4). The audio analyzer combines the picture data with the audio test signals it generates internally and transfers them to the DUT in a single HDMI data stream.

The analyzer section of the R&S®UPP receives all HDMI data and analyzes the audio content. The video content can be passed over a separate HDMI connection to an external monitor for visual analysis. Besides pure audio measurements, the R&S®UPP can optionally conduct a number of basic video measurements:

- Pixel clock, HSync and VSync frequencies, display of timing parameters
- Bit error rate over an HDMI transmission path
- Time offset between video and audio signals using the lip sync function

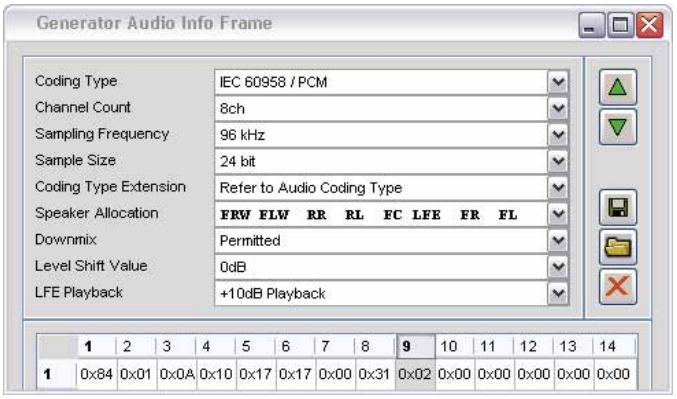


Fig. 5 Interconnected HDMI devices use audio InfoFrames to exchange functionality information.

InfoFrames

A variety of InfoFrames are transmitted over HDMI. The source product description InfoFrame, for instance, contains general information on an HDMI source. The auxiliary video InfoFrame provides an HDMI sink with a range of information, including the video format being transmitted, the color depth, color range, etc. (Fig. 5).

The R&S®UPP audio analyzer generates all this data to match the HDMI signals to be output. Optionally, users can edit the InfoFrame data and deliberately send incorrect data to the DUT in order to test how it will respond and to verify whether it will correct errors as required by the HDMI specification.

Enhanced extended display identification data (E-EDID)

The E-EDID packet is stored in the HDMI sink, for example a TV monitor. It contains all the information that the HDMI source (such as an AV receiver) needs to transmit the video and audio data in the formats that the HDMI sink can process. The data packet is transmitted via the display data channel (DDC). The generator in the R&S®UPP reads the DUT's E-EDID information so that the test signals can be set in the suitable format. Conversely, the analyzer provides the DUT with its E-EDID information. If required, users can alter the R&S®UPP audio analyzer's E-EDID information in order to test how the DUT will respond. In many applications, the comprehensive functionality provided by the R&S®UPP eliminates the need for specialized HDMI protocol testers.

High-bandwidth digital content protection (HDCP)

This encryption is used to prevent unauthorized copying of films, etc. When the R&S®UPP audio analyzer receives an encrypted signal, it automatically decrypts the signal for measurement.

Consumer electronics control (CEC)

This is an independent, bidirectional data line which transmits signals from a remote control to all connected HDMI devices, allowing users to use the same remote control for all components in a system. In the R&S®UPP audio analyzer, the CEC data is passed on unchanged.

Audio return channel (ARC)

The ARC allows audio signals to be transmitted from a TV to an AV receiver (in order to output audio through the loudspeakers in a multimedia system, for instance). With the HDMI option, the R&S®UPP analyzer can generate and measure audio data on the ARC.

HDMI Ethernet channel (HEC)

The HEC enables HDMI devices to access content on the Internet. For this to function, a device needs to be connected to a LAN (generally, via an RJ-45 port); it can then distribute Internet data over HDMI to other connected devices. The ARC and HEC are transmitted on a separate line in the HDMI line known as the HEAC line. The R&S®UPP audio analyzer has two RJ-45 ports for connecting the Ethernet line and testing Ethernet functionality.

Klaus Schiffner

The fast and secure way of certification: EMC diagnostics during development

Time-consuming fixes, repeated acceptance testing, missed market launch date? A horrific scenario, yet one that can be avoided by using spectrum analyzers for simple EMC diagnostics during development. Since developing complex electronic products involves tremendous cost and effort, it is worthwhile to assess EMC properties before final acceptance testing. The R&S®FSV-K54 is a powerful option now available for the R&S®FSVR and R&S®FSV families of analyzers.

A cost-effective way to play it safe

Investing in an in-house EMC test lab or resorting to external service providers are two methods companies can use to test their electrical and electronic innovations for compliance with official EMC regulations. Performing these types of measurements is often too expensive for small and medium-sized companies.

One appealing alternative is the use of precompliance test receivers and/or spectrum analyzers for performing EMI measurements during development and preparing for compliance testing as early as in the lab [*]. These measurements provide a comprehensive overview of the basic EMI behavior of a product and help identify potential problems early on.

Since developing complex electronic products involves tremendous cost and effort, it is worthwhile to assess EMC properties before final acceptance testing. Otherwise, there is a risk of time-consuming and expensive fixes, which require acceptance testing to be repeated several times and, in turn, jeopardizing the planned date of market introduction. Serious defects in the EMC design are practically impossible to fix later, which is why clear-sighted action pays off. Observing the relevant EMC regulations earlier on during the development phase requires less time and money for ensuring the EMC conformance of a particular product. Then, getting beyond the final hurdle of "certification", i.e. submitting the necessary proof that the specified limits have been complied with, is usually little more than a formality.

EMC diagnostics with spectrum analyzers

The R&S®FSV-K54 EMI measurement application option is for anyone who wants to use the R&S®FSV signal and spectrum analyzer and the R&S®FSVR real-time spectrum analyzer to perform measurements during development that very closely resemble the standard-compliant EMI measurement. The option is ideal for developers in the IT, communications and automotive industries, for T&M and control engineering, household appliance development, universities and for service and test labs. The high-performance features of these analyzers simplify the way toward fast and secure certification.

EMI measurement detectors

Comparing the amplitudes of noise signal spectra with the emission limits laid down in the product family standards

In research and development environments, the EMC behavior of circuit designs can be assessed and analyzed with reliable and reproducible results using the R&S®FSVR real-time spectrum analyzer (photo) or the R&S®FSV signal and spectrum analyzer. The analyzers offer a high degree of accuracy and sensitivity for detecting even low signals with the precision stipulated.

Key features of the R&S®FSV-K54 option at a glance

- EMI measurement detectors: peak, quasi-peak RMS, average, as well as CISPR-average and RMS-average
- 6 dB bandwidths or bandwidths in line with CISPR 16-1-1: 200 Hz, 9 kHz, 120 kHz, 1 MHz
- 6 dB bandwidths or bandwidths in line with MIL standard: 10 Hz to 1 MHz, decadical
- Measurement marker with selectable detector assignment
- Limit line comparison and consideration of correction value tables (transducer factors)
- Logarithmic frequency axis

