News from Rohde & Schwarz

Arbitrary/function generator – unprecedented wealth of signals for virtually any requirement

Economical network coverage expansion of DVB-T main transmitters

Extremely fast and precise measurements of optical components

2004/I

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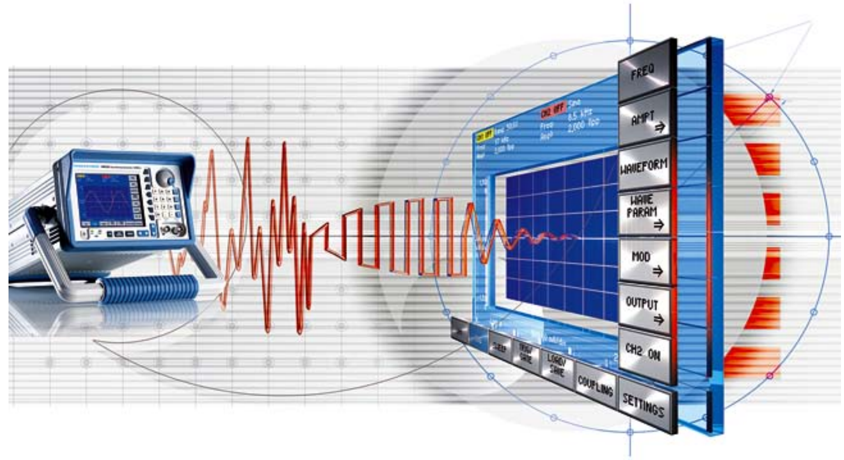

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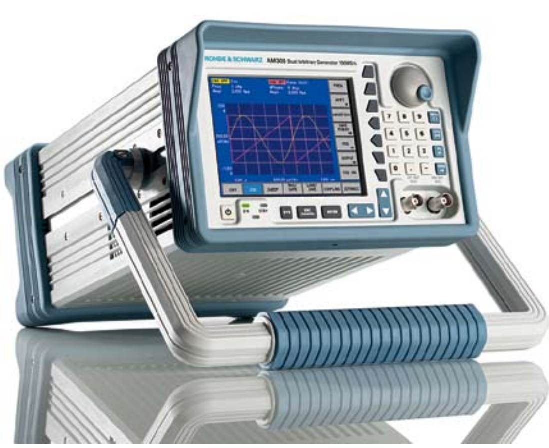
The new Dual-Channel Arbitrary/Function Generator R&S®AM300 ideally complements the Family 300 line of instruments, for example as a universal signal or trigger source, pulse generator or I/Q baseband signal source (page 21).

The Prequalification Tester R&S®TS8955 can be progressively expanded into the Conformance Test System R&S®TS8950 (page 4).



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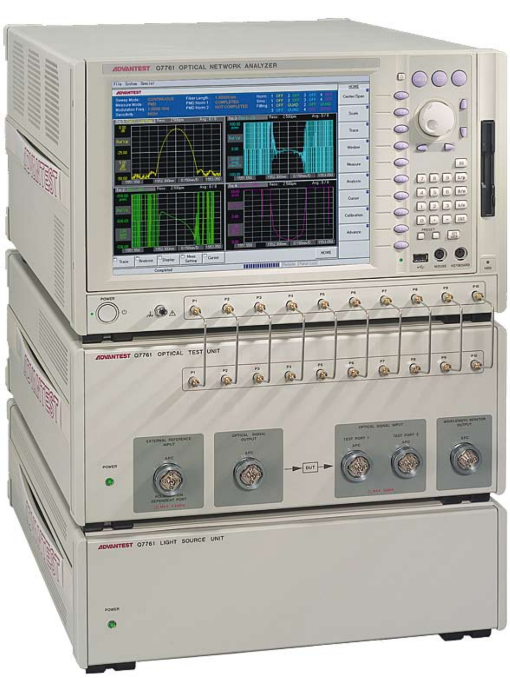
Since introducing the Handheld Spectrum Analyzer R&S®FSH 3 in July 2002, Rohde & Schwarz has added many new functions and features as well as a new model (page 32).



The Optical Network Analyzer Q 7761 – the flagship among Advantest's optical test instruments – allows the transmission characteristics of optical system components and modules to be measured extremely quickly and at the highest measurement resolution (page 46).

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FIG 1 The Prequalification Tester R&S®TS8955 in the configuration for receiver measurements.

Can a GSM, (E)GPRS or WCDMA test system that is minimally configured for development and quality assurance easily be expanded into a complete conformance test system? The answer is "yes" if it is the new Prequalification Tester R&S®TS8955.

Prequalification Tester R&S®TS8955

GSM, EGPRS and WCDMA receiver measurements at a mouse click

Broad expandability

Test systems for mobile radio often become the focus of attention only when user equipment needs to be certified (conformance test). However, a classic selectivity test, for example, requires a system solution with at least two test instruments even during the development of a receiver. The effort involved in setting up and maintaining such a test environment should not be underestimated. The new Prequalification Tester R&S®TS8955 (FIG 1) is the answer.

A test environment for user equipment of the second and third mobile radio generations is based on the simulation of a base station. Accordingly, the Universal Radio Communication Tester R&S®CMU200 is the heart of the new prequalification tester. The

R&S®CMU200 is impressive not only due to its outstanding signal characteristics but also because of its flexibility with regard to different mobile radio standards. One and the same device can simulate a GSM, GPRS, EGPRS or WCDMA base station.

Fading profiles must be simulated when testing receiver characteristics under realistic environmental conditions. A particularly elegant solution is provided by the Baseband Fading Simulator R&S®ABFS from Rohde&Schwarz, which can be looped into the transmission signal path of the R&S®CMU200 at the IQ level. Fading simulation at the IQ level is highly precise and does not require any expensive RF signal modifications. Realistic interference signals for selectivity measurements are provided by the Signal Generator R&S®SMIQ, for example, which has an integrated fading simulator.

FIG 2 provides an overview of classic receiver test scenarios and the required configuration of the R&S®TS8955. Depending on the configuration or required test application, the RF switching unit can be either a single coupler or a true switching matrix.

Bit error or block error analysis

Receiver measurements in digital transmission systems are usually based on bit error or block error analysis. The R&S®CMU200 transmits standard test patterns on the downlink test channel. Reception errors can be analyzed without an additional interface to the DUT in two ways offered by the R&S®CMU200 for all specified mobile radio standards:

Loopback of the test pattern

The DUT returns the test pattern exactly as received. The uplink channel is considered error-free in this case. The R&S®CMU200 compares sent and received data and calculates the bit error rate. This method is standard in circuit-switched systems such as "classic" GSM.

Acknowledgement operation

In this case, test data blocks are sent to the DUT, which acknowledges correct reception following channel decoding. The R&S®CMU200 can then calculate the block error rate. This method is standard in data-oriented or packet-switched systems such as GPRS, EGPRS and WCDMA.

Test scenarios at the click of a mouse

The RS-PASS software (parametric application software for test systems) from Rohde&Schwarz controls the test sequences. It can be installed on any PC running under Microsoft® Windows®. Its graphical user interface TSCC (test system control center) is always the same regardless of the device configuration and does not differ in any manner from the software in the Test Systems R&S®TS8950 and R&S®TS8950W/G [1, 2]. After the individual instruments have been interconnected and connected to the controller and thus to RS-PASS via the IEC/IEEE bus, the RS-PASS system explorer automatically identifies the current device configuration. The test system is then ready.

Depending on the configuration and accuracy requirements, local calibration can be performed with a power meter (e.g. the R&S®NRVD). RS-PASS provides the required procedures and takes the individual device configuration into account.

The required test scenarios can now be compiled. The conformance test sce-

FIG 2 Configurations of the R&S®TS8955 for receiver test methods.

Receiver test method	Instruments	Test reference			
		GSM 3GPP TS 51.010	GPRS 3GPP TS 51.010	EGPRS 3GPP TS 51.010	WCDMA 3GPP TS 34.121
Sensitivity	R&S®CMU200	14.2.*	14.16.1	14.18.1.*/.6*	6.2/3.*
Performance	R&S®CMU200 R&S®ABFS	14.2.* 14.10.* (AMR)	14.16.*	14.18.*	7.*
Selectivity	R&S®CMU200				
Co-channel suppression	R&S®ABFS	14.4/8.*	14.16.2.*	14.18.2.*	
Adjacent channel suppression	1 to 2 R&S®SMIQ	14.5.*	14.16.2.*	14.18.3.*	6.4.*
Intermodulation suppression	R&S®SMP	14.6.*	14.16.2.*	14.18.4.*	6.7.*
Blocking	RF switching matrix	14.7.*	14.16.2.*	14.18.5.*	6.5.*

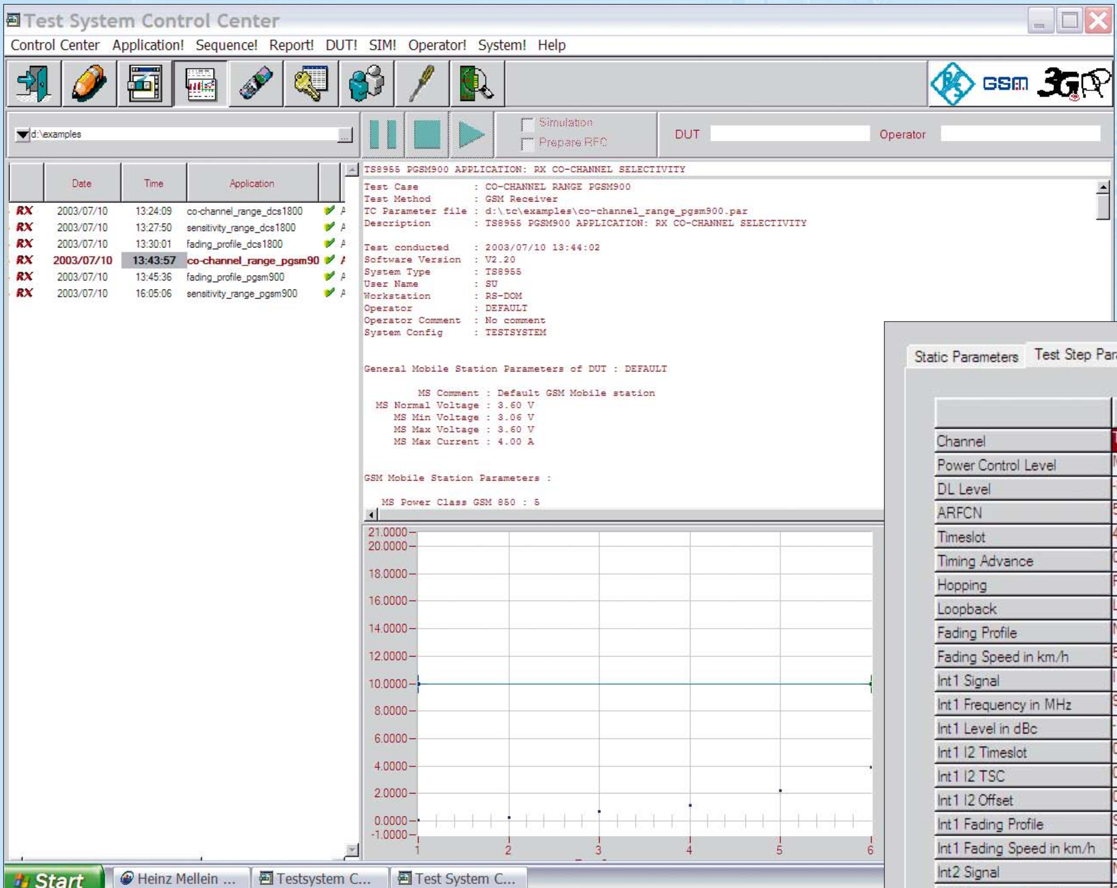

FIG 3
Result for selectivity test with increasing co-channel interference level.

	1	2	3	4	5	6
Channel	TCH/FS	TCH/FS	TCH/FS	TCH/FS	TCH/FS	TCH/FS
Power Control Level	Max	Max	Max	Max	Max	Max
DL Level	-80	-80	-80	-80	-80	-80
ARFCN	50	50	50	50	50	50
Timeslot	4	4	4	4	4	4
Timing Advance	0	0	0	0	0	0
Hopping	False	False	False	False	False	False
Loopback	Loop A	Loop A	Loop A	Loop A	Loop A	Loop A
Fading Profile	None	None	None	None	None	None
Fading Speed in km/h	50.0	50.0	50.0	50.0	50.0	50.0
Int1 Signal	I1	I1	I1	I1	I1	I1
Int1 Frequency in MHz	945.0000	945.0000	945.0000	945.0000	945.0000	945.0000
Int1 Level in dBc	-10	-9	-8	-7	-6	-5
Int1 I2 Timeslot	0	0	0	0	0	0
Int1 I2 TSC	0	0	0	0	0	0
Int1 I2 Offset	0	0	0	0	0	0
Int1 Fading Profile	Static	Static	Static	Static	Static	Static
Int1 Fading Speed in km/h	50.0	50.0	50.0	0.0	0.0	0.0
Int2 Signal	None	None	None	None	None	None
Int2 Frequency in Hz	0	0	0	0	0	0
Int2 Level in dBc	0	0	0	0	0	0
Int2 I2 Timeslot	0	0	0	0	0	0
Int2 I2 TSC	0	0	0	0	0	0
Int2 I2 Offset	0	0	0	0	0	0
Int2 Fading Profile	None	None	None	None	None	None
Int2 Fading Speed in km/h	0.0	0.0	0.0	0.0	0.0	0.0
Temperature in °C	0.0	0.0	0.0	0.0	0.0	0.0
Temperature	Normal	Normal	Normal	Normal	Normal	Normal
Voltage in V	0.0	0.0	0.0	0.0	0.0	0.0
Voltage	Normal	Normal	Normal	Normal	Normal	Normal
Rx Result Rate in s	2	2	2	2	2	2
Meas 1 Type	FER TCH	FER TCH	FER TCH	FER TCH	FER TCH	FER TCH
Meas 1 Samples	100	100	100	100	100	100
Meas 1 Limit in %	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000

FIG 4
Parameter editor for test scenarios.

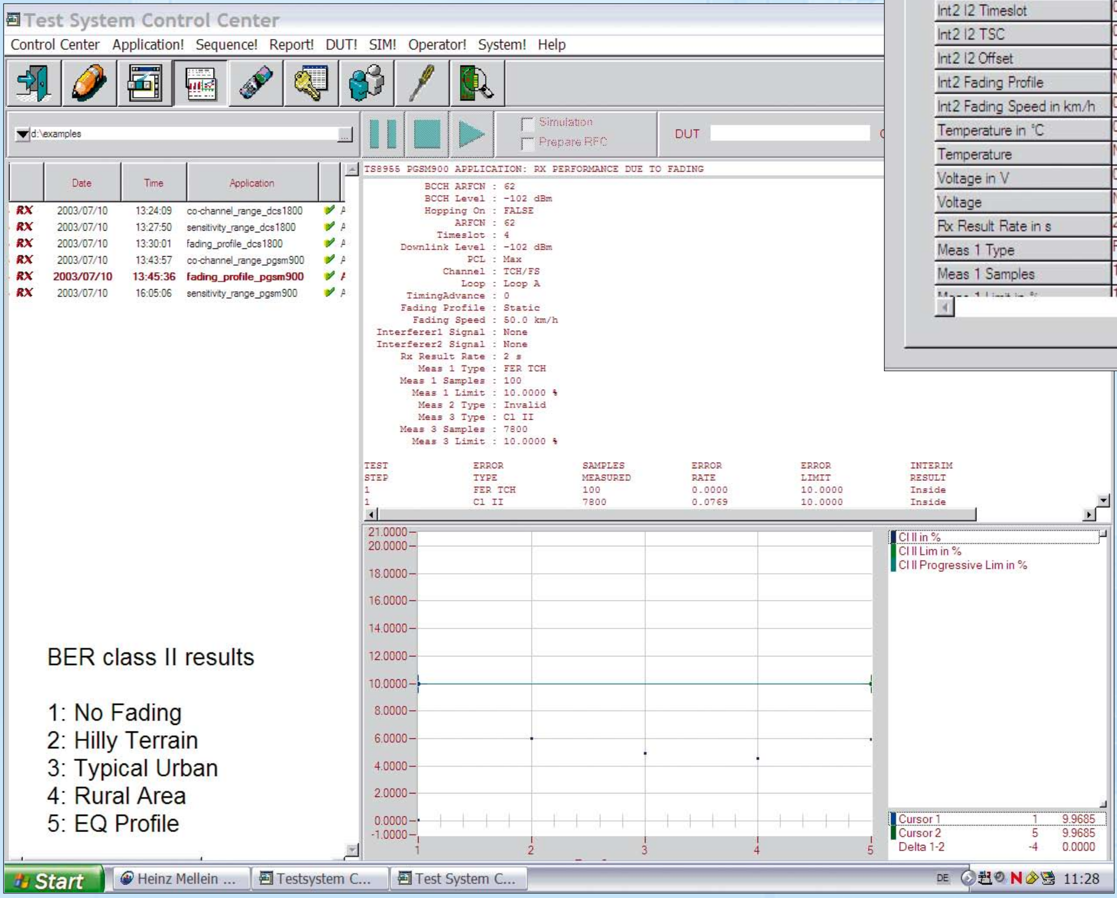

FIG 5
Result of performance measurements under different fading profiles.

narios for the various mobile radio standards can be used as a model. In most cases, even measurements that comply with conformance tests can be performed with an R&S®TS8955. However, a conformance test is a go/no-go test, i.e. the final question is always whether a measured value is within or beyond the specified tolerance range.

Yet, very complex questions arise during development: What is the sensitivity of a receiver in all permitted frequency channels? How does selectivity behave as the relative interference level increases (FIG 4 shows an RS-PASS parameter set, FIG 3 the result)? Or how does performance vary from one fading profile to the next if the conditions remain the same? The measurement result in FIG 5 shows that the *Hilly Terrain* profile is apparently the most difficult for the receiver, together with the "academic" equalizer test profile *EQ*.

RS-PASS allows such test scenarios to be compiled with just a few mouse clicks. Its graphical online representation of measurement results makes immediate analysis possible.


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FIG 6 The flexibility of the Prequalification Tester R&S®TS8955 allows it to be progressively expanded to an RF Test System R&S®TS8950.

The final step: the conformance test

The flexibility of the R&S®TS8955 makes it possible to progressively expand the small system into the complete RF Test System R&S®TS8950 (FIG 6). Transmitter measurements in compliance with the conformance test can be achieved by adding a Spectrum Analyzer R&S®FSP or R&S®FSU, for example. This allows each user to create a small or large system depending on individual requirements. RS-PASS ensures identical user interfaces whether in customized test sets or in conformance test environments at the test house. The calibration procedures, which are provided by the software and tailored to all possible configurations, ensure maximum measurement accuracy in the system and when changing from one system to another.

It should be noted that 100% compliance with the conformance test specifications is not possible for all test cases with an R&S®TS8955 test system based on the Universal Radio Communication Tester R&S®CMU200. The only way to support all conformance tests is to replace the radio communication tester with a Protocol Tester R&S®CRTU-G or R&S®CRTU-W. However, the differences are often marginal, i.e. they involve only signalling sequences. These signalling sequences can also be recorded in the R&S®CMU200 and displayed on the R&S®TS8955 by using the same tool, the Message Viewer R&S®CRTU-GP01, as for protocol recordings on an R&S®CRTU-G/R&S®TS8950. A DUT tested on the Prequalification Tester R&S®TS8955 can therefore be submitted for conformance testing with confidence.

Heinz Mellein

More information and data sheets of the Test Systems R&S®TS895x at www.rohde-schwarz.com.

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[2] RF Test Systems R&S®TS8950G/R&S®TS8955G – Reliable RF testing of GSM, GPRS and EDGE mobile phones. News from Rohde&Schwarz (2002) No. 174, pp 4–7

◆ "UMTS – Einführung und Messtechnik", Krüger und Mellein, Franzis' Verlag 2003

Universal Protocol Tester R&S®CRTU-G

Fading applications with convenience

The Universal Protocol Tester R&S®CRTU-G [1] covers various markets, from development through to conformance test and type approval. Its outstanding hardware concept also satisfies users who place the highest of demands on flexibility and configurability. In combination with the Baseband Fading Simulator R&S®ABFS [2], the generation of fading applications becomes child's play without the need for any additional equipment such as RF combiners.

Multipath propagation – a permanent interference factor

When it comes to testing a mobile phone and its multipath compensation capabilities, fading applications play a vital role. In the daily use of mobile phones, multipath propagation is a permanent interference factor. It is the result of reflections on surfaces such as streets or buildings and causes a signal travelling over different propagation paths to arrive several times and with time delay at the mobile phone receiver. This can lead to significant interference in reception. The Universal Protocol Tester R&S®CRTU-G is now equipped with an integrated fading solution that, in combination with the Baseband Fading Simulator R&S®ABFS, enables the user to conveniently perform fading measurements.

Only one optional IQ/IF interface needed

Even in its basic version, the R&S®CRTU-G offers almost all functions required for fading measurements; only the R&S®CRTU-B7 IQ/IF interface card option is additionally required. This two-channel interface card is integrated in the IQ/IF path, thus providing an external interface. Moreover, it is particularly of interest to development engineers who do not yet have a means to connect their mobile telephone module to the R&S®CRTU-G protocol tester via an RF interface.

Before such a module can be connected to the IQ/IF interface, the interface inputs and outputs must be set by means of the configuration manager (FIG 1). This makes it possible, for example, to operate the interface card in bypass mode and to feed and drop IF signals both on the transmit and receive path.

Connection of the R&S®ABFS fading simulator

Furthermore, the R&S®CRTU-B7 option makes it possible to connect the Baseband Fading Simulator R&S®ABFS with the protocol tester. For measurements under fading conditions, this creates a test setup that is able to fade two channels with up to twelve paths. The R&S®CRTU-G is connected simply by using the supplied cable set (FIG 2).

For this purpose, the IQ/IF interface must be switched to fading mode, which is accomplished either via the configuration manager or, more conveniently, under the control of the applicable test case.

The fading mode permits signals to be coupled or decoupled from the transmit path. When added to the transmit path, the fading simulator receives the signal from the protocol tester, subjects it to fading and couples the signal again into the transmit path of the R&S®CRTU-G. The faded signal is applied to the DUT that is connected to the protocol tester. The receive path of the IQ/IF interface is switched to bypass mode since the signals do not need to be coupled or decoupled.

Control of the fading simulator

The R&S®ABFS fading simulator is connected to the protocol tester via the supplied IEC/IEEE-bus cable. The simulator is then controlled from the tester. A fading test case that is implemented in the R&S®CRTU-G can now be configured and controlled by means of a single command of the R&S®CRTU-GA05 software option, for example via fading profile and speed. Moreover, the R&S®CRTU-B7 option is automatically switched to fading mode; manual configuration is not necessary.

The combination of the R&S®CRTU-G and R&S®ABFS is also used in the R&S®TS8950G conformance test systems. In addition to validated RF conformance tests, these systems also permit user-defined RF tests that ideally complement the above standalone solutions with regard to complexity and RF accuracy.

