# News from Rohde & Schwarz


High-end spectrum analyzers with excellent RF performance

GSM protocol analyzer: new reference for development and production

Precompliance test receiver: multitalent in the development lab

2001/II
171

ROHDE & SCHWARZ

**With the new FSU spectrum analyzers, Rohde&Schwarz launches its third generation of high-end analyzers on the market. These instruments distinguish themselves by their outstanding RF performance – in particular, minimal inherent noise floor and phase noise and excellent intermodulation characteristics (page 20).**

Photo 43761

Photo 43667/6

**The GSM Protocol Analyzer CRTU-G simulates a GSM base station where mobile phones can be tested with any imaginable signalling scenario.**

**The NGMO2 is more than just an extremely precise high-speed voltage source. It combines a voltage source, a programmable DC load, a digital voltmeter that can be used separately, a current and voltage transient recorder as well as a simple squarewave generator.**

Photo 43603/2

The ESPI defines the decisive criteria in the precompliance class such as range of functions, measurement speed and measurement accuracy. Photo 43665/4

Photo 43702/2

After the very positive response to the liquid-cooled, high-power transmitters of the NH/NV6000/7000 family on the world market, Rohde&Schwarz now presents the extremely compact, air-cooled UHF Transmitter Family NH/NV7001 for medium power classes.

## EMC/FIELD STRENGTH

### Test receivers



## BROADCASTING

### TV transmitters



### Test transmitters



### Reference



## RADIOMONITORING

### Monitoring systems



### Receivers



## MISCELLANEOUS



**For reasons of space, Part 4 of the refresher topics "Measurements on MPEG2 and DVB-T signals" has had to be postponed to News 172.**

**Imprint** Published by Rohde&Schwarz GmbH&Co. KG · Mühldorfstrasse 15 · 81671 München
Support Center: Tel. (+49) 01805124242 · E-mail: customersupport@rohde-schwarz.com
Fax (+4989) 4129-13777 Editor and layout: Ludwig Drexl, Redaktion – Technik (German)
English translation: Dept. HW-UK7 · Photos: Stefan Huber · Circulation (German, English and French) 90000
approx. 5 times a year · ISSN 0028-9108 · Supply free of charge through your nearest Rohde&Schwarz representative · Printed in Germany by peschke druck, München · Reproduction of extracts permitted if source is stated and copy sent to Rohde&Schwarz München.

GSM Protocol Analyzer CRTU-G

# Changing of the guard: after more than 10 years, a new GSM reference system

**For more than 10 years Rohde & Schwarz has been successful in the market with the reference systems CRTP 02 and CRTC 02 for development and conformance testing of GSM * mobile phones. Higher standards for applications and frequent changes of the GSM specification made it necessary to continually adapt the testers to the new requirements. A point has been reached now where a new platform has to be introduced to cope with the versatile requirements: the Universal Protocol Tester CRTU-G. It is based on a future-proof RF unit that can be upgraded to meet future standards.**

Photo 43 667/4

**FIG 1 The Universal protocol Tester CRTU-G simulates a GSM base station where mobile phones can be tested with any imaginable signalling scenario**

## Reference in development and production

A reference implementation of a GSM base station has been realized in the CRTU-G (FIG 1) in addition to other functions. The CRTU-G is used in the development of mobiles and respective chip sets and supports the software development of protocol stacks. It provides defined interfaces to higher protocol layers. For these applications, an early integration of new GSM functions is particularly important to ensure that mobiles with new characteristics can be brought to the market in time. For this reason, Rohde & Schwarz implements these functions in cooperation with the customer.

Another key application is conformance testing on mobiles in line with *GCF* (GSM Certification Forum). All test houses offering this service use protocol analyzers from Rohde & Schwarz. The analyzers are the core of the GSM Conformance Test Systems TS 8916 and TS 8950. These systems are the validated basis for conformance tests on mobiles.

## Impressive basic functions

The CRTU-G simulates a GSM base station for testing mobile phones in the receive and transmit direction. To accomplish this, the CRTU-G provides two independent RF channels, each of which serves up to four timeslots in the uplink and downlink and thus covers all circuit-switched applications (speech, constant data transmission) and *GPRS* (packet-switched data trans-

* Abbreviations in the text are explained in the box on page 8.

mission). Packet-switched data transmission can be carried out with *GMSK* or *8PSK* modulation so that GPRS and *EDGE* applications (*EGPRS*) can be simulated. The DUT is connected to the CRTU-G via various physical interfaces:

- RF interface
- Analog I/Q interface
- Digital serial data interface
- IF interface

The CRTU-G is able to trigger various external instruments – e.g. for RF measurements that have to be synchronized to signalling – and additional protocol analyzers of the same type in the event that up to eight RF channels are required. Because of the narrow tolerances of the RF modules, the instrument is particularly suitable for bit error rate (BER) measurements. While the lower layer of the protocol stack is only used for *BER* measurements, the higher layers are also required for *BLER* measurements.

The CRTU-G complies with the GSM Phase 2 Plus standard. The software of the CRTU-G is compatible with that of the Digital Radiocommunication Test Sets CRTP02 and CRTC02 so that most of the application programs of the latter can be used with the CRTU-G.

The Windows 2000™ operating system in the CRTU-G provides a commonly-used and well-known user interface. An external monitor, keyboard, mouse and an external CD-ROM drive are supplied with the unit. The CRTU-G provides a network interface and further means for software installation. It is also equipped with several USB interfaces.

## The RF unit – a future-proof platform in the CRTU-G

The CRTU-G is based on the RF unit CRTU-RU (radio unit) which uses the same RF modules as the CMU200 (see article on this successful radio communication tester on page 9). In contrast to the RF unit of the CMU200, the CRTU-RU contains two RF channels. When supplemented by a link handler for each RF channel and a MAC/speech module, this universal platform becomes the CRTU-G for GSM. The link handlers ensure undisturbed execution of all time-critical processes at the lowest protocol layer. The *MAC* signal processor meets the increased demands of GPRS for the realtime behaviour of signalling. The speech signal processor on the same module converts speech into data and vice versa. FIG 2 shows the block diagram of the CRTU-G.

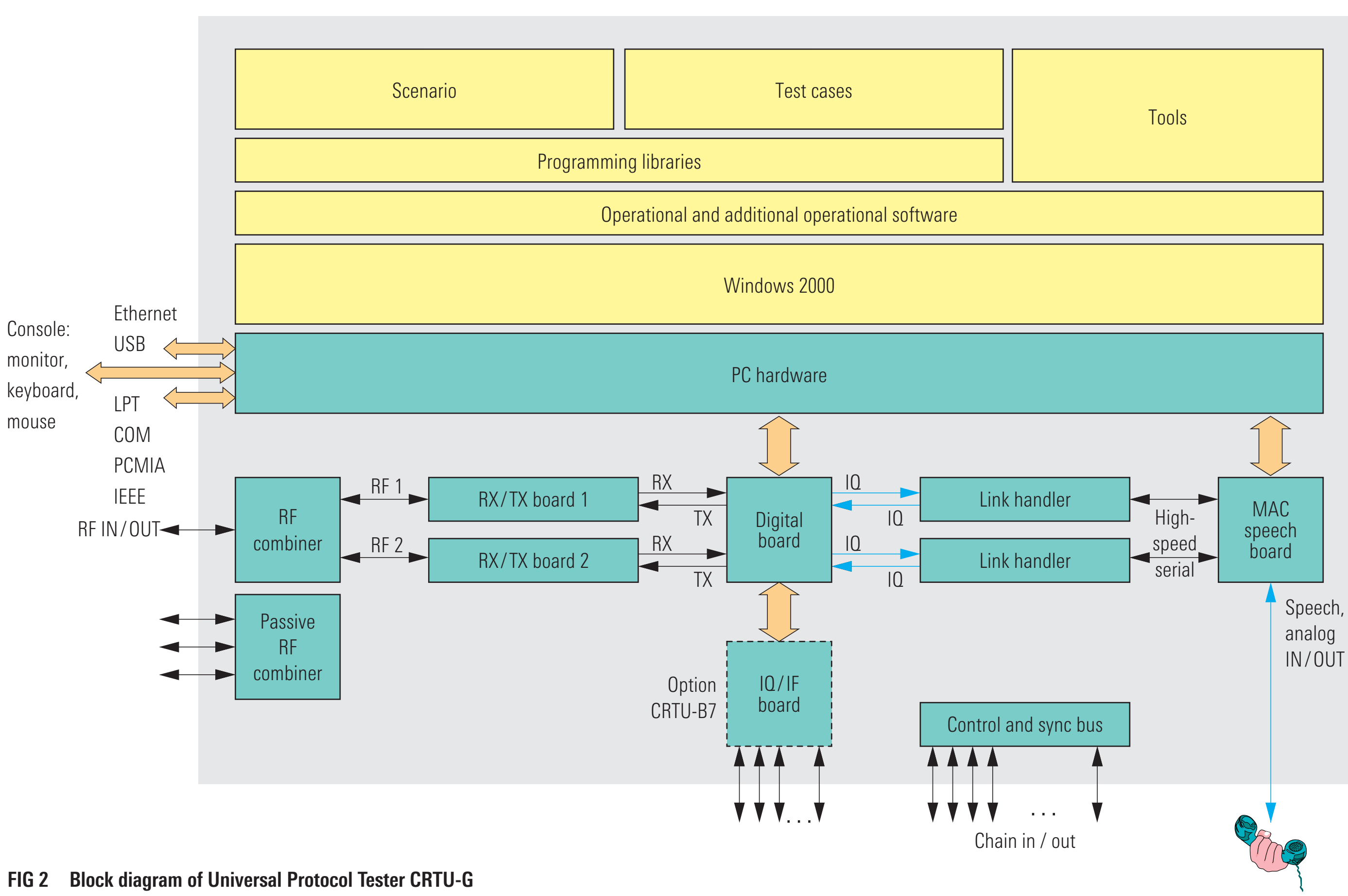



**FIG 2 Block diagram of Universal Protocol Tester CRTU-G**

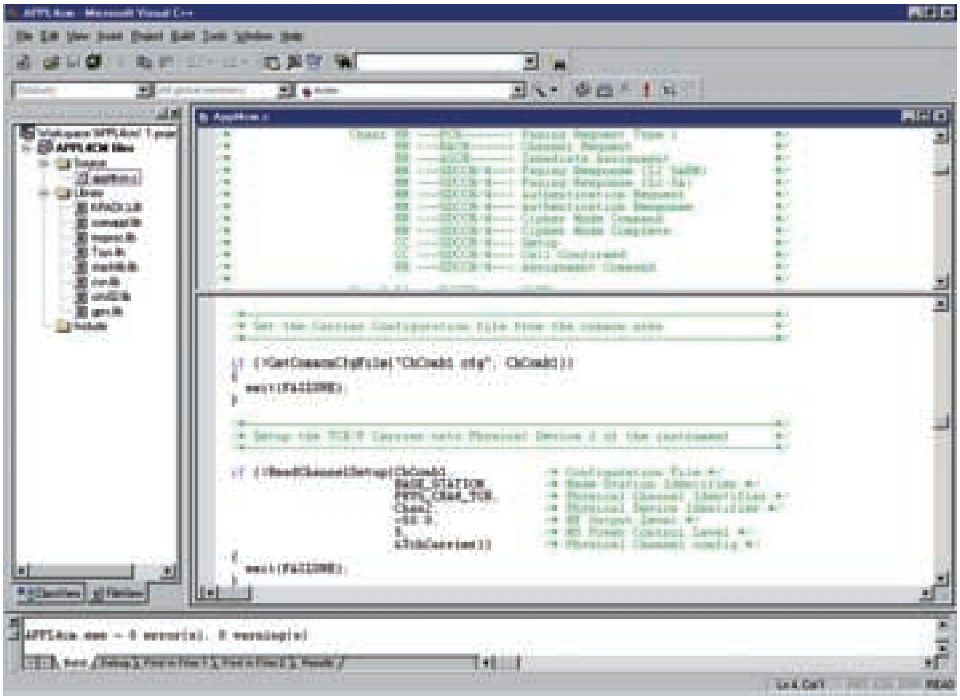


**FIG 3 API for Visual C++™**

The RF unit CRTU-RU also serves as a basis for future mobile radio standards, e.g. *WCDMA*. In this case, external link handlers providing a higher processing power can be installed and connected to the analog IQ/IF interface. The available frequency range from 10 MHz to 2.7 GHz meets all requirements of the next generation of mobile radio standards. The RF unit also comprises a cascading system which allows the setup of cross-standard multichannel systems, e.g. GSM and WCDMA in the same system. The built-in RF coupler is very useful for combining RF signals. The CRTU-RU platform offers the standard interfaces COM1, COM2, LPT, IEC (IEEE) and USB and also additional interfaces for remote control or for connecting external units (Ethernet interface). This makes the CRTU-G fit for the future.

## Baseband fading with CRTU-G

Thanks to the optional analog IQ/IF interface card CRTU-B7, defined baseband fading can be created in the two RF channels. Previously, RF fading simulators were required for these tests – complex method, which also impairs the RF quality of the output signal.

The Baseband Fading Simulator ABFS [*] from Rohde & Schwarz can be easily connected to the CRTU-G. It generates fading profiles with up to 12 paths for each of the two RF channels. This configuration complies with ETSI specifications.

## CRTU-G – the multichannel system

The two RF channels of the CRTU-G are sometimes not sufficient for certain test scenarios in GCF. For instance, up to six RF channels with GSM signalling are required for cell selection tests and many of the GPRS test cases need four or more RF channels.

These tests are performed with several cascaded CRTU-Gs. Up to four units can be combined and synchronized to form an 8-channel system. The internal RF coupler combines the RF signals without the need for path calibration of additional units.

If four timeslots per RF channel are not sufficient, this configuration allows two RF channels to be combined to one channel with a total of eight timeslots. This is also possible when only one CRTU-G is used, but in this case, the number of signalling channels is reduced to one.

## CRTU-G – the multimode system

Thanks to the built-in RF coupler and the ability to remotely control external instruments, the CRTU-G is able to combine RF signals from different sources and integrate GSM and other mobile radio standards, e.g. IS 136 (*TDMA*) for North America, in another unit. Taking GSM and IS 136 as an example, the Radio Communication Tester CMU 200 with option IS 136 is integrated in a multimode system so that GSM/IS136 handover tests can be simulated. This configuration can also be used for EGPRS Compact, the North American version of EGPRS.

## Open programming platform

The test scenarios simulated with the CRTU-G are based on individual test programs. A variety of sample programs and program libraries are supplied with the analyzer, including some of the validated test scenarios stipulated in the 3GPP specification TS 51.010-1 (former ETSI 11.10). Source code is provided for all programs and many of the libraries.

Prior to initial use, the programs have to be translated into machine language. The compiler for Visual C++™ is provided in the Windows 2000™ operating system for this purpose. Project files supplied with the system considerably facilitate the translation. The project files contain information for complete test-case packages including several test programs along with instructions for the compiler.

The user can thus prepare own programs on the basis of available sample programs or test cases. Well-documented program libraries reduce programming under Visual C++™ to function calls. This does not reduce programming possibilities, however. All functions of Visual C++™ and various debug facilities are also available to the user.

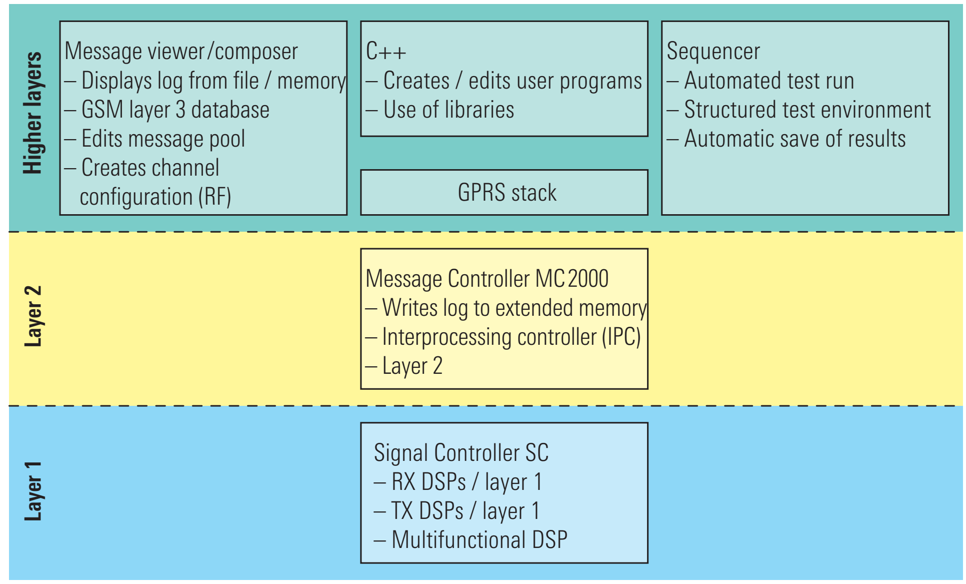



**FIG 4 Integration of protocol layers**

Library functions for screen display, keyboard entries and error handling complete the package (FIG 3). For reasons of compatibility with available software, the command prompt window of Windows 2000™ (previously MS-DOS box) is used by these functions. This does not limit the programs' memory requirements or program execution, since true 32-bit applications are involved.

## System software always up to date

The system software of the CRTU-G is compatible with GSM Phase 2 Plus and continuously upgraded to meet specifications. In order to keep the user current, Rohde & Schwarz offers service contracts for software updates. Presently, the system software can be upgraded with GPRS and *AMR* functions.

## Integration of protocol layers

Layer 1 is implemented in the CRTU-G by the two link handlers and the RF modules. The required software (signal controller) runs on the signal processors. It is restarted prior to each test. The message controller is the interface to the next higher layer. The interprocessing controller of the message controller transfers the messages between the layers. The message controller also logs all messages from or to the DUT at layer 2 so that log files are available at the end of the test for analysis. The test programs are based on these layers and represent the higher layers (FIG 4).

With GPRS, the higher layers handle *LLC*, *SNDCP* and *PPP* for data transfer as well as *SM*, *GMM* and *GSMS* for the required signalling. All these functions are controlled by the message controller and run independently in the GPRS stack. So the messages are not only recorded at different positions, particular protocol layers can also be skipped. This is sometimes required, e.g. when the corresponding protocol layer is not yet available in the DUT. The extended functions for EGPRS (EDGE) such as incremental redundancy and link adaptation will be integrated in the GPRS stack.

## Versatile tools for comprehensive analyses

The message viewer (FIG 5) is used for analysis. It permits the log files written by the message controller to be viewed and provides details about the DUT behaviour. Messages can be analyzed at different locations in the layer model, ranging from layer 1 in which only the burst content is documented in hexadecimal format, up to the mnemonic display of layer 3 in which the messages are displayed in plain text.

With the message composer, the message pool files can be created and modified without accessing the program's source code. Thus there is no need for tedious compiling of GSM messages during programming. With the aid of the message composer the channel configuration can be created or adapted.

The automatic execution of several test scenarios – individually or in loops – is controlled by a sequencer. Not only is it responsible for remote control of the DUT, but also for the automatic storing

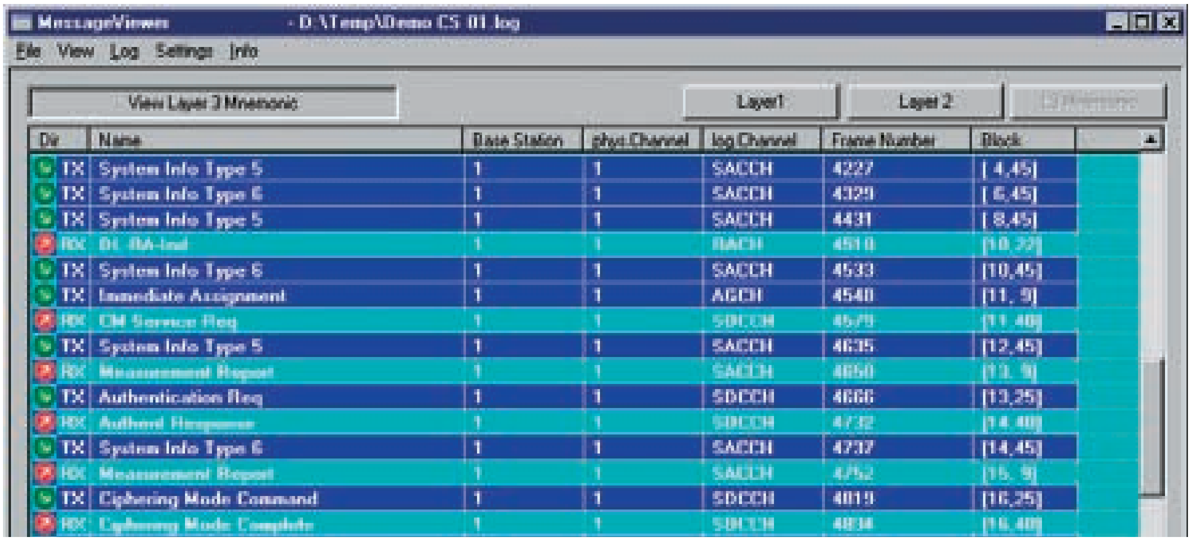



**FIG 5** **The message viewer informs on log files written by the message controller**

of measurement results. A configuration program helps to select the correct *SIM* parameters, *PICS* files and other parameters. Comprehensive hardware analysis with fast diagnosis guarantees the necessary reliability of the test results.

## Comprehensive support upon request

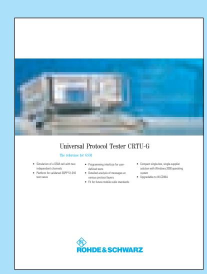
Rohde & Schwarz supports the user with regard to the versatile capabilities of the CRTU-G and its open programming interface. If desired, the company's customer support center can provide comprehensive support for technical questions and offers service contracts. A special site is available on the Internet for registered customers.

Nils Pickert

## Abbreviations used

| | |
|---|---|
| *AMR* | Adaptive multirate |
| *BER* | Bit error rate |
| *BLER* | Block error rate |
| *EGDE* | Enhanced data rates for GSM evolution |
| *EGPRS* | Enhanced GPRS |
| *GCF* | GSM Certification Forum |
| *GMM* | GPRS mobility management |
| *GMSK* | Gaussian minimum shift keying |
| *GPRS* | General packet radio services |
| *GSM* | Global system for mobile communication |
| *GSMS* | GPRS short message service |
| *LLC* | Logical link control |
| *MAC* | Medium access control |
| *PICS* | Protocol implementation conformance statement |
| *PPP* | Point-to-point protocol |
| *SIM* | Subscriber identity module |
| *SM* | Session management |
| *SNDCP* | Subnetwork-dependent convergence protocol |
| *TDMA* | Time division multiple access |
| *WCDMA* | Wideband code division multiple access |
| *8PSK* | 8-phase shift keying |

**More information and data sheet at www.rohde-schwarz.com (search for CRTU-G) or at www.protocol-testing.rohde-schwarz.com**



REFERENCE
[*] Baseband Fading Simulator ABFS – Reduced costs through baseband simulation. News from Rohde & Schwarz (1999) No. 163, pp 11–13

Universal Radio Communication Tester CMU200

# Signalling and RF measurements for Bluetooth™


Photo 43238/16

**The new *Bluetooth*™** option shows that the capabilities of the CMU200 [*] are not restricted to RF tests in line with classic mobile standards such as GSM, IS95 or IS136.**

## Bluetooth functions in the CMU200

With the *Bluetooth* option, the CMU supports a great variety of applications in R&D, service and production, whether acting as a multimode tester or "simply" as an RF tester for *Bluetooth*.

### Signalling

*Bluetooth* modules are normally tested in a realistic environment with normal signalling, i.e. without particular adaptation of hardware and software. During the RF tests, tester and DUT form a pico network where the CMU functions as the master, signalling the parameters for the individual test steps to the DUT (slave).

### Inquiry

In this mode, the CMU searches for DUTs in its environment and stores their addresses in a list (FIG 1).

### Paging, connection

The radio communication tester pages the DUT with a specific address entered by the user or obtained through inquiry and sets up a connection in the event of a positive response.

### Activating the *Bluetooth* test mode

To perform an RF measurement after a successful call setup, the test mode defined by the *Bluetooth* standard is activated via the air interface. The CMU sets the DUT as required:

- Transmitter test or loop-back mode
- Frequency hopping or discrete frequency
- Packet type: DH1, DH3 or DH5
- Payload lengths: 2 bytes to 339 bytes
- Payload data: PRBS, 1010 pattern, etc
- Data whitening: on/off

Important parameters of the DUT such as version number or service class are exchanged during call setup and displayed as an additional signalling information on the CMU.

## Bluetooth transmitter measurements

Nominal power, peak power, leakage power and time alignment measurements can be selected in the power menu of the CMU. The CMU interprets the content of the received signal and sets the appropriate measurement range. The nominal power and the peak power are measured during a burst. The measured leakage power is used to determine the on/off power ramping of the transmitter at the edges of the transmitted packet while the packet alignment measurement determines the transmit time of the DUT with respect to the timing predefined by the master. The last measurement checks whether the slave responds within the tolerances of a specified time window.