Features of the R&S®FSV-K54 option	Function	Benefits
EMI bandwidths	bandwidths for commercial (CISPR) and military (MIL) standards	standard-compliant IF bandwidths provide for correct, reproducible measurements of the pulsed energy
EMI detectors	detectors with weighting factor for pulse analysis	standard-compliant signal analysis using detector weighting
Limit lines	limit lines in accordance with standards	direct comparison against specified limits with PASS/FAIL results
Correction value table (transducer factors)	frequency-dependent correction values for installed accessories	greater accuracy during amplitude measurements by considering the frequency response of the accessories
Log. sweep	logarithmic sweep	correlation and easy comparison using measurement screenshots for documentation purposes
Measurement marker	linking of selectable detectors to the measurement markers to allow weighting of the signal levels for direct comparison with the limit line	immediate level comparisons deliver critical PASS/FAIL information for specified limits
Frequency table Peak search	marker peak search for a maximum of 16 points	critical signals are displayed immediately and can be analyzed using the measurement marker and selectable detector
Touchscreen	menu, function and parameter selection on the display	convenient operation
Enabling of options via key code	installation of option	easy upgrade of spectrum analyzers for EMI diagnostics, without having to recalibrate the instruments
Spectrogram mode	standard with R&S®FSVR optional with R&S®FSV (R&S®FSV-K14)	seamless recording of a frequency band over time for the analysis of critical signal amplitudes
Operating mode: realtime mode	realtime analysis (R&S®FSVR only)	seamless recording and analyzing of unstable, sporadic signals with CPU processing

(EN 55011 to EN 55025) requires using the defined IF bandwidths and detectors, e.g. in line with CISPR. Detectors with CISPR-compliant time constants are slow due to their required transient response, making them unsuitable for fast preview measurements. For this reason, fast peak and average detectors are used to identify the critical disturbance levels and frequencies. The R&S®FSV-K54 option includes all the necessary detectors for this purpose. The advantages of the R&S®FSVR and R&S®FSV spectrum analyzers, with their fast sweep cycles and simultaneous display of up to three traces of different detectors (e.g. two Pk+ traces and one AV trace), prove valuable when performing these types of measurements.

Detectors with CISPR-compliant time constants are used only for final measurements when analyzing critical frequencies with signal levels that exceed or are very close to the limit value. In order for the impulsive disturbance to be weighted correctly, the measurement time required for the final test is one second per frequency.

Correct pulse weighting – with bandwidths in line with CISPR and MIL standards

A qualitative assessment yielding average accuracy is often sufficient for EMC measurements performed during development, e.g. when localizing disturbance sources with sensors or near-field probes. However, this is less true for test setups and coupling devices used to measure the disturbance voltage, disturbance power and disturbance field strength in order to find out whether a DUT complies with the maximum permissible limit values. These types of measurements require a precise, reproducible, quantitative assessment with specified IF bandwidths and detectors. The CISPR bandwidths correspond to the pulse bandwidth (approx. –6 dB) and are to be used in line with the corresponding CISPR bands:

- CISPR band A (9 kHz to 150 kHz) B_{res} = 200 Hz
- CISPR band B (150 kHz to 30 MHz): B_{res} = 9 kHz
- CISPR band C (30 MHz to 300 MHz): B_{res} = 120 kHz
- CISPR band D (300 MHz to 1 GHz): B_{res} = 120 kHz
- CISPR band E (1 GHz to 18 GHz): B_{res} = 1 MHz

Fig. 1 The main menu for EMI applications offered by the R&S®FSV-K54 option.

Spectrum analyzers normally offer resolution bandwidths with Gaussian or Gaussian-like distribution characteristics with a specified bandwidth of 3 dB. However, both CISPR and MIL standards require steep –6 dB filters for EMI measurements.

EMI limit lines, transducer tables

The new option for measurement tasks performed during development expands the range of Rohde&Schwarz spectrum analyzers by adding a database with limit lines in line with the relevant standards. They can be easily activated to display any potential out-of-limit conditions during tests (LIMIT CHECK). When using different limits, e.g. for proprietary standards in the automotive industry, the other limit lines can simply be entered and saved in the tables.

The effect of attenuator pads and pulse limiters, as well as cable losses, antenna factors and the frequency response of an external preamplifier must be taken into consideration to ensure high measurement accuracy and reproducibility. These frequency-dependent correction values are stored in transducer tables. Depending on the application and how the measurement is activated, the correction values are calculated into the current readings, without affecting the measurement speed.

The R&S®FSV-K54 option provides all the required settings and analysis functions for diagnostic and precompliance measurements. It shows critical signals identified using the AUTO PEAK SEARCH function in a well-organized table: Values that overshoot the limit line are shown in red, valid signal amplitudes in green and values lying within the tolerance range (MARGIN) in yellow (Fig. 1). All these features are included in the entire R&S®FSVR and R&S®FSV family of spectrum analyzers, offering users nine models for performing EMI measurements in the 10 Hz to 40 GHz range for EMI applications (Fig. 2).

Example: working with broadband noise spectra

If the user is certain that a DUT is only emitting narrowband disturbance and no broadband pulsed signals, it is also possible to perform the measurement using a spectrum analyzer equipped with an overload indicator at the RF input and coupled with the RF attenuator setting. The coupling ensures valid, reproducible measurements and an accurate level display.

If pulsed disturbance signals are present in the spectrum, caution is required. The spectrum of very short pulses or pulses with steep edges can reach very high frequencies. The input of the spectrum analyzer is loaded with high voltages. The spectral components of these voltages are outside the analysis bandwidth and may overload the analyzer. This need not necessarily trigger an overload detector but can also be expressed by incorrectly displayed signal amplitude values that appear to be below the limit lines. The result: successful EMC measurements during development but an unpleasant surprise during certification.

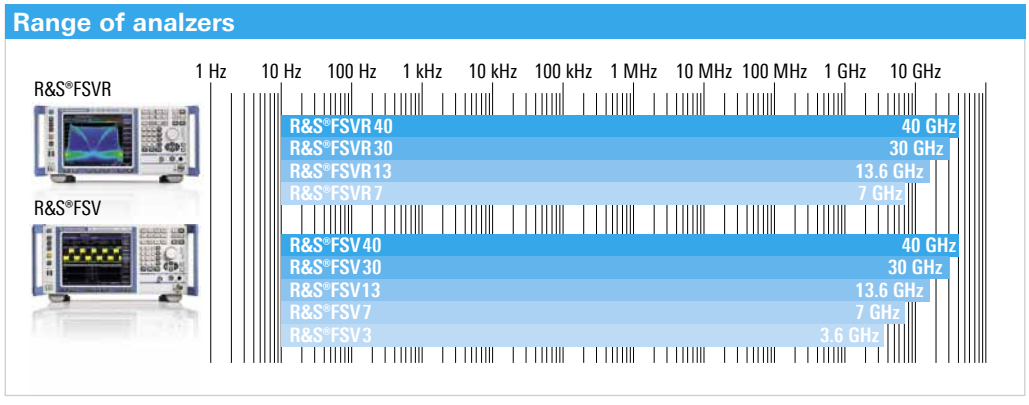
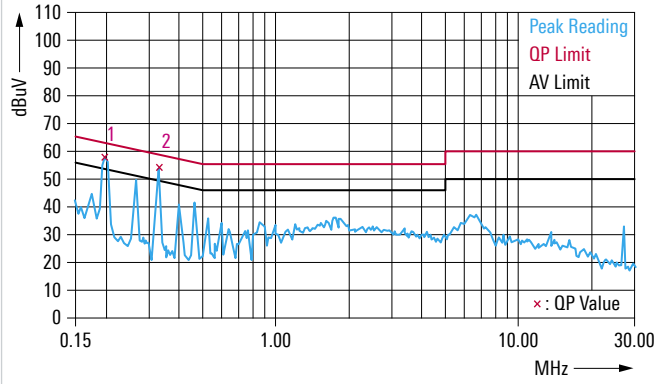


Fig. 2 The R&S®FSVR and R&S®FSV family of spectrum analyzers in combination with the R&S®FSV-K54 option offer nine different models for performing EMI measurements.