Markus Hendeli

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

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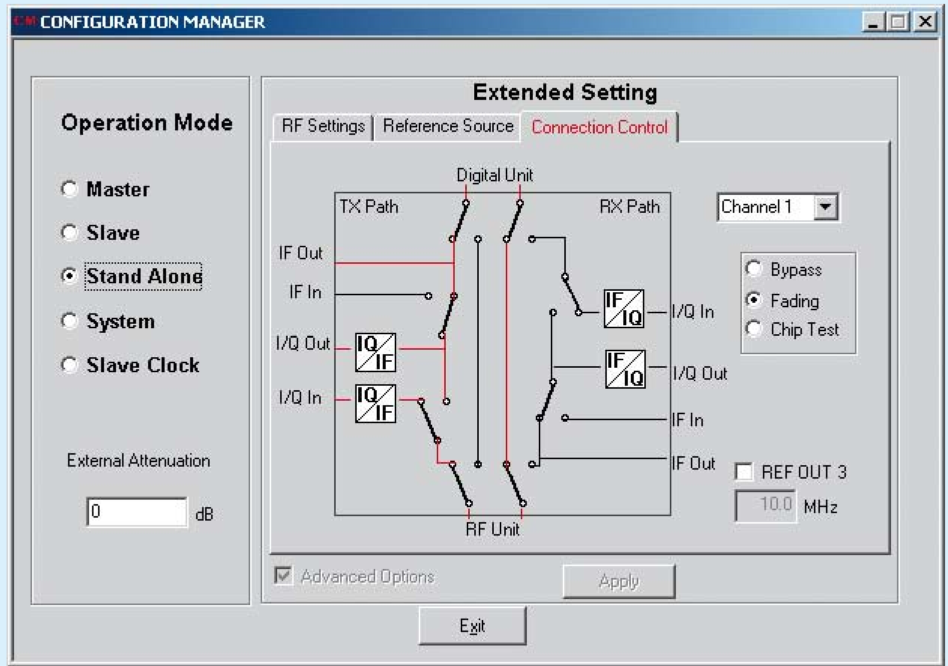
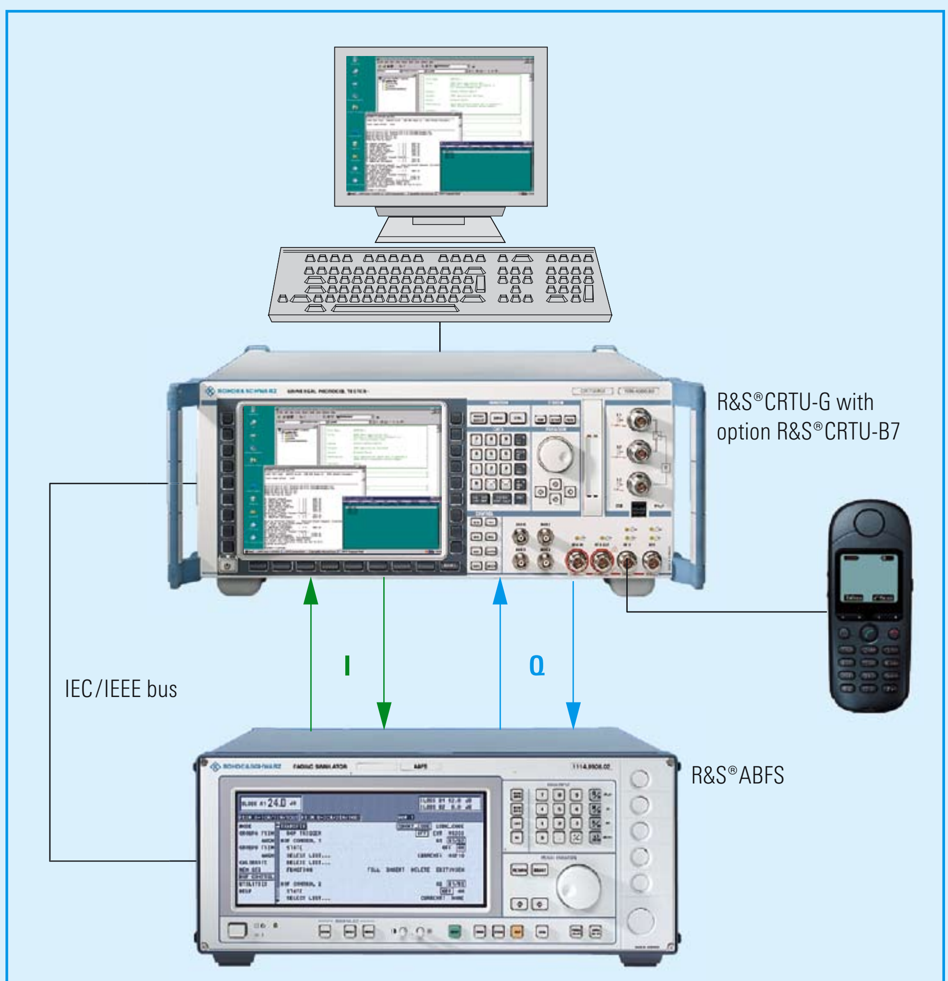


FIG 1 The configuration manager provides a convenient means of setting the IQ/IF interfaces.

FIG 2 Combining the R&S®CRTU-G with the R&S®ABFS provides a powerful minisystem for performing fading measurements.



Universal Radio Communication Tester R&S®CMU 200

Expanding WCDMA receiver tests

Mobile user equipment for applications with high data rates such as video transmission or Internet browsing is equipped with complex receivers. The R&S®-K65 to -K69 (3GPP FDD) WCDMA software packages for the R&S®CMU 200 [*] provide new measurement components for receiver tests that help to examine these sophisticated receivers in UMTS mobile phones and to assess their quality. This article covers the BER measurement with asymmetric data rates in the DUT transmitter and receiver, explains UMTS-specific blind transport format detection (BTFD) tests and presents measurements that the DUT itself carries out (UE measurement reports).

BER measurements with asymmetric data rates

A typical receiver test setup is shown in FIG 1: The Universal Radio Communication Tester R&S®CMU 200 transmits the required pilot and synchronization signals over the air interface. It generates random data in the baseband, codes it, inserts it into a dedicated channel (DCH) in the downlink[1] and transmits the modulated data to the DUT over the air interface. During the receiver tests, the DUT is typically in loopback mode, i.e. the DUT demodulates the received data, decodes it in the baseband and then transmits it back in the uplink[2] with a time delay. If the test setup can ensure that the uplink is free of transmission errors, the R&S®CMU 200 can compare the data in the downlink and uplink and determine the typical receiver key parameters BER[3] and BLER[4].

The 3GPP 34.121 test specification for RF measurements defines propagation conditions in the RF channel which, in conjunction with the quality of the individual stages in the receiver, affect the measured error rate. If the symbol rate on the radio frequency remains constant (3.84 Mchip/s for 3GPP FDD), error detection and correction in the receiver decreases (depending on the system) as the actual information data rate increases and vice versa.

Receiver tests check the receiver sensitivity for different useful information data rates. For radio-frequency tests, the 3GPP standard has specified examples of several reference measurement channels (RMC) for different useful information data rates (12.2 kbit/s, 64 kbit/s, 144 kbit/s, 384 kbit/s). The above model works as long as the same data rates are processed in the uplink and downlink.

But things are different if mobile user equipment that is primarily used for Internet browsing, for example, mainly requires high data rates only in the downlink. The equipment therefore comes with a powerful receiver, while the transmitter can be a more basic model. Thus, the method described above, i.e. the same data rates in the downlink and uplink, is no longer applicable.

A method is implemented in the R&S®CMU 200 that is able to perform useful receiver tests despite this asymmetry with the support of the test loops defined in 3GPP TS 34.109. For this purpose, transport blocks for useful information are generated in the baseband of the radio tester in a defined time grid (FIG 2). Each transport block with a length of N+n (bits) is filled with the data b_0 to b_{N+n-1}; after the cyclic redundancy check (CRC) checksum has been added, the block is then processed and modulated in the individual function blocks of the baseband and transmitted over the air interface (FIG 3). The receiver in the DUT performs these steps in reverse order so that b_0' to b_{N+n-1}' are present in decoded form in the DUT. Part of this data is then transmitted back to the tester.

1) Downlink (DL): transmit signal of the radio tester to the DUT.
2) Uplink (UL): transmit signal of the DUT to the tester.
3) BER: bit error ratio.
4) BLER: block error ratio.

On page 14, you will find another article on the Universal Radio Communication Tester R&S®CMU 200 titled "Solutions not only for (E)GPRS mobile radio development".

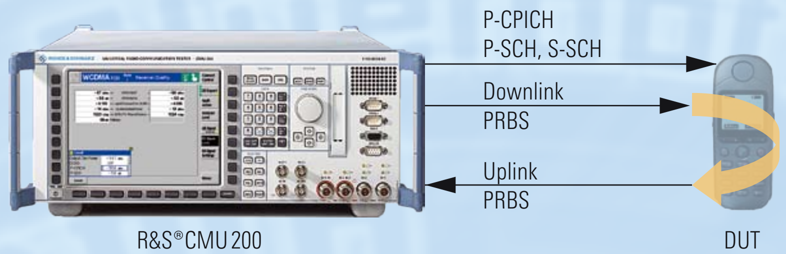


FIG 1 Test setup for BER measurements with the DUT in loopback mode.

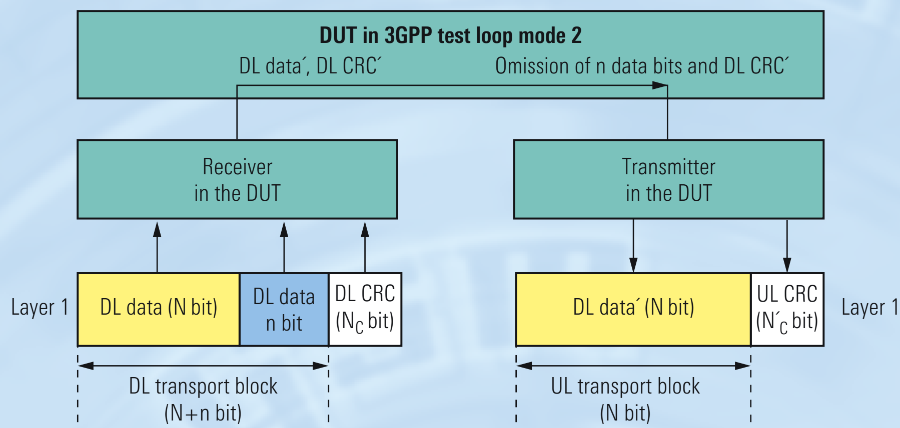
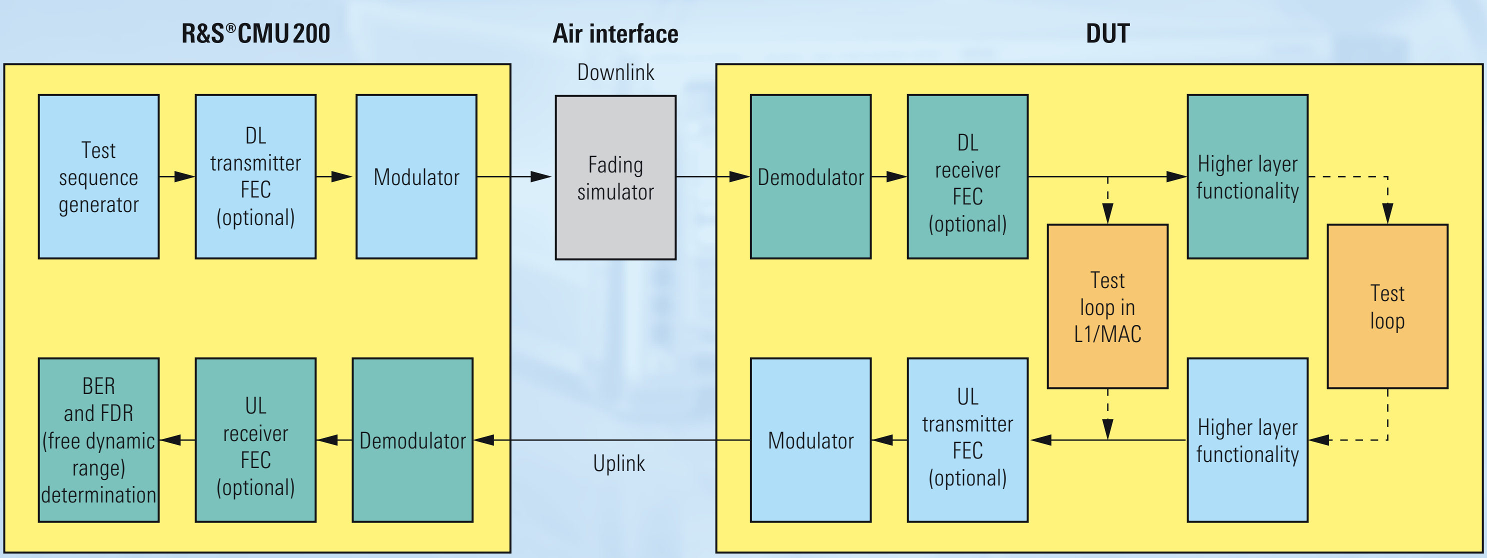


FIG 2 DUT in test loop mode 2 in accordance with 3GPP TS 34.109.

FIG 3 The processing stages in the R&S®CMU 200 and DUT.



An uplink channel with reduced data capacity can only process transport blocks with reduced length N with b_0' to b_{N-1}' in the baseband (per time unit) and transmit them over the air interface. The R&S®CMU 200 thus only compares b_0 to b_{N-1} with b_0' to b_{N-1}' and then calculates the BER and the number of defective blocks from the result.

Due to the coding and interleaving steps in the baseband chain, bits b_0 to b_{N-1} in the transmission channel are not transmitted one after the other as a packet but at different points in time over the air interface. Even if the data volume is reduced, the BER provides a valuable assessment of the receiver quality, with the receiver itself being operated at the full data rate. The tester provides the data rate combinations 384/144, 384/64 and 144/64 (each DL/UL in kbit/s).

Selectable resources – occupancy in the transmission channel

In practice, transmission channels are often used only to transmit "in batches", i.e. there are significant differences between the peak and average data rates during a connection and these differences may affect the entire mobile phone, including its power management. The R&S®CMU 200 is able to emulate these conditions by setting up a high-capacity transmission channel in the downlink but not at full occupancy, i.e. it fills only every second, fourth, etc, block with data. If a receiver measurement is performed simultaneously during this phase, the tester, of course, takes into consideration only the data blocks that were actually filled with useful information.

BTFD measurements

To save transmission bandwidth and signal energy, the transport format combination identifier (TFCI) signalling bits – which inform the DUT about the data rate and the transport format used – can be omitted on the dedicated downlink channel. For this purpose, special timeslot formats are defined in 3GPP TS25.211 without TFCI bits (NTFCI = 0), or these bits are not transmitted via discontinuous transmission (DTX), i.e. they are modulated with zero energy (FIG 5).

The DUT must be able to detect the transport format from the data stream even without this signalling information in order to correctly decode the useful information. This is referred to as blind transport format detection (BTFD).

During call setup, the radio tester uses the signalling channel to inform the DUT about the nine transport formats that are defined in 3GPP TS34.121 for the BTFD measurement. The mobile phone must now select the correct data rate from among these different formats. As in the test setup for BER/BLER measurements, the DUT is also operated in test loop 2 for BTFD.

The radio tester transmits a user-selected data rate on the downlink (FIG 4). In accordance with 3GPP TS34.121, the measurement needs to be carried out only with the DTCH rates 12.2 kbit/s, 7.95 kbit/s and 1.95 kbit/s. The R&S®CMU 200, however, lets the developer choose from among the nine data rates provided. The DUT detects the transport format used and transmits the data and the downlink CRC checksum back to the tester in the uplink. The uplink is configured in such a way that the nine different transport formats and the downlink checksum can be transmitted.

By using the received data stream, the R&S®CMU 200 determines the BER and BLER and – as a new feature – the false transport format detection ratio (FDR). An FDR event is counted if a valid data block with valid checksum arrives in the tester uplink but does not correspond to the transport format previously sent in the downlink.

Measurement reports of the DUT

Mobile user equipment itself must perform measurements in order to assess the channel quality in the offered cells or in a call that is already set up. For example, the power measured in the CPICH pilot channel in a WCDMA cell during connection setup is incorporated as a key parameter in the power setting of the DUT transmitter. The more power the user equipment has for receiving the pilot signal, the less power it will use when starting to send the uplink signal.

Once the R&S®CMU 200 has established a connection to the DUT, it can send sig-

FIG 4 Data rates that the R&S®CMU 200 provides for the nine different transport formats (orange: the data rates specified by 3GPP TS34.121).

	1	2	3	4	5	6	7	8	9
DTCH	12.2 kbit/s	10.2 kbit/s	7.95 kbit/s	7.4 kbit/s	6.7 kbit/s	5.9 kbit/s	5.15 kbit/s	4.75 kbit/s	1.95 kbit/s

nalling messages to the DUT over the air interface requesting the DUT to send back the internal measurement results as a "measurement report", which the R&S®CMU 200 can then display. The developer can thus assess the accuracy of both the receiver and the internal correction tables at a glance (FIG 6).

The user equipment must be able to measure the power, timing and transmission quality not only of its "own" cell but also that of any adjacent cells such as WCDMA cells or those of other networks, e.g. GSM. This topic will be discussed in more detail in a future issue.

Summary

The flexible Universal Radio Communication Tester R&S®CMU 200 offers a versatile scope of tools for signalling and test and measurement. As a result, the R&S®CMU 200 is becoming a standard piece of equipment in UMTS development and quality labs as well as in setups for production and system test solutions.

Stefan Loth; Pirmin Seebacher

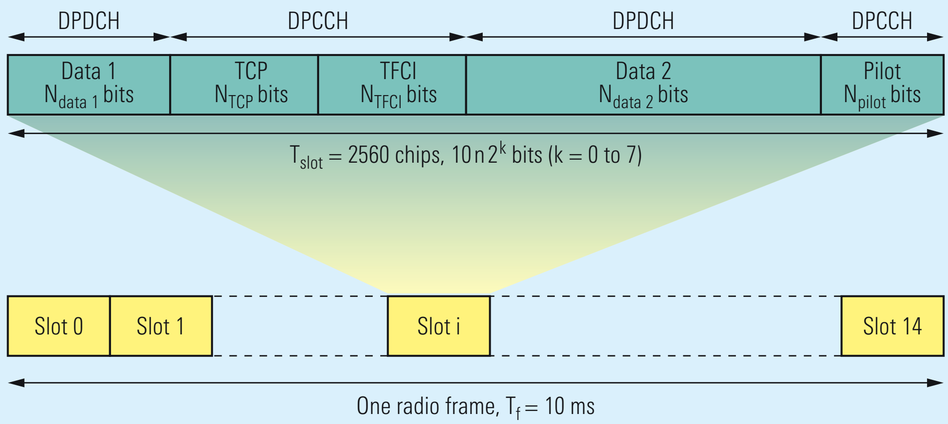
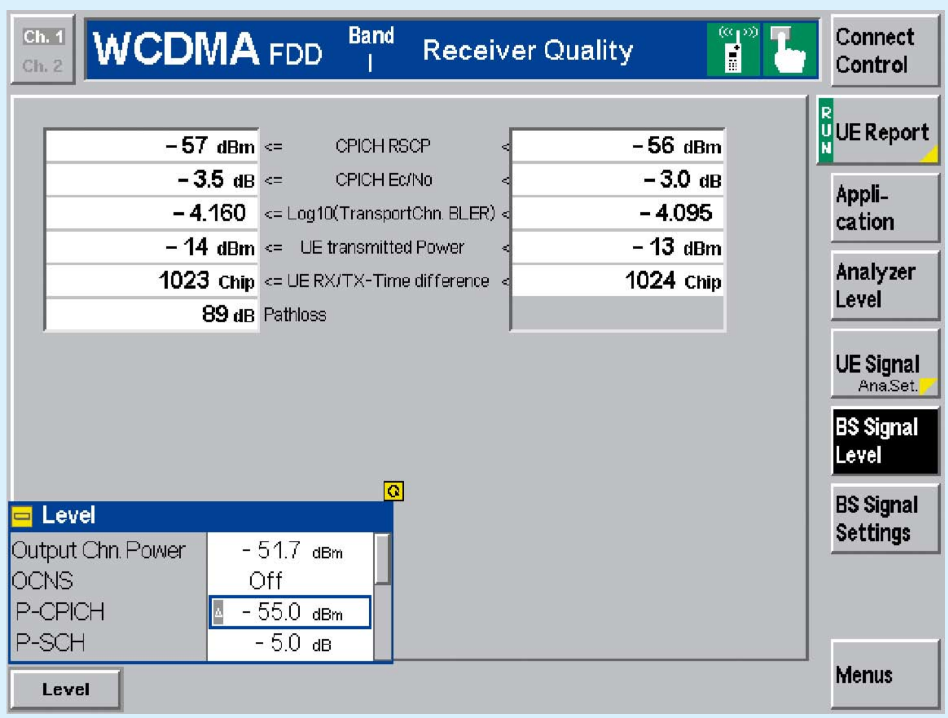
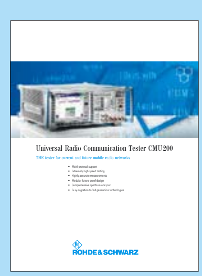


FIG 5 **DPCH channel structure in the downlink.**

FIG 6 **The "UE measurement report" menu on the R&S®CMU 200 displays the accuracy of the receiver and the internal correction tables of a mobile phone.**



More information and data sheet at www.rohde-schwarz.com (search term: CMU 200)



REFERENCES

[*] Universal Radio Communication Tester R&S®CMU 200: Signalling and RF measurements for WCDMA. News from Rohde & Schwarz (2003) No. 177, pp 9–12

– 3GPP standard

Universal Radio Communication Tester R&S®CMU 200

Solutions not only for (E)GPRS mobile radio development

Modern mobile radio systems have become so complex that even development departments have difficulty keeping track of all system details. A mobile radio tester is therefore expected not only to provide universal and highly accurate test technology but also to support development engineers in their challenging tasks.

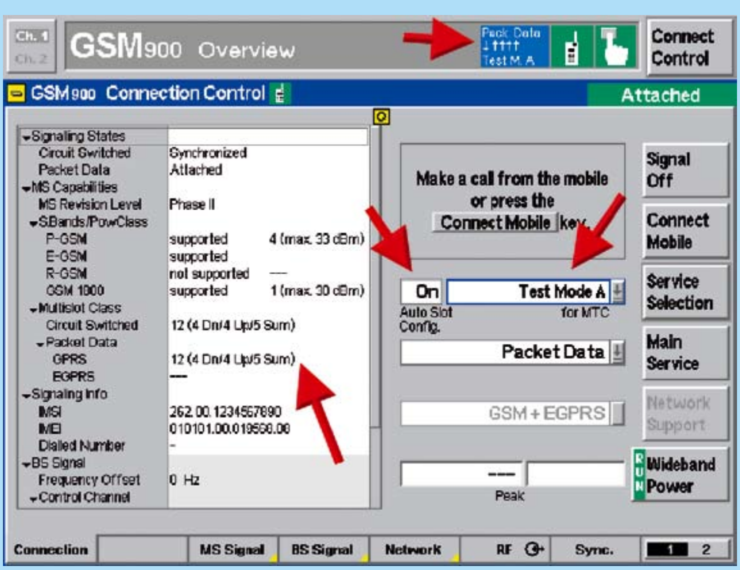
Timeslot configuration

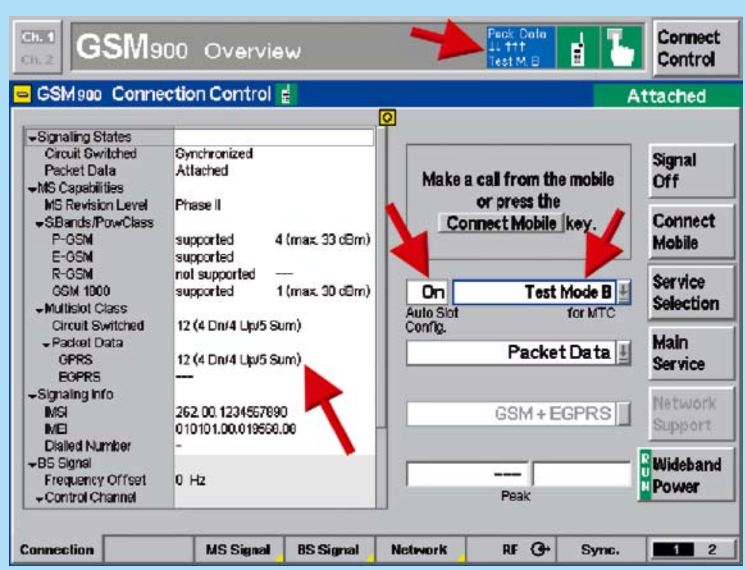
Some system details are hard to monitor – for example, the timeslot configuration of a packet data link. Depending on the multislot class of the mobile phone, only specific timeslot combinations can be used for connection setup. All in all, there are 45 different multislot classes. Timeslot distribution among uplink and downlink also determines which timeslots can be used. It is virtually impossible to handle these diverse combinations without assistance of some kind, which is where the Universal Radio Communication Tester R&S®CMU 200 comes in: As soon as a mobile phone registers on it, the R&S®CMU 200 determines the phone's multislot class and automatically sets the optimum timeslot combination for each connection setup on the basis of the type of connection. For example, in test mode A the R&S®CMU 200 sets the maximum number of uplink timeslots, whereas in test mode B it uses a distribution that is as even as possible across the uplink and downlink. With BLER measurements, it sets the maximum possible number of downlinks (FIG 1). Users need not concern themselves with the optimum timeslot combination for each test because the instrument takes care of this.

