News from Rohde & Schwarz

Extremely fast, precise, and highly scalable production tester for wireless devices

Universal analyzer for all major digital and analog TV standards

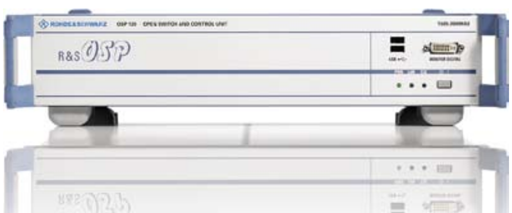
Wideband monitoring receiver provides functionalities previously available only with entire systems

2008/I
195

ROHDE&SCHWARZ

45148

The new R&S®CMW500 wideband radio communication tester is tailored to meet the requirements of modern alignment and test concepts in the production of mobile wireless devices and their modules – this marks a breakthrough in scalability and speed (page 4).



The new R&S®OSP modular platform makes RF switch and control tasks fast and easy (page 28).

Mobile spectrum analysis up to 18 GHz together with the capability to analyze wideband communications standards make the new R&S®FSL18 unique (page 32).

Two new sensors place Rohde & Schwarz once again in the lead of power meter technology. The sensors convert any signal source into a highly accurate power reference (page 36).

MOBILE RADIO

Radiocommunications testers

R&S®CMW500 Wideband Radio Communication Tester
Breakthrough in scalability and speed in production 4
Fast tests of TD-SCDMA wireless devices in production 10

Protocol testers

R&S®CRTU-G Protocol Tester
Test cases for UMA/GAN 13
R&S®CRTU-W Protocol Tester
Test cases for IMS validated 16

Coverage measurement systems

R&S®TSMx Radio Network Analyzers
HSPA measurements with all the bells and whistles 18

WPAN / WLAN / WMAN / WWAN

Signal generators

R&S®Axx / R&S®SMx Signal Generators
IEEE 802.11n: all signals for development, production, service 24

GENERAL PURPOSE

Reference

R&S®EVS300 ILS/VOR analyzer
Study substantiates excellent results achieved in highly challenging measurements 26

Test systems

R&S®OSP Open Switch and Control Unit
Modular platform for RF switch and control tasks 28

Spectrum analyzers

R&S®FSL18 Spectrum Analyzer
Portable spectrum analyzer for applications in the microwave range 32

Power meters / voltmeters

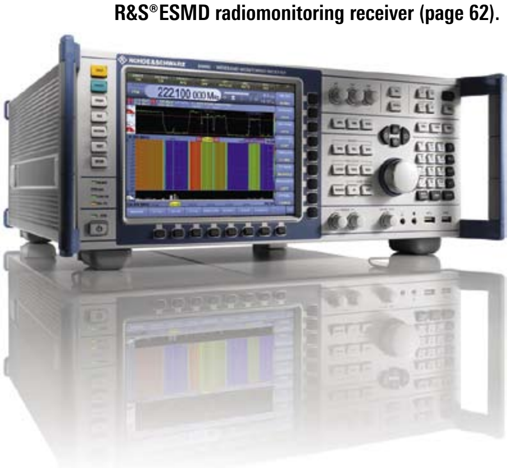
◁ R&S®NRP-Z28/R&S®NRP-Z98 Level Control Sensors
Integrated solution for feeding calibrated signals 36

Signal generators

R&S®SMA100A Signal Generator
Caution: T&M equipment can also give away secrets 40

The R&S®ETL TV analyzer is a versatile platform, in particular with respect to TV transmitter commissioning, installation, and service, as well as coverage measurements for terrestrial television, and measurements on cable headends (page 48).

Fast detection of signals, highly accurate measurements and demodulation, and versatility are the major advantages of the new R&S®ESMD radiomonitoring receiver (page 62).



EMC/FIELD STRENGTH

Test receivers

R&S®ESU EMI Test Receiver
Accurate detection of impulsive electromagnetic disturbance 42

Test methods

Convenient manual solutions for tricky measurement tasks 44

BROADCASTING

TV analyzers

R&S®ETL TV Analyzer
The all-purpose instrument for all major digital and analog TV standards 48

TV transmitters

R&S®SLx8000 Low-Power Transmitter
Compact low-power transmitters for all important TV standards 56

Monitoring systems

R&S®DVM MPEG-2 Monitoring System
New scheduler suite for convenient monitoring of digital TV signals 59

RADIOMONITORING

Receivers

R&S®ESMD Wideband Monitoring Receiver
The radiomonitoring specialist: versatile, fast, accurate 62

RADIOCOMMUNICATIONS

Reference

R&S®Series 4200 Radiocommunications System
Reliable radiocommunications for civil aviation 68

MISCELLANEOUS

Newsgrams 70

Published by Rohde&Schwarz GmbH&Co. KG · Mühldorfstrasse 15 · 81671 München
Support Center: Tel. (+49) 01805124242 · E-mail: customersupport@rohde-schwarz.com
Fax (+4989) 4129-13777 · Editor and layout: Ludwig Drexl, Redaktion – Technik (German)
English translation: Dept. 9MC7 · Photos: Rohde&Schwarz · Printed in Germany · Circulation (German, English, French, and Chinese) 80000 approx. 4 times a year · ISSN 0028-9108 · Supply free of charge through your nearest Rohde&Schwarz representative · Reproduction of extracts permitted if source is stated and copy sent to Rohde&Schwarz München.


ROHDE&SCHWARZ
CMW 500 · WIDEBAND RADIO COMMUNICATION TESTER
WCDMA FDD TX Measurement - Multi Evaluation
UL Frequency: 1922.6000000 MHz
Ref. Level: 0.00 dBm
Connector: RF1 COM
ACLR
Emission Mask
1 MHz Current
30 kHz Current
CDP vs Slot
DPCCH Current
DPDCH Current
Assign View
EVM
Magnitude Error
Phase Error
ACLR
Emission Mask
CDP vs Slot
WCDMA Meas
Multi Evaluation
RF Settings
Trigger
Display
Config ...
Repetition ...
Stop Condition ...
Statistic Count ...
Measurement Length ...
Slot Number Table Values ...
Measurement Period ...
Assign Views ...
MENU
TASKS
LAN
SENSOR
USB

R&S®CMW500 Wideband Radio Communication Tester

Breakthrough in scalability and speed in production

State-of-the-art wireless devices are increasingly evolving into multistandard platforms. This trend and the overall cost pressures are forcing manufacturers to make their production processes more efficient and cost-effective. Rohde&Schwarz has therefore joined hands with mobile radio manufacturers and chipset developers to find solutions. The new R&S®CMW500 wideband radio communication tester from Rohde&Schwarz now stands available as the impressive result of these efforts (FIG 1).

FIG 1
The R&S®CMW500 non-signaling tester is a fast, precise, and highly scalable tool in production. Featuring a frequency range up to 6 GHz and an IF bandwidth of 40 MHz/70 MHz (analyzer/generator), the production tester is optimally prepared to handle future technological developments.

For TD-SCDMA tests by means of the R&S®CMW500, refer to the article on page 10.

Future-proof and scalable

While the achievements of the 3G standard are being implemented step by step in mobile wireless devices, new standards (3.9G, LTE) are being developed as quickly as possible. Mobile radio manufacturers of course do not want to purchase new test equipment for every new standard. Future-proof test equipment is therefore required, i.e. equipment that is also ready to handle tomorrow's requirements. The R&S®CMW500 meets this criterion. Its hardware is designed to operate in a frequency range up to 6 GHz. The instrument is calibrated up to 3.3 GHz as standard and up to 6 GHz with the R&S®CMW-KB036 option. You can enable the extended frequency range when required and thus pay only for what you really need.

Large transmission bandwidths are an integral aspect of future mobile radio standards. Standards such as LTE/EUTRA stipulate bandwidths up to 20 MHz, which the R&S®CMW500 even exceeds – offering reception bandwidth of 40 MHz and transmission bandwidth of 70 MHz. Featuring digital IF and baseband processing, the tester provides extremely high accuracy.

The task of aligning mobile wireless devices often calls for very wide RF level ranges. If the tester does not offer the required dynamic range, external amplifiers or attenuators have to be provided, which will impair reliability and accuracy. With its very wide input and output level range, the R&S®CMW500 eliminates the need for such external equipment. Moreover, the tester's flexible RF frontend (FIG 2) makes external switching matrices superfluous in many cases. For example, to perform a sequential test of two mobile wireless devices, you can measure the first device on one RF connector even as you are connecting the second device to the other RF connector on the tester. When measurements on the first device are completed, the RF connection is switched over to measure the second device. The R&S®CMW500 thus reduces the number of extra RF components that have to be used in a test system. This, in turn, cuts down on costs without any loss in reliability and accuracy.

In production test systems, highly accurate reference measurements are often required at specific points in the test setup. The R&S®CMW500 optimally supports this requirement, allowing you to add an R&S®NRP-Z power sensor to its measurement process. All you have to do is connect the appropriate power sensor to the R&S®CMW500; the tester will handle everything else. The R&S®NRP-Z power sensors meet a variety of test requirements over a wide power range (up to a frequency as high as 40 GHz, depending on the model).

Instruments in production test systems are in most cases remote-controlled from a central controller and thus need no display. The R&S®CMW500 therefore comes in two models – with and without a display.

While test systems used to be controlled mainly via GPIB, there is a clear trend today toward remote control via LAN. The R&S®CMW500 is equipped as standard with a SCPI-based LAN and optionally with a GPIB interface (R&S®CMU-KB612A). Moreover, it can be software-updated to handle LXI Class C.

The tester is even optimally prepared to handle requirements yet to be defined. Its digital IF processing and a versatile internal wiring and slot system mean that future requirements can be met by simply plugging in the appropriate expansion modules.

Multistandard solution

Modern mobile wireless devices support numerous mobile radio standards plus Bluetooth® and WLAN. The use of classic, standard-specific alignment procedures would result in test and alignment times that far exceed acceptable limits. State-of-the-art concepts, therefore, are aimed at performing transmitter and receiver alignment using general-purpose measurements as far as possible. To this effect, the R&S®CMW 500 includes as standard an RF power meter with versatile configuration capabilities and a CW / dual-tone generator. The power meter offers various filters with different characteristics and bandwidths for evaluation and provides comprehensive statistical analysis functions.

Ideal also for complex signals and measurements

To generate complex signals, the tester can be expanded with an arbitrary waveform (ARB) generator (R&S®CMW-B110A option). The ARB generator features a variable clock rate of 400 Hz to 100 MHz and a memory depth of 1 Gbyte, and delivers arbitrary, user-specific modulation signals. The R&S®WinIQSIM2 waveform creation tool is available to help you generate waveform files. With the R&S®CMW-KG200 and R&S®CMW-KG400 options, the ARB generator can produce GSM, GPRS, EDGE and WCDMA signals directly without requiring any waveform files.

The R&S®CMW 500 contains as standard an I/Q recorder for the analysis of complex signals. The signal to be measured is recorded over a defined period of time, and the I and Q values are transferred to an external PC for analysis.

This can be done more conveniently and rapidly using various R&S®CMW 500 measurement options. These options determine, for example, all relevant parameters of a GSM or WCDMA signal in a minimum of time. Measurement options are currently available for GSM / GPRS / EDGE, WCDMA, CDMA2000®, TD-SCDMA and mobile WiMAX – each of them designed for maximum performance. This means, for example, that measurement data is analyzed right where it is collected. A high-speed digital signal processing (DSP) system with specially designed hardware support analyzes recorded measurement data in virtually no time. It thus reduces the data to be transferred to an acceptable minimum. You therefore do not need to manipulate sample rates and bus transfer times in order to optimize processing times, as would be necessary with test systems that have to transfer all measurement data to the controller for signal processing. An independent DSP system allows you to perform numerous measurements in realtime because it is not loaded with any parallel processes such as the processing of data for displaying traces on screen. Moreover, the DSP system is supported by an intelligent sample logic, allowing signal analysis even as the signal is being recorded. This enables, for example, seamless measurements of indefinite length, if the time required for the applied measurement algorithm is shorter than the corresponding signal segment.

Speed advantage through multi-evaluation measurements

In the past, it was often difficult to identify the cause of an error. For example, when out-of-tolerance values were detected during GSM modulation analysis, it would have been useful to see the power characteristic for the signal segment being measured. This was rarely possible because signal recording was restarted with each measurement. The R&S®CMW 500 has overcome this obstacle; it can simultaneously perform numerous measurements on a given signal segment (multi-evaluation measurements). If an error is detected, all measurements carried out on that segment can be used to trace the cause of the error (FIG 3). The real advantage of parallel measurements, however, is the reduction of measurement time: The R&S®CMW 500 carries out a large number of measurements in no more time than for a single measurement. In conjunction with the intelligent sample logic mentioned above, this reduces measurement time to a minimum.

R&S®Smart Alignment minimizes alignment times

Alignment using general-purpose measurements that are not specific to any standard is only the first step toward reducing measurement time. An analysis of the process times required for alignment reveals that the critical factor is not measurement times but handling times. Coordinating the test sequence takes up most of the time. In the conventional approach, the controller sets the required frequency first on the tester and then on the mobile wireless device. Next, it sets the first power control level on the wireless device and starts the measurement. The result is transferred to the controller. Then the next power level is set and the next measurement performed. After all power control levels

FIG 2 Block diagram of the R&S®CMW500. With all test components integrated in a single box, the R&S®CMW500 offers outstanding measurement accuracy without any effort required on the part of the user. There is no need for costly and time-consuming repetitive self-alignment procedures. The flexible RF frontend can in many cases replace an external switching matrix (e.g. when testing a mobile wireless device with multiple receive and transmit paths, or when testing and aligning two mobile wireless devices in parallel).

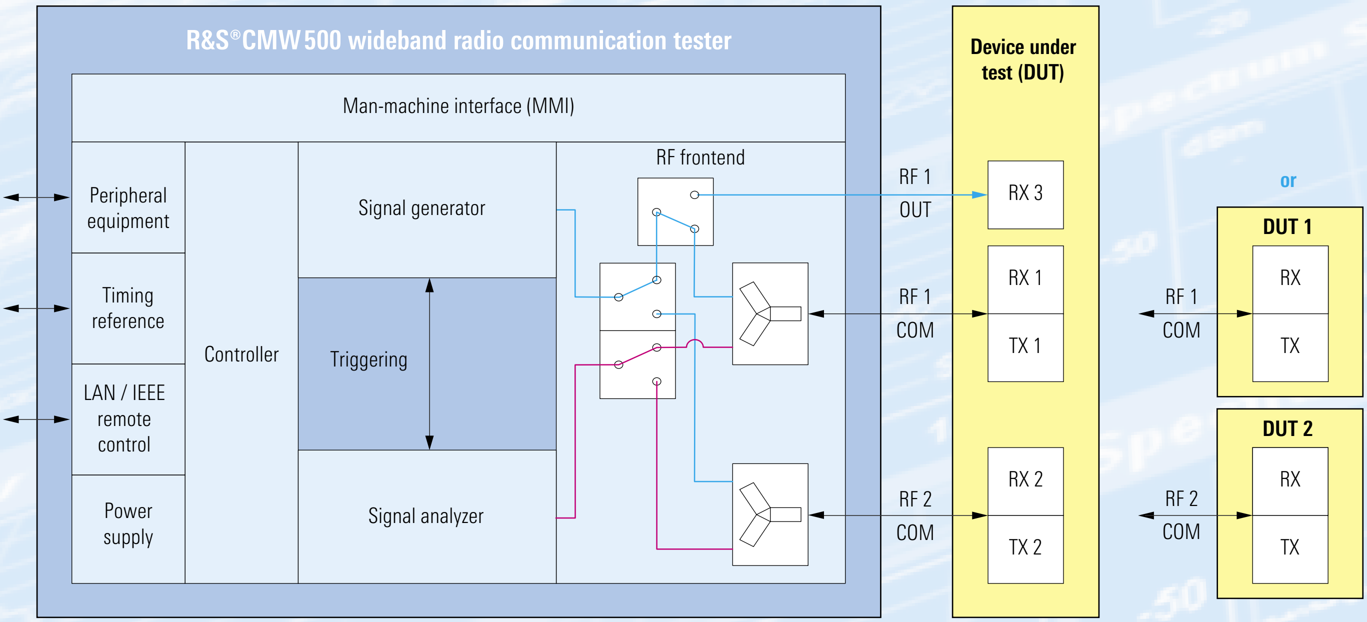
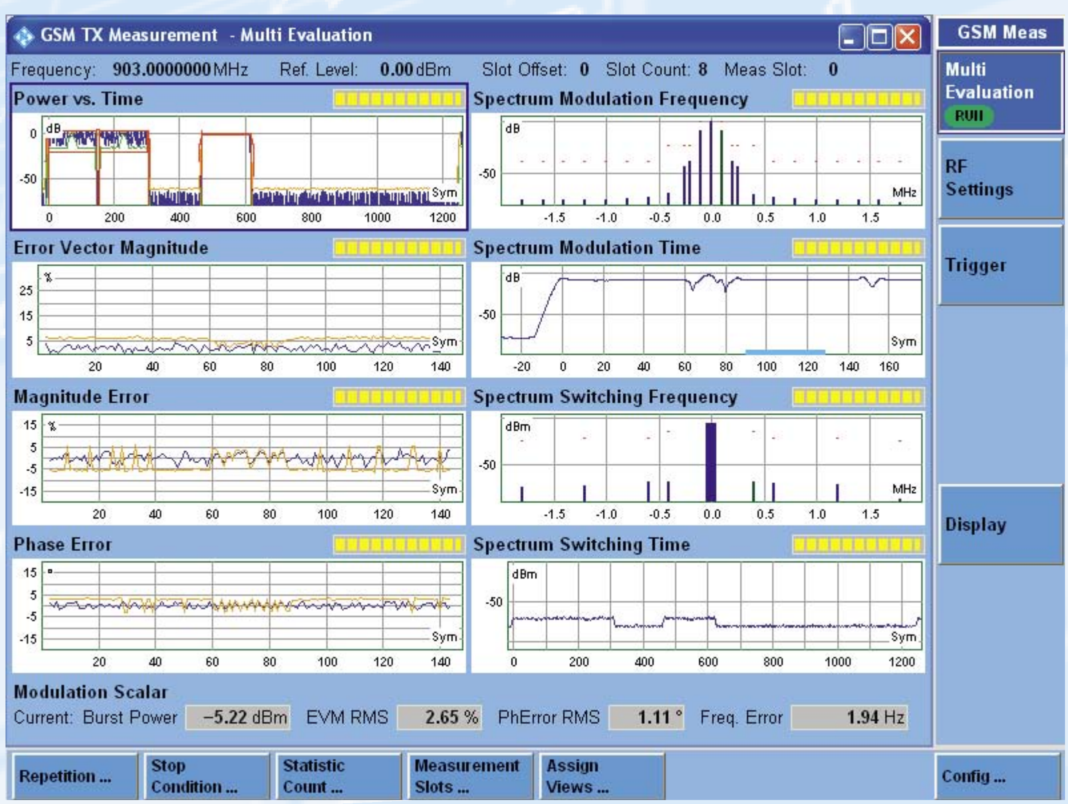


FIG 3
The R&S®CMW-KM200 option (TX measurement, GSM/GPRS/EDGE, uplink) offers a variety of measurements and statistical evaluations from which you may select as needed. The selected measurements are performed in parallel on a specific signal segment (multi-evaluation measurement). All results can be displayed in an overview window. For detailed analysis, you can enlarge each partial measurement to full-screen size. Multi-evaluation measurements are available as options for all important mobile radio standards.



at the first frequency have been measured, the controller advances to the next frequency, and the test sequence is repeated.

With a state-of-the-art approach like the R&S®Smart Alignment concept, predefined frequency/power sequences are started synchronously on the mobile wireless device and on the tester. They are processed in parallel, i.e. without any time loss, and all results are transferred to the controller. This approach drastically reduces alignment times. The R&S®CMW500 can both generate and analyze R&S®Smart Alignment frequency/level sequences by means of its power meter (FIG 4) and its CW/dual-tone generator (FIG 5). The step width can of course be adapted to the characteristics of the device under test. In addition, the ARB generator enables you to control the processing of a frequency/level sequence as required by using markers stored in the waveform file.

Bit error ratio (BER)

The BER is used to assess the quality of the receiver of a mobile wireless device. The classic approach determines the BER by means of a measurement loop. The tester transmits a standard-compliant signal with PRBS-modulated data content (PRBS = pseudo random binary sequence) to the mobile wireless device, which receives and decodes the signal. The mobile wireless device re-encodes the decoded signal in line with the standard and returns it to the tester. The tester analyzes the signal and compares its data content with that of the original signal. This approach has two disadvantages. First, this measurement requires a fully functional mobile wireless device capable of transmitting and receiving standard-compliant signals. In the case of a GSM phone that can serve one timeslot only, the measurement takes eight times the minimum theoretical time because data exchange takes place only in one of the eight timeslots. Second, standard-compliant coding of the PRBS data means that not all data bits are available for determining the BER, as numerous bits are required for the header and for error correction. Plus, the standard error correction mechanisms impede the objective quality assessment of the receiver.

State-of-the-art approaches for measuring the BER use a method referred to as single-ended BER. The tester transmits a defined PRBS-modulated signal, and the receiver in the mobile wireless device determines the BER by comparing the received signal with the expected signal. Since neither a standard-compliant signal nor a loop is used, all bits of the signal are available for measuring the BER, which dramatically cuts down on test times.

Summary

But, there are drawbacks to everything. This also applies to state-of-the-art measurement approaches in production. The classic approaches permitted you to measure every standard-compliant mobile wireless device: All that was required was conventional signaling or a simple test interface on the wireless device in order to make all required test settings. Test sequences could easily be adapted to changing requirements.

State-of-the-art measurement approaches, by contrast, demand that even chipset manufacturers give careful consideration to subsequent alignment and test procedures in production. This is because the predefined frequency/level sequences are not defined by any standard, and subsequent modifications to such sequences are difficult to make with a finished chip. These drawbacks have so far kept manufacturers from switching to modern alignment methods. In the meantime, however, cost and time pressures in production have grown to such an extent that an increasing number of manufacturers are adopting new concepts.

Rohde & Schwarz is also an experienced partner for wireless device manufacturers when it comes to state-of-the-art alignment and test methods. Furthermore, the company supports manufacturers in the implementation of the new concepts. The R&S®CMW500 wideband radio communication tester is tailored to meet the requirements of modern alignment and test concepts. Owing to its high flexibility and extremely short measurement times, the R&S®CMW500 marks a breakthrough in scalability and speed in production.

Rudolf Schindlmeier

More information and product brochure at www.rohde-schwarz.com (search term: CMW500)

FIG 4
The universal power meter of the R&S®CMW 500 can track the frequency/level sequences returned by the mobile wireless device when using state-of-the-art alignment concepts, and analyze the power of the individual frequency/level steps of a sequence. The tester can perform various statistical analyses (e.g. minimum/maximum power or standard deviation), depending on requirements. The number of frequency/level steps of a sequence is selectable between 1 and 500.

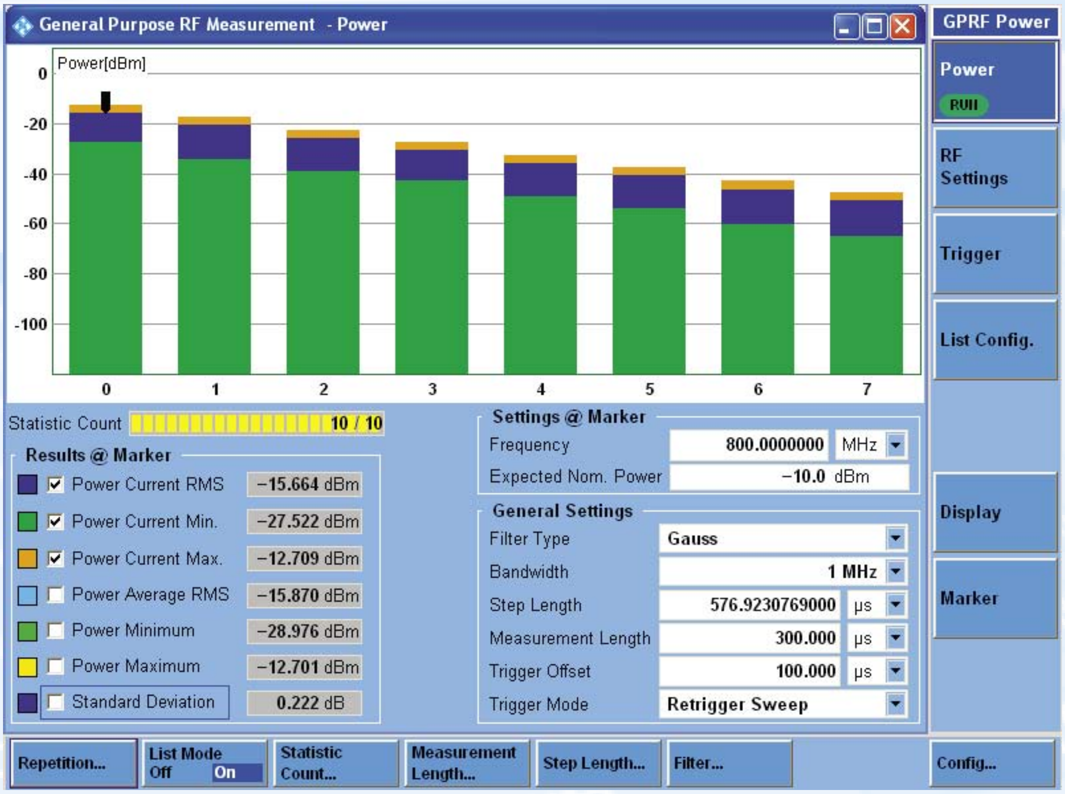
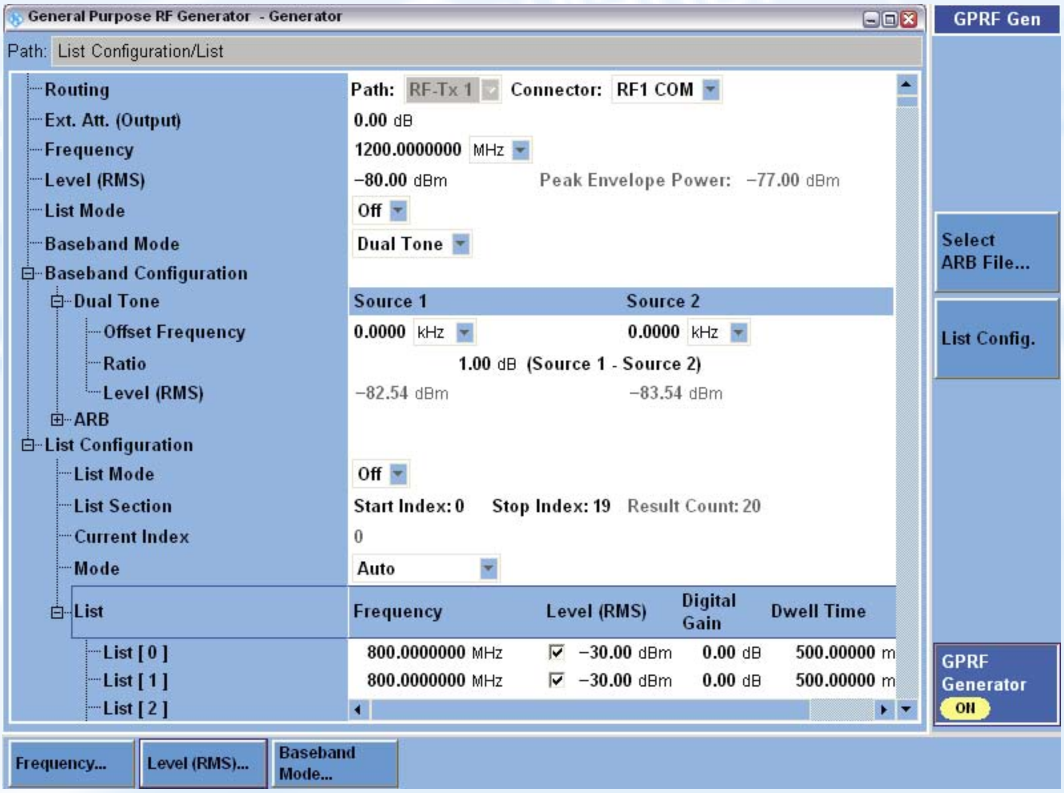


FIG 5
The CW/dual-tone generator of the R&S®CMW 500 can deliver sequences of up to 2000 frequency/level steps. Two separate functions are available for level setting – "Level (RMS)" and "Digital Gain". You can thus control the R&S®CMW 500 gain and attenuation paths exactly as needed. Adjusting the digital gain will not cause any change to the tester's gain and attenuation paths. You can thus implement extremely linear level characteristics, avoiding any effects on the device under test that might distort results.



R&S®CMW500 Wideband Radio Communication Tester

Fast tests of TD-SCDMA wireless devices in production

With its integrated vector signal generator and analyzer, the new R&S®CMW500 wideband radio communication tester offers comprehensive testing of TD-SCDMA mobile phones – at a speed that will impress you.

TD-SCDMA – Chinese 3G standard

Time division synchronous code division multiple access (TD-SCDMA) is a further third-generation (3G) mobile radio standard in addition to 3GPP FDD and CDMA2000® that has been approved by ITU. As a time division duplex (TDD) system, TD-SCDMA uses the same carrier frequency in the uplink and downlink. Data transmission rates of up to 2 Mbit/s are attained at a chip rate of 1.28 Mchip/s and a bandwidth of 1.6 MHz. Either QPSK or 8PSK – for maximum data rates – modulation is used. Seven timeslots, which can be allocated as needed between the uplink and downlink depending on utilization and data volume, are available for transmission.

This standard, which is primarily supported and driven by Chinese organizations and their industry partners, will definitely be considered and put into operation when 3G licenses are allocated in the near future in China.

This means that a large number of TD-SCDMA mobile phones and modem cards will have to be manufactured within a short period of time and that the right type of measuring equipment must be provided in sufficient numbers in production. Measurements that have to be performed during the calibration of the receive and transmit section and during final testing can be carried out in a time-optimized way in the non-signaling mode by using vector signal generators and analyzers (see box on left).

Rohde & Schwarz has already been offering test solutions for the TD-SCDMA standard for quite some time: the R&S®SMx generator family [1] and the R&S®FSU / FSP / FSQ spectrum and signal analyzers [2]. The new R&S®CMW500 wideband radio communication tester with its integrated vector signal generator and analyzer now complements this portfolio as an ultrafast one-box solution.

The most important measurements on TD-SCDMA wireless devices

Accurate power control of the individual mobile wireless devices within a cell is essential to smooth operation – especially in CDMA networks. A mobile phone must be able to exactly maintain the transmit power allocated to it. The **transmit power is adjusted** in a relatively early phase of production. The mobile phone transmits RF signals on different frequencies and with various power levels. The values measured with an analyzer are first compared with nominal values and then correction values are defined.

To help ensure trouble-free network operation, the base station needs information about the exact receive field strength at the individual subscribers within a cell. Therefore, each mobile phone continuously measures the signal field strength and reports it to the base station. To **align the receiver signal strength indicator** (RSSI) of a mobile phone in production, the test assembly generates an RF signal in a specific frequency / level combination. The mobile phone records the field strength, thus allowing correction values to be derived and stored in the phone.

A final test, which is an integral part of production, is performed on the mobile phone to ensure standard-compliant operation. The TD-SCDMA RF signals are checked for spectral purity on the transmitter end during **power, modulation and spectrum measurements**. The receiver quality is verified by means of bit error ratio (BER) measurements. Like calibration, final testing requires the least time in the non-signaling mode.

R&S®CMW500: fast multistandard platform

As a multistandard platform, the new R&S®CMW500 wideband radio communication tester supports not only TD-SCDMA but also offers measurement options for GSM/GPRS/EDGE, WCDMA, CDMA2000® and mobile WiMAX, thus featuring a number of advantages:

R&S®Smart Alignment

For the calibration of the transmit/receive section, the R&S®CMW500 includes a flexibly configurable RF power meter and a CW/dual-tone generator as standard. This normally time-consuming calibration process can be greatly speeded up – to the extent supported by the chipset – by means of a predefined frequency/level sequence (FIG 1). The R&S®CMW500 processes such sequences with both the level meter and the generator (for details see page 6: "R&S®Smart Alignment minimizes alignment times").