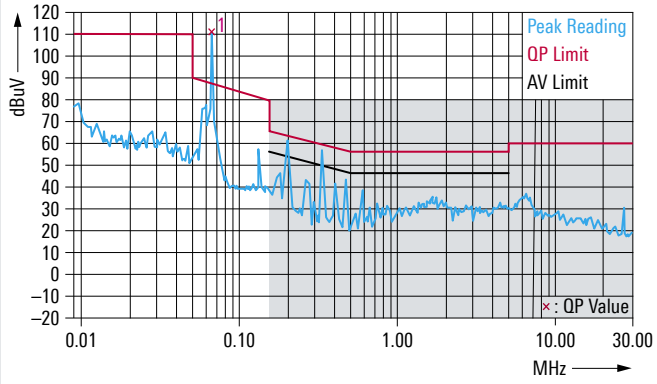
Measurement on a switching power supply



	Frequency	Corr. factor	Reading dBµV		Emission dBµV		Limit dBµV		Margins dB		Notes
No.	MHz	dB	QP	AV	QP	AV	QP	AV	QP	AV	Notes
1	0.19770	0.12	56.10	51.78	56.22	51.90	63.71	53.71	–7.49	–1.81	
2	0.32969	0.12	52.33	47.23	52.45	47.35	59.46	49.46	–7.01	–2.11	

Fig. 3 EMI measurement performed during development to show conducted disturbances on a switching power supply in compliance with EN 55022. There are two critical signal peaks at 197 kHz and at 329 kHz.

Measurement on a switching power supply



	Frequency	Corr. factor	Reading dBµV		Emission dBµV		Limit dBµV		Margins dB		Notes
No.	MHz	dB	QP	AV	QP	AV	QP	AV	QP	AV	Notes
1	0.06585	0.12	119.42	117.13	119.54	117.25	87.49	N/A	32.05	N/A	

Fig. 4 Same measurement as shown in Fig. 3, but with the focus on frequencies below 100 kHz. At 65.8 kHz, the fundamental frequency of the switching power supply with a signal amplitude that is too high.

Fig. 3 shows the results of an EMI measurement performed during development to show conducted disturbances on a switching power supply in compliance with EN 55022. The measurement between 150 kHz and 30 MHz shows two critical signal peaks at 197 kHz and at 329 kHz, which are just below the quasi-peak limit lines. Even when analyzing the measurement with the quasi-peak detector, they are still within the valid range. In the range below 100 kHz (Fig. 4), however, there is an interferer at 65.8 kHz (the fundamental frequency of the switching power supply) with a high signal amplitude at 110 dBµV. This amplitude is large enough to overload the RF input of many analyzers. The entire energy content of the input spectrum makes up the total load; the signals at 197 kHz and 329 kHz are harmonics of the fundamental frequency (3× and 5×) of the switching power supply resulting from overload. This is not immediately apparent in Fig. 3, which is why, for the sake of safety, a steep 150 kHz highpass filter should be used when performing conducted EMI diagnostic measurements during development with spectrum analyzers, in general in the case of unknown DUTs. In the example above, this filter would have suppressed the fundamental frequency of the switching power supply at 65.8 kHz by approx. 60 dB. Overloading would have been prevented and the measurement result would have been correct.

Summary

The R&S®FSV-K54 EMI measurement application option expands the R&S®FSVR real-time spectrum analyzer and the R&S®FSV signal and spectrum analyzer by adding EMC functions such as CISPR and MIL bandwidths, CISPR detectors, limit lines, correction value tables and logarithmic sweep display. As a result, EMC measurements can be performed quickly at the diagnostic and precompliance level. Convenient analysis and marker functions allow the analyzers to serve a key role during EMC measurements in development. However, utmost reliability and reproducibility are achieved using full-compliance EMI test receivers with integrated preselection filters.

The two well-established R&S®FSVR and R&S®FSV spectrum analyzer families also include the entire range of features provided by general-purpose analyzers. They offer a variety of options for measuring RF parameters and analyzing digitally modulated signals.

Volker Janssen

Reference
* CISPR 16-1-1, 2010 (Ed. 3): Specification for radio disturbance and immunity measuring apparatus and methods.

Efficient coverage analysis for terrestrial broadcast networks

In combination with an R&S®ETL or R&S®ETH TV analyzer, the new R&S®BCDRIVE broadcast drive test software quickly and reliably performs measurements to acquire the geographical distribution of the signal quality during drive tests. The system delivers accurate results with a single drive test – for multiple frequencies and for a large number of terrestrial broadcast standards. The intelligent functionality for displaying vast amounts of measured data in Google Earth makes it possible to recognize critical reception areas with pinpoint accuracy.

New possibilities for an ordinary task

Operators of terrestrial broadcast networks have to completely and reliably cover specific regions and areas. For this reason, they use complex simulation programs during the planning phase to predict and check the coverage that will be provided by planned transmitter sites. Yet because the propagation characteristics of a region are complex and cannot be determined in detail, a series of real field measurements must be performed after commissioning to verify the actual coverage situation.

Most terrestrial broadcast signals are received at a stationary position, which is why coverage specifications are frequently designed for this type of reception. In order to analyze the coverage conditions in this situation, a test vehicle is driven to a number of separate locations to take a representative stationary measurement at each. The vehicle is often equipped with a 10 m antenna mast in order to ensure that the reception conditions resemble those of rooftop antennas to the greatest extent possible. Since this method is highly time-consuming, in most cases it is only possible to approach a coarsely meshed network of measurement points in practice. Hence, the actual coverage of a region is analyzed with less detailed information.

In contrast, measurements performed continuously while the test vehicle is moving provide information about the reception at many different locations in a short amount of time. However, at increasing vehicle speed and in the case of pronounced multipath reception, the Doppler effect will cause the signal quality to decrease, meaning that the signal quality does no longer represent stationary reception conditions. Still, these types of measurements are useful for the following tasks:

- Analysis of the receive field strength, since this is not affected by the Doppler effect
- Analysis of broadcast services intended for mobile reception and that therefore explicitly include the Doppler effect in their coverage requirements
- Preparation for subsequent stationary measurements, which are then limited to locations where mobile reception was not possible

System overview

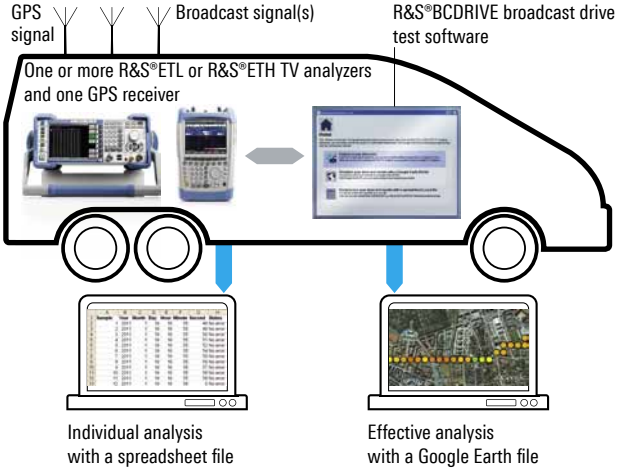


Fig. 1 In combination with the R&S®ETL or R&S®ETH TV analyzers, the R&S®BCDRIVE broadcast drive test software quickly and reliably performs measurements to acquire the geographical distribution of the signal quality.