But sometimes problems still occur, e.g. the mobile phone may not have correctly signalled the multislot class yet. In this case, simply correct the automatic selection of the tester or switch off the automatic function completely.

Measuring GMSK and 8PSK bursts simultaneously

EGPRS phones generate both 8PSK- as well as GMSK-modulated signals. For example, with a packet data link at the appropriate data rate, the useful data must be transmitted in 8PSK-modulated data bursts. In contrast, the bursts the





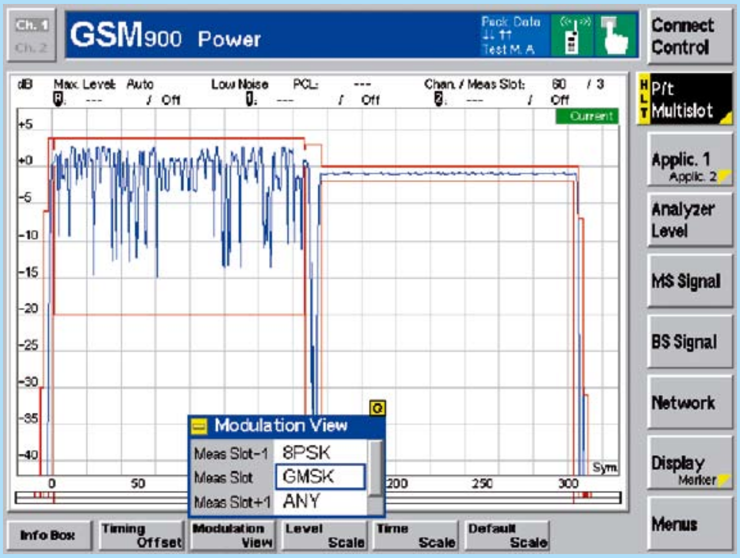


FIG 2 By means of the comprehensive timeslot-dependent trigger functionalities, the multislot power ramp measurement of the R&S®CMU200 picks out differently modulated bursts from the data stream of the mobile phone for the measurement.

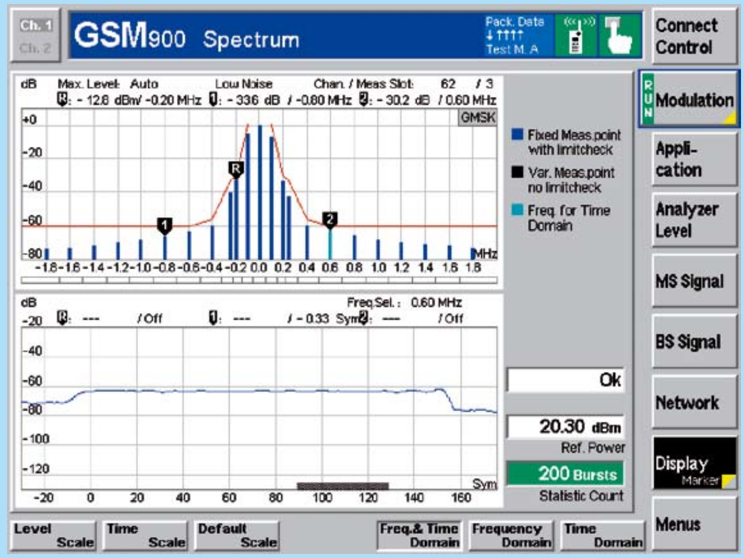


FIG 3 The GSM spectrum measurement of the R&S®CMU200 not only provides the usual display in the frequency domain but also outputs the measurement results at the selected offset frequency in the time domain.

phone uses to acknowledge received data are transmitted as GMSK data bursts.

It is quite a challenge to separate the two differently modulated data bursts during the measurement. But here again, the R&S®CMU200 provides excellent support due to its integrated multislot power ramp measurement and its versatile timeslot-dependent trigger functionalities. The development engineer simply changes the modulation mode to be evaluated in this timeslot. If ANY is selected, the tester automatically determines the received modulation mode and activates the correct power/time template. If GMSK is selected, only GMSK signals are evaluated, and with 8PSK, of course, only 8PSK signals (FIG 2). In the same convenient manner, the tester also selects the access bursts from the data stream.

Spectrum measurement with frequency and time domain display

In development, it is often necessary to view a measured spectrum not just in the frequency domain but also in the time domain, which provides many valuable clues about the cause of poor spectral behaviour. The GSM spectrum measurements of the R&S®CMU200 were therefore expanded by a time display. Operation is child's play. After the user selects the required offset frequency in the frequency domain display, the timing of this offset frequency in the time domain is output in the lower display (FIG 3). Versatile zoom functionality makes it possible to enlarge the display of sections of interest.

Rudolf Schindlmeier

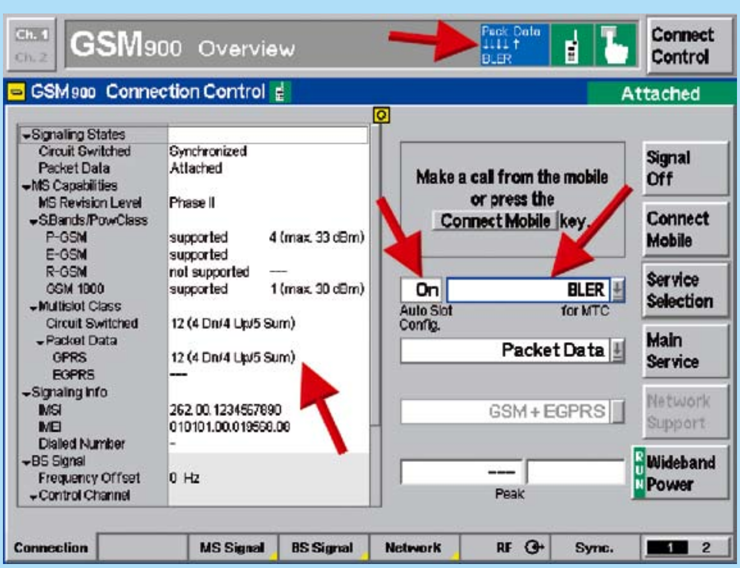


FIG 1
The R&S®CMU200 determines the multislot class of the connected mobile phone and automatically sets the ideal timeslot combination based on the type of connection.

Analyzers R&S®FSP/FSU/FSQ

Test of HSDPA base stations

The new R&S®FS-K74 application firmware expands the test functionality of the Spectrum Analyzers R&S®FSP and R&S®FSU and the Signal Analyzer R&S®FSQ to include code domain analysis of HSDPA signals for WCDMA 3GPP FDD – at the highest speed currently available on the market.

More information and R&S®FS-K72 data sheet at www.rohde-schwarz.com (search term: FS-K72)

REFERENCE

[*] Spectrum Analyzers R&S®FSU/R&S®FSP: Firmware for 3G code domain measurements. News from Rohde&Schwarz (2002) No. 175, pp 15–17

HSDPA – an extension of the 3GPP standard

HSDPA (high speed downlink packet access) is part of Release 5 of the 3GPP WCDMA specifications. HSDPA, which is an extension of the 3GPP standard, has been specified for the three transmission modes FDD, TDD and TD-SCDMA, which is the low chip rate option of TDD. The new data service boosts data throughput in mobile radio systems, offering a maximum data rate of 14.4 Mbit/s for a 3.84 MHz HSDPA channel. For mobile radio systems using several transmit and receive antennas, data rates of more than 20 Mbit/s have been reported to be possible. Network operators will thus be able to include high-speed services where needed, for example at hot spots such as airports, without any impact on the rest of the 3GPP network.

Principles of HSDPA

In cellular communication systems, the quality of a signal received by a mobile phone depends on a number of factors: the distance between the mobile phone and the base station, as well as fading, noise and interference. To maximize system capacity, peak data rate and coverage, the base station initially transmits the signal to a particular user at maximum power and subsequently varies the signal power according to the quality of the transmission link.

With HSDPA, the power of the transmitted signal is kept constant, and the modulation and the coding scheme are adapted optimally to match current signal quality and channel status. Normally, subscribers close to the base station are assigned modulation of higher order and coding of lower redundancy than more distant users. The parameter values are varied as signal quality deteriorates. To ensure high efficiency, the system must be able to respond quickly to fast or slow fading. Thus, the mobile phone continuously signals channel quality to the base station, and the base station adapts the signal as required.

Characteristics of HSDPA signals

HSDPA signals are fully integrated into WCDMA signals, and HSDPA users coexist with non-HSDPA users on the same frequency. HSDPA signals cannot be identified solely by examining the spectrum. Instead, code domain analysis is required.

HSDPA uses codes with a spreading factor of 16. A maximum of 15 different codes are available, which can be assigned to a single user or distributed among up to 15 users. The number of codes assigned to a user depends on propagation conditions and the capabilities of the mobile phone. Either QAM or 16QAM is used with each code.

Type	Number of channels
P-CCPCH+SCH	1
Primary CPICH	1
PICH	1
S-CCPCH containing PCH (SF=256)	1
DPCH (SF=128)	30/14/6
HS-SCCH	2
HS-PDSCH (16QAM)	8/4/2

FIG 1 Test model 5 specified in 3GPP TS 25.141.

Measurements on HSDPA base station transmitters

For tests on HSDPA base stations, the 3GPP TS 25.141 standard has specified a new measurement for determining modulation accuracy. The test signal to be used is described in test model 5, which specifies control channels, traffic channels and two, four or eight 16QAM HSDPA channels (FIG 1). This signal is used to measure the error vector magnitude (EVM).

Using test model 5 to measure modulation accuracy means placing considerably more stringent requirements on base stations. In accordance with Release 99, the modulation quality is determined from two parameters: EVM and the peak code domain error (PCDE). EVM is measured with one or optionally two active codes. Meeting PCDE specifications is a demanding task for transmitter designers, because the signal used in the PCDE test has a higher crest factor and places more stress on the transmitter. The PCDE requirement of approx. –33 dB corresponds to a composite EVM of 30%. Modulation error requirements are likewise more exacting in the case of HSDPA, with a specified value of <12.5%.

The fast measurement solution from Rohde & Schwarz

The R&S®FS-K74 firmware option provides up to 1.5 code domain measurements per second, including EVM and PCDE calculation – the fastest measurement currently available on the market. The option seamlessly integrates into the R&S®FS-K72 option [*]. The measurement and result displays are identical, with the only difference being that any HSDPA signal that is present is automatically identified and included in all calculations. All measurements provided by R&S®FS-K72 – e.g. EVM versus chip, power versus timeslots – are also available with R&S®FS-K74.

The code domain display in the upper part of FIG 2 does not reveal that several 16QAM signals are present in the spectrum. In the lower part of FIG 2, the parameter values of the selected signal (marked red) are displayed, with 16QAM being indicated as the modulation format. The 16QAM modulation format can also be recognized from the symbol constellation diagram (FIG 3).

With the new application firmware options described in this issue, the Analyzers R&S®FSP, FSU and FSQ support numerous 2G, 2.5G and 3G standards and thus become true multistandard platforms.

Johan Nilsson

Additional articles on the R&S®FSP/FSU/FSQ are found on pages 18, 27, 30 and 36.

FIG 2
Code domain spectrum and overview of main modulation parameters.

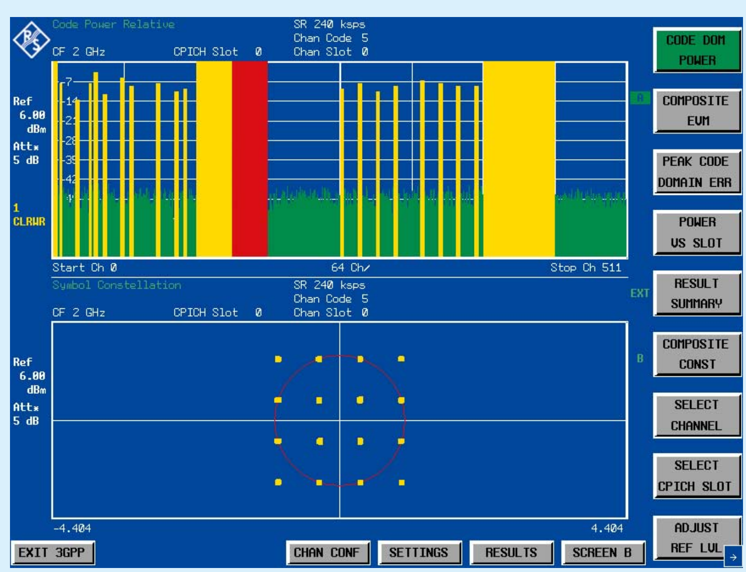


FIG 3
Constellation diagram of HSDPA code (marked red) using 16QAM.

Analyzers R&S®FSP/FSU/FSQ

Test of TD-SCDMA base stations

The new R&S®FS-K76 application firmware enhances the test functionality of the Spectrum Analyzers R&S®FSP and R&S®FSU and the Signal Analyzer R&S®FSQ. For the first time worldwide, R&S®FS-K76 now makes it possible to perform TD-SCDMA code domain measurements with a spectrum analyzer. TD-SCDMA (time division synchronized code division multiple access) is a new standard mainly endorsed by China. R&S®FS-K76 enables the peak code domain power and modulation accuracy of TD-SCDMA signals to be measured in the same manner as for WCDMA and cdma2000 signals.

TD-SCDMA – a new standard in two versions

TD-SCDMA has been specified by two different standardization organizations: 3GPP[1)] and the China Wireless Telecommunication Standard group (CWTS). The 3GPP TD-SCDMA standard is also known as the low chip rate (LCR) option of TDD, and the CWTS standard is also referred to as TD-SCDMA system for mobile communication (TSM). The main difference between the two standards is that TSM is intended for use with GSM core networks and LCR with UTRAN[2)]. The signals and measurements for physical layer tests are identical, with minor differences existing with respect to requirements.

CDMA systems differentiate between users by codes and not by frequencies. TD-SCDMA employs a chip rate of 1.28 Mchip/s and a bandwidth of 1.6 MHz. TDD systems operate on the same frequency in the uplink and the downlink, and differentiate between users by time division duplex (TDD). To avoid interference in the network, it is mandatory that the base station and the mobile phone do not transmit at the same time. To synchronize transmission of the mobile phones, the signal from the base station contains a downlink pilot timeslot (DwPTS).

FIG 1 shows the timeslot structure of a TD-SCDMA frame. The first timeslot (Ts0) of the frame is always used for transmission in the downlink, the second one (Ts1) in the uplink. The remaining timeslots can be configured by the network for either uplink or downlink transmission by moving the switching point. Either QPSK or – if very high data rates are to be achieved – 8PSK modulation is used for the different codes.

For a detailed analysis of the performance of a CDMA transmitter, looking at the spectrum alone is not sufficient, since CDMA systems differentiate between users by codes. It is therefore necessary for the analyzer to despread the signal and measure the power and quality of each individual code.

Code domain analysis

The main application of the new R&S®FS-K76 firmware is to determine the code domain power of the individual physical channels and to check each one for compliance with specified nominal values. Moreover, this measurement is ideally suited for detecting impairments in the transmitter.

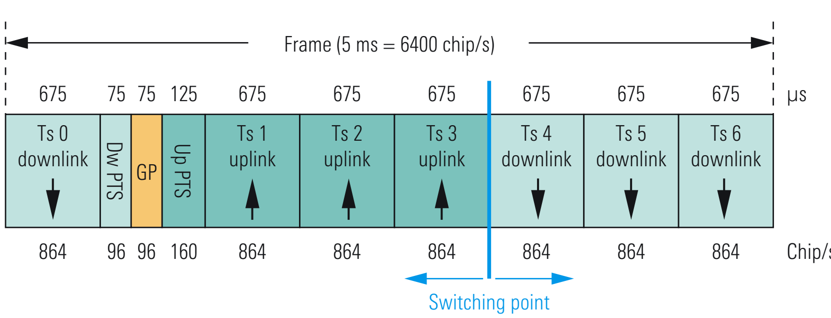


FIG 1
Time domain structure of TD-SCDMA signal.

1) Third Generation Partnership Project
2) UTRAN – UMTS Terrestrial Radio Access Network
UMTS – Universal Mobile Telecommunications System

The firmware automatically detects data rates and modulation formats, freeing the user from having to do so. All important modulation accuracy parameters, e.g. error vector magnitude (EVM), peak code domain error (PCDE) and frequency error, are available at a glance (FIG 2). Detailed analysis of all parameters can be performed very conveniently. An example of this is shown in FIG 3, where the EVM across all captured timeslots is displayed and can be checked for compliance with standard requirements.

Spectrum measurements

R&S®FS-K76 offers ready-to-run functions for the most common spectrum measurements, such as code domain power versus time, transmit power, adjacent channel power, as well as spectrum emission mask. The integrated RMS detector allows accurate transmitter power measurements irrespective of the modulation mode.

Multistandard platforms for 3G

With the new application firmware options described in this issue, the Analyzers R&S®FSP, FSU and FSQ support numerous 2G, 2.5G and 3G standards (FIG 4). All applications can be installed together, making the analyzers versatile multistandard platforms.

Johan Nilsson

Additional articles on the R&S®FSP/FSU/FSQ are found on pages 16, 27, 30 and 36.

More information and data sheets for the analyzers and options at www.rohde-schwarz.com

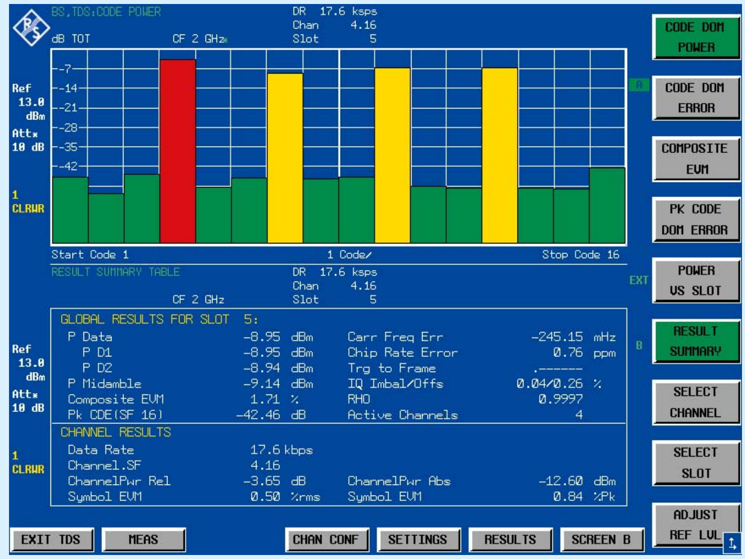


FIG 2 Code domain spectrum and overview of main modulation parameters.

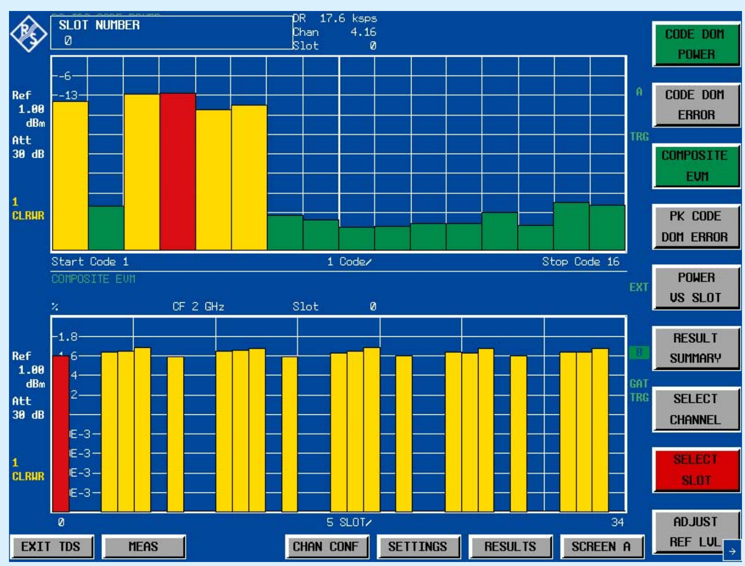
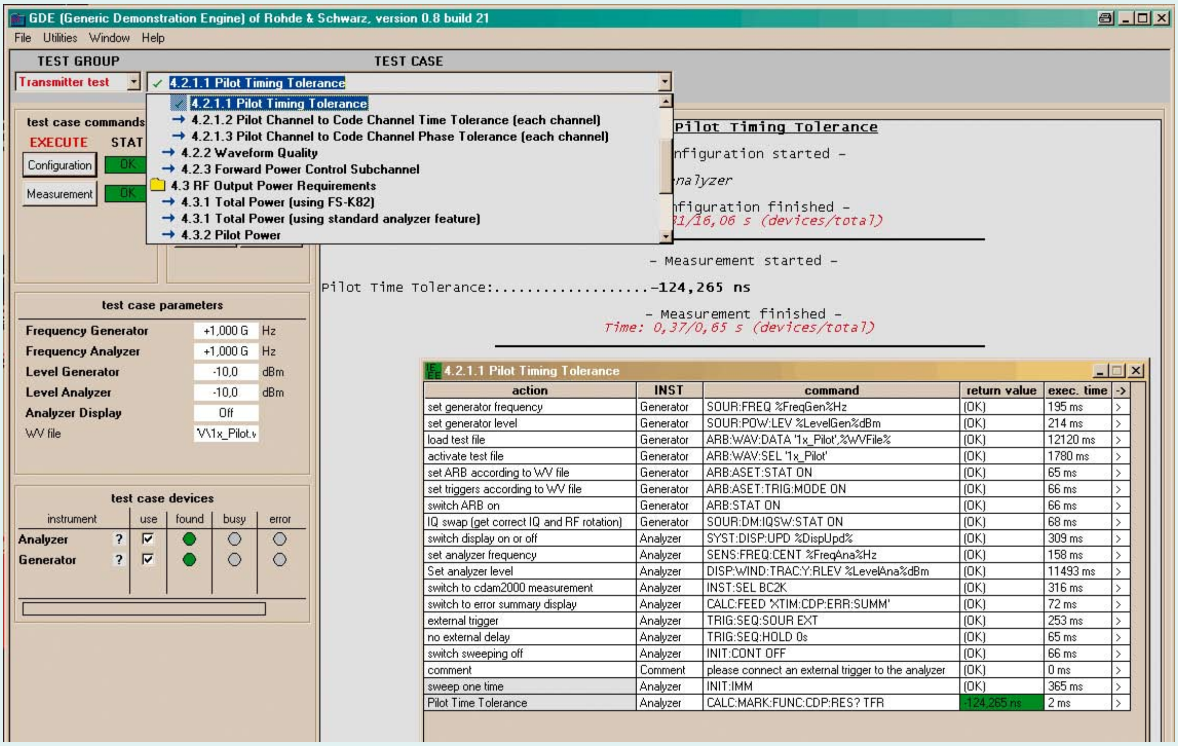


FIG 3 Composite EVM versus timeslots.

FIG 4 The analyzers support measurements to a variety of standards.

Option	Standard
R&S®FS-K5	GSM/EDGE
R&S®FS-K72	3GPP FDD base stations
R&S®FS-K73	3GPP FDD user equipment
R&S®FS-K74	3GPP HSDPA base stations
R&S®FS-K76	TD-SCDMA base stations
R&S®FS-K82	cdma2000 base stations
R&S®FS-K83	cdma2000 and 1xEV-DV mobile stations
R&S®FS-K84	cdma2000 and 1xEV-DO base stations

Measurements on cdma2000 base stations



The free-of-charge application software can be used to perform all tests on a cdma2000 base station.