Fast test of receiver quality

The R&S®CMW500's arbitrary waveform generator option (R&S®CMW-B110A) can generate any modulation signal you need. The tester can create TD-SCDMA reference measurement channels (12.2 kbit/s to 2048 kbit/s) for the uplink or downlink in realtime. These channels are required for BER measurements and for assessing the quality of receivers. During BER measurements, PRBS-modulated data content is normally sent to the mobile phone and, from there, looped back to the tester for evaluation purposes. However, most of the chipsets used with TD-SCDMA support single-ended BER, which allows evaluation by the mobile phone itself. Thus, the loop is no longer necessary. The test is carried out in the non-signaling mode, which considerably reduces test time (FIG 2).

Specified tests verify whether the mobile phone transmitter or receiver is operating in compliance with the standard. Relevant receiver tests for TD-SCDMA are stipulated in the 3GPP TS25.102 specification (FIG 3). Required TD-SCDMA test signals can be configured with the R&S®WinIQSIM2™ waveform creation tool and generated by the ARB generator in the R&S®CMW500.

Multiple transmitter tests in parallel

The relevant test cases for transmitter tests are defined in the 3GPP TS25.102 specification (FIG 3). The R&S®CMW500 supports all these measurements. Owing to specially developed hardware, its fast DSP system evaluates the measured data in a very short amount of

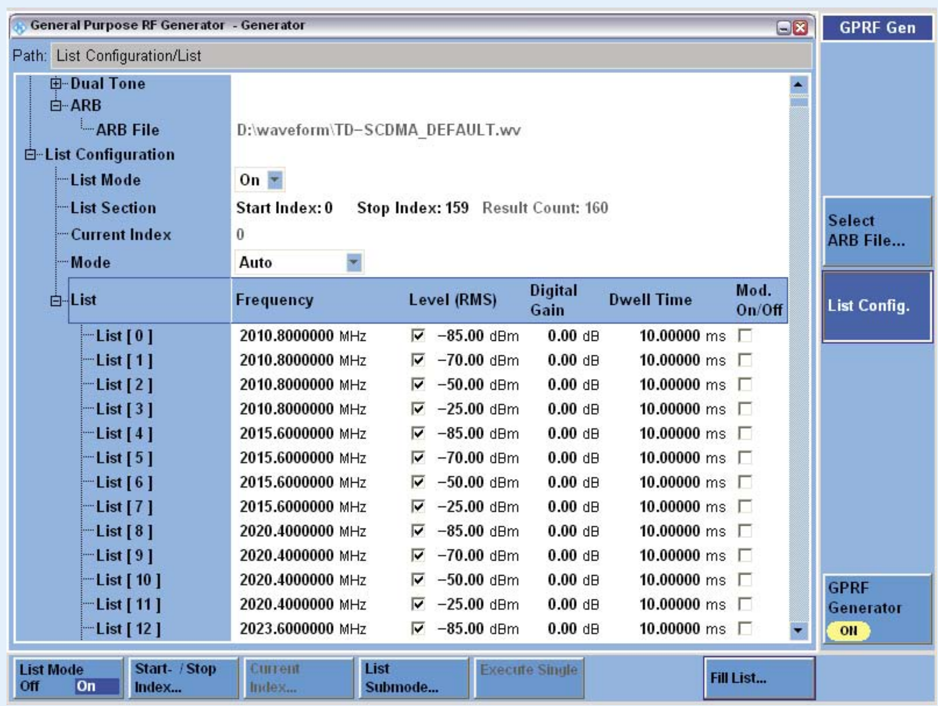
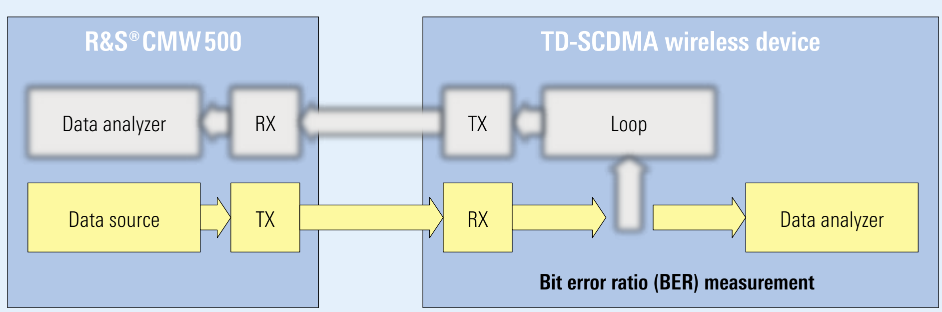


FIG 1 Fast alignment of the receiver signal strength indicator (RSSI) in a mobile phone using a predefined frequency/level sequence from the R&S®CMW500 generator. As a precondition, a mobile phone must be able to adhere to this sequence on its own.

FIG 2 Checking of the receiver quality without the customary loop back to the measuring instrument. Once the generation algorithm of the data stream sent by the tester is known, the wireless device can calculate the bit error ratio of the demodulated and decoded data stream on its own.



Transmitter tests		Receiver tests	
6.2	Transmit power	7	Receiver characteristics
6.2.1	UE maximum output power	7.3	Reference sensitivity level
6.3	UE frequency stability	7.4	Maximum input level
6.4	Output power dynamics	7.5	Adjacent channel selectivity (ACS)
6.4.2	Minimum output power	7.6	Blocking characteristics
6.5	Transmit ON/OFF power	7.7	Spurious response
6.5.1	Transmit OFF power	7.8	Intermodulation characteristics
6.5.2	Transmit ON/OFF time mask		
6.6	Output RF spectrum emissions		
6.6.1	Occupied bandwidth		
6.6.2.1	Spectrum emission mask		
6.6.2.2	Adjacent channel leakage power ratio (ACLR)		
6.8	Transmit modulation		
6.8.2	Error vector magnitude (EVM)		
6.8.3	Peak code domain error		

FIG 3 Transmitter and receiver tests in the 3GPP TS 25.102 specification.

FIG 4 Based on identical sample sets, the multi-evaluation measurement allows the parallel evaluation of the measured signal. The measurement determines the error vector magnitude (EVM), magnitude error, phase error, frequency error, I/Q origin offset, I/Q imbalance, adjacent channel leakage ratio, spectrum emission mask, occupied bandwidth, code domain power and peak code domain error power.

time and allows multiple measurements to be performed in parallel on the same signal segment also in realtime (multi-evaluation measurement, FIG 4). If an error occurs, all measurements can easily be used to trace the cause of the error. For details, see page 6: "Speed advantage through multi-evaluation measurements".

Summary

The R&S®CMW 500 wideband radio communication tester is a powerful test platform that is setting new standards in measurement speed, accuracy and safety of investment owing to its versatile enhancement options.

Thomas A. Kneidel

More information at www.rohde-schwarz.com (search term: CMW500)

REFERENCES

[1] R&S®SMx Signal Generators: The world's first integrated signal generator solution for TD-SCDMA. News from Rohde & Schwarz (2006) No. 189, pp 16–19
[2] R&S®FSP / FSU / FSQ Analyzers Test of TD-SCDMA base stations. News from Rohde & Schwarz (2004) No. 181, pp 18–19

R&S®CRTU-G Protocol Tester

Test cases for UMA/GAN

The UMA Alliance has developed the unlicensed mobile access (UMA) technology with the aim of making unlicensed parts of the frequency spectrum available to mobile radio applications and enabling seamless roaming from standards such as WLAN or Bluetooth® to the conventional GSM and UMTS mobile radio networks. In 2005, UMA was integrated into the 3GPP and standardized as generic access network (GAN). The R&S®CRTU-G protocol tester offers extensive protocol tests for the development and certification of GAN mobile phones.

WLAN supplements conventional mobile radio networks

Mobile phones are versatile: The mobile solutions of the past that only allowed a call en route have rapidly evolved into multifunctional devices that hardly anyone wants to do without even at home or at work. However, poor reception in buildings will quickly limit their usability. Using WLANs as a supplement in mobile radiocommunications offers an efficient and economical solution to this problem.

The UMA protocol enables, for example, phones supporting GSM and WLAN to use all voice and data services provided both through the conventional GSM network and through a WLAN. The protocol ensures a soft handover between the two transmission technologies.

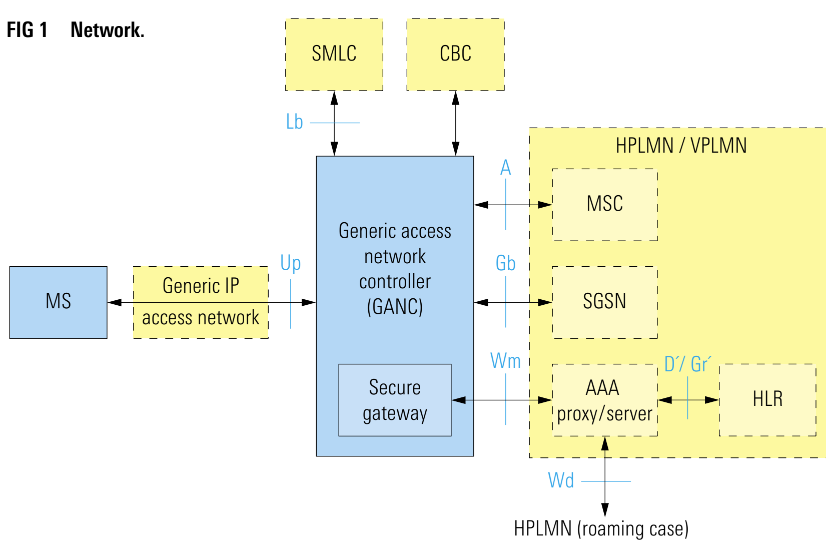
UMA/GAN networks

UMA/GAN networks include one or more access points that provide the radio interface to mobile phones in the unlicensed spectrum as well as one or more GAN controllers (GANC) that are connected to the network like a base station subsystem (FIG 1). The A interface for circuit switched services, known from the GSM network, and the Gb interface for packet-switched services serve as interfaces. The GANC contains a secure gateway that handles authentication and encryption. Encryption is based on the internet protocol security (IPsec) protocol well-known in the IP community.

The UMA/GAN protocol

The UMA/GAN protocol basically covers "Discovery", "Registration", "Circuit-Switched Domain" and "Packet-Switched Domain". A successful Discovery procedure enables the network to allocate a GANC to a mobile station (MS) at which the MS can book in via the Registration procedure to obtain GAN services. These services include, for example, simple circuit-switched phone calls, handovers (CS domain) from GAN to GSM and vice versa as well as FTP transfers (PS domain).

FIG 1 Network.



Abbreviations in FIG 1

AAA	Authentication, authorization and accounting
CBC	Cell broadcast center
GANC	GAN controller
HLR	Home location register
HPLMN	Home PLMN
MS	Mobile station
MSC	Mobile switching center
PLMN	Public land mobile network
SMLC	Mobile location center
SEGW	Security gateway
SGSN	Serving GPRS support node
VPLMN	Visited public land mobile network

UMA/GAN on the protocol testers

Equipped with the R&S®CRTU-UA01 (GAN protocol stack) software packages and the test cases of R&S®CRTU-UC01 to -UC05, the R&S®CRTU-G protocol tester with its well-known convenient user interface provides extensive protocol tests for the development and certification of GAN-based mobile stations. These tests cover all GAN test cases specified by 3GPP in TS51.010 for the following:

- Discovery (R&S®CRTU-UC01)
- Registration (R&S®CRTU-UC02)
- Lower Layer Failure (R&S®CRTU-UC03)
- Circuit-Switched Domain Tests (R&S®CRTU-UC04)
- Packet-Switched Domain (R&S®CRTU-UC05)

IPsec in UMA/GAN

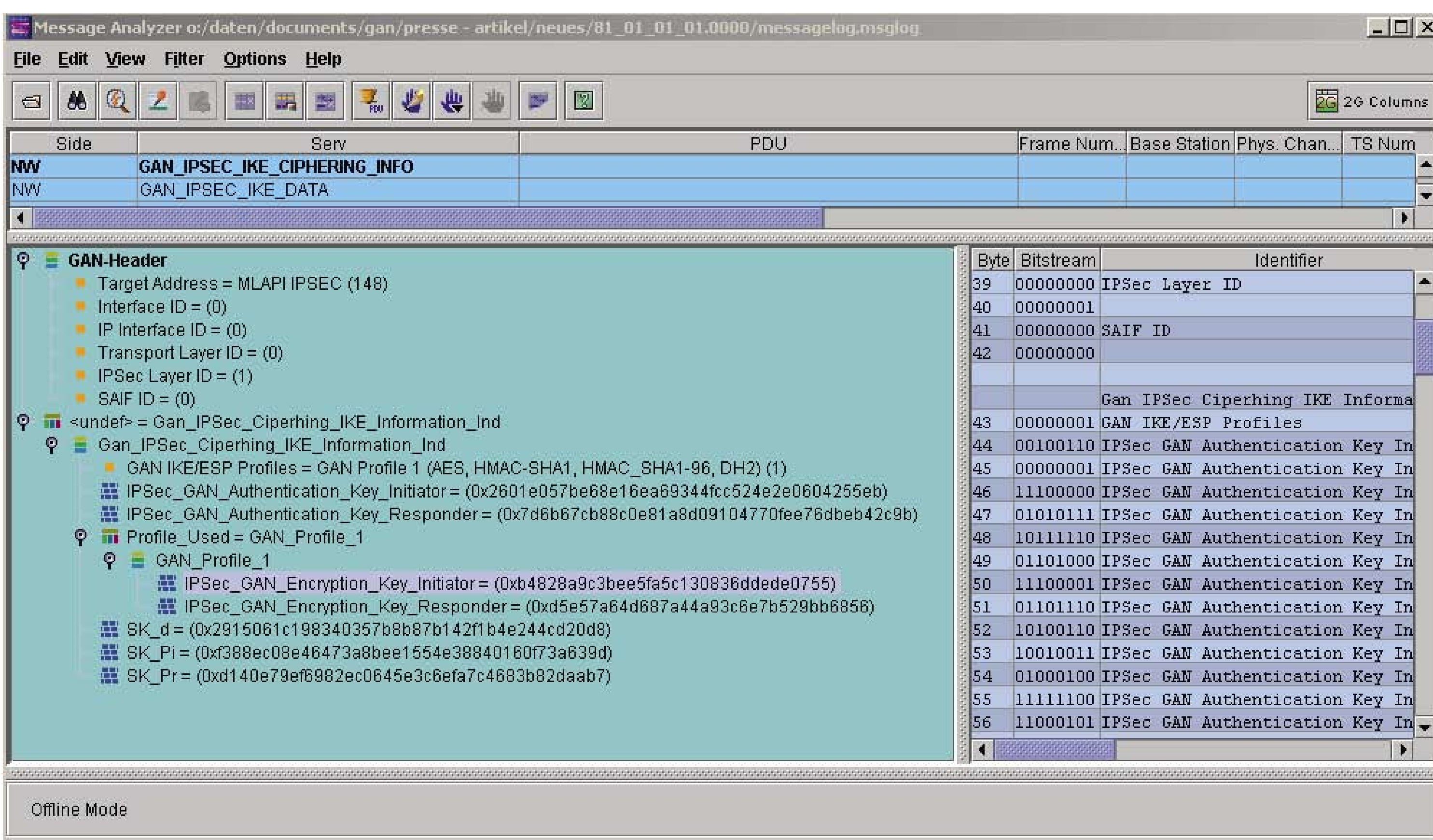
The IPsec protocol provides integrity, confidentiality and authenticity in UMA/GAN. Communications between MS and GANC are performed by means of encoded data packets transmitted through an IPsec tunnel. IPsec has thus become an integral part of all GAN test cases specified in TS51.010 and a prerequisite for passing GAN tests.

Detecting protocol errors in encoded messages is difficult as the plain text is obviously not easily readable. Rohde & Schwarz has, therefore, integrated IPsec into the protocol stack of R&S®CRTU-UA01. This makes it possible to record, decrypt and decode all IPsec messages – an invaluable help in pinpointing any error in the complex IPsec implementation. Here, not only information on IP addresses and keys to decode the ESP blocks (FIG 2) will be stored but also the Internet key exchange (IKE) messages from IPsec in which these keys are being negotiated are made readable – a special feature of the Rohde & Schwarz solution. Instead of encoded IKE messages (FIG 3), the Rohde & Schwarz log provides detailed plain text information allowing efficient troubleshooting (FIG 4).

Summary

The extensive and detailed results provided by the UMA/GAN protocol test solution from Rohde & Schwarz enable the efficient and time-saving analysis of test results in the familiar R&S®CRTU-G

FIG 2 IPsec – encapsulated security payload key of initiator and responder.



environment. The R&S®CRTU-UA01 and R&S®CRTU-UC01 to -UC05 UMA/GAN products excellently supplement and complete the protocol testing portfolio of Rohde&Schwarz.

Alexander Eis

More information and data sheets at www.rohde-schwarz.com (search term: CRTU)

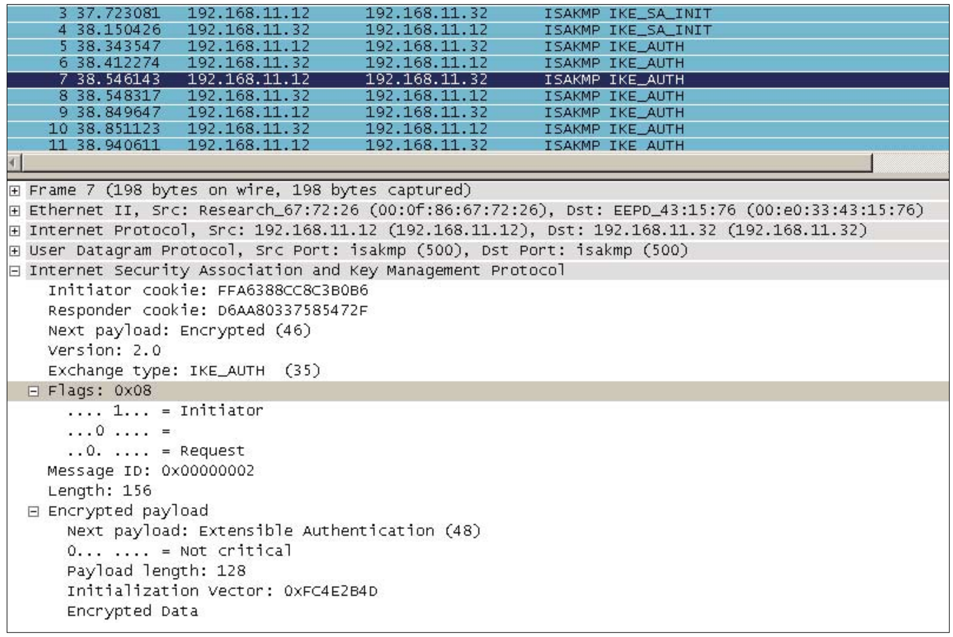
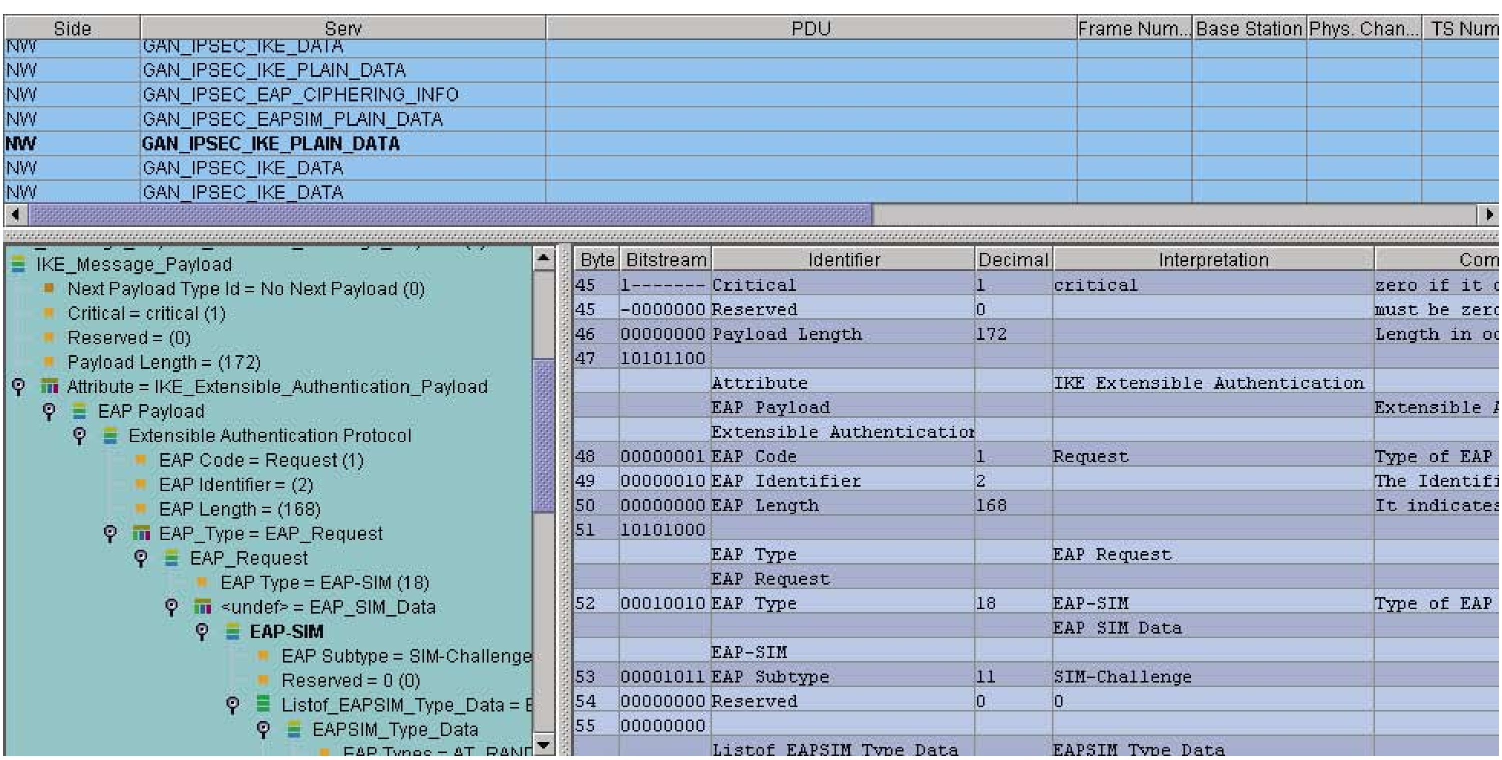


FIG 3 **Encoded IKE message.**

FIG 4 **Decoded IKE message.**



R&S®CRTU-W Protocol Tester

Test cases for IMS validated

The IP multimedia subsystem (IMS) is a 3GPP-standardized architectural framework for mobile radio networks that provides end users with most diverse services via an IP network. Rohde & Schwarz is the only supplier who is already now offering test cases for related mobile conformance tests.

IMS: more than only voice over IP

The next generation mobile networks (NGMN), based on WiMAX or LTE, will differ from the existing networks not only by higher data rates and shorter latencies but, from today's point of view, also by the fact that they will exclusively support purely packet-oriented network protocols. The IP multimedia subsystem (IMS, see box below) is a 3GPP-standardized architectural framework for mobile radio networks that provides end users with most diverse services via an IP network, e.g. services for voice, videotelephony or multimedia applications.

The IMS has been placed between the transport and the application layer and so isolates the underlying transport network from the application. Therefore, applications and services may be provided for and billed to different terminals without forcing the provider to worry about the connection type of the respective terminal. Services such as voice, video and data, which used to be strictly separated, will now move closer together owing to this Internet protocol. So a video connection may be set up or a short text message sent concurrently with a voice call.

These two fundamental principles lead to the fixed mobile convergence (FMC) of networks and applications. The services will unite at the upper layers while, on the underlying transport network, the differences between wireless and wireline networks will vanish. Users can in the future be reached at their telephones at home, en route on their mobile phones or at their laptops in a hotel room via one single number or identity.

Details on IMS

The call session control functions (CSCF) are the core components of the IMS. There are three different CSCFs: proxy CSCF, interrogating CSCF and serving CSCF (FIG 1). In this context, terminals supporting IMS are referred to as user agents (UA). These UAs always communicate with the P-CSCF as their central access point to the IMS. The P-CSCF performs access control, for example, and sets up a secure connection to the UA. During the registration of a UA in the IMS via the session initiation protocol (SIP), the P-CSCF determines the appropriate I-CSCF by means of the user ID that the UA wants to register. For this purpose, the P-CSCF may use either preconfigured entries or DNS procedures. The I-CSCF will then contact the home subscriber server (HSS) that is comparable to the home location register in mobile radio networks. The HSS stores user preferences and settings and the associated S-CSCFs. An S-CSCF may be associated with different services and is to be selected depending on the service to be used. The S-CSCF serves to authenticate the user.
The AKA algorithm known from WCDMA is used in the IMS to authenticate and generate keys. To this end, the S-CSCF inquires the necessary keys from the HSS. Via the I-CSCF and P-CSCF it returns an authentication request to the UA in the form of a negative reply to the initial SIP-REGISTER request. As soon as the UA has correctly responded to this request with another REGISTER request, it has been successfully registered in the IMS, which the S-CSCF confirms by a positive reply.
This complicated architecture with its three different CSCFs may appear unnecessary and exaggerated but its purpose becomes clear in the case of roaming: Network providers are, of course, unwilling to disclose their internal network structure and want to prevent any access to their own user databases. Since the UA always communicates with the local P-CSCF in the accessed network, this P-CSCF must be denied access to the HSS. The I-CSCF is thus in charge of hiding the network architecture from other providers.

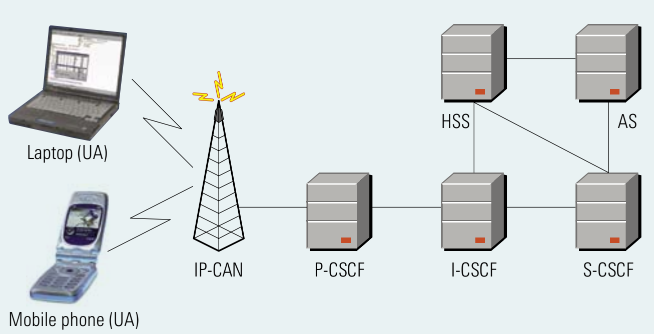


FIG 1 Schematic view of a part of the IMS architecture: On the left, IMS terminals setting up, via the IP-CAN, a connection to the IMS with the central CSCFs.

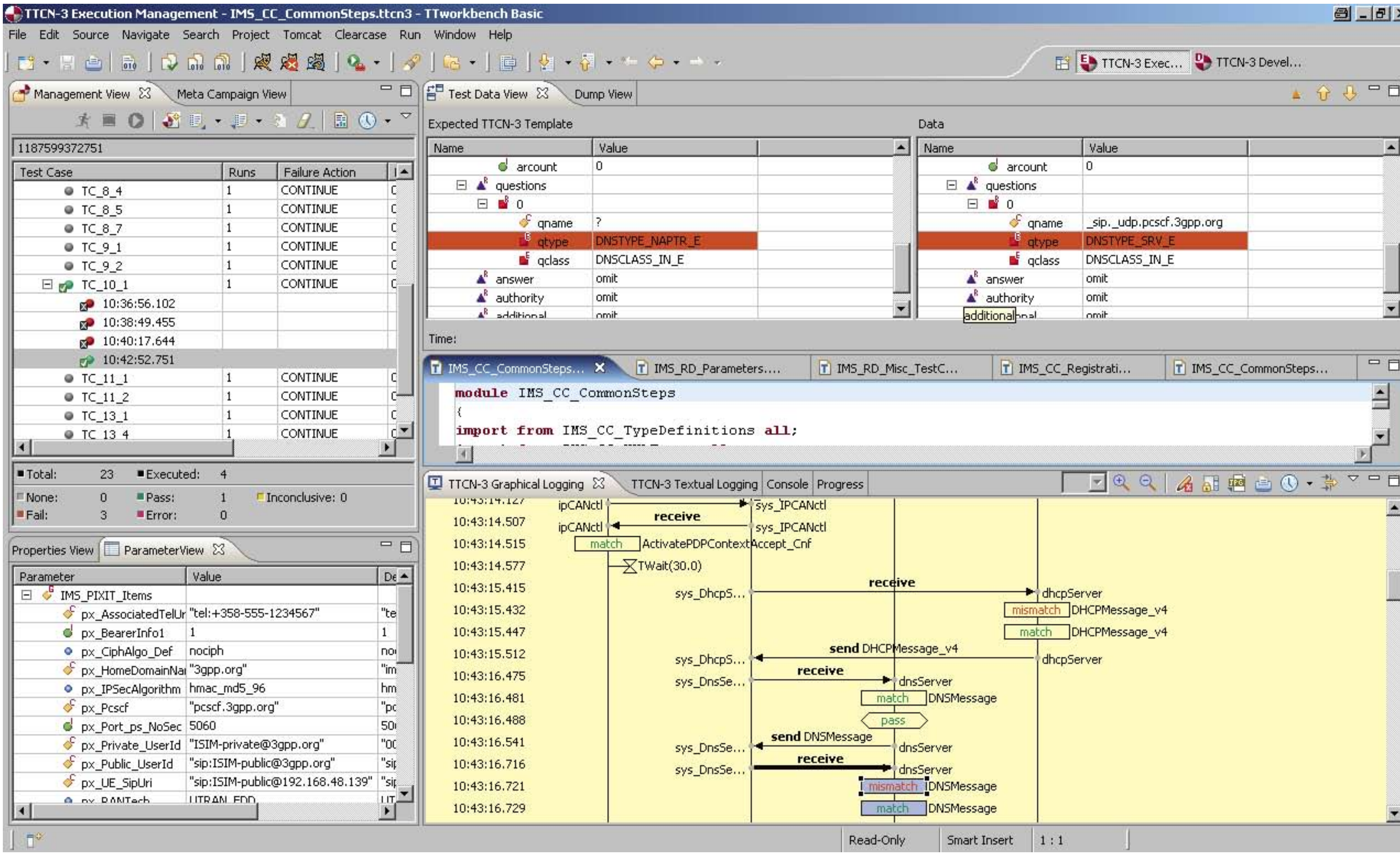


FIG 2 Highlights of the integrated TTCN-3 development environment for the analysis of results are a realtime message sequence chart and a sophisticated feature for comparing received and expected messages.

The complete conversion to IMS-based networks involves considerable efforts and must be seen as a long-term goal. However, there are already first approaches to provide IMS-based services in existing networks. For example, the US operator AT&T has launched video sharing on the market. This service allows transmitting a live video stream via the IMS in parallel to a circuit-switched voice connection. Here, 3GPP has not re-specified the protocols required for communications between the different network components and the terminals. Instead, already established Internet protocols (SIP, SDP, RTP) will be used.

In early 2006, 3GPP started to specify test cases to test the conformance of the basic IMS functionality of mobile devices and commissioned ETSI to translate these test cases into the TTCN test specification language. The Global Certification Forum (GCF) has already included these test cases in its mobile device certification program. Rohde & Schwarz is closely cooperating with ETSI and has developed the R&S®CA-AC05 product specifically tailored to the R&S®CRTU-W protocol tester to carry out conformance tests and to pass certification tests. The test cases cover, for example, registration and authentication procedures, P-CSCF discovery and specific error cases. Rohde & Schwarz is the only supplier who has already validated some of these test cases with GCF. TTCN-3 has for the first time been used in a Rohde & Schwarz product. The R&S®CRTU-WT23 option provides an integrated development environment including editor, compiler and execution environment (FIG 2). During execution, for example, a message sequence chart is set up and continuously updated to allow the realtime examination of the signaling procedure between mobile device and protocol tester. Expected and actually received messages can very conveniently be compared which speeds up the identification of signaling errors.

Michael Siggelkow

R&S®TSMx Radio Network Analyzers

HSPA measurements with all the bells and whistles

HSPA technologies in UMTS networks not only significantly increase data throughput in the uplink and downlink but also complexity. This makes achieving the targeted network quality in these "turbo networks" even more critical. And this is where the R&S®TSMx radio network analyzers (FIG 1) and the R&S®ROMES coverage measurement software come into their own.