R&S®BCDRIVE: intelligent and efficient

No matter what method is performed — stationary measurements, mobile measurements or a combination of the two — the new R&S®BCDRIVE broadcast drive test software from Rohde&Schwarz gives users a tool for performing coverage analyses quickly with a minimum of resources. The program can control one or more R&S®ETL or R&S®ETH TV analyzers to accurately perform all measurements required for quality assessment and root cause analysis at one-second intervals — in accordance with a variety of terrestrial broadcast standards

R&S®ETH – full support of DVB-T/DVB-H and ISDB-T					
	Receive field strength	Signal synchronization	Modulation error ratio	Bit error rates	Channel impulse response
DVB-T / DVB-H	●	●	●	●	●
ISDB-T	●	●	●	●	●

R&S®ETL – support of many broadcast standards								
	Receive field strength	Signal synchroni-zation	Modulation error ratio	Bit error rates	Channel impulse response	Signal-to-noise ratio	MPX level / peak deviation	RDS bit error rate
ATSC ATSC Mobile DTV	●	○	○	○	○			
DAB / T-DMB	●	●	●	●	●			
DTMB	●	○	○	○ 1)	○ 1)			
DVB-T / DVB-H	●	●	●	●	●			
DVB-T2	●	●	●	●	●			
FM (radio)	●						●	○
ISDB-T	●	●	●	●	●			
Analog TV	○					○		

● Mobile measurement ○ Stationary measurement 1) For OFDM signals

Fig. 2 The R&S®ETH and R&S®ETL TV analyzers support a variety of broadcast standards and provide all measurements required for signal quality assessment — in many cases for mobile reception as well.

(Figs. 1 and 2). R&S®BCDRIVE can even be run directly on the R&S®ETL so that no additional controller is required during the drive test. All that is additionally required is a USB GPS receiver (e.g. R&S®TSMX-PPS) and a measurement antenna for the desired frequency range. The transducer function included in the R&S®BCDRIVE broadcast drive test software makes use of the measurement antenna characteristics and automatically converts the signal power into the more reliable receive field strength value.

The software provides two methods for performing a complete analysis of all the frequencies transmitted in a terrestrial broadcasting network during a single drive test. Firstly, each frequency is measured by a dedicated TV analyzer. Advantage: Maximum measurement speed delivering maximum spatial resolution, particularly for mobile measurements. Secondly, a single TV analyzer can also be used to measure multiple frequencies cyclically in series — but at the expense of the measurement speed and lower resultant spatial resolution. Both methods can also be combined as needed to achieve a well-balanced compromise between cost and speed (Fig. 3).

Maximum user friendliness

R&S®BCDRIVE performs as much of the configuration as possible. For example, the software works in the background to automatically identify any available R&S®ETL or R&S®ETH TV analyzer and to configure them for field measurements by activating the preselector or automatically adjusting the expected input level.

The clearly structured, task-oriented operating concept requires just a few easy configuration steps to quickly achieve the desired results. Help texts and context-related tooltips explain the function and effect of each specific setting.

When performing stationary analysis at several predetermined locations, the software ensures that all instruments are correctly configured upon arrival at each measurement point and that recording can be started at the press of a button.

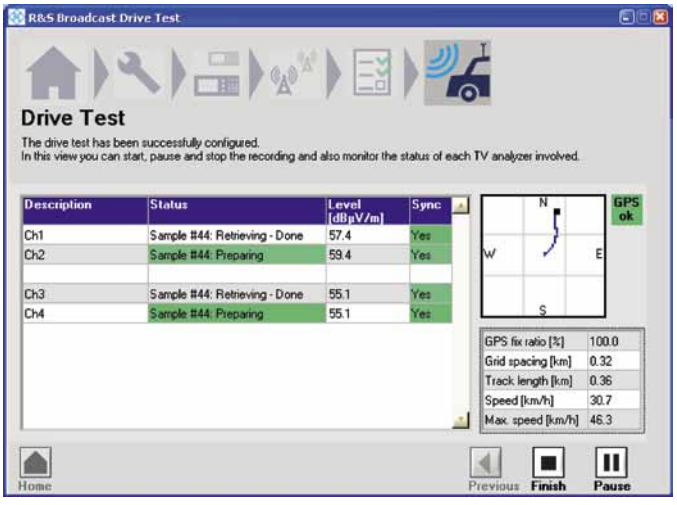


Fig. 3 This view in R&S®BCDRIVE shows a well-balanced compromise for measuring multiple frequencies during a single drive: Two R&S®ETL TV analyzers are used in parallel. The first measures channels 1 and 2 in series; the second measures channels 3 and 4 in series.

Intelligent presentation of the measurement results

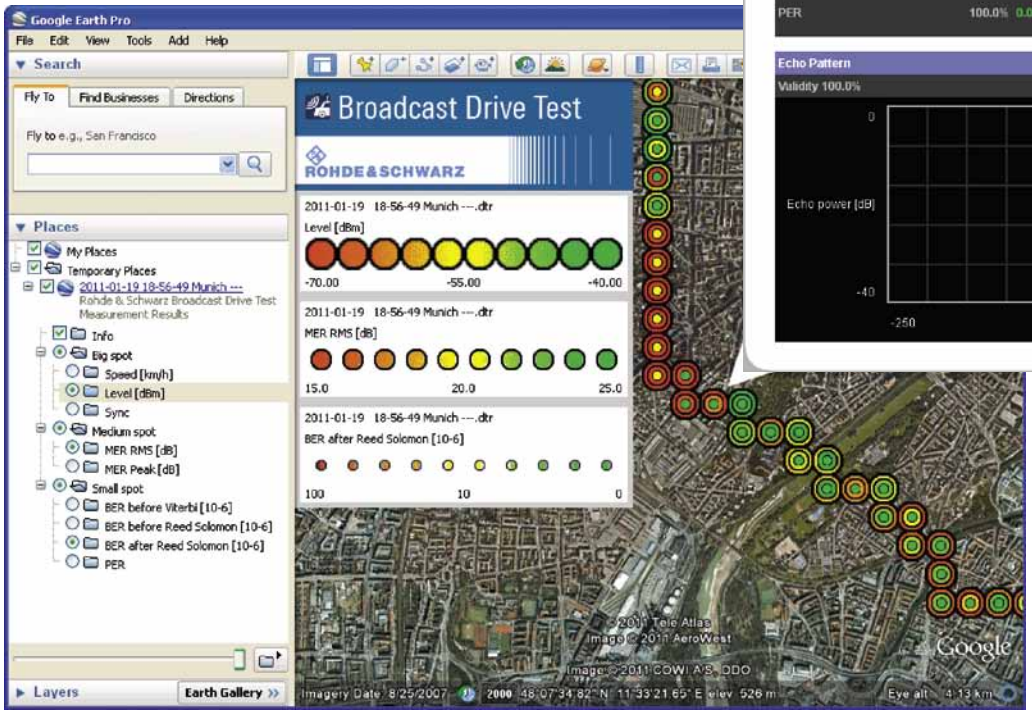
The software exports the recorded data in a format that can be displayed in Google Earth and organizes the often vast amounts of data in a way that makes critical reception areas immediately apparent. For this purpose, each numeric measured value can initially be displayed on the map as a color gradient ranging from red to yellow to green in accordance with user-defined limits. Depending on the zoom level, the software aggregates adjacent values in a single spot. The color of the spot indicates the poorest of all the aggregated values.

Up to three independent color gradients can be displayed at the same time, differentiated by the size of the measurement points. The color spots can be used to show the correlation between different types of measured values for the same frequency, such as the receive field strength, modulation error ratio and bit error rate. However, it is also possible to directly compare a single measured value type, e.g. the receive field strength at different frequencies. For advanced correlation analysis, Google Earth provides the appropriate feature for displaying external data, such as 3D building models or coverage prediction results of the simulation tool used beforehand.

For more in-depth analyses, clicking any measurement point on the map opens an extensive, detailed view listing all results available for this location (Figs. 4 and 5). For more specific testing, the R&S®BCDRIVE broadcast drive test software can export data in the .csv format for spreadsheet programs used for fully customized analyses.