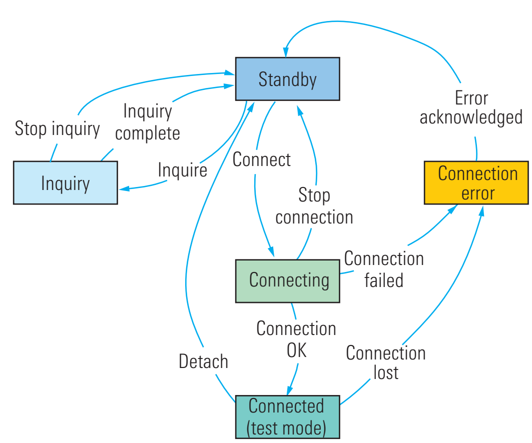



**FIG 1 CMU200 inquiry mode: the tester stores all found DUT addresses in a list**

** BLUETOOTH is a trademark owned by Bluetooth SIG, Inc., USA, and licensed to Rohde&Schwarz.

# Key parameters of the Bluetooth RF interface

The most important technical parameters of the *Bluetooth* RF interface are shown in FIG 2. A *Bluetooth* subscriber always operates alternately as transmitter or receiver within a timeslot. The coloured segments in FIG 3 mark the relevant basic elements of a physical packet:

### Access code (72 bits)

This area supports the identification and synchronization of *Bluetooth* instruments. A typical 1010 pattern is sent as the 4-bit preamble at the beginning. A measuring instrument must be able to accurately measure the frequency deviation of the DUT within 4 μs.

### Header (54 bits)

This area of the packet contains organizational information important for the call: the current address of the called partner in the pico network, packet types used and also flow control and handshake information.

### Payload (0 to 2744 bits)

Packet area of variable length where payload data is normally transmitted. The maximum length of the payload is defined so that at least 220 μs are available between the end of the payload and the change of the timeslot for the synthesizer of the *Bluetooth* signal to settle to the next frequency channel.

| Parameter | Data | Comment |
|---|---|---|
| Frequency band | 2.4 GHz to 2.493 GHz | V1.0b: partly national assignment; max. number of channels per system: 79 |
| Channel spacing | 1 MHz | |
| Modulation | Gaussian frequency shift keying (GFSK); B x T = 0.5 | Max. frequency deviation 160 kHz |
| Time multiplex | 625 μs/timeslot | Master and slave send alternately |
| Frequency hopping | 1600 hops/s | The frequency is changed in each timeslot (3200 hops/s during call setup, i.e. the frequency is changed in each half timeslot) |
| Physical packet types | 1, 3 and 5 slots | Variable packet length for current packet type. Packet formats with different error correction are used depending on the application. |
| Power classes | 0/+4/+20 dBm | |

**FIG 2 Key technical parameters of *Bluetooth* RF interface**

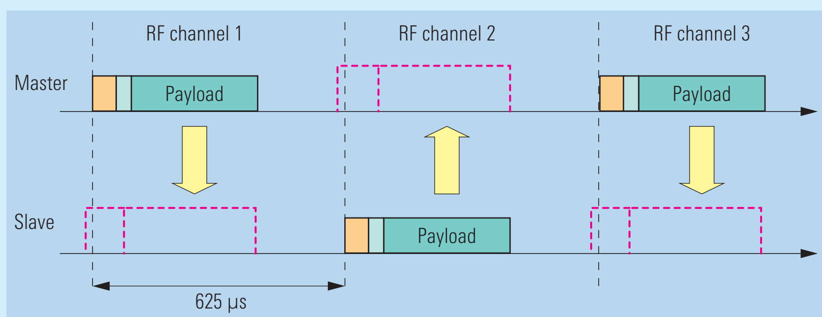


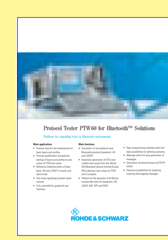

**FIG 3 Information transmission to *Bluetooth* standard with frequency hopping and time multiplex**

### Further information and instruments for *Bluetooth*

- **In this edition:** Test tip – Generating *Bluetooth* RF test signals quickly and easily (pp 50 – 51)
- **Test tip:** Accurately measuring drift on *Bluetooth* transmitter modules. News from Rohde & Schwarz (2000) No. 169, pp 40 – 41
- **Protocol Tester PTW 60** for *Bluetooth* applications – Comprehensive protocol tests to *Bluetooth* qualification program. News from Rohde & Schwarz (2000) No. 169, pp 8 – 10 (search for PTW 60 to find data sheet)
- **Test System TS 8960:** www.rohde-schwarz.com (search for TS 8960)
- ***Bluetooth* flyer** (search for 0757.5489)
- ***Bluetooth* RF Test Specification**, Revision 0.9, 14 March 2000
- ***Bluetooth* Core Specification**, Revision 1.1, 12 June 1999

### Or on the Internet:

- **Rohde & Schwarz and *Bluetooth*:** www.rohde-schwarz.com/bluetooth
- **Official *Bluetooth* website:** www.bluetooth.com



Data sheet PTW 60

*Bluetooth* flyer

| | Data pattern 101010 | Data pattern 11110000 | PRBS and others |
|---|---|---|---|
| **Frequency accuracy** (measurement along the preamble) | X | X | X |
| **Frequency drift** | X | – | – |
| **Maximum drift** | X | – | – |
| **Average frequency deviation** | X | X | – |
| **Max. frequency deviation** | X | X | – |
| **Min. frequency deviation** | X | X | – |

**FIG 4** ***Bluetooth* modulation measurements that can be performed with the CMU 200**

Due to its large memory, the CMU is able to graphically display data sections from 1/16 timeslot to a packet of five timeslots in length.

## Modulation measurements

As stipulated by the *Bluetooth* RF test specification, the test methods used depend on the data patterns stimulated in the payload. Supported measurements are listed in FIG 4.

The graphics display of the CMU offers flexible means for selecting and extending measurement ranges. For instance, the settling characteristic of the signal can be conveniently analyzed with the pretrigger function (FIG 5). Markers facilitate a detailed analysis of individual ranges.

Not only is it necessary for a DUT to hop quickly between frequencies, the DUT must also maintain a constant carrier frequency during transmission after the hops. Keeping the frequency drift low over the maximum length of the DH5 packet is therefore quite an ambitious task. To be able to execute the required measurement algorithm for all data, the measuring instrument has to store this period at a high resolution.

## Test modes of the CMU for transmitter tests

The CMU carries out all power and modulation measurements on DH1, DH3 and DH5 packets, etc by varying several parameters – i.e. TX test or loop back. Special test modes of the CMU are described below:

### All channels

In this mode, the CMU evaluates the signal actually received during frequency hopping, independent of the channel number. Thus, measurement results are quickly obtained for all 79 occupied channels. The level spreads which may be caused, for instance, by frequency response are qualitatively recorded either as numeric values or in graphical form via the displayed statistical minimum and maximum values obtained in power measurements.

### Single

In this mode, frequency hopping can be performed for signalling. However, the CMU examines only one user-selected channel.

### Simultaneous

This mode is optimized so that measurement results for five different frequency channels are rapidly obtained with the reduced hopping function defined in the standard.

## Receiver measurements

A condition for receiver measurements is that the DUT decodes the payload bits generated by the tester and returns them to the measuring instrument. The CMU switches the DUT into loop-back mode and compares the data received with the data previously sent.

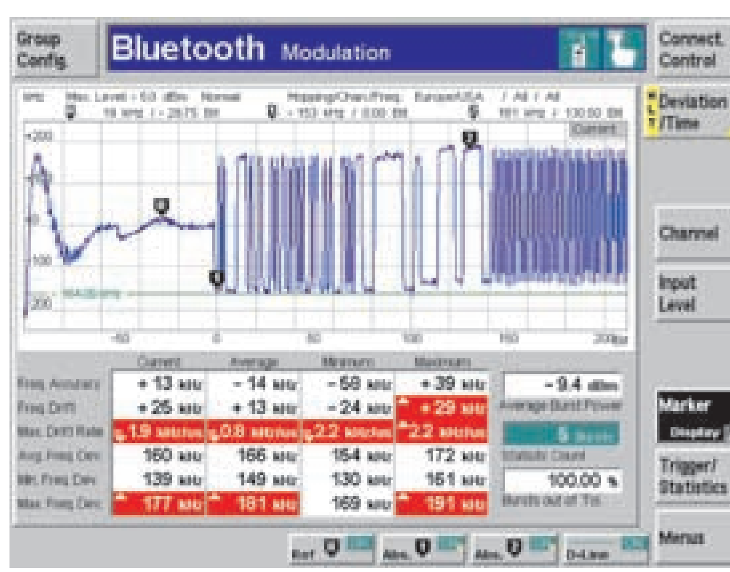



**FIG 5 Graphics display: the CMU 200 provides convenient means for signal analysis**

### Bit error rate (BER)

The BER of the payload data is calculated as follows: errored bits ÷ (total number of bits received by the tester in loop-back mode) x 100%.

### Packet error rate (PER)

If the DUT is not able to understand certain packets, e.g. because the sync word cannot be identified, the CMU marks these packets and they are included in the packet error rate calculation. PER = marked packets ÷ (total of sent packets) x 100%.

### BER search

In this mode, the CMU performs a sequence of BER measurements at a continuously reduced transmission level. The measurement is stopped when a user-defined limit for the BER measurement result is exceeded.

For generating the data pattern used in the loop-back mode, the CMU not only provides a great variety of ready-made data sequences (pseudo random, 1010, 1111000, etc) but also allows the users to define their own data sequences. The desired boundary conditions for receiver measurements can be defined in five test setups.

As with transmitter measurements, flexible receiver measurements can also be carried out in the non-hopping or the realistic hopping mode for different packet types and data lengths.

## Parallel operation for high measurement speed

Due to the high measurement speed and large memory capacity of the CMU, transmitter and receiver measurements can be carried out in parallel. When measurements are performed during frequency hopping, a great test depth is rapidly attained. Only a few seconds are required between call setup, transmitter and receiver measurements and call detach.

## Many convenient measurement functions

The CMU offers a great number of statistical monitoring and measurement functions. It is possible, for instance, to define individual tolerances for each measured value and to stop a measurement sequence after a certain number of measurements or when a tolerance has been exceeded. Besides the common traces for power and modulation versus time, averaged minimum or maximum traces can also be displayed over a user-defined number of packages.

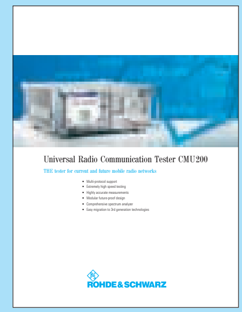
## Numerous other applications

A great number of additional *Bluetooth* measurements can be performed with the CMU. For instance, the receiver signal strength indicator (RSSI) test point in the DUT can be stimulated and adjusted by accurate setting of the CMU transmitter level. In the non-signalling mode, the CMU periodically sends a *Bluetooth* packet. In addition to power and frequency, a frequency offset and data pattern can also be selected and used, for instance, for stimulation when a *Bluetooth* FM demodulator is to be measured.

## Spectrum analyzer

The RF function group is implemented in the CMU as the basic package along with the *Bluetooth* option. It allows simple RF signals to be generated in a wide level and frequency range. The built-in analyzer evaluates RF input signals in the time or frequency domain.

**More information and CMU200 data sheet at www.rohde-schwarz.com, search for CMU200 (*Bluetooth* options CMU-B53, -K53, -U53 in the data sheet)**




REFERENCES
[*] Universal Radio Communication Tester CMU200 – On the fast lane into the mobile radio future. News from Rohde&Schwarz (1999) No. 165, pp 4–7

## Summary

The CMU supplements the *Bluetooth* test solutions from Rohde&Schwarz: the Protocol Tester PTW60 and the TS8960 which is the world's first RF test system for *Bluetooth* components (box on page 10). The CMU has been designed for many subsequent extensions. It may be possible, for instance, to perform *Bluetooth* measurements in addition to measurements in other networks such as GSM; this opens up new prospects for production lines in the future. Customers already using a CMU200 may order an upgrade kit.

Pirmin Seebacher; Dieter Mahnken

Universal Radio Communication Tester CMU 200

# First WCDMA measurement functions

**After providing support for the most important 2nd-generation mobile radio standards such as GSM, IS 136, AMPS and CDMA [1], [2], Rohde & Schwarz now presents the CMU 200 as a tester for mobile phones to the *WCDMA (3GPP/FDD)* standard*. The first functions described in this article carry out transmitter measurements on WCDMA uplink signals.**

* Abbreviations in the text are explained in the box on page 15.

## Main parameters of a WCDMA mobile phone

The most important parameter is the **transmit power** of the uplink signal:

- To ensure proper performance of the mobile phone, it is essential that the maximum transmit power (+33 dBm +1/−3 dB) is accurately met. If the transmit power is too high, too much current will be drained from the battery and other mobile phones in the network will be disturbed. If it is too low, the coverage range or the *QoS* is reduced.
- The mobile phone must be able to reduce its transmit power below a defined maximum level (<−50 dBm).
- When inactive, the mobile phone should not exceed a defined off power (−56 dBm).
- As with CDMA systems, accurate power ramping is also essential in *WCDMA* systems. With *WCDMA*, the mobile phone should send at a power level between +33 dBm and <−50 dBm which corresponds to a dynamic range of more than 83 dB. The individual power levels (1/2/3 dB) must be accurately met.

The CMU 200 measures this dynamic range with different measurement bandwidths for the maximum and the minimum/off power. The excellent level measurement accuracy and linearity of the CMU 200 are a great advantage in this case.

Another important parameter is the **modulation quality**. If the modulation quality is poor, bit errors and mutual interference of the code channels will occur. The error vector magnitude (*EVM*) and the frequency error are measured. I/Q errors, i.e. I/Q origin offset and I/Q imbalance, can be analyzed at the baseband level. They indicate a malfunction of the I/Q modulator. A typical parameter of *WCDMA* is the peak code domain error (*PCDE*). To measure this error, the total error vector is divided

FIG 1 Graphical display of modulation analysis

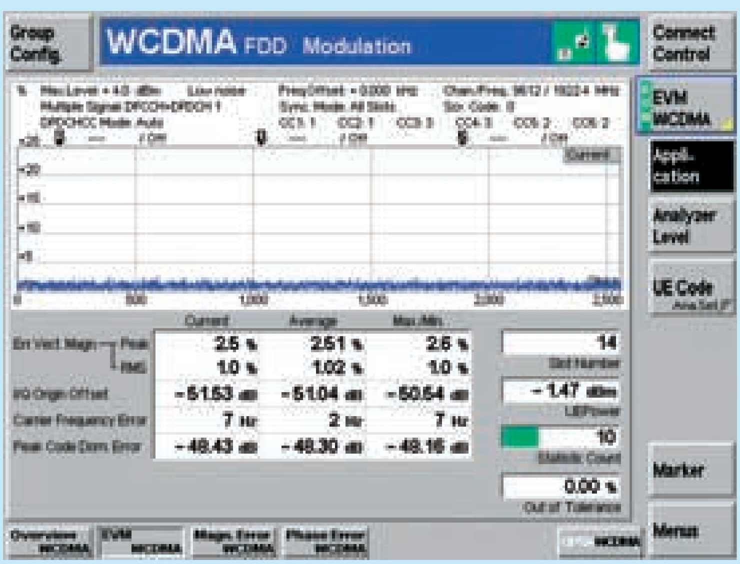
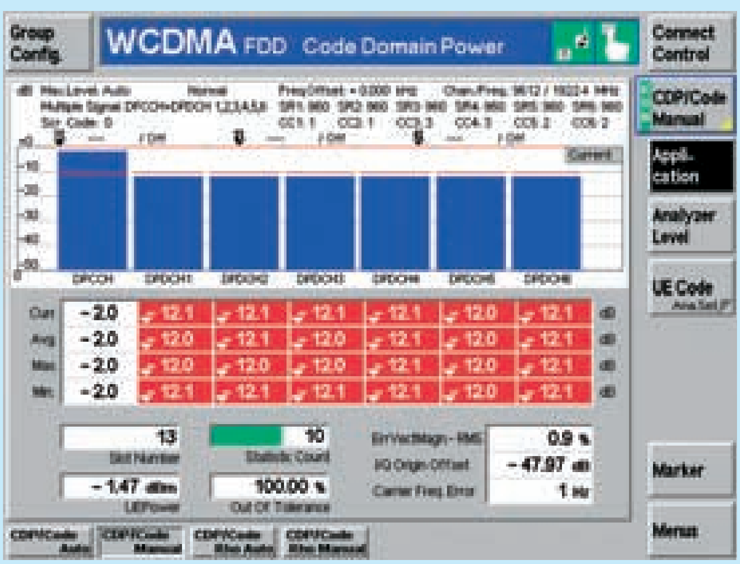



FIG 2 Code domain power



among the individual code channels. The code domain error is the ratio of the average code power to the average power of the reference signal. The *PCDE* is the maximum code domain error that occurs for all codes within a timeslot.

Results of modulation analysis are displayed on the CMU 200 graphically versus time (FIG 1) or as numeric values in an overview menu.

## Code domain power

Since data and control channels of *WCDMA/FDD* are separated by different codes that are mutually orthogonal, it is important for the analysis that the signal sent by the DUT can be split up again into the code channel components used. The power of one of these code channels is referred to as the code domain power (*CDP*) (see also [3] and [4]).

FIG 2 shows a *CDP* measurement with the CMU 200. The *CDP* of the control channel (DPCCH) and of the six possible data channels (DPDCH) of a mobile phone is displayed. In the example, the *CDP* of the data channels is reduced by 10 dB with reference to the control channel.

## Frequency spectrum

The frequency spectrum of the *WCDMA* signal generated by the transmitter limits the system performance. If a mobile phone exceeds the frequency range assigned to it, other subscribers or services will be disturbed. The *3GPP* standard defines an adjacent-channel leakage ratio **(*ACLR*) measurement** where the power of adjacent channels (±5 MHz offset from frequency used) and of alternate channels (±10 MHz) is measured. The CMU 200 displays a continuous frequency spectrum with a span of 25 MHz (FIG 3) and the integrated power values of the four adjacent channels (FIG 4). The CMU 200 naturally offers a sufficient dynamic range for the measurement (FIG 5).

Because of national requirements, additional spectrum characteristics are specified by the *3GPP* standard: the **spectrum emission mask** (continuous spectrum measured at 30 kHz and 1 MHz bandwidths, FIG 6) and the **occupied bandwidth** (bandwidth covering 99% of the total signal power). These measurements are an integral part of the *ACLR* analysis in the CMU 200.

## A test platform with proven characteristics

As defined by the standard, the CMU 200 always considers a whole timeslot which is 666 µs long and contains 2560 chips. Free running and external triggering modes are provided so that continuous or one-shot measurements can be taken.

Statistical evaluation is possible by recording average, maximum and minimum values for a selectable number of timeslots.

Markers (absolute and relative) as well as auxiliary marker lines facilitate the reading of measured values in the dis-

FIG 3 ***ACLR*** **displayed as continuous frequency spectrum**

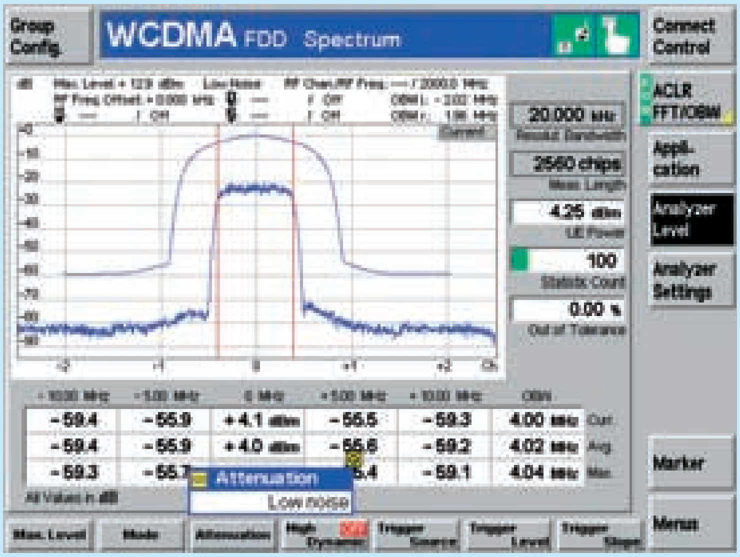
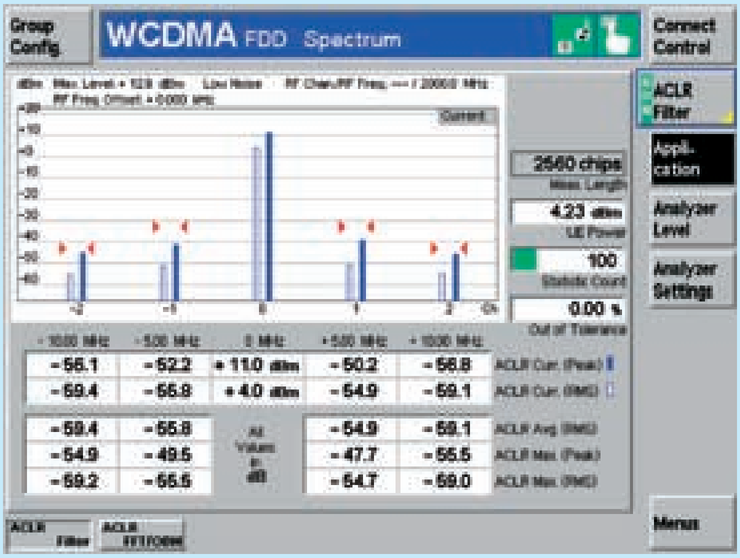



FIG 4 ***ACLR*** **in adjacent channels**



play menus. Tolerances can be set for go/nogo evaluation. Results violating a tolerance limit are displayed on a red background.

Using the CMU 200 platform for *WCDMA* has great advantages:

- The CMU 200 is a multistandard tester, i.e. measurement functions for all essential standards can be implemented. Switching from one standard to another takes only a few seconds.
- A flexible hardware and software update concept for the integration of additional *WCDMA* functionality levels or for the adaptation to changes in the *3GPP* standard.
- The CMU 200 has proven its great reliability, high measurement speed and accuracy as well as signal quality in many production lines.
- Low weight and compact design make it easy to handle.
- The well-known menu structure which provides easy operation of the CMU 200 is used for the *WCDMA* option. Users familiar with operating the CMU 200 in another network, e.g. GSM, will have no problems using *WCDMA*.
- Remote-control capabilities correspond to those of the CMU basic unit. Know-how acquired in the generation of remote-control programs for other function groups can therefore be directly utilized.

## Functions planned for the future

The evolution of the CMU 200 advances at a great pace:

- Measurements of power ramping versus time (inner loop power)
- *WCDMA* generator for synchronizing mobile phones and for BER measurements
- Signalling for call setup and call clear-down as well as loop-back for BER measurements.

Gottfried Holzmann

REFERENCES


[1] CMU 200 – Adding CDMA now provides full 2G capability. News from Rohde & Schwarz (2001) No. 170, pp 7–11
[2] CMU 200 – Successful mobile-radio tester now with US TDMA and AMPS standards. News from Rohde & Schwarz (2000) No. 168, pp 10–15
[3] Signal Analyzer FSIQ – Ready for all measurements on 3GPP base station transmitters. News from Rohde & Schwarz (2001) No. 170, pp 15–17
[4] Signal Generator SMIQ – Fit for 3G with new options. News from Rohde & Schwarz (2000) No. 166, pp 10–12

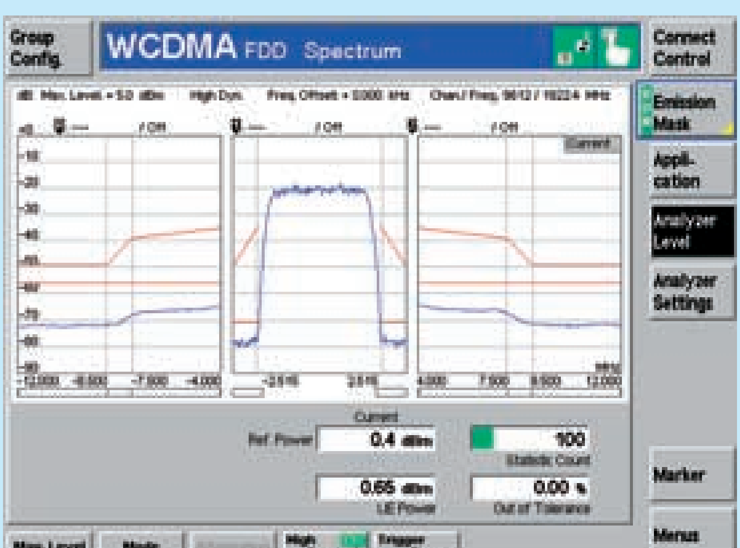

ADDITIONAL REFERENCES


– See box on page 12


## Abbreviations used

| | |
|---|---|
| *ACLR* | Adjacent channel leakage power ratio |
| *CDP* | Code domain power |
| *EVM* | Error vector magnitude |
| *FDD* | Frequency division duplex |
| *ME* | Magnitude error |
| *OBW* | Occupied bandwidth |
| *PCDE* | Peak code domain error |
| *PE* | Phase error |
| *QoS* | Quality of service |
| *SEM* | Spectrum emission mask |
| *TDD* | Time division duplex |
| *WCDMA* | Wideband code divison multiple access |
| *3GPP* | 3rd generation partnership project |

**FIG 6 Spectrum emission mask**




| | Minimum requirements Mobile phone | Minimum requirements Base station | Guaranteed dynamic range of CMU 200 |
|---|---|---|---|
| Adjacent channel | 33 dB | 45 dB | 54 dB |
| Alternate channel | 43 dB | 50 dB | 62 dB |

**FIG 5 Dynamic range of CMU 200 with comfortable margin**

### Condensed data of WCDMA option for CMU 200

| | |
|---|---|
| Standard | 3GPP-FDD, testing mobile phones |
| Frequency range | specified: 1920 MHz to 1980 MHz<br>unit functioning: 10 MHz to 2700 MHz |
| Measurement capabilities | |
| Power measurements | Max / Min / Off |
| Modulation analysis | EVM, ME, PE, freq error, I/Q offset, I/Q imbalance, rho, PCDE |
| Code domain power | CDP / rho value |
| Spectrum measurement | ACLR, OBW, SEM |
| Order designation | U65 / K65 |

### I/Q Modulation Generator AMIQ/Signal Generator SMIQ

# With WinIQSIM™ well equipped for 3G TDD standards

**The successful team of AMIQ and SMIQ with I/Q Simulation Software WinIQSIM™ (FIG 1 and [1], [2], [3]) for generating test signals to digital standards has again been extended and become more versatile. The 3G standards TD-SCDMA and 3GPP-TDD are now implemented in WinIQSIM™, opening up a wide range of new test scenarios.**

## The challenge: third-generation mobile radio

The number of subscribers to second-generation mobile radio networks is constantly growing. Network capacity is almost exhausted – particularly in Japan – while the need for mobile data services using high data transmission rates is rapidly increasing. To promptly respond to market requirements, 2.5th-generation mobile radio systems (GPRS/EGPRS, HSCSD) are currently being set up as an interim solution. However, the high demands for new services can only be satisfied by third-generation (3G) mobile radio systems. The International Mobile Telecommunications-2000 (IMT-2000) has defined three different modes for the global 3G standard. The 3GPP-WCDMA-TDD (time division duplex) mode has been defined in addition to the multicarrier mode (cdma2000) [4] and the 3GPP-WCDMA-FDD mode (first mobile networks in Japan as of summer 2001), which can already be handled by WinIQSIM™. The new 3GPP-WCDMA-TDD mode is also intended for use in picocells and in-house networks.