The many sides to network quality

HSPA technologies for UMTS networks increase the data throughput in the downlink up to 14.4 Mbit/s and in the uplink up to 5.74 Mbit/s (see opposite page for HSPA details). However, the attainable data throughput is only one characteristic of a network – and different situations might place completely different requirements on the network. For example, while an FTP download requires the highest possible data rate, for voice over IP it is the maximum round trip time (RTT) that makes a difference.

To ensure that the targeted network quality is met, measurement systems are needed that allow the available quality of service (QoS) to be precisely viewed and analyzed, while at the same time making all relevant technical measurement values – e.g. layers 1 through 3, Internet protocol, etc. – available in a format that can be used in real-life scenarios for error analysis or optimization.

R&S®ROMES: sophisticated measurement methods for HSPA

Measurement systems must use sophisticated methods of data collection, preparation, and visualization if measurements in HSPA networks are to be meaningful. However, since the relevant measurement data can change during each transmission time interval (TTI), enormous amounts of data have to be processed. The mobile phone device drivers included in the R&S®ROMES coverage measurement software collect this data and input it into the software in blocks of 200 ms each (100 TTIs for HSDPA). This block size ensures that the generated load for the measurement system stays within limits, while also maintaining a continuous flow of measurement results on the screen for the user.

FIG 1 Essential measurement aids: the R&S®TSMx radio network analyzers.

44941/1

HSPA – a brief overview

HSDPA (release 5)
HSDPA was introduced with the objective of using the radio channels as efficiently as possible as well as to achieve a significant increase in data rates in the downlink as compared to UMTS. It was also intended as the first step toward reducing the round trip time (RTT).

These objectives were achieved as a result of many changes to the physical layer and the MAC layer. Parallel **HARQ processes** and **AMC** ensure both higher data throughput and a more efficient use of the RF resources. To reduce the RTT, it was necessary to move parts of the MAC layer from the radio network controller (RNC) to the 3G base station. This was the only way to achieve a transmission time interface (TTI) of 2 ms. As a result, every 2 ms the process transmits data blocks for which the transmission parameters can then be adapted to the current radio field conditions (AMC). To do this, the mobile phone must report the successful or failed receipt of a data packet to the base station every 2 ms. The base station adapts the transmission parameters using the channel quality indicator (CQI), which the mobile phone determines based on the receive quality of the pilot signal and periodically reports to the base station (every n TTI).

Three new channels were introduced to implement these requirements. In the downlink, the high speed downlink shared channel (HS-DSCH) handles the data transport. The mobile phone detects the configuration of the HS-DSCH via the high speed shared control channel (HS-SCCH). As the names of these two channels indicate, they are not reserved for a single mobile phone, but instead are used by the base station to serve multiple mobile phones in parallel. In the uplink, the high speed dedicated physical control channel (HS-DPCCH) ensures the rapid transmission of the CQI values and the acknowledgement signals for the data packets.

HSUPA (release 6)
All improvements that HSDPA provides in the downlink are to be provided by HSUPA in the uplink. It therefore makes sense to use similar methods. As a result, efficient data transmission is provided by means of HARQ processes here as well, and the TTI was reduced to 10 ms or 2 ms, respectively. To achieve the rapid response times required, a part of the MAC layer had to be moved to the base station.

While the factor that limits throughput for HSDPA is the CQI of the radio field as determined by the mobile phone, in the uplink it is the maximum transmit power that the base station can allot to a mobile phone. Although the maximum transmit power that can be allotted is limited by the maximum transmit power of each mobile phone, the base station must in general limit the transmit power for a given mobile phone so that it does not overpower the other phones. The base station regulates the transmit power using grants it assigns to the mobile phones. The serving cell can set this power to a defined initial value by assigning an absolute grant. Moreover, any base station that is disrupted by a transmitting mobile phone can use a relative grant to stepwise reduce in the phone's allotted transmit power.

The objective was achieved by introducing five new channels. The E-DCH dedicated physical data channel (E-DPDCH) and the E-DCH dedicated physical control channel (E-DPCCH) together serve to transmit the data in the uplink. The data is sent to the base station via the E-DPDCH and the format via the E-DPCCH. In the downlink, the E-DCH absolute grant channel (E-AGCH) and the E-DCH relative grant channel (E-RGCH) regulate the permitted transmit power. Finally, the acknowledgements from the base station to the mobile phone needed for the HARQ processes are forwarded via the E-DCH hybrid ARQ indicator channel (E-HICH).

Hybrid automatic repeat request (HARQ)

Multiple HARQ processes allow efficient use of the transmit and processing time for data packets. After a data packet has been sent for a process, the sender does not have to wait for an acknowledgement, but rather can immediately send a packet for another process. The sender does not expect a successful or failed receipt to be acknowledged for the packet until some time later.

This method also increases efficiency because it does not completely discard failed transmissions, but rather uses intelligent algorithms to combine them with additional transmissions of the same (payload) data block. This increases the likelihood of successful decoding of the packet.

Adaptive modulation and coding (AMC)

During modulation and coding of the data, high payload data throughputs are associated with less robust transmission. Therefore, the optimum parameters are continually being sought for the current transmission conditions so as to ensure secure transmission with the highest possible throughput.

HSDPA allows a choice between modulation modes (QPSK and 16QAM). Various options are also available for coding the data. Modulation and coding can be adapted per TTI, permitting a rapid response to changes in the radio field. The same applies analogously to HSUPA.

Aggregated values are usually more useful than a number of individual raw measurement values in gaining an overview of the network status. This is why, during the measurements, the R&S®ROMES mobile phone drivers prepare additional statistics and analyses from the raw data provided by the phone. All measured values can be viewed and analyzed as standard R&S®ROMES signals shown as 2D chart, alphanumeric view, or route track view, and then linked with other signals from R&S®ROMES for further analysis.

If a problem area is identified, R&S®ROMES has special views where it can provide full access to all available measured values for a TTI to allow detailed analysis.

Views in R&S®ROMES: clear and detailed

HSUPA/HSDPA: How good is the data transmission right now?

The HSUPA view (FIG 2) and the HSDPA view (FIG 3) provide an initial impression of the quality of the current data transmission. Both views include a bargraph using colors to indicate the success of the transmission. Green bars show successfully transmitted packets or TTIs, and red bars represent faulty packet or TTI transmissions. Yellow bars indicate TTIs in which no data transmission took place (discontinuous transmission, DTX).

The y-axis in the HSUPA view represents the number of bits transmitted by the mobile phone (transport block size, TBS) and defined for each TTI based on the permissible transmit power. This allows the relationship between the block size and the transmission success to be read immediately.

In the HSDPA view, the bar size represents the CQI. This value, which the mobile phone calculates from the pilot signal of the base station, reflects the required data rate.

Decode statistic views: How large are the transmission blocks?

The software generates statistics for both transmission directions describing the transmission quality of the HARQ processes. A distinction is made between (data) blocks and (data) sub-blocks. Blocks that have to be resent are called sub-blocks. Here is an example of a transmission process:

In a first transmission attempt, a block is sent within a TTI. If the receiver can decode the contents, the transmission is ended successfully (the number of blocks and sub-blocks is equal in this case, i.e. it is 1). If the transmission fails – because the receiver cannot decode the data – a sub-block error (SBLE) results and the transmission must be repeated. To initiate this, the receiver sends an error message (NACK – not acknowledged) to the sender, which then reattempts the transmission. If the receiver is able to decode this second sub-block, one sub-block error and one sub-block success will be counted, resulting in a sub-block error rate (SBLER) of 50%. The (data) block itself was transmitted successfully, however, so the resulting block error rate (BLER) is 0%. A block error is present if the sender exceeds the maximum permissible number of send attempts for a block. When this happens, the sender reports this block to the higher layers as not transmitted.

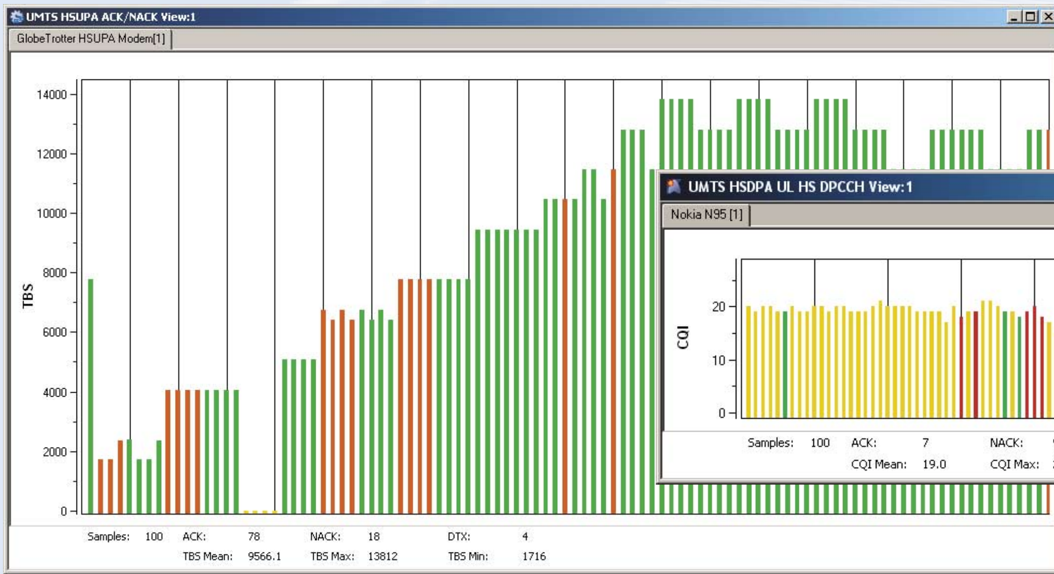
The spread is also calculated to show how many attempts were necessary to successfully transmit of a block. Because the block size affects the level of protection for the data to be transmitted, R&S®ROMES breaks down the statistics accordingly. This means that the user can clearly see the relationship between block size and transmission probability (FIGs 4 and 5).

R&S®TSMx radio network analyzers from Rohde&Schwarz

Third-generation mobile radio networks require measurement methods that identify potential problem spots and offer solutions in the easiest way possible. The R&S®TSMx radio network analyzers from Rohde&Schwarz meet exactly these needs, because in combination with the R&S®ROMES software they offer sophisticated algorithms for neighborhood analysis. They are an indispensable aid in all cycles of a mobile radio network and deliver measurement results much faster and more precisely than test mobile phones. Their broadband RF frontend and the simple and modular option concept offer utmost flexibility for network operators, service providers, regulatory authorities, and hardware manufacturers.

Abbreviations

AMC	Adaptive modulation and coding
BLER	Block error rate
CQI	Channel quality iIndicator
DTX	Discontinuous transmission
HARQ	Hybrid automatic repeat request
HSDPA	High speed downlink packet access
HSPA	High speed packet access
HSUPA	High speed uplink packet access
NACK	Not acknowledged
RNC	Radio network controller
RTT	Round trip time
SBLE	Sub-block error
SBLER	Sub-block error rate
TBS	Transport block size
TTI	Transmission time interval



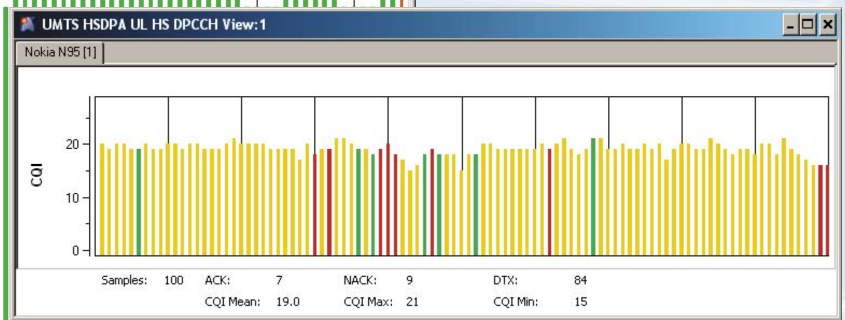


FIG 3 In this example, it is immediately obvious that the large number of TTIs without data is the cause of the low throughput.

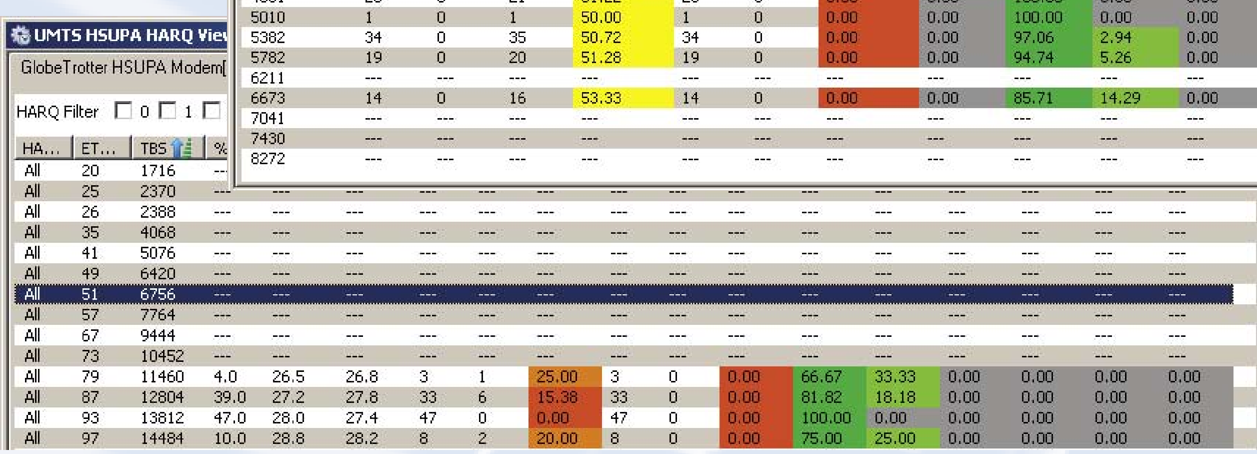
FIG 2 This example clearly shows the stepwise increase in the serving grant, resulting in a higher transport block size (see also FIG 8).

FIG 4 In this example, many different transport blocks of varying sizes are used for transmission. It can be seen that an increase in size also increases the probability of sub-block errors.

UMTS HSDPA Decode Statistic View:1

Nokia N95 [1]

TBS	SB+	SB++	SB-	SBLER [%]	BL+	BL-	BLER [%]	# 1 [%]	# 2 [%]	# 3 [%]	# 4 [%]	# 5 [%]	#>5 [%]
866	9	0	3	25.00	9	0	0.00	66.67	33.33	0.00	0.00	0.00	0.00
1074	1	0	0	0.00	1	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
1405	5	0	1	16.67	5	0	0.00	80.00	20.00	0.00	0.00	0.00	0.00
1430	---	---	---	---	---	---	---	---	---	---	---	---	---
1593	---	---	---	---	---	---	---	---	---	---	---	---	---
1871	4	0	0	0.00	4	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
2320	---	---	---	---	---	---	---	---	---	---	---	---	---
2630	2	0	0	0.00	2	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
2775	---	---	---	---	---	---	---	---	---	---	---	---	---
3090	4	0	0	0.00	4	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
3319	---	---	---	---	---	---	---	---	---	---	---	---	---
3502	10	0	0	0.00	10	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
3762	1	0	1	50.00	1	0	0.00	0.00	100.00	0.00	0.00	0.00	0.00
4189	31	0	10	24.39	31	0	0.00	70.97	29.03	0.00	0.00	0.00	0.00
4581	20	0	21	51.22	20	0	0.00	0.00	100.00	0.00	0.00	0.00	0.00
5010	1	0	1	50.00	1	0	0.00	0.00	100.00	0.00	0.00	0.00	0.00
5382	34	0	35	50.72	34	0	0.00	0.00	97.06	2.94	0.00	0.00	0.00
5782	19	0	20	51.28	19	0	0.00	0.00	94.74	5.26	0.00	0.00	0.00
6211	---	---	---	---	---	---	---	---	---	---	---	---	---
6673	14	0	16	53.33	14	0	0.00	0.00	85.71	14.29	0.00	0.00	0.00
7041	---	---	---	---	---	---	---	---	---	---	---	---	---
7430	---	---	---	---	---	---	---	---	---	---	---	---	---
8272	---	---	---	---	---	---	---	---	---	---	---	---	---



UMTS HSUPA HARQ View

GlobeTrotter HSUPA Modem[

HARQ Filter 0 1

HA...	ET...	TBS	%														
All	20	1716	---														
All	25	2370	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	26	2388	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	35	4068	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	41	5076	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	49	6420	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	51	6756	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	57	7764	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	67	9444	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	73	10452	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
All	79	11460	4.0	26.5	26.8	3	1	25.00	3	0	0.00	66.67	33.33	0.00	0.00	0.00	0.00
All	87	12804	39.0	27.2	27.8	33	6	15.38	33	0	0.00	81.82	18.18	0.00	0.00	0.00	0.00
All	93	13812	47.0	28.0	27.4	47	0	0.00	47	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
All	97	14484	10.0	28.8	28.2	8	2	20.00	8	0	0.00	75.00	25.00	0.00	0.00	0.00	0.00

FIG 5 This view shows that mostly large transport block sizes are being used, which frequently require a second transmission.

Performance views – throughput

Both views show the change over time for the most important HSPA parameters. The HSDPA view (FIG 6) includes sections for the transmission parameters required by the mobile phone and those set by the network, as well as the delta between the two. It also shows the data throughput in both the MAC layer and the RLC layer.

The HSUPA view (FIG 7) displays the success rates and the throughput of the data transmission. The software shows the corresponding values both in combination as well as listed out for the individual base stations involved in the transmission. The payload limit section also shows the factors limiting the throughput. This method of combining the success rates and the payload limit makes efficient analysis possible in those cases where the data rates are low.

Progress views – packet tracking in R&S®ROMES

These views (FIGs 8 and 9) allow easy tracking of the transmission parameter control over time. For each TTI, the software displays the corresponding parameters in the form of colored squares. This type of display makes it possible to evaluate the status of the data transmission at a glance. Analysis of HARQ processes is thus easy with the HSDPA view. The HSUPA view, however, permits a rapid analysis of how the serving grant is regulated in the serving and non-serving cells.

The data quality analyzer handles data traffic

The test data traffic is generated with the R&S®ROMES data quality analyzer option. This option is continually being improved to reflect new technologies. It now allows, for example, adaptation of the buffers in use, which ensures optimum throughput. Even next-generation HSPA data cards that register in the operating system exclusively as network cards can be used.

The IP tracer makes it all crystal clear

The IP tracer rounds out the software functionality. This tool can be used to record and analyze the entire IP data traffic (optionally without payload) on a specific data link. Combining the IP data traffic with the layer 3 messages from the mobile phone creates the layer 3 view as a powerful tool for analyzing all protocols involved.

Unparalleled interworking

Of course, all described modules can be operated in parallel with other R&S®ROMES modules, including the UMTS PN scanner or the GSM network scanner. As a result, just one drive test is needed to prepare a quality of service report, identify problem spots, and at the same time collect all conceivable measurement values for optimization.

Andreas Spachtholz

More information on the radio network analyzers and the R&S®ROMES coverage measurement software at www.rohde-schwarz.com (search term: TSM or Romes)

REFERENCES

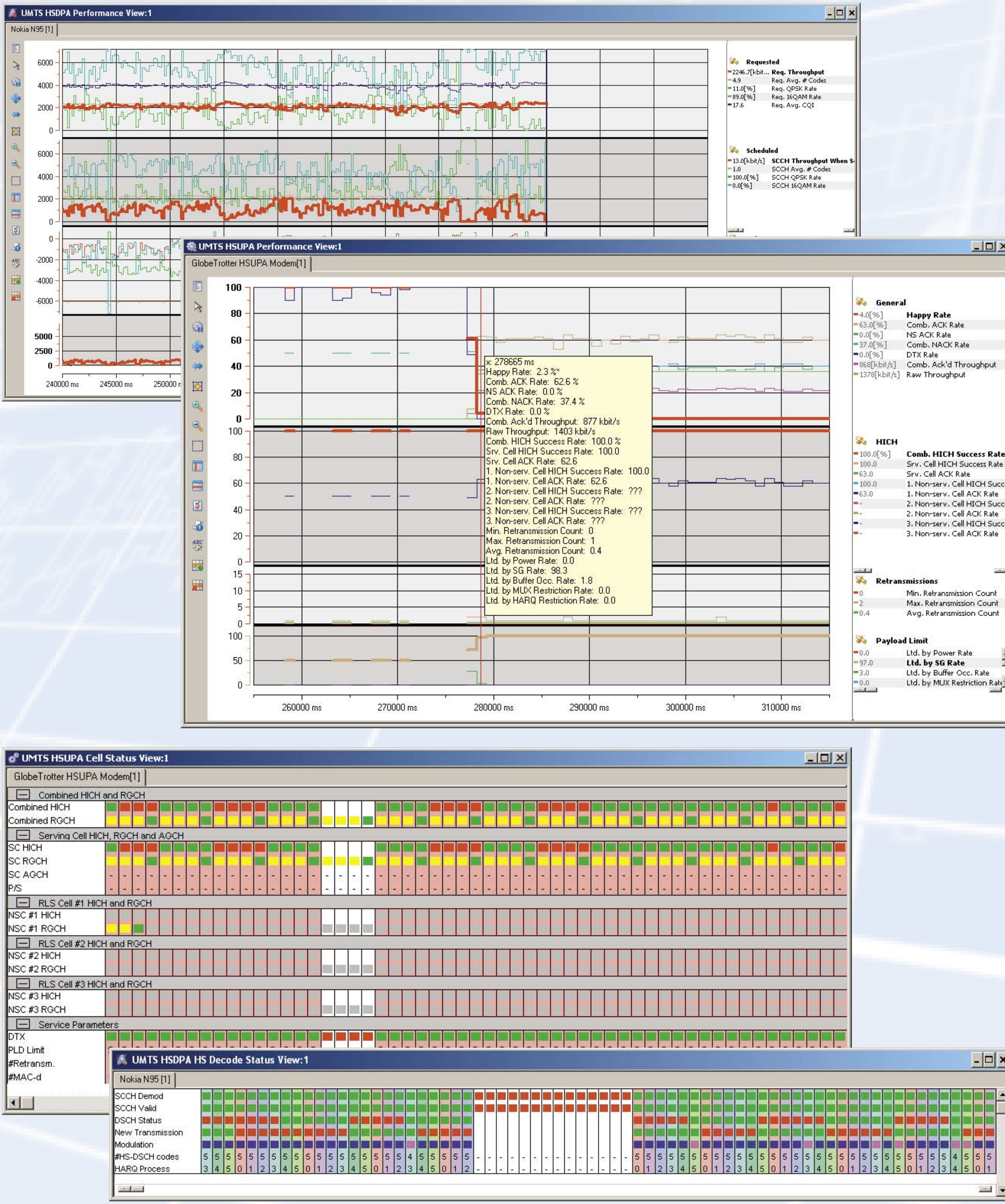
R&S®TSMx Radio Network Analyzers – Radio network analyzers for all tasks and any budget. News from Rohde & Schwarz (2007) No. 192, pp 5–8

FIG 6 The upper graph shows the throughput desired by the mobile phone based on the radio field conditions. The remaining graphs show the throughput assigned by the network, as well as the delta between the two.

FIG 7 A typical start of transmission. First comes the "buffer" as the limiting element because it still has to be filled by the application (e.g. by the FTP client). But shortly after that the serving grant limits the maximum data throughput.

FIG 8 The green squares in the second line (RGCH) very nicely show the stepwise increase of the serving grant in every fourth TTI (see also FIG 2).

FIG 9 The progress of the HARQ process is clearly displayed. The red square in the third line shows a faulty transmission in HARQ process 3 (first column). HARQ process 3 is continued in column 7. The new transmission indicator (line 4) shows that this is a retransmission that fails again (line 3). Finally, the green square in column 13 and line 3 shows a successful data transmission. New (payload) data can now be transmitted. The green square in column 19 shows the new transmission indicator set in the next TTI of process 3.


UMTS HSDPA Performance View:1
Nokia N95 [1]
Requested
2246.7[kbit... Req. Throughput
4.9 Req. Avg. # Codes
11.0[%] Req. QPSK Rate
89.0[%] Req. 16QAM Rate
17.6 Req. Avg. CQI
Scheduled
13.0[kbit/s] SCCH Throughput When S
1.0 SCCH Avg. # Codes
100.0[%] SCCH QPSK Rate
0.0[%] SCCH 16QAM Rate
240000 ms
245000 ms
UMTS HSUPA Performance View:1
GlobeTrotter HSUPA Modem[1]
x: 278665 ms
Happy Rate: 2.3 %
Comb. ACK Rate: 62.6 %
NS ACK Rate: 0.0 %
Comb. NACK Rate: 37.4 %
DTX Rate: 0.0 %
Comb. Ack'd Throughput: 877 kbit/s
Raw Throughput: 1403 kbit/s
Comb. HICH Success Rate: 100.0 %
Srv. Cell HICH Success Rate: 100.0
Srv. Cell ACK Rate: 62.6
1. Non-serv. Cell HICH Success Rate: 100.0
1. Non-serv. Cell ACK Rate: 62.6
2. Non-serv. Cell HICH Success Rate: ???
2. Non-serv. Cell ACK Rate: ???
3. Non-serv. Cell HICH Success Rate: ???
3. Non-serv. Cell ACK Rate: ???
Min. Retransmission Count: 0
Max. Retransmission Count: 1
Avg. Retransmission Count: 0.4
Ltd. by Power Rate: 0.0
Ltd. by SG Rate: 98.3
Ltd. by Buffer Occ. Rate: 1.8
Ltd. by MUX Restriction Rate: 0.0
Ltd. by HARQ Restriction Rate: 0.0
General
4.0[%] Happy Rate
63.0[%] Comb. ACK Rate
0.0[%] NS ACK Rate
37.0[%] Comb. NACK Rate
0.0[%] DTX Rate
868[kbit/s] Comb. Ack'd Throughput
1378[kbit/s] Raw Throughput
HICH
100.0[%] Comb. HICH Success Rate
100.0 Srv. Cell HICH Success Rate
63.0 Srv. Cell ACK Rate
100.0 1. Non-serv. Cell HICH Succe
63.0 1. Non-serv. Cell ACK Rate
2. Non-serv. Cell HICH Succe
2. Non-serv. Cell ACK Rate
3. Non-serv. Cell HICH Succe
3. Non-serv. Cell ACK Rate
Retransmissions
0 Min. Retransmission Count
2 Max. Retransmission Count
0.4 Avg. Retransmission Count
Payload Limit
0.0 Ltd. by Power Rate
97.0 Ltd. by SG Rate
3.0 Ltd. by Buffer Occ. Rate
0.0 Ltd. by MUX Restriction Rate
260000 ms
270000 ms
280000 ms
290000 ms
300000 ms
310000 ms
UMTS HSUPA Cell Status View:1
GlobeTrotter HSUPA Modem[1]
Combined HICH and RGCH
Combined HICH
Combined RGCH
Serving Cell HICH, RGCH and AGCH
SC HICH
SC RGCH
SC AGCH
P/S
RLS Cell #1 HICH and RGCH
NSC #1 HICH
NSC #1 RGCH
RLS Cell #2 HICH and RGCH
NSC #2 HICH
NSC #2 RGCH
RLS Cell #3 HICH and RGCH
NSC #3 HICH
NSC #3 RGCH
Service Parameters
DTX
PLD Limit
#Retransm.
#MAC-d
UMTS HSDPA HS Decode Status View:1
Nokia N95 [1]
SCCH Demod
SCCH Valid
DSCH Status
New Transmission
Modulation
#HS-DSCH codes
HARQ Process

R&S®Axx / R&S®SMx Signal Generators

IEEE 802.11n: all signals for development, production, service

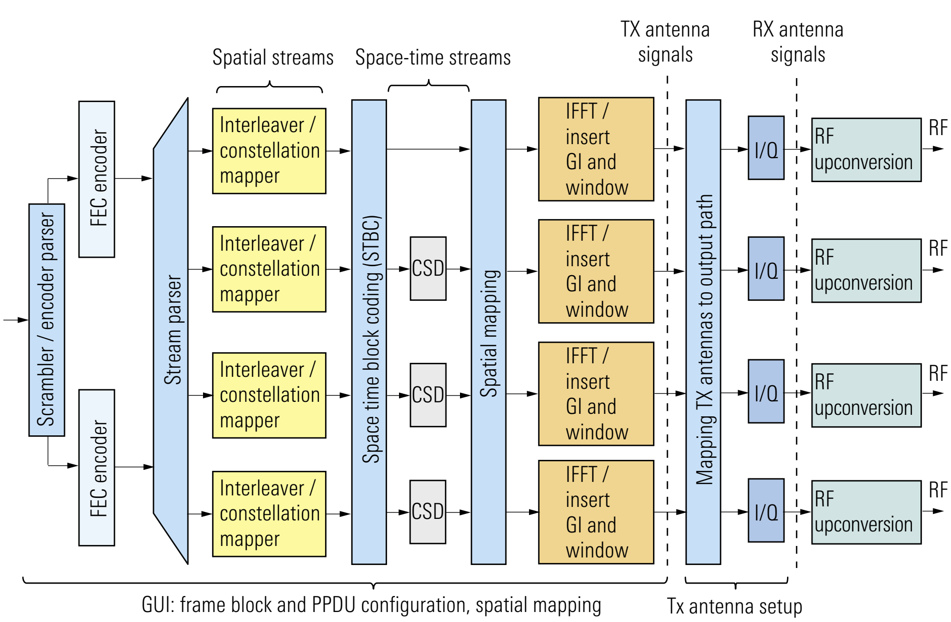
WLAN-n (IEEE 802.11n), the standardized "pre n draft" expansion of the IEEE 802.11a/g Wi-Fi mobile radio standards, is going to ensure a net data throughput of up to 100 Mbit/s in wireless LANs. The R&S®SMU200A, R&S®SMJ100A, R&S®SMATE200A, R&S®AMU200A and R&S®AFQ100A generators with their new -K54 and -K254 options generate the signals required for testing.

Complete solution for WLAN-n

IEEE 802.11n is the expansion of the WLAN IEEE 802.11a/g standards for peak data rates up to 600 Mbit/s. 802.11n – like 802.11a/g – uses OFDM modulation. In addition, the MIMO technology and also a special coding method are employed up to a bandwidth of 40 MHz to increase the data rate. This expansion providing higher data rates is also known as *High Throughput Mode* (HT mode). Correspondingly, the non-HT mode ensures backward compatibility with IEEE 802.11a/g.

IEEE 802.11n signals are generated in several steps. In the HT mode, the user data to be transmitted is specifically encoded and subsequently radiated via up to four transmitting antennas (FIG 1):

FIG 1 Signal flow during the generation of IEEE 802.11n signals.



In the first step, the data is scrambled, encoded and split into a maximum of four spatial streams. Each spatial stream is interleaved and then separately modulated by means of the BPSK, QPSK, 16QAM or 64QAM method. Subsequently, space time block coding (STBC) may optionally be used to provide redundancy and an increased immunity of transmissions to interference. A cyclic shift to decorrelate the space-time streams is followed by spatial mapping, i.e. the distribution of the pre-encoded data to the respective OFDM carriers. The transmitter tries to optimize the spatial mapping with respect to the current transmission conditions, i.e. MIMO channel. To this end, channel sounding is first performed on the transmission channel. Now an inverse fast Fourier transform (IFFT) follows to convert the signal from the frequency domain back into the time domain, and a guard interval (GI) is added to protect the signal from inter symbol interference (ISI) in case of multipath propagation. Finally, the signals are allocated to the different transmitting antennas.

The development and test of modules and equipment for compliance with IEEE 802.11n therefore requires, on the one hand, that all new functions provided in addition to the conventional WLAN are tested in detail while, on the other, the correct implementation of backward compatibility must be ensured. The new IEEE 802.11n option for the signal generators has precisely been designed for this purpose. Special attention has been devoted to keeping the signal generation of this complex standard simple and clear for the user.