Marius Schipper

For more information and ordering information, visit:
http://www.rohde-schwarz.com/product/BCDRIVE.html



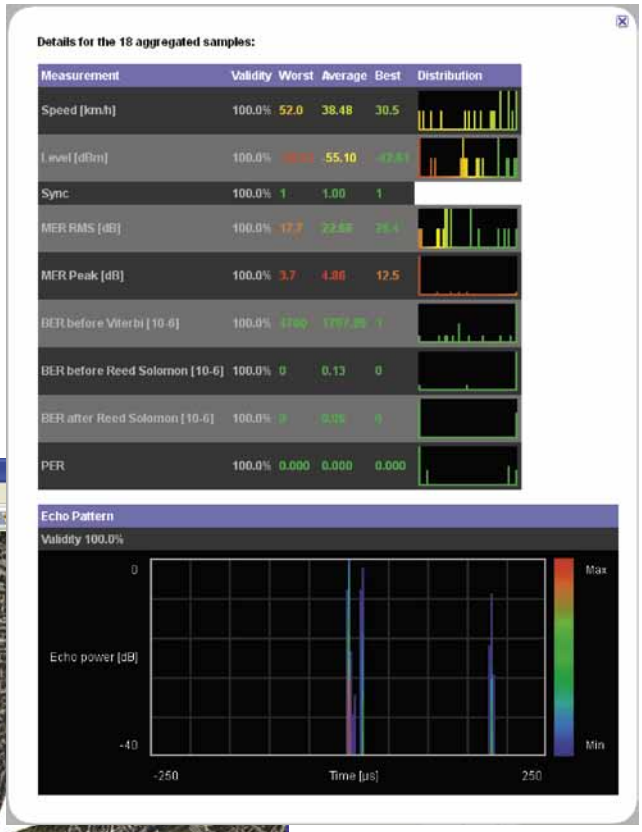


Fig. 4 Functionality for displaying measurement results in Google Earth for direct color-based correlation analysis of the various measurements. In this example, the receive level is indicated by the outer ring of the color spot, the modulation error ratio by the middle ring and the bit error ratio by the center of the color spot for each measurement location. Clicking each of these locations opens a detailed view on a white background (Fig. 5). Depending on the zoom level in Google Earth, adjacent measurement points are aggregated automatically to ensure that the display remains discernible.

Fig. 5 Clicking one of the measurement points opens a summary of all values measured for that location.

TeleZüri opts for file-based workflows with systems from DVS

Reliable, flexible and future-ready – these are the main reasons why TeleZüri switched to file-based workflows and has placed high-end systems from DVS, a Rohde&Schwarz subsidiary*, at all strategic positions in the new production chain. Switzerland's largest local TV broadcaster used the transition to make HD the standard resolution in its workflows.

Challenging and future-ready

TeleZüri was looking to make its production processes even more efficient, particularly for tasks such as ingest, editing, graphics and playout. The company also wanted to completely switch from tape-based operation to consistent file-based workflows. The only way to achieve these challenging goals was with innovative, state-of-the-art technology (Fig. 1). And with highly skilled partners: Jordi AG, the Swiss systems partner of TeleZüri, developed the file-based workflow, and a major part of the high-end studio technology is from DVS Digital Video Systems GmbH, a new member of the Rohde&Schwarz group of companies.

DVS supplied the key equipment for the new system: six VENICE video servers, a DVS-SAN with 96 Tbyte for central storage and a SpycerBox with 48 Tbyte for reliable nearline storage. TeleZüri combined this equipment with an AVECO s.r.o automation system and a NorCom Information Technology AG production system to successfully transition to file-based workflows. It was not possible to immediately switch to completely file-based workflows since there was still tape-based SD material to be processed, e.g. archive material and material coming from ENG cameras or satellite newsfeeds.

* See box on page 37.

Fig. 1 High-end technology from DVS maximizes studio efficiency, especially for tasks such as ingest, editing, graphics and playout – and all with consistent file-based production processes.

Photo: DVS

TeleZüri
TeleZüri was founded in 1994 and was one of Switzerland's first regional TV broadcasters, delivering information to the region in and around Zurich (potential audience: 2.7 million). News broadcasts and talk shows make TeleZüri the information station for the entire Zurich region. As a forward-thinking TV station, TeleZüri is increasingly placing importance on new distribution channels such as video on demand or mobile applications to meet the changing media consumption behavior among its younger audience.

VENICE video servers: fast and reliable

The six VENICE video servers provide 22 video channels spread across the entire workflow and are responsible for key broadcasting tasks such as ingest, news playout and on-air playout (Fig. 2). Content coming from a wide range of sources such as ENG cameras, archive tapes, satellite newsfeeds and live signals from studios, is ingested via two VENICE video servers. The user can control all tasks via the video server's convenient GUI. VENICE uses its integrated hardware scaler to convert source material from SD to HD in realtime so that all content is available in HD throughout the entire production chain. This solution frees journalists from time-consuming searching and conversion tasks and allows them to fully concentrate on creative work instead.

Two VENICE video servers provide eight channels for studio playout. These channels are controlled via multiple protocols and systems. For playout of primary events, VENICE is connected to the NorCom newsroom control system (NRCS): Rundowns are sent to VENICE using media object server (MOS) protocol. The VENICE video server GUI not only shows users a comprehensive overview of the playlist, it also allows them to run individual clips. Thanks to the dynamic playlist, changes in the rundown such as adding additional clips or changing the running order can be done manually by the user or automatically by the NRCS even during broadcast operations.

File-based production chain at TeleZüri

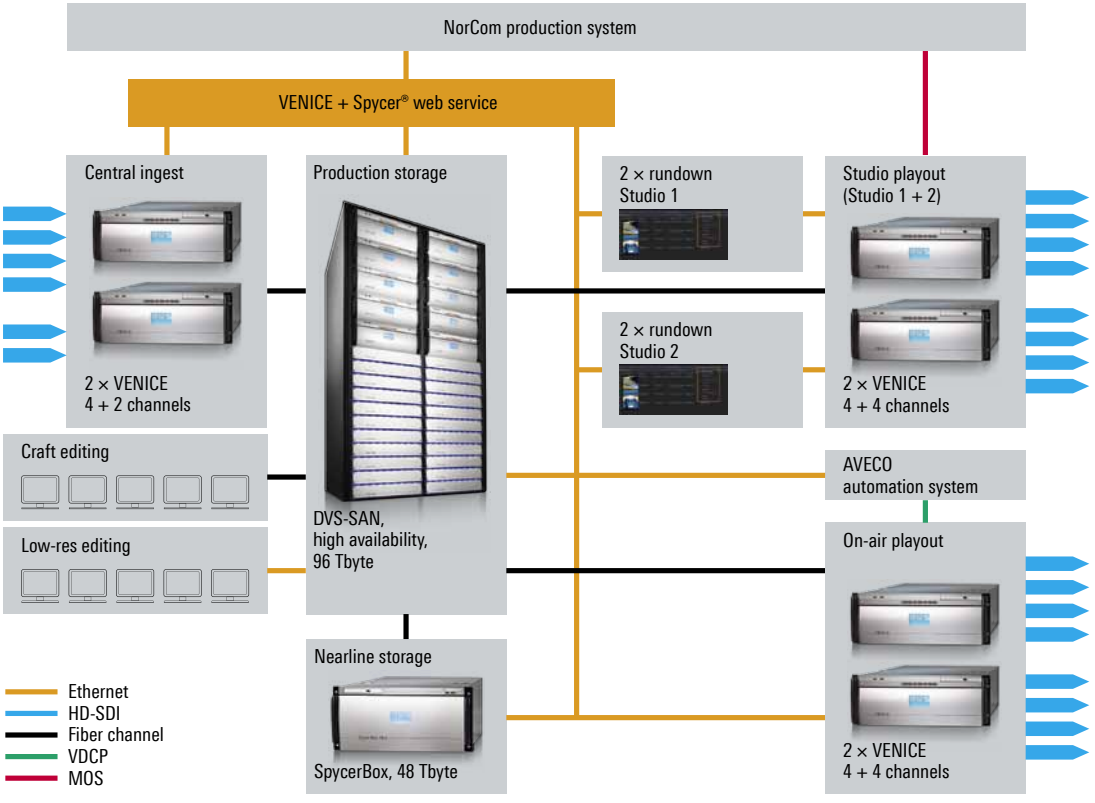


Fig. 2 Six multichannel VENICE video servers are responsible for key broadcasting tasks such as ingest, news playout and on-air playout.