Application note and software free of charge

The cdma2000 standard is being used in more and more countries, particularly in Asia. For base station measurements, the 3GPP2 C.S0010 standard ("Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations") specifies a total of 15 transmitter and 14 receiver measurements. These are subdivided into various test scenarios (e.g. different fading profiles). The tests require signal generators and analyzers with various options plus a variety of settings, which are extensive in some cases.

The application note 1MA61 "cdma2000 Base Station Test with R&S Equipment" covers all required base station measurements. A brief introduction provides all important details of the standard as related to measurements. This is followed by the instruments and options required for each measurement. Furthermore, the measurement procedure is described in written form and with a block diagram. Tips for performing tests correctly and instrument screenshots showing typical measurement results make implementing the tests easier. Tables provide a quick means of finding the required test instruments and signals.

Also available is free-of-charge application software which can be used to carry out all base station tests (FIG). For demonstration purposes or if RF components (e.g. base station output amplifier) need to be tested, the base station signal can be automatically generated with a signal generator.

Several methods are available by keeping the remote control sequence (provided as an individual file for each test) and program code separate from one another. The remote control sequences can be easily modified or copied directly from the file into a customer-specific program for instrument remote control. The application software carries out the tests and generates a straightforward report with the results. In addition, a measurement of the execution time and an error log permit detailed analysis of the program sequence. Performing tests multiple times makes it possible to assess the reproducibility of measurements.

Martin Weiss

More information at www.rohde-schwarz.com (search term: 1MA61)

Dual-Channel Arbitrary/Function Generator R&S®AM 300

Unprecedented wealth of signals for virtually any requirement

The new Dual-Channel Arbitrary/ Function Generator R&S®AM 300 ideally complements the Family 300 line of instruments, for example as a universal signal or trigger source, pulse generator or I/Q baseband signal source.

Function, arbitrary and I/Q baseband generator

A new member has now been added to the successful family of the R&S Smart Instruments™: the Dual-Channel Arbitrary/Function Generator R&S®AM 300 (FIG 1). Offering high versatility at a favourable price like the Spectrum Analyzer R&S®FS 300 and the RF Signal Generator R&S®SM 300 [1, 2], the R&S®AM 300 also comes with a wide frequency range and a variety of attractive functions built-in as standard.

The R&S®AM 300 combines the functionality of three instruments in one unit – a function, arbitrary and I/Q baseband generator. Unprecedented in this price category are the two user-configurable channels that make it easy to generate complex signals.

Like the other members of the Family 300, the R&S®AM 300 features a high-resolution 5.4" colour display that truly reproduces generated waveforms – even in the arbitrary mode. Any variation of a signal parameter can immediately be followed on the screen as the waveform changes. This is of great advantage especially in the dual-channel mode. The instrument's straightforward operating concept allows more than 100 parameters to be configured fast and conveniently.

FIG 1 Three in one – the R&S®AM 300 is a function, arbitrary and I/Q baseband generator featuring two user-configurable channels.

The generator supplies an extensive range of waveforms in a frequency range of 10 µHz to 50 MHz. The R&S®AM 300 not only provides the waveforms commonly found in function generators such as sine, triangle, ramp, square and noise but also any user-defined arbitrary signals. The optional R&S®AM 300-K2 Waveform Composer software (see box below) is a convenient development environment both for designing custom waveforms and for importing, editing and processing data from other sources such as Mathcad®, Matlab® or a digital oscilloscope. Using the remote control software, custom waveforms can be loaded on the instrument from an external PC via a USB cable or a USB memory stick. A minimum of 500 waveforms can be stored on a commercial 256 Mbyte USB memory stick and recalled on the instrument from a menu.

An outstanding feature of the R&S®AM 300 is its built-in dual-channel capability. This feature considerably extends the range of applications that require signals with a defined time relationship. When controlled by a common reference clock, the two channels operate in full frequency- and phase-synchronism, with phase offset selectable in steps of 0.01°. Apart from fully synchronized signals, the generator can supply two independent signals of different frequency.

The possibility of adding together the signals of the two channels is of interest in many applications. This feature allows complex test signals to be created even from simple standard waveforms, for example by the superposition of useful and interference signals.

Where instruments have to be integrated into test systems, correct triggering or synchronization is of crucial importance. The R&S®AM 300 has two sync outputs, whose signals can be linked with various internal events:

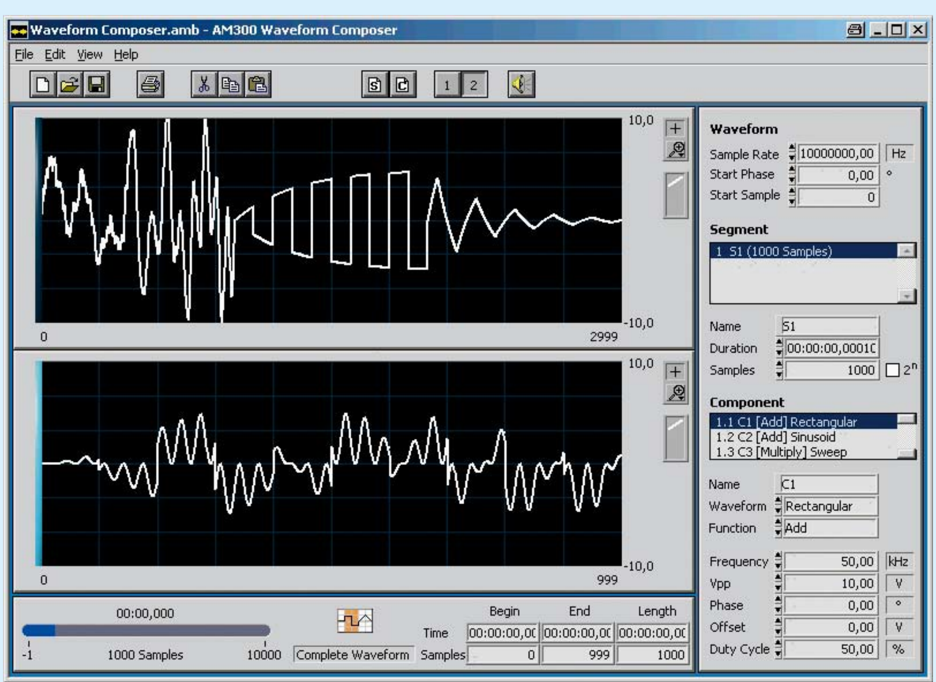
- Zero crossing of signal amplitude or phase
- Zero crossing of phase of modulation signal
- Internal or external trigger signal
- Waveform markers

The trigger system used allows operational sequences of the generator to be synchronized to external or internal events. Signals can be time-controlled by trigger events via adjustable gates. Available functions include sample & hold, block end and burst. They enable signal bursts of a defined time or with a defined number of cycles to be generated. The repetition rate of the signal

Arbitrary waveform generation made easy – with the R&S®AM 300-K2 Waveform Composer software from Rohde & Schwarz

The optional Waveform Composer software makes it possible to generate and edit virtually any arbitrary waveform and display it on screen while being created:

- Definition of waveforms by segments that may contain different components
- Linking of various waveforms (components) of a segment by addition, multiplication, division or subtraction
- Analytical (by mathematical expressions), graphical or point-by-point waveform definition
- Simultaneous display of two different waveforms
- Import of numerous waveform formats
- Setting of markers to be issued at the sync outputs
- Comprehensive editing tools and zoom functions for waveform processing



bursts as well as the gate length can be controlled by the instrument's internal trigger generator or an external signal.

The integrated modulator of the R&S®AM300 provides AM, FM, φM, PSK and FSK modulation. Complex test signals for a variety of applications can thus be generated. AM signals created with the generator have a dynamic range wider than 60 dB, which is ideal for testing the dynamic response of receivers (automatic gain control (AGC) loops).

In designing the instrument, particular importance was attached to the output signals meeting exacting quality standards. The vertical resolution of 14 bits makes for high signal quality and accuracy of the set parameters. This becomes evident when looking at the spectrum of an AM signal with 100% modulation depth (FIG 2). Modulation distortion is no more than 0.01%; phase noise is very low.

The frequency accuracy and the phase noise primarily depend on the characteristics of the reference frequency generator. The R&S®AM300 uses a high-grade temperature compensated crystal oscillator (TCXO) with a temperature drift as low as 1 ppm. From the reference frequency thus obtained, the variable clock for arbitrary waveform generation is derived by means of direct digital synthesis (DDS), which ensures that the high-quality characteristics of the reference signal are maintained. An external reference frequency can also be used for synchronization; in this case, the frequency and the phase noise are mainly determined by the external reference. ▶

Any application you like

There is virtually no area of electronics where the user will not profit from the advantages of the R&S®AM300. In medical electronics, for example, the generator simulates slow signals such as cardiac rhythms; in the automobile industry, it delivers acceleration sensor signals for triggering airbags or controlling anti-skid systems. Moreover, the generator is ideally suited as a broadband I/Q modulation source for generating digitally modulated signals, e.g. for the RF Signal Generator R&S®SM300. All these applications with their widely differing range of requirements in terms of signal frequency and channel characteristics are perfectly covered by the R&S®AM300. On pages 24 and 25, you will find a selection of typical application examples illustrating the virtually unlimited possibilities offered by this extremely versatile generator.

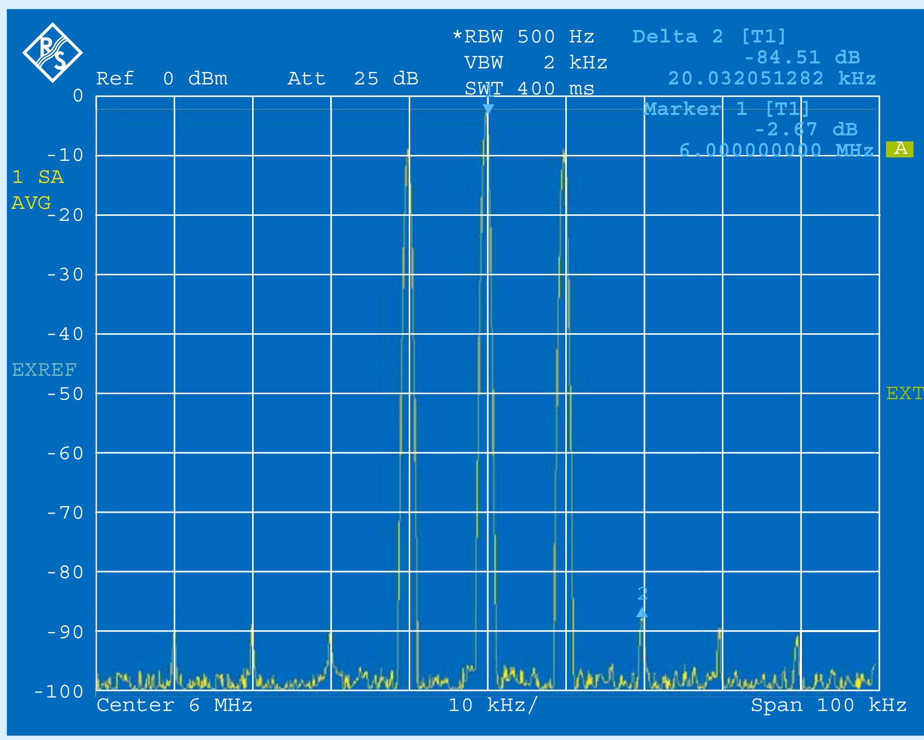
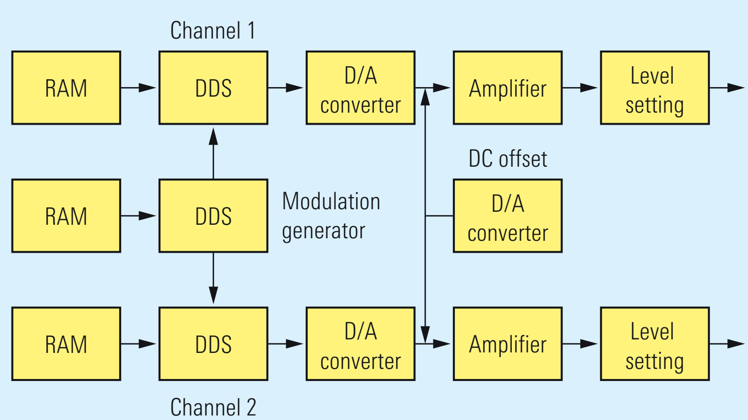
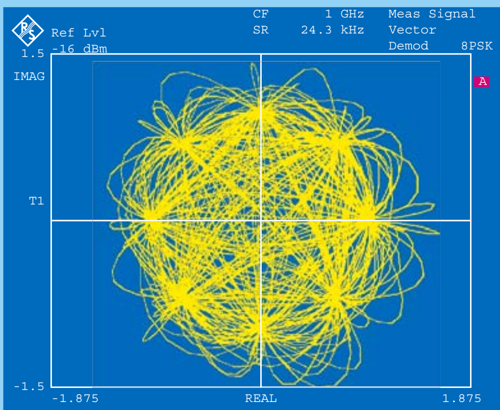


FIG 2 Output spectrum of an amplitude-modulated sine signal with 100% modulation depth.

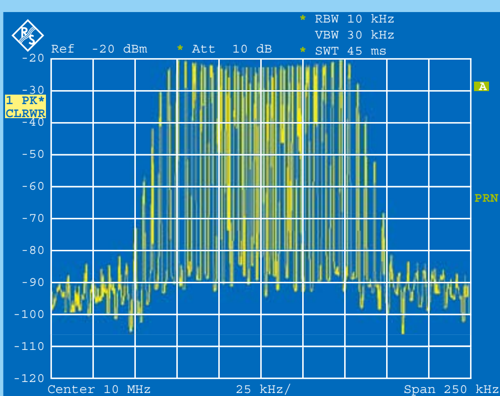
FIG 3 Block diagram of the R&S®AM300.



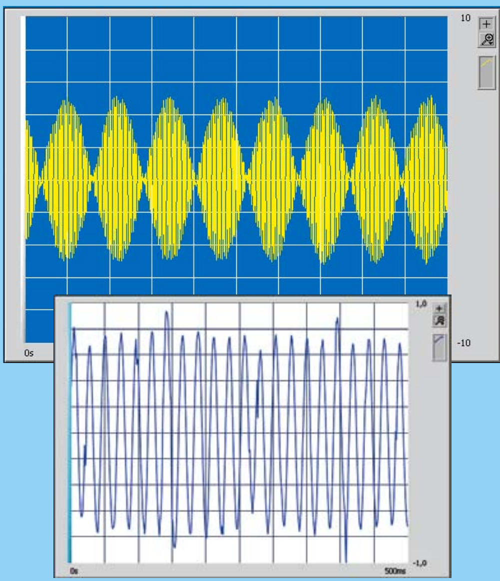
Dual-Channel Arbitrary/Function Generator R&S®AM 300 …



Constellation diagram of 8PSK-modulated signal.



Spectrum of FM signal.



Top: two-tone signal with superimposed noise (e.g. ringing of a phone). Bottom: sensor signal recorded with a digital oscilloscope.

Development and testing of modules and components for analog and digital communication systems (GSM, WLAN, etc)

Testing of amplifiers, filters, receivers or switches with digitally modulated signals

◁ The R&S®AM 300 serves as an I/Q source and controls the I/Q inputs of a vector signal generator, e.g. the R&S®SM 300. The I/Q data for the generator is created by means of a mathematical program such as Matlab. The quality of the DUT output signals is tested by means of a spectrum or signal analyzer, e.g. the R&S®FS 300 or the R&S®FSQ. With its two sync outputs, the R&S®AM 300 can also be used as a clock or trigger source.

Measurements on analog systems requiring a wide range of different test signals:

- Precise oscillator signals, e.g. replacing LO signals
- Modulation signals with arbitrary waveforms
- AM, FM or φM signals

◁ The R&S®AM 300 supports the analog AM, FM and φM modulation standards. For tests in the lower IF range (<35 MHz), the generator supplies the signals already modulated. In higher frequency ranges, its output signal is fed to the AM or FM input of a signal generator, e.g. the R&S®SM 300. The R&S®AM 300 supplies sine signals of excellent quality in terms of harmonics and phase noise.

Simulation of signals

Simulation of sensor signals or the starting characteristic of power supplies – a frequent requirement in electronic circuit design

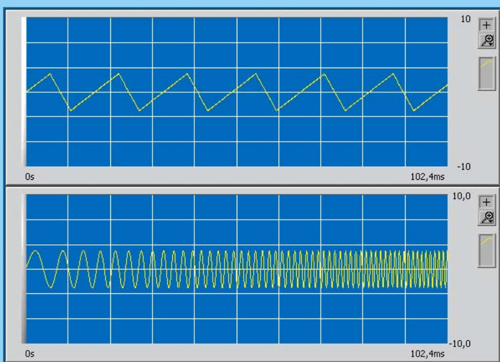
◁ Arbitrary waveforms – generated on a PC with the Waveform Composer software or another waveform editor – are loaded into the generator memory. By appropriately setting the sampling rate, amplitude and phase on the R&S®AM 300, a variety of test scenarios can be created.

Reproduction of signals captured with an oscilloscope

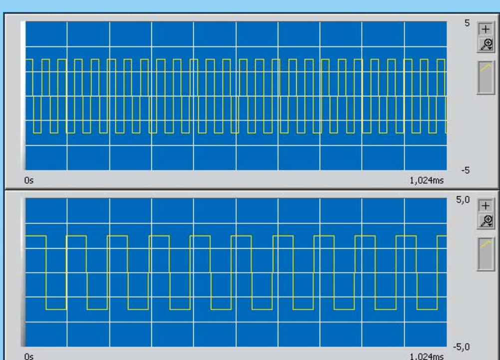
In many cases, signals created on a PC are not adequate for testing electronic circuits. Some tests require “real” sensor signals that can be correctly generated only in a real test environment (e.g. for automobile crash tests).

◁ This can easily be accomplished with the R&S®AM 300: The sensor signal is sampled with an oscilloscope or an A/D converter and loaded into the waveform memory of the generator. The Waveform Composer software includes filters for importing a variety of file formats. The generator then reproduces a signal that is an exact copy of the original signal.

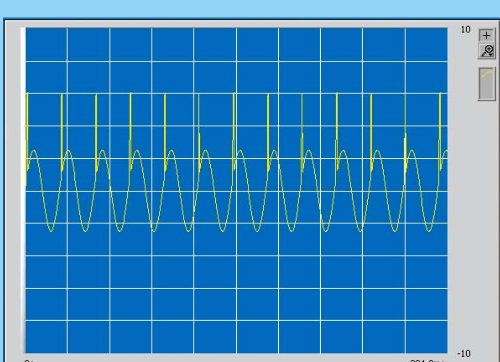
… virtually unlimited applications



Triangle and sweep function generator signals.



Square signals of different frequency for synchronizing measuring instruments.



Sine signal with superimposed pulsed interference.

Development and tests involving mixed signals

Troubleshooting of circuits with mixed signals by using external signals

Frequently, parts of an electronic circuit do not operate properly in the beginning. In such cases, external signals supplied by a function generator can prove very helpful in analyzing the defective circuit elements.

◁ The R&S®AM 300 provides a wide variety of waveforms that can be used as external signals for circuit testing.

Synchronization of electronic circuits and measuring instruments

To measure electrical signals in circuits, trigger signals are needed that are not always available.

◁ For applications of this type, the R&S®AM 300 supplies trigger signals of different frequency in the two channels that are perfectly suited for controlling external measuring instruments.

Testing of susceptibility of electronic circuits to interference

Susceptibility to interference is an important characteristic of electronic circuits. Suitable test signals consist of an ideal signal with superimposed noise, pulsed interference, etc.

◁ The two channels of the R&S®AM 300 make it possible to simultaneously generate the useful signal and the interference signal. Adding the output signals of the two channels together yields a test signal that includes both components. By varying the parameter values in a desired channel (e.g. amplitude or phase), different test scenarios can be simulated quickly and easily.

Condensed data of the R&S®AM 300

Max. frequencies	35 MHz sine, 50 MHz square, 100 Msample/s arbitrary, 500 kHz for triangle, ramp and exponential
Standard functions	sine, square, triangle, ramp, pulse, noise, exponential
Modulation	AM, FM, φM, FSK, PSK
Arbitrary waveforms	100 Msample/s, 256k points per channel
Amplitude range	1 mV to 10 V (V_{pp}), with 14-bit resolution
Pulse	20 ns to 9999 s selectable pulse width; rise time <10 ns
Sweep	linear and logarithmic
Trigger	1 trigger input, 2 sync outputs
Burst	1 to 65 535 cycles per burst

Well-thought-out design, tried-and-tested concept

The R&S®AM 300 is based on components of the Family 300 platform that have already proven successful in the R&S®FS 300 and R&S®SM 300. The operating concept, too, follows a common philosophy.

Signal generation in the R&S®AM 300 is DDS-based. The core of each direct digital synthesizer is formed by a 48-bit phase accumulator, which determines the instantaneous phase value of the signal to be generated. The phase accumulator output signal is used to access the waveform memory, which contains the digital signal data. For each channel of the generator, 256k-point waveform memory is available.

Modulation also employs a DDS system (FIG 3). Depending on the selected modulation, the data read from the modulation waveform memory controls either the carrier frequency via the DDS of the respective channel, the signal phase by adding together the phases, or the signal amplitude by multiplying the carrier amplitude by a value from the waveform memory. Digital modulation yields excellent signal characteristics and high reproducibility of signal parameters.

State-of-the-art digital/analog converters offer outstanding performance characteristics. Owing to the well-thought-out design of the analog modules, this high performance is maintained up to the output of the generator. The use of complex calibration and correction algorithms ensures that the set parameter values remain within specified limits irrespective of the temperature and other settings.

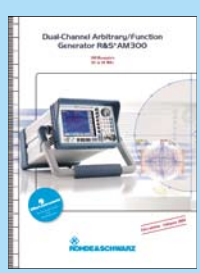
Remote control via USB

The R&S®AM 300 can be remote-controlled from a PC via its USB interface, which is implemented as standard. Software drivers for LabView and LabWindows/CVI are available; other software drivers can be linked in the form of dynamic link libraries (DLLs) to all common development environments (Visual Basic, C++, Delphi, Matlab, etc) in all common programming languages. The command structure used for the drivers is the same as in other function and arbitrary signal generators and is designed for fast programming of the instrument. Software drivers can be downloaded from the Internet and are continuously updated for all Rohde & Schwarz instruments.

In addition to the software drivers, a free software application is available for the R&S®AM 300 that allows convenient remote control of the instrument from a PC without any programming expertise being required. This application forms the interface between the Waveform Composer software and the generator and supports all commands of the instrument; in addition, it allows all instrument settings to be stored on hard disk.

The software can be started separately for each instrument of the Family 300 connected to the PC, which means that several units of this family can be controlled simultaneously. Measurement tasks involving several units can thus be controlled from a single PC. Commercial USB cables are used for connection to the PC, eliminating any need for expensive extra hardware such as IEC/IEEE bus cards.

More information and data sheet at www.rohde-schwarz.com (search term: AM 300)



REFERENCES
[1] Spectrum Analyzer R&S®FS 300: Favourably priced and universal for laboratory, service and production. News from Rohde & Schwarz (2003) No. 177, pp 20–23
[2] Vector Signal Generator R&S®SM 300: Wide variety of test signals at an excellent price. News from Rohde & Schwarz (2003) No. 180, pp 28–31

Summary

The Dual-Channel Arbitrary/Function Generator R&S®AM 300 is a real all-rounder, combining a wealth of functions and applications in a single unit. Whether as a signal generator for standard or arbitrary waveforms or as a baseband source for digital modulation, the R&S®AM 300 offers superb signal quality at a favourable price.

With its outstanding characteristics – including a high sampling rate, two channels and a variety of modulation modes, to name just a few – the generator is ideally suited for solving any demanding task in the development lab. The capability of creating arbitrary waveforms on a PC and downloading them on the instrument opens up virtually unlimited possibilities in waveform generation.