Only a few operating steps are necessary to prepare the generators for receiver tests – irrespective of whether frames with HT mode (up to 600 Mbit/s) or without HT mode (up to 54 Mbit/s) are to be generated. The information data to be transmitted (PPDU) may be voice or data, possible physical modes include *Legacy* (backward compatibility with 802.11a/g), *High Throughput Mixed* (HT MM) and *High Throughput Greenfield* (HT GF). Available transmission modes include *20 MHz*, *40 MHz*, *Duplicate*, *Upper* and *Lower*. In the *Duplicate* mode, the same carriers (with 90° phase shift) are transmitted on the two upper and lower 20 MHz channels. All important PPDU parameters can be set separately for each frame (FIG 2). Spatial streams, space-time and extended spatial streams may be varied. Conventional PPDUs have a maximum length of 4095 bytes and HT PPDUs 65 535 bytes. The raw data rate can be set between 6 Mbit/s and 600 Mbit/s depending on the spatial stream setup and data settings such as modulation, guard and channel coding. PLCP preamble, interleaver and time domain windowing may be enabled or disabled. In addition, the MAC settings (HT and Legacy) and the spatial mapping mode of the current frame can be set (direct or spatial expansion). So the flexible signal generator solution of Rohde & Schwarz allows the verification of all functions of the standard in both physical layer and MAC layer.

Considering the backward compatibility of IEEE 802.11n and this standard's manifold options for variation, the capability of generating signals that reflect this variety is of paramount importance. The frame block configuration provides this capability. The user may cascade up to 100 frame blocks, i.e. groups of equally configured frames, that will be continuously transmitted in sequence (FIG 3). This makes it possible to combine different configurations such as the HT mode and the conventional modes of 802.11a / g in order to scrutinize the receiver under any aspect.

The R&S®SMU 200 A, R&S®SMJ 100 A, R&S®SMATE 200 A, R&S®AFQ 100 A and R&S®AMU 200 A signal generators with their new software options generate signals in accordance with IEEE 802.11n Draft 3.00. Moreover, the weighted signals of the up to four antennas can be added to enable simple diversity and MIMO tests also in the absence of a channel simulator.

For even more realistic channel simulations, the R&S®SMU 200 A and R&S®AMU 200 A generators may be equipped with an internal R&S®SMU-/ R&S®AMU-B14/-B15 fading simulator and the R&S®SMU-K74 / R&S®AMU-K74 2×2 MIMO fading option. The optional R&S®SMU-K62 / R&S®AMU-K62 AWGN module adds noise. In summary, a solution scalable according to application and test requirements is now available to test receivers for the IEEE 802.11n standard under realistic conditions.

Rachid El Assir; Simon Ache

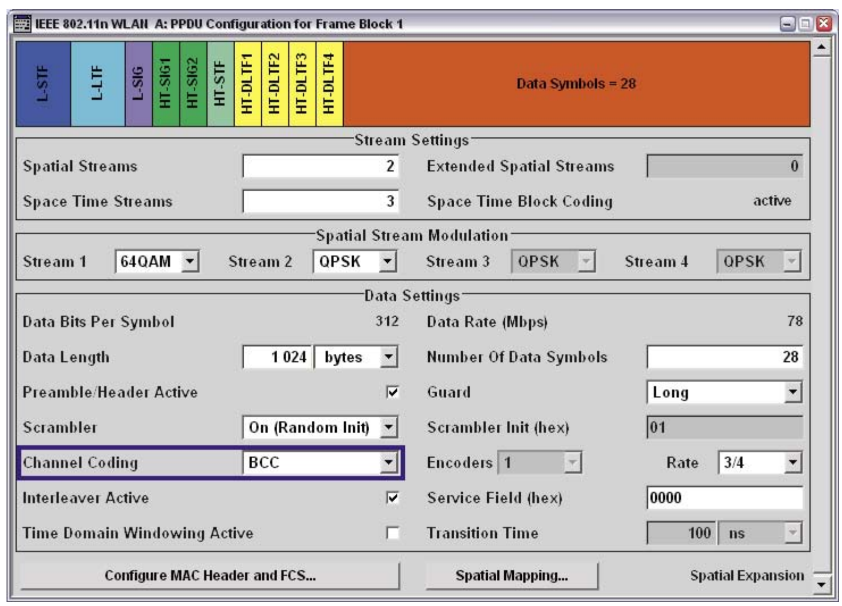
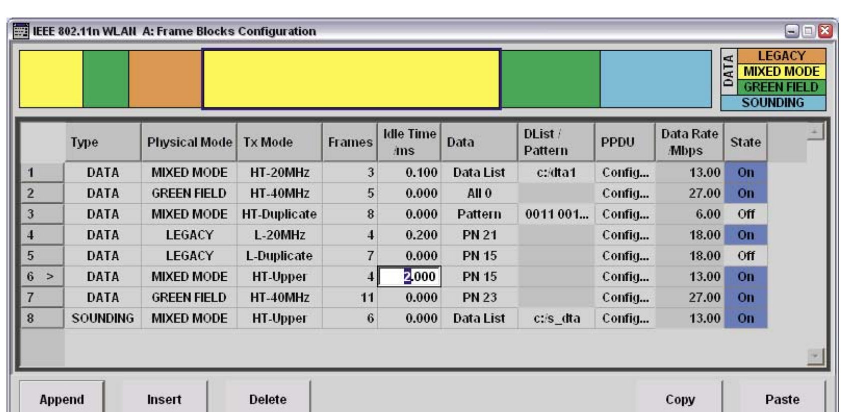


FIG 2 PPDU configuration menu of a frame block.

FIG 3 Configuration menu for the frame blocks.



	Type	Physical Mode	Tx Mode	Frames	Idle Time /ms	Data	DList / Pattern	PPDU	Data Rate /Mbps	State
1	DATA	MIXED MODE	HT-20MHz	3	0.100	Data List	c:/dta1	Config...	13.00	On
2	DATA	GREEN FIELD	HT-40MHz	5	0.000	All 0		Config...	27.00	On
3	DATA	MIXED MODE	HT-Duplicate	8	0.000	Pattern	0011 001...	Config...	6.00	Off
4	DATA	LEGACY	L-20MHz	4	0.200	PN 21		Config...	18.00	On
5	DATA	LEGACY	L-Duplicate	7	0.000	PN 15		Config...	18.00	Off
6 >	DATA	MIXED MODE	HT-Upper	4	2.000	PN 15		Config...	13.00	On
7	DATA	GREEN FIELD	HT-40MHz	11	0.000	PN 23		Config...	27.00	On
8	SOUNDING	MIXED MODE	HT-Upper	6	0.000	Data List	c:/s_dta	Config...	13.00	On

R&S®EVS300 ILS/VOR analyzer

Study substantiates excellent results achieved in highly challenging measurements

In a scientific study, FCS Flight Calibration Services GmbH examined the safety-relevant impact of multipath propagations on the results achieved by the R&S®EVS300 during measurements on instrument landing systems (ILS). The study attests the ILS/VOR analyzer an outstanding suitability for field operation.

R&S®EVS300: mastering the most difficult measuring tasks

Since its market launch in February 2006, the R&S®EVS300 ILS/VOR analyzer (FIG 1) has successfully been employed worldwide for the installation and maintenance of terrestrial flight navigation equipment. The regular calibration of instrument landing systems by ground measurements and flight inspections — an ICAO requirement — decisively requires mastering the peculiarities of measurements in dynamic RF field environments. Such RF fields are characterized by the multipath propagation of ILS signals on airports caused, for example, by reflections from buildings or tail units of modern aircraft. They can produce a falsified demodulation of the useful signal in the ILS receivers, which would cause a deviation of the aircraft from the nominal approach course or glide angle toward the runway.

Dr.-Ing. Jochen Bredemeyer, head of Research & Development at FCS GmbH, therefore examined the safety-relevant impact of multipath propagations on measurements carried out with the R&S®EVS300 ILS/VOR analyzer. In his scientific study, he investigated both the influence of filter bandwidths in digital signal processing and the behavior of the R&S®EVS300 analyzer's automatic gain control (AGC).

The results are convincing: Owing to its high measuring sensitivity and level stability, the R&S®EVS300 yielded excellently reproducible and accurate measurement results. FIG 2 shows, by way of example, the difference in depth of modulation (DDM) as an ILS control variable during ground measurements along the runway. Here, Dr. Bredemeyer examined the impact of a reflector with limited dimensions and a maximum reflection coefficient of r = 0.3. The AGC follows continuously and without discontinuities the minima and maxima of the level variations caused by multipath propagation. This makes the R&S®EVS300 also particularly suitable for measurements involving high level differences as they occur, for example, when driving across the runway in front of the ILS antenna array. FIG 3 documents the low inherent noise of the R&S®EVS300.

As a consequence of the outstanding outcome of the study, FCS GmbH is planning to use the R&S®EVS300 in its two Beech KingAir 350 flight inspection aircraft (FIGs 4 and 5) as a supplement to the existing flight inspection system. Moreover, Rohde & Schwarz and FCS will also cooperate in other fields of T&M technology for terrestrial navigation equipment.

Benjamin Marpe

FIG 1 The R&S®EVS300 ILS/VOR analyzer.

R&S®EVS300 ILS/VOR analyzer

Its wide range of functions makes the R&S®EVS300 ideal for ILS/VOR/marker beacon measurements on the ground and in the air. Its extremely fast processing of measured data, its remote control capability and its large internal data memory round out the successful design. For detailed information about the R&S®EVS300 see [*]

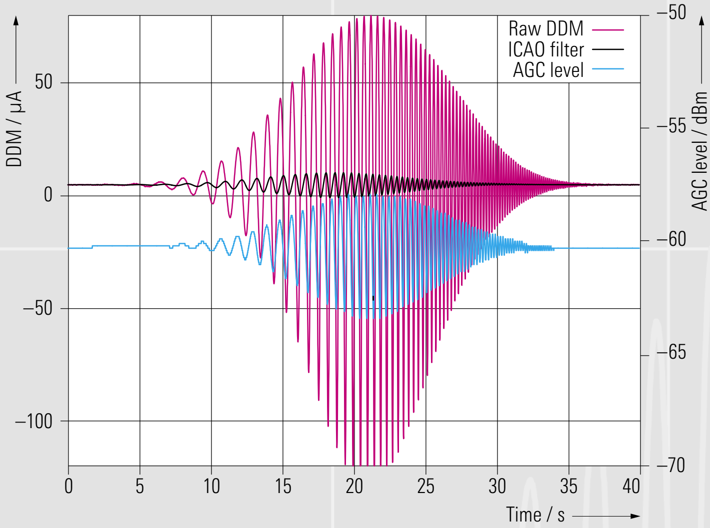


FIG 2 **DDM of a synthetic reflection over 200 m at a speed of 60 km/h (reflection coefficient r = 0.30).**

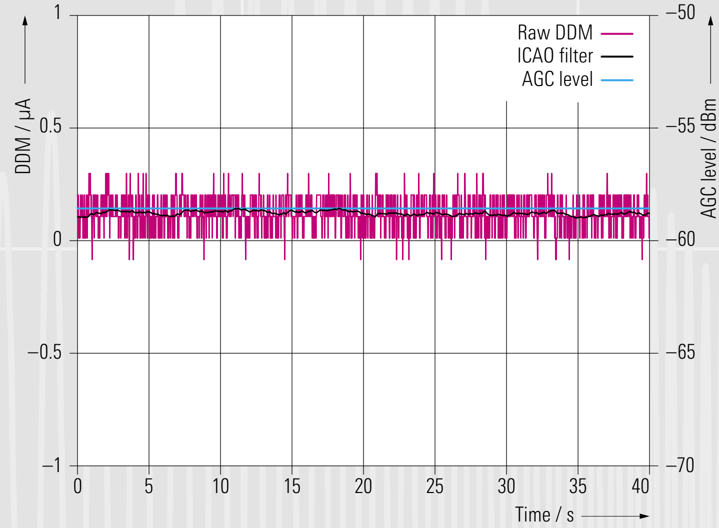


FIG 3 **Noise of the DDM with synthetic input signal at the R&S®EVS300 (reflection coefficient r = 0, input level <–58 dBm).**

FIG 4 **Beech KingAir 350 (D-CFMD) flight inspection aircraft.**

Courtesy: Claude-Alain Fauser

FIG 5 **Part of the flight inspection system in the interior of the flight inspection aircraft.**

Courtesy: Claude-Alain Fauser

More information and data sheets at www.rohde-schwarz.com (search term: EVS300)

REFERENCES

[*] R&S®EVS300 ILS/VOR Analyzer: High-precision level and modulation analysis of ILS and VOR signals. News from Rohde&Schwarz (2007) No. 194, pp 30–32

Contacting FCS

FCS Flight Calibration Services GmbH
Hermann-Blenk-Straße 32 A
38108 Braunschweig / Germany
Phone: +49 5312377-0
Fax: +49 5312377-99
E-mail: info@flightcalibration.de

R&S®OSP Open Switch and Control Unit

Modular platform for RF switch and control tasks

The new R&S®OSP modular platform makes RF switch and control tasks fast and easy. The expandable base unit and optional modules open up a wide range of applications, from simple RF switch functions to the RF wiring of complex EMC systems.

Versatile addition to product portfolio

The new, favorably priced R&S®OSP switch and control platform for switching signal paths between the DUT and the test equipment allows automated and thus cost-efficient measurements. This is especially advantageous in the case of complex test sequences in R&D, conformance and performance testing as well as automated production. The compact test sets made possible by the platform contain few additional external components and cables and are the prerequisite for reliable and reproducible measurements.

Compact and modular

The instruments of the R&S®OSP platform are accommodated in a 19" cabinet of only two height units. The R&S®OSP120 base unit (FIG 1) with its internal CPU control provides, together with the instrument software, convenient and intuitive operation via the Ethernet interface. A manually operable model featuring a display and control pad is in the pipeline.

The CAN-bus-controlled R&S®OSP 150 extension unit is the perfect addition for complex switching tasks, remote switching and later expansions (FIG 2).

Versatile modules for a wide range of tasks

Module slots on the rear panel of the R&S®OSP (FIGs 3 and 4) allow the instrument to be configured for the application at hand by means of different RF changeover relays and input / output modules. For example:

- Modules with six coaxial changeover relays (SPDT) or two coaxial multi-position relays (SP6T) for the frequency range from DC to 18 GHz
- The universal digital I/O module with 16 inputs and 16 outputs (open drain) for querying external states and controlling other external devices and relays

Additional modules featuring coaxial relays from DC to 40 GHz, solid-state relays as well as relay driver modules for RF power relays and multiplexer modules are in the pipeline.

Easy system integration via Ethernet interface

The Ethernet interface of the R&S®OSP 120 allows the instrument to be quickly connected to a measuring instrument, a laptop or a control computer of a test system or integrated into the Ethernet networks of test systems or companies. The remote-control capability of the R&S®OSP and the versatile RF modules make the platform ideal especially for recurring RF switch and control tasks, from simple RF switch functions to the RF wiring of complex systems such as EMC systems (see application examples on page 30).

Remote control via a LAN

The R&S®OSP 120 is remote-controlled via a supplied operating program or from application programs. For control via an external application program, a VXI-11-compatible software interface and a VISA library based on it are available. It is thus possible to directly control the R&S®OSP from the C, LabWindows/CVI, VXI P&P and IVI programming languages by using the SCPI command set. For users of LabView (National Instruments), there is also a virtual instrument available for easy integration.

User-friendly operating program

The program for setting the switch and control platform features intuitive operation. Its plug-and-play functionality supports the user by automatically detecting the current configuration and the connected extension units. The current configuration is visible in the left-hand window of the R&S®OSP operating program (FIG 5). The individual switch states of the modules are graphically displayed and can be switched by a simple click of the mouse on the icon.

In addition, each relay and each digital input / output can be activated or deactivated for path control. The switch states defined in this way can be used to quickly switch over the switch states taken into account in the path. This procedure makes it possible to independently switch relay groups that are typical, for example, in EMC systems.

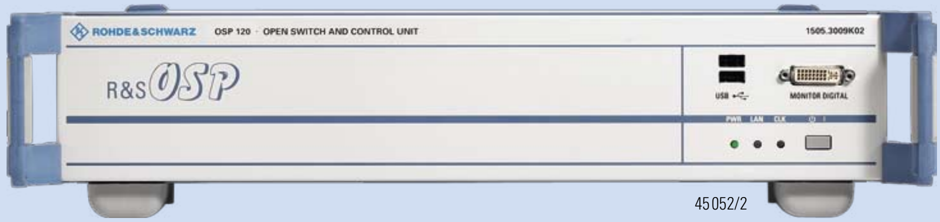


FIG 1 **R&S®OSP 120 base unit.**

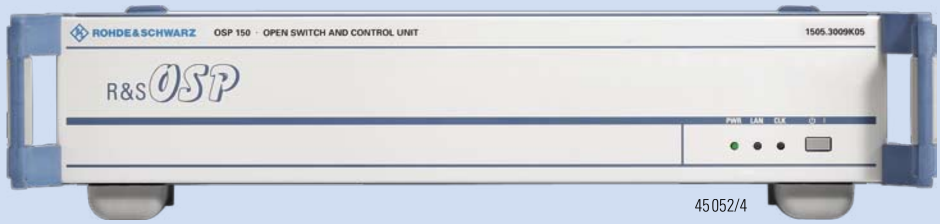


FIG 2 **R&S®OSP 150 extension unit.**

FIG 3 **Rear panel of the R&S®OSP with three modules.**

FIG 4 **Some of the modules for the R&S®OSP.**

Cascadable for complex switching tasks

For complex switching tasks or later expansions, several R&S®OSP 150 extension units can be connected to a base unit (FIG 6). The units are controlled via the CAN bus. This low-emission bus ensures that the circuits carry signals only during the control processes. Remote switching is thus possible even in EMC-critical areas.

Together with a converter from CAN bus to fiber-optic links (FOL), the R&S®OSP 150 extension unit can be used for remote switching tasks in shielded chambers (FIG 7).

Application examples

Multiplexing between DUTs

RF testing of multiple printed panels requires, for example, multiplexing the RF signals to the individual DUTs. FIG 8 shows a schematic diagram of a test system for aligning and calibrating the transmit and receive sections of RF modules. The coaxial changeover relays of the R&S®OSP-B 101 module are used to multiplex the antenna paths and to switch over between the signal generator and the spectrum analyzer (transmit and receive paths).

Signal-path switching in EMC test systems

In EMC test systems, e.g. for automatic testing of electromagnetic immunity, path switchover according to the measurement task and the frequency bands is necessary with each scan (FIG 9). In addition, to determine the net power, the monitor outputs (forward and reverse power) of the corresponding amplifiers must be switched. Automating such tasks by means of the R&S®OSP RF switch and control platform and suitable EMC software, e.g. R&S®EMC 32, ensures cost-efficient, error-free and optimized measurements. Plus, the software can automatically generate the required test reports.

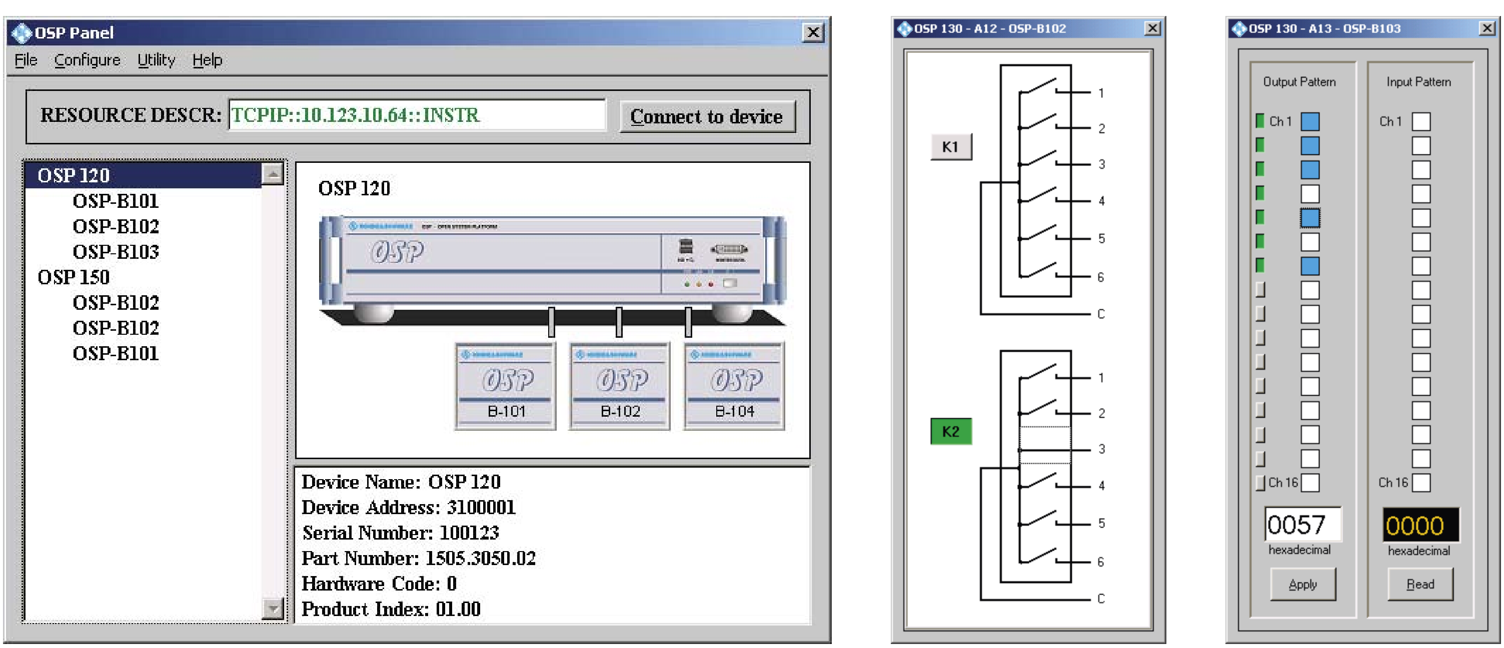
Summary

The R&S®OSP modular switch and control platform is suitable for a wide variety of RF switching tasks and is thus an all-purpose addition to the Rohde & Schwarz range of products.

Gert Heuer; Bernhard Rohowsky; Stefan Bauer

More information, flyers and data sheets at www.rohde-schwarz.com (search term: OSP)

FIG 5 Operating program of the R&S®OSP showing the windows for the R&S®OSP-B 101 (2 × SP6T) and R&S®OSP-B 103 (16 digital inputs / outputs) modules.



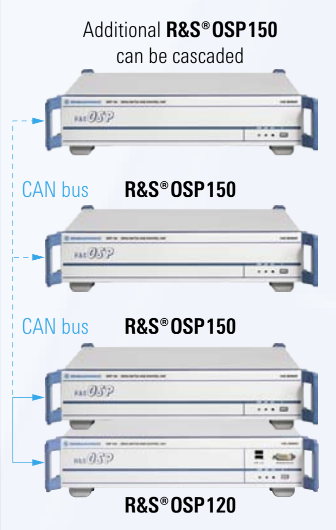


FIG 6
Extending the R&S®OSP120 base unit with the R&S®OSP150.

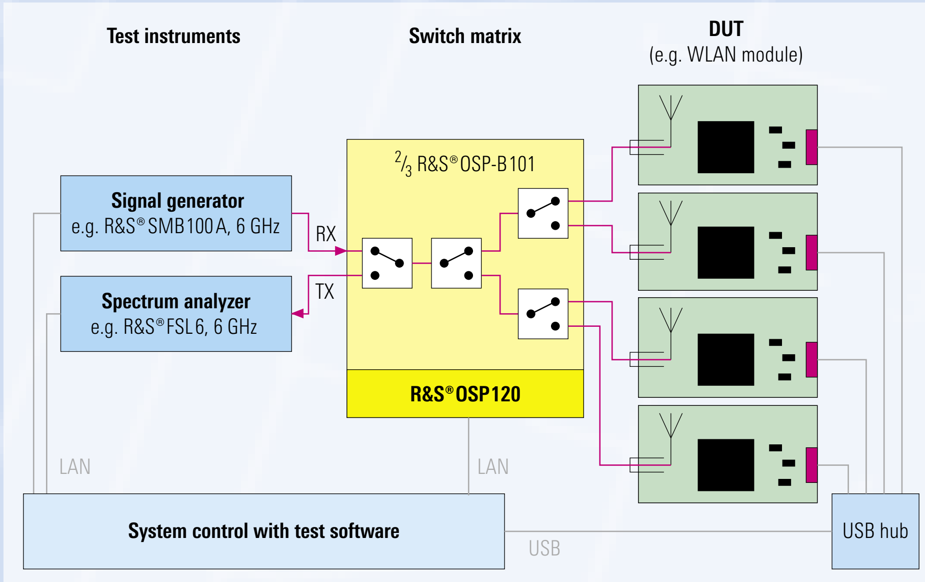


FIG 8 **RF test of multiple printed panels.**

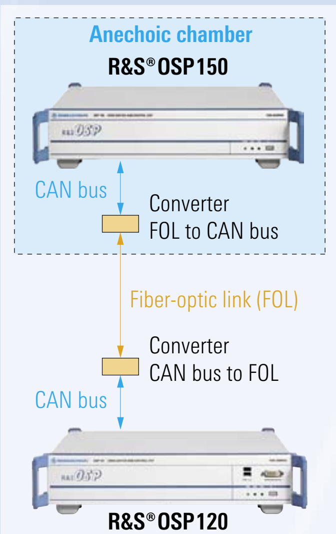
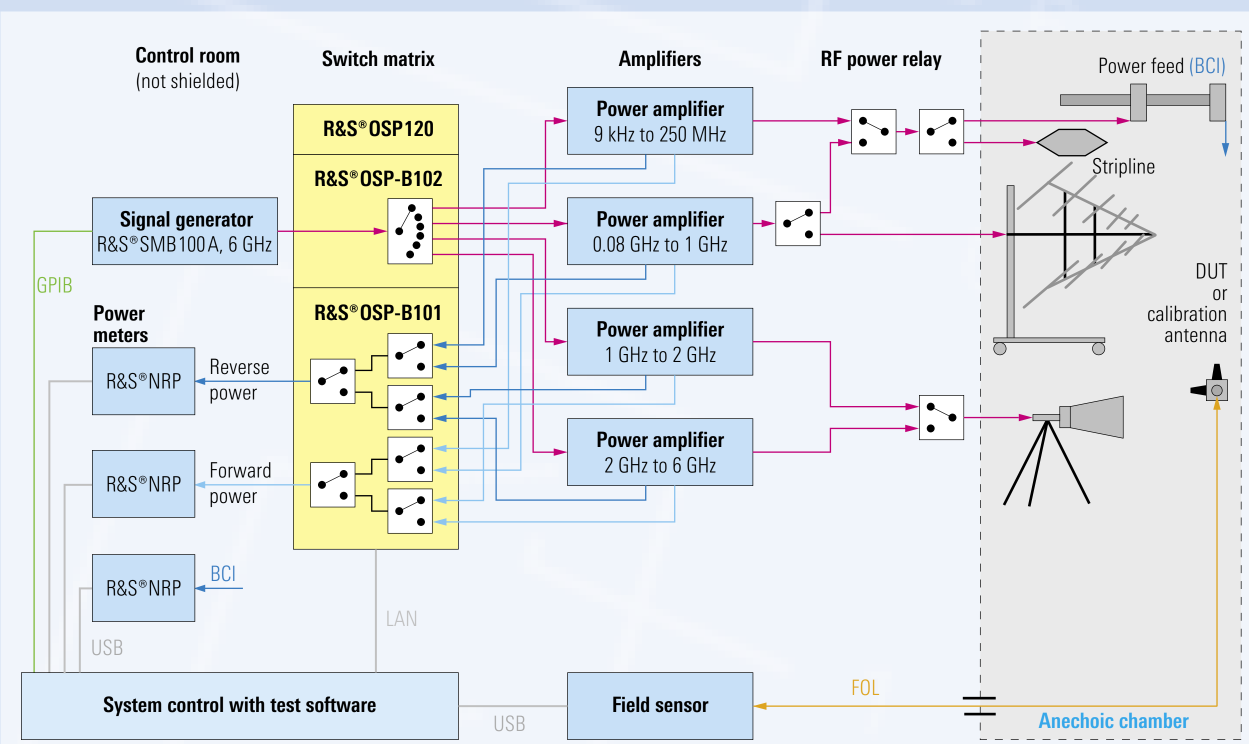


FIG 7
Remote operation of the R&S®OSP150.

FIG 9
Configuration of an EMC test system.



The wide range of spectrum analyzers from Rohde & Schwarz includes instruments for every need. The portfolio is continuously being enhanced to keep pace with technical innovations.

FIG 1 The R&S®FSL18 spectrum analyzer from Rohde & Schwarz is just as handy and compact as the R&S®FSL3 and R&S®FSL6 from the same family.

R&S®FSL18 Spectrum Analyzer

Portable spectrum analyzer for applications in the microwave range

Mobile spectrum analysis up to 18 GHz together with the capability to analyze wideband communications standards make the new R&S®FSL18 unique.

Growing demand: spectrum analysis in the microwave range

With its wide frequency range from 9 kHz to 18 GHz, the R&S®FSL18 (FIG 1) allows you to perform spectrum and modulation measurements on microwave systems. This includes not only measurements on radar systems and microwave link systems but also production tests on microwave components such as mixers and amplifiers. Owing to the high I/Q demodulation bandwidth and the comprehensive software selection of the R&S®FSL family, the new spectrum analyzer is the only instrument in its class to support the WLAN, WiMAX and WCDMA standards. FIG 2 gives you an overview of the R&S®FSL family.

FIG 2 The R&S®FSL family: an overview.

Model	Frequency range	Frequency range of tracking generator	Output power of tracking generator	Demodulation bandwidth
R&S®FSL3, model .03	9 kHz to 3 GHz	–	–	20 MHz
R&S®FSL3, model .13	9 kHz to 3 GHz	1 MHz to 3 GHz	–20 dBm to 0 dBm	20 MHz
R&S®FSL6, model .06	9 kHz to 6 GHz	–	–	20 MHz
R&S®FSL6, model .16	9 kHz to 6 GHz	1 MHz to 6 GHz	–20 dBm to 0 dBm	20 MHz
R&S®FSL18, model .18	9 kHz to 18 GHz (overrange 20 GHz)	–	–	28 MHz

General-purpose spectrum analyzer …

You can use the R&S®FSL18 for a variety of applications. The analyzer has a number of excellent features that are unique in its price range and make it ideal for many applications in development, production, installation and service.

Excellent demodulation characteristics

With the largest I/Q demodulation bandwidth in its class (28 MHz), the R&S®FSL18 covers the signal bandwidths up to wideband technologies such as WiMAX. The R&S®FSL18 is thus perfect for modulation measurements – no matter whether in the production of WLAN chipsets or during the maintenance and installation of WiMAX networks. Moreover, the wide frequency range allows you to perform measurements up to the 5th harmonic of 3G mobile radio transmitters.

Precise power measurements

Another unrivaled characteristic in its class is the low overall measurement uncertainty, which yields accurate and reliable results even in the microwave range (for details, see box "Condensed data of the R&S®FSL18" on page 35).

Extensive scope of functions

Its extensive scope of functions, which is normally provided only by high-end spectrum analyzers, make the R&S®FSL18 truly impressive. Integrated routines – e.g. for adjacent-channel power (ACP), 3rd order intercept (TOI) or occupied bandwidth (OBW) – make measurements easy and quickly provide results. Depending on the application, you can also expand the analyzer using the numerous tailormade firmware options from Rohde & Schwarz, e.g. the R&S®FSL-K91 option for performing measurements on WLAN signals. This option offers a user interface tailored to the application and user-specific measurement results such as modulation quality (EVM, flatness, constellation diagram), spectrum mask and adjacent-channel power. In addition to WLAN, WiMAX, Bluetooth® and WCDMA applications, the R&S®FSL18 – together with the R&S®FSL-K7 option – can also be used as an analog modulation analyzer for amplitude-, frequency- and phase-modulated signals. For a complete list of options offered, see the product brochure and the data sheet.

Pulsed signal measurements

The R&S®FSL18 offers resolution bandwidths from 1 Hz to 10 MHz (20 MHz zero span). Owing to its wide bandwidth, it can analyze pulsed signals both in the frequency and time domain (FIGs 3 and 4).