The video servers enable title sequences with transparency effects by supporting file formats with integrated alpha channel. Key and fill signals are available on the HD-SDI ports (3 Gbit/s), allowing producers at TeleZüri to implement sophisticated opening and closing sequences.

Reliable storage solution

The DVS-SAN is configured as the system's central storage, providing the greatest possible reliability thanks to its redundant design. It is able to run continuously around the clock and offers maximum availability. All connected systems such as online and offline editing workstations can directly access the data stored on the DVS-SAN. As the VENICE systems used for ingest and studio playout have no internal storage, DVS-SAN in the perfect addition thanks to its guaranteed real-time performance.

A SpycerBox with 48 Tbyte not only functions as reliable nearline storage, it also serves as backup and archive storage for all TeleZüri data.

Always in the picture with content management

The intelligent Spycer® content management software from DVS is used to manage the material within the entire network. Spycer® offers high-speed copying processes as well as searching and editing of image data. TeleZüri opted for the Sony XDCAM EX file format as it provides a good combination of image quality and data rates at 35 Mbit/s. It is also natively supported by the VENICE video servers.

Summary

Peter Canale, Head of Business and Technology at TeleZüri, is fully satisfied with the new workflows: "We benefit enormously from the introduction of tapeless workflows using DVS technology. The six VENICE systems save us a considerable amount of time, allowing us to respond more quickly and flexibly during our current broadcast operations."

As a result of the successful transition, TeleZüri is now able to offer its services to the sports channel Schweizer Sportfernsehen (SSF), which is located at the TeleZüri premises.

Katrin Brussa; Niklas Fabian

DVS Digital Video Systems GmbH

DVS Digital Video Systems GmbH headquarters in Hanover.

In December 2010, Rohde&Schwarz integrated Hanover-based DVS Digital Video Systems GmbH into the Rohde&Schwarz group. The company, which was founded in 1985 and now has 130 employees, is the leading international manufacturer of hardware and software for professional film and video post production. DVS also produces digital video systems and storage solutions for the film and TV industry. With its future-ready systems, DVS offers flexible solutions for modern, file-based workflows:

VENICE multichannel video server
VENICE enables fast and efficient processing of various compressed and uncompressed formats. The DVS system is a solid server for ingest, playout and transcoding.

CLIPSTER® workstation
The award-winning CLIPSTER® workstation is the world's most popular system for bringing encrypted film to movie theaters. The DVS flagship enables users to perform all the steps in a digital intermediate (DI) workflow on one system – steps that would otherwise need to be distributed over several products. This workstation provides online editing of film data, conversion to various output formats, color correction and even film restoration. CLIPSTER® can handle any level of resolution – SD, HD, 2K and even 4K.

DVS-SAN / SpycerBox storage systems
Thanks to their versatility and performance, the modular DVS-SAN and SpycerBox high-end storage systems are the perfect solution for the post production and broadcast markets. The DVS-SAN handles hundreds of connected clients effortlessly and can provide huge amounts of data to a wide variety of processing systems. The SpycerBox improves the performance of file-based workflows.

Spycer®
The intelligent Spycer® content management software accelerates the workflow and removes the uncertainty of finding image sequences and their metadata in complex networks. Spycer® supports large post production houses and broadcast networks in creating a transparent network that makes the contents of all connected systems available.

For more information, visit **www.dvs.de**

Tracking down interference – in vehicles and on foot

No signal goes undetected – the R&S®DDF007 portable direction finder turns any vehicle into a high-precision mobile direction finder in just a few minutes. On foot, when tracking down interference in buildings or in difficult terrain, the direction finder helps operators pinpoint the location of a signal source. With its integrated wideband receiver and compact DF antennas, this compact device is unique on the global market. Designed for flexibility and a broad scope of applications, the R&S®DDF007 redefines what modern direction finding can do.

Fig. 1 Short-duration radio interference can be easily located using two – or preferably three – compact DF stations installed at exposed sites. The figure shows an R&S®DDF007 portable direction finder with the R&S®ADD107 compact VHF / UHF DF antenna mounted on a wooden tripod.

Full range of functions in a handheld format

The R&S®DDF007 portable direction finder (Fig. 1) has a wide 20 MHz to 6 GHz frequency range that covers all important radio services. Above 173 MHz, it uses the high-precision correlative interferometer DF method. The DF system includes the R&S®DDF007 and a compact DF antenna with integrated GPS module, electronic compass and optional magnetic mount vehicle adapter (Fig. 2). The direction finder's integrated wideband receiver offers ample functionality for signal detection and display, including a panorama scan function for the fast scanning of wide frequency ranges and a fast spectrogram (waterfall) display. The direction finder also has a map display function including triangulation that visualizes DF results on a map and makes it possible to locate transmitters by means of a running fix (Fig. 3).

The R&S®DDF007 is based on the R&S®PR100 portable receiver and includes the full functionality of that device. All R&S®PR100 options are also available for the R&S®DDF007.

Unmatched versatility and flexibility

Locating radio interference sources

When radio interference, such as caused by defective electronic equipment, degrades or even disrupts radiocommunications, quick and effective action is needed. Interference often originates from inside buildings or densely built-up areas, making it difficult to locate its sources. This is the type of scenario where the R&S®DDF007 compact DF system comes into its own. Within minutes, it turns any vehicle into a DF system that can quickly detect and home in on interference sources. To identify the rooms in a building from which interference originates, the R&S®HE300 portable directional antenna is used instead of a DF antenna (Fig. 4).

Key features of the R&S®DDF007

Wide frequency range

- DF mode: 20 MHz to 6 GHz
- Receive mode: 9 kHz to 7.5 GHz

Integrated, fast wideband receiver

- Fast spectrum monitoring
- Detailed IF spectrum display at high bandwidths
- Demodulation of wideband signals
- Signal analysis in receive mode (option)

High-precision DF method

- Correlative interferometer DF method in the range above 173 MHz

Integrated map display (option)

- Integration of OpenStreetMap (OSM) digital maps
- Triangulation based radiolocation
- Integration of application-specific maps (option)

Control and system software

- R&S®DF7-CTL control software
- R&S®RAMON software components (options)

Innovative, compact DF antennas and accessories

- Multi-element DF antennas in the range above 173 MHz
- Integrated GPS module and electronic compass
- Vehicle adapter with magnetic mount (option)
- Lightweight wooden tripod (option)

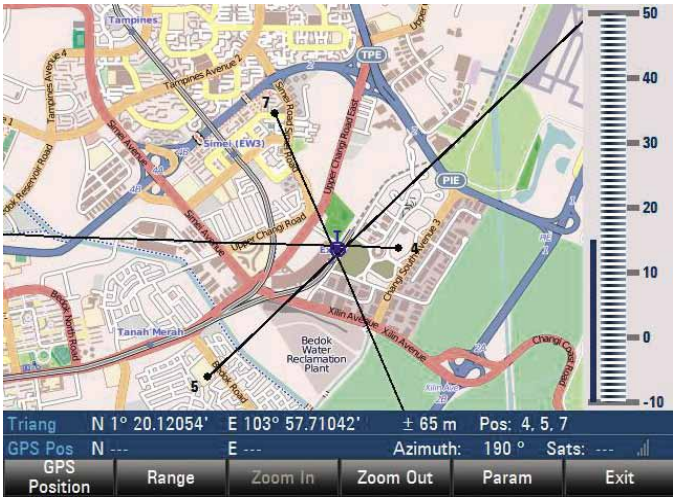
Compact, lightweight lithium-ion battery pack

- Two hours of DF operation or four hours of receive operation (with receiving antenna) on a single battery charge

Detailed technical information and product brochure at www.rohde-schwarz.com

Fig. 2 R&S®ADD107/207 DF antenna with magnetic mount vehicle adapter.