The third instrument of this line also offers the user the well-known advantages of the Family 300 platform concept: wide range of functions, compact design, 5.4" colour display, effective RF shielding, universal carrying handle and a user-friendly operating concept – all of which facilitate measurements.

Robert Obertreis; Rudolf Reckziegel

Signal Analyzer R&S®FSQ

New functions of optional Vector Signal Analyzer R&S®FSQ-K70

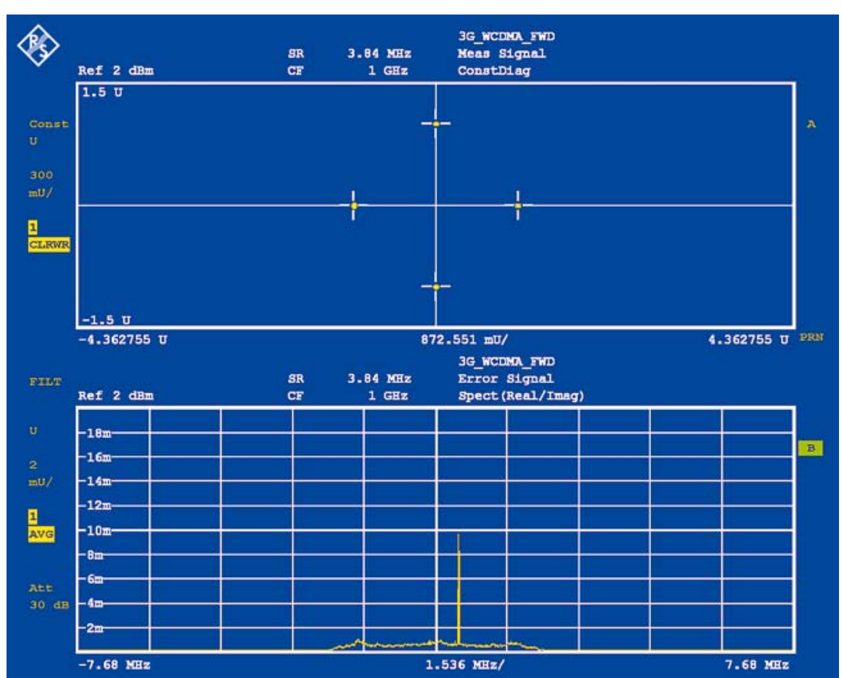
Application Software R&S®FSQ-K70, introduced a year ago as a new option for the Signal Analyzer R&S®FSQ [1], now includes new functions. In addition to the spectral analysis of modulation errors, R&S®FSQ-K70 now offers measurements with a symbol rate of up to 25 Msymb/s. The display of AM/AM and AM/φM compression characteristics is complemented by the automatic measurement of the compression point. All measurements possible with the option can be carried out not only via the RF input, but also via the analog I/Q baseband input (option R&S®FSQ-B71) of the signal analyzer.

Spectral analysis functions

In addition to result displays in the time domain (e.g. EVM, real and imaginary component, frequency or magnitude versus time), R&S®FSQ-K70 now offers spectral analysis functions. For example, the EVM measurement trace can, at a keystroke, be switched to an error spectrum with selectable linear or logarithmic level scaling. The fixed FFT length of 4k points yields a frequency resolution so high that interference in the error spectrum can conveniently be identified. Spectral measurements can be performed on test signals synchronized to the frequency and the symbol clock as well as on non-synchronized raw signals, in many cases freeing the operator from having to switch between the vector signal analyzer mode and the spectrum analyzer mode.

FIG 1 (lower diagram) shows the spectrum of an I/Q error signal. A sinewave carrier is superimposed on the WCDMA test signal; the carrier power is 40 dB lower than the useful signal power. The interfering carrier is hardly visible in the constellation diagram (FIG 1, upper dia-

FIG 1 Spectral analysis of a WCDMA signal with superimposed sinewave interference. Top: constellation diagram; bottom: spectrum of error signal.



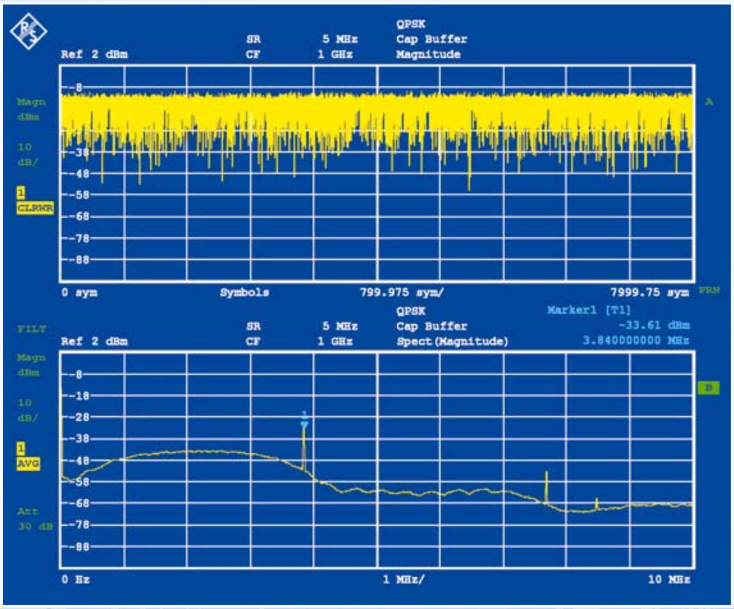


FIG 2 Top: raw signal in capture buffer.
Bottom: magnitude spectrum of raw signal in capture buffer.

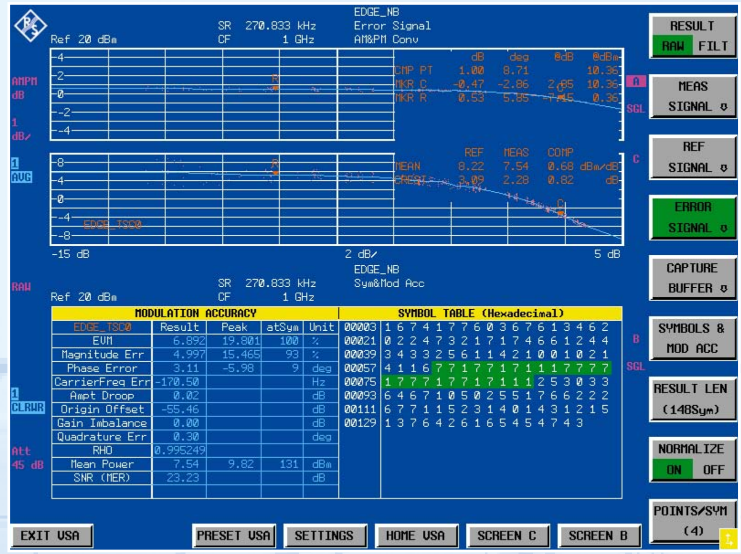


FIG 3 Measurement of 1 dB compression point using an EDGE burst as an example.

FIG 4
Zoom view of FIG 3 – compression point (1 dB), reduction of mean power and of crest factor at current modulation of DUT.

FIG 5 Adjacent channel interference indicated by raised shoulders in WCDMA signal spectrum.
Top: distortion characteristics of AM/AM and AM/φM conversion; bottom: raw signal spectrum (capture buffer).

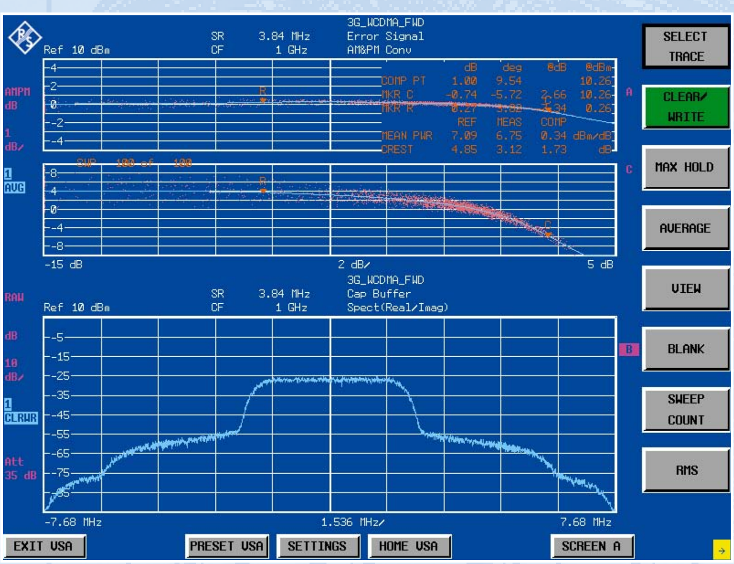
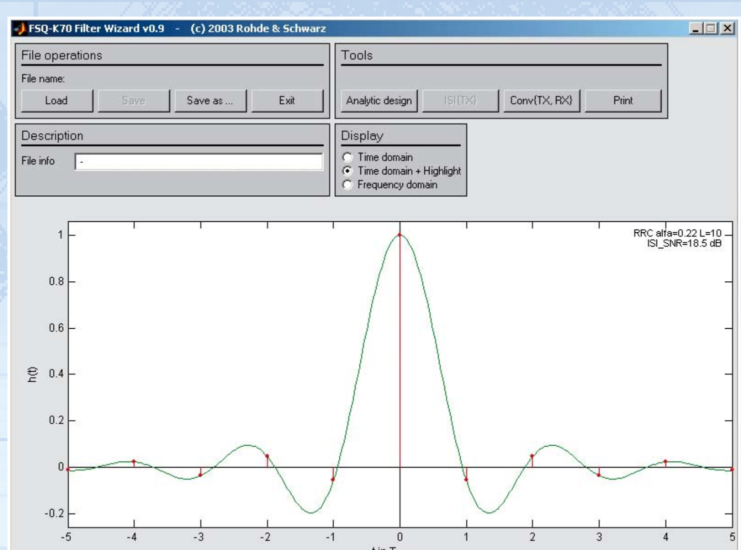


FIG 6 FILTWIZ software for conversion of user-specific filters.



gram) but clearly discernible in the spectrum of the error signal. This measurement is very helpful, such as in identifying and removing modulation interference caused by switched-mode power supplies in mobile radio transmission equipment.

Measurements on I/Q raw signal

New opportunities for analyzing non-synchronized raw signals are made possible by the display of their real and imaginary components plus FM demodulation. For example, the synthesizer transient response can be examined. In addition, the fact that the magnitude spectrum of many PSK- or QAM-modulated signals contains a spectral line at the frequency of the symbol rate (FIG 2) opens up yet another application of interest: Assume, for example, that you analyze an unknown signal at a sampling rate of 20 MHz and that the result shows a spectral line at the symbol rate of 3.84 MHz. This spectral line indicates a WCDMA signal. Measurements of this type thus make it possible to detect and categorize unknown modulation signals.

Automatic measurement of compression point

In addition to the normalized compression characteristic, R&S®FSQ-K70 now determines the compression point and displays the DUT compression at the current modulation (FIGs 3 and 4). By comparing the average power of the test signal with the theoretical average power of an undistorted signal (reference signal), R&S®FSQ-K70 determines the compression ratio (FIG 5, upper diagram, MEAN PWR). Likewise, it reveals the reduction of the crest factor due to compression. The spectral display of the raw signal provides information about adjacent channel interference; the raised shoulders right and left of the transmission channel indicate the power injected into the adjacent channels (FIG 5, lower diagram). Due to these enhanced analysis features, the dynamic compression of a DUT can for the first time be analyzed directly and need not be derived from secondary test parameters (e.g. EVM).

Comprehensive import and export capabilities

Standards, demodulation filters and mappings can be exported from and imported into the instrument at a keystroke. Measurement settings that have been validated and stored in the development lab can thus be transferred to instruments in production fast and easily. User-specific mappings created with MAPWIZ [2] software, described in an earlier issue of News, can be loaded into the instrument in this way. Moreover, the new Windows® FILTWIZ software package [3] now allows user-specific filters to be converted to the R&S®FSQ-K70 format and suitable receive filters to be calculated that can be used in the instrument (FIG 6). The R&S®FSQ is thus the only signal analyzer that can demodulate single-carrier signals with user-defined mappings and filters.

More information and data sheet at www.rohde-schwarz.com

REFERENCES

[1] Signal Analyzer R&S®FSQ – Application software for precise vector signal analysis. News from Rohde & Schwarz (2003) No. 178, pp 32–34

[2] Search term: MAPWIZ

[3] Search term: FILTWIZ

[4] Search term: FSQ-K70

Summary

All measurement and analysis functions provided by the R&S®FSQ-K70 software option can also be carried out via the analog I/Q baseband input. This means that vector signal analysis can be performed on RF, IF and baseband signals with just a single instrument. The new measurement functions, e.g. error analysis in the spectral domain and determination of DUT compression, make R&S®FSQ-K70 a software package with unique features.

Given the wide range of options now available for the R&S®FSQ, this signal analyzer has become one of the most compact solutions for spectrum, vector, mobile radio and WLAN measurements. Due to the wide variety of analysis and evaluation functions, the R&S®FSQ can perform tasks that would otherwise require several instruments.

As usual, the software update for instruments running on Windows® NT or Windows® XP can be downloaded free of charge from the Rohde & Schwarz homepage [4].

Hagen Eckert

Additional articles on the R&S®FSQ are found on pages 16, 18, 30 and 36.

The broadband option R&S®FSQ-B72 for the Signal Analyzer R&S®FSQ from Rohde & Schwarz makes it possible for the first time to analyze bandwidths up to 120 MHz with excellent level and phase accuracy by using just a spectrum analyzer. Thus, the R&S®FSQ once again proves that it is first class in the analysis of extremely broadband signals. It also sets new standards in dynamic range as well as amplitude and phase accuracy with large bandwidths.

Additional articles on the R&S®FSQ are found on pages 16 18, 27 and 36.

Signal Analyzer R&S®FSQ

Broadband signal analysis up to 120 MHz

New requirements for signal analysis

The trend in communications has long been toward ever faster transmission speeds and thus larger bandwidths in the transmission channels. Combining several channels into one transmit path places higher and higher demands on amplifiers or mixers with regard to bandwidth, amplitude accuracy and phase stability. T&M instruments – especially in spectrum analysis – must keep pace with this development, because far more is clearly demanded of them than of the components to be measured.

The demands placed on output amplifiers of modern base stations (multicarrier power amplifiers) are increasing disproportionately to the number of carrier signals to be transmitted in parallel. Amplifier performance with respect to nonlinear distortion largely determines the transmission quality of the entire system. Feed-forward compensation increases the dynamic range of the amplifier and reduces distortion and thus the resulting adjacent channel power. An important requirement when adjusting the compensation is that the wanted carrier signals and their (unwanted) intermodulation products be detected simultaneously and with high precision by a T&M instrument.

With satellites, transponders still operate at a channel bandwidth of 36 MHz, although the expansion to 72 MHz will soon be available. The modulation quality needs to be assessed for the entire transmission range, i.e. at least the channel bandwidth is required as the bandwidth for signal sampling.

The entire occupied bandwidth needs to be detected in one operation also in the case of pulse spectra as typically used, for example, in radar measurements. Even higher requirements for level accuracy and phase linearity are involved, because the phase performance is of fundamental importance to the transmission system.

FIG 1
Typical level drift across the frequency within the analysis bandwidth.

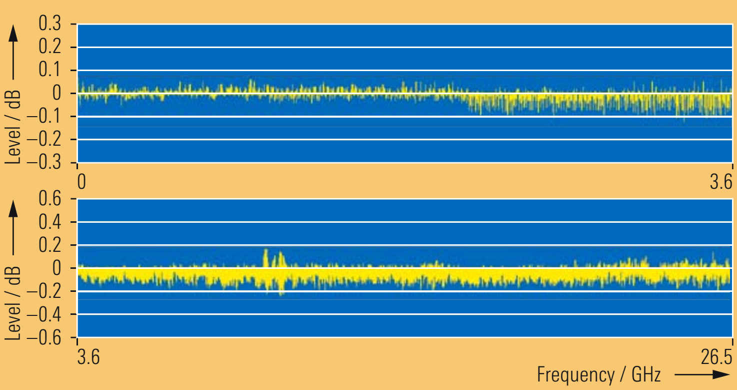
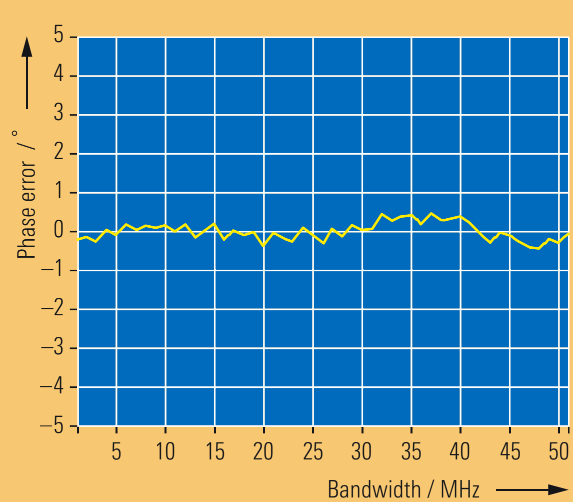


FIG 2
Typical phase drift at an analysis bandwidth of 50 MHz.



The ideal solution in this case is to perform broadband sampling of the signal in the time domain and then to calculate the power spectrum by means of fast Fourier transformation (FFT). However, this method places extremely high demands on the characteristics of the signal analyzer in use:

- The analysis bandwidth must cover the useful signals as well as any intermodulation products. For a signal with four carriers and a 5 MHz channel bandwidth, for example, a bandwidth of 60 MHz is necessary in order to detect all third-order intermodulation products.
- The entire analysis bandwidth must be free of interference products from the analyzer.
- The level and phase drift within the analysis bandwidth must be significantly lower than that of the DUT.

New dimensions in spectrum analysis

With the option R&S®FSQ-B72, the R&S®FSQ opens up a new dimension in spectrum analysis. The usable analysis bandwidth ranges from 60 MHz for frequencies ≤3.6 GHz up to 120 MHz for frequencies >3.6 GHz. Even as the option was being designed, special emphasis was placed on low tolerances within the analysis bandwidth. The result is impressive: Level drifts of <0.3 dB within the analysis bandwidth for frequencies up to 3.6 GHz and of <0.8 dB for higher frequencies are unprecedented in this class of instruments (FIG 1). This is accompanied by a phase drift of typically only ±2° for the entire frequency range (FIG 2).

This makes the R&S®FSQ ideal for the analysis of broadband, digitally modulated signals. With satellites, for example, the measurement of EVM and other modulation parameters becomes child's play when the vector signal analyzer option (R&S®FSQ-K70) is used. FIG 3 shows the spectrum and the modulation parameters of a QPSK signal with a 50 MHz symbol rate, generated with the Signal Generator R&S®SMU200 and recorded with the vector signal analyzer option of the R&S®FSQ.

FIG 4 shows the spectrum of a multicarrier sinewave signal that covers the entire 120 MHz range of the analysis bandwidth. In this case, the result was extracted as I/Q data from the instrument and then graphically processed. A usable dynamic range of typically 58 dB at 100% modulation by the input signal also meets any requirement in this regard.

Ottmar Steffke

FIG 3 Spectrum and modulation parameters of a QPSK signal with a 50 MHz symbol rate.

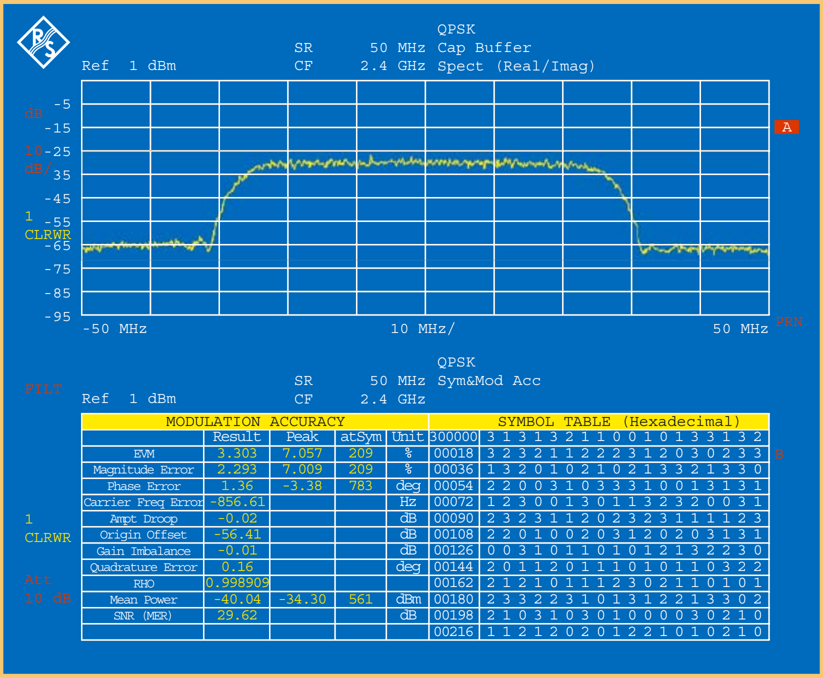
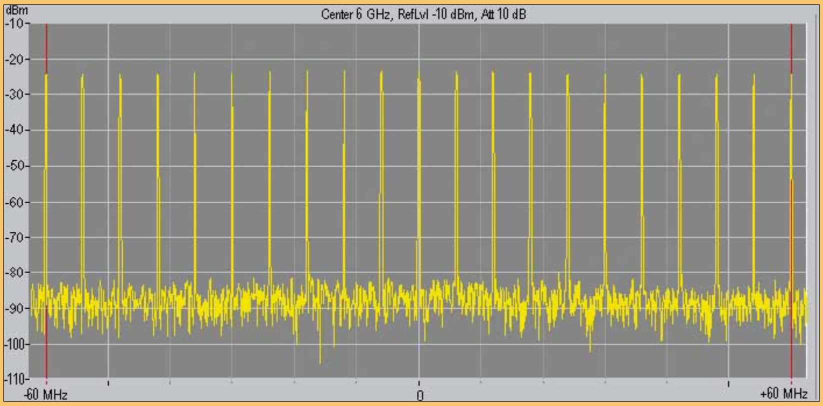


FIG 4 Multicarrier sinewave signal with an analysis bandwidth of 120 MHz.



Handheld Spectrum Analyzer R&S®FSH 3

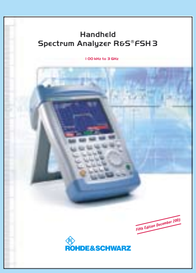
Numerous expansions and a new model

Since introducing the Handheld Spectrum Analyzer R&S®FSH 3 (FIG 1) in July 2002, Rohde & Schwarz has added many new functions and features as well as a new model. The R&S®FSH 3 is now the most versatile instrument in this segment.

43888/36b

FIG 1 Vector reflection measurement with the R&S®FSH 3 and the VSWR Bridge and Power Divider R&S®FSH-Z2.

More information and data sheet at www.rohde-schwarz.com (search term: FSH 3)



REFERENCES
[*] Handheld Spectrum Analyzer R&S®FSH 3 – New mobility in spectrum analysis. News from Rohde & Schwarz (2002) No. 175, pp 20–25

Success through versatility

High market acceptance and feedback from numerous customers prompted Rohde & Schwarz to transform the Handheld Spectrum Analyzer R&S®FSH 3 [*] into an RF multifunctional analyzer: It now also functions as a power meter, cable and antenna analyzer as well as a vector network analyzer. It thus provides the four most important RF analysis functions that developers, service technicians and installation and maintenance crews need in their day-to-day work. For example, it can be used in the maintenance or installation of transmitter systems (e.g. checking cables and antennas), in the assessment of signal quality in broadcasting, private mobile radio and service (e.g. measuring electric field strength) or in simple lab applications. The R&S®FSH 3 can handle any of these tasks quickly and reliably because of its simple operation, high measurement accuracy and robustness.