TDD systems use the same frequency in both transmit directions. Uplink and downlink are separated by time multiplex, i.e. by assigning timeslots to a transmit direction.

In addition to the 3GPP-TDD mode using 3.84 Mchip/s, a low-chip-rate mode of 1.28 Mchip/s has been defined and is currently standardized in 3GPP under the name TD-SCDMA. For this mode, which is particularly favoured in China, the core of existing GSM systems can be used. Many major telephone and base station manufacturers will offer products for the FDD and the TDD mode of 3GPP, and by 2003 or 2004 the first mobile radio networks will be operating on a TDD basis. WinIQSIM™ is the first software on the market to simulate both TDD modes.

FIG 1 The AMIQ (bottom) and the SMIQ are a good team, e.g. for simulating multicarrier applications such as GSM with TD-SCDMA if an RF test signal is required

Photo 43528/2

## Common features of TD-SCDMA and 3GPP-TDD

TD-SCDMA and 3GPP-TDD are very similar. The special features of each standard are described in the boxes on the following pages. An outstanding characteristic of the 3GPP-TDD standard is that asymmetrical bandwidths can be assigned to the uplink and downlink. This means that large data quantities, e.g. data from the Internet, can be transmitted on the downlink while a lower

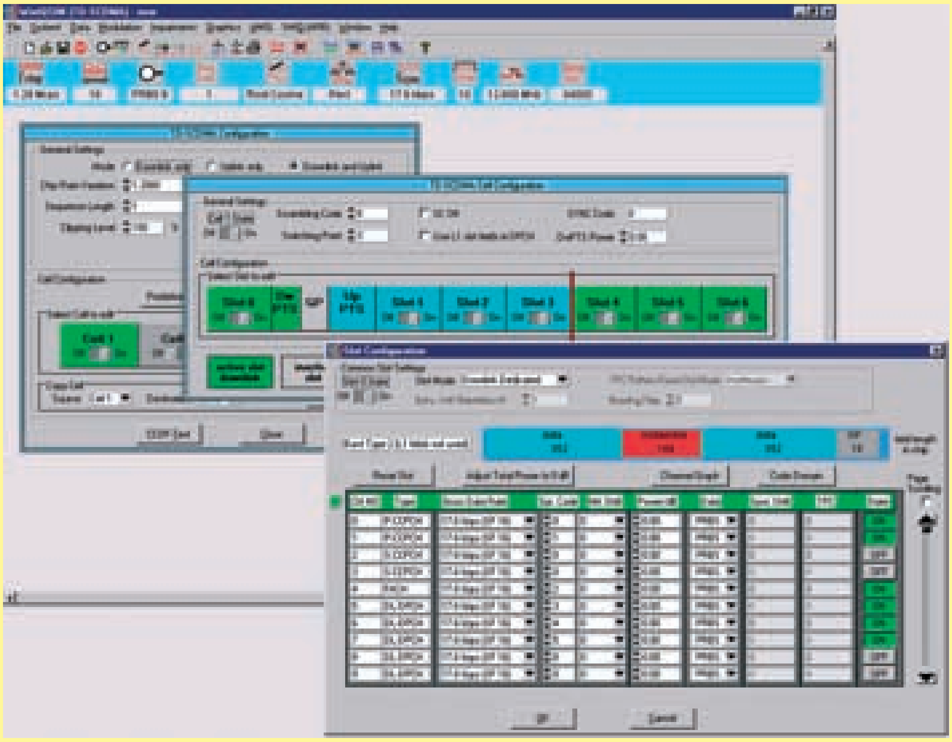


**FIG 2 Configuration of a TD-SCDMA cell**

## Special features of TD-SCDMA

A TD-SCDMA frame consists of seven traffic timeslots for data transmission and two special slots for synchronization (DwPTS and UpPTS). Switchover between downlink slots and uplink slots is defined by a settable switching point. The first slot is always used for the downlink. It is followed by downlink and uplink pilot timeslots. The subsequent slots up to the switching point are used for the uplink, all others for the downlink. All the frame configurations defined by the standard are available (FIG 2). Burst types 1 and 2 of TD-SCDMA and all physical channel types can be set (P-CCPCH, S-CCPCH, FACH, DL-DPCH, UL-DPCH, PRACH).

A menu is available for convenient definition of standard test scenarios. In this menu the number of code channels and the height of the crest factor can be set.

data rate is available on the uplink, e.g. for transmitting the Internet address. The available bandwidth – a limited and expensive resource in mobile radio systems – can thus be tailored to requirements.

With WinIQSIM™, the uplink and the downlink can be simulated separately. To investigate the complete behaviour of a cell (base station with all connected mobiles), e.g. for interference measurements, the uplink and downlink can also be generated together. WinIQSIM™ simulates up to four of these cells (with settable scrambling code) simultaneously. Up to 16 code channels using different spreading codes may be active simultaneously in every timeslot of a frame. All the spreading factors defined by the standards can be set between 1 and 16. Frequency, scrambling code, timeslot and spreading code are therefore decisive parameters of a link in TD-SCDMA or 3GPP-TDD systems.

WinIQSIM™ supports the configuration of the new systems in many ways. The channel tables of the individual slots show domain conflicts (overlapping code channels in the code area) and eliminate them, if required. The whole code domain can be graphically displayed and the structure of an edited code channel consisting of data and control fields can also be shown.

Parameters such as power, data, spreading factor and spreading code can be set separately for each code channel. In addition to the standard signal representations in the time and frequency domain, WinIQSIM™ displays the complementary cumulative distribution function (CCDF) with the aid of which signal statistics and the probability of power peaks – e.g. when many channels are superimposed – can be observed. Methods for limiting the crest factors (clipping) are, of course, also available. The physical random access channel (PRACH) can be simulated in both standards and in TD-SCDMA it can be simulated together with the uplink pilot timeslot.

## SMIQ or AMIQ?

The two new standards are offered – together with the I/Q Simulation Software WinIQSIM™ – for both the AMIQ and the option SMIQ-B60 (arbitrary waveform generator). The two platforms support the user in different ways.

### Signal Generator SMIQ as stand-alone unit

The options SMIQ-B60 (arbitrary waveform generator), SMIQ-K13 (3GPP-TDD) and SMIQ-K14 (TD-SCDMA) enhance the SMIQ for comprehensive tests on amplifiers and components. All the effects of signal generation on signal spectrum and envelope can be simulated. Synchronization tests on mobiles can also be performed via the available signalling channels (P-CCPCH, P-/S-SCH or DwPTS).

### I/Q Modulation Generator AMIQ

When equipped with the options AMIQ-K13 (3GPP-TDD) and AMIQ-K14 (TD-SCDMA), the AMIQ offers capabilities that are far beyond those of the SMIQ. The digital and differential outputs of the AMIQ allow accurate tests to be carried out directly in the baseband. With the AMIQ 04, long BER measurements can be performed at the physical level, where sequence lengths of more than 100 frames may occur with 3GPP-TDD and of more than 600 frames with TD-SCDMA. The AMIQ 04 is particularly suitable for simulating multicarrier applications such as GSM with TD-SCDMA or 3GPP-FDD with -TDD allowing the new systems to be tested under real operating conditions. If an RF test signal is required, an additional SMIQ is useful.

## Special features of 3GPP-TDD

The 3GPP-TDD frame comprises 15 slots that can be assigned to the uplink or downlink as required. In contrast to TD-SCDMA, the transmit direction can be changed from slot to slot (FIG 3). Any of the three 3GPP burst types can be selected for each slot in addition to the transmit direction. All physical channel types are also available, and a combination of the TPC and TFCI fields can additionally be defined for each code channel.

The 3GPP-TDD standard sets very high demands on the ON/OFF ratio, i.e. the output power ratio between active and inactive slots. Because of the analog effects of signal generation (e.g. carrier leakage of I/Q modulator), it is not sufficient to generate baseband signals with a wide dynamic range. For inactive slots, the RF must also be switched off. WinIQSIM™ together with the AMIQ automatically supplies a data-active signal to a marker output. This signal with shiftable start and stop edges marks the area of an I/Q signal which contains active TDD system slots. The signal can be used to control the SMIQ pulse modulator and thus to switch off the RF signal in inactive slots. This considerably increases the ON/OFF ratio (FIG 4).

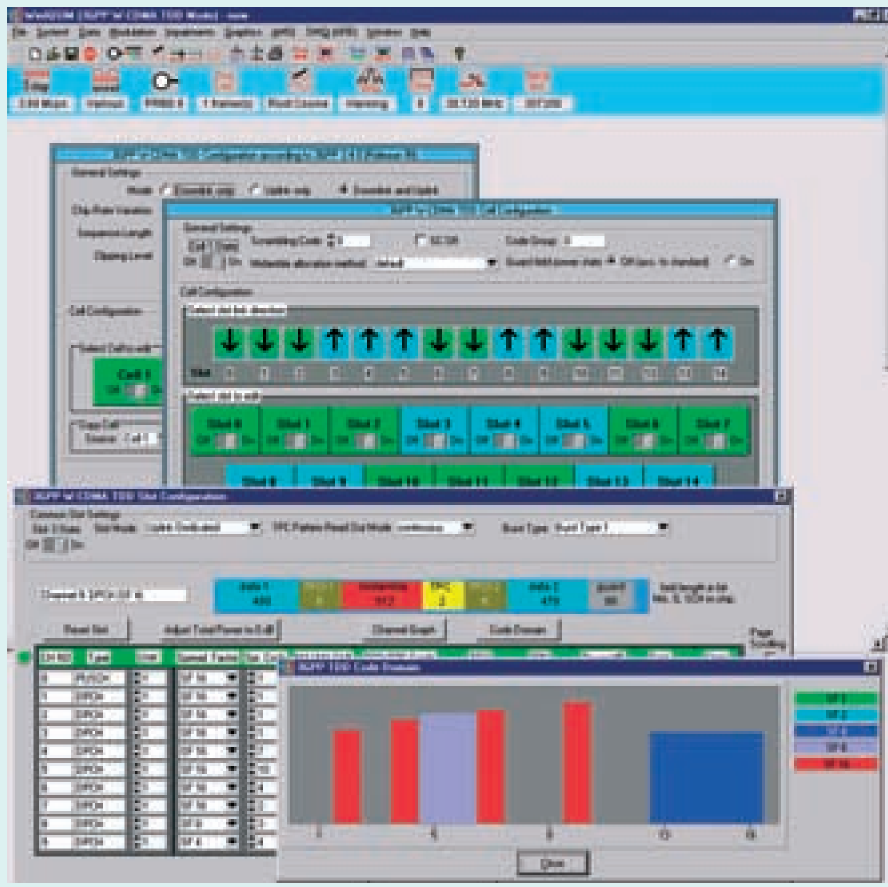


FIG 3
Configuration of a 3GPP-TDD cell

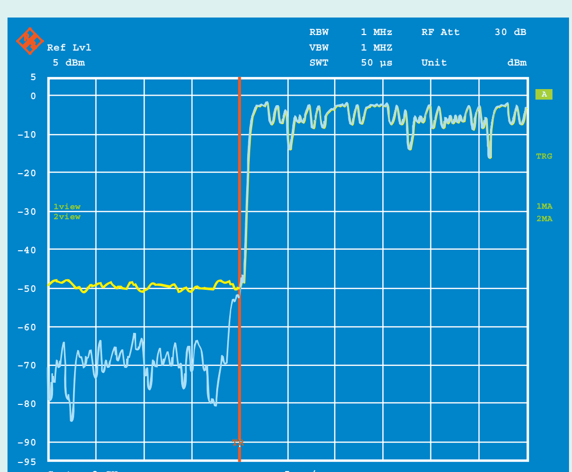


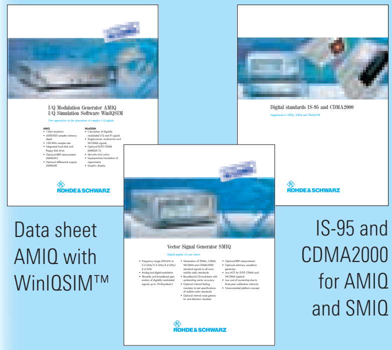

FIG 4
Increasing the ON/OFF ratio with data-active marker and pulse modulation (yellow: without, blue: with data-active marker)

## Summary

Even in this early development phase, WinIQSIM™ – together with the AMIQ and SMIQ – supports the 3GPP-TDD and TD-SCDMA standards by offering comprehensive capabilities for signal generation. As with 3GPP-FDD, WinIQSIM™ system updates quickly adapt the software to new requirements as may be caused by modifications to the standard or by market developments.

Andreas Pauly

**More information and data sheets at www.rohde-schwarz.com (search for AMIQ, SMIQ, WinIQSIM).**



Data sheet AMIQ with WinIQSIM™

IS-95 and CDMA2000 for AMIQ and SMIQ

Data sheet SMIQ


REFERENCES

[1] I/Q Modulation Generator AMIQ – New models 03 and 04 as well as digital I/Q output option. News from Rohde & Schwarz (2000) No. 166, pp 22–23

[2] Signal Generator SMIQ – Fit for 3G with new options. News from Rohde & Schwarz (2000) No. 166, pp 10–12

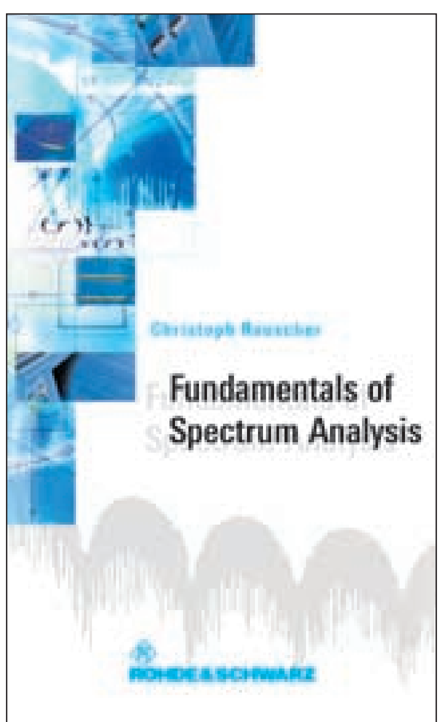
[3] I/Q Simulation Software WinIQSIM™ – New approaches in calculating complex I/Q signals. News from Rohde & Schwarz (1998) No. 159, pp 13–15

[4] I/Q Simulation Software WinIQSIM™ – CDMA2000 test signals in unrivalled variety. News from Rohde & Schwarz (2000) No. 168, pp 27–29


BOOK TIP | General purpose

## Fundamentals of Spectrum Analysis

A comprehensive introductory guide to spectrum analysis, covering both theory and practice for carrying out typical measurement tasks, has now been published in-house by Rohde & Schwarz and can be obtained from our local representatives at a nominal charge of DM 10. The 220-page hardback book was written by Rohde & Schwarz experts, whose many years' experience in the development and practical application of spectrum analyzers enables them to convey in-depth insight into the subject. Extensively illustrated with full colour printing, the book makes a perfect reference source or textbook for scientists, technicians, or students involved in spectrum analysis.




The text first covers the physics of electrical signals in the time domain and the frequency domain, before explaining the basic measurements possible with a spectrum analyzer. The example of an analyzer operating on the heterodyne principle is used to illustrate the individual instrument modules, their characteristics and interdependencies; a fold-out block diagram makes for easy orientation. The middle chapters of the book deal with the performance characteristics of an analyzer, i.e. the characteristics that determine the quality of an instrument, such as spectral purity, dynamic range, measurement accuracy and measurement speed. The final third of the book describes day-to-day spectrum analysis measurement tasks, explains test setups and provides help for analyzing measurement results. A number of test tips spread across the book offer a practical guide for users, helping them avoid common errors, or providing simple solutions to standard measurement tasks.

In contrast to the few books available on the subject, all of which are rather outdated, Fundamentals of Spectrum Analysis is based on the latest technology and thus provides the reader with the know-how needed to carry out today's measurement tasks, such as those required in digital mobile radio. In addition, examples from a spectrum analyzer data sheet show the performance data that can realistically be expected from a state-of-the-art instrument.

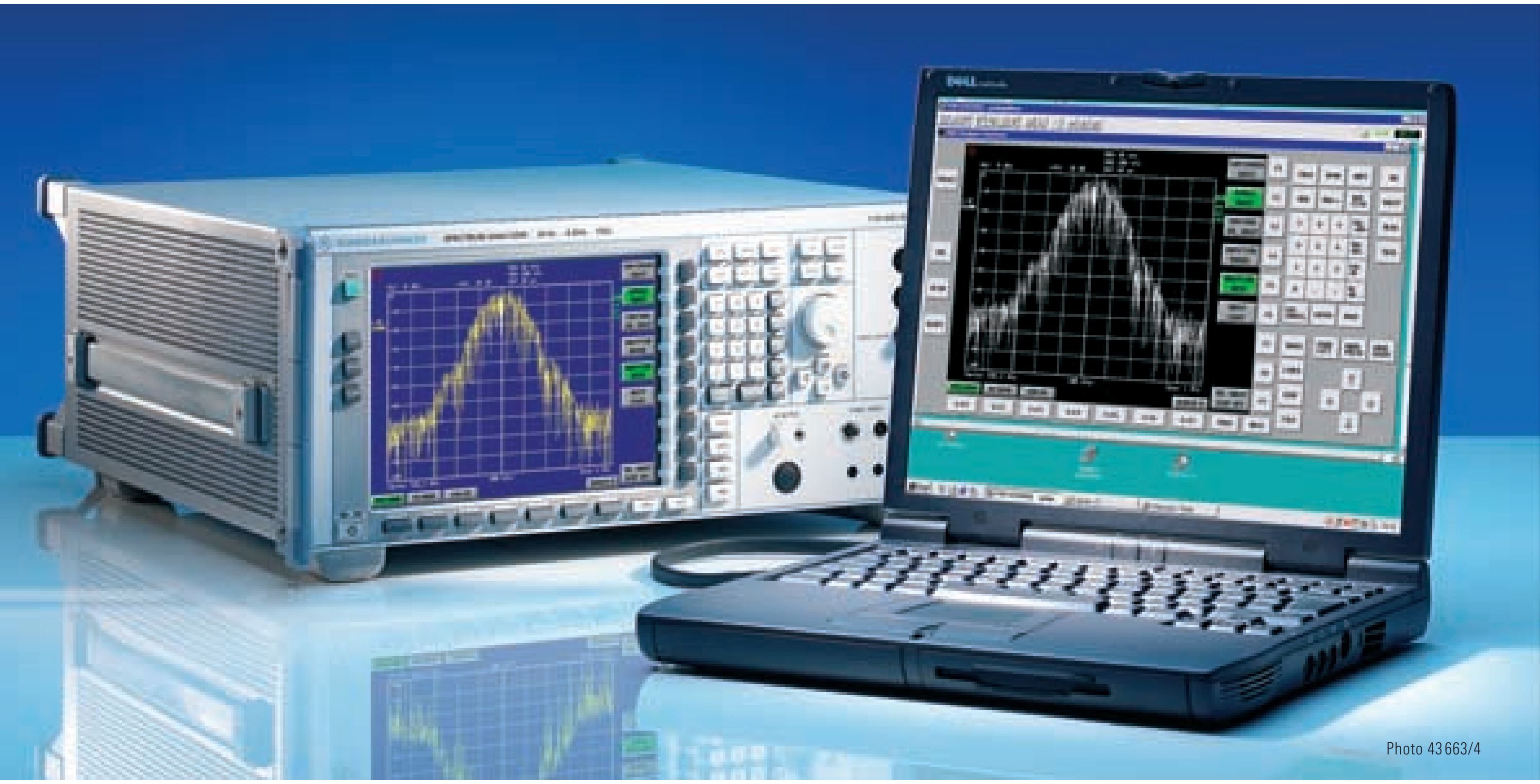


Photo 43 663/4

**FIG 1** The FSU family consists of two analyzers for the RF range and the lower microwave range: the FSU 3 (20 Hz to 3.6 GHz) and the FSU 8 (20 Hz to 8 GHz). The PCAnywhere software allows remote control of the analyzers with a mouse.

**With the new FSU spectrum analyzers, Rohde & Schwarz launches its third generation of high-end analyzers on the market. Like their predecessors – the FSA (1986) and the FSE (1995) [1] – they again set high standards and offer measurements which previously were not possible with spectrum analyzers, or at least were insufficient.**

### Spectrum Analyzer FSU

# Best RF performance – third generation of high-end analyzers

## Excellent RF performance

High-end spectrum analyzers distinguish themselves from medium-class instruments by their outstanding RF performance, in particular, minimal inherent noise floor and phase noise and excellent intermodulation characteristics. In these disciplines, the FSU (FIG 1) anticipates the future increased demands placed on dynamic range, measurement accuracy and speed. The FSU 3 and FSU 8 are based on the general-purpose spectrum analyzers of the FSP family [2], in which the RF hardware has been replaced by a high-end concept satisfying the most exacting requirements.

The FSU's advanced concept is most apparent in large-signal behaviour such as intrinsic intermodulation and compression characteristics as well as in phase noise.

In the frequency ranges around 1 GHz and 2 GHz, which are important for mobile communications, the FSU is the first spectrum analyzer to guarantee a third-order intercept point of >+20 dBm. Typically, even +25 dBm are achieved.

The 1 dB compression point of the input mixer is +13 dBm. Such a high dynamic range is associated with a high usable mixer level; the reference level can be set up to +5 dBm without RF attenuation (mixer level: the level at the RF input minus the attenuation of the RF attenuator). With all other customary spectrum analyzers on the market, the maximum mixer level is limited to –10 dBm. Thus, the FSU displays a considerably larger dynamic range on the screen, for example with phase noise or spurious measurements, without the carrier signal overdriving the signal path.

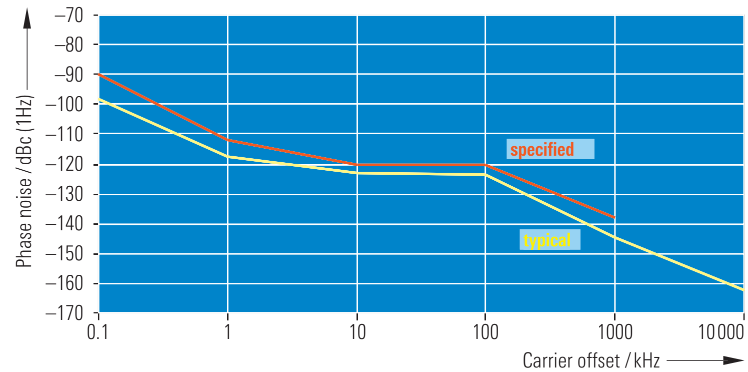



**FIG 2 Phase noise of the FSU at an input frequency of 1 GHz**

## Unrivalled low phase noise

The high dynamic range does not come at the expense of higher inherent noise, however. With <–145 dBm and typically –148 dBm displayed average noise level up to 2 GHz at 10 Hz resolution bandwidth, the FSU remains state-of-the-art. This outstanding dynamic range is the result of a new symmetric frontend design (patent pending).

Phase noise is another parameter that has a particular influence on measurements of densely occupied spectra with widely different signal levels as well as on noise power measurements in the adjacent channels of radio transmission systems. The extremely low phase noise of the FSU's local oscillators prevents very low signals from being covered up. With broadband transmission systems such as WCDMA according to 3GPP, a low phase noise far off from the carrier is important. But spurious emission measurements are often limited by phase noise, as with GSM for example. The FSU provides the best results ever produced by a spectrum analyzer. At a 10 MHz carrier offset, for example, the phase noise is –162 dBc (1 Hz) as is shown in FIG 2. In order to minimize the phase noise for critical applications and different carrier offsets, the user can change the PLL bandwidths of the first local oscillator in the FSU, as is also the case with the FSA and FSE.

For general applications, the FSU sets the PLL bandwidth automatically, of course.

The adjacent-channel power measurement of a 3GPP-WCDMA signal serves as an example which demonstrates the extremely high usable dynamic range. With an adjacent-channel leakage ratio (ACLR) of 77.5 dBc, the FSU even surpasses the Signal Analyzer FSIQ from Rohde & Schwarz, which until now exhibited the best performance on the market with 75 dBc. FIG 3 shows the attainable adjacent-channel leakage ratio as a function of the mixer level applied.

The 5 dB steps of the RF attenuator guarantee an optimal setting of the mixer level for maximum dynamic range. Thus, the FSU achieves an ACLR dynamic range of at least 76 dB for all RF signal levels.