… in installation and service

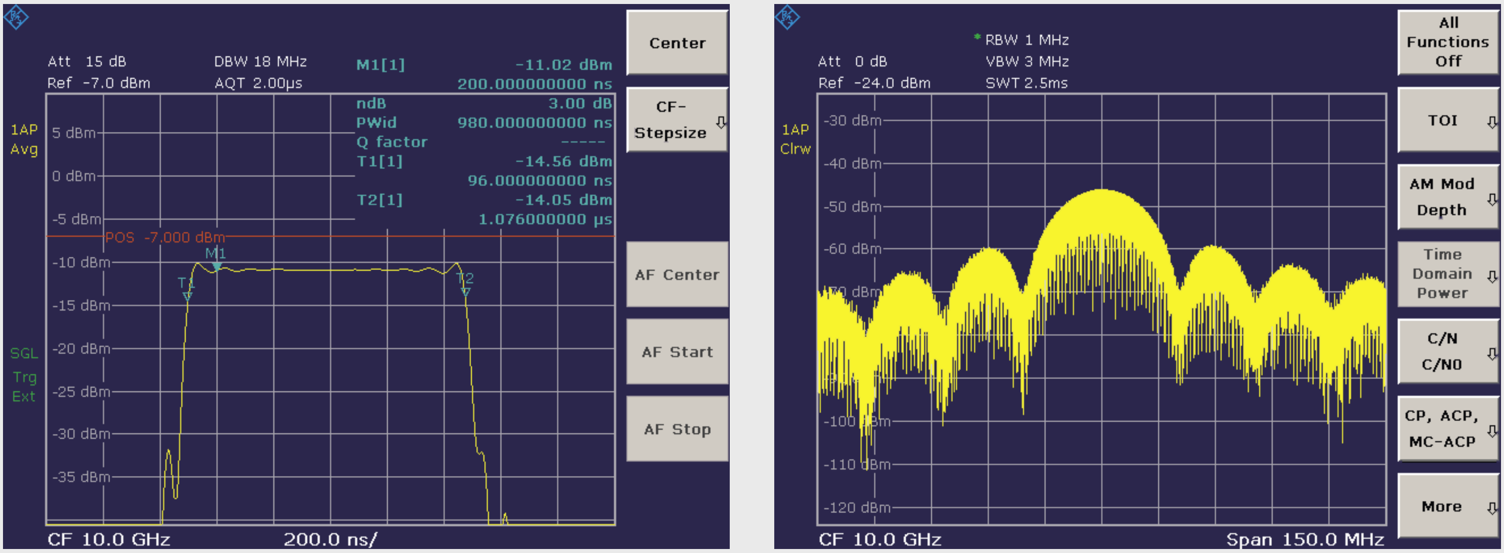
Low weight (<8 kg), small size and optional DC/battery operation make the R&S®FSL18 ideal for mobile field applications where an AC supply is not always available. Transmitter measurements for civil and military applications – from WiMAX and SatCom to radar – are no problem at all.

Another special feature of this spectrum analyzer is the fact that you can directly add a power sensor from the R&S®NRP-Z series. The R&S®FSL-K9 option and a connected power sensor allow very precise measurements of the DUT power – an enormous advantage for applications where level accuracy is crucial. The R&S®FSL18 can thus replace a power meter. This is particularly important in mobile applications.

… in production

With its extensive scope of functions, the spectrum analyzer is also a cost-efficient solution for applications in production. Production experts will appreciate its high measurement speed in addition to its level accuracy: high throughput is obtained with 80 sweeps/s in zero span (including all data transfers). Moreover, measurements with up to 300 analyzer settings can be performed by a single remote-control command in the frequency list mode. Power measurements in the time domain using channel filters and a fast frequency counter with a res-

FIGs 3 and 4 Typical applications of the R&S®FSL18 include measurements in the microwave range, e.g. measurement of the pulse width using the n-dB-down marker or measurement of the envelope spectrum of pulsed signals.



olution of 0.1 Hz at a measurement time of <50 ms are also part of the concept.

The R&S®FSL18 also excels with its connectors since they help ensure fast remote control via GPIB and LAN (FIG 5). USB ports for connecting additional components such as keyboard and mouse, USB stick or power sensors are also available.

… in development

Impressive technical features and a wide scope of functions make the R&S®FSL18 an analyzer with an attractive price/performance ratio. It can be used as a universal measurement tool at any workplace in addition to high-performance spectrum analyzers. The range of measurements offered, the user interface and remote-control commands conform to those of high-end spectrum analyzers from Rohde & Schwarz. Therefore, existing measurement solutions can be easily and quickly transferred to the R&S®FSL18. This eliminates having to port them to various platforms. And you do not have to be specially trained for the different T & M solutions. The R&S®FSL18 is also ideal for research and education at institutes and universities.

Summary

The R&S®FSL18 is a versatile and powerful spectrum analyzer up to 18 GHz. It can perform measurements on radar systems and microwave link systems. Plus, it is the right tool in production applications for microwave components such as amplifiers or in the installation and maintenance of WiMAX networks. This versatility and the analyzer's attractive price/performance ratio make it an indispensable do-it-all tool.

Dorothea von Droste

Condensed data of the R&S®FSL18

Frequency range	9 kHz to 18 GHz (20 GHz overrange)
Resolution bandwidths	1 Hz to 10 MHz (20 MHz zero span)
Video bandwidths	1 Hz to 10 MHz
I/Q demodulation bandwidth	28 MHz
Phase noise	<–98 dBc/Hz, 10 kHz carrier offset, 500 MHz <–115 dBc/Hz, 1 MHz carrier offset, 500 MHz
DANL (1 Hz RBW)	<–140 dBm (1 GHz) <–130 dBm (18 GHz) <–152 dBm (1 GHz, preamplifier)
TOI	10 dBm, typ. 13 dBm
1 dB compression point	+5 dBm
Level measurement uncertainty	<0.5 dB for f < 3 GHz, <0.8 dB for f < 6 GHz, <1.2 dB for f <18 GHz

FIG 5 The plug & play concept of the R&S®FSL18 allows you to retrofit hardware options on site without recalibration. This saves time and money and thus enhances the scope of functions for future applications.

44277/12

More information, brochure and data sheet at www.rohde-schwarz.com (search term: FSL)

FIG 1 Power splitter and power sensor in one box: the new R&S®NRP-Z28/-Z98 level control sensors.

R&S®NRP-Z28/R&S®NRP-Z98 Level Control Sensors

Integrated solution for feeding calibrated signals

Two new sensors place Rohde & Schwarz once again in the lead of power meter technology. The sensors convert any signal source into a highly accurate power reference.

Highly accurate and extremely convenient

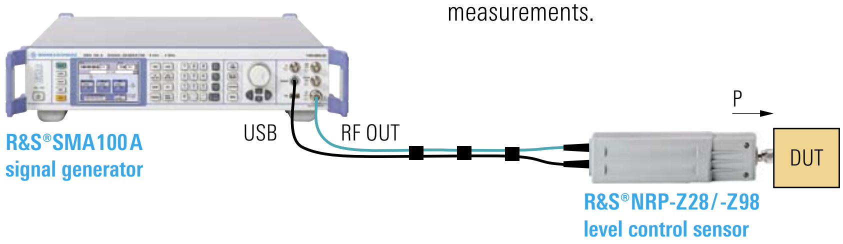
The two new products provide a one-box solution to replace the conventional power splitter / power sensor assembly previously needed for feeding signals to a DUT. They combine highly accurate measurements with ease of operation, particularly when used in conjunction with one of the R&S®SMU / R&S®SMJ / R&S®SMATE / R&S®SMA / R&S®SMB / R&S®SMF signal generators from Rohde & Schwarz. These signal generators can not only function as a power meter base unit, but will also improve their amplitude accuracy significantly by using a level control sensor. There are plenty of applications, starting with level calibration of spectrum and signal analyzers, and extending to the provision of calibrated levels for all types of receiver measurements.

Conventional power sensors are ideal for measuring the power available from an output. Due to excellent impedance matching they absorb the applied signal almost completely and reproducibly convert it into an easily measured physical quantity. If properly calibrated, they can measure the nominal power of a source very accurately.

In the past, the only commercially viable method used for measuring the applied power was to use directional power sensors. These sensors include an integrated directional coupler for signal tapping and can measure the power both of the wave incident on the DUT and of the wave reflected by it. Such power measurements are restricted to levels of more than 1 W.

To perform measurements in the more relevant level range below 100 mW (+20 dBm), users either had to configure their own small measurement system, consisting of a directional coupler or power splitter, one or two power sensors, and a connection cable – or settle for a significant decrease in accuracy.

FIG 2 Test setup using level control sensors.



The advantages of the new solution

The new R&S®NRP-Z28 and R&S®NRP-Z98 level control sensors (FIG 1) make these compromises unnecessary, because applied power levels are measured easily in the same way as with absorbing power sensors (FIG 2). In this case, the level control sensors are simply hooked up to the input of the DUT and then connected to either a signal generator or another signal source via a microwave cable. Either the signal generator itself (FIG 3), an R&S®NRP power meter, or a PC with USB interface can be used for displaying the measurement result. The measurement range for the applied level extends from –67 dBm to +20 dBm and the frequency range from 9 kHz to 6 GHz (R&S®NRP-Z98) or from 10 MHz to 18 GHz (R&S®NRP-Z28). The measurement uncertainty is comparable to that of commercial power sensors.

The advantages of the new solution can best be seen in comparison with a simple test setup, i.e. a direct cable connection between the signal generator and the DUT. In this case, the level applied to the DUT is read from the entry field of the signal generator; the cable loss typically is not taken into consideration. This can lead to a significant offset between the level that is set and the level that is actually applied (FIG 4). Level control sensors measure the applied power directly at the input of the DUT and therefore provide a clear advantage.

A further improvement is achieved with respect to impedance matching. In the case of direct cable connection, mismatch errors become apparent by the strong ripple of the trace, whereas this is barely noticeable when using level control sensors. This is because the level control sensors can be matched much better to 50 Ω than a signal generator. In addition, signal generator impedance matching is further impaired by the connection cable.

Of course, these disadvantages of direct cable connections are already well known, and a simple correction method is, therefore, frequently used. You simply premeasure the power at the DUT input using an absorbing power sensor (substitution) and use the measurement result as a "user correction" on the signal generator. As shown by the yellow trace in FIG 4, this does indeed compensate for the cable loss, and the amplitude accuracy of the signal generator level only plays a minor role. However, because this has little effect on the ripple, this method is only partially successful. Moreover, it would also be necessary to connect a very well matched attenuator to the cable output in order to somewhat reduce the ripple – or you could simply use a level control sensor.

In cases where even level control sensor matching isn't enough, it is possible to make use of another improvement referred to as gamma correction. This involves a numeric compensation of the influences resulting from impedance mismatch. FIG 4 gives an example of the residual ripple (blue trace) eliminated by gamma correction. However, although effective, this method does

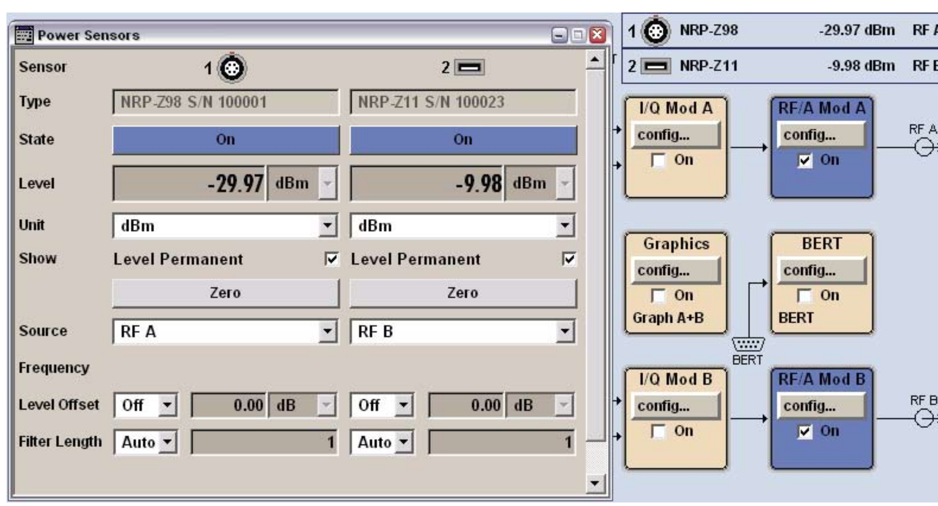


FIG 3 Menu for power measurements using the R&S®SMU/R&S®SMJ signal generators and display of measurement results in the block diagram.

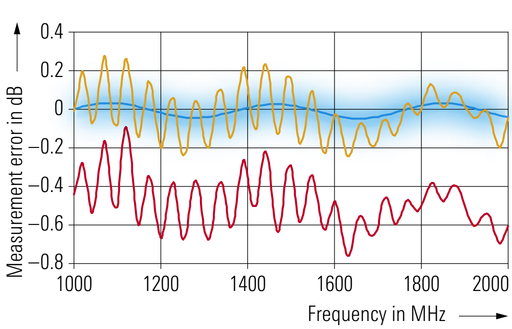


FIG 4
Level accuracy with a configuration like in FIG 2 compared to an equally long cable connection. The traces show the signal level on the DUT:
- **(blue) relative to the measurement results of the level control sensor (the blue trace shows the measurement uncertainty);**
- **(red) relative to the level setting of the signal generator for a cable connection;**
- **(yellow) relative to the level setting of the signal generator following a "user correction" (with power sensor at end of cable).**

The measurements were carried out with an R&S®SMATE signal generator, an R&S®NRP-Z28 level control sensor and a dummy load (SWR 1.6).

Two power sensors that are equal to the task

The new level control sensors use a broadband, resistive power splitter as a signal divider; for detection, they use a tried-and-tested power sensor with a USB interface (FIG 5). To this extent, they are very similar to the R&S®NRP-Z27 and R&S®NRP-Z37 power sensor modules. The difference lies in their configuration and calibration. While the R&S®NRP-Z27 and -Z37 measure the applied power (i.e. they act as absorbing power sensors), the two level control sensors measure the power that is output. To do this, one of the two outputs of the power splitter is connected to the power sensor and the other to the test port.

By virtue of its symmetrical configuration and its two 50 Ω resistors used for signal division, the power splitter ensures that the power applied to the power sensor and the power applied to the DUT are approximately the same, even if there is a significant mismatch on the side of the DUT. This type of configuration is well known and frequently used worldwide for feeding calibrated signals to DUTs. But this still falls far short of the accuracy achieved with a power meter. To achieve this level of accuracy, any residual asymmetry of the power splitter would have to be eliminated; this could be done, for example, by using a second power sensor for a calibration. The power ratio of the two sensors would then have to be taken into account during the subsequent measurement on the DUT. Since this is a time-consuming process, particularly when measuring at several frequencies, it is used only in exceptional cases to improve accuracy.

Rohde & Schwarz demonstrates a better way with the new level control sensor. Above and beyond the integration of all components in a single box, it is primarily the following measures that ensure the high degree of accuracy and simple handling:

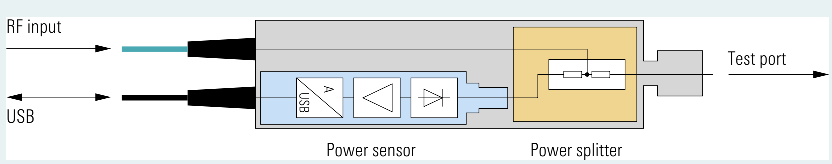


FIG 5 Block diagram of the R&S®NRP-Z28 / -Z98 level control sensors.

Gamma correction during test port calibration at the factory

Just like with the other R&S®NRP-Zxx sensors, calibration uncertainties resulting from impedance mismatch are widely eliminated during production. Since the complex reflection coefficients on both sides of the calibration interface must be known, this is also called a gamma correction. Only by this correction method can the specified measurement uncertainty reach the levels associated with power meters.

Stored calibration data

The power ratios between the internal and external power sensor derived during calibration in the factory are offset against the calibration data of the internal sensor and then stored in the sensor itself. As a result, the power applied to the DUT can be measured immediately – without further corrections.

Power sensors in patented three-path technology

For the level control sensor from 10 MHz to 18 GHz, the tried-and-tested R&S®NRP-Z21 is used, which also permits simple analysis of the power envelope with a video bandwidth of 100 kHz. In the level control sensor for lower frequencies, an R&S®NRP-Z91 average power sensor is used. Both sensors provide a very wide dynamic range and a high degree of sensitivity plus the ability to measure accurately regardless of the waveform.

Gamma correction by the user

Gamma correction is ideal for significantly reducing measurement uncertainty with a strongly mismatched DUT. Therefore, Rohde & Schwarz also provides users with the equivalent reflection coefficients obtained during the production of the level control sensors.

Embedding

Since there are at least three types of RF connectors just for the frequency range below 4 GHz, the use of adapters is hard to avoid. But something that is not critical at all for a signal generator or spectrum analyzer can quickly lead to the specified measurement uncertainty being vastly exceeded on a power sensor. Therefore, Rohde & Schwarz has taken the following precautions with regard to the level control sensors:

First, the test port uses a male N connector instead of a female connector, permitting a direct connection to most measuring instruments. This already provides a major advantage over commercial power splitters that use only female N connectors. If adapters must be used, such as when converting to the 7/16 or SMA systems, the user can embed the adapter in the application. To do this, the four S-parameters of the adapter have to be determined using a vector network analyzer and then stored in the sensor (up to 1000 frequency points). The advantages: The high degree of measurement accuracy is maintained, in particular in connection with active gamma correction, and the process is foolproof. Comparable advantages can be achieved by embedding an attenuator that is hooked up to the test port, e.g. in order to apply very small signals outside the measurement range of the level control sensors.

not see much practical use because the complex reflection coefficients of the DUT and the source would have to be measured to make this correction. That's not the case for level control sensors. Rohde & Schwarz ensures highly accurate measured values for the equivalent source reflection coefficients of level control sensors. You then simply have to provide the reflection coefficients of the DUT – a standard measurement task – and the sensor does the rest. The remaining mismatch uncertainty is typically small enough so as to be considered negligible (FIG 6).

From signal generator to level calibrator

Even if it is clearly sufficient in many cases to know the exact level applied to the DUT, there are applications for which a small deviation from a nominal value is needed. Because the alternating measurement and correction of a level setting is cumbersome and time-consuming, these tasks are frequently performed by level calibrators, which set the desired level value immediately and highly accurately.

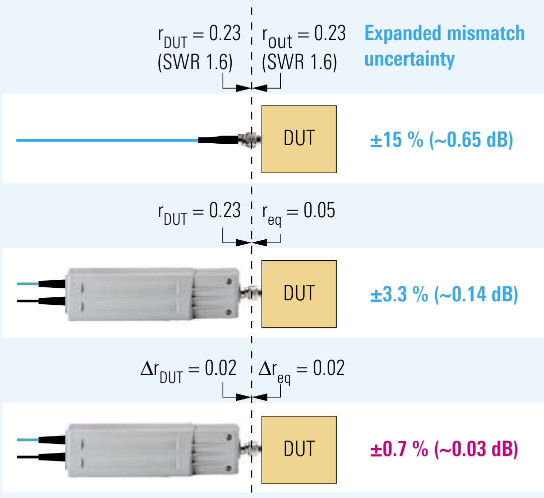
The introduction of the level control sensors now makes this functionality also available for signal generators of the R&S®SMU / SMJ / SMATE / SMA / SMB / SMF family. The "user correction" function on the signal generator is used for this purpose, and the signal generator is run through a training sequence while the DUT is connected. This is done before the nominal level is set. The level setting on the signal generator is then corrected so that the desired nominal level is present on the DUT. Except for the DUT-specific training sequence, this level calibrator is almost identical to conventional instruments of this type. In terms of accuracy, it can even be superior (FIG 7).

Outlook

The R&S®NRP family is continually being enhanced. As always, the focus remains on benefits for the user: high quality at a reasonable price, leading-edge technology, and true to the motto "plug in and measure".

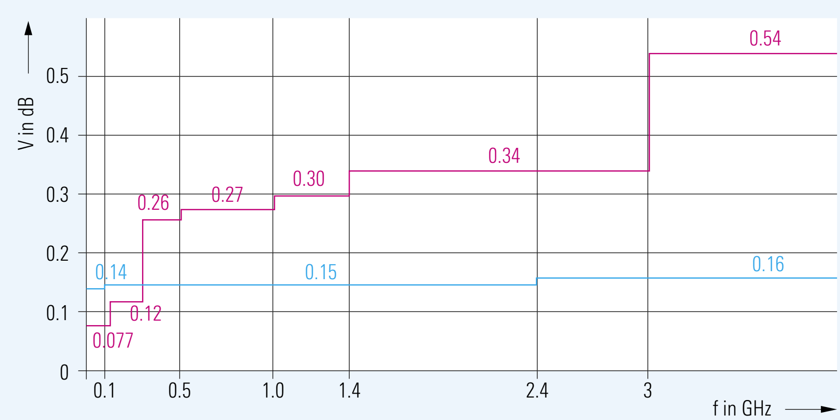
Thomas M. Reichel

FIG 6 Mismatch uncertainty using a DUT featuring an SWR of 1.6:
1 with cable (source with an SWR of 1.6);
2 with the R&S®NRP-Z28 / -Z98 in the frequency range up to 4 GHz without gamma correction;
3 like 2, but with gamma correction. The measurement uncertainties for the complex reflection coefficients relevant for the gamma correction were assumed to be 0.02.



More information at www.rohde-schwarz.com (search term: NRP-Z28)

FIG 7 Amplitude accuracy for a level calibrator when feeding a DUT with an SWR of ≤1.5.
Red: Competitor.
Blue: The R&S®SMU / R&S®SMJ / R&S®SMATE generators after user correction with the R&S®NRP-Z28 / -Z98 (reproducibility in relation to the training sequence is taken into consideration).



R&S®SMA100A Signal Generator

Caution: T&M equipment can also give away secrets

Measuring instruments used in security areas should not contain confidential instrument settings or useful data when taken outside these areas. The R&S®SMA100A signal generator from Rohde & Schwarz is extremely discreet in this respect: In addition to high performance, it features a number of important characteristics that make it safe to use in this environment.

Preventing access to confidential data

Some of the settings of electronic measuring instruments (e.g. frequency ranges, level ranges, or sweep ranges) as well as useful data are still stored internally even after the instrument is switched off. If these instruments are used in security-critical applications, it is important that third parties do not have access to these settings, since this information may provide clues about secret applications, for example. If such instruments are removed from the security area (e.g. when transported to another department or due to calibration or repair at an external service provider), precautions must be taken to ensure that this security-critical information does not fall into the wrong hands.

The R&S®SMA100A signal generator from Rohde & Schwarz is exemplary here: As an analog high-end signal generator with excellent specifications, it is of course also used in security-critical applications, where it offers a number of special features.

Confidential data only on memory card

When the generator was designed, particular emphasis was placed on storing confidential data and settings in non-volatile form only on the generator's CompactFlash™ memory card. No security-relevant data is stored in the other storage locations in the instrument, or it is deleted when the generator is switched off.

If the generator is equipped with the R&S®SMA-B80 removable mass storage option, you can take out the CompactFlash™ memory card and safely remove the generator from the security area.

For operating the instrument outside the security area, an optional spare CompactFlash™ memory card (R&S®SMA-Z10) is available, which does not contain security-relevant data. You insert the spare card into the slot, switch on the signal generator, and then perform an internal instrument adjustment – the generator is now ready for operation, calibration, or repair.

Deactivating interfaces by means of software

Instrument interfaces can also pose safety risks since they can be used to export confidential data, for example. In the case of the analog R&S®SMA100A signal generator, USB and LAN interfaces can therefore be quickly and easily deactivated by means of software. A password is required in order to reactivate the interfaces.

Utmost safety – Linux operating system

Another safety advantage of the R&S®SMA100A is its Linux operating system, which provides a high degree of safety against viruses, worms, and security gaps.

Document with technical details

On the Rohde&Schwarz website, you can find a Technical Information article about the R&S®SMA100A signal generator describing everything that has to do with its use in security areas (see box).

The article also includes a detailed description of the types of storage used in the signal generator and indicates where the data is stored. Moreover, the article provides details on how to use the CompactFlash™ memory card and how to deactivate/reactivate the instrument interfaces (USB/LAN).

Thomas Rieger

More information and Technical Information at www.rohde-schwarz.com (search term: SMA100A)


Resolving Security Issues
when working with the R&S® SMA100A in
Secure Areas

Technical Information "Resolving security issues when working with the R&S®SMA100A in secure areas".

When the R&S®SMA-B80 option is installed, internal generator data and settings can be stored on a removable CompactFlash™ memory card.

44434/3

R&S®ESU EMI Test Receiver

Accurate detection of impulsive electromagnetic disturbance

The R&S®ESU EMI test receiver (FIG 1) for detecting electromagnetic disturbance is recognized globally as a benchmark for compliance measurements. Using the currently available amplitude probability distribution (APD) function, the R&S®ESU accurately detects impulsive electromagnetic disturbance such as from microwave ovens.

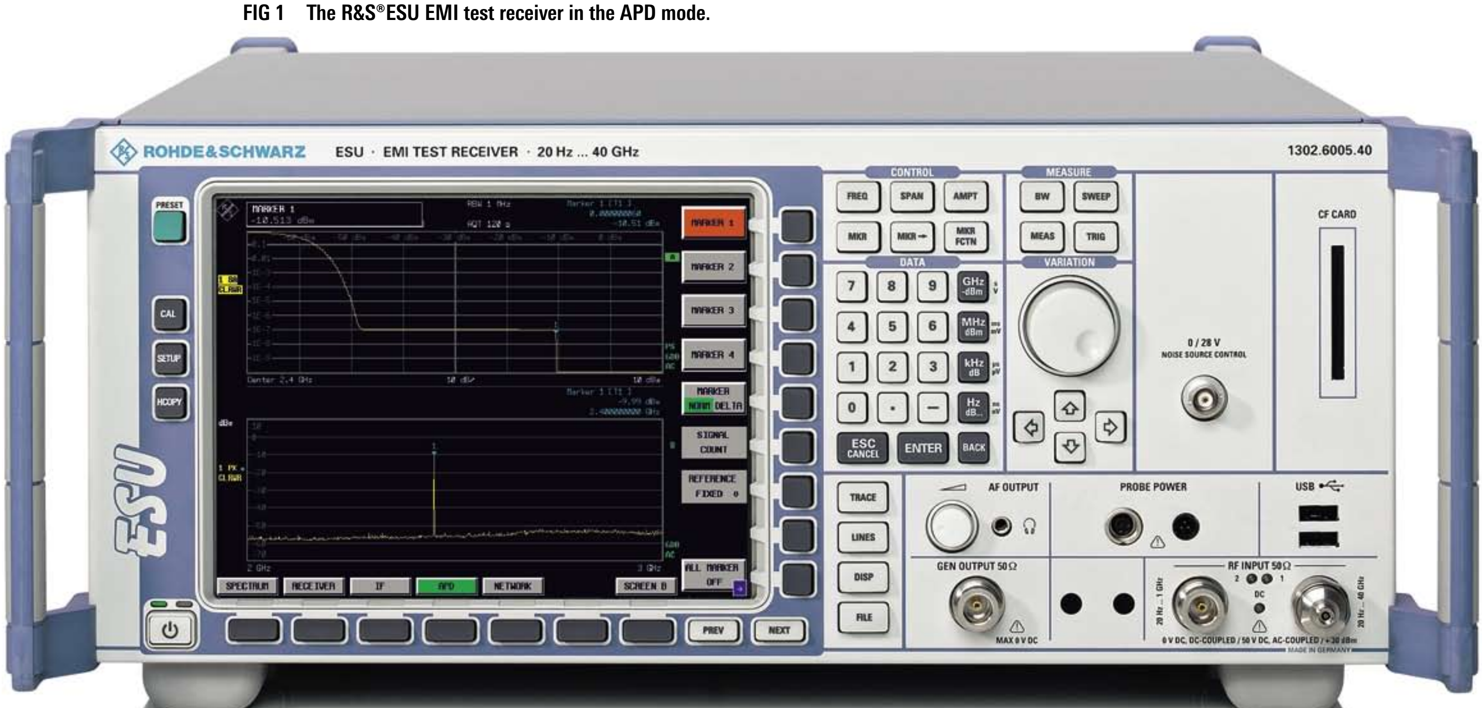
New weighting functions in CISPR 16-1

After the introduction of AM broadcasting in the 1920s, the many radio listener reports on disturbance made disturbance suppression necessary for the first time. However, because measurement processes had yet to be developed, the initial standards were more akin to a how-to guide for noise suppression. It was not until later that actual disturbance voltage measurement processes were developed.

With the foundation of the International Special Committee on Radio Interference, CISPR, (Comité International Spécial des Perturbations Radioélectriques) in 1933, systematic studies began with the goal of defining uniform weighting processes. It was recognized early on that the way broadcasting is affected depends both on the type of disturbance (broadband or narrowband) and on the radio service itself. It was dependence on the pulse frequency in particular that finally lead to the definition and introduction of the quasi-peak detector.

During definition of the weighting function, the goal was to keep the effort for disturbance suppression at a minimum, i.e. the suppression must be just good enough to provide adequate protection against radiated emission so that radio listeners are not bothered by disturbance on a subjective scale. That is why quasi-peak weighting simulates the radio receiver including the listener.

FIG 1 The R&S®ESU EMI test receiver in the APD mode.



44499/1n

When receiving analog-modulated signals, the disturbance, i.e. the level of psycho-physical annoyance, is a subjective value. Although it can be heard or seen, it usually cannot be measured in hard numbers. Today's dominance of digital broadcasting and communications systems has caused a fundamental shift in this scenario. For receivers of digitally modulated signals, it is possible to determine the level of disturbance for which complete error correction is still possible, for example, using the critical bit error rate. This is why CISPR and ITU already started 15 years ago to study the effects of impulsive disturbance on digital radio services.

As a result of these studies [1] [2], new weighting functions were introduced in the CISPR 16-1 basic standards [3]: the RMS average detector and the amplitude probability distribution (APD).

The APD (FIGs 2 and 3) of a given disturbance is defined as the cumulative distribution of the "probability of time that the amplitude of disturbance exceeds a specified level" [3]. The APD measurement can be used to determine a product's capability to generate disturbance signals in digital communications systems. For example, this could be used for microwave ovens, which frequently impair WLAN communications in the frequency range from 2400 MHz to 2500 MHz.

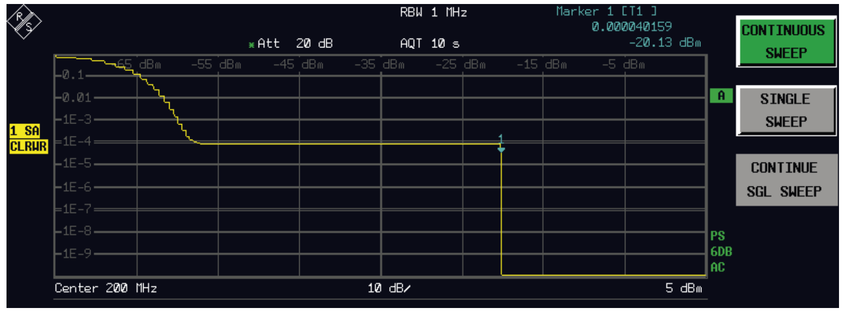


FIG 2 **APD function for a pulsed signal (pulse duration = 1 ms, pulse repetition frequency = 0.10 Hz).**

FIG 3 **Specification of the APD function and comparison with the R&S®ESU EMI test receiver.**

	CISPR 16-1-1	R&S®ESU
Dynamic range of amplitude	>60 dB	>70 dB
Amplitude accuracy	better than ±2.7 dB	typically <0.2 dB
Maximum measurable time period	≥2 min 1)	2 min (no dead time)
Minimum measurable probability	10^{-7}	10^{-7}
Amplitude level assignment	at least two amplitude levels with a resolution of 0.25 dB	625 levels with a resolution of 0.128 dB
Sampling rate	≥10 Msamples/s for B_{res} = 1 MHz	10.2 Msamples/s for B_{res} = 1 MHz, 4.0 Msamples/s for B_{res} = 200 Hz, 9 kHz, 120 kHz
Amplitude resolution of APD display	≤0.25 dB	0.128 dB

1) An intermittent measurement is possible if the dead time (during which no values are measured) is less than 1% of the total measurement time.