Fig. 3 Triangulation result displayed on the R&S®DDF007.



Locating short-duration radio interference
Short-duration radio interference can be located using two, or preferably three, compact DF stations including the R&S®DDF007. The compact DF antennas are mounted on lightweight wooden tripods and installed temporarily at exposed sites, for example on the roofs of tall buildings (Fig. 1). The complete equipment for a DF station can be carried, and the DF station set up, by just one person.

The R&S®DDF007 uses automatic or manual triangulation to locate a signal source. Manual triangulation requires no extra equipment. To locate a signal source at close range, the operator can turn a DF station into a mobile direction finder quickly and easily.

Locating public mobile radios
Public mobile radios, which are hardly any larger than cell phones, are widely used since they are readily available and can be operated without a license. They are frequently used for mobile applications, and their emissions typically last only a few seconds. This makes it difficult to reliably locate a signal source, especially in built-up areas.

Small, handy, and easy to operate – with a patented DF method requiring significantly less hardware

Single-channel correlative interferometer DF method

The correlative interferometer DF method is based on measuring the phase differences between a reference element and the other elements of a DF antenna. A patented Rohde&Schwarz method makes it possible to carry out this measurement by means of a single receiver. To measure the phase angle between the signals of two antenna elements – independently of the frequency and phase modulation of the signal to be DF'd – the phase of one of the two signals is shifted in four steps (0°/90°/180°/270°) in the quadrature multiplexer and then added to the second signal. The receiver measures the amplitude of the sum signal after each phase shift. From the four amplitude values obtained, the phase angle between the two signals can be calculated. This measurement is performed for each antenna element.

The single-channel interferometer DF method developed by Rohde&Schwarz offers clear advantages over most conventional interferometer direction finders that use at least two receivers. The two receive paths must be in phase and need to be calibrated accordingly since otherwise measurement times will be significantly extended. Moreover, the local oscillator signals need to be multiplied and distributed in-phase. This means that more hardware is necessary compared to a single-channel interferometer direction finder – an additional receive path, in-phase multiplication and distribution of the local oscillator signals, a calibration signal generator, calibration signal distribution and an additional cable to the DF antenna for the calibration signal.

Fig. 4 The R&S®DDF007 portable direction finder with the portable R&S®HE300 active directional antenna (with 500 MHz to 7.5 GHz module).

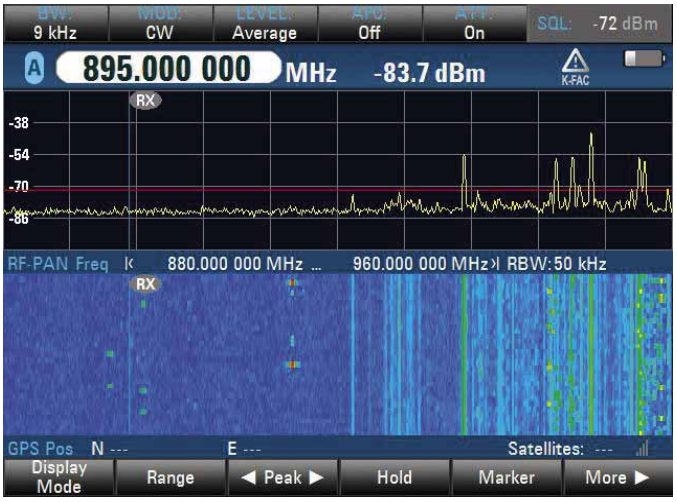


Fig. 5 The R&S®DDF007 in panorama scan mode.

The problem can be solved using a DF network with two, or preferably three, R&S®DDF007 based DF stations. The DF stations are interconnected via PCs and radio links (for example GSM or UMTS). One PC in the network locates the target radio, using automatic triangulation, and displays the result on a map. The DF network can also be remotely controlled.

Location results can be significantly affected by DF errors, depending on the distance between the direction finder and the transmitter. High DF accuracy is therefore mandatory. Here again, the R&S®DDF007 is at the cutting edge – in conjunction with the compact multi-element DF antenna, it offers DF accuracy unparalleled for an instrument of this size.

Locating interference in security-critical areas

Locating interference in security-critical areas such as airports, seaports or military bases, or during large events, calls for high flexibility. Here, the extremely versatile R&S®DDF007 DF system comes into its own. It can be deployed as a fixed or mobile DF station, or as a portable manual direction finder for indoor applications. The integrated high-performance wideband receiver makes it possible to scan the spectrum at high speed and identify, analyze and record signals (Fig. 5). To perform detailed signal analysis, classification and demodulation/decoding in realtime, the R&S®DDF007 is connected to a PC running the R&S®GX430 signal analysis and processing software. The R&S®DDF007 in receive mode transfers the demodulated signals as I/Q data with a bandwidth of up to 500 kHz to the external PC via its Ethernet interface.

Summary

The compact DF system based on the R&S®DDF007 portable direction finder offers functional diversity and performance previously not found in a system of this size. It can be used as a fixed or mobile DF station, or as a portable manual direction finder for indoor applications, and can be reconfigured within minutes to meet the requirements of a given task. The R&S®DDF007 comes with a wide range of powerful software options and add-ons, making it an excellent choice for all applications that call for a compact and flexible yet powerful DF system.

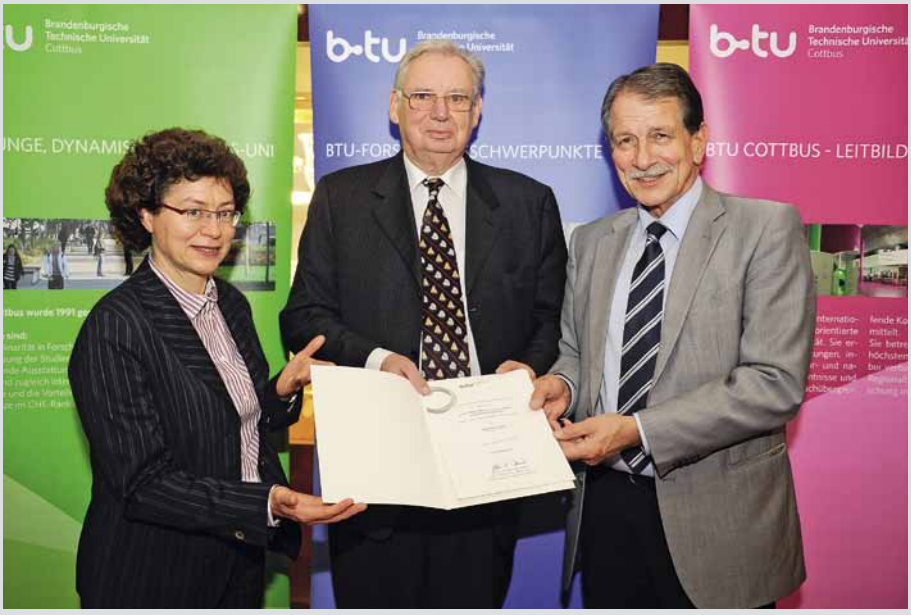
The R&S®PR100 portable receiver can be enhanced to include the functionality of the R&S®DDF007 portable direction finder. Apart from the DF antenna, this merely requires a firmware update plus the enable code. Operators can perform this upgrade on site.