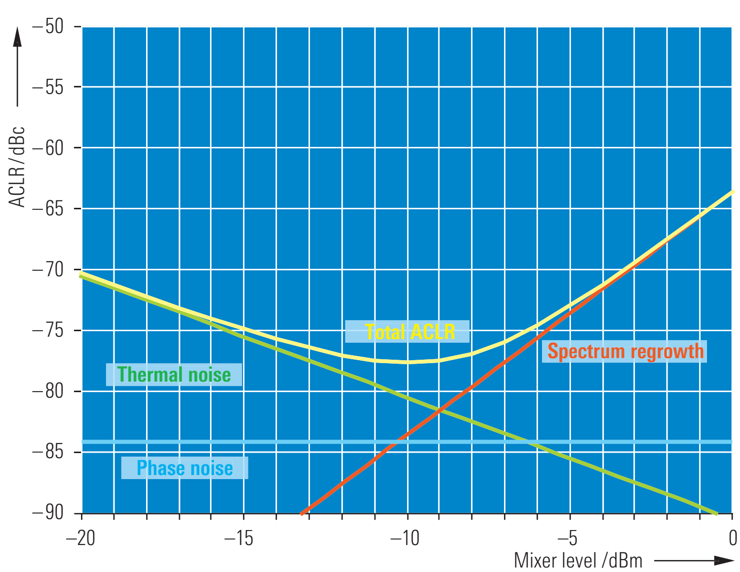



**FIG 3 ACLR for a WCDMA signal (3.84 MHz bandwidth, 12 dB crest factor)**

## Previously unmatched measurement level accuracy

In addition to the RF dynamic range, the measurement level accuracy plays an important role for all applications. The FSU again offers unprecedented values. A low level measurement error provides more room for tolerances in production and helps to achieve a higher throughput (FIG 4).

One parameter that influences the level accuracy is the frequency response of the RF input. Due to the exceptional 50 Ω matching of the first mixer, the uncorrected frequency response is decidedly flat. Thanks to extensive internal correction tables, the FSU can thus guarantee a frequency response of less than 0.3 dB up to 3.6 GHz for attenuator settings from 10 dB upwards. The FSU sets the gain of the signal path during the sweep according to a Rohde & Schwarz-patented method so that all frequency response errors up to the first intermediate frequency are corrected (FIG 5).

The digital filters (10 Hz to 100 kHz bandwidth) result in an extremely small display nonlinearity. The level linearity is only dependent on the linearity of the 14-bit A/D converter used at the last intermediate frequency, whose nonlinearity is kept very low by dithering of the signal.

The display linearity, which in conventional devices is dependent on analog logarithmic amplifiers, is practically error-free in the FSU due to arithmetic taking of the logarithm. So the guaranteed values for the display linearity of the FSU are rather a problem for verification by external measurement devices and their traceability to standards. The converter itself has a nonlinearity of approx. 0.03 dB over a display range of 70 dB. With a reasonable outlay for calibration tools, the guaranteed value for the display linearity is ≤0.1 dB.

The total measurement uncertainty of the FSU for frequencies up to 3.6 GHz and 70 dB display range is 0.3 dB (95% confidence level), which makes power meters unnecessary in many cases and leads to unprecedented accuracy for selective power measurements without requiring elaborate correction procedures. Above all, with digitally modulated signals such as WCDMA, the RMS detector contributes considerably to accurate and stable power measurements, whose results are independent of the signal characteristics. By selecting the appropriate sweep time, the user can influence the reproducibility of the measurements.

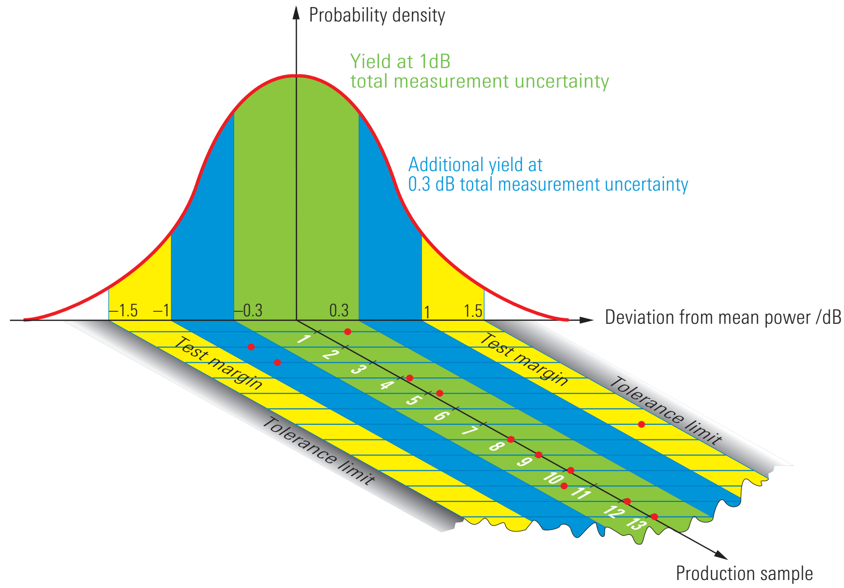



FIG 4 **The extremely accurate FSU can increase production yields**

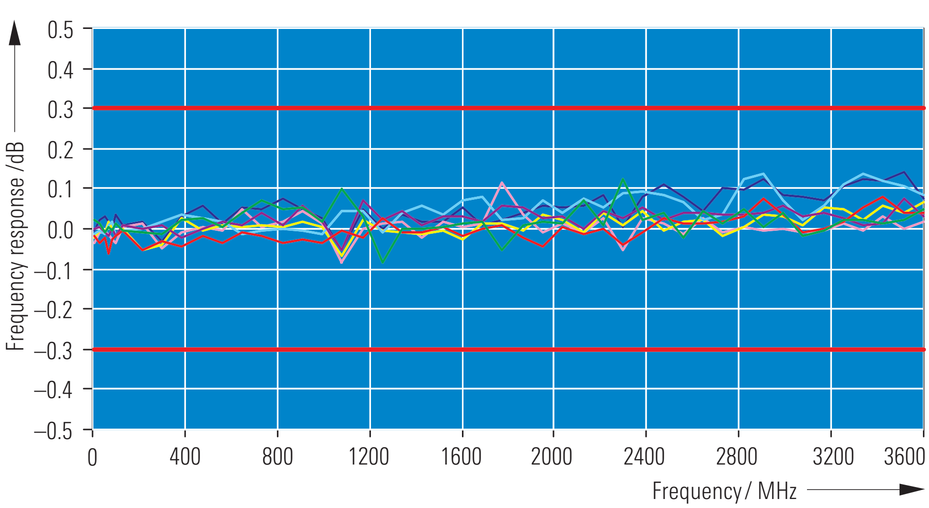



**FIG 5 Frequency response of the FSU between 10 MHz and 3.6 GHz (7 different devices)**

The video signal for power integration is available with a resolution of 24 bits, which results in an unrestricted dynamic range of over 100 dB for the RMS detector.

## Numerous bandwidths

An essential feature of spectrum analyzers is the number of resolution bandwidths, since this determines the resolution of the measured signal spectra. The FSU offers a wide variety of bandwidths and filter characteristics. For very

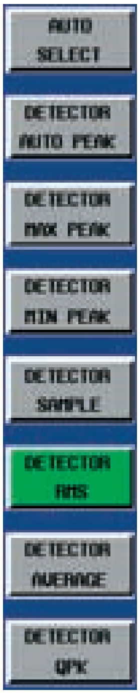



**FIG 6**
**The FSU provides all detectors**

narrow resolution bandwidths from 1 Hz to 30 kHz, FFT filters are provided, which offer a considerable advantage when examining spectra close to the carrier (for example, phase noise in the immediate vicinity to oscillators). In comparison to sweep filters, the measurement time is significantly reduced for small bandwidths through the use of the FFT algorithm.

The FSU utilizes digital sweep filters with Gaussian characteristics (in 1/2/3/5 sequence) in the range from 10 Hz to 100 kHz. Not only do they provide a higher selectivity (shape factor 60 dB : 3 dB = 4.5) than conventionally implemented 5-pole filters (shape factor 60 dB : 3 dB = 9), but due to their precisely known characteristics and their transient response, they allow a sweep that is faster by a factor of 2.5. Because of their higher selectivity, a wider filter can be used in many applications. Doubled bandwidth reduces the sweep time to a fourth. And finally, digital sweep filters improve measurement accuracy, since their gain is precisely known and no additional level error occurs when switching bandwidths.

For the bandwidth range from 200 kHz to 50 MHz, analog sweep filters (in 1/2/3/5 sequence) are available, which are built as a 5-pole filter for up to 5 MHz bandwidth. The 10 MHz, 20 MHz and 50 MHz bandwidths are implemented with fixed-tuned channel filters. With a 50 MHz bandwidth, the FSU offers the largest bandwidth ever for any spectrum analyzer designed for general industry applications, and takes into account the development of wideband transmission systems.

As is the case with the FSP, the FSU also contains additional channel filters with nearly rectangular passband characteristics, in conjunction with 38 different bandwidths from 100 Hz and up. Root-raised cosine filters are available in the FSU and FSP – again a first for a spectrum analyzer – which are prescribed for power measurements according to the IS 136, TETRA or WCDMA standards. In addition, channel filters are available for adjacent-channel power measurements according to ETS 300… for analog radio transmission systems with 12.5 kHz or 25 kHz transmission bandwidths. Once again, the FSU allows measurements which were previously not possible or were insufficient with spectrum analyzers.

## Complete set of detectors

A complete set of detectors is available in the FSU (FIG 6). In addition to the usual detectors such as Max Peak, Min Peak, Auto Peak and Sample, the RMS and average detectors used in the FSE family of analyzers are naturally included as well. For EMI precompliance measurements, the quasi-peak detectors according to CISPR16 with their associated 6 dB bandwidths of 200 Hz, 9 kHz and 120 kHz can be used. All detectors are implemented digitally so that detection and hold time, temperature drift, aging and errors due to switching are not present. Of course, the trace operations Max Hold, Min Hold and Average are implemented, which allows trace averaging to be carried out in both logarithmic and linear scaling.

## Numerous standard functions for laboratory and production

For general applications in the laboratory or in production, the FSU offers numerous functions which considerably simplify measurements and help to avoid errors:

- Two independent measurement settings selectable at a keystroke
- Split-screen display with independent measurement settings in both windows
- 4 markers or delta markers
- Noise marker for measuring noise power density
- Phase noise marker for measuring oscillator phase noise
- Automatic intermodulation measurements for determining the third-order intercept point
- Frequency counter with 0.1 Hz resolution for a 30 ms measurement period
- Measurement of the amplitude modulation depth
- AM and FM demodulator
- Power measurement in time domain (mean, RMS and peak power)
- Measurement of occupied bandwidth
- User-definable limit lines (absolute or relative) with selectable limit values and pass/fail indication

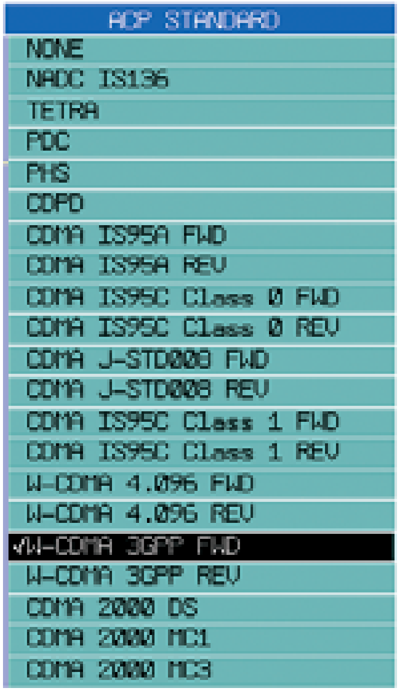



**FIG 7 The FSU provides simple-to-use functions for all of the important transmission standards**

## Numerous functions for convenient measurements

The FSU combines its exceptional RF dynamic range with a series of functions which considerably simplify measurements, particularly on digitally modulated signals. Measurements can now be carried out which previously were not possible with a spectrum analyzer.

Special attention should be given to the digital transmission methods, whether they are TDMA for GSM or EDGE or CDMA for WCDMA according to 3GPP.

### Adjacent-channel power

One of the most important spectrum measurements is the measurement of the adjacent-channel power, which determines whether the subscribers in the adjacent channels are disturbed by excess power. The FSU is ready for all the important transmission standards (FIG 7) with simple-to-use functions, which configure the analyzer so that it carries out the measurement concerned with the correct settings and optimal dynamic range. The user chooses the desired standard from a list; the FSU sets the optimal attenuation and reference level.

The FSU automatically uses the prescribed filters for all standards and calculates the power in the various channels by integration of the measurement values within the channel. The RMS detector guarantees very precise and reproducible measurement results. In addition to the integration method, the FSU also offers measurement of the adjacent-channel power in the time domain; the power in the individual channels is measured over a selectable time period, which clearly saves time compared to the integration method. For the WCDMA standard, speed advantages of up to a factor of 4.5 can be achieved with the same stable measurement results. This is particularly an advantage in mass production, when nearly a 100% test of all components must be carried out.

The power or adjacent-channel power measurement in TDMA systems requires special functions such as triggering on a TDMA burst, gated sweep and power measurements in the time domain. For triggering, the FSU creates a threshold derived from the RF signal. With a bandwidth of 50 MHz and the gated sweep function, it triggers on a TDMA signal in time or frequency domain and measures within the chosen time period. DUTs which do not offer a trigger signal can therefore be operated without additional circuitry. In the time domain, the FSU measures the power by integration over the selected time span. In addition to the numerical values, the standard deviation is also output, which provides information about the stability of the measurement result.

### Amplitude statistics

Digitally modulated signals often contain both an FM and AM component, as for example the QPSK-modulated 3GPP WCDMA signal. When designing transmitters and receivers, not only the average power is important, but also the power peaks and the frequency of their occurrence. In addition to the spectrum and time characteristic, the FSU measures the amplitude distribution of signals; the usual representation is the com-

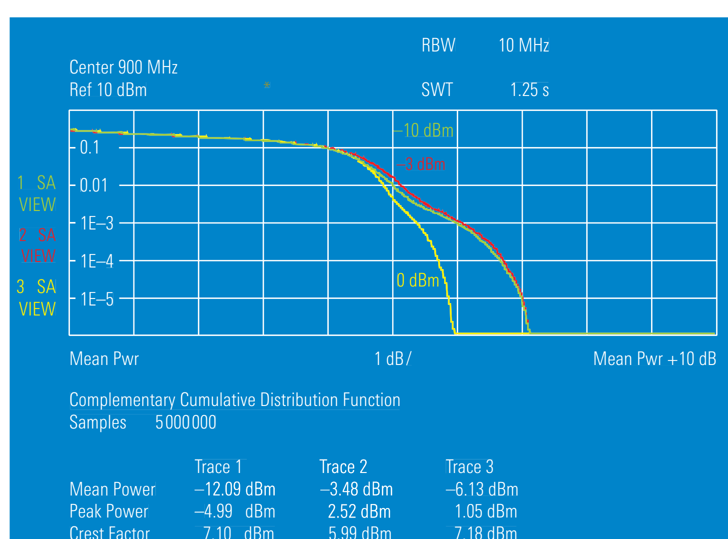



**FIG 8 CCDF measured at the output of a power amplifier for different input levels**

plementary cumulative distribution function (CCDF). Beginning with the average power, the percentage of the power peaks in the signal is represented. FIG 8 shows the CCDF of a WCDMA signal measured at the output of a power amplifier for different input levels. With this function, the FSU adds a further dimension to the assessment of RF signals.

### IQ data

For applications which in addition to the magnitude also require the phase of an RF signal, the FSU provides the inphase and quadrature components via the IEC/IEEE bus or LAN interface. It saves the data for each component in a half-megaword RAM. The sampling rate of max. 32 MHz for the IQ signal and the memory size (0.5 k to 0.5 M) are configurable.

## High measurement speed

In addition to measurement accuracy, high throughput is an absolute must when using spectrum analyzers in production. The throughput determines how much investment is required for a particular production goal.

A high measurement rate for both manual and remote-controlled operation is the basic prerequisite for high measurement speed. With 25 traces displayed per second, the FSU provides for convenient alignments. In remote-controlled operation, it is extremely fast in the zero span mode, providing more than 60 traces consisting of 625 points each via the IEC/IEEE bus or LAN interface.

However, this does not say everything about the speed at which measurements can be carried out by the FSU. Intelligent measurement routines and functions in this high-end device contribute considerably to avoiding "measurement overhead" in the specific task. The FSU provides a frequency list mode, in which a record can be entered via the remote interface which contains the frequency and associated settings such as bandwidth, detector, measurement period and reference level. Upon receiving a command, the FSU measures at the given frequency and returns the results as a data record. With harmonic measurements, for example, only the interesting frequencies are recorded, and uninteresting frequency ranges are skipped. And finally, the short settling time of the FSU synthesizer contributes to the measurement speed.

## FSU compatible with FSE

The FSU family expands the functionality of the FSE family. Above all, the compatibility for remote operation is of special importance. Previous investments in test programs are not lost when switching to the FSU, since it is command-compatible with the FSE and FSIQ, as far as the functions are supported by both families. Even functions which have been implemented differently in the FSU in comparison to the FSE – for example, the summary marker – are command-compatible with the FSU, and can still be used.

Josef Wolf

**More information and data sheet at www.rohde-schwarz.com (search for FSU)**


REFERENCES

[1] Spectrum Analyzer FSEA/FSEB – New dimensions ins spectrum analysis. News from Rohde&Schwarz (1995) No. 148, pp 4–8

[2] Spectrum Analyzer FSP – Medium class aspiring to high end. News from Rohde&Schwarz (2000) No. 166, pp 4–7

ADDITIONAL REFERENCES

– Measurement of Adjacent Channel Leakage Power on 3GPP WCDMA Signals with the FSP. Application Note 1EF41


### Condensed data of Spectrum Analyzer FSU

| | |
|---|---|
| Frequency range (FSU3/FSU8) | 20 Hz to 3.6 GHz/8 GHz |
| Amplitude measurement range | –155 dBm to 30 dBm |
| Amplitude display range | 10 dB to 200 dB, 10 dB steps, linear |
| Amplitude measurement uncertainty | <0.3 dB (to 3.6 GHz), <2 dB (3.6 GHz to 8 GHz) |
| Resolution bandwidths | 1 Hz to 30 kHz, FFT filter in steps of 1/2/3/5, 10 Hz to 20 MHz in steps of 1/2/3/5 and 50 MHz, EMI bandwidths 200 Hz, 9 kHz and 120 kHz, channel filters 100 Hz to 4.096 MHz |
| Detectors | Max Peak, Min Peak, Auto Peak, Sample, Average, RMS, Quasi-Peak |
| Display | 21 cm (8.4") colour TFT LCD, SVGA resolution |
| Remote control | IEC 625-2 (SCPI 1997.0), RS-232-C, LAN via 100Base-T |
| Dimensions (W x H x D) | 465 mm x 197 mm x 517 mm |
| Weight (FSU3/FSU8) | 14.6 kg/15.4 kg |

Signal Generator SMIQ

# Modes and accuracy of electronic level setting

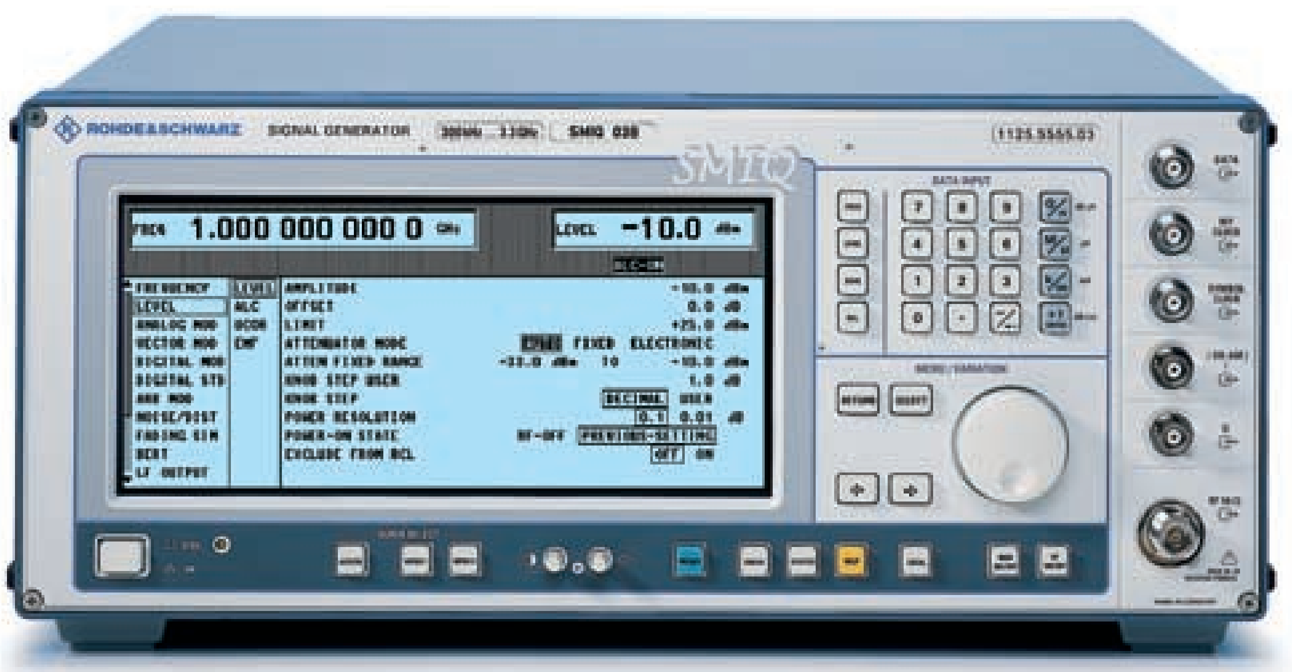



Photo 43304/3n

**FIG 1** **The SMIQ offers a great variety of functions for level reduction and automatic level control**

**Mechanical attenuators for level setting require a long setting time and are subject to wear and tear when frequently switched. For this reason the Signal Generator SMIQ is additionally equipped with facilities for electronic level setting.**

## Mechanical and electronic level setting in the SMIQ

Most signal generators are equipped with mechanical attenuators that are subject to mechanical stress when frequently switched. To reduce this stress, two electronic level attenuators (FIG 2) are additionally available in the Signal Generator SMIQ (FIG 1). Electronic level setting in the SMIQ with a dynamic range of up to 90 dB has the advantage of operating without wear and tear and also permits fast level setting without impairing the level accuracy. This is an important aspect when using the SMIQ in a production environment where millions of level settings have to be carried out.

## Three level attenuation modes

Three level attenuation modes are available in the SMIQ for setting the RF output level (FIG 3). The user can select the mode that is appropriate for his application:

- ATTENUATOR MODE AUTO is the standard operating mode of the SMIQ. The level is set by switching the mechanical attenuator in 5 dB steps. The difference between the mechanically set and the desired attenuation is automatically set by the ALC loop (FIG 2). In this mode, the ALC loop operates in the range between 0 dB and 4.9 dB.
- With ATTENUATOR MODE FIXED, the mechanical attenuator remains in the current position during subsequent

level settings. The level is electronically set by means of the ALC loop in a range between 0 dB and –25 dB in relation to the RF level at the time the mode was selected.

- In the ATTENUATOR MODE ELECTRONIC, the level attenuator at the I/Q modulator output reduces the RF level by up to 70 dB. When the ALC loop is switched on in addition, a total dynamic range of 90 dB is obtained for level setting.

## Four ALC modes

Four ALC modes are available in the SMIQ to adjust the RF level to the set reference level (FIG 3). This variety ensures that the level is always optimally adapted to the different analog and digital modulation modes or mobile radio standards. The user can be confident that the optimum level stability and level accuracy is always obtained.

- ALC AUTO is the default setting during operation. The ALC status is automatically adapted to the operating conditions of the SMIQ and the ALC loop is automatically set to ON or OFF depending on the selected modulation.
- ALC ON forces the ALC loop to be active irrespective of the modulation or operating mode set on the SMIQ.
- If the ALC OFF MODE SAMPLE & HOLD is selected, the level is recalibrated each time the level or the frequency is set. The SMIQ switches to the CW mode for a short period and activates

## Top fit: three circuits for level setting in the SMIQ

The SMIQ contains three circuits for level attenuation / level control. The automatic interaction of the three circuits guarantees optimum stability and a high linearity and accuracy of the RF level. FIG 2 shows the order in which the level switching modules are installed in the SMIQ signal path.