Description of APD function using microwave ovens as an example

In this example, the APD function is described based on the disturbance field strength measurement of microwave ovens in the frequency range from 1 GHz to 18 GHz. CISPR 11 [4], which is the current standard for microwave ovens, defines peak and average limits for this purpose. The weighted average value is determined by reducing the video bandwidth to 10 Hz in the logarithmic mode. However, this cannot be used to determine the true average value, and the weighted average value is too imprecise, particularly for impulsive disturbance originating from microwave ovens.

In such cases, the APD function can be used as an alternative method because it can also determine the true average value. As with the conventional method, the peak detector is first used to perform a preview measurement. If the result of the preview measurement exceeds an acceptance level as defined in relation to the limit line, the APD is measured at these identified frequencies.

The APD must be measured using one of the following two methods:

- Measurement of the disturbance field strength level $E_{measured}$ in dB(μV/m), with reference to the defined probability of occurrence over time p_{limit}
- Measurement of the probability of occurrence over time $p_{measured}$ during which the envelope of the disturbance exceeds a defined level E_{limit} in dB(μV/m)

The R&S®ESU divides its 80 dB display range for the disturbance field strength level into 625 subranges and, for every subrange, measures a disturbance field strength level $E_{measured}$ as well as the probability $p_{measured}$ with which this level is attained. This means that both APD measurement methods are applicable.

Because peak limits and average limits are already specified in CISPR 11, it is recommended that these limits be used together with an APD limit p_{limit}. The EUT is considered to have passed the test when both values fall below the limits. The APD limits are currently under discussion in the responsible committees. Alternatively, the APD data can be used to calculate the linear average value, which can then be compared directly against the average limit. The peak limit is compared against the measured disturbance field strength level $E_{measured}$ at a probability of occurrence over time of 10^{-7}, for example.

Summary

With the APD function currently available in the R&S®ESU EMI test receiver, electromagnetic disturbance emitted by microwave ovens can now be detected very accurately. This is a particular advantage when performing very time-consuming measurements with high redundancy in type approval and quality acceptance testing. Users of the APD function have the following advantages:

- Wide dynamic range
- Improved detection of pulsed signals as compared to weighting involving the reduction of the video bandwidth
- Higher accuracy and reproducibility as compared to peak value measurements using a spectrum analyzer
- Alternative method for disturbance field strength measurements on microwave ovens in accordance with CISPR 11.

Jens Medler; Matthias Keller

More information and data sheet at www.rohde-schwarz.com (search term: ESU)

REFERENCES

[1] Amendment 1:2005 to CISPR 16-3:2003 (2nd Ed.) Specification for radio disturbance and immunity measuring apparatus and methods – Part 3: CISPR technical reports
[2] Amendment 2:2006 to CISPR 16-3:2003 (2nd Ed.) Specification for radio disturbance and immunity measuring apparatus and methods – Part 3: CISPR technical reports
[3] CISPR 16-1-1:2006 (2nd Ed.) Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus
[4] CISPR 11:2003 (4th Ed.) Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement

Convenient manual solutions for tricky measurement tasks

Despite the availability of software for fully automatic EMI measurements, manual EMI measurements still have a place in test laboratories when it comes to handling tricky measurement tasks. State-of-the-art EMI test receivers offer special functions for this purpose – and help to reduce measurement time.

Valuable functions in state-of-the-art test receivers

There are quite a number of tools that support you in handling tricky manual EMI measurement tasks. The following three functions have proved to be particularly helpful and effective:

IF (spectrum) analysis – an efficient tool

The purpose of IF analysis is to provide a continuous spectral display of the RF input signal around the receiver frequency over a definable range. Ideally, this display is shown at the same time as the numeric measurement at the current receive frequency (FIG 1).

Because the center frequency of the spectrum always corresponds to this receive frequency, the test receiver can be tuned to the signal to be analyzed very reliably and – most importantly – very quickly. In addition, the user has a very accurate overview of the spectrum occupancy around the measurement channel and, with a sufficiently large IF bandwidth, of the spectral distribution of a modulated signal in the measurement channel. Receive signals can thus be classified quickly as either disturbance or useful signals, regardless of whether they are CW signals that appear as unmodulated carrier signals or impulsive disturbance appearing as narrow lines across the screen.

In addition, by adding parallel audio demodulation for AM or FM, identifying the measured signals becomes even easier; for example, ambient disturbance signals can be detected and excluded during open-area tests.

State-of-the-art test receivers can display traces together with various weighting information, such as Max Hold, Min Hold, or Average Value (AVG). By using this feature on traces from the IF analysis, the user has additional options for characterizing the input signal: With modulated signals, the spectrum is gradually filled within the Max Hold display until all occurring spectral maxima have been reached. Pulse-like signals also fill the Max Hold display until the complete spectrum is displayed and the worst-case level can be reliably determined. In contrast, pulse-like signals are suppressed by the Min Hold display, while sinewave signals are shown unchanged. The combination of the Max Hold and Min Hold displays allows you to easily identify CW interferers with very low levels within a TV signal, for example.

Another helpful feature is the analysis of the displayed trace(s) using numerous marker functions, e.g. for quickly and accurately determining frequencies and relative levels on the trace. Also of note is the "Center = Marker Frequency" function: At a keystroke, the receiver frequency can be set such that the signal to be measured is situated exactly at the center frequency (FIG 1).

In addition to the numeric display, the measured values weighted by the various CISPR detectors are also visualized in a bargraph. This allows you to quickly recognize the effects that technical modifications have on the device under test. Even when the receiver frequency is changed, the bargraph will follow the signal without interruption, making it easier to search for the highest signal level. The highest level value and the associated frequency are also registered and displayed by the receiver. The "Add to Peak List" button sends this frequency to a separate frequency list and stores it for subsequent final measurement.

FIG 1 R&S®ESU EMI test receiver, (split-screen display) in the IF analysis mode.
***Top*: numeric display of receiver frequency and level for max. three different detectors including Max Hold display for level and frequency as well as parallel, quasi-analog bargraph (RBW 120 kHz; measurement time 1 s). *Bottom*: spectrum around the receiver frequency (RBW 10 kHz; span 1 MHz). Trace 1 (yellow): ClearWrite; trace 2 (blue): Max Hold with marker peak measurement. Second menu bar at right: optional marker functions for trace analysis.**

IF analysis is thus a very useful tool for precisely tuning the test receiver frequency as well as for rapidly identifying signals and analyzing their surrounding spectrum.

Drifting disturbance signals – immediate and correct weighting with "Threshold Scan"

Regardless of whether disturbance voltage, disturbance power, or disturbance field strength is being measured, the time needed is considerable. To reduce this problem, EMI test receivers have for many years used special measurement routines that minimize the time required for the measurement. For many years, one of the methods practiced in the EMC world has been to perform preview measurements with a peak detector, determine the frequencies with significant disturbance, and then perform a standard-conforming final measurement on a limited number of frequency points. However, this method is limited if the disturbance signals are unstable and drift in frequency. Because the final measurement is not always performed immediately after the preview measurement when the above method is used, the critical disturbance frequency determined during the preview measurement sometimes shifts so much by the time the final measurement is run that the maximum noise level can no longer be measured correctly.

In these cases, a modified procedure, the "Threshold Scan" [1], is used. Here, too, preview measurement and final measurement are separate measurements thus helping to save time. However, the measurement is different in that when a definable limit value is exceeded, the preview measurement is stopped immediately and the final measurement is performed with standard-conforming receiver settings (FIG 2). The preview measurement is then continued with the next frequency step. As soon as the limit value is exceeded again, the next final measurement is performed.

This process has a distinct advantage: The final measurement, which might include a quasi-peak weighting, always immediately follows the preview measurement. This minimizes measurement errors caused by frequency drift of the interferers. At the same time, the receiver stores the final measurement values in a separate table (Peak List) for later analysis and documentation.

Time-domain analysis – oscilloscope function for test receiver

The measurement sequence described above – consisting of preview measurement, data reduction, and final measurement – of course helps to reduce the overall measurement time. However, preview measurements for radiated disturbance measurements can take several hours. The decisive parameter here is the measurement time per frequency step. For example, to accurately detect impulsive disturbance signals, the duration must at least equal the reciprocal value of its pulse repetition frequency (PRF). For an impulsive disturbance signal of 100 Hz PRF, a measurement time of at least 10 ms is required.

This is where some EMI test receivers can help: You can perform a scan on the defined receive frequency in the time domain, similar to the zero span of the spectrum analyzer.

This time-domain analysis measures disturbance over time – comparable to an oscilloscope. For example, you can determine the pulse rate of a disturbance signal with broadband characteristic so as to set the measurement time optimally; that is, as short as possible but also as

FIG 2 R&S®ESPI test receiver: screen display in the "Threshold Scan" mode after detection of a drifting disturbance signal with broadband characteristic. Quasi-peak limit line in accordance with EN 55 022. The number of final measurements in the 150 kHz to 1 MHz range was limited to twelve measured values, and each disturbance signal was accurately determined.

long as necessary. You can also determine whether and how strongly a disturbance signal with a narrowband characteristic is fluctuating, as well as whether it is amplitude-modulated or pulsed.

A special application is click rate analysis [2]: Thermostatic or program-controlled electrical devices, such as washing machines and air conditioners, generate discontinuous disturbances. Because of their aperiodic timing, these click disturbances have higher limit values than continuous interferers. CISPR 14 or EN 55 014 contain disturbance voltage limit values with click rate weighting [3]. To use these higher limit values, the duration of the clicks, their repetition rate (click rate), and their levels must be measured in order to determine the limit values that must be met (FIG 3).

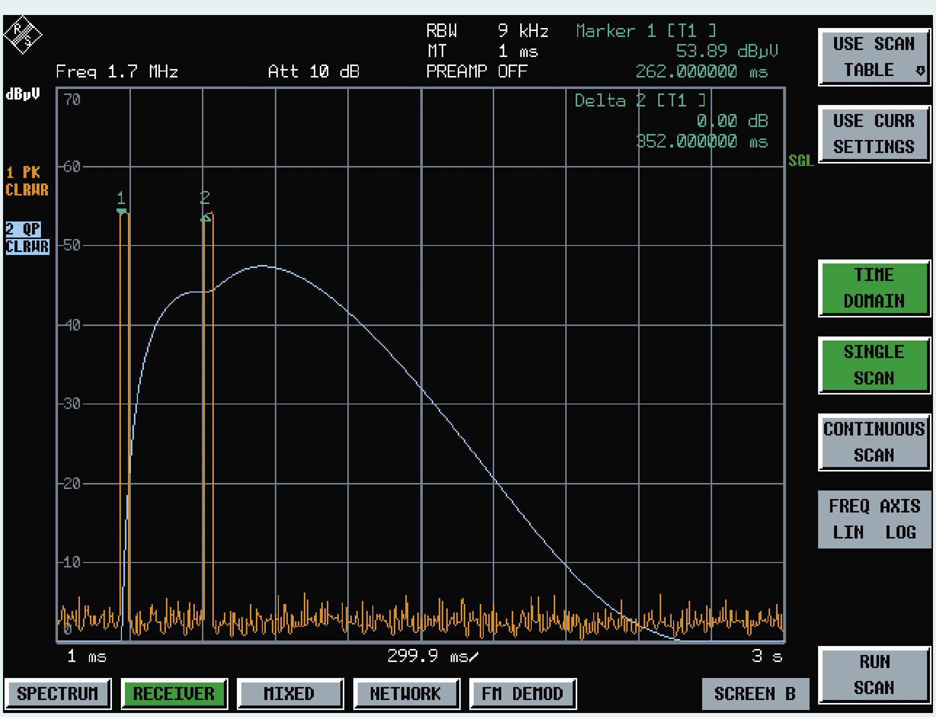
Clicks are typically measured with special click rate analyzers. Alternatively, however, a time-domain analysis integrated into the test receiver can consecutively determine the pulse height and duration of each of the frequencies specified by the standard, thus replacing the functionality of the expensive click rate analyzer. In this case, the test receiver must fulfill the requirements of CISPR 16-1-1 with respect to the accuracy of the pulse duration measurement for pulse durations of 10 ms and greater. In addition, the result memory must be large enough to record the peak value and quasi-peak value for at least two hours without gaps. But state-of-the-art EMI test receivers with a memory capacity of up to two million values per trace are capable of doing this.

Summary

Additional functions of state-of-the-art EMI test receivers such as IF analysis, threshold scan, and time-domain analysis make tricky measurement tasks much easier to perform. Thus, an investment in such state-of-the-art receiver technology is definitely worthwhile.

Karl-Heinz Weidner

FIG 3 R&S®ESCI EMI test receiver: screen display in time-domain analysis mode (measurement frequency 1.7 MHz; resolution bandwidth 9 kHz; measurement time 1 ms; monitoring time 3 s): two click disturbances at an interval of about 350 ms, display of peak value (orange) and quasi-peak value (blue).



More information on comprehensive range of EMC test equipment at www.rohde-schwarz.com (search term: type designation)

REFERENCES

[1] R&S®ESPI Precompliance Test Receiver: Improved, patented EMC test method for drifting interference signals. News from Rohde & Schwarz (2004) No. 181, pp 42–43

[2] R&S®ESCI EMI Test Receiver: Click rate analysis in accordance with CISPR 14. News from Rohde & Schwarz (2005) No. 185, pp 32–33

[3] EN 55 014, Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus; Part 1: Emission

45120-2

The all-purpose instrument for all major digital and analog TV standards

Transmitter production, installation, and service require measuring equipment that can handle the wide variety of TV standards in place around the world. The new R&S®ETL multistandard platform (FIG 1) ideally fulfills these needs. It not only analyzes all conventional TV standards and offers spectrum analysis functions, but it is also open for future developments.

FIG 1
The R&S®ETL combines TV test receiver and spectrum analyzer functionality in a single unit while providing high measurement accuracy.

In vogue: multistandard platforms

Not infrequently, broadcasters must set up and operate multiple transmitter networks in parallel using varying standards. In addition to the analog transmitter networks still in use, these are largely networks for digital terrestrial television, and more recently also for mobile television. The standards vary accordingly – a situation that affects not only manufacturers of TV transmitters, but also the service providers who install and maintain transmitters around the world. All users share the desire to employ as few measurement instruments as possible in their daily tasks; this means they need equipment that handles all of the necessary measurements for all standards being used. The new R&S®ETL TV analyzer with its multistandard platform concept is the perfect answer to these needs.

Innovative device concept

The R&S®ETL designers didn't just think about combining all significant TV standards in a single device. They also wanted to create the most flexible platform possible – one that can quickly be adapted to any future developments such as new standards or enhancements of existing standards. The result is an innovative device concept that integrates both hardware- and software-based demodulators.

Software-based demodulators

Normally, commercially available, hardware-based demodulators are used in TV analyzers. This reduces the development effort as well as the procurement costs for these devices. However, these advantages are offset by fundamental disadvantages. For example, commercial hardware demodulators typically offer only limited performance, oriented toward the terminal equipment it is designed for (set-top boxes, mobile phones). In addition, the options are limited both for implementing new types of measurements and for quickly adapting them to evolving market requirements.

To avoid these disadvantages, Rohde&Schwarz has developed software-based demodulators. One of the main considerations was to ensure that these demodulators operate in realtime in order to detect short-duration interference and to provide uninterrupted demodulation and continuous recording of measured values. The results are convincing: The new software-based demodulators meet these criteria with a performance that simply cannot be achieved by hardware-based demodulators.

The central component is a field programmable gate array (FPGA) that can be "loaded" with the demodulator to be used (FIG 2). This makes integrating new standards in the R&S®ETL as easy as switching among the various demodulators. New demodulators can be activated simply with a license key. And the R&S®ETL is extremely versatile: Besides its software-based demodulators, it also allows the use of hardware-based demodulators if they offer sufficient performance. The R&S®ETL is perfectly suited to handle any task both now and in the future.

Analysis in realtime

Speed is not only an advantage when carrying out measurements, but also when analyzing TV signals. In addition to its innovative demodulators, the high-speed signal processing in the R&S®ETL also makes it possible to detect short-duration interference as well as to perform adjustments in realtime.

The speed of the R&S®ETL becomes especially apparent when displaying the constellation of digitally modulated TV signals (FIG 3), when displaying the channel impulse response for DVB-T/-H, or when measuring the frequency response, group delay, and phase in the TV channel.

Efficiency through versatility

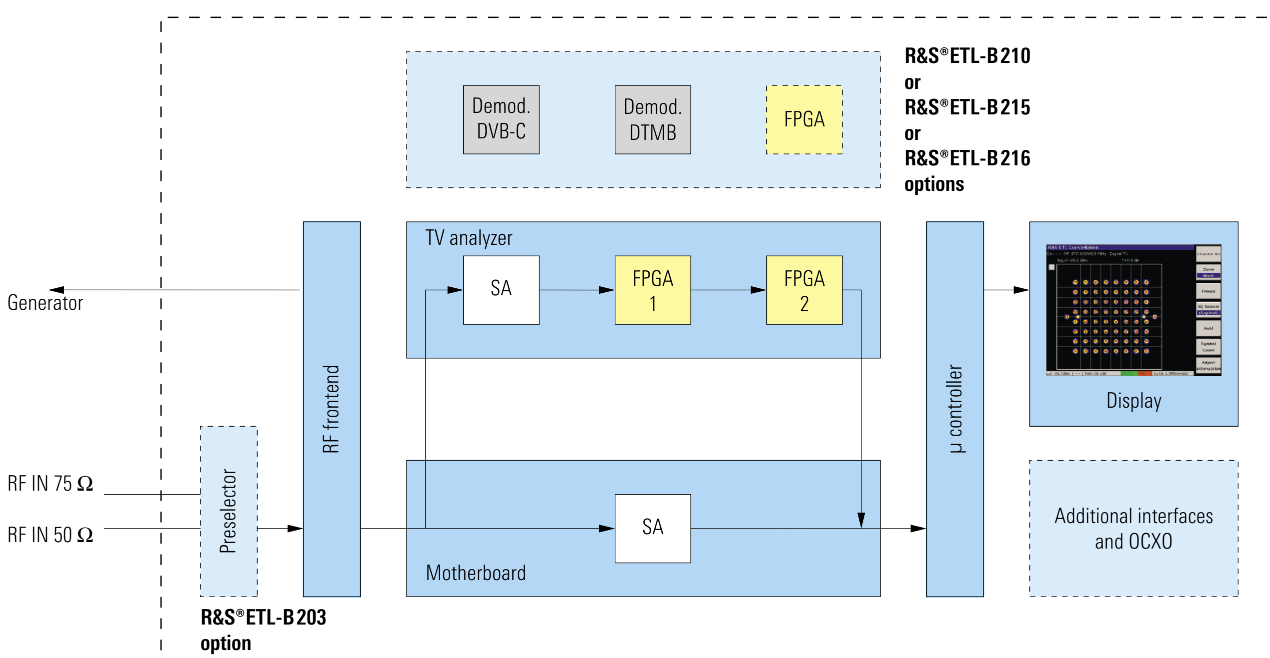
Versatility in a TV analyzer means not only that it can handle large numbers of TV standards, but also that it can provide all of the different measurements needed across a variety of applications.

The R&S®ETL also fits the bill here due to its extensive array of measurements and functions for analyzing TV signals at the modulation level or in the frequency spectrum. This combination of TV signal analysis and spectrum analysis in a single unit and with a common user interface allows rapid processing of measurements, even after only brief training. In most cases, the only measuring equipment needed is the R&S®ETL – an efficient all-purpose instrument, indeed.

The frequency range of the analyzer is from 500 kHz to 3 GHz. As a result, it covers not only the conventional broadcast frequencies, but also the increasingly important frequencies in the L and S bands, considerably expanding its range of applications. It is already designed to analyze the analog TV standards used worldwide, as well as the digital standards DVB-T/-H, DVB-C, and DTMB (China, GB 20600-2006 standard).

The wide variety of TV-specific measurements provided by the R&S®ETL is complemented by spectrum measurements usually available only with spectrum analyzers. As a result, measurements such as shoulder distance in accordance with ETSI TR 101 290, channel power, and adjacent-channel power can be carried out using a single instrument. Special functions such as frequency counters as well as noise and phase noise markers round out the range of measurement functions.

FIG 2 Block diagram of the R&S®ETL TV analyzer.



For transmitters or cable headends

The R&S®ETL TV analyzer offers all significant measurements required for acceptance testing, maintenance, and servicing of DVB-T / -H transmitters or digital cable headends. The central screen contains the *Digital Overview*, which provides a clear display of all essential parameters (FIG 4). A pass / fail display shows at a glance whether all parameters are within tolerances. Softkeys provide quick access to additional measurements. All quality parameters are quickly recorded step-by-step.

The R&S®ETL offers a series of measurements for analog TV, enhanced by a video scope function (FIG 5). As a result, additional measurements are available for analog TV signals that haven't already been replaced by digital standards. You can read more about transmitter measurements using the R&S®ETL starting on page 53.

Options for just about any task

Because the R&S®ETL is primarily designed for work at different sites, a lot of emphasis was placed on low weight, robust housing, and compact dimensions. But in spite of its small size, it offers a surprising palette of options for a wide variety of tasks.

For example, it can be equipped with an internal preselector that has an additional 75 Ω RF input. This makes it possible not only to make measurements on full-capacity TV cable systems, but also to perform coverage measurements in the field.

FIG 3 Constellation diagram of a DVB-T / -H signal (additional C/N = 30 dB).

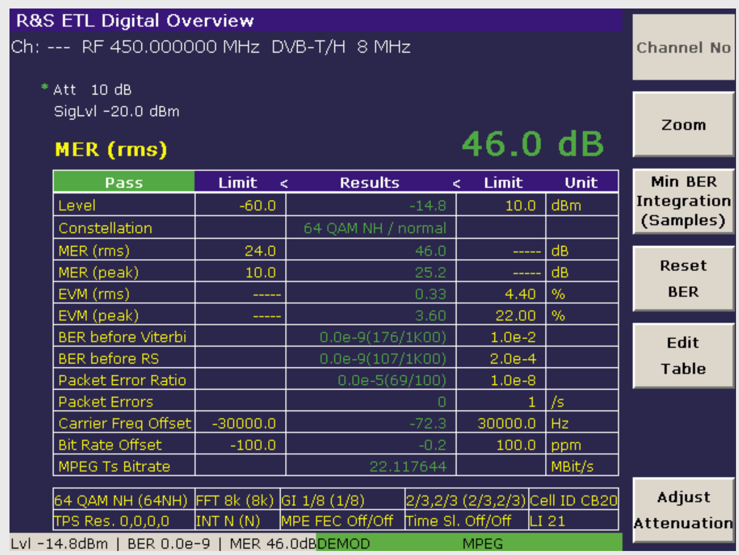


FIG 4 All essential parameters at a glance (e.g. for DVB-T / -H). The MER value is also shown enlarged (zoom function).

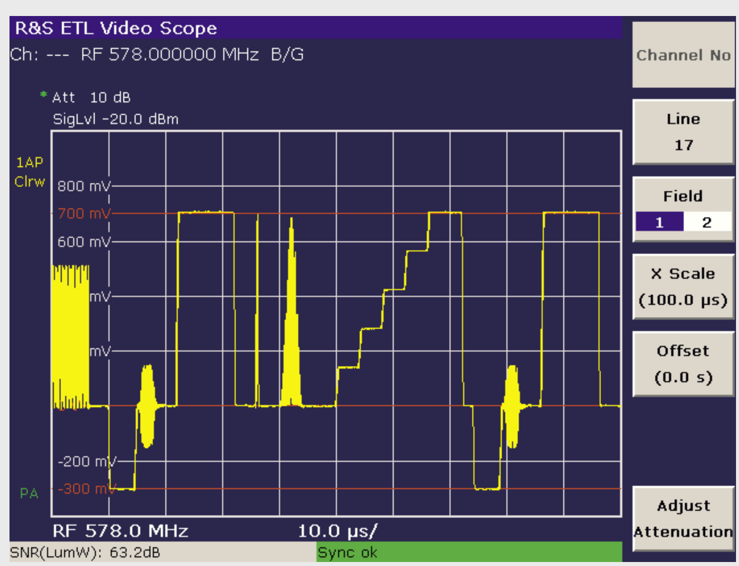


FIG 5 Video scope function for analog TV with display of the SNR value.

45151/7

FIG 6 The user can simply plug new options for the R&S®ETL into the slots on the rear panel.

The rear panel offers multiple slots for additional interfaces (FIG 6), e.g. I/Q inputs for use in research and development or in the series production of chips, as well as GPIB or DC interfaces. Users can quickly install these options themselves.

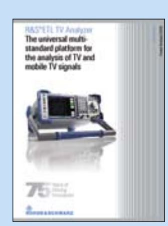
A special feature are the MPEG options for the R&S®ETL that offer an in-depth analysis of the MPEG baseband usually available only with separate MPEG-2 transport stream analyzers. These options also allow a TV picture to be displayed on the R&S®ETL screen, thus rounding out the varied analysis functions covering everything from RF and modulation through to the baseband. These options will be presented in more detail in one of the next issues.

Summary

The R&S®ETL TV analyzer is a versatile platform, in particular with respect to TV transmitter commissioning, installation, and service, as well as coverage measurements for terrestrial television, and measurements on cable headends. Using only a single unit, broadcast transmitters or CATV systems can be installed easily and with high precision, and maintained cost-effectively. Due to its compact and robust design, the R&S®ETL is suitable for mobile applications, which greatly simplifies network coverage measurements.

Werner Dürport

More information, product brochure and data sheet at www.rohde-schwarz.com (search term: ETL)



Measurements using the R&S®ETL TV analyzer

A wide field: measurements on digital terrestrial broadcast transmitters

Error-free functioning of broadcast transmitters must be ensured during their production, commissioning, and operation. Moreover, different countries and different customers impose different limit values on transmitters that must be met. As a general rule, therefore, testing is required for the following functions:

- **Modulation parameters:** In addition to the obligatory frequency setting, modulation standards and modes as well as baseband signals should be checked. Measurement of the modulation error ratio (MER) is an important benchmark. However, transmission errors should also be measured (BER measurement).
- **Transmitter parameters:** The essential parameters are output power and I/Q alignment.
- **Precorrection:** The signal being transmitted must be precorrected in the exciter. The exciter should therefore be specifically set for each transmitter during production. Changes to the overall system require realignment, even during operation.
- **Spurious emissions:** The transmitting system must be checked to determine if it affects other transmission channels during operation.

A possible test setup for transmitter acceptance testing is shown in FIG 7. As a complement to the R&S®ETL, the R&S®DVM 400 MPEG-2 monitoring system from Rohde&Schwarz completes the range of measuring instruments (see page 59 for news about the R&S®DVM). Besides analyzing the MPEG-2 transport stream and decoding the included programs, the system also applies a reference transport stream to the transmitter's exciter for test purposes. Power ratings of several kilowatts at the transmitter's antenna output make measurements there impossible. Therefore, a directional coupler decouples a portion of the actual power and sends it to the test receiver.

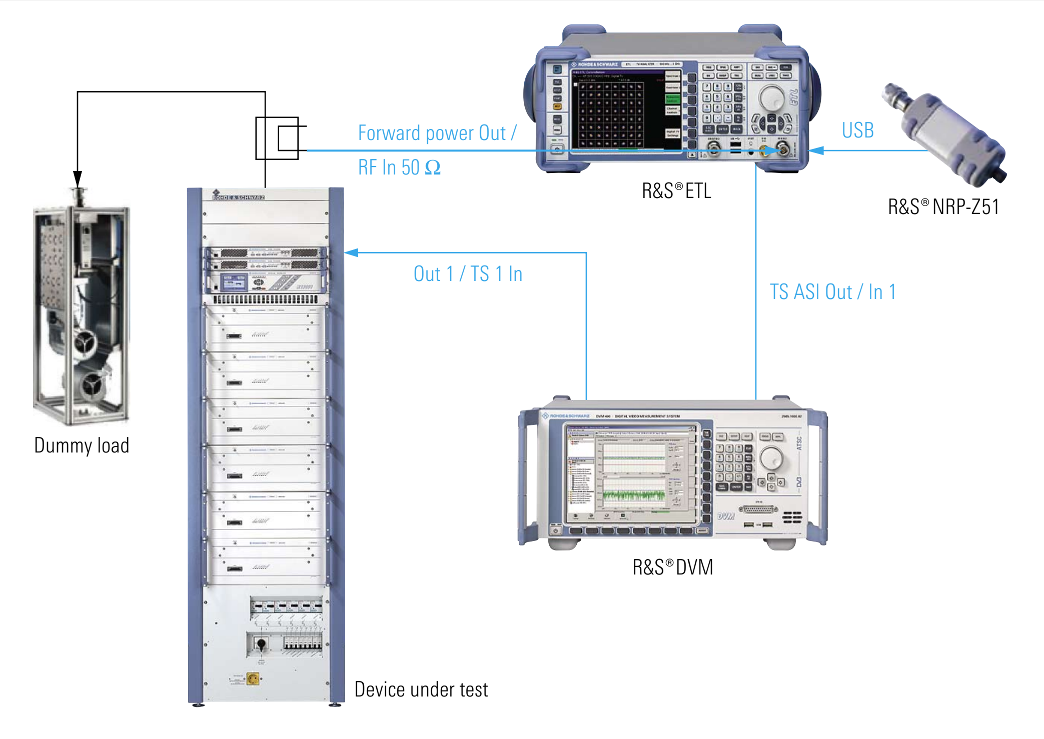
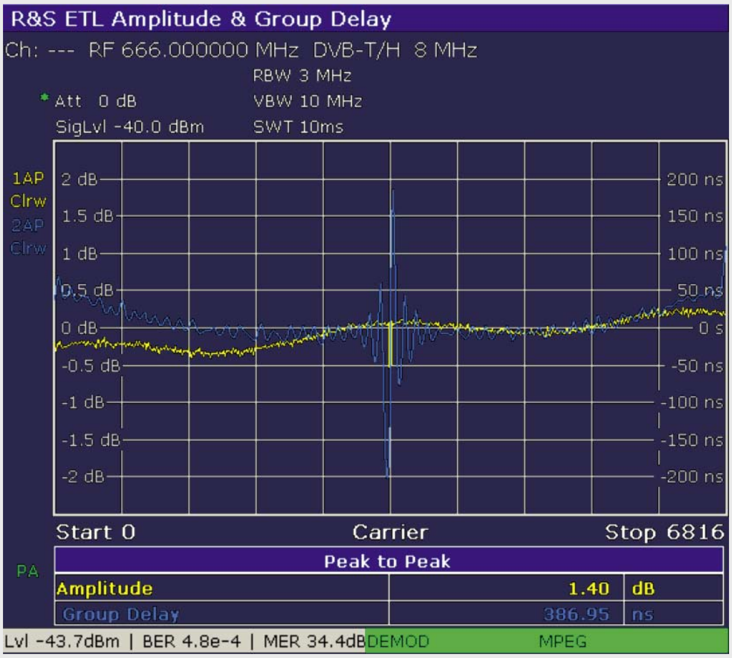
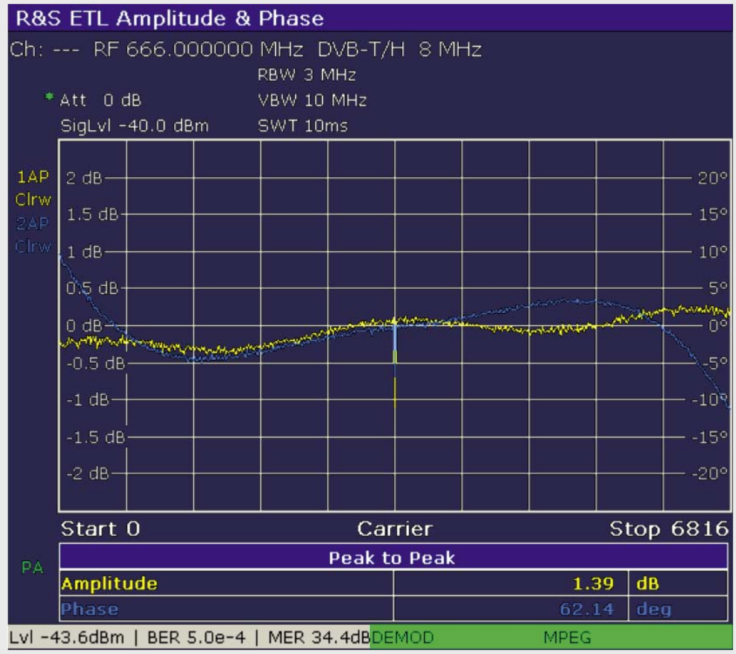


FIG 7 Typical test setup for transmitter acceptance testing.