New model with preamplifier

The R&S®FSH3 is now available in three models. Model 03 with resolution bandwidths from 100 Hz to 1 MHz is the basic analyzer. Since February 2004, it includes a preamplifier as standard. This preamplifier increases sensitivity by approx. 15 dB. Model 13 offers resolution bandwidths from 1 kHz to 1 MHz plus a tracking generator, which is a prerequisite for network analysis and distance-to-fault measurements. Top-of-the-line model 23 additionally includes a 20 dB preamplifier, resolution bandwidths from 100 Hz to 1 MHz and a selectable output level for the tracking generator (–20 dBm/0 dBm). The integrated adjustable preamplifier ensures a displayed average noise level of typically less than –135 dBm, which is useful for displaying very weak signals. Dense signals are reliably selected by means of the additional bandwidths of 100 Hz and 300 Hz. The higher 0 dBm output power of the tracking generator also allows interference-proof distance-to-fault measurements.

Vector reflection and transmission measurements

The R&S®FSH3 can also handle measurement tasks that are normally possible only with a vector network analyzer. In reflection measurements, the analyzer displays the results in a Smith chart and allows the user to perform a detailed analysis of DUT matching (FIG 2). In addition, it uses vector system error correction in calibration. This procedure offers significant advantages with regard to measurement uncertainty particularly in the case of well matched DUTs, as shown in the following example. At 900 MHz, the return loss of an antenna is approx. 20 dB. In scalar measurements, the measurement uncertainty is between +2 dB and –2.6 dB. In vector measurements, it is only 0.6 dB. In the first case, the high measurement uncertainty may lead to unnecessary replacement or repair of the antenna.

This method also comes in handy with transmission measurements, because the dynamic range can be increased from 60 dB in scalar measurements to 80 dB for vector measurements by reducing the internal crosstalk.

Higher resolution in distance-to-fault measurements

With the R&S®FSH3, the horizontal resolution (distance) in the case of distance-to-fault (DTF) measurements is determined by the display resolution of 301 pixels. For a 30 meter cable, this yields a maximum resolution of 10 cm. A zoom function allows significantly higher resolution and uses an expanded FFT algorithm that calculates 1024 pixels. The resolution of a 30 meter cable is 2.9 cm in this case. FIG 3 shows the zoom function activated for precise analysis of a cable fault. In addition to the actual reflection location, a second one is seen that is caused by a line connector of approx. 10 cm in length.

FIG 2 Vector reflection measurement of a multicircuit bandpass filter.

FIG 3 Application of the zoom function with distance-to-fault measurement.

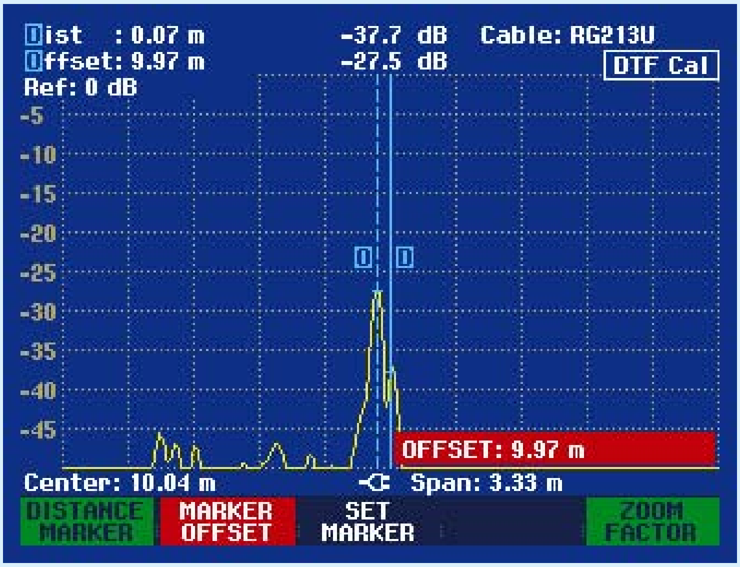


FIG 4 The R&S®FSH3 with the new Directional Power Sensor R&S®FSH-Z44.

Additional new features

- Limit lines with limit monitoring (FIG 7)
- Positive or negative frequency offset for measurements on frequency-converting DUTs
- Multimarker mode, six markers or delta marker
- Standard measurement routine for determining the occupied bandwidth with modulated signals
- One-port cable loss measurement
- External reference input
- Minimum sweep time 20 ms (previously 100 ms)
- Minimum marker and minimum peak detektor
- Storing of antenna factors, cable models and limit lines together with all settings and measured values
- Higher resolution of the VSWR display (1 to 1.1 and 1 to 1.5) for extremely well matched DUTs
- High-resolution level display 1 dB/div
- Switchover to monochrome display and transreflective display for better contrast in the case of strong solar radiation in the field

FIG 6 Field strength measurement with the R&S®FSH3 and the active Directional Antenna R&S®HE200.

FIG 5 Simultaneous display of the transmitter output power and the antenna matching.

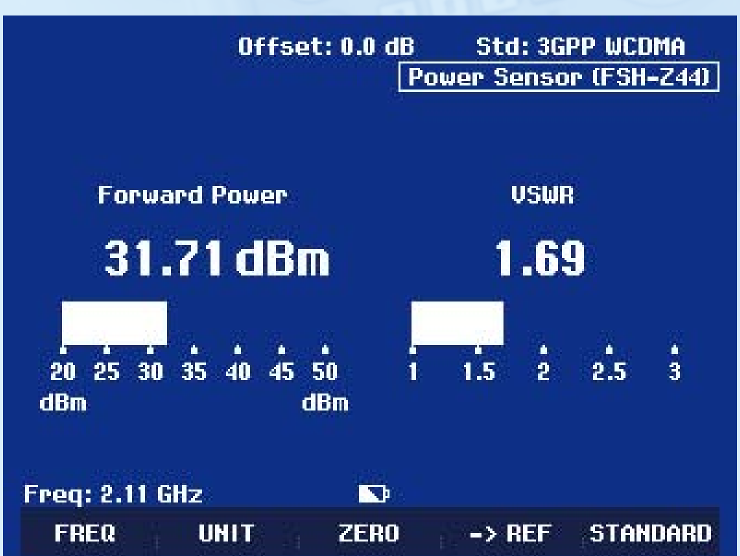
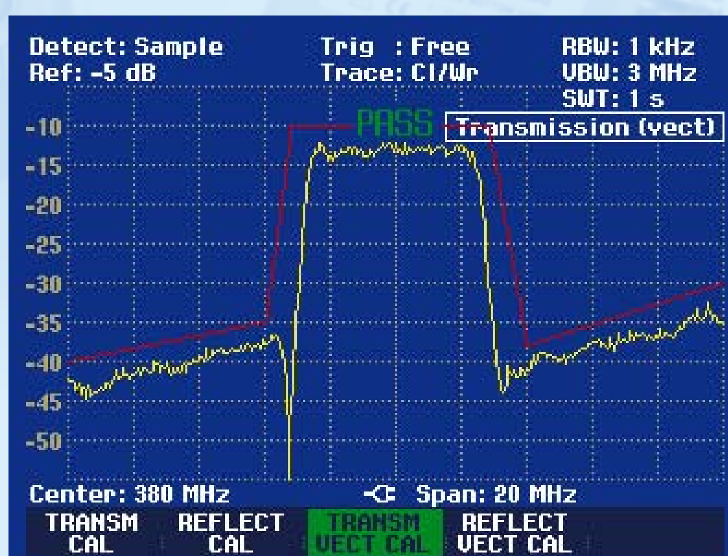


FIG 7 Testing of a bandpass filter by using a limit line.



Selectable frequency range for distance-to-fault measurements

With the method used by the R&S®FSH3 for distance-to-fault measurements, the frequency range required for the measurement is significantly dependent on the cable parameters (length and velocity factor). In the case of DUTs with an operating frequency range smaller than that required for the measurement, the R&S FSH3 allows the user to specify the frequency range. It adapts the length resolution to the specified frequency values. It is therefore possible, for example, to measure a cable that is specified only up to 1 GHz without exceeding the cable's operating frequency range.

Simplified use in the field

To minimize the time required for calibration in scalar network analysis and distance-to-fault measurements, the user can store the calibration data together with the measurement results. After the stored data set is reactivated, the measurement is started immediately without recalibration.

The additional analysis of the phase information in the DTF measurement reduces the number of calibration steps by 50% because calibration is performed only with a short circuit. To ensure the quality of the calibration, the R&S®FSH3 constantly monitors the instrument temperature. If the temperature has changed significantly between calibration and measurement, the analyzer indicates this change, thus helping rule out unnoticed measurement errors.

Handling of the cable parameters for the DTF measurement was simplified further. The required cable models are usually generated, modified and loaded into the analyzer by using Control Software R&S®FSH View on the PC. The most commonly used cable types are predefined and are supplied with the R&S®FSH. However, if field use reveals that the cable type to be measured is not included in the R&S®FSH3 cable model list, the cable parameters can also be entered directly on the R&S®FSH3 without a PC.

Power measurements

In addition to the power sensor for up to 8 GHz (R&S®FSH-Z1) which was made available at market introduction, the analyzer can measure power down to the microwave range with high accuracy and dynamic range by using the 18 GHz Power Sensor R&S®FSH-Z18. But it is also possible to simultaneously measure output power and matching of RF transmitters from 200 MHz to 4 GHz by using the new Directional Power Sensor R&S®FSH-Z44 (FIG 4). Connected directly at the transmitter output, the analyzer, equipped with the R&S®FSH-Z44, shows the power that is output by the transmitter in W or dBm as well as the return loss or the VSWR of the antenna under operating conditions (FIG 5). Because the maximum load is 120 W, it is usually not necessary to have a power attenuator. To enable the power display for modulated signals to be corrected, the R&S®FSH3 allows the most common transmission standards to be specified, i.e. GSM/EDGE, 3GPP WCDMA, cdmaOne, cdma2000 1X, DVB-T and DAB.

Field strength measurement

The R&S®FSH3 is also ideal for measuring electric field strength. It takes into account the specific frequency-dependent antenna factors for the individual antenna and displays the field strength directly in dBµV/m or V/m. The antenna factors for the Directional Antenna R&S®HE200 (FIG 6) are supplied as standard. An additional 200 kHz filter is provided for EMF measurements on GSM signals. Together with the RMS detector, this filter allows the implementation of standard-compliant measurements as required by various countries such as Switzerland. For quick and easy analysis of the emission spectrum, the R&S®FHS3 provides two user-definable limit lines with automatic limit monitoring.

Easy documentation of results

To make it easy to document results, a macro for Microsoft® Word is provided in addition to Control Software R&S®FSH View, which is supplied with the R&S®FSH3. With just a few mouse clicks, the user can add the results and instruments settings to an existing measurement report. If the results need to be further analyzed at some point later, the user can shift markers and activate additional markers with the software.

Remote control as a retrofit

Experience has shown that a handheld analyzer primarily intended for use in the field needs to be remote-controllable with user-specific programs. Every R&S®FSH3 can now be retrofitted with this capability as an option.

Rainer Wagner

Analyzers R&S®FSP/FSU/FSQ

Easy replacement of HP 856x and HP 859x spectrum analyzers in T&M systems

Anyone who has ever developed a certified T&M system knows the problem: What can be done once the instruments get older and spare parts are no longer available? With older controllers, a modern, PC-based solution is usually the answer. But when it comes to T&M instruments, e.g. the HP 856x or HP 859x family of spectrum analyzers, there are no successors with a compatible remote control command set. Yet without these, you cannot avoid expensive modifications and renewed certification of the control programs. A solution is found in the Rohde & Schwarz spectrum and signal analyzers of the R&S®FSP, R&S®FSU and R&S®FSQ families (FIG), which provide an expanded command set compatible with the HP 856x and HP 859x.

With its comprehensive portfolio of spectrum analyzers and outstanding command compatibility, Rohde & Schwarz in many cases can offer a technically and economically attractive solution when replacing older HP 856x and HP 859x analyzers.

History of the IEC/IEEE bus command sets

In the 1980s, when the GPIB interface was first implemented in T&M instruments for remote control, the command set was often limited to converting the front panel key codes into combinations of letters and digits – and this was of course completely dependent on the instrument and manufacturer.

In the next stage of development, the key codes were replaced by simple abbreviations of the settings to be changed, e.g. CF for center frequency. The use of delimiters was optional; lowercase and uppercase letters made commands distinct. Characters such as = and / were permitted as part of the command. The result was combinations such as the following for setting a center frequency of 3 GHz, a span of 2 MHz, marker to next peak, and blank trace C:
CF3GZSP2MZKSKKSk

The HP 8566 A and HP 8568 A spectrum analyzers came on the market during this period. The HP 8566 B and HP 8568 B successor generation expanded the number of characters per command word. The blank space was introduced to separate commands and data, and the semicolon to separate individual commands. The uppercase/lowercase distinction was dropped. Thus, the command sequence for the setting described above became
CF 3GZ;SP 2MZ;MKPK NH;BLANK TRC

This convention was also used in later instrument families such as the HP8560E through HP8565E, plus the HP8590E and HP8594E. In contrast, the use of combined commands in accordance with the IEEE 488.2 standard was reserved for the next generation of instruments such as the Spectrum Analyzer R&S®FSA from Rohde & Schwarz. The command sequence then became:
FREQUENCY:CENTER 3GHZ; :SPAN 2MHZ; :MARKER NEXT_PEAK; :TRACE3 BLANK

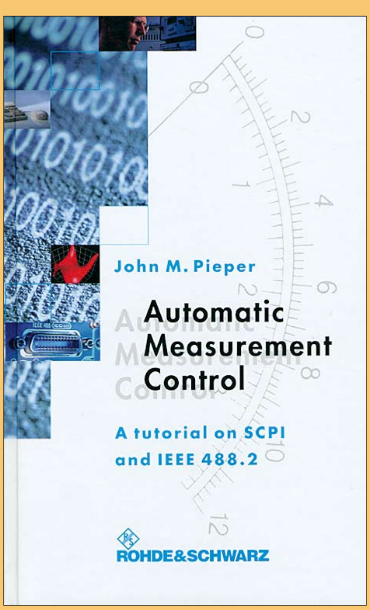
Although the rules for command structure were now defined, the commands themselves were nevertheless arbitrarily created by the instrument manufacturers. This did not change until the introduction of the SCPI standard (standard commands for programmable instruments). Since then, modern analyzers such as the R&S®FSP, R&S®FSU and R&S®FSQ accept command sequences such as the following:
SENS:FREQ:CENT 3GHZ;SPAN 2MHZ;:CALC:MARK:MAX;:DISP:WIND:TRAC:STAT OFF

Instruments of this generation have thus reduced the problem of interchangeability to a minimum. However, the situation is quite different if these instruments need to be compatible with those of the earlier generations.

What does command-compatible mean?

Command-compatible does not merely mean being able to understand the commands of another instrument. Compatibility also means that the same command sequences yield the same results as with the original. Simply duplicating the command recognition of the original is not sufficient. Rather, an entire series of other conditions must be met:

- The available commands must be sufficient for the planned applications.
- The default setting is the starting point for every remote control program and therefore must match the original instrument.
- The response to the query for instrument ID and firmware version must match the original so that recognition of the instrument model will be successful in the control program.
- The output format for queries must match the original, because the memory depth of control programs is often tailored to the responses of the original instrument.
- It must be possible to duplicate the responses of the status reporting system (service requests) as exactly as possible, including the response time and the assignment of the status registers.
- The interdependencies of the instrument settings must match the original, because they are the basis for obtaining the same results from the same command sequences.
- The response times of the original are the upper limit for command processing in order not to exceed the timeout values predefined in the control program.



Related book

To eliminate the problem of incompatible command sets from different manufacturers and instruments, the major T&M instrument manufacturers established a standard command language in the early 1990s. This language is based on the data formats and protocols found in the IEEE 488.2 standard. Since that time, the "Standard Commands for Programmable Instruments" (SCPI) have significantly simplified the development and maintenance of T&M applications both with respect to programming and system design when using components from different manufacturers.

To find out more about SCPI, refer to the book titled "Automatic Measurement Control" from Rohde & Schwarz. It provides a detailed description plus numerous examples of the principles and use of the language. You can obtain a copy for a nominal fee from any Rohde & Schwarz representative.

The objective in the development of compatible command sets in the Rohde & Schwarz analyzers was to make the behaviour so close to the original that no type of control program would notice any difference.

How compatible are the Rohde & Schwarz analyzers?

The R&S®FSP, R&S®FSU and R&S®FSQ analyzers from Rohde & Schwarz are presumably the only analyzers that can reliably recognize both the commands of the earlier HP 8566 A/HP 8568 A families as well as the newer HP 8566 B/HP 8568 B, HP 856x E and HP 859x E families.

Limitations in delimiters between commands and data were eliminated by expanding the command recognition algorithms. Thus, commands such as the following are recognized without any problem:
CF3GZSP2MZKSKKSk

For data queries, the output formats are identical to the original. This is true both for individual values as well as for entire traces. The fact that small differences in the output format and in the number of test points between the HP 8566 B, HP 856x E and HP 859x E were accounted for is just as standard as support for a wide range of units.

When an HP 85xx emulation is selected, the default settings for the selected instrument are automatically activated. This includes frequency range, reference level and input coupling as well as the number of test points and the IEC/IEEE bus addresses.

The more than 200 commands cover everything from default settings and numerous marker and trace functions up to save and recall. Options such as tracking generators and audio demodulators are also supported. Firmware version queries are answered with original data; the response character sequence following an ID query can be selected by the user.

A special challenge was to reduce the hierarchical SCPI status register structure to a register with a maximum of seven events. The primary task was to determine all conditions under which a new measurement is started and then under which the end of sweep is reported by a service request.

The significance of the setting interdependencies is especially made clear by the delta marker example. Switching on this marker when noise measurement is active – depending on the emulated instrument type – either causes noise measurement to be deactivated or phase noise measurement to be activated. Therefore, each command was thoroughly analyzed for dependencies and differences between the instrument models, and the response time during emulation was taken into account.

Summary

The R&S®FSP, R&S®FSU and R&S®FSQ are the only analyzers that support not only the command set of the HP 8566 B und HP 8568 B but also the commands and syntax of the earlier HP 8566 A models and the modern HP 856x E and HP 859x E models. The compatible command sets are already included in the base unit; they do not interfere with any installed software option.

The more than 200 supported commands contain not only instrument-specific default settings but also special features in command processing, status administration and response formatting.

With its comprehensive portfolio of spectrum analyzers and available command compatibility, Rohde & Schwarz in many cases can offer a technically and economically attractive solution when replacing older HP 856x and HP 859x analyzers. The Rohde & Schwarz instruments have already withstood the test of numerous implementations. The number of applications is constantly increasing as more and more commands are added.

Ottmar Steffke

Additional articles on the R&S®FSP/FSU/FSQ are found on pages 16, 18, 27 and 30.

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

Portable System for EMF Measurements R&S®TS-EMF

Even more universal: EMF measurements from 100 kHz to 40 GHz and for UMTS

The expanded frequency range of 100 kHz to 40 GHz and the newly implemented measurement method for UMTS make the R&S®TS-EMF test system (FIG 1) even more universal in application.

FIG 1 Portable System for EMF Measurements R&S®TS-EMF.

From LW to SHF using just one test system

With EMF measurements, all emitters in the vicinity must be taken into account, even if the measurements focus on only one special radio service or transmitter location. This is a highly complicated task when manually performing frequency-selective measurements. The R&S®TS-EMF, however, quickly and easily provides users with an overview of the different radio services on site. The previous frequency range of 80 MHz to 2.5 GHz covered all wireless radio applications as well as TV and FM broadcast frequencies. With its expanded frequency range of 30 MHz to 3 GHz, the base system with an isotropic antenna now also covers VHF radio services (e.g. civil authorities radio).

Measurement and evaluation at low frequencies

Many EMF test specifications begin at 100 kHz [1] or below. Studies show that medium- and shortwave transmitters even several kilometers away significantly contribute to emissions and must therefore be taken into account [2].

The inclusion of low frequencies places additional requirements on the R&S®RFEX measurement software. There is usually no fixed channel spacing in this frequency range, which is why the software alternatively evaluates the highest field strength peaks within a measurement packet. In addition, the software adds up the individual emissions not only with reference to power, but below 10 MHz also with regard to field strength according to the body current model. The data and associated units to be indicated in the report can be selected.

These measurements must always take the near field conditions into account. At frequencies above 30 MHz, you are virtually always in the radiated field, which means there is a fixed relationship between the electric and magnetic fields as well as the power flux density. At frequencies below 30 MHz, it must be determined whether you are in the reactive near field, depending on the distance from the transmitter (FIG 2). The electric and magnetic fields must be measured in the reactive near field. This can be done very easily using the Loop Antenna R&S®HFH 2-Z2, which is widely used in field strength test and measurement. The R&S®TS-EMF can also be combined with other desired antennas (FIGs 3 and 4). The software automatically evaluates the measurements in different polarizations.

Measurements up to 40 GHz

Most EMF measurements are performed up to 3 GHz, because this covers the radio services most widely used. But if, for example, radar or directional radio is also to be taken into account, measurements above 3 GHz are required. A frequency range up to 40 GHz is possible by combining the R&S®TS-EMF with the Spectrum Analyzer R&S®FSP or R&S®FSU. Directional antennas such as the outstanding R&S®HL 050, which covers the entire frequency range from 850 MHz to 26.5 GHz (FIG 3), are usually used in this case, especially for the stirring method.

	Reactive near field	Radiated near field	Far field
Limit distance*	0 to λ	λ to $2D^2/\lambda$	$>2D^2/\lambda$
E perpendicular to H?	No	Almost	Yes
E, H ~ 1/r	No	No	Yes
$Z_F = E/H$	$\neq 377\ \Omega$	$\approx 377\ \Omega$	$= 377\ \Omega$
To measure	E and H	E or H	E or H

FIG 2
Differences between near and far field;
*** heavily dependent on the type of transmit antenna (D = largest antenna dimension, e.g. diameter of a parabolic reflector).**

FIG 3 Configuration of the R&S®TS-EMF with the R&S®FSP / FSU / ESPI.

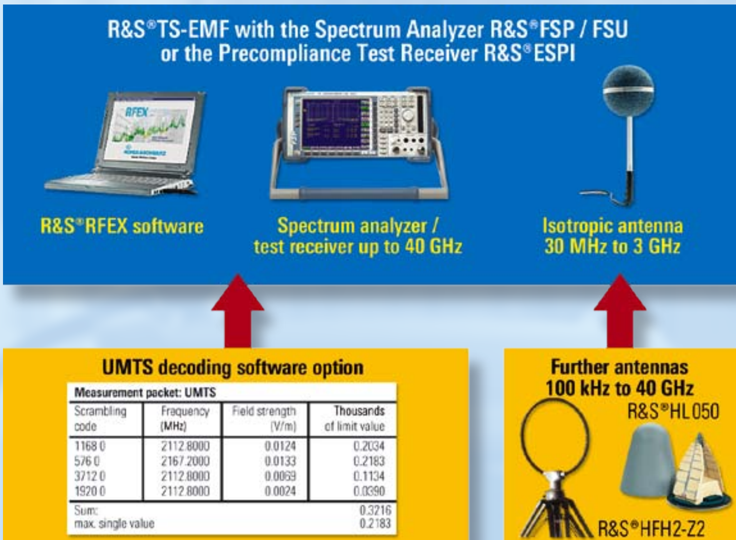


FIG 4 Configuration of the R&S®TS-EMF with the R&S®FSH3.

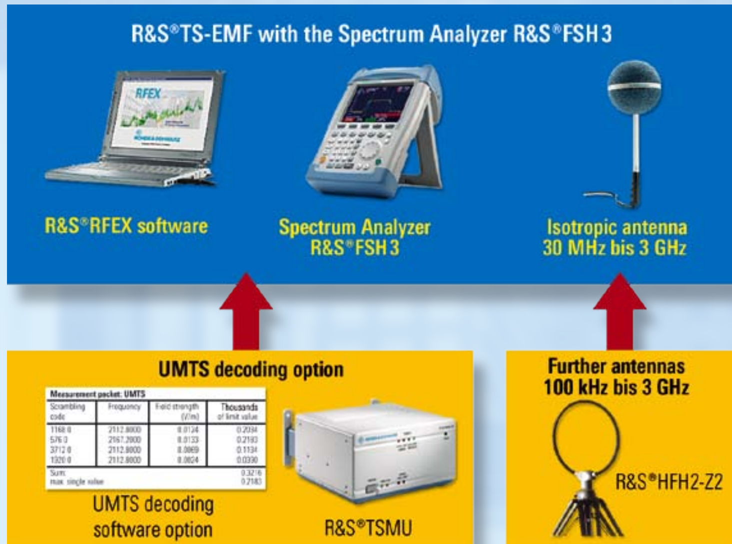


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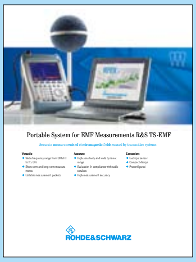
FIG 5 The R&S®TS-EMF with the Radio Network Analyzer R&S®TSMU.