① The mechanical attenuator is located between the RF output circuit and the instrument output and has the following features:
- Switchable in 5 dB steps
- Attenuation range 135 dB (5 dB steps)

② The automatic level control (ALC) loop is located in front of the mechanical attenuator ① in the SMIQ signal path and has the following features:
- Electronic level attenuation, setable in 0.1 dB or 0.01 dB steps
- Attenuation range 25 dB (linear)

ALC has three tasks:
- Level setting
- Constant level regulation over temperature and time
- Amplitude modulation (AM) by varying the nominal output level ($V_{nominal}$ in FIG 2)

③ The PIN diode attenuator is located at the I/Q modulator output and has the following features:
- Electronic level setting with 0.1 dB or 0.01 dB resolution
- Attenuation range 70 dB

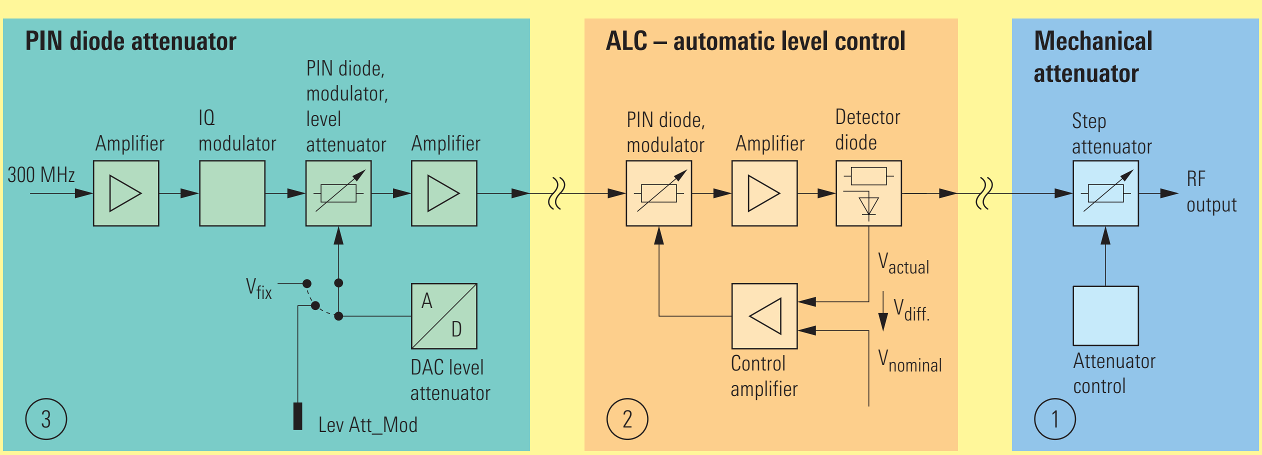
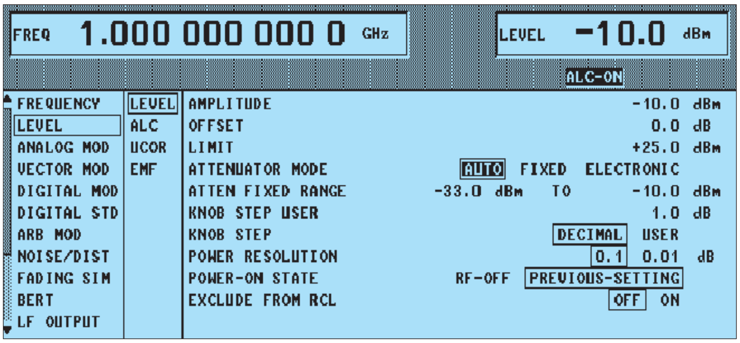



**FIG 2 Three circuits for level setting in the SMIQ**

▶ the ALC. When the nominal level value is attained, it is held and the ALC loop is switched off.

- In the ALC OFF MODE TABLE, the reference value for level setting is taken from a table and the level is adjusted each time the level or frequency is changed.

Each of these attenuator or ALC modes has specific advantages and disadvantages with respect to level setting time, level accuracy, level stability and repeatability in the different analog or digital modulation modes that can be set on the SMIQ. A description of these advantages and disadvantages and a detailed list are given in an application note [*] which is supplied free of charge.



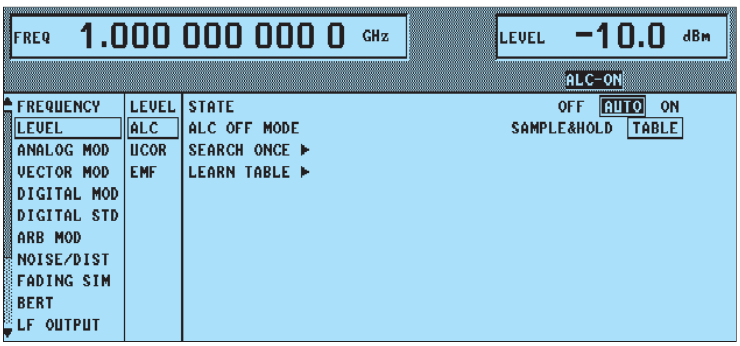



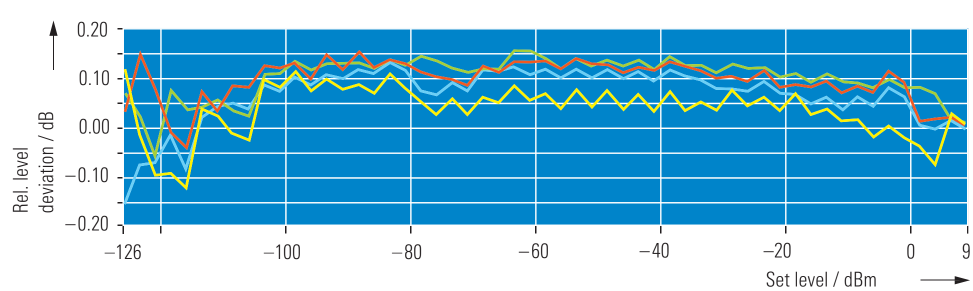

**FIG 3**
**In the LEVEL-LEVEL menu (top), various attenuation modes can be set; in the LEVEL-ALC menu (bottom), up to four ALC modes can be selected**

## Minimal level uncertainty

The traces in FIG 4 show the level uncertainty of the SMIQ at four frequencies.

- 89 MHz, used for analog broadcasting
- 900 MHz for the GSM mobile radio standard
- 1900 MHz for the PCS band
- 3.3 GHz, the maximum frequency range of the SMIQ03B

With all measurements, the RF level was switched in 2.5 dB steps through the whole dynamic range. As shown in FIG 4, when comparing the mechanical attenuator and the electronic level attenuator, the total level uncertainty in relation to a set reference level of 9 dBm and 10 dBm respectively is not greater than ±0.15 dB for the mechanical attenuator (top) and 0.6 dB for the electronic level attenuator (bottom). Although the level uncertainty of the electronic attenuator is slightly higher, particularly at low levels, the bottom traces in FIG 4 show a constant level characteristic over the entire dynamic range which is almost comparable to that of the mechanically switched attenuator.



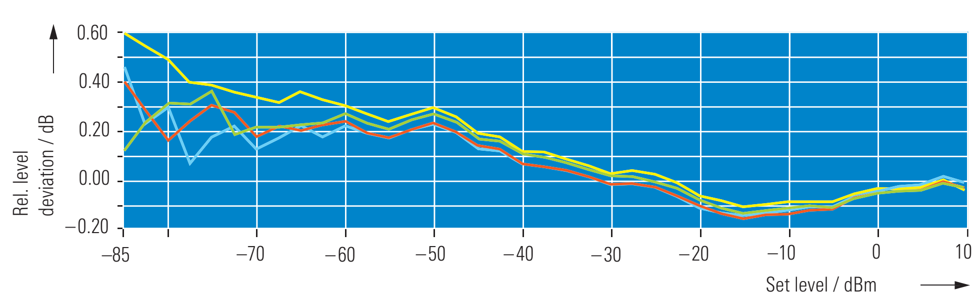




**FIG 4**
**Measured relative deviation from set level of mechanically switched attenuator (top) and electronic attenuator (bottom); blue: 89 MHz, red: 900 MHz, green: 1.9 GHz, yellow: 3.3 GHz**

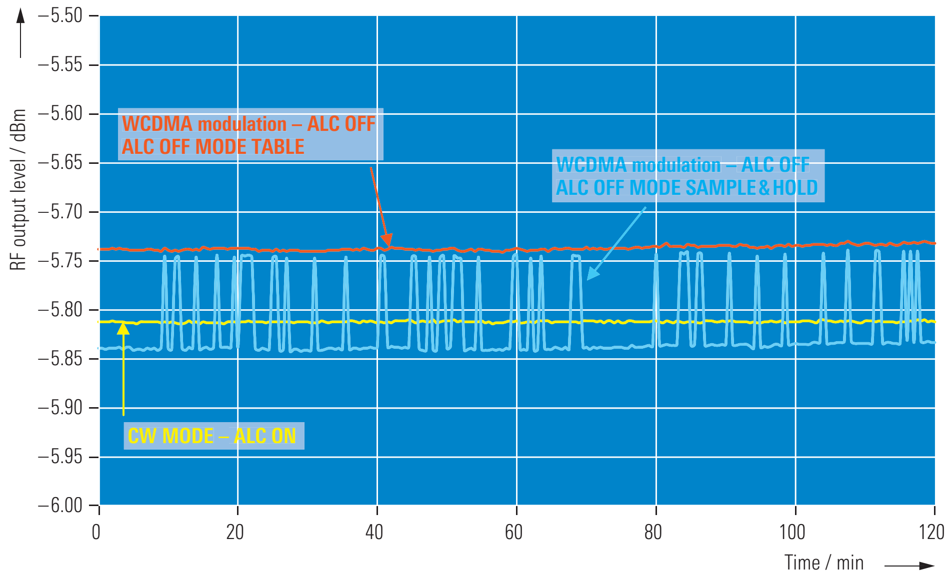



**FIG 5**
Level stability of a WCDMA signal. To show the level stability of the ALC, a CW signal was measured before as a reference.

The application note mentioned above describes a great variety of measurements including the most common combinations of attenuator and ALC modes which can be set on the SMIQ.

## High level stability and repeatability

FIG 5 shows the level uncertainty of a WCDMA carrier in contrast to a CW carrier of the same frequency. To correctly determine the level stability, the deviation from the nominal level is measured in the CW mode and the level stability versus time is observed. A nominal level of −5.8 dBm and a frequency of 2 GHz is set. Every 30 seconds, the RF level is randomly attenuated and then reset to the nominal level for a measurement period of two hours. The stability of the CW signal is constant at approx. −5.81 dBm. The ALC continuously controls the RF level and corrects level deviations from the nominal value. If WCDMA modulation is switched on and the ALC mode SAMPLE & HOLD is selected, the repeatability of the level settings deteriorates and the output level alternates between two values differing by 0.1 dB. With the ALC OFF MODE TABLE, this effect does not occur and the repeatability is not impaired.

The advantage of the SAMPLE & HOLD mode is that the recalibration recommended for the TABLE mode is not required with temperature variations exceeding 5 °C.

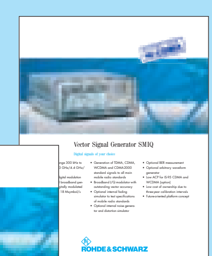
The graph clearly shows the advantages of the TABLE mode concerning repeatability. The level stability is very similar to that of the ALC ON mode and allows accurate level settings within a few hundredths of a dB. This is particularly relevant with the ATTENUATOR MODE ELECTRONIC, where the levels are set and corrected using the ALC OFF MODE TABLE. This guarantees accurate electronic level setting over a wide dynamic range and provides high level stability and repeatability in production as well as fast level setting.

Dr Markus Banerjee

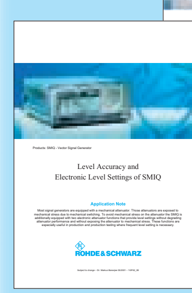

**More information on the SMIQ in this edition:**

**With WinIQSIM™ well equipped for 3G TDD standards (p 16)**


**More information and data sheets at www.rohde-schwarz.com (search for AMIQ, SMIQ, WinIQSIM).**



Data sheet SMIQ



Application Note 1GP42


REFERENCE
[*] Level Accuracy and Electronic Level Settings of SMIQ. Application Note 1GP42 from Rohde & Schwarz (homepage: Products & More – Application Note 1GP42)

Power Supply/Dual-Channel Analyzer NGMO 2

# Fast dual power supply with analysis functions


Photo 43 603/1

**FIG 1 The NGMO 2 offers versatile functions on two channels**

**With the NGMO 2, Rohde & Schwarz has extended its comprehensive line of power supplies [*] to include an outstanding voltage source for the laboratory, with functionalities far beyond those of conventional units.**

## Dual-channel versatility

The NGMO 2 (FIG 1) is more than just an extremely precise high-speed voltage source. It combines a voltage source, a programmable DC load, a digital voltmeter that can be used separately, a current and voltage transient recorder as well as a simple squarewave generator – and each of these features is provided twice. As a genuine, unrestricted dual-channel unit, the NGMO 2 supplies up to 2.5 A in the range 0 V to 15 V or 5 A between 1.8 V and 5 V as well as short-duration peak currents up to 7 A. The high setting and backreading resolution of 1 mV ensures that DUT power supply voltages in the lower range can be adequately reproduced and evaluated, as is required in particular for battery-powered circuits.

## Current measurements with 100 nA resolution

The setting resolution of the current limit value plays a minor role since the set current limit value is primarily intended to prevent damage to DUTs during normal operation of a laboratory power supply (i. e. constant-voltage operation). For this purpose, the NGMO 2 provides a resolution of 1 mA, which is completely sufficient.

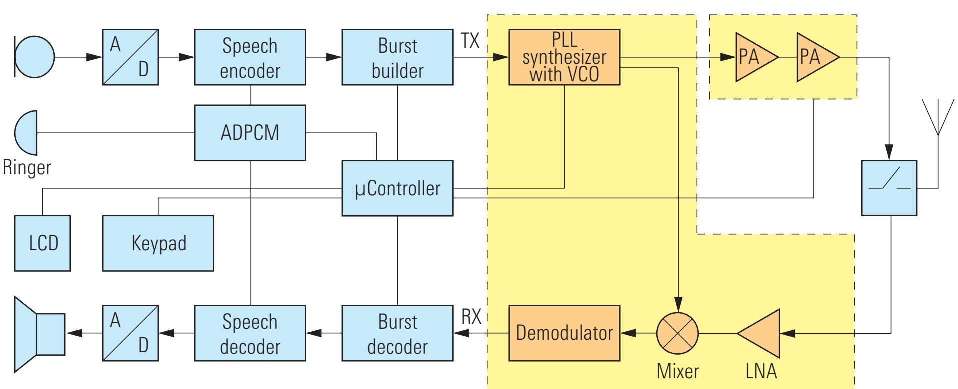
What is more important, however, is the possibility of measuring the current actually consumed by the DUT. Given the fact that the NGMO 2 can measure peak currents up to 7 A, and that currents occurring in the μA range also have to be tested, the resolution limit of up-to-date A/D converters would soon be reached with conventional concepts. The solution consists in dividing the ammeter into several ranges. The NGMO 2 has three ranges, which allow accurate conclusions to be drawn on the actual current drain irrespective of the DUT operating mode. As a result, a resolution of up to 100 nA is obtained so that the currents can also be measured with high precision in the OFF mode.

To obtain reproducible measurements of such small currents it is absolutely essential that the DUT be supplied from an extremely low-interference and low-noise source. Rohde & Schwarz has made no compromises on this point; the NGMO 2 operates according to an optimized version of the tried-and-tested linear controller concept and offers numerous advantages if it is necessary to react very quickly to large dynamic load variations.

## Transient recorder in each channel

Today, purely static operation is seldom encountered in measurement technology. In order to achieve maximum operating times and degrees of integration, almost all the subassemblies of a circuit are activated only when they are actually needed. This is very useful as regards energy consumption, but rather problematic from a testing point of view if an NGMO 2 is not available. The NGMO 2 has a fast transient recorder for current or voltage per channel so that dynamic processes such as current drain or voltage variations, can be collected, stored and further processed. Compared to solutions involving a measurement shunt or separate instruments, a current transient recorder integrated in the power supply offers not only advantages in terms of price and space but also constant and thus reproducible conditions for the DUT. Neither different internal resistances in the test path (which result from the different measurement ranges of the ammeters), nor critical additional lines to external shunts influence the controlling behaviour of the source or distort the current measurement.

Many complex applications can be implemented with only one NGMO 2. For example, fast current transients that occur during the staggered activation of mobile phone subassemblies can be detected and further processed for subsequent fault location. By calculating the difference between the elementary streams assigned to a defined time interval, the tester can determine whether the subassemblies of his circuit are functioning correctly (FIG 2).



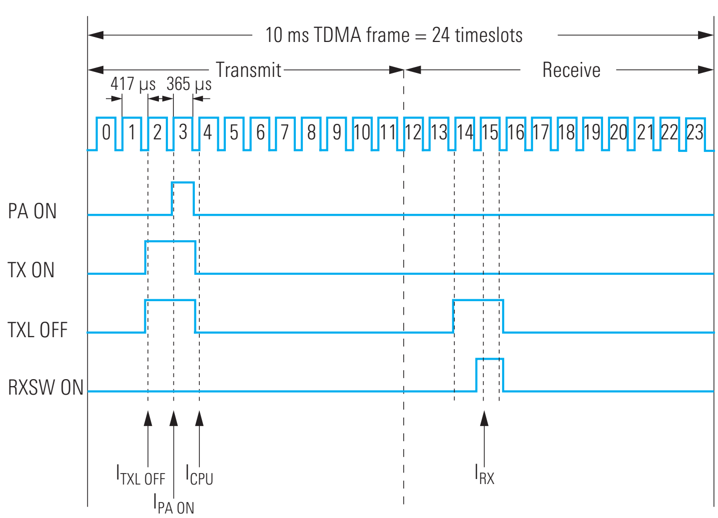




**FIG 2**
**Example: DECT phone. Since the individual subassemblies are activated at different times, their correct operation can be checked by forming the difference between the elementary streams assigned to different time intervals and read by the NGMO 2.**

## Accurate aid for circuit development

The NGMO 2 proves its impressive capabilities in the development and use of ASICs, FPGAs or similar VLSI circuits. To obtain efficient energy consumption, the developer can use technology-based values, but the quantity of energy actually consumed by the integrated circuit depends on additional influences. For example, different bus line lengths produce different capacitive loads for the drivers in the intended IC application. This necessitates higher currents so that the level change required at the line capacitances for information transmission can be performed in the desired time. Given the numerous information lines in highly integrated circuits, this results in significant current drain. This, in turn, causes higher power dissipation, which has to be taken into account in cooling the IC. For this reason, it is very useful to obtain detailed information from the NGMO 2 on the time characteristic of the current drain so that the developer of the integrated circuit can define permissible operating conditions, and the IC user can check the operating conditions for compliance.

## Excellent load regulation

The extreme load steps that occur on GSM mobile phones are regulated by the NGMO 2 very quickly (FIG 3). The unit also reliably prevents voltage dips, which cause undervoltage detectors of DUTs to respond and may switch the DUTs off. In addition, the internal resistance of the source can be set variably. Thus, various battery load states or the internal resistances of the batteries used can be taken into account for the check of battery-operated units, if required.

## Virtually a small test system

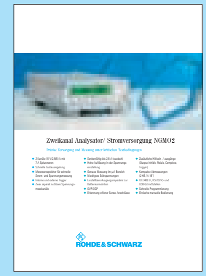
The NGMO 2 can be remote-controlled via the built-in IEEE 488.2 and RS-232-C interfaces as well as the USB interface (currently in preparation) and its extremely fast command processing and short measurement times ensure high test throughput. Additional inputs such as Trigger and Output Inhibit as well as outputs for Measurement Complete make this power supply an ideal choice for use in time-critical applications. Since the NGMO 2 can drive up to four auxiliary relays via open-collector outputs, it can be used as a simple mini test system – and all this for the price of just one power supply.

With its numerical result functions such as absolute minimum, absolute maximum, high level, low level or RMS value, the NGMO 2 facilitates evaluation. The measured values can of course be transferred to a PC for individual evaluation or storage.

Thanks to its wide range of functions, this compact and intelligent power supply is an indispensable aid for all manufacturers of modern electronic assemblies. Despite the large number of built-in functions, the NGMO 2 remains true to a basic principle: the major functions for the laboratory power supply can be operated easily and intuitively.

Lutz Fischer

**More information and data sheet at www.rohde-schwarz.com (search for NGMO 2)**



REFERENCES

[*] For the comprehensive line of power supplies from Rohde & Schwarz, refer to the Test & Measurement Products catalog or to the homepage at Products & More – Test & Measurement – Power Supplies – Products

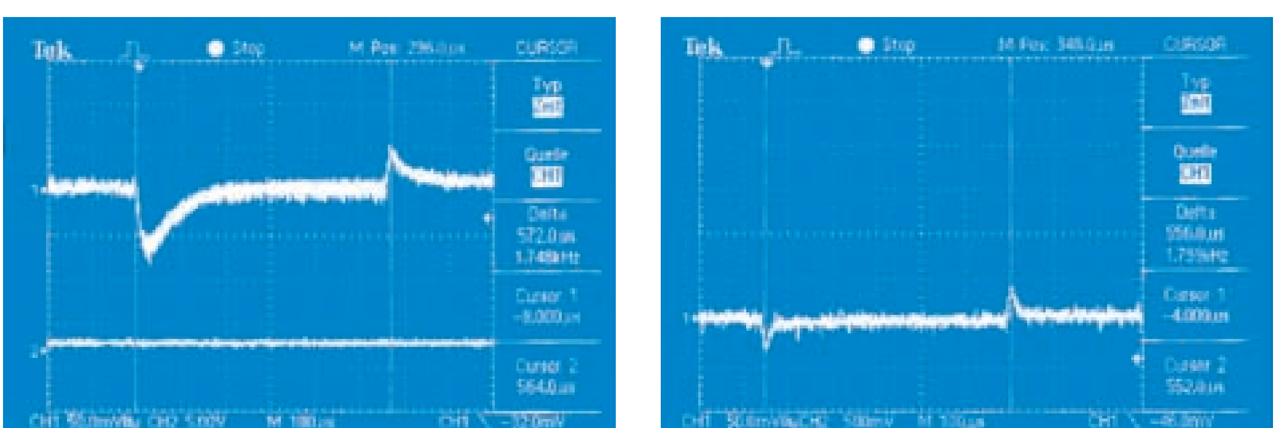


**FIG 3 Left: load regulation of non-optimal lab power supply connected to critical GSM mobile phone. Right: excellent regulation with the NGMO 2.**

Precompliance Test Receiver ESPI

# Multitalent in the development lab

**The EMI Test Receiver ESI from Rohde & Schwarz has established itself worldwide as a standard in the area of compliance testing. If the measurement task, however, is the testing of EMC properties during development rather than compliance testing to standards, the need often arises for a "smaller" and more cost-effective solution. And if this solution offers the complete repertoire of a standard spectrum analyzer in addition to receiver functions, it is ideal for development laboratories and other facilities which do not absolutely need to conform to the strict CISPR measurement requirements.**

Photo 43 665/9

**FIG 1 The ESPI defines the decisive criteria in the precompliance class such as range of functions, measurement speed and measurement accuracy**

## Precompliance has a new name: ESPI

In many areas of electronics such as radiocommunication or data technology, there is a steady increase in applications which use ever higher frequencies. This is accompanied by a definite increase in EMC measurement requirements and in the demand for measurements above 1 GHz. As a result, these issues have been addressed in the two new Precompliance Analyzers / Test Receivers ESPI 3 (9 kHz to 3 GHz) and ESPI 7 (9 kHz to 7 GHz) (FIG 1).

The two new models are based on the modern FSP [1] spectrum analyzer family, and add the advantages of an analyzer to those of a classic test receiver to form a combination which sets new standards for versatility and performance in the area of precompliance measurements.

The range of functions is particularly tailored to the interests of the development laboratory. Numerous integrated measurement functions such as power measurement in frequency and time domain, APD (amplitude probability distribution) and CCDF (complementary cumulative distribution function) signal statistics, measurement of noise and phase noise or of the third-order intercept point, plus the standard functions of a spectrum analyzer, cover practically all basic measurement tasks. Based on this, the ESPI models provide all functions required for EMC measurements (see box below).

Through the combination of the flexibility and high measurement speed of a spectrum analyzer with the specific properties of a test receiver in one device, the ESPI is equally well suited for general spectrum analysis applications and EMI diagnostic measurements, and is therefore a true multitalent for every development laboratory.

## EMC-relevant performance features of the ESPI

- Receiver mode
- Scan mode with user-definable frequency ranges including receiver settings
- EMI bandwidths
- Parallel weighting with Peak, Quasi-Peak and Average detectors
- Evaluation functions for prescan, data reduction and final measurement
- Predefined and user-programmable limit lines (FIG 2)
- Consideration of transducer factors (FIG 3)


**FIG 2 The ESPI supports the convenient generation and saving of practically any number of limit lines, with up to 50 reference points per line. Each limit line can have a fixed relation to one of three traces. Furthermore, a margin for a limit line (MARGIN) can be predefined and monitored (LIMIT CHECK). The limit values of the most important commercial standards have already been programmed in the ESPI.**

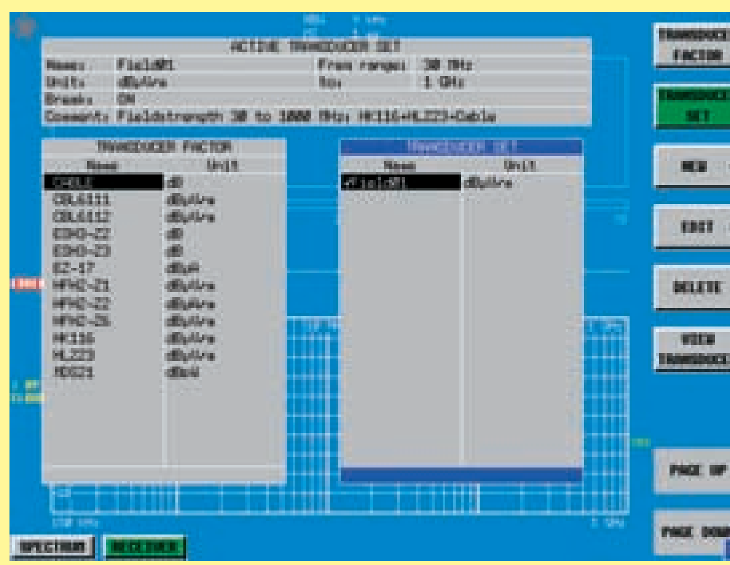



**FIG 3 Frequency-dependent correction values with up to 50 reference values per data record (antenna transducer, cable attenuation etc) can be simply and easily generated and saved as a TRANSDUCER FACTOR. In addition, several transducer factors can be combined to form a TRANSDUCER SET. An automatic compatibility check ensures that settings are error-free. The number of transducer factors and sets which can be saved is practically unlimited. A variety of factors have already been programmed in the factory. With VIEW TRANSDUCER, every saved factor can be graphically displayed on the screen as a trace.**

## Why precompliance measurements?

Testing of electric or electronic devices for compliance with legal EMC regulations and limit values requires either an in-house EMC test laboratory or support from an external service provider. For small and medium-sized companies which often need to carry out these types of measurements, both options can be too expensive.