FIGs 8 and 9 Amplitude, group delay, and phase response show linear distortions within the transmission channel. The measurement after the channel filter, in particular, makes it possible to determine the quality of the linear precorrection used.

This means that various completely different measurement functionalities, i.e. TV analyzer, spectrum analyzer, and power meter, are required. The new R&S®ETL TV analyzer from Rohde & Schwarz combines all of these functionalities in a single unit. A brief description of these functionalities and the essential measurements follows.

TV analyzer measurement functionality

The R&S®ETL measures all modulation-specific parameters in realtime, evaluates them, and displays them graphically. By virtue of its software-based demodulators, it can support a broad range of standards. In addition to the constellation diagram (FIG 3) and the central "Overview" view (FIG 4), FIGs 8 through 11 show additional measurement functions based on the DVB-T / -H implementation.

Power measurement

The R&S ETL® can also serve as the base unit for the power sensors of the R&S®NRP family, and thus can be used to evaluate and display the signal power (FIG 12). The R&S®NRP-Z51 thermal power sensor is especially suited for precision measurements of the RMS power, e.g. for DVB-T / -H.

Spectrum analysis

In addition to its TV analyzer measurement functionality, the R&S®ETL offers an array of familiar measurement functions from the Rohde & Schwarz family of spectrum analyzers. Their description would, however, exceed the scope of this article. Of paramount importance are spectrum analyzer measurements for determining out-of-band emissions.

Summary

The R&S®ETL brings together a wide variety of measurements in a single unit, allowing users to complete their tasks quickly and effectively. Beyond the functions described here for digital television, it also supports the analysis of analog TV signals. The R&S®ETL is a well-thought-out package and the ideal intrument for checking TV transmitter quality over a diverse range of

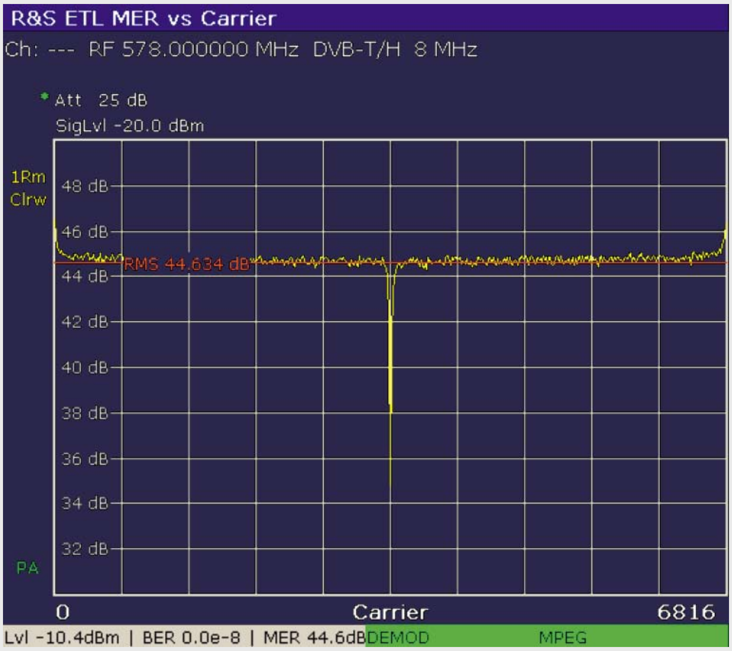


FIG 10 Besides the calculation of the RMS value for all carriers, this figure also shows the measured modulation error ratio (MER) as a function of the carrier. This makes it possible to identify problems during I/Q alignment as well as possible interference or distortion in the channel.

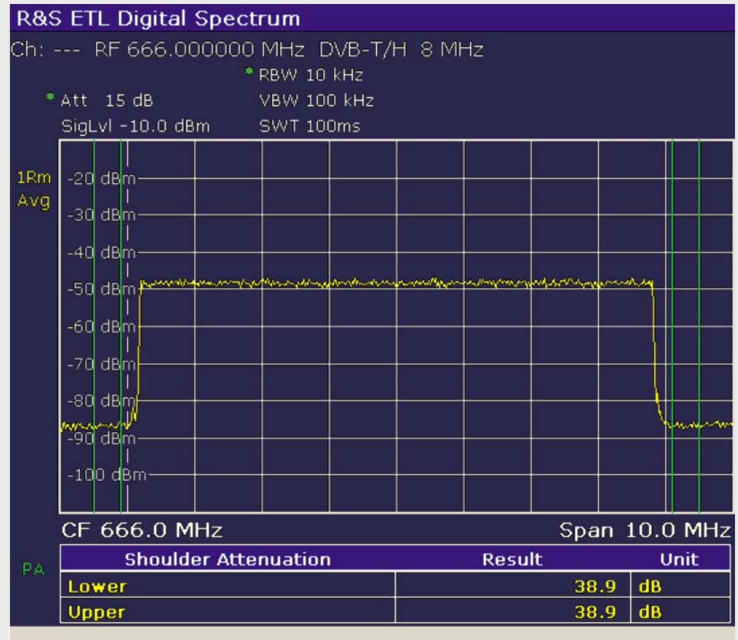


FIG 11 During the spectrum measurement, the "Shoulder Attenuation" function permits the power to be measured in the directly adjacent channels. This measurement is implemented in accordance with the ETSI TR 101 290 standard.

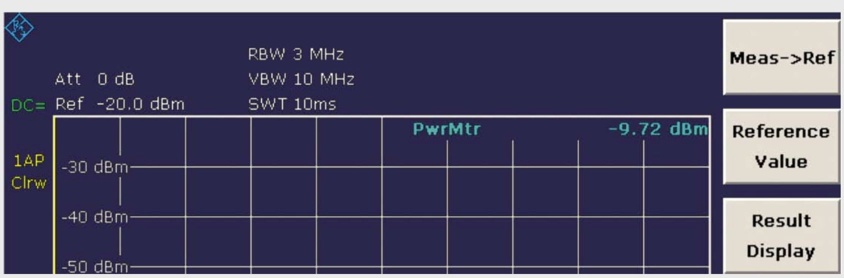


FIG 12
The R&S®ETL can also serve as the base unit for the power sensors of the R&S®NRP family.

applications. Its extensive measurement capabilities (e.g. MER >40 dB) allow early diagnosis of dangerous trends during routine checks so that countermeasures can be taken before the transmitter system fails. For more details regarding transmitter measurements, see the 38-page application note **Quality Measurements on Digital and Analog TV Transmitters Using the R&S®ETL**, available for free download under the search term "7BM67" on the Rohde & Schwarz website.

Harald Gsödl

R&S®SLx 8000 Low-Power Transmitter

Compact low-power transmitters for all important TV standards

The new R&S®SLx 8000 transmitter family (FIG 1) has been optimized for low-power operation in digital and analog TV networks. The extremely compact solution for the UHF and VHF range supports the DVB-T / -H and ATSC standards as well as analog TV standards.

Increasingly in demand

The demand for low-power transmitters is clearly increasing. The reasons are obvious: To quickly cover a high percentage of the population, digital TV networks have initially been set up in big cities. But people in most countries now expect the same level of coverage as they received with analog TV. This means that gaps in coverage need to be quickly closed.

In addition, more and more countries are setting up new networks to allow TV reception on mobile user equipment such as mobile phones or PDAs. These networks, which support standards such as DVB-H, A-VSB, MediaFLO™ or T-DMB, often require different network planning based on a higher number of low-power transmitters. The reception of such signals by means of short antennas, in buildings or vehicles, places a different set of demands on technical equipment.

High requirements also on low-power transmitters

Both cases call for the cost-efficient and quick installation of numerous low-power transmitters or regenerative retransmitters with an RF frontend. Top transmitter quality and reliability are crucial in order to avoid nationwide replacement or modification work that would result in high follow-up costs. Particularly remote stations with low-power transmitters could make servicing disproportionately expensive. At such sites, the space available for an additional transmitter is often limited and the voltage supply either does not match the nominal voltage or is subject to strong variations. Therefore, transmitters must meet a variety of requirements in order to ensure reliable and cost-efficient operation 24 hours a day.

FIG 1 Extremely compact R&S®SLx8000 low-power transmitter with output power (in this example) of 10 W for DVB-T / -H, 16 W for ATSC and 20 W for ATV.

FIG 2 ***TV Technology*** **trade journal award for the new low-power transmitters from Rohde & Schwarz.**

Everything in one box: the new R&S®SLx 8000 transmitter family

The conditions and requirements outlined above served as the starting point for the Rohde & Schwarz product designers and development engineers in their effort to create a new, robust and flexible low-power transmitter family based on decades of experience with sound and TV transmitters. The high-end components and sophisticated technologies from the high-power transmitter families were to be used for the low-power transmitters by even higher integration. The aim was to implement a highly compact, yet top-quality low-power solution with a price/performance ratio that was viable in the marketplace.

Rohde & Schwarz can be proud of the result: The R&S®SLx 8000 transmitter family was presented at two international trade fairs for broadcasting in 2007 – NAB in Las Vegas and IBC in Amsterdam. The transmitters immediately received a very positive response from visitors all over the world. During IBC, they won the "STAR 2007" award from the *TV Technology* trade journal for their impressive design (FIG 2). The award also applied to the new R&S®XLx 8000 family of transposers, which have almost identical components and will be featured in one of the next issues.

Future-proof owing to digital signal processing

The new transmitter family currently supports the standards and power classes listed in FIG 3. Additional standards such as ISDB-T (Japan, Brazil) or DTMB (China) can be easily implemented owing to digital signal processing. The implementation for the two major mobile TV standards MediaFLO™ and A-VSB has almost been completed. The transmitters' digital signal processing makes them a wise investment: Non-major modifications and improvements to established standards can be easily implemented by a firmware update – on site or from a remote location. Thus, the nationwide network is always up to date.

Analog goes digital – by pressing a button

Future-proofness must also be provided by transmitters used in existing analog transmitter networks that are to be "digitized" at some point in the future. The R&S®SLx 8000 A transmitters designed for analog operation already include all connectors to handle the major digital standards. By pressing a software key when the time comes, you can switch the transmitter over to the desired digital standard.

Owing to this high flexibility, you can even set up an analog network today without needing to know which digital standard will be used in future.

FIG 3 **Key facts about the R&S®SLx 8000 low-power transmitters (width 19").**

Standard	UHF	VHF	Height units (inch)
DVB-T/-H	**R&S®SLV 8000** 2 W to 100 W	**R&S®SLW 8000** 25 W to 50 W	2 or 3
ATSC	**R&S®SLV 8000** 3 W to 150 W	**R&S®SLW 8000** 40 W to 80 W	2 or 3
ATV (B/G, D/K, M/N, I)	**R&S®SLV 8000 A** 5 W to 250 W	**R&S®SLW 8000 A** 50 W to 125 W	2 or 3
DAB/T-DMB	–	**R&S®SLA 8000** 75 W to 300 W	3 or 4

Easy and convenient operation

The new transmitters are operated from their front control panel or from a PC with a commercial web browser and Java™ technology (FIG 4). The user interface has the same design as the "8000" generation of transmitters. The transmitters can optionally be operated or monitored from a remote location via SNMP or floating contacts.

For user convenience, all operational data are stored on a CompactFlash™ memory card. When a transmitter is replaced, this card can be inserted into the new transmitter, which will be configured automatically when started. Alternatively, the data can be stored and loaded via Ethernet.

To make field operation easier, all digital transmitters are equipped with a database containing precorrection parameters. This innovative, factory-configured broadband precorrection capability is individually checked for each DTV transmitter at the end of the production chain. It enables you to change the channel and reduce the output power down to max. 10 dB without requiring any manual correction of the output stage amplifier. A transmitter-inherent routine automatically chooses the right precorrection parameter set for the selected channel and the set power.

Versatility through options

Despite their compact design, the transmitters offer enough space for additional internal options, thus making the transmitters even more versatile: A precise GPS receiver is used for synchronization purposes in single-frequency networks and an RF receiver for DVB-T/-H signals transforms a transmitter into a regenerative re-transmitter or monitors the signal quality at the transmitter output.

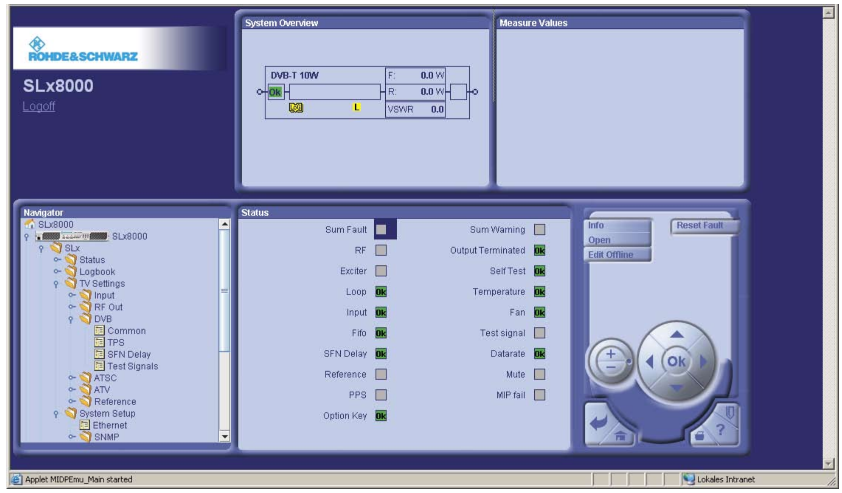


FIG 4 Convenient transmitter operation.

The high-quality wide-range power supply (90 V AC to 260 V AC), which is built in as standard, is extremely reliable even if the supply voltage varies strongly. The transmitters can optionally be equipped with a suitable DC power supply (–48 V) to meet the requirements of infrastructures with an uninterrupted DC voltage supply.

Summary

Due to their compact and robust design, the award-winning R&S®SLx 8000 transmitters are also ideal for remote stations. Their straightforward operating concept and sophisticated innovations such as factory-configured broadband precorrection or easy switchover from analog to digital mode make the transmitters ideal for full-coverage use both in analog and digital transmitter networks. Full terrestrial coverage with digital data services has become a major factor in modern civilizations. Rohde & Schwarz's large production capacity helps ensure short delivery times for the large numbers of units needed to quickly expand the networks – and without any compromises to quality.

Hannes Strobel

More information and data sheet at www.rohde-schwarz.com (search term: SLx8000)

R&S®DVM MPEG-2 Monitoring System

New scheduler suite for convenient monitoring of digital TV signals

The R&S®DVM (FIG 2) is a versatile system for monitoring digital TV signals. The R&S®DVM scheduler suite control software, developed specifically for the R&S®DVM, offers a number of convenient enhancements.

Monitoring automatically adapted to transport streams

Digital TV signal monitoring must conform to the specific requirements of each transport stream, such as the limit values for the data rate of the included programs. These parameters are stored together with the remaining settings in the monitoring configuration. For example, if a network operator uses a single channel to transmit different transport streams that vary in regard to programs, data rates, or coding methods depending on the time of day (FIG 1), an automatic switchover to the monitoring configuration that matches the measurement parameter would be convenient.

Users of the R&S®DVM monitoring system from Rohde & Schwarz do not have to develop separate software for this purpose, as the new R&S®DVM scheduler suite can automate this switchover easily. This software always uses the correct monitoring configuration for each transport stream.

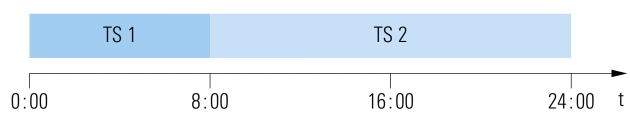


FIG 1 Transmission with varying transport streams (TS).

Powerful: R&S®DVM for monitoring DTV networks

The R&S®DVM brings together in a single device all the functions needed for complete monitoring of DTV networks. It provides real-time monitoring of numerous RF characteristics, of the transport stream structure and its contents. Owing to the high integration density, up to four monitoring units operating in parallel can be accommodated in a single box of only one height unit. Numerous interfaces for the various digital TV standards, including the new DVB-S2 satellite standard, are available. For DVB-H networks, additional monitoring functions specialized for time slicing were developed. All measurements can be configured according to the needs of the user and the characteristics of the network. A hardware decoder makes it possible to check the video contents of SD and HD formats, which are coded in accordance with MPEG-2 or MPEG-4 / AVC/H.264. Software options allow the R&S®DVM to be expanded into a full-featured MPEG analyzer.

Its SNMP interface allows the R&S®DVM to be integrated into network management systems. However, a conventional web browser also permits direct access to the measurement results and the device configuration. The user administration developed specifically for the R&S®DVM controls the access rights for local and network users. This both secures the system against unauthorized access and prevents improper configuration by unauthorized users.

43979/9

FIG 2 The R&S®DVM100L takes up only one height unit, but can monitor up to four signals simultaneously.

The intuitive interface makes configuration of the control program quick and easy (FIG 3). Once the monitoring system is selected, the software automatically finds all available monitoring configurations. These can then be placed in a central table and each assigned line-by-line to individual time periods. The integrated "active period editor" makes it easy to assign time periods clearly and conveniently: The individual measurement steps are assigned to the appropriate monitoring time periods with just a few clicks of the mouse in the graphical assignment display (FIG 4).

Multiple signals – and only one monitoring unit

The R&S®DVM scheduler suite offers an excellent solution whenever sequential testing is sufficient for monitoring multiple signals: Using the scheduler suite, an individual monitoring unit can automatically monitor any number of channels in sequence (FIG 5).

The switchover is done completely autonomously, making manual replugging unnecessary. In the case of an RF or IP transmission, the software simply sets the receiver to a new frequency or port number. In the case of direct ASI feed, the ASI switching matrix included in every R&S®DVM monitoring system is switched over automatically. This means that up to four transport streams fed in via separate cables can be sequentially monitored without any additional costs. The number of TS ASI inputs can be expanded as needed because the R&S®DVM scheduler suite can alternatively access external routers (FIG 6). Transitioning to a new signal takes just a few seconds. The software activates the appropriate monitoring configuration so that the relevant configuration is always active, even if the signal characteristics change.

Measurement results displayed graphically

Another useful function of the R&S®DVM scheduler suite is the graphical display of measurement results versus time. The application stores the monitoring results for each channel in a separate file for further analysis by other programs. For analysis purposes, the software collection contains the "graphical log viewer", which can display the performance of various channels and measurement value types simultaneously (FIG 7). All data can be checked simply and easily over a long time period.

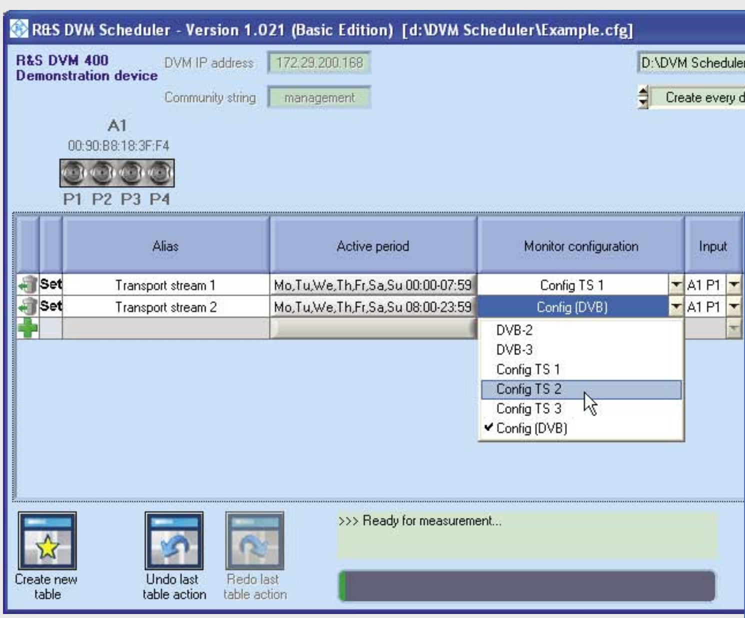


FIG 3 The first table line specifies that the first monitoring unit in the R&S®DVM monitoring system will use configuration "Config TS 1" between midnight and 8 a.m. – matching transport stream 1. Transport stream 2 is assigned "Config TS 2" for the remaining time.

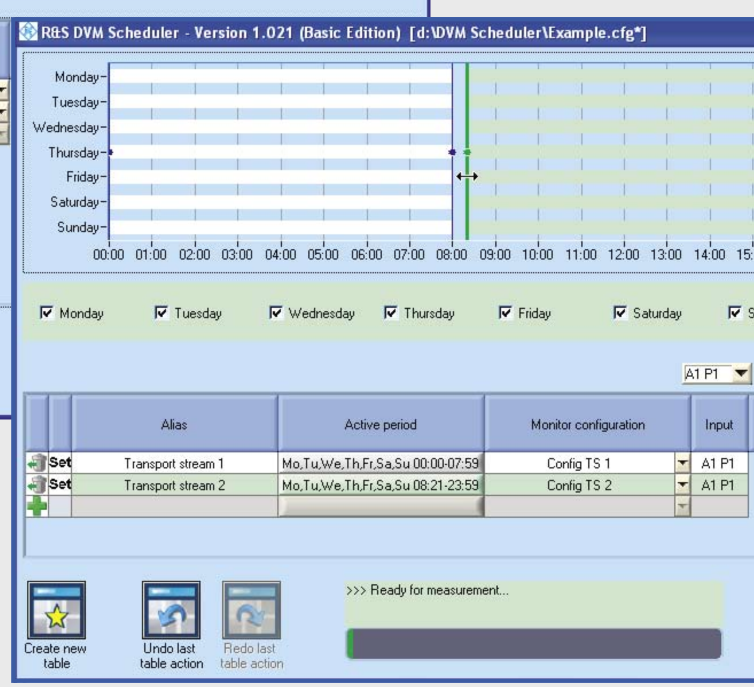


FIG 4
The graphical user interface of the "active period editor" allows the rapid assignment and scheduling of all measurement steps. In this example, the monitoring start for transport stream 2 is shifted to 8 a.m. on all week days.

Usable for all models

The software controls the R&S®DVM monitoring system via its SNMP interface, which makes it usable for all models. The software can be installed onto devices that have already been supplied. PCs connected to a system via Ethernet are also suitable as a platform. This network connection additionally allows subsequent changes to the software configuration by remote control.

Summary

In combination with the easy-to-use R&S®DVM scheduler suite software collection, the R&S®DVM monitoring systems make monitoring of digital TV signals even more flexible. As a result, various monitoring configurations can be assigned automatically to the appropriate transmitted transport streams throughout the day. Because a single monitoring unit can be used for sequential analysis of various channels, overall costs are reduced. The recorded measurement values are quickly analyzed and easily evaluated by means of the "graphical log viewer".

Best of all: You can receive the software collection for free from your nearest Rohde & Schwarz representative.

Marius Erver

More information and data sheets at www.rohde-schwarz.com (search term: DVM)

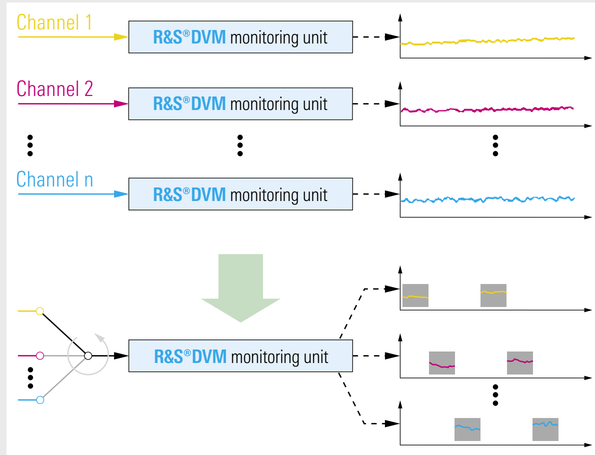


FIG 5
The R&S®DVM scheduler suite enables an individual R&S®DVM monitoring unit to check any number of channels in sequence.

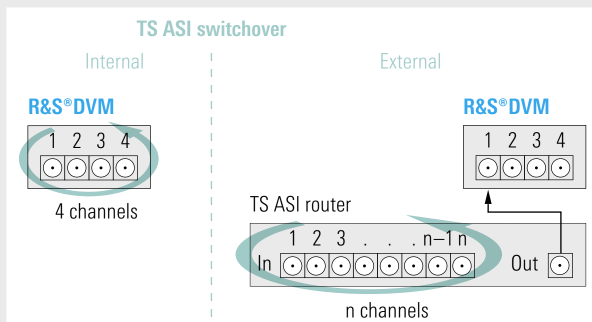
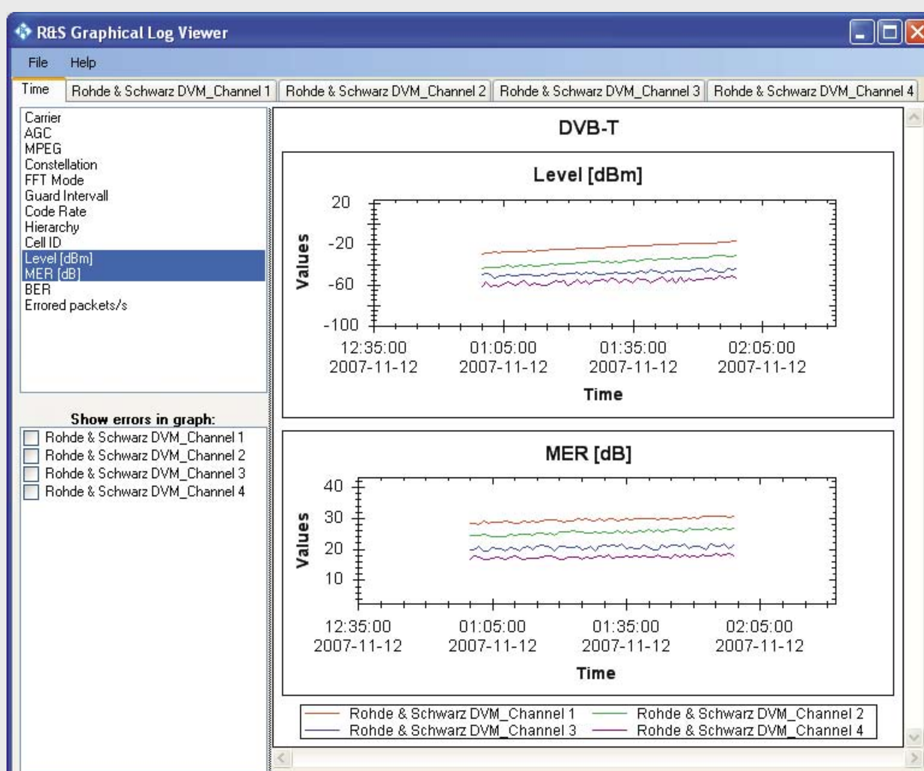


FIG 6
The internal ASI switching matrix of the R&S®DVM monitoring systems permits cyclic selection of the four TS ASI feeds. By using an external router, this number can be increased.

FIG 7 The "graphical log viewer" included in the suite uses an expanded plot function to provide a detailed comparison of report entries as well as receive measurement values for various channels.




ROHDE&SCHWARZ
ESMD · WIDEBAND MONITORING RECEIVER
222.100 000 MHz

45063/12

The radiomonitoring specialist: versatile, fast, accurate

Fast detection of signals, highly accurate measurements and demodulation, and versatility are the major advantages of the new R&S®ESMD radiomonitoring receiver. Due to these advantages plus other attributes such as a wide frequency range and expandability for use as a direction finder, the R&S®ESMD provides functionalities previously available only with entire systems.

Special characteristics

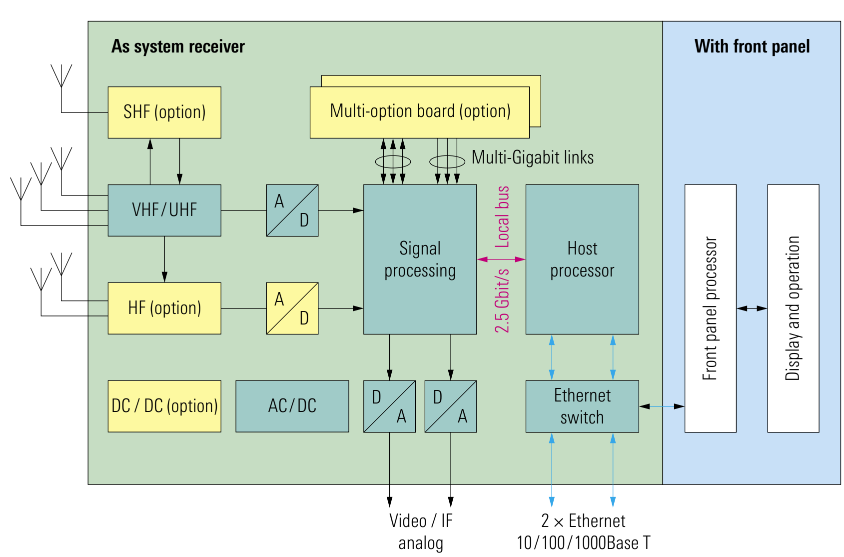
Modern radiomonitoring equipment has to handle a vast array of tasks, including stationary or mobile use, wideband scan or narrowband demodulation, or manual or fully automatic operation. The R&S®ESMD (FIG 1) takes on all of these challenges easily with its wide range of functions, its modular architecture, and its variety of available enhancements (FIG 2) – characteristics that allow users to adapt the receiver optimally to their individual requirements. The special characteristics of the R&S®ESMD are as follows:

- Large frequency range from 9 kHz to 26.5 GHz
- Excellent RF performance
- Simple and quick operation via the front panel
- Fast scan modes
- Gap-free IF spectrum up to 20 MHz bandwidth (realtime bandwidth)*
- Demodulation from 100 Hz to 20 MHz (realtime bandwidth)
- ITU-compliant measurement of signal parameters between 100 Hz and the full realtime bandwidth
- Analog two-channel IF / video output up to 20 MHz bandwidth
- Direction finding
- Standardized 1 Gbit Ethernet data interface
- Standardized command set (SCPI)
- Easy serviceability and maintainability

In the base version, the R&S®ESMD detects frequencies from 20 MHz to 3.6 GHz. Two frequency range expansions are available for installation in the instrument. With the expansions for the microwave range (3.6 GHz to 26.5 GHz, SHF option) and the shortwave band (9 kHz to 32 MHz, HF option), the receiver can cover the entire frequency range from 9 kHz to 26.5 GHz. Up to six antennas that are switched internally can be connected in this configuration.

FIG 1
Shortwave or microwave, demodulation or spectrum display, detection of pulsed signals or direction finding: The R&S®ESMD provides all of these capabilities in one compact device.

FIG 2 Simplified block diagram of the R&S®ESMD system architecture.



* Maximum bandwidth that is processed without interruption.

The R&S®ESMD offers excellent RF performance over the entire receive range (see condensed data on page 67). This is of particular importance in scenarios where very strong and very weak signals occur closely together, or when scanning for signals that are difficult to detect, because the user must be certain that the correct signal is being detected, and not some artifact generated by the receiver itself, for example.

The R&S®ESMD combines outstanding RF characteristics with innovative broadband technology: For example, in the HF range, it functions as a direct receiver. Its carefully designed preselection as well as the absence of mixers, oscillators, and the like, make it a first-class receiver, even in the shortwave range up to 32 MHz.

Even though many radiomonitoring tasks can be carried out automatically these days, manual operation of the receiver is often indispensable. The R&S®ESMD front panel has been optimized for these types of tasks (FIG 1). All important functions, including frequency entry, bandwidths, demodulation mode, AGC / MGC, and scan parameters, can be set using fixed keys. The smooth-running frequency setting knob makes tuning to signals easy, and the high-resolution TFT display (1024 × 768 pixels) ensures that all device parameters and measurement results are clearly visible (FIG 3).