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



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[1] prEN54000, February 2002
[2] Bochtler/Eidher/Wuschek: Großräumige Ermittlung von Funkwellen in Baden-Württemberg, July 2003 ("www.lfu.baden-wuerttemberg.de/lfu/abt3/funkwellen")
[3] SAEFL: Mobilfunk-Basisstationen (UMTS-FDD), Messempfehlung (draft of 17 Sept. 2003)
[4] Radio Network Analyzer R&S®TSMU: Performance giant in compact format sets new standards. News from Rohde&Schwarz (2003) No. 180, pp 4–7

Measurement of UMTS emissions

While the construction of UMTS networks is progressing at a fast pace, no rules or regulations regarding UMTS and EMF measurements were established yet. The Swiss Agency for the Environment, Forests and Landscape (SAEFL) is now the first civil authority to publish a measurement recommendation [3]. Other countries are expected to adopt a similar form of the measurement methods described therein.

A (simplified) comparison with GSM shows the conditions of EMF measurements in UMTS emissions. With GSM, fixed frequencies are assigned to each base station. A continuous signal is transmitted at constant power at one of these frequencies, which makes it possible to simply extrapolate to the maximum field strength generated by a base station. The measured field strength can be assigned to the base station by means of the frequency.

In the case of UMTS, however, all base stations of a network operator transmit at the same frequency. The base stations are differentiated by means of scrambling codes with which each base station encodes its own signal. With this type of coding, the signal is simultaneously spread, creating a noiselike signal with a bandwidth of 5 MHz. The transmission power depends on the amount of transmitted data and is between approx. 10% for the organization channels and the maximum output power at full capacity utilization.

Frequency-selective measurement with UMTS

Frequency-selective measurements, which are standard practice for measuring electromagnetic fields in the environment, can also be performed for UMTS – but with the following restrictions:

- Assignment to a base station not possible
- Statement only regarding the momentary value
- Restricted sensitivity caused by a broadband, noiselike signal

The measurements obtain only the current summed value of all UMTS base stations in the vicinity. The worst-case scenario for extrapolation to the maximum possible field strength presupposes that only the organization channels were active at the time of the measurement. However, the result of this extrapolation can be as much as 10 dB too high if data was also transmitted at the time of the measurement. This measurement uncertainty can be minimized by performing long-term measurements with the R&S®TS-EMF.

The measurement is made using the RMS detector and at a signal-matched bandwidth. Channel power measurement must be set if the Spectrum Analyzer R&S®FSH 3 is used. The measurement parameters for UMTS are stored in a predefined measurement packet that comes with the test system. Rohde & Schwarz verified the measurement-packet settings on real and synthetic UMTS signals.

Code-selective measurement with UMTS

UMTS emissions must be decoded so as to avoid the restrictions of frequency-selective measurements and to be able to use a measurement method that is comparable to GSM. Decoding must be precise and reproducible, even under complex reception conditions involving strong reflections, no line of sight to the transmitting antenna and simultaneously several base stations. Important factors for this measurement are high sensitivity and wide dynamic range, high measurement speed for mobile measurements (stirring method) and the possibility to process many codes in parallel (due to the time offset, each reflection is processed as a separate code).

Rohde & Schwarz has acquired wide-ranging experience with UMTS radiated emission measurements with its coverage test systems for measuring network quality. Owing to this experience, an option for decoding the UMTS organization channel (CPICH) has been added to the R&S®TS-EMF, allowing the test system to comply with the preferred measurement method described in the Swiss recommendation. The system allows the field strength to be accurately measured and extrapolated to the maximum emission and assigned to the base station. The sensitivity is greater than with a spectral GSM measurement. Decoding by means of the R&S®RFEX software can be implemented in connection with a Spectrum Analyzer R&S®FSP or R&S®FSU or the Precompliance Test Receiver R&S®ESPI. Alternatively, the Radio Network Analyzer R&S®TSMU (FIGs 4 and 5) can be used for performing pure UMTS measurements or as a compact addition to the R&S®FSH 3 [4]. Existing test systems can be retrofitted with this option. A version without an isotropic antenna is available for users who apply only the stirring method.

Summary

The expanded frequency range of 30 MHz to 3 GHz and the option for precise UMTS measurements provide the Portable System for EMF Measurements R&S®TS-EMF with the greatest possible flexibility in EMF measurements. Additional antennas and spectrum analyzers for the range from 100 kHz to 40 GHz are available for more exacting measurement requirements. Frequency-selective measurements involving UMTS systems are subject to restrictions. CPICH channel decoding, available as an option to the R&S®TS-EMF, yields an accurate measurement method comparable to the technique used with GSM.

Jürgen Kausche; Gerd Mielke

Precompliance Test Receiver R&S®ESPI

Improved, patented EMC test method for drifting interference signals

To increase the probability of detecting drifting interference signals, the Test Receiver R&S®ESPI was expanded to include a function that reduces the time between prescan measurement and final measurement to a minimum. This function is based on a method patented by Rohde & Schwarz.

Principle

For several instrument generations now, Rohde & Schwarz test receivers have included methods for reducing data and optimizing final measurements in order to reduce total test time. Prescan measurements with the fast peak detector, determination of critical frequencies and time-saving standard-compliant final measurements on a limited number of test points have been accepted methods for years in the EMC world.

The challenge for an automatic test method is particularly high if the interference signals are not stable and drift in frequency. Since prescan and final measurements cannot occur at the same time, it is possible that the interference frequency determined with the prescan measurement may have changed to such an extent by the time final measurement is performed that it is either not detected at all or only partially (FIG 1).

The new method basically retains the prescan/final measurement division since this has the advantage of reducing the number of measurements with long measurement times. However, the measurement procedure is designed in such a way that exceeding a limit value immediately interrupts the prescan measurement and initiates a final measurement with standard-compliant receiver settings. The prescan measurement is then resumed at the next frequency.

Detailed description

Before a measurement is started, a limit line is assigned to each trace and the LIMIT CHECK function is activated. This

FIG 1 Two cycles recorded several minutes apart. The interference signal, measured with the V-Network R&S®ENV 216 on a switching power supply, has clearly left the measurement bandwidth.

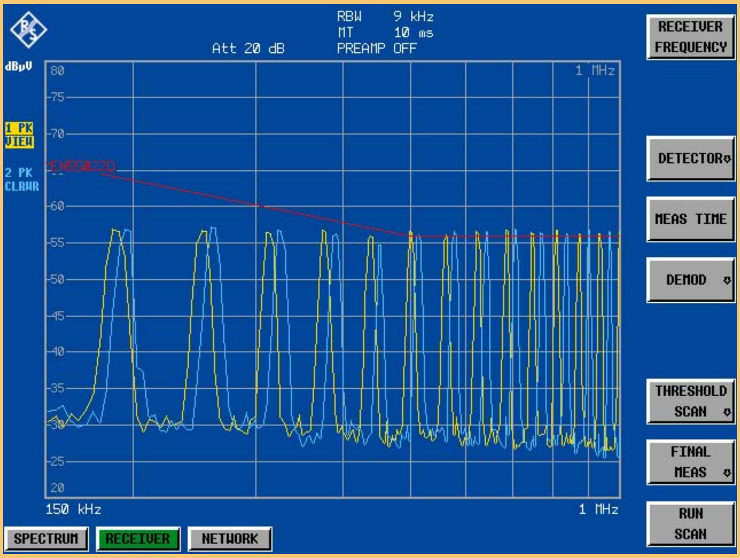
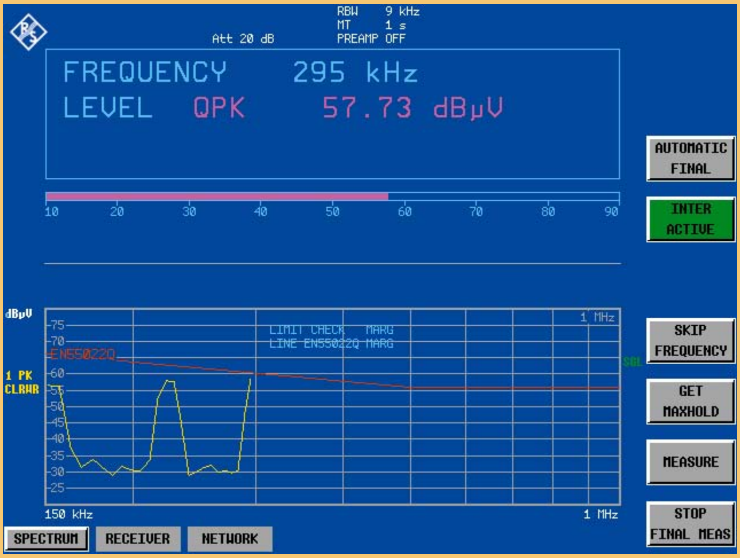


FIG 2 The prescan measurement was interrupted; the receiver is in the final measurement phase.



allows the receiver to compare the prescan measurement values with the limit values.

The R&S®ESPI first analyzes the interference spectrum with a fast prescan. As soon as the measured level drops below the specified offset to the limit line, the instrument interrupts the prescan, sets the frequency to be examined on the bar graph display in the top half of the screen and starts the final measurement (FIGs 2 and 3). Since the final measurement immediately follows the prescan measurement, the probability that drifting and fluctuating interference signals will be reliably detected increases significantly. The receiver marks the final measurement value on the screen, adds it to the peak list and stores it for later documentation (FIG 4).

With some applications, it is necessary to decide on a case-by-case basis whether a final measurement of the detected interference signal is necessary. The automatic mode described above is complemented with an interactive mode for this purpose. In this case as well, the bar graph display is set appropriately for final measurement when an interference signal occurs. Now, however, the receiver waits, and the user has the chance to alter the frequency in order to precisely locate the interference signal, e.g. by using an audio demodulator. Final measurement is then started only after the MEASURE button is pressed. If the level of the interference signal fluctuates, the highest measured level that is automatically recorded in this interim phase (GET MAXHOLD) can be added to the peak list. If the interference signal is not of interest (e.g. ambient noise), the user can also skip the final measurement (SKIP FREQUENCY).

With the narrowband/broadband differentiation function, which is optional, the receiver automatically decides which detector to use for final measurement. It compares the positive and negative peak values of the prescan measurement. If the difference exceeds a selectable threshold, a broadband interference signal is assumed to be present and the quasi-peak detector is used for final measurement. If the difference falls below this threshold, a narrowband interference signal is present, and the final measurement is performed with the average detector.

Even though the EMC T&M equipment from Rohde&Schwarz has reached a highly acclaimed level, the company will continue to invest in its R&D to make it even more efficient and user-friendly.

Matthias Keller

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

REFERENCE

- Precompliance Test Receiver R&S®ESPI: Measurement of conducted EMI when using a switching power supply. News from Rohde&Schwarz (2002) No. 175, pp 30–34

FIG 3 Display after detection of a drifting broadband interference signal. The number of final measurements was limited to twelve, and every interference signal was reliably determined.

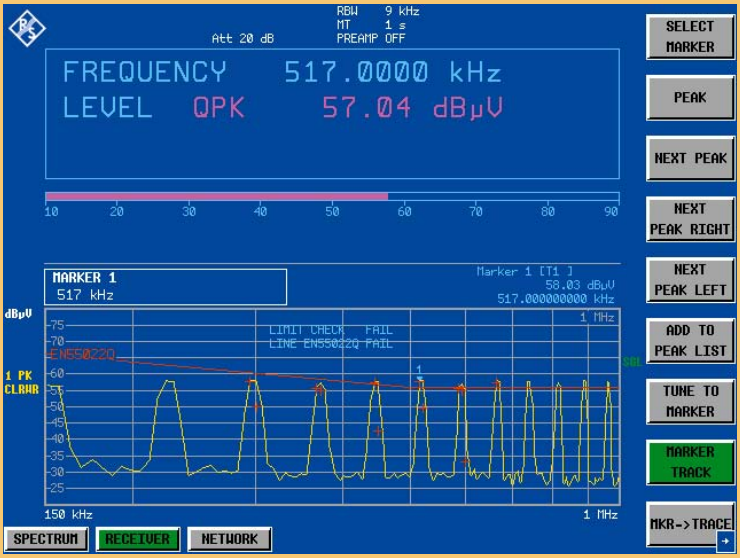
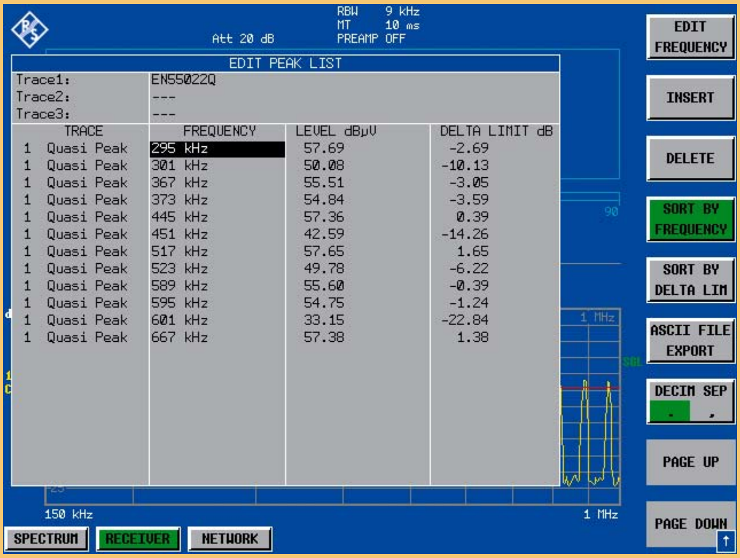


FIG 4 Peak list with the final measurement results. Frequency, level and offset to the limit line are documented.



The DVB-T Transposer/Gap Filler R&S®XV 7002 is an outstanding solution for expanding the network coverage of main transmitters or filling gaps in field strength.

UHF DVB-T Transposer/Gap Filler R&S®XV 7002

Economical network coverage expansion of DVB-T main transmitters

The new UHF DVB-T Transposer/Gap Filler R&S®XV 7002 (FIG) from Rohde & Schwarz complements the company's DTV Low-Power Transmitter Series R&S®SV 7002. Thus, Rohde & Schwarz can now supply DVB-T network operators with a full range of transmitter products – from low to high power.

Economical closure of coverage gaps

As the expansion of digital TV networks continues to grow, operators are increasingly faced with the challenge of closing gaps in network coverage. One solution is low-power transmitters. Another is to use transposers. Transposers do not require any signal feeds because they receive the off-air signal of a main transmitter. This significantly reduces network operator costs, as there is no need for a costly signal feed to the low-power transmitter station.

With its DVB-T Transposer/Gap Filler R&S®XV 7002, Rohde & Schwarz complements its DTV Low-Power Transmitter Series R&S®SV 7002 [1] and can now provide DVB-T network operators with all required transmitter products – from low to high power. The R&S®XV 7002 is a cost-efficient solution for ensuring or expanding network coverage of main transmitters or for filling gaps in field strength.

SFN or MFN

The R&S®XV 7002 receives a UHF DVB-T signal and transposes it to an intermediate frequency (IF) in two stages. After signals are processed, the IF is converted to the selected UHF channel. For use in a single frequency network (SFN), the operating channel is identical to the receiving channel (gap filler mode). If the transposer needs to be implemented in a multifrequency network (MFN), a channel other than the receiving channel is selected as the operating channel (transposer mode). A subsequent amplifier from the Low-Power Transmitter Series R&S®SV 7002 amplifies the signal to the required output power.

Compact design

The compact base unit R&S®XV 702 is 19 inches in width and occupies only one height unit. It contains the frequency converter as well as the IF signal processing module with precorrector.

The RF-to-IF conversion and vice versa take place at two fixed intermediate frequencies (double conversion). This method allows quick frequency changes without filter adjustment and ensures outstanding image rejection in the transposer's frontend. SAW filters at the IF ensure the required high level of adjacent channel suppression.

Main characteristics

- Quick frequency changes without filter adjustment
- High adjacent channel selectivity by using SAW filters at the IF
- High-stability frequency reference (OCXO)
- Easy precorrection of the subsequent amplifier
- Installation in 19" racks possible
- Uniform family concept
- Easy operation

Power classes designed for real conditions

The R&S®XV 702 is equipped with the same external interfaces as the DVB-T Exciter R&S®SV 702 [2]. Thus, all amplifiers of the Low-Power Transmitter Series R&S®SV 7002 can be used. They are based on LDMOS transistor technology and are available in power classes of 10 W, 20 W, 50 W and 100 W.

Easy operation

With only four entry keys and a display, the R&S®XV 702 is easy to operate on-site. The menu for setting the instrument is divided into a home area and various submenus. In the home area, all important parameters such as receive and transmit channel, operating mode (local or remote control) and the amplifier output power are indicated. Remote control is made possible by relay contacts (also optionally available as RS-232-C and SNMP).

Uniform family concept

All DVB-T low-power products from Rohde & Schwarz are part of a comprehensive product family. Since the individual modules are compatible with one another, customized systems can be configured as required for the specific application or power class, for example. High uniformity among the products minimizes costs for maintaining spare parts and training operating staff.

Simone Gerstl; Ludwig Moll

Condensed data of the R&S®XV 7002

Receive frequency range	UHF
Transmit frequency range	UHF
R&S®XV 702 RF output power	0 dBm, 12 dBm
R&S®XV 7002 RF output power	10 W, 20 W, 50 W, 100 W
TV standard	DVB-T ETS 300 744

More information and data sheet at www.rohde-schwarz.com (search term: XV 7002)

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[2] DTV Exciter R&S®SV702: Compact exciter for digital terrestrial TV. News from Rohde & Schwarz (2003) No. 177, pp 40–41

Optical Network Analyzer Q7761 from Advantest

Extremely fast testing of optical components

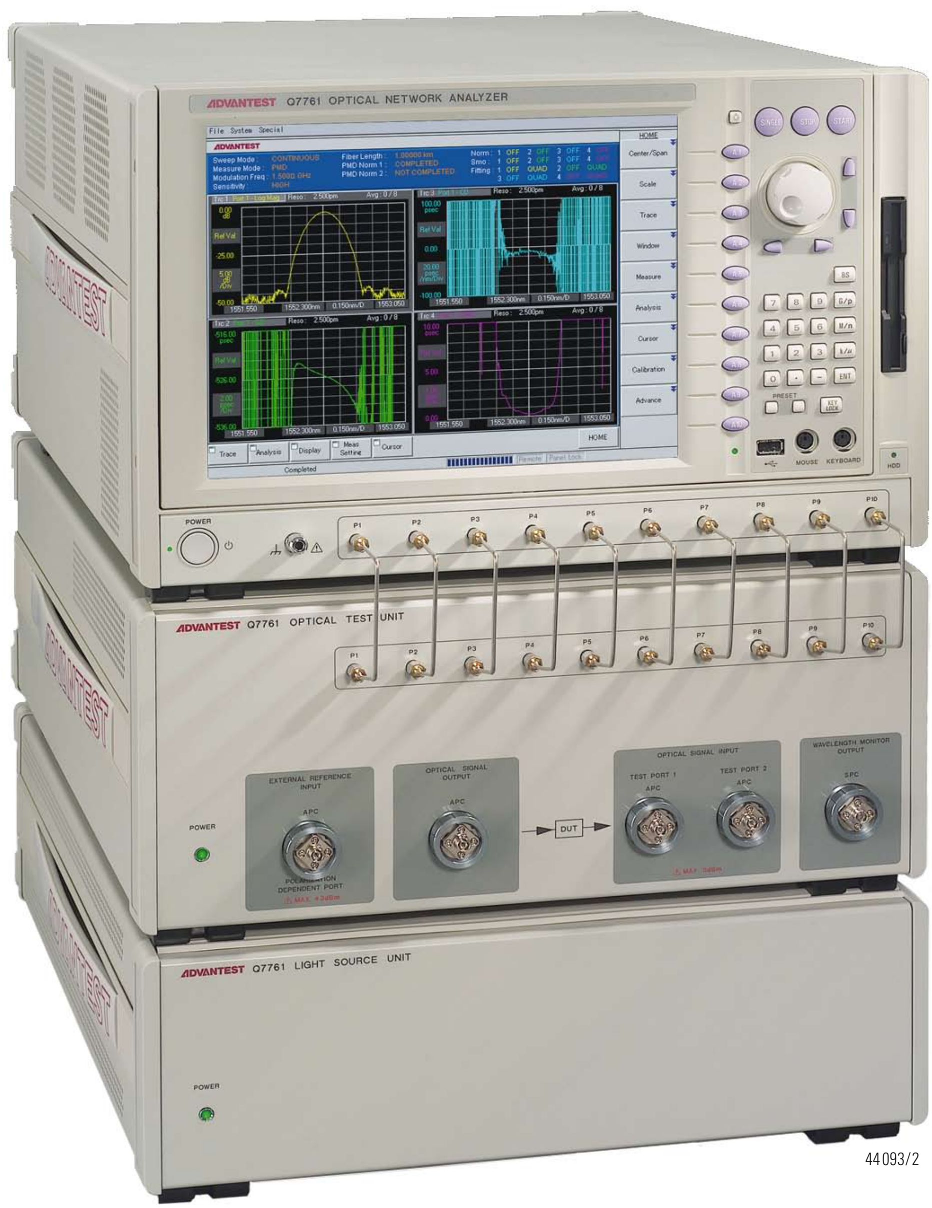
For many years, Advantest has been developing and manufacturing opto-electronic test instruments for the telecommunications industry, which is a main focus in the photonics market. The new Optical Network Analyzer Q7761 (FIG 1) – the flagship among Advantest's optical test instruments – allows the transmission characteristics of optical system components to be measured extremely quickly and at the highest measurement resolution.

All important measurements with just one instrument

The introduction of the new Optical Network Analyzer Q7761 is a giant step toward the fastest and most precise measurements of parameters of optical transmission components in dense wavelength division multiplex (DWDM) engineering.

Owing to enormous bandwidth requirements, data rates in modern fiber-optic networks are growing from a cur-

FIG 1 The flagship among the optical test instruments from Advantest: the new Optical Network Analyzer Q7761.