As an economical alternative, the precompliance receiver and/or analyzer allows development-related measurements and preparation for compliance testing to be carried out in the in-house development laboratory.

The main task of such precompliance EMI measurements is to get a comprehensive idea of the fundamental interference behaviour of a product, and recognize potential problems at an early stage. The development of complex electronic products is too costly and expensive to wait until the final acceptance test for evaluation and diagnosis of EMC characteristics and to put up with the high risk of time-intensive and costly improvements involving one or more repetitions of the acceptance measurements. The market launch schedule can be quickly delayed due to subsequent modifications, since serious flaws in the EMC-compliant design can hardly be repaired. The earlier EMC regulations are observed during the development phase, the lower the time and financial expenditure for securing EMC conformance of a product will be. Clearing the last hurdle of "certification", i.e. proof that the prescribed limits have been complied with, is then only a formality.

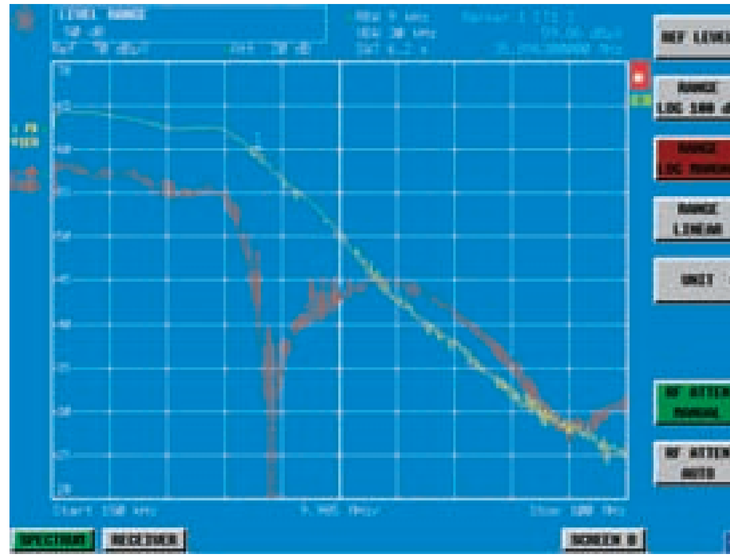



**FIG 4 Result of measuring pulsed broadband interference with preselection (yellow) and without preselection (red). When preselection is disabled, the measurement result may be partly falsified by more than 10 dB, due to compression and intermodulation.**

## Preselection – important quality feature or unnecessary cost factor?

Compliance with the requirements specified in CISPR 16-1 for measuring equipment, i.e. the standard-conformant measurement of electromagnetic interference, places very high demands on the characteristics of the test receiver, which must correctly record and evaluate the pulsed or sinusoidal, modulated or intermittent interference sources. Pulse weighting with a CISPR quasi-peak detector, as specified in the standard, for example, requires a dynamic range which can only be realized with highly complex circuitry. Professional devices of this type [2] are absolutely required for compliance measurements, however they are also quite costly.

Such a technical expenditure cannot be justified in so-called precompliance receivers or analyzers. It is most important for the appropriate measuring equipment to be cost-effective. Nevertheless, a series of fundamental quality requirements exists for devices of this class, whose fulfilment is indispensable if the results achieved are to be reliable and meaningful.

If it is really certain that the DUT emits only narrowband interference and no broadband pulsed signals, a spectrum analyzer without preselection can be used, such as the basic version of the ESPI. The broadband input of the analyzer is quickly overdriven, however, when pulsed interference signals occur. An example of this is shown in FIG 4: With preselection enabled (ESPI-B2 option), the ESPI can correctly display the broadband signal spectrum with its typical trace waveform (yellow). The bandpass filters connected ahead significantly reduce the signal level at the input mixer so that neither compression nor intermodulation can distort the measurement results. The red trace shows the measurement results determined for the same interference signal, but with preselection disabled.

In addition, the overload detector, which reliably reacts to pulsed signals, warns the user if a level in the signal path is overdriven and the measurement result is therefore invalid. For this reason, the ESPI continuously monitors the receive path and thus guarantees the reliability of the measurement results.

It quickly becomes apparent that the use of a preselection filter also offers clear advantages for precompliance measurements:

- This is the only way to measure pulsed and broadband interference signals
- Measurement results will be reproducible and reliable

## Top-class technical performance at a low price

The ESPI offers a complete range of detectors: Max Peak, Min Peak, Average, Quasi-Peak and RMS. In the spectrum analyzer mode, the Sample detector is also available. Any combination of three detectors, e.g. Max Peak, Quasi-Peak and Average, can be simultaneously displayed as a bargraph or frequency spectrum. If desired, the quasi-peak detector can automatically be linked with the bandwidths and time constants prescribed by the CISPR standard, in order to ensure correct operation.

For carrying out EMI measurements, the CISPR bandwidths of 200 Hz, 9 kHz and 120 kHz as well as a filter with 1 MHz pulse bandwith for the range above 1 GHz can be set in both analyzer and test receiver modes (FIG 5).

In addition to the standard 3 dB bandwidths (10 Hz to 10 MHz in 1, 3, 10 sequence), the ESPI is also equipped with approx. 40 digitally implemented channel filters for all the common radio services. Thus, measurements on radiocommunications spectra can be carried out considerably easier and faster. The filters mentioned can again be used in both analyzer and receiver mode.

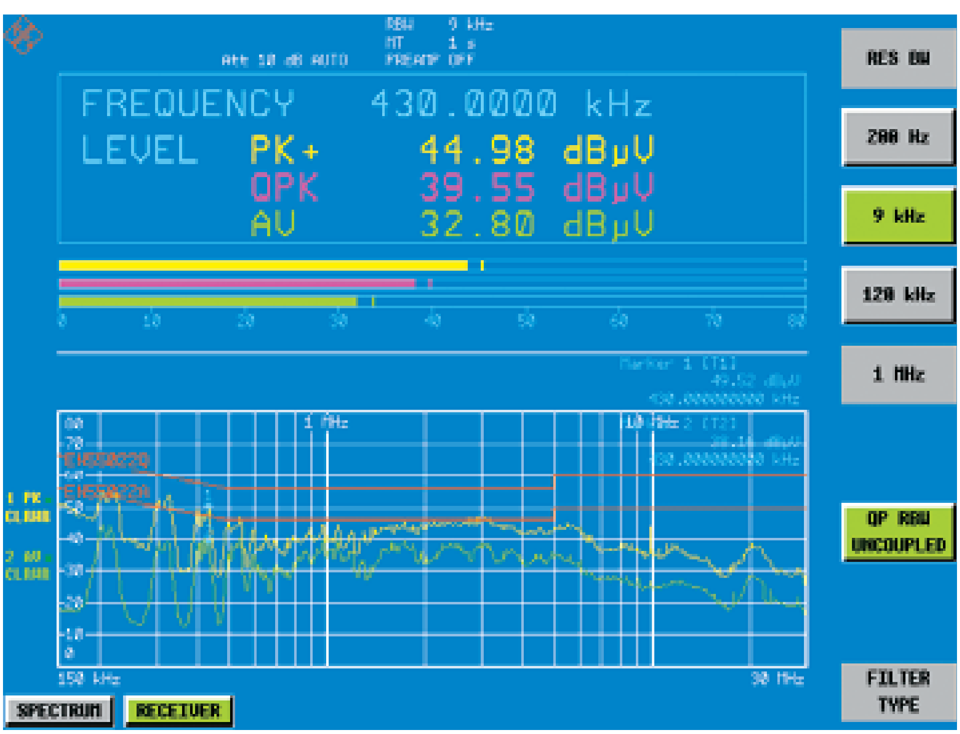



**FIG 5 The standard SPLIT SCREEN display in the receiver mode shows the continuously updated level values for the selected detectors and the set frequency in the upper window. With TUNE TO MARKER or MARKER TRACK, frequency tuning and numeric level measurement can be linked to the marker settings in the lower window. Thus, final measurements on "critical frequencies" become considerably easier.**

For EMC measurements, the scan, i.e. the recording of the frequency spectrum with defined step widths and dwell time per measurement result, is often preferred instead of the sweep. The ESPI handles this easily, since the high measurement speed of the analyzer is also available in this typical receiver mode. Very little additional internal processing time is required beyond the actual measurement time. Even the parallel transfer of all measured level values via IEEE/IEC bus or the optional LAN interface (100Base-T) does not noticeably slow down the measurement. Only 5 s are required for a continuous scan with the standard 120 kHz resolution bandwidth that covers the CISPR bands C and D (30 MHz to 1000 MHz), using a set measurement time of 100 µs and the peak detector. During this time, the ESPI calculates and stores nearly 20000 measurement values, i.e. the measurement takes only 250 µs per frequency step. This type of measurement is based on a scan table with up to ten subranges, each with individually settable parameters such as start and stop frequency, step width, resolution bandwidth, measurement time and fixed or automatic RF attenuation (FIG 6). If the preselector / preamplifier option is available, the preamplifier can also be separately enabled for each subrange.

As with the spectrum analyzer mode, the displayed trace is compressed to 501 measurement values. However, the ESPI internally saves all measured levels – up to 100000 values for each of the three traces. Once the scan is completed (which can be time-consuming, depending on the test specification), the exact values can be recalled from the background memory at any time for evaluation. The zoom function can, for example, show a portion of the spectrum and reveal details which are hidden in the overall display. With the marker, the peaks are determined and the corresponding bargraph is automatically set

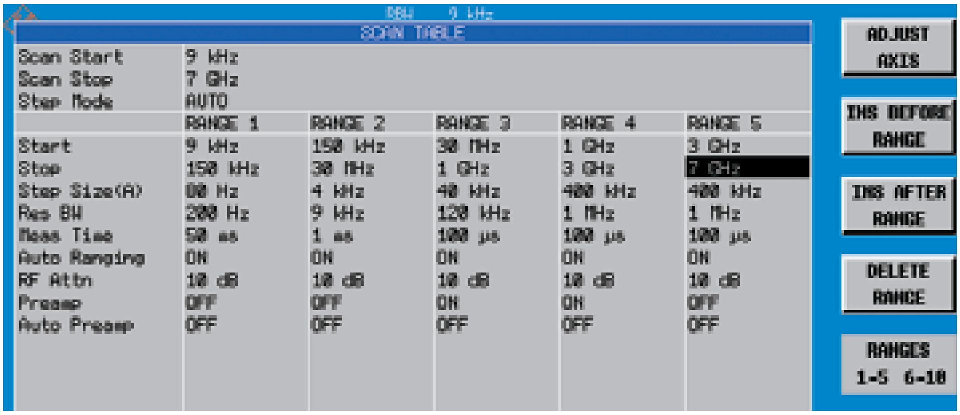



**FIG 6 In the RECEIVER mode, the ESPI is tuned in fixed frequency steps according to the settings in the scan table. The scan table can be programmed for a maximum of ten frequency subranges with individually settable parameters (e.g. start/stop frequency, step width, measurement time, IF bandwidth and input attenuation). By simply setting the START and STOP frequencies, subsequent scans will automatically load the parameters previously set in the scan table. This guarantees a reproducible and standard-conformant measurement sequence every time.**

to the frequency of the interference found by the prescan. For further processing, the measurement results can be saved to the built-in disk drive or internal hard disk. In addition, the frequency and level of the trace can be saved as ASCII files. Statistical assessment or comparison of several scans can be easily automated by means of a spreadsheet analysis program, for example.

In the spectrum analyzer mode, however, all functions which are required for EMC measurements according to civil standards are also available: bandwidths, detectors, evaluation functions and the optional preselector and preamplifier.

The FSP-B9 option (internal tracking generator up to 3 GHz) and the FSP-B10 option (generator control) enhance the ESPI test receivers to scalar network analyzers. Through selective measurement, the gain, frequency response, insertion loss and return loss can be measured with a wide dynamic range without being influenced by harmonics or spurious emissions from the generator. Thus, inspecting a test cable and determining its attenuation are easy, which increases the reliability of the measurements.

## Document and report generation made easy

The measurement alone is not enough; the results should be documented without great expenditure and in the most flexible manner. Due to its PC-compatible processor, the ESPI offers the best prerequisites. This includes screenshots without requiring additional conversion software, Windows printer support and print-to-file functions in the WMF, EMF and BMP data formats.

Measurement results and their associated settings can be jointly or separately saved to the internal hard disk or built-in 3½" disk drive. For connection to usual data networks, a LAN interface is available, which permits output via a network printer or file storage on a network server.

### Condensed data of ESPI3 / ESPI7

| | |
|---|---|
| Frequency range | ESPI 3: 9 kHz to 3 GHz<br>ESPI 7: 9 kHz to 7 GHz |
| Frequency scan | |
| Receiver mode | scan with max. 10 subranges with different settings, e.g. measurement time per frequency: 100 µs to 100 s |
| Analyzer mode | sweep time (span ≥10 Hz): 2.5 ms to 16000 s<br>zero span (0 Hz): 1 µs to 16000 s |
| IF bandwidths (available in analyzer and receiver modes) | user-selectable: 10 Hz to 10 MHz (–3 dB), in 1, 3 ,10 sequence<br>CISPR: 200 Hz, 9 kHz, 120 kHz (–6 dB),<br>1 MHz (pulse bandwidth), various channel filters |
| Detectors (3 simultaneously) | |
| Receiver mode | Max/Min Peak, Quasi-Peak, Average, RMS |
| Analyzer mode | Max/Min/Auto Peak, Sample, Quasi-Peak, Average, RMS |
| Displayed average noise level | |
| RBW 10 Hz, Avg, preamp on (opt. -B2) | typ. –155 dBm / –153 dBm (ESPI 3 / 7); 0.01 GHz to 1 GHz |
| 1 dB compression (input mixer) | (0 dB attenuation, f >200 MHz): 0 dB nominal |
| Phase noise | 10 kHz / 1 MHz: –113 dBc / –125 dBc (1 Hz) |
| Level measurement accuracy | total error: 1.5 dB in receiver mode<br>0.5 dB in analyzer mode without preselection (ESPI-B2);<br>QP display: in line with CISPR16-1,<br>≥10 Hz pulse repetition frequency (with option ESPI-B2) |
| **Options** | |
| ESPI-B2 | preselector/preamplifier<br>11 bandpass/highpass filters (can be disabled in analyzer mode); preamplifier 20 dB, switchable;<br>9 kHz to 3 GHz |
| FSP-B1 | rugged case, carrying handle |
| FSP-B4 | OCXO reference frequency |
| FSP-B9 | internal tracking generator 9 kHz to 3 GHz, IQ modulator |
| FSP-B10 | external generator control |
| FSP-B16 | LAN interface (100Base-T) |

## Ergonomics and design set high standards

Due to its large 21 cm colour TFT display, the clarity and readability of the displayed traces and selected parameters are not an issue – even in split-screen mode. The ESPI sets new standards beyond its class.

Complex measurement settings are easily carried out through a combination of vertical and horizontal rows of softkeys. For the most important parameters such as frequency, amplitude / attenuation and bandwidth, separate hardkeys and unit keys are provided.

In addition to functioning as a desktop unit, the ESPI with its compact dimensions and its light weight of 11 kg is especially suited for mobile use. A particularly robust version with shock absorbing corners and adjustable handles that also serve as a stand is optionally offered.

Naturally, the ESPI is environmentally friendly. The unit was designed with a minimal amount of materials, mutual compatibility of materials to ensure easy identification of substances as well as fast and easy disassembly.

Matthias Keller; Karl-Heinz Weidner

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


REFERENCES

[1] Spectrum Analyzer FSP – Medium class aspiring to high end. News from Rohde & Schwarz (2000) No. 166, pp 4–7

[2] EMI Test Receivers ESI – EMI professionals through to 40 GHz. News from Rohde & Schwarz (1999) No. 162, pp 7–9

IN BRIEF | Latest news


## Latest news on the homepage of Rohde & Schwarz

Interested visitors of the Rohde & Schwarz Internet site have certainly noticed that since the end of May, the News section has been considerably expanded. An online editorial service that is exclusively dedicated to this task, prepares the news from the various divisions of the company, which are of interest for worldwide publication, and according to the medium, presents them in condensed journalistic form. Customers and interested individuals are thus supplied with more immediate and relevant news from Rohde & Schwarz. Detailed information for each of the subjects can be obtained via the corresponding links. Interested? Take a look at www.news.rohde-schwarz.com

UHF Transmitter Family NH/NV 7001

# Medium-power transmitters for terrestrial digital and analog TV

**After the very positive response to the liquid-cooled, high-power transmitters of the NH/NV 6000/7000 family [1] on the world market, Rohde & Schwarz now presents the compact, air-cooled Transmitter Family NH/NV 7001 for medium power classes (FIG 1).**

## Air-cooled, modular design

The transmitters of the NH/NV 7001 family use the new Exciters SV/SH/SC 700 for high-quality modulation of digital (DVB) or analog (ATV) TV signals. The Broadband Amplifiers VH 650 A2 with state-of-the-art LDMOS technology are used for amplification.

The NV 7001 digital TV transmitters cover a power range from 200 W to 800 W (DVB-T) or from 250 W to 1 kW (ATSC). The transmitters of the NH 7001 family provide 500 W to 2000 W of power for analog TV. The two transmitter families use identical components in the racks (FIG 2):

- One or two digital exciters (dual-drive option)
- Up to four broadband amplifier modules, each with an output power of 200 W for DVB-T or 500 W for ATV combined
- Up to four 2 kW switching power supply units
- Output filter (for ATV)

## Exciters for digital and analog TV standards

The new Exciters SC/SH/SV 700 used in analog and digital TV systems are notable for their compact design, flexibility and future-proofness. Optionally, two compact exciters can be accommodated in a 19" frame to implement modern redundancy concepts with considerably reduced space requirements.

Photo 43702/1

**FIG 1**
**2 kW transmitter of the NH 7001 family for analog TV**

They support the digital standards DVB-T (ETS 300 744) and ATSC (A 54) as well as the analog standards B/G, D/K, M/N and I.

The TV exciters comprise an encoder, equalizer, modulator, synthesizer and a CCU for transmitter control. Due to their uniform structure and design they can be easily adapted to analog and digital TV standards. The exciters used for the various applications differ only in the encoder which processes the input signals and generates digital quadrature baseband signals in all cases. Subsequent signal processing is basically the same in all models and is carried out by a common hardware platform, which is optimally adapted to the individual applications. Thus, three types of TV exciters are available:

- SH 700: used in analog high-power TV transmitter systems with separate video and audio amplification (split mode); NH 7000 family
- SC 700: used in analog TV transmitter systems with a common path for video and audio signals (combined mode); NH 7001 medium-power transmitters
- SV 700: for digital TV

## Analog TV with SC 700

The Exciters SC 700 contain an encoder for analog TV signals. The video input signal is digitally processed irrespective of the selected TV standard. Signal processing including vestigial sideband filtering is therefore perfectly stable and not subject to aging. Switching to other TV standards is handled via software so that no exchange of hardware is required. The analog audio signals are also converted into digital signals and processed by a digital signal processor (DSP), e.g. dual-sound coding. One or two high-quality sound subcarriers are generated by subsequent digital frequency modulation. Various encoder modules are available for the different audio standards:

- The NICAM add-on module processes analog audio signals when acting as a coder modulator and processes a digital data stream when acting as a NICAM modulator.
- The BTSC add-on module with a bandwidth of 120 kHz for the N/M TV standards provides an audio input for routing the BTSC sound multiplex signal.

## Digital TV with SV 700

The Exciter SV 700 is used in digital TV systems. For DVB-T, data processing of the DVB encoder is in line with the DVB standard ETS 300 744. The encoder comprises an asynchronous serial interface (ASI) the data buffer and flexible clock processing of which enable the network operator to use standardized feed paths.

An automatic switchover unit supports the implementation of redundant feeder networks.

For use in single frequency networks (SFN), an SFN adapter integrated in the encoder accepts time reference pulses from an external or optionally integrated GPS receiver.

For ATSC/8VSB signals, the ATSC encoder operates according to the ATSC standard A 54. Its input section also accepts ASI signals in addition to the commonly used SMPTE 310 signals.

## Digital signal processing

The digital baseband signals from the encoder are routed to the subsequent digital precorrector. The digital precorrector comprises a group-delay equalizer for correcting linear filter effects and a linearity equalizer for correcting nonlinearities of the power amplifiers. Both stages operate completely digitally so that the set signal parameters are maintained.

The baseband signals are subsequently converted into analog signals and mixed to the RF by direct modulation. The mixer frequency is supplied by a synthesizer which can be synchronized to external references or the optional internal GPS receiver.

## Operation from display or PC

The transmitter is operated from the central control unit (CCU) via the menu-supported graphical display. All parameters can additionally be controlled from a PC via an RS-232-C interface. Furthermore, the exciter can also be remote-controlled and monitored via an RS-485 interface, a modem or TCP/IP/SNMP interface (option NetLink [2]).

## High-efficiency power amplifiers

Due to the lateral diffused metal oxide silicon (LDMOS) power transistors featuring high gain and linearity, a high efficiency, compact design and a continuous broadband characteristic is achieved for the Power Amplifiers VH 650 A2 between 470 MHz and 862 MHz. A control system prevents the other modules from being overdriven if one amplifier fails, thus ensuring that all amplifiers remain at the same level and operating point. The amplifier plug-in (FIG 3) comprises guard circuits protecting it against reflection and overtemperature. The main components such as preamplifiers and output amplifiers with current sensors are installed on an extremely effective, patented heat sink. With this heat sink, the heat produced by the amplifiers can be effectively dissipated with relatively little air.

Transistor currents and various internal voltages can be measured via a service connector on the front panel. The output power is set with the aid of a reference voltage generated by the CCU.

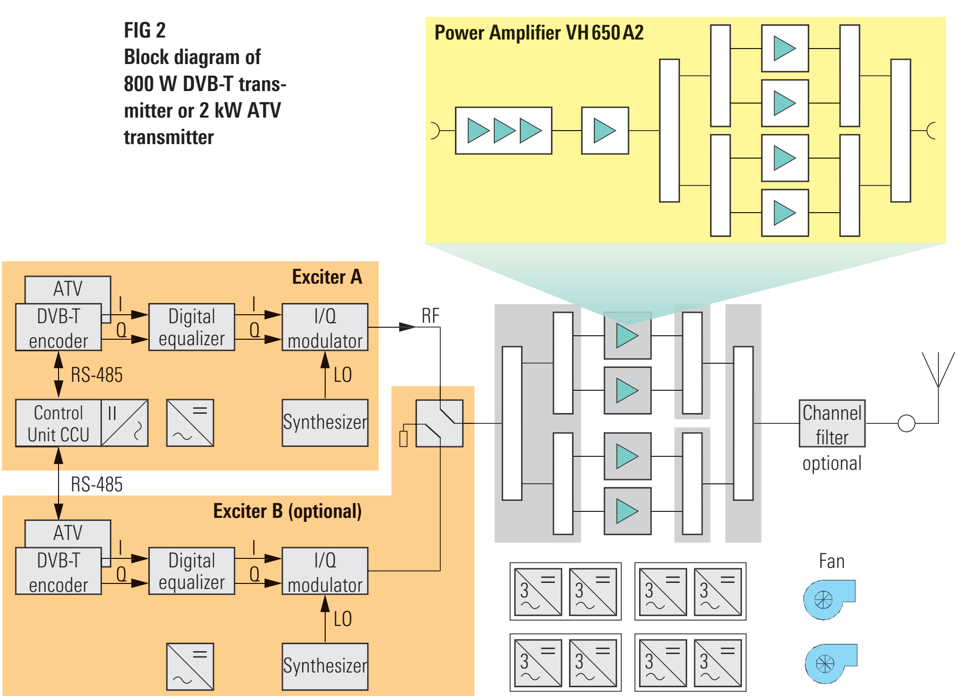



**FIG 2**
**Block diagram of 800 W DVB-T transmitter or 2 kW ATV transmitter**

Photo 43 705

**FIG 3**
**Plug-in Amplifier VH 650 A2 with side cover open**

## "On air" also during power failure

Every amplifier is provided with a 2 kW switching power supply. This redundant unit ensures continuous transmission even if a power supply unit or an amplifier fails. A special feature of each switching power supply is that it consists of two separate 1 kW power supplies, which together feed the preamplifier and separately feed each half of the output amplifier. If a 1 kW power supply fails, the respective amplifier plug-in continues to operate with a quarter of its output power. Switching power supplies are primary-switched, short-circuit-proof, 3-phase regulators with internal cooling. Power supplies and amplifiers can be replaced during transmitter operation without causing a program failure.

## Flexible cooling

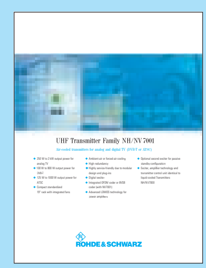
The cooling air for the transmitter can be taken in at the bottom or the top of the 19" standard rack, or air can be taken from the room at the rear of the rack. In the latter case, the rear panel acts as an air filter. The outgoing air is expelled at the top.

Two fans with long life are installed in the rack for cooling the amplifiers by two parallel air streams. A fan can therefore be replaced during operation without leading to a program failure.