Whether you wish to monitor specific frequencies or scan for difficult-to-detect signals over a wide frequency range, fast scan modes are a must for every modern radiomonitoring receiver. The R&S®ESMD has three scan modes. The frequency scan is suited for sequential scanning of a frequency band with fixed channel spacing. The memory scan processes up to 10 000 channels in any sequence as defined by the operator. Both scan modes achieve speeds of up to 1000 channels/s.

The highest scan rate is offered by the R&S®ESMD in the panorama scan (PSCAN) mode:

Step width (kHz)	Channels (1/s)	Scan rate (GHz/s)
100	200 000	20
50	360 000	18
25	560 000	14
12.5	800 000	10
6.25	1 000 000	6.25

Even at very small resolution bandwidths, the R&S®ESMD achieves a scan rate of up to 20 GHz/s (FIG 4). As a result, the PSCAN is ideal for scanning both for short-duration signals and for frequency hoppers, even over wide scan ranges.

FIG 3 Important tools in radiomonitoring: spectral and waterfall display (spectrogram). The 20 MHz wide spectrum shows four digital broadcast signals, one DVB-T signal to the left and three DAB signals to the right. The high time resolution of the realtime spectrum makes the null symbols in the DAB data streams clearly visible in the waterfall display.

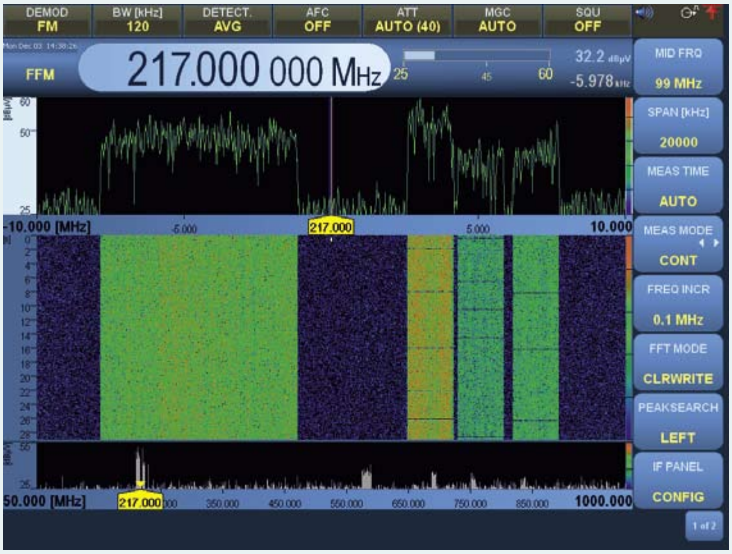
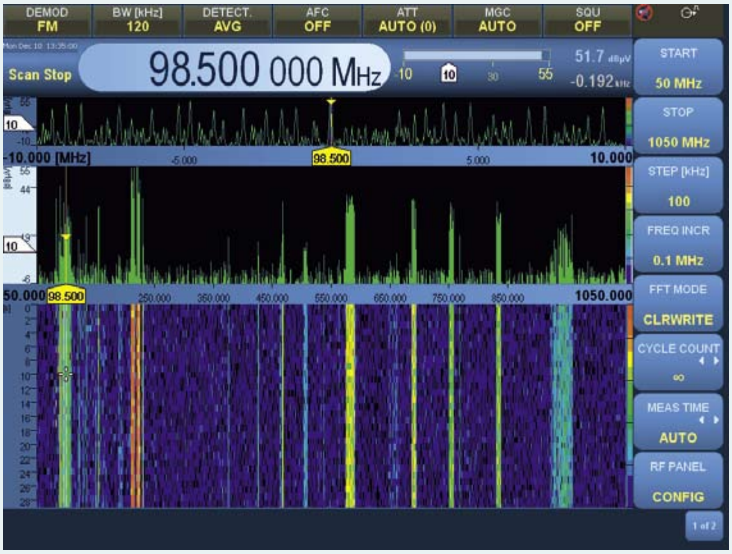


FIG 4 PSCAN from 50 MHz to 1050 MHz: The step width (resolution bandwidth) is 100 kHz. In this setting, the scan range (span) of 1 GHz is run through twenty times per second. The left edge of the spectrum shows the VHF FM broadcast band, and the GSM band at 900 MHz is seen to the right.



Signal processing in realtime

The digital signal processing in the R&S®ESMD consists of two parallel, independently parameterized paths (FIG 5). One path calculates the IF spectrum, while the other path is used for demodulation, automatic gain control (AGC), measurement value calculation, and reconversion to an analog signal (video signal). Both paths work completely without interruption and in realtime.

The spectrum path allows reliable monitoring of the spectral characteristics for even very quickly changing signals. Its effectiveness becomes obvious when monitoring signals with a pulse structure (FIGs 6 to 8). The enormous amount of data obtained during spectrum calculation is difficult for externally connected systems to handle (FIG 9). Therefore, the device already performs data reduction by means of various weighting filters (Average, MAXHOLD, MINHOLD).

Even at small spectrum bandwidths, the user benefits from the receiver's processing power: The signal processing overlaps the spectrum calculations, which improves the time resolution. Alternatively, a weighted overlap

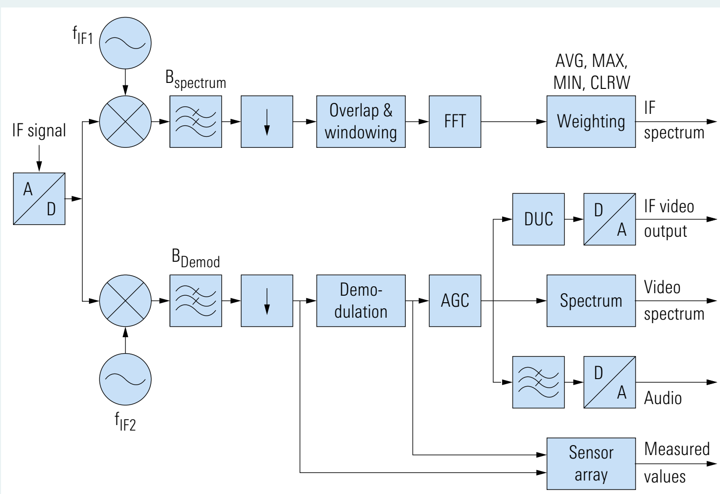
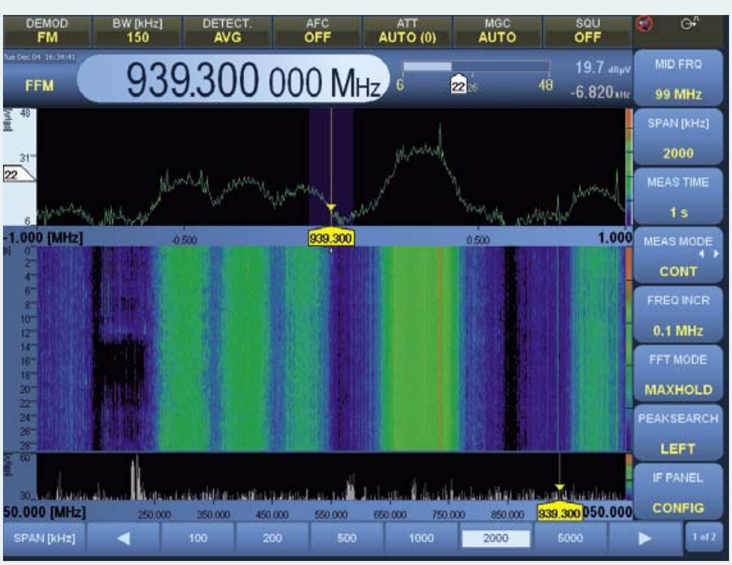
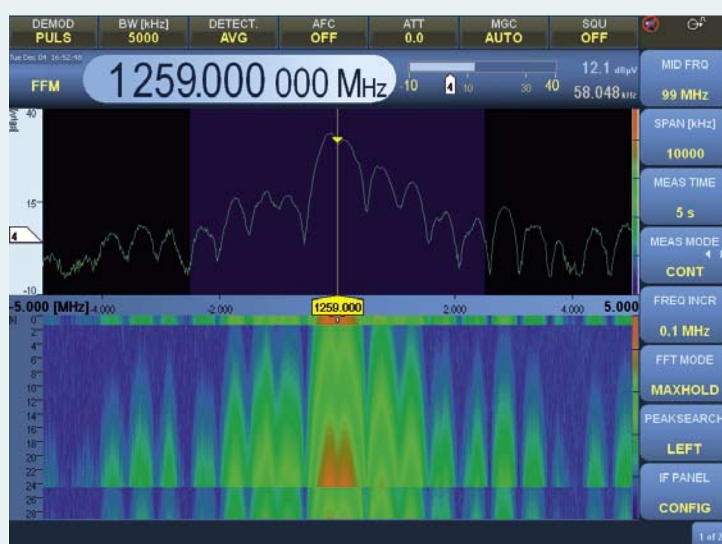


FIG 5 Block diagram of the signal processing in the R&S®ESMD.

FIG 8 Analysis of a GSM signal using the IF spectrum: The signal to the right of the center shows an obvious peak. This is the frequency correction burst (FCB), which spectrally corresponds to a carrier signal. The FCB is emitted only by GSM base stations, lasts 576 µs, and is repeated every 46 ms or 51 ms.



FIGs 6 and 7 Detection of long-range radar on the antenna: The distance of 500 kHz between the zeroes on the sin(x)/x-shaped spectrum leads one to suppose a pulse length of about 2 µs. The supposition is confirmed by measuring the amplitude-demodulated signal (envelope) using an oscilloscope connected to the analog video output of the R&S®ESMD.



add (WOLA) spectrum can be calculated that significantly improves the adjacent channel suppression in the spectrum.

The demodulation path is the method of choice when analyzing the time domain characteristics of signals. Because signal processing is carried out in parallel, the user can view radio signals from various angles. The R&S®ESMD simultaneously provides the wideband, demodulated, and gain-controlled signal, as well as a narrowband audio signal, various signal levels, and modulation parameters such as modulation depth and frequency deviation. In addition, it calculates the spectrum of the demodulated signal. This video spectrum is extremely helpful in determining the characteristics of signals (FIG 10), and it can even be useful in discerning some of the characteristics of highly complex, spread-spectrum (DSSS) third-generation mobile signals (FIG 11).

Expandable for use as direction finder

The direction from which an electromagnetic wave arrives at an antenna is information whose importance cannot be overestimated. The equipment needed to determine this angle of incidence is normally both extensive and expensive. Not so with the R&S®ESMD: As the first monitoring receiver from Rohde & Schwarz, it can be upgraded to a full-featured direction finder (R&S®DDF 255) without any additional equipment. Either the correlative interferometer method or the Wattson-Watt principle is used to determine the bearing. Up to three DF antennas can be connected directly to the receiver.

Because the DF functionality is fully integrated into the scan sequences, it satisfies the requirements for a variety of scenarios. So whatever the situation – whether cyclical monitoring of distress frequencies, interception of classic voice communications (FIG 12), or finding the bearing of short-duration signals in the millisecond range – the R&S®ESMD from Rohde & Schwarz is an extremely compact and cost-efficient solution.

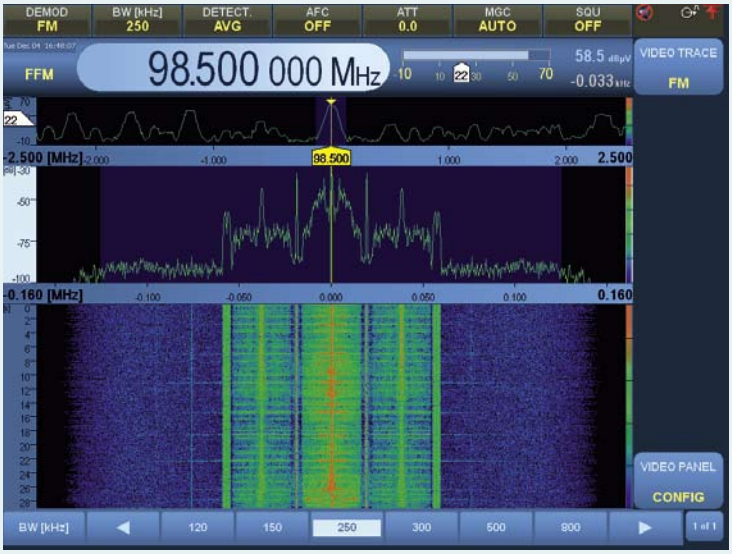
State-of-the-art and compatible: the system interfaces

The R&S®ESMD is equipped with two triple-mode 1 GBit Ethernet interfaces for data output and remote control (10 / 100 / 1000BaseT). As a result, backward compatibility with other Rohde & Schwarz monitoring receivers, such as the R&S®EB 200, R&S®ESMB, R&S®EM 050, R&S®EM 550, R&S®EM 510, and R&S®PR 100, is ensured. And the same applies to data and command formats. Seamless integration in existing monitoring systems is thus no problem at all.

FIG 9 To allow the comparison of the realtime capability of monitoring receivers, a virtual scan speed is frequently specified. This value identifies the scan speed in scan ranges that are smaller than the maximum bandwidth of the receiver. This could also be called a realtime scan because the settling time of the synthesizer is immaterial within the realtime bandwidth of a receiver. At large bandwidths and a fixed frequency resolution, this quantity will only reflect the processing power of a receiver.

Frequency resolution (kHz	Number of spectra (1/s)	Time resolution (µs)	Scan rate of realtime scan (B = 20 MHz)
12.5	12 500	80	250 GHz/s
25	25 000	40	500 GHz/s
50	50 000	20	1000 GHz/s
100	100 000	10	2000 GHz/s

FIG 10 Video spectrum of a frequency-demodulated VHF FM multiplex signal. This view shows the structure of such a signal with 19 kHz pilot tone and RDS subcarrier.



The R&S®ESMD has connections for external accessories, such as GPS or an electronic compass. Like earlier devices, this receiver also offers comprehensive selftests at the module level, ensuring a high degree of serviceability and maintainability. Extensive recalibrations after a module replacement are thus eliminated.

Both the modular design and the multi-option boards that allow implementation of future functionality enable the R&S®ESMD to easily address new developments in radiomonitoring such as larger realtime bandwidths.

Paul Renardy

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

Summary

Shortwave or microwave, demodulation or spectrum display, detection of pulsed signals or direction finding: The R&S®ESMD provides all of these capabilities in one compact device. Because there are so many device options, this article can offer only a brief overview of the receiver's most important characteristics. The R&S®ESMD and its expansions offer well over one hundred different combinations, making it adaptable to almost any task. An upcoming issue will highlight the most important options.

Condensed data of the R&S®ESMD (typical values)

Frequency range	9 kHz to 26.5 GHz
Noise figure	
HF	12 dB
VHF	10 dB
UHF	12 dB
3rd order intercept point (IP3)	
HF	35 dBm (at input level of –6 dBm)
VHF	23 dBm
UHF	23 dBm
Synthesizer settling time	1 ms
Demodulation modes	AM, FM, φM, I/Q, PULSE, TV, LSB, USB, ISB, CW
ITU-compliant measurement values	frequency, frequency offset, frequency deviation, phase deviation, modulation depth, field strength
Demodulation and measurement bandwidths	31 bandwidths from 100 Hz to 20 MHz
IF spectrum bandwidths	14 bandwidths from 1 kHz to 20 MHz
Data interface	1 Gigabit Ethernet (10/100/1000Base T)
Video/IF output (switchable)	2 channels, gain-controlled, level >0 dBm

FIG 11 Video spectrum of a UMTS signal. For digitally modulated signals whose envelopes are not constant, the baud rate or chip rate in the spectrum of the squared baseband signal can be determined by means of spectral lines that are symmetrical to frequency 0. In this case, this phenomenon occurs at a frequency of 3.84 MHz, which corresponds to the UMTS chip rate.

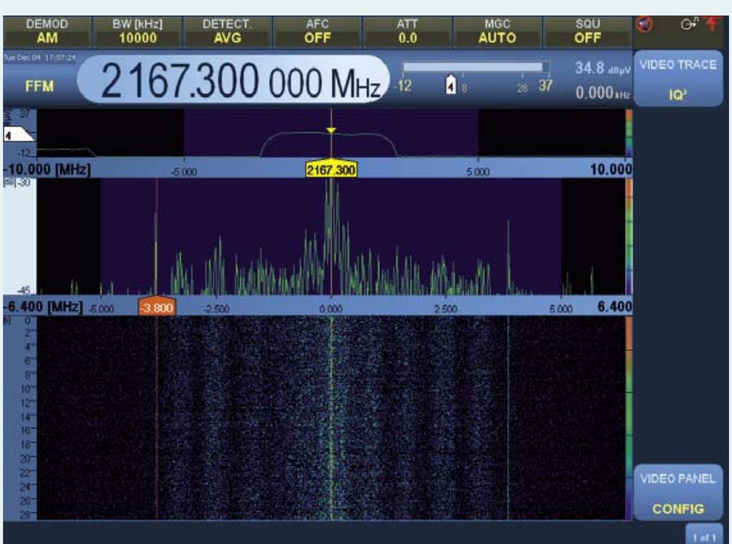
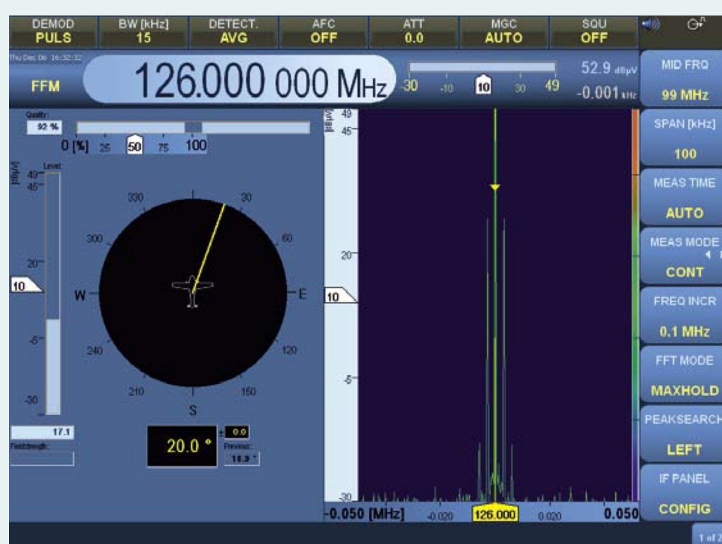


FIG 12 The R&S®ESMD after being upgraded to a direction finder: DF measurement of a voice channel in the aeronautical radio band.



R&S®Series 4200 Radiocommunications System

Reliable radiocommunications for civil aviation

SITA and Rohde & Schwarz have concluded an agreement for the supply of more than 400 VHF transceivers of the R&S®Series 4200 over the next few years.

International selection procedure

SITA (Société Internationale de Télécommunication Aéronautique) is a communications service provider for airlines and operates a worldwide communications network with integrated radio stations that enables the exchange of data between aircraft in flight or on the ground and the airlines' operations centers (see box on opposite page) or the ATC centers. This network will be expanded and modernized in the years to come. Following an international selection procedure, SITA decided in favor of the R&S®XU 4200 VHF transceivers of the R&S®Series 4200 from Rohde & Schwarz (FIG 1). Since the radios will be installed at sites worldwide, some of which are very difficult to access, they must ensure extremely reliable and failsafe operation. In addition, maintenance must be reduced to a minimum. For these reasons, the transceivers are equipped with a high-precision oscillator that needs to be calibrated only after 15 years of operation. This means that preventive maintenance, which would require on-site personnel at the radio stations, does not have to be performed.

Worldwide data network

An IP-based network makes it possible to update, monitor and remote-control every radio from an operations center. Software updates and expansion of functionality, e.g. adaptation to future data infrastructures or introduction of VHF digital link (VDL) mode 2 [*], can be carried out without requiring any personnel on site. This concept also allows the remote modification of parameters as well as monitoring and reading of operating data such as component temperature.

Just as the airlines can monitor their aircraft from the ground via SITA's services, SITA uses the new generation of the R&S®Series 4200 to get an overview of the technical condition of the radio system and can thus ensure that the data service is available to its demanding customers at all times.

Bernhard Maier

FIG 1 The R&S®XU 4200 VHF transceiver from the R&S®Series 4200.

45 068/4

R&S®Series 4200 radio family

Their modular and compact in design makes the R&S®Series 4200 radios for use in civil and military air traffic control extremely reliable and ready for upcoming transmission standards. Essential functions of the radios are software-implemented, and new features can be added by means of software download. The radios can be remote-controlled and monitored via the standard LAN interface.

More information and data sheet at www.rohde-schwarz.com (search term: Series 4200)

REFERENCES

[*] R&S®Series 4200 Radiocommunications System – Ready for tomorrow's requirements: next generation of ATC radios. News from Rohde & Schwarz (2006) No. 191, pp. 52–56

This article presents the R&S®Series 4200 and describes VHF digital link mode 2 in greater detail.

SITA – a communications service provider for airlines

The tough competition on the market for air travel and air transport forces airlines to optimally use their fleets and their capacities. To improve the planning for the deployment of the aircraft, dispatchers and maintenance crews need as much information as possible about the current location and technical condition of the aircraft. The more up-to-date the information, the higher the safety of planning and the better the capability to respond to unforeseen events.

This is why airlines began in the 1980s to automatically send aircraft information from the different flight phases to their operations centers via ground radiocommunications stations. This data provided dispatchers at all times with a current overview of the exact location of the aircraft. In the years that followed, further messages were transmitted that showed the aircraft engineers the technical condition of aircraft and engines. In addition, the dispatchers were able to inform the pilots via radio data about the weather or changes in flight plan. Pilots are less distracted due to the reduction in voice communications, and they do not have to write down the information transmitted because it can be printed out in the cockpit. FIG 2 shows an overview of the multitude of messages exchanged during the various flight phases via the aircraft communications addressing and reporting system (ACARS).

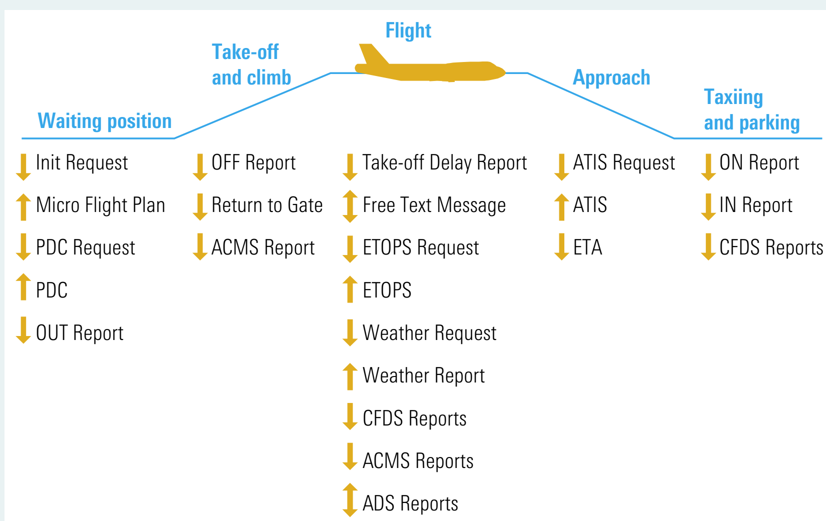


FIG 2 A multitude of ACARS messages are sent during the different flight phases.

Since airlines require all this information about their entire fleets, radio coverage must be ensured worldwide, or at least wherever airlines operate aircraft. SITA as a communications service provider for airlines maintains a worldwide communications network with data links and servers to provide access to the data transmitted by the aircraft. More than 880 radiocommunications stations at airports and on land ensure data exchange between aircraft and ground stations at all times. Amplitude modulation with a data rate of 2.4 kbit/s has so far normally been used for data transfer via the air interface (MSK, minimum shift keying).

The SITA network will be expanded and modernized in the years to come. On the one hand, an increasing number of airlines are using the ACARS service, which means that radio coverage has to be extended to areas that have so far not been covered. On the other hand, modern aircraft transmit more and more information about the technical condition of the individual units and components. Especially the new Airbus A380 sends large amounts of data to dispatchers and technicians via this service. To handle this data volume, the VDL mode 2 transmission method has been defined on the air interface. It attains a gross data rate of 31.5 kbit/s (D8PSK, differential eight phase shift keying) and will step-by-step replace the old analog AM-MSK method in the years to come.

The radiocommunications systems in many aircraft are already equipped with this technology, which will become mandatory for new aircraft in Europe as of 2014. In the future, VDL mode 2 will not only be used for the airlines' fleet management but also for air traffic control. The ATC controller will then be able to communicate with the pilot not only via voice but also via data telegram (CPDLC, controller pilot data link communications). This will reduce the work load as well as prevent radiofrequency congestion.

Joining hands for digital terrestrial TV in Hong Kong: broadcasters, research institutes and Rohde & Schwarz.

Rohde & Schwarz contributes to digital TV in Hong Kong

Together with broadcasters and research institutes, ROHDE & SCHWARZ Hong Kong Ltd. is supporting the pilot project to implement digital terrestrial TV.

The Digital Terrestrial Television Local Testing Group (DTTG) is responsible both for rollout and preliminary testing. During the initial project phase, which continues up to mid-2008, the reception of DTMB signals by set-top boxes and digital user equipment is to be checked. Rohde & Schwarz has provided the test and measurement systems that are required for the new digital broadcasting standards. In addition, TV modulators were sold to research institutes and to Hong Kong University (HKUST). The two TV broadcasting corporations that are taking part in the pilot project – Television Broadcast Limited (TVB) and Asia Television Limited (ATV) – also chose Rohde & Schwarz transmitters that comply with the DTMB standard.

TETRA for Colombian bus network

Transportes Inteligentes S.A. (TISA), a consortium of Brazilian and Colombian companies and investors, has chosen ROHDE & SCHWARZ de Colombia S.A. to supply a TETRA communications system.

In October 2007, the local transportation company Metrolinea S.A granted a 15-year concession to TISA, which is based in Bucaramanga in the Santander region. Rohde & Schwarz is now supplying TISA with a network consisting of five R&S®DIB-500 base stations and two R&S®DMX-500 exchange units including redundancy configuration. The communications system can interconnect more than 500 transport buses and maintenance staff.

Awards go to EMC experts from Rohde & Schwarz once again

After being nominated by CISPR, the international special committee on radio interference, Manfred Stecher and Jens Medler received the *1906 Award* of the International Electrotechnical Commission (IEC) in October 2007.

The IEC presents this award to especially active members for their expertise and commitment in the international standardization processes. Medler and Stecher represent Rohde & Schwarz on various bodies and committees dealing with disturbance measurement methods and instruments.

Stecher received the award for studying the effects of impulsive disturbance on digital radio services, which resulted in a new weighting function within the CISPR 16-1-1 basic standard: the RMS average detector (see page 42 of this issue).

Medler was honored for his effort in the development of objective picture assessment. This assessment method is used to test immunity to disturbance of consumer electronics equipment and has now become a part of the CISPR 20 product standard. The IEC also acknowledged Medler's enormous contribution to the development of the new product standards for testing immunity to disturbance and emissions of multimedia devices.

Albert Habermann passes away at the age of 97

In 1934, Albert Habermann joined the "Physikalisch-Technische Entwicklungslabor Dr. Rohde and Dr. Schwarz" as its first engineer. Together with the company founders, he established the basis for transforming Rohde & Schwarz into the global electronics group it is today. He retired in 1976 but stayed in close contact with the company even in his later years.

In 1937, Habermann took various areas including training, order processing and materials procurement under his wing. He soon became Dr. Hermann Schwarz's right-hand man and second in command. In 1944, he became Factory Manager of ROHDE & SCHWARZ Messgerätebau in Memmingen and helped to rebuild the company following the war. Upon his return to Munich in 1953, he assumed responsibility for production. In 1966, he joined Corporate Management. Owing to his intense commitment to the company and its people, he made a major contribution to the success of Rohde & Schwarz throughout his career.

Dr. Bernhard Thies, managing director of DKE, presents the *1906 Award* to Jens Medler.

Rohde & Schwarz now an NGMN Alliance sponsor

Rohde & Schwarz has joined the Next Generation Mobile Networks (NGMN) Alliance as a sponsor, thus enabling the company to make a greater contribution to next generation mobile standards such as WiMAX and 3GPP LTE.

Industry requirements can better be identified by exchanging ideas and expertise with others. As a result, a product portfolio that meets these needs can be created in the shortest time possible. Rohde & Schwarz already offers test solutions for chipsets, user equipment and infrastructure for upcoming pilot projects. The marketing of such technologies is also supported.

Rohde & Schwarz becomes member of LTE industry initiative

Rohde & Schwarz has joined LTE-SAE Trial Initiative (LSTI).

Leading telecommunications providers and network operators have joined hands to actively promote the further development of broadband mobile radio networks based on UMTS Long Term Evolution (LTE) technology. As a member, Rohde & Schwarz will help speed up interoperability testing (IOT) and initial field tests. One LSTI objective is to assure the interoperability of wireless networks and wireless devices from various manufacturers.

Rohde & Schwarz ranked as one of Germany's best employers for fifth time

A high level of trust in employees by management, a large degree of freedom for employees to develop their own ideas and innovations and a strong identification of the staff with the company: These are the areas where Rohde & Schwarz excelled in the "Best Workplaces in Germany" survey conducted by the Great Place to Work Institute® Germany. The Munich-based electronics specialist has now been selected for the list five times and – like last year – won 4th place in the category of large companies. About 250 companies took part in the survey.

WiMAX communication tester wins "Best in Test" award

Every year, the editors of the Test & Measurement World trade journal present the *Best in Test* award to important, innovative products from various fields. This year, the R&S®CMW 270 WiMAX communication tester was selected best product in the RF / wireless test category.

The jury was particularly impressed by the maximum throughput of the R&S®CMW 270 in the production of WiMAX chipsets and mobile stations. The WiMAX communication tester combines signal generation and signal analysis in a single box.

Together with the eleven winners in the other categories, the R&S®CMW 270 will now compete for the "Test Product of the Year" in April.

Emmy for broadcast equipment from Rohde & Schwarz

The American National Academy of Television Arts & Sciences (NATAS) has awarded an Emmy to Rohde & Schwarz. The company received the award in the category "Monitoring for compliance standards for ATSC & DVB transport streams".

Rohde & Schwarz impressed the Academy with its state-of-the-art R&S®DVM measurement platform (see also page 59 of this issue) and its many years of experience in this special field. The Technology & Engineering Emmy Awards are handed out once a year to honor excellence in technological achievements. Advances that allow consumers to use a wide variety of media platforms even more efficiently are nominated. Rohde & Schwarz is proud to have received its third Emmy award.

DVB-T seminar in Prague now a regular event

Each year, ROHDE & SCHWARZ Praha, s.r.o. now organizes two one-day DVB-T seminars.

▽

Digital broadcasting was a popular topic at the seminar in the Czech Republic.

In late 2007, seminars were held in Pilsen and Prague.

In Pilsen, the seminar was held for the teaching staff from West Bohemia University and the engineers from the Czech office of Panasonic AVC Networks. In Prague, staff members from national broadcasting organizations, potential DVB-H providers, universities, government authorities as well as engineers from various TV equipment manufacturers attended the seminar. Walter Fischer from the Munich training center delivered a presentation on guidelines for programming MPEG-4, H.264 and DVB-T / -H. Managing Director Pavel Salanda and Sales Engineer Tomas Straka used the opportunity to present not only new instruments but also the Rohde & Schwarz subsidiary in the Czech Republic. More than 80 participants attended the two seminars.

ROHDE & SCHWARZ

www.rohde-schwarz.com

Europe, Africa, Middle East: +49 18 05 12 42 42 or +49 89 412 91 37 74, customersupport@rohde-schwarz.com
North America: 1-888-TEST-RSA (1-888-837-8772), customer.support@rsa.rohde-schwarz.com
Latin America: +1-410-910-7988, customersupport.la@rohde-schwarz.com
Asia / Pacific: +65 65 13 04 88, customersupport.asia@rohde-schwarz.com

News from Rohde & Schwarz 195 (2008/I) · PD 5214.0653.72