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More information and data sheet at www.rohde-schwarz.com (search term: Q7761)

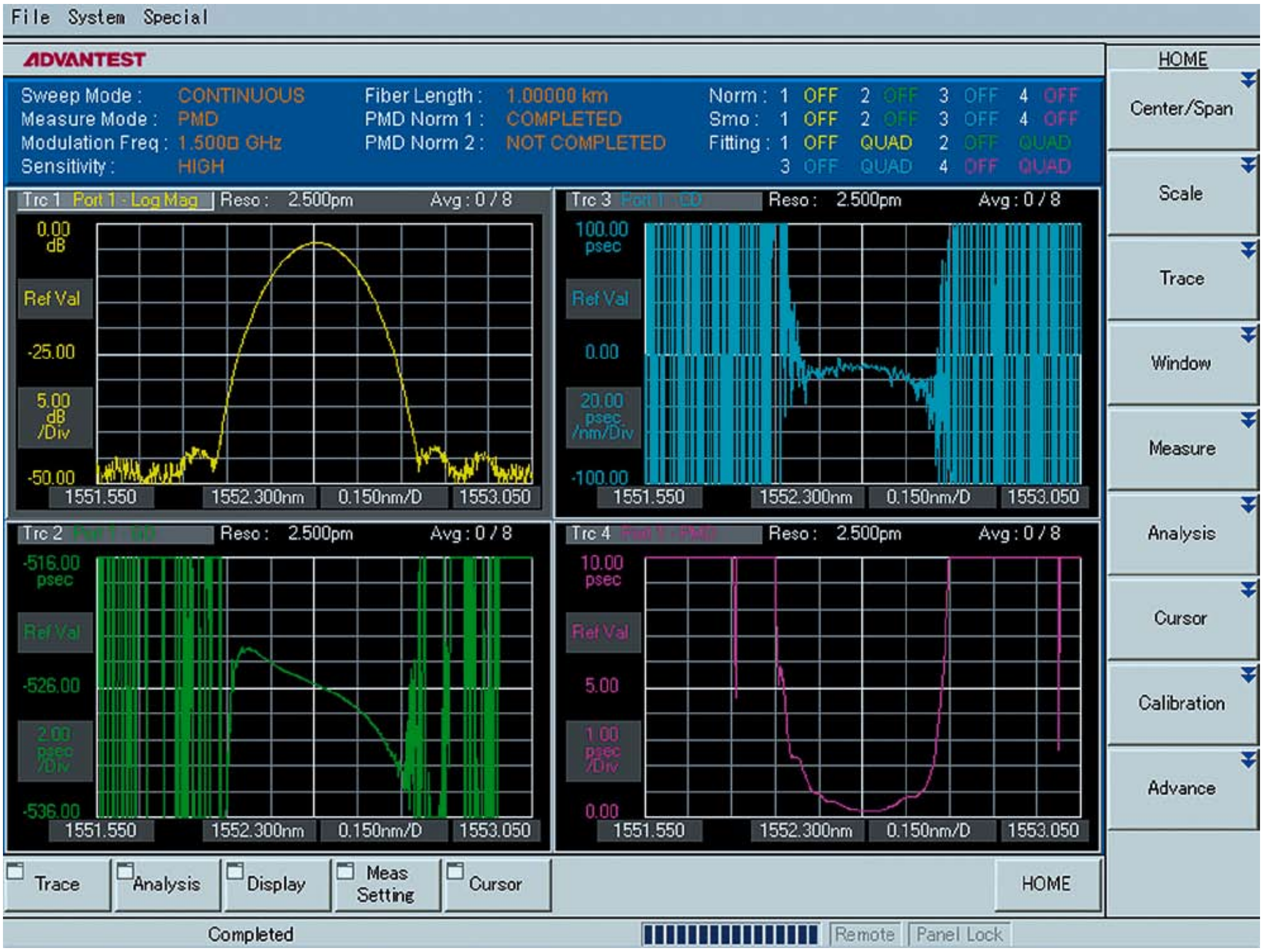


FIG 2 **All-in-one display of the measurement parameters on the 12" screen with four windows: The network analyzer displays all important dispersion characteristics at a glance after super-fast measurements.**

rent 10 Gbit/s to 40 Gbit/s. A value of 160 Gbit/s is already being developed. As transmission paths get longer and longer, poor dispersion characteristics are increasingly becoming an obstacle for error-free high-speed transmission. They must therefore be precisely measured and monitored. Measurement values in the range of a few femtoseconds (10^{-15}) must be detectable.

As the first test instrument of its class, the Optical Network Analyzer Q7761 combines measurements of chromatic dispersion (CD), polarization mode dispersion (PMD) and second-order PMD. And it does so at the highest measurement resolution and in a single fast sweep (e.g. 1.5 s within a wavelength span of 1 nm). Sweep times in the milliseconds range, as are common in RF engineering, cannot yet be attained. However, the sweep time of 1.5 s is already a hundred-fold improvement in comparison to the predecessor model. Additional simultaneous measurement parameters include amplitude, group delay and polarization dependent loss (PDL). The analyzer's measurement principle is based on the polarization phase shift method (PPS).

The instrument's special features include an outstanding wavelength accuracy of 5 pm (or 1.5 pm with an external wavelength meter), a large dynamic range of 60 dB and the capability for two-channel measurements. The 12" colour screen can be divided into four windows for simultaneously observing the different parameters when making adjustments (FIG 2). The signal source is a rapid and built-in wideband tunable laser source (TLS) for the wavelength range of 1525 nm to 1625 nm.

Joachim Heinze

An additional new test instrument from Advantest – the Optical Spectrum Analyzer Q8341 – is presented on page 48.

Optical Spectrum Analyzer Q8341 from Advantest

Fast and precise testing of laser diodes

In the coming years, the DVD market in particular will experience strong growth as the CD player market declines. The number of laser diodes implemented worldwide in optical memory drives amounts to over 500 million units. The Optical Spectrum Analyzer Q8341 from Advantest (FIG 1) was recently developed specifically for testing laser diodes.

Testing of modern blue-violet laser diodes

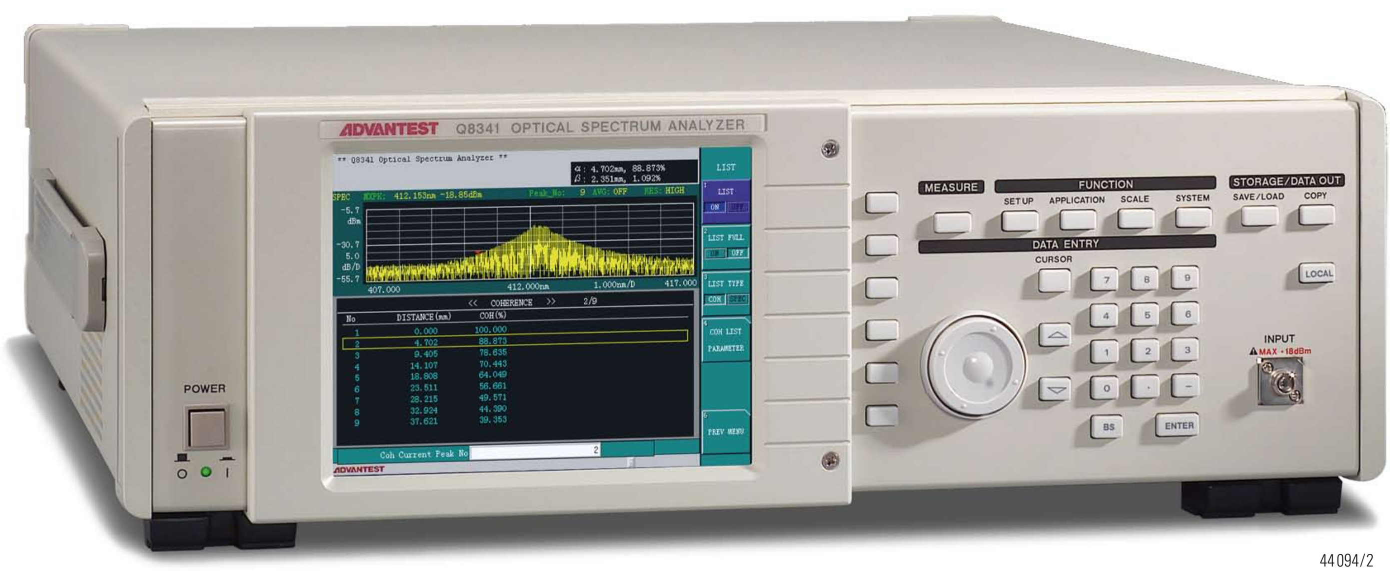
The new Optical Spectrum Analyzer Q8341 addresses the consumer market for optical memory drives that include built-in short wavelength laser diodes (250 nm to 800 nm). To increase disk data capacity, wavelength must be reduced for the purpose of higher resolution. With red laser diodes at 780 nm und 640 nm as a starting point, researchers are currently focusing on 400 nm, which will soon make it possible to store more than 20 Gbyte of data on a disk by using blue-violet laser diodes (FIG 2). Such diodes will be used in the near future for laser printers and beamers with improved resolution.

The Optical Spectrum Analyzer Q8341 is based on a Michelson interferometer and offers the world's fastest measurement of only 0.5 s over a wavelength range of 350 nm to 1000 nm. The wavelength accuracy and the resolution have a value of less than 10 pm. A built-in helium-neon laser as a reference path in the interferometer ensures the calibrated long-term accuracy. Fast Fourier transform (FFT) signal processing is used to display not only the spectral representation but also the coherence length up to 40 mm at a resolution of 1 µm.

The Q8341 is a compact laboratory instrument equipped with a colour display and all common interfaces. It outputs all important measurements at the press of a button (FIG 3). Its outstanding technical characteristics make it an ideal choice for the development of blue-violet laser diodes of the next generation and the increasingly miniaturized optical recording units in memory devices.

Joachim Heinze

FIG 1 The Optical Spectrum Analyzer Q8341 from Advantest.



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Special features of the Optical Spectrum Analyzer Q 8341

- Super-high measurement speed:<2 s (standard) 0.5 s (option)
- Coherence measurement with 1 µm resolution
- Max. coherence length: approx. 10 mm (standard) approx. 40 mm (option)
- Max. wavelength resolution (at 650 nm): 0.001 nm
- Wavelength measurement range:350 nm to 1000 nm
- Wavelength accuracy: ±0.05 nm (standard) ±0.01 nm (option)
- Max. input level: +10 dBm
- Compact and lightweight (max. weight 16 kg)
- 6.5" colour display

More information and data sheet at www.rohde-schwarz.com (search term: Q 8341)

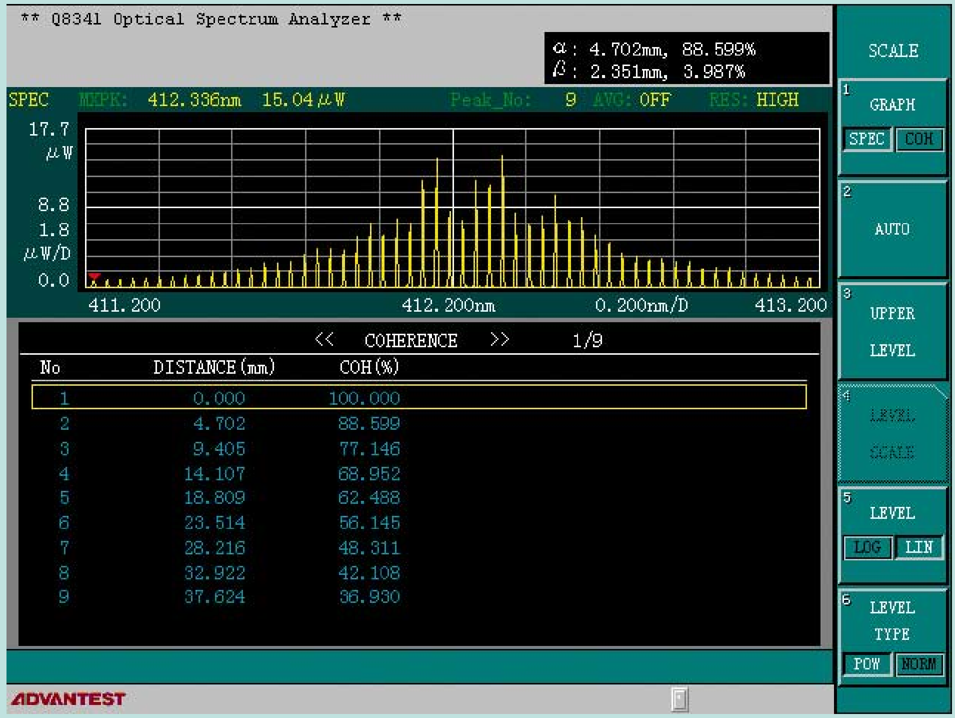
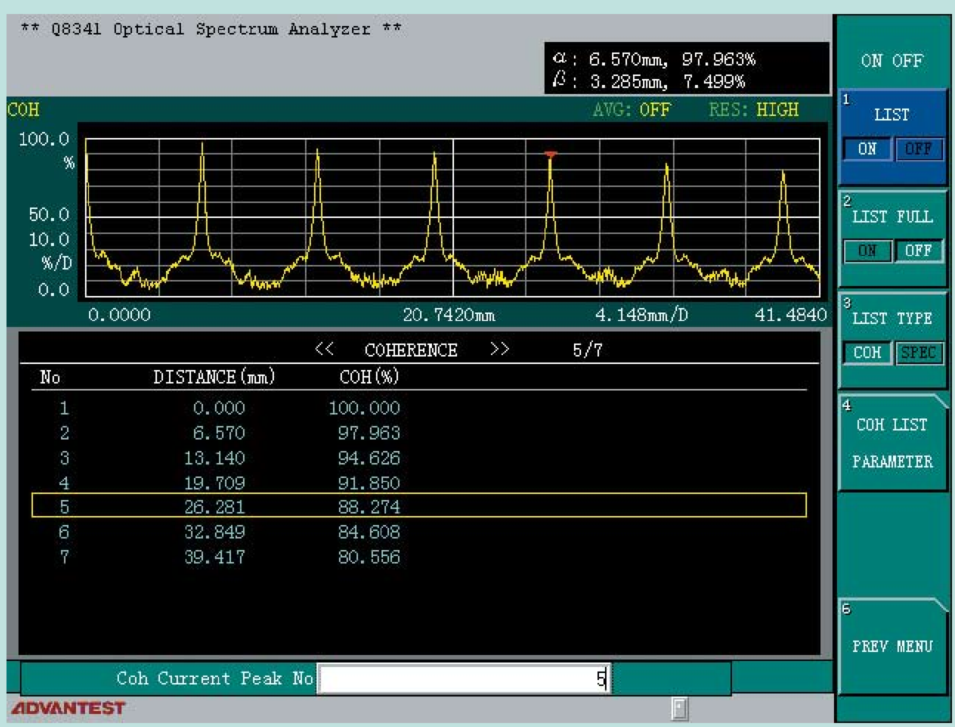


FIG 2 Measurements of a blue-violet laser diode. Top: spectrum. Bottom: coherence length shown as clearly defined numerical values.

FIG 3 An important characteristic of DVD laser diodes is the analysis of coherence length. The Q 8341 can measure this value at the press of a button and display important parameters such as the alpha and beta values (upper right).



Closer to the customer

Rohde & Schwarz can now respond even faster to customer requirements in the Asian/Pacific region. The Taiwan office has assumed responsibilities for the entire Rohde & Schwarz product portfolio, previously handled by different companies. Plus, a new office was founded in the Philippines. In India, too, market presence was further expanded by the opening of a new office in Mumbai (formerly known as Bombay).

In Singapore, the local subsidiary Rohde & Schwarz Regional Headquarters Singapore is taking over marketing and sales from the previous partner Infotel. The same excellent quality of service will be maintained. However, to reflect the expanded tasks on the Asian market, Rohde & Schwarz Service Centre Asia Pte. Ltd. will be renamed Rohde & Schwarz Systems & Communications Asia Pte. Ltd.

Rohde & Schwarz streamlines operations in Scandinavia

To meet changed market conditions in Scandinavia, Rohde & Schwarz is restructuring its regional subsidiaries there.

Cooperation among the subsidiaries in Sweden, Norway and Denmark will be expanded to leverage synergy, increase efficiency and present a common face when offering customer service. As part of the restructuring, Niels Frandsen was appointed new Managing Director at Rohde & Schwarz in Denmark in 2003. At the same time, Markus Becker, who remains Managing Director of Rohde & Schwarz Marketing and Sales in Europe, took over as Managing Director of the Swedish subsidiary Rohde & Schwarz Sverige AB.

Large order for encryption devices for the German armed forces

Represented by the German Federal Office for Information Management and Information Technology (IT-AmtBw), the German armed forces have placed an order worth several million euros with Rohde & Schwarz SIT GmbH for ELCRODAT 4-2 encryption devices.

These multifunction crypto devices can be operated both in mobile and stationary mode for encrypting and decrypting analog and digital messages at the security levels "VS – Highly Classified" and "NATO Top Secret". The devices are planned for use in the air force, navy and army. The Tiger and NH 90 helicopters as well as the K 130 corvette plus the U 212 submarine will be equipped with this modern crypto technology. This large order underscores the position of Rohde & Schwarz SIT as a leading supplier of professional encryption systems in Europe.

As a multi-application device, the ELCRODAT 4-2 replaces the previous versions ED 4-1, ED 5-2, EB 3-1 and EB 3-2 but is still interoperable with them. In several other international programs, the device has also been short-listed for encryption projects.

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ORGA Test Systems and Rohde & Schwarz provide all-round solutions for GSM tests

ORGA Test Systems and Rohde & Schwarz are providing the first GCF-validated tests for the current SIM application toolkit (3GPP TS 11.10-4 Release 99).

For this purpose, the manufacturers jointly implemented the standards in test cases. The combination of ORGA Test Systems' IT3 Platform and the Universal Protocol Tester R&S®CRTU-G from Rohde & Schwarz enables seamless and quick access to all test cases, making operation significantly easier. For the first time, it provides mobile radio equipment manufacturers and operators with an official test solution for the current SIM application toolkit tests (Release 99).

Both companies cooperated closely in developing and implementing the tests, ensuring that the IT3 Platform and the R&S®CRTU-G work together seamlessly when performing the tests in the combined test environment. The test package, which was validated recently by the Global Certification Forum (GCF), therefore contains both parts: the SIM interface tests as well as the handset tests over the air interface.

Rohde & Schwarz markets *Bluetooth*® protocol analyzer from Frontline

Rohde & Schwarz is now the European distributor for the new *Bluetooth*® protocol analyzer in USB stick version from Frontline, complementing its product portfolio of *Bluetooth*® test equipment.

The analyzer decodes the new *Bluetooth*® protocols of version 1.2 in realtime, features comprehensive *Bluetooth*® profiles and permits multimode sniffing, i.e.

simultaneous analysis on the air interface and the serial HCI interface. It is ideal for troubleshooting and verifying *Bluetooth*® applications.

Rohde & Schwarz receives TETRA radio order from Oman oil industry

R&S BICK Mobilfunk has received an order to supply a TETRA radio system for the Sultanate of Oman.

The system will primarily be used for the security and operation of the local oil fields. The customer, Petroleum Development Oman (PDO), selected various potential suppliers after opening the invitation to tender and then conducted the tender process on the Internet. Rohde & Schwarz was awarded the order for its *ACCESSNET*®-T system.

Before Rohde & Schwarz was selected, TETRA was chosen as the standard for the future radio system. The convincing factor was the “multivendor” principle because TETRA is an internationally uniform open standard. Thus, users are not tied to individual manufacturers. This acts as a safeguard against the future and ensures a favourable price/performance ratio, because numerous manufacturers are available to compete.

The new radio system in Oman consists of 21 R&S®DOB-500 outdoor base stations and two R&S®DMX-500 exchanges. For documentation purposes, the exchanges have an interface for voice and data recorders. The order additionally includes setting up handovers to the telephone network (PABX) and other radio systems. The required terminals will be purchased once the radio network is ready. In the near future, PDO will use the new TETRA radio system to handle all mobile communication.

Large-scale orders for TV and sound broadcast networks

DVB-T transmitters of all power classes for digital TV network in Italy

The Italian network operator Elettronica Industriale has contracted Rohde & Schwarz to supply DVB-T transmitters with a total worth of several million euros.

The high-power and, above all, low-power transmitters will be used to set up Italy’s first digital TV network. A large number of transmitters of the R&S®SV 7002 family was ordered; they are notable for their high flexibility and compact design. The order also includes the high-power transmitters of the R&S®NVx family. They feature an ultra-modern liquid-cooling concept that makes maintenance very easy and cost-effective and reduces space requirements to a minimum.

Transmitters and T&M solutions for TV and sound broadcast network in Georgia

The Georgian network operator E-Media has commissioned Rohde & Schwarz to set up a nationwide TV network and an FM sound broadcast network.

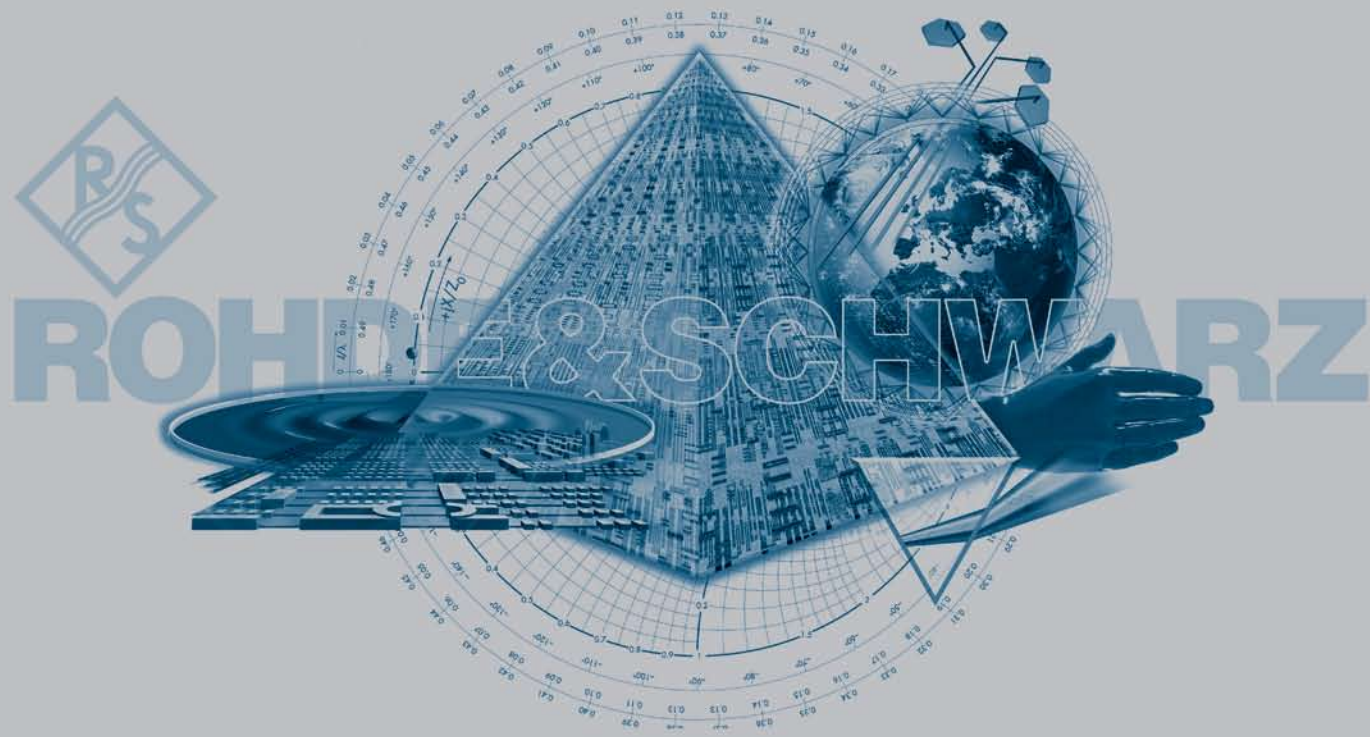
On the basis of the contract, Rohde & Schwarz will supply a large number of analog TV and FM transmitters as well as the T&M equipment required for setting up and operating the transmitters. The transmitter network, which has been in operation since November 2003, is an important milestone for Rohde & Schwarz in order to strengthen its leading market position in the Commonwealth of Independent States.

Good price/performance ratio, comprehensive expert consulting and local support by Techno-Media – Rohde & Schwarz’s qualified local partner – were the reasons why E-Media entrusted Rohde & Schwarz with setting up two broadcast networks simultaneously.

The TV network comprises 21 liquid- and air-cooled transmitters with output power from 500 W to 5 kW. The T&M equipment required for commissioning and servicing was also supplied by Rohde & Schwarz. By the end of the year, about 75% of the Georgian population will receive the TV channel.

Rohde & Schwarz was also awarded the contract for setting up a sound broadcast network. The first order covered eleven FM transmitters with output power from 500 W to 2.5 kW. Techno-Media handled the local implementation for both projects.

Visit us on Internet at www.rohde-schwarz.com



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Rohde & Schwarz GmbH & Co. KG · Mühldorfstrasse 15 · 81671 München, Germany · P.O.B. 80 14 69 · 81614 München
Support Center: Tel. (+49) 18 05 12 42 42 · E-Mail: customersupport@rohde-schwarz.com · Fax (+49 89) 41 29-137 77

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