The required output filter can be accommodated in the upper half of the rack where the output directional coupler and an optional relay remote-control interface are also installed.

Cornelius Heinemann; Hans Seeberger; Rainer Steen

**More information and data sheet at www.rohde-schwarz.com (search for NV 7001)**




REFERENCES

[1] UHF Transmitter Family NV/NH7000 – Liquid-cooled TV transmitters for terrestrial digital TV. News from Rohde & Schwarz (1999) No. 165, pp 11–13

[2] NetLink – Remote control and monitoring of transmitters on the Internet. News from Rohde & Schwarz (2001) No. 170, pp 27–29


### Condensed data of NV / NH 7001

| | |
|---|---|
| Frequency range | 470 MHz to 862 MHz |
| RF output power | 200 W to 800 W (DVB-T)<br>250 W to 1 kW (ATSC)<br>500 W to 2 kW (analog TV) |
| TV standards | digital: DVB-T ETS 300 744, ATSC / 8 VSB A 54)<br>analog: B / G, D / K, M / N, I |
| Colour transmission | PAL, SECAM, NTSC |
| Sound transmission | dual-sound coding to IRT or<br>FM single sound and NICAM 728 (–13 dB / –20 dB) or<br>FM single sound (–10 dB) or<br>BTSC multiplex signal (–10 dB) |
| Interfaces | RS-232-C, RS-485, modem, TCP/IP / SNMP (NetLink) |
| Transmitter dimensions (W x H x D) | 570 mm x 2004 mm x 800 mm |

TV Test Transmitter SFQ

# Test signals for DVB-T diversity reception

**To test diversity receivers, two or more RF signals have to be applied to the various antenna inputs. In order that these signals represent the real receive situation, however, special conditions must be fulfilled. A new option for the TV Test Transmitter SFQ (FIG 1) generates signals which optimally suit these requirements.**


**FIG 1** With the new optional Noise Generator SFQ-B5, the SFQ can generate signals for testing diversity receivers

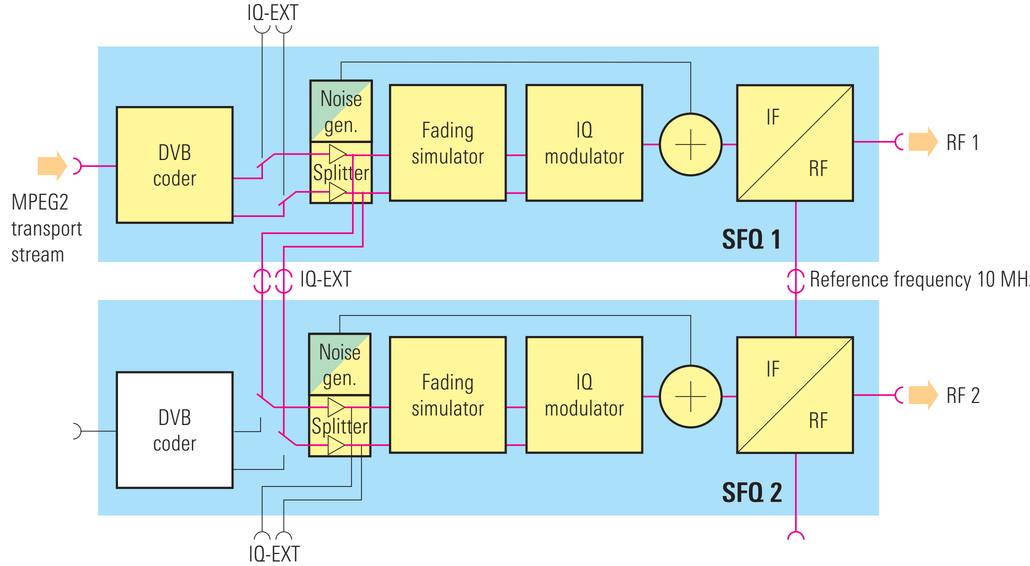
## Unrivalled method for testing DVB-T diversity reception

The change to digital terrestrial TV (DVB-T) has greatly advanced in many European countries. In Germany, a decision has been made in favour of DVB-T and implementation will soon take place. While stationary reception via a directional roof antenna was envisaged at first, the so-called portable in-house method will finally be used in Germany. In this case, the receive antenna is integrated in the TV set or the signals are received by a room antenna. Experience has shown that certain modes of the DVB-T standard are suitable for mobile radio reception (combination of various system parameters, e.g. QPSK or 16QAM, code rate 1/2 or 2/3). According to the current line of thinking, it can be assumed that reception in vehicles (cars, trams, trains, etc) will be possible wherever portable in-house reception can be realized.

This attractive extension of the application field is mainly due to new, innovative receiver concepts. Receivers using diversity reception, i.e. those which intelligently combine signals from two or more antennas, are the most promising. Diversity reception is particularly suitable in cars where various input signals are received by different windshield antennas.

From a technical point of view, the benefit of diversity reception can be described as a simplification of the receive situation where Rayleigh channels are often converted to Rice chan-

**FIG 2**
**Depending on the number of signals required, two or more TV Test Transmitters SFQ can be connected**




nels so that the receivers can operate with a considerably lower S/N ratio. When diversity antennas are used, a much higher location probability (and presumably also a higher time probability) can be expected for the coverage of an area in comparison to conventional methods.

## Test setup

To test diversity receivers, two or more RF signals have to be applied to the various antenna inputs. To represent the real receive situation, the signals must have the same RF frequency and use bit-synchronous data transmission, but they must be completely uncorrelated (i.e. different in amplitude and phase) in the simulated transmission channels. This corresponds to a receive situation where the receive antennas differ by at least half a wavelength.

The new optional Noise Generator SFQ-B5 [*] for the TV Test Transmitter SFQ generates signals which meet all these requirements. Bit synchronization of data is guaranteed because only one DVB-T coder is used, the I/Q output signals of which are then processed by two or more units. A 0 dB splitter is therefore provided in this option. The first outputs of the splitter are internally connected to the fading simulator; the second outputs are implemented as a connecter pair so that several SFQs can be combined (FIG 2).

The fading simulators are normally set to the same fading patterns (paths). Due to the internal random processes used in this case, the required uncorrelated RF signals are obtained.

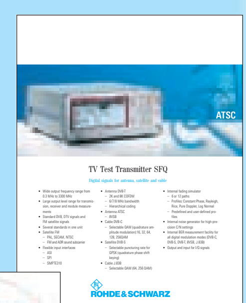
To synchronize the RF output frequencies, an SFQ acting as the master generates an internal 10 MHz reference frequency to which the reference frequencies of the other units are synchronized. A laboratory test setup is thus obtained in which real and repeatable test scenarios for the development of DVB-T diversity receivers can be created.

This unique method was successfully used for measurements within the EU development project MOTIVATE to demonstrate the efficiency of various diversity receivers. Comparisons with field measurements suggest that this test setup is able to handle the most complex situations in the practice.

Dr Jürgen Lauterjung

**More information and data sheet at www.rohde-schwarz.com (search for SFQ)**

Data sheet SFQ





The DTV Dream Team CD can be obtained free of charge from any Rohde & Schwarz representative.

REFERENCE
[*] TV Test Transmitter SFQ – High-precision internal noise source enhances measurement functions. News from Rohde & Schwarz (2001) No. 170, pp 37–38

# TV project in Nigeria

**With the successful introduction of new transmitter families on the market in the past four years, Rohde & Schwarz has become the leading European manufacturer for analog and digital TV transmitters. Based on this, the company is making an effort to systematically access the overseas markets. The company's activities and investments regarding sales structure and service have also led to an increasing success in countries outside Europe. A good example is the large TV project in Nigeria.**

The first carefully packed transmitters arrive in Nigeria

Nigeria is one of the most densely populated countries in Africa. Rich in natural resources and a leading economic force, it is one of the most interesting markets on this continent besides South Africa.

As part of a project for nationwide broadcasting coverage, the national broadcaster NTA has placed an order with Rohde & Schwarz for the supply and commissioning of 99 high-power VHF and UHF TV transmitter stations. Once the project is completed, most of the Nigerian people including all large cities will be able to receive the national programs. The programs will be fed to the various transmitter stations via microwave or satellite links. The project is implemented in two phases: in phase I, the old transmitters installed in the 80s are replaced, and in phase II, new TV stations are set up to improve the nationwide coverage. The project is expected to be completed by the end of 2001.

It is a great success for Rohde & Schwarz to have gained access to this market and to implement a project of this size in Africa. Rohde & Schwarz won this project against strong international competition. The main reason for the success was the company's long-term strategy to invest in the development of the African market. This was convincingly complemented by reliable and cost-effective products and solutions. The liquid-cooled transmitter offered by Rohde & Schwarz was well received due to its compact design and features such as digital upgradeability, ease of operation, problem-free installation, ruggedness, etc.

The first stations have already been put into operation. For the implementation of this project, Rohde & Schwarz utilized the local competence available in Nigeria. This has proved to be very satisfying and successful for both partners. As part of a long-term commitment to the Nigerian market, Rohde & Schwarz has carried out a 1-month training for the engineers of NTA to enable them to install the transmitters on their own.

The success of this large-scale project has led to a strong presence and customer confidence. With this reference in hand, Rohde & Schwarz is assured further success on the African continent.

Eshwarahally Vikas

Monitoring and coverage measurement systems

# Complete product line from a single source

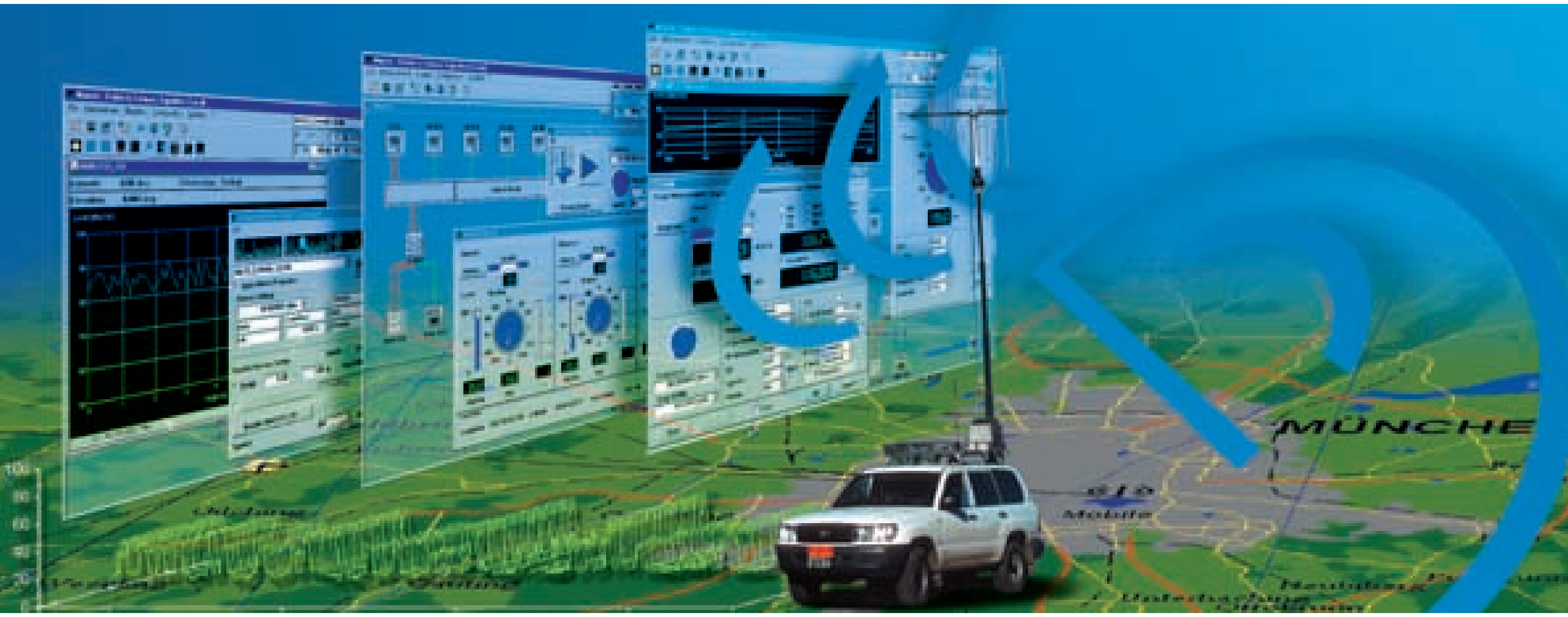


Photo 43 336/2

**Rohde & Schwarz has given serious attention to the customers' requirements for the supply of complex systems from one source and has therefore developed some system instruments in addition to the extensive range of standard units, which form the core of monitoring [1] and coverage measurement systems [2]. These system instruments are also of interest for other applications.**

## System Process Controllers SPCx

Thanks to most up-to-date top-quality components, the **SPCx system process controller family** represents the state of the art in controller technology. The devices can optionally be adapted to practically all user requirements.

Three basic models are available for a wide variety of applications:

- The **19" SPCR model** possesses an extremely robust design and has a special electromagnetic shielding for installation in system racks. It is suitable for stationary, transportable and mobile systems.
- The **SPCT model** is accommodated in a tower and designed for stationary systems with no exacting requirements concerning EMC or in applications where low space requirements are of minor importance.
- The robust **SPCN notebook** is ideal for systems where space is at a premium, e.g. in small vehicles or in transportable systems.

## GSM Communication Unit GC 127

The **GSM Communication Unit GC 127** (FIG 1) combined to a router transmits data or audio signals via a GSM network. Consequently, mobile or transportable stations can be remote-controlled without requiring a telephone or any other links.

## Station Monitoring Unit SA 129

The **Station Monitoring Unit SA 129** has extensive features for monitoring a distant station. Various sensors are available for monitoring the opening of windows or doors, temperature, relative humidity, smoke detection and power supply. The sensor messages are automatically transmitted by telephone to the station monitoring unit at the central station and output to an LCD display or printer or displayed by a light or acoustic signal. The remote-controlled system can be reinitialized by interrupting the power supply, the system process controller being shut down beforehand to prevent data loss.

## RF Switch Units ZS 127 x

The universal family of **RF Switch Units ZS 127 x** has been developed for stationary, transportable and mobile systems. The units can dynamically switch different receive antennas to a receiver and can be manually operated at the front panel or by means of software, e. g.ArgusMon [3], via an RS-232-C interface.

The **ZS 127** (FIG 2) is fitted with a 1-out-of-6 RF switch, which covers the frequency range from DC to 3 GHz (optionally to 26.5 GHz). The model can optionally be equipped with a 1-out-of-8 or 1-out-of-12 RF switch in the frequency range up to 3 GHz.

The **ZS 127 A1** has a 1-out-of-8 RF switch and can be controlled in addition via a TTL control line from a Rohde & Schwarz receiver, for example.

The **ZS 127 AT** has the same functionality as the ZS 127 A1. In addition, the unused inputs are terminated into 50 Ω, which is often necessary when connecting multicouplers or power dividers. The model can be equipped with a 1-out-of-12 RF switch as an option.

The **RF Switch Unit ZS 127 Z1** (FIG 3) designed for outdoor use is fitted with a 1-out-of-2 RF switch, which covers the frequency range from DC to 3 GHz. In addition, the unit can be installed as a detached RF switch at a maximum distance of 15 meters. It can also be controlled by the Antenna Control Units GB 127 x.

## Antenna Control Units GB 127 x

The universal **Antenna Control Units GB 127 x** have been developed for stationary, transportable and mobile systems. They can control antenna rotators, adjustable-height masts and RF switches. The core of the new family is formed by the **Antenna Control Units GB 127 S and GB 127 M**. They can be operated via the front panel or by means of the ArgusMon software [3] via an RS-232-C interface.

The **GB 127 S** (FIG 4) is a universal antenna control unit mainly designed for stationary systems. Normally, it is used in conjunction with the compact **Rotator Control Unit RD 127** (FIG 5), which contains the RF switch and an electronic control system for the connection of various antenna rotators. The RD 127 may vary in configuration, from one or two 1-out-of-2 RF switches to one 1-out-of-8 RF switch for different frequency ranges. The great benefit of this rotator control unit is that it can be installed on the mast close to the antennas. Consequently, the RF cables need not be laid from each antenna to the station; only one RF cable and a control line to the GB 127 S are required, which can be up to 120 meters in length.

If it is not necessary to control the antenna rotators, the **RF Switch Unit ZS 129 A2** is the optimum solution (FIG 6). It is designed for outdoor use and fitted with a 1-out-of-8 RF switch, which covers the frequency range from DC to 3 GHz.

The **Antenna Control Unit GB 127 M** is primarily designed for mobile and transportable systems. It differs from the GB 127 S only by the additional electronic control system for the antenna rotators. The **RF Switch Unit ZS 129 A4** (FIG 7) is ideal for installation on the roof of a vehicle. It has two 1-out-3 RF switches and is significantly smaller than the ZS 129 A2. The maximum control cable length is 10 meters.

The two antenna control units can also control the RF Switch Unit ZS 129 A5. This unit is installed in a rack within the station or vehicle. It can accommodate various RF switches, power dividers and filters.

The product line is regularly completed and extended because customer satisfaction is of utmost importance to Rohde & Schwarz: the supply of complete systems from one source.

Jörg Pfitzner

**More details, data sheets and technical information at www.argus.rohde-schwarz.com or www.rohde-schwarz.com (search for the type designation)**

REFERENCES

[1] Spectrum monitoring and management system for Sri Lanka – Electromagnetic waves do not stop at frontiers … News from Rohde & Schwarz (2000) No. 168, pp 40 – 42

[2] Coverage Measurements System ARGUS-FMTV – Optimum use of frequency thanks to reliable forecasts in planning. News from Rohde & Schwarz (2001) No. 170, pp 30 – 33

[3] Spectrum Monitoring Software ARGUS 4.0 – New software generation for spectrum monitoring systems. News from Rohde & Schwarz (2000) No. 167, pp 18 – 20

# Selection of system instruments


Photo 43247

FIG 1
**GSM Communication Unit GC127**

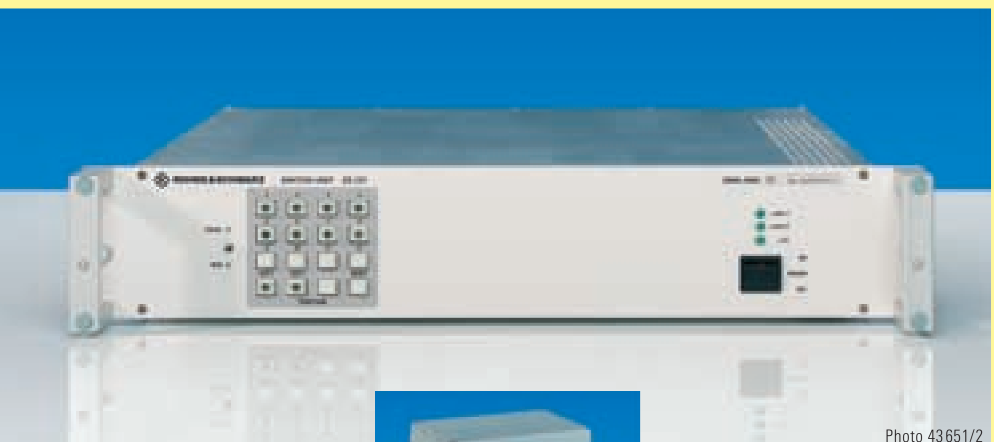


Photo 43651/2

FIG 2
**RF Switch Unit ZS127**


Photo 43668

FIG 3
**RF Switch Unit ZS127Z1**


Photo 43650/2

FIG 4
**Antenna Control Unit GB127S**


Photo 43670

FIG 5
**Rotator Control Unit RD127**

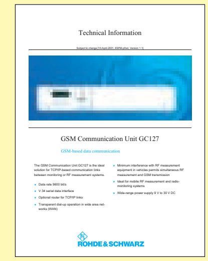

Photo 43669

FIG 6
**RF Switch Unit ZS129A2**

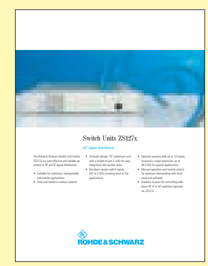

Photo 43671

FIG 7
**RF Switch Unit ZS129A4**

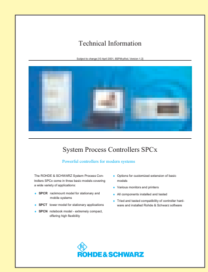
# References



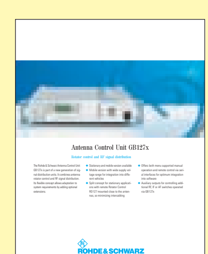

Technical information GSM Communication Unit GC127




Data sheet RF Switch Unit ZS127x




Technical information System Process Controller SPCx




Data sheet Antenna Control Unit GB127x

Miniport Receiver EB 200

# IF panorama option – nothing hidden in the spectrum

**Even in its basic version, the EB 200 (FIG 1) offers a range of functions in the frequency range from 10 kHz to 3 GHz that previously was hardly imaginable for such a compact unit. With the IF panorama option, it turns into a radiomonitoring specialist.**


Photo 43 013/1N

FIG 1 With the IF Panorama Option EB 200-SU, the EB 200 turns into a radiomonitoring specialist

News from Rohde & Schwarz has often reported that the "little one" is most versatile (see also [1])


Application notes

Miniport Receiver EB 200

Hard times for eavesdroppers

◁ Detection and localization of spy transmitters (No. 164, pp 24–25)


Articles

Miniport Receiver EB 200/Compact Receiver ESMC

Mini-receivers: remote control lends weight to network role

The EB 200 in computer-controlled monitoring systems (No. 165, pp 16–17) ▷


Firmware options for Miniport Receiver EB 200

Coverage and field-strength measurements with the mini-receiver

◁ Field-strength and coverage measurements (No. 170, pp 12–14)

## IF panorama: Indispensable for efficient radiomonitoring

With conventional receivers, the panorama display unit usually shows only the set receiver frequencies. The signal at the receiver IF output is analogously displayed by means of a simple spectrum analyzer. In many cases, this panorama display is implemented as an external add-on unit, which is relatively large and heavy and consumes a correspondingly high amount of power.

Not with the EB 200: During the development of the IF Panorama Option EB 200-SU, it was possible to avoid all these disadvantages by a consequent utilization of **digital signal processing**. This option uses FFT to calculate a spectrum of the scenario around the receiver frequency up to 250 times per second. These spectra are combined to form an image and are shown on the instrument display so that all details are revealed.

In the **MIN mode**, for example, the new option stores all spectral lines with their minimum level. It is thus possible to determine spectral lines with constant level from very noisy signals. These lines are permanently available and their amplitudes vary just slightly. FIG 2 shows the spectrum of a signal which is applied to the antenna input of the EB 200 with a level of –10 dBμV. The panorama unit is placed in the CLRWRITE mode, in which the spectrum is not further processed for display. FIG 3 shows the same signal in the MIN mode for a measurement lasting one second. A single spectral line is clearly visible, but the noise display is suppressed.

A similar result is obtained in the **AVG mode** (FIG 4). The noise floor, however, is not suppressed but smoothed. This method has the advantage that the magnitude of the spectral lines is maintained and their level can be exactly measured directly with the level ruler.

In the **MAX mode**, all spectral lines are stored with their maximum level. When a long measurement time is selected, e.g. five minutes, it appears that the spectrum is building up. FIG 5 shows the spectrum of a radiotelephony band after such a measurement time. The occupied radiotelephony channels are clearly visible. The MAX mode is also well suited for burst signals (single emissions of short duration) and frequency hop signals.

The IF panorama can be directly used for tuning by activating the **step function** via softkeys ⊥ TO ▲ (move to next peak left) and ⊥ TO ▲ (move to next peak right). This is best done with the MAX mode and a measurement time of 100 ms to 1 s. In the radiotelephony band, for example, signals appear and disappear at irregular intervals. Selecting an appropriate measurement time can, however, artificially slow down the disappearance such that even short emissions can easily be detected. The two softkeys help the user to move rapidly from an occupied channel to the next one (e.g. to store the new frequency in a memory location). Unoccupied channels are skipped. The threshold predefined by the squelch setting determines which signals are relevant.