Philipp Strobel

Professor Dr. Ulrich Rohde honored

In honor of his commitment to the university, Prof. Dr.-Ing. Dr. h. c. mult. Ulrich L. Rohde was named honorary senator of the Brandenburg University of Technology Cottbus in October 2011. In 2008, Prof. Dr. Rohde established a foundation with a generous donation from his private assets. The Ulrich L. Rohde Foundation Professorship promotes academic teaching and research in the fields of electronics and information technology. One particular focus is RF and microwave engineering. In October 2009, the foundation began funding the department chair, administrative office as well as the necessary lab equipment.

In addition to numerous other professorships and doctorates, Rohde was also conferred a doctorate in engineering for his work about "active coils".



Prof. Dr. Ulrich L. Rohde (center) was presented the highest honor by the president of the university, Prof. Dr. Walther Zimmerli (right), and by Prof. Dr. Magdalena Mißler-Behr (left).

China Mobile tests TD-LTE with T&M equipment from Rohde&Schwarz

China Mobile uses the R&S®CMW 500 wideband radio communication tester in its research institute lab to perform RF tests on wireless devices for time division LTE (TD-LTE). China Mobile plays a leading role in TD-LTE. The Chinese 4G wireless communications standard succeeds TD-SCDMA, the Chinese 3G standard. The TD-LTE cooperation with the Chinese mobile radio network operator is to continue on a long-term basis. The institute also performs measurements under real-world conditions. Since the beginning of 2011, it has already implemented TD-LTE test networks in six major cities: Shanghai, Hangzhou, Nanjing, Guangzhou, Shenzhen and Xiamen.

New IETD software for the German armed forces

To manage interactive electronic technical documentation (IETD), the German armed forces opted for a software solution developed jointly by Rohde&Schwarz and Elektroniksystem- und Logistik-GmbH (ESG). The software complements the existing system and now allows documentation to be displayed, used interactively and printed out with both stationary and mobile user equipment. ESG provides additional software for testing and administration. In addition, ESG is responsible for ensuring documentation is centrally available. The service package also includes maintenance contracts.

Korea Telecom relies on Rohde&Schwarz

Korea Telecom uses T&M instruments from Rohde&Schwarz for the wide-spanning expansion of its LTE network, which will be in progress through 2013. The two companies have decided on a long-term cooperation. Using the scalable R&S®TS8980 RF test system, the South Korean network operator is testing transmitters and receivers in LTE-compatible wireless devices. Korea Telecom uses the R&S®CMW500 wideband radio communication tester for RF and protocol testing on LTE wireless devices. The tester also provides measurements for a smooth handover between the new LTE and existing WCDMA infrastructure.

Chinese civil aviation administration deploys radio equipment from Rohde&Schwarz

The China Air Traffic Management Bureau (CAAC) purchased 294 ATC radios, which will be installed at 20 locations in the CAAC Northwest air traffic control region. The order is the largest that Rohde&Schwarz has been awarded to date for the airspace in Northwestern China. The R&S®Series4200 radios are used for communications between the flight operations centers on the ground and the aircraft.

Collaboration between Rohde&Schwarz SIT and Adyton Systems

Rohde&Schwarz SIT and the Leipzig-based technology company Adyton Systems will be working together in the future to develop and market next-generation firewall products. The basis for this partnership will be the next-generation firewall developed by Adyton with innovative technology that allows network traffic to be screened practically in real-time at several different levels (single pass). In the future, Rohde&Schwarz SIT will be marketing the next-generation firewall worldwide under the name R&S®SITGate to government institutions, infrastructure operators and companies with especially sensitive data. A common criteria certified model is currently in the planning stages.

R&S®THU9 TV transmitter receives award

The new R&S®THU9 high-power transmitter family is the winner of a superior technology award recipient (STAR) prize. Having just been introduced to the market, the transmitter won the coveted prize from the renowned technical magazine at the IBC 2011. Each year, the award is conferred to an outstanding technological innovation in the broadcasting industry. The technical editors judge the products with respect to how they benefit customers, e.g. efficient functioning or potential savings.

HAMEG products receive dual logo

The T&M products from HAMEG Instruments are now directly available from Rohde&Schwarz almost anywhere in the world. The products now have a new logo including both company names to further improve the brand awareness and growth of HAMEG on an international level. HAMEG Instruments has been part of Rohde&Schwarz since 2005 and supplements the parent company's portfolio of T&M products in the lower price segment.

Further awards for the R&S®RTO oscilloscope

Readers of the German trade journal Elektronik rated the R&S®RTO oscilloscope number one in the "Test and Measurement" category (NEWS (2011) No. 203, p. 70). Two additional awards have now followed:

Innovation award from EDN China
The Chinese trade journal EDN China selected the R&S®RTO as the winner of its Leading Product award. The prize was accepted by the Rohde&Schwarz subsidiary in China. The oscilloscopes won out over 16 products in the "Test and Measurement" category.

Funkschau: ITK Product of the Year
Readers of Funkschau, a German trade journal for communications, selected the R&S®RTO oscilloscope as 2011 ITK Product of the Year. The instruments won in the category of "T&M Equipment".

Branda Huang, publisher of EDN China (first from right), presented the prize to Ray Chen (far left), product specialist for oscilloscopes at Rohde&Schwarz China.

Acting editor-in-chief Markus Kien presents the reader prize to (from left) Dr. Markus Freidhof (R&D), Sylvia Reitz (product management), Guido Schulze (product management), who appeared on behalf of the Rohde&Schwarz oscilloscopes R&D team.

TeraTom project at Long Night of the Sciences

Rohde&Schwarz participated in the Long Night of the Sciences in late October 2011. In collaboration with the chair for RF engineering from the University of Erlangen, the company presented the joint research project TeraTom and demonstrated a mapping radar system. The project makes it possible, for example, to detect foreign bodies in food such as glass shards in chocolate or screws in muesli. One prominent visitor to the booth was the Bavarian Minister of the Interior, Joachim Herrmann.

Had to manage a big rush (from left): Andreas Schiessl and Christian Evers from Rohde&Schwarz, Prof. Lorenz-Peter Schmidt from the Department of RF Engineering at the University of Erlangen as well as Sherif Ahmed from Rohde&Schwarz.

Your question:

What does the R&S®RTO have to offer at 4 GHz bandwidth?

Our answer: The best precision and acquisition rate in its class.
The new R&S®RTO model is a powerful solution for developing digital, analog and RF designs. The extremely low-noise frontend offers the full measurement bandwidth of 4 GHz even at the smallest scaling (1 mV/div). The dynamic range (ENOB > 7 bit) is outstanding, as is the acquisition rate of 1 million waveforms per second. Fast FFT analysis, high dynamic range and a maximum bandwidth of 4 GHz also make the new R&S®RTO ideal for frequency domain measurement.

For more information, visit www.scope-of-the-art.com/ad/faq-rto4

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