One of the great advantages of this interactive step method is that no channel spacing has to be entered as step width (e.g. 25 kHz) due to the high resolution of <1 kHz per spectral line. As a result, signals that often change their frequency and use frequencies which are not in the channel spacing can easily be detected and traced (direction finding is ▶

**FIG 2**
**CLRWRITE mode: spectrum without electronic processing**

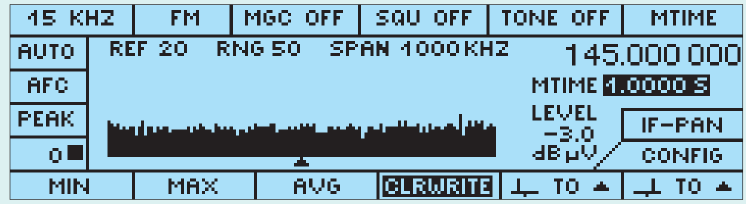



**FIG 3**
**MIN mode: same input signal but with suppressed noise**

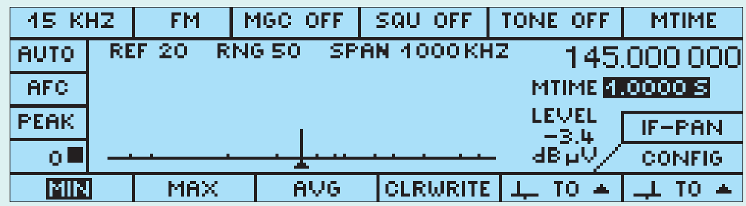



**FIG 4**
**AVG mode: same input signal, the exact level of the spectral line, however, being maintained by smoothing**

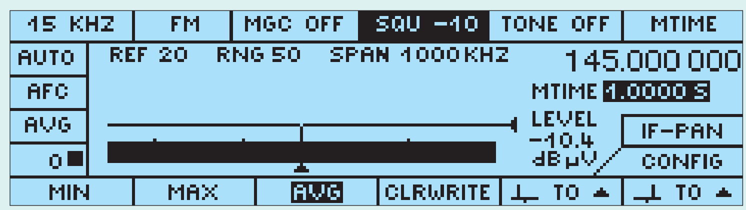



**FIG 5**
**MAX mode: spectrum of a radiotelephony band after a measurement time of five minutes**

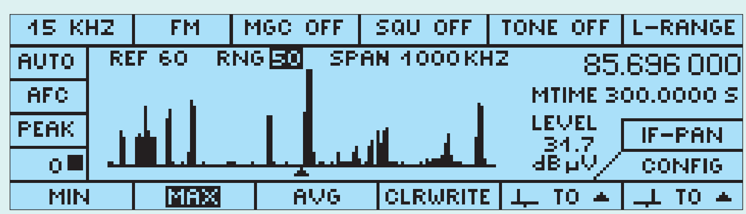



**FIG 6**
**spectrum in the 20 m band, ±25 kHz near the receive frequency**

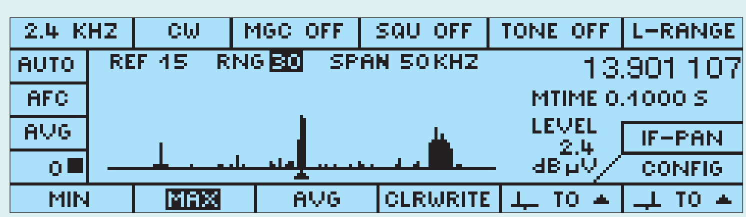
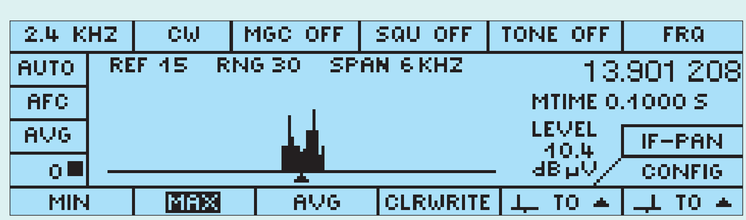



**FIG 7**
**Approximate resolution 8 Hz: marker and space frequency of FSK signal clearly visible**



possible with the EB 200 and the Digital Direction Finder DDF 190 [2]).

For combining broadband signals comprising more than one spectral line, the EB 200 employs a **special search algorithm**, which searches to the right or left of the center for the next local level maximum that does not belong to the current center signal. With squelch switched off, the EB 200 automatically determines the level of the noise floor via spectral estimation and then uses it as a search threshold.

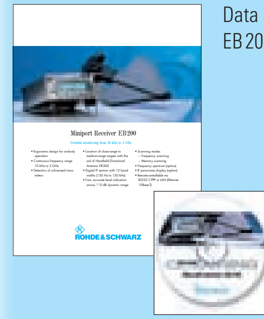
The IF panorama also performs well in the **shortwave range**. A high spectral resolution is required in this case. The display range on the EB 200 can be varied to nearly any value between 150 Hz and 1 MHz, which corresponds to a frequency resolution of 120 mHz to 1 kHz. FIG 6 shows a spectrum of ±25 kHz near the receive frequency in the 20 m band.

As shown in FIG 7, the up-to-date FFT panorama display can also be used on the EB 200 for **signal analysis**. The receive signal is displayed with a resolution of approx. 8 Hz. The mark and space frequency of an FSK (frequency shift keying) signal is clearly visible.

Of course, the data can be transferred to a PC via the EB 200 remote-control interface so that a detailed spectrum analysis can be performed. All image details can be output on a large display, e.g. by means of the Spectrum Monitoring Software ARGUS [3] with up to 1200 spectral lines at repetition rates of up to 20 images per second.

Theodor Fokken; Martin Hisch

**More information and data sheet at www.rohde-schwarz.com (search for EB 200)**



Data sheet EB 200

CD-ROM on EB 200 available free of charge from any Rohde & Schwarz representative


REFERENCES

[1] Miniport Receiver EB 200 and Handheld Directional Antenna HE 200 – Radiolocation from 10 kHz to 3 GHz now with portable equipment. News from Rohde & Schwarz (1997) No. 156, pp 4–6

[2] DDF190 – Now from 0.5 MHz through 3000 MHz. News from Rohde & Schwarz (2000) No. 166. pp 16–17

[3] ARGUS 4.0 – New software generation for spectrum monitoring systems. News from Rohde & Schwarz (2000) No. 167, pp 18–20


TEST TIP | Mobile radio

# Generating Bluetooth™ RF test signals quickly and easily

***Bluetooth* RF test signals are required for receiver and transmitter measurements in development and production. In practice, a few "bursted" signal types with defined data content are sufficient in addition to continuous signals containing random data. These signals can be generated quickly and easily with the Signal Generator SMIQ.***

## Bluetooth bursts

Bluetooth uses the time division duplex method (TDD). Transmitted and received bursts continuously alternate in time. One so-called "packet" containing an access code, a header and the payload containing the user data is transmitted with each burst (FIG 1).

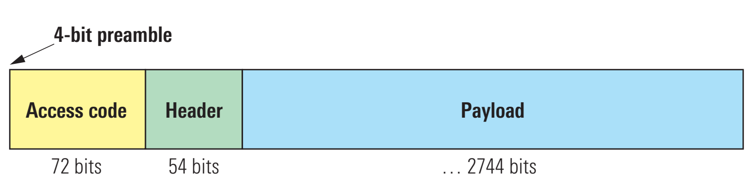



**FIG 1 General structure of a *Bluetooth* packet**

* BLUETOOTH is a trademark owned by Bluetooth SIG, Inc., USA, and licensed to Rohde & Schwarz.

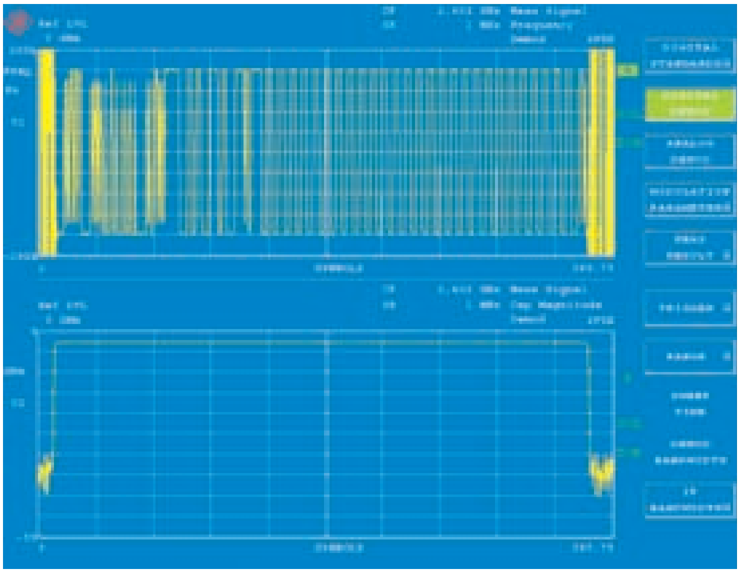


**FIG 2** ***Bluetooth*** **burst with payload pattern 1111 0000**

The 72-bit access code contains a 4-bit preamble, a 64-bit synchronization word derived from the module address, and four filler bits. The 54-bit header contains link controller information such as the active member address, type code, flow control, etc. This data is different for each DUT and depends on the current connection.

Only the bits of the preamble and the payload data – which are independent of the DUT and the connection – are relevant for *Bluetooth* RF tests. Since the number of payload data bits can vary, a burst may require one, three or five timeslots.

Bursted test signals are mainly required for *Bluetooth* transmitter measurements in the loop-back mode. The DUT is switched to a test mode in which the received stimulus signal is directly returned to the transmitter stage. The output power, adjacent-channel power, output spectrum as well as the drift and modulation characteristic of the transmitter are then measured, for instance, with a spectrum analyzer.

The *Bluetooth* test specification prescribes a specific constant payload pattern for each individual test; the access code and header are not evaluated. For this reason, test signals with a constant, repetitive packet content are sufficient in practice.

These repetitive bursts can be easily generated with the Signal Generator SMIQ. Modulation data and control signals for ramp generation are taken from the SMIQ's data memory. The generator also supplies trigger signals for the beginning of the burst and the payload. *Bluetooth* packets for 1-slot, 3-slot and 5-slot bursts are available in the SMIQ with the payload patterns PRBS 9, 1111 0000 and 1010 1010 specified by the standard.

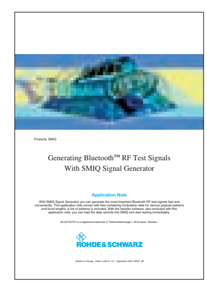
FIG 2 shows a recorded test signal with the payload pattern 1111 0000, which is used for measuring the modulation deviation.

## Continuous test signals

If permitted by the DUT, continuous signals can also be used in the loop-back mode. A continuous data flow is particularly useful for BER measurements. In this case, the measurement is more than twice as fast as with 1-slot bursts. The SMIQ generates the required random data pattern in realtime.

## Instructions for test signal generation

Instructions for generating of these test signals are provided in an application note**, which can be downloaded free of charge from the Rohde & Schwarz website. Modulation patterns for all three payloads prescribed by the standard for one-, three-, and five-slot bursts are contained in the annex of the application note. With the aid of the transfer program supplied with the application note, the data can be rapidly transferred from the PC to the Signal Generator SMIQ.




Detlev Liebl

**More technical information at www.rohde-schwarz.com**
**(homepage: Products & More – Application Notes – Bluetooth – 1MA31)**

REFERENCES


** Generating *Bluetooth*™ RF Test Signals with Signal Generator SMIQ, Application Note 1MA31 from Rohde & Schwarz

- *Bluetooth* RF Test Specification, version 0.9, 14. March 2000
- *Bluetooth* Core Specification, version 1.1, 22. February 2001
- Transmitter Measurements on *Bluetooth* Modules, Application Note 1MA26 from Rohde & Schwarz
- Transmitter Measurements on *Bluetooth* Modules with FSP, Application Note 1MA33 from Rohde & Schwarz


The **Test Receivers/Spectrum Analyzers ESPI** from Rohde & Schwarz are the new standard in the EMI precompliance class (see article on page 33).

Data sheet PD 0757.6540.21

**Switch Unit ZS 127 x** The RF Switch Unit Family ZS 127 x is a cost-effective and reliable approach to RF and IF signal distribution (see article on page 45).

Data sheet PD 0757.6533.21

**Antenna Control Unit GB 127 x** There are two models: The GB 127 S (stationary) and the GB 127 M (mobile) both of which can be equipped with other modules (such as rotator control, antenna selector, etc) (see article on page 45).

Data sheet PD 0757.6656.21

**EMC Test System TS 9994** for car component development.

Flyer PD 0757.6591.21

**Spectrum Analyzer FSU** The FSU family is the third generation of high-end analyzers Rohde & Schwarz has launched. They enable measurements which previously were not possible with spectrum analyzers, or at least were insufficient (see article on page 20).

Data sheet PD 0757.6504.22

**Monitoring Receiver ESMB** New monitoring receiver from 9 kHz to 3 GHz, for all radiomonitoring tasks according to ITU-R.

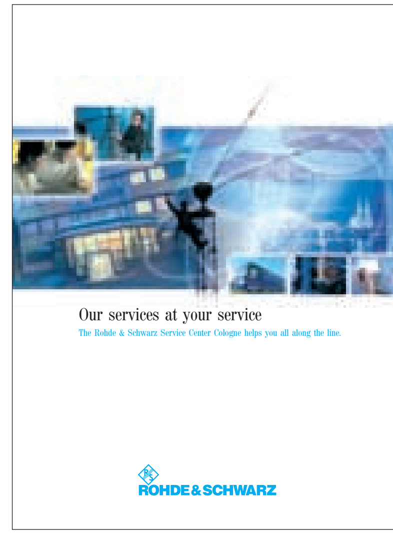
Data sheet PD 0757.5808.21

**VHF Transmitter Family NM / NW 7000** Liquid-cooled high-power transmitters for digital and analog TV (DVB-T or ATSC).

Data sheet PD 0757.6627.21

**Our services at your service** This brochure details the complex range of services provided by the Rohde & Schwarz Service Center in Cologne. Besides standard and custom solutions in the fields of T & M, communication engineering, and system and data products, the competence in technical documentation and seminars and training courses is featured.

Brochure PD 0757.3386.22




**Spectrum Monitoring and Management System ARGUS-IT** On 20 pages a variety of components such as receivers, antennas and system software is presented. Radiomonitoring covers the spectrum from single stations to nationwide networked systems.

Data sheet PD 0757.4818.22

**FM Measurement Demodulator FS-K7 for FSP** New extension for the FSP.

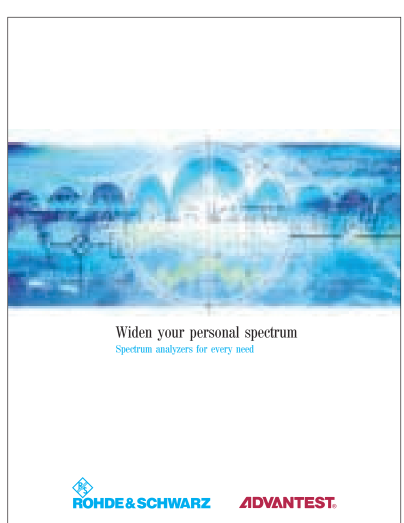
Data sheet PD 0757.6685.21

The **Universal Relay Card TS-PRL1** for the Test System Versatile Platform TSVP provides numerous basic functions required in production environments, and can replace several special cards. It is fitted with a CompactPCI interface.

Data sheet PD 0757.6610.21

**Widen your personal spectrum** The brochure gives an overview of the current range of spectrum analyzers from Rohde & Schwarz and Advantest. Structured according to the application fields mobile radio, general-purpose RF applications and microwave, the brochure allows a fast and application-oriented selection of models with the help of appropriate criteria.

Brochure PD 0757.6785.21




## New application notes

**IQWizard** is a software solution for loading I/Q signals from different file formats and for measuring I/Q signals with the FSIQ (with option -B70), FSP or FSU analyzers from Rohde & Schwarz. The measured data can be stored in the various common file formats for subsequent processing with tools such as MathCAD, MatLab or ADS. IQWizard uses a TCP/IP interface to transfer the I/Q data into the AMIQ via the WinIQSIM program.

Application Note 1MA28

**Swept Adjacent-Channel Power Analysis on Digital TV Amplifiers** In the wide frequency range from 54 MHz to 890 MHz, the adjacent-channel power performance of power amplifiers in terrestrial digital TV antenna systems must be ensured. Measuring these specifications is time-consuming. The application software, which is available together with the application note, provides rapid measurements of the adjacent-channel power in compliance with FCC guidelines over the complete frequency range by using the Signal Generators AMIQ and SMIQ as well as the Analyzers FSP / FSU or FSE.

Application Note 1MA43

## NEWSGRAMS | International

### Rohde & Schwarz takes over hardware encryption business from Siemens

**With effect from 1 May 2001, Rohde & Schwarz SIT GmbH has taken over the hardware encryption business segment of Siemens Information and Communication Mobile (ICM).**

By integrating the Siemens security experts, Rohde & Schwarz SIT has become Germany's leading provider for official and commercial encryption and expanded its product range by adding numerous encryption solutions.

Rohde & Schwarz SIT has long been active in communications security. By taking over the information security division of Bosch Telecom GmbH in 1999 the company enhanced its expertise. For the same reason, Rohde & Schwarz SIT has now taken over the hardware encryption segment from Siemens. The increased know-how will create the foundation for further growth and entry into new markets. Siemens is withdrawing from this business to concentrate more on its core business in mobile communications.

"The takeover is an important step for us towards market leadership in Germany in professional solutions for communication security", explains Henning Krieghoff, President of Rohde & Schwarz SIT GmbH. "Joining the capacity and capability of both companies provides the basis for successful growth and broadening of the product spectrum, especially in the direction of the commercial market."

### Rohde & Schwarz acquires new plant from Tesla in the Czech Republic

**On 1 May 2001, Rohde & Schwarz took over the Tesla Prag a.s. plant in Vimperk (Czech Republic) comprising 42000 m$^2$ real estate. The aim of the takeover is to reduce the load on the Memmingen and Teisnach plants which was triggered by the high demand for communications and T & M equipment and the resulting order boom.**

By adding a third production site, Rohde & Schwarz has secured the production of its high-tech instruments in the long term. Since 1991, Tesla Vimperk has mainly been carrying out production for Rohde & Schwarz. This resulted in staff numbers rising to over 200 employees, all of whom will now be taken over.

There are plans to modernize the plant in the near future. This will ensure that the high quality standard is maintained in future. Johann Kraus, the Managing Director of the new plant, is optimistic: "We manufacture parts and modules to complete units in Vimperk. Thanks to the company group's exceptionally successful development of turnover in the last few years, the high throughput of all three plants will be ensured."

Monika Roth

## 155 TV transmitters for DVB-T TV network in Sweden

**In the fourth phase of the extension of the digital terrestrial TV network in Sweden, Rohde & Schwarz has been awarded the contract to supply 40 Transmitters NV7000. As the main supplier to the operator Teracom, Rohde & Schwarz was involved in all the phases of construction, and supplied a total of over 155 transmitters.**

Since work began on setting up the network, over 30 transmitter stations have been established with these transmitters. The most important factors for choosing Rohde & Schwarz as the main supplier were modern technology and the comprehensive, space-saving overall concept.

Five transmitters were configured in a "four-plus-one" standby system for each station. The newly-developed "n+1" Automatic Switchover Unit GB700 was also used. This flexible, highly integrated solution makes for considerably higher network availability. Since the transmitters had to take up as little space as possible, Rohde & Schwarz also designed special solutions, such as two 200 W transmitters in one rack. Another first was a 3.4 kW transmitter, which is accommodated in one rack with eight amplifiers.

Photo 43392/5

## Innovative T & M and transmitter technology at the IBC 2001 in Amsterdam

**Rohde & Schwarz will be represented at this year's International Broadcasting Convention (IBC), which takes place in Amsterdam from 14 to 18 September 2001 (hall 8, stand 271).**

The company will be exhibiting its new T & M solutions as well as numerous new TV and sound broadcasting transmitters. Among the products to be presented are a new low-power UHF transmitter family for digital and analog, as well as new DAB transmitters for the L band. The highlights in the field of T & M are the Test Transmitter SFL, Monitoring Receiver ETX, and DTV Recorder Generator DVRG for SDI (serial digital interface). In addition, datacasting solutions for DAB and DVB will be presented.

## World's first tap-proof mobile telephone from Rohde & Schwarz

**Damage due to business espionage amounts to billions worldwide. That is reason enough for companies to protect themselves. Government officials, authorities or banks and insurance agencies must also ensure the confidentiality of their communications. To provide protection against espionage in mobile communication, Rohde & Schwarz SIT, a subsidiary of Rohde & Schwarz, has launched the first tap-proof mobile phone.**


Photo 43756/4

The TopSecGSM is based on a standard Siemens mobile phone which has been enhanced with a crypto module. By pressing a button, the user can switch to crypto mode and carry out secure mobile communications. A combination of asymmetric 1024-bit encryption and a symmetric 128-bit algorithm offers the highest level of security.

For encrypted transmissions, the unit uses the GSM data channel. First, the station being called, which must also be a TopSec mobile telephone or have a TopSec box for landline use, is contacted for key exchange. A 128-bit key is randomly determined out of $10^{38}$ possibilities, and is securely transmitted by means of a 1024-bit encryption algorithm. This encryption process, which lasts approx. 10 to 15 seconds, is also shown in the display of both units. Afterwards, an incoming call is signalled on the unit called – the tap-proof connection is established.

The TopSecGSM works in both GSM frequency ranges of 900 MHz and 1800 MHz and is now available from Rohde & Schwarz sales departments.

## Roschi Rohde & Schwarz AG to represent Tektronix in Switzerland

**Since 1 June 2001, Roschi Rohde & Schwarz AG has represented Tektronix in Switzerland and is thus in a position to provide its customers with an ideal supplement to the present product range.**

In the US, Canada and Mexico, Tektronix and Rohde & Schwarz have cooperated successfully in the T & M field for some years. Erwin Schudel, currently Director of Sales at Swiss Textronix International AG in Zug, will assume the position of Director of Sales T & M and Test Systems at Roschi Rohde & Schwarz in Ittigen.

"The new alliance in Switzerland means that our customers will benefit from a comprehensive spectrum of complementary products", says Heinz Lutz, President of Roschi Rohde & Schwarz AG. "We can now offer an extensive range of products and services for all test and measurement applications from a single source."

## New subsidiary in Korea

**Rohde & Schwarz has now set up its own subsidiary in Korea. For this purpose, the company converted the previous subsidiary Hana Technica, which had represented Rohde & Schwarz in Korea since 1990, to Rohde & Schwarz Korea Ltd. The newly founded company, managed by Sukwang Kim, has taken over the entire Hana Technica staff.**

Rohde & Schwarz cooperated successfully with Hana Technica for many years. During this time, the company evolved into a respected supplier of electronic T & M products and communication systems in Korea.

"Korea is one of the world's largest markets for Rohde & Schwarz products, and the Korean manufacturers are active worldwide", says President Friedrich Schwarz. "By setting up Rohde & Schwarz Korea Ltd, we can provide our customers with on-site support in development and production and offer them optimum help with applications as well as service and calibration."

"Rohde & Schwarz has long-standing customer relationships in Korea which can now be consolidated even further", adds Sukwang Kim, Managing Director of Rohde & Schwarz Korea Ltd. "The expansion of the Korean telecommunication and media sector is one of our future priorities: We will provide the right products at the right place and at the right time."

Stefan Böttinger

## New heads of sales at Rohde & Schwarz

**At the beginning of the new fiscal year (1 July 2001), Rohde & Schwarz restructured sales both at the top management level and in three international regions, appointing new heads of sales in North and Latin America as well as in Europe.**

**Wulf-Dietrich Oertel** (57) is the new Executive Vice President of the International Sales and Service Division of Rohde & Schwarz. He joined the company in 1963 and soon assumed responsibility for sales. He set up the sales network in the Mediterranean countries, organized direct sales in the Middle East and in the Asia / Pacific region, and founded separate sales organizations in Europe. Wulf-Dietrich Oertel is on the Board of Directors of many national subsidiaries. In his new position, he sees his primary task as setting up decentralized on-site competence in order to differentiate Rohde & Schwarz from its competitors and provide added value for customers.

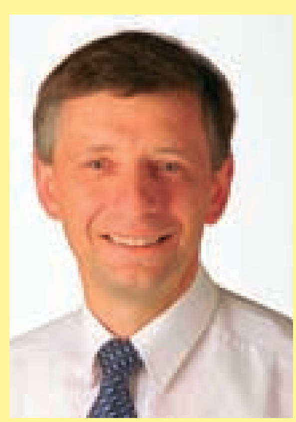
**Wolfgang Schmittseifer** (45) has been appointed Managing Director for Sales in North America, a major growth market for Rohde & Schwarz. In his new position, he is responsible for all corporate sales activities in the USA and Canada and for the cooperation with the sales partners Tektronix, Acrodyne and Honeywell. His activities focus on the expansion of the regional sales and service structures. Wolfgang Schmittseifer was formerly Managing Director of the Australian Rohde & Schwarz subsidiary.

Rohde & Schwarz has appointed **Dr Wolfgang Winter** (44) as Managing Director for Sales in Latin America. He is responsible for the development and expansion of the regional sales and service structures. "Latin America is a continent with great potential and an important future market for Rohde & Schwarz," says Dr Winter. "Our major key accounts have already discovered this region. Over the next few years, our company will also increase its presence on this continent." Before taking on this newly created position, Dr Winter was Director of Sales West Europe at Rohde & Schwarz.

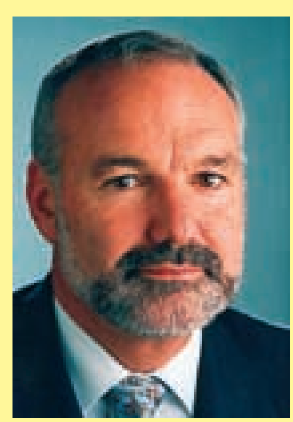
There are also changes in Europe: since 1 July 2001, **Philippe Catherine** (48) has been the new Managing Director for Sales of Rohde & Schwarz. He is now responsible for all European sales activities, subsidiaries and repesentatives of the company. Philippe Catherine has been with the company for eight years. Until recently, he was Managing Director of Rohde & Schwarz France S. A. In his position as the new European Managing Director for Sales, he plans to improve the consistency of company policy for the individual subsidiaries and so foster customer satisfaction and increase market shares.

**Wulf-Dietrich Oertel: "Thanks to our decentralized on-site competence we can set ourselves apart from our competitors."**

**Wolfgang Schmittseifer: "North America is one of the major growth markets for the future."**



**Dr Wolfgang Winter: "Latin America is a continent with great potential."**



**Philippe Catherine: "We aim to consolidate our position as European market leaders."**

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

ROHDE & SCHWARZ

ROHDE & SCHWARZ GmbH & Co. KG · Mühldorfstrasse 15 · 81671 München, Germany · P.O.B. 80 14 69 · 81614 München
Support Center: Tel. (+49) 018 05 12 42 42 · E-Mail: customersupport@rohde-schwarz.com · Fax (+49 89) 41 29-137 77

News from Rohde & Schwarz 171 (2001/II) · PD 0757.6340.21 · B42622