News from Rohde & Schwarz

Datacasting – broadcasting and Internet go new ways together

RF tests on base stations with new Radio Communication Tester CMU 300

Coverage measurement systems for mobile radio and broadcasting

2001/I
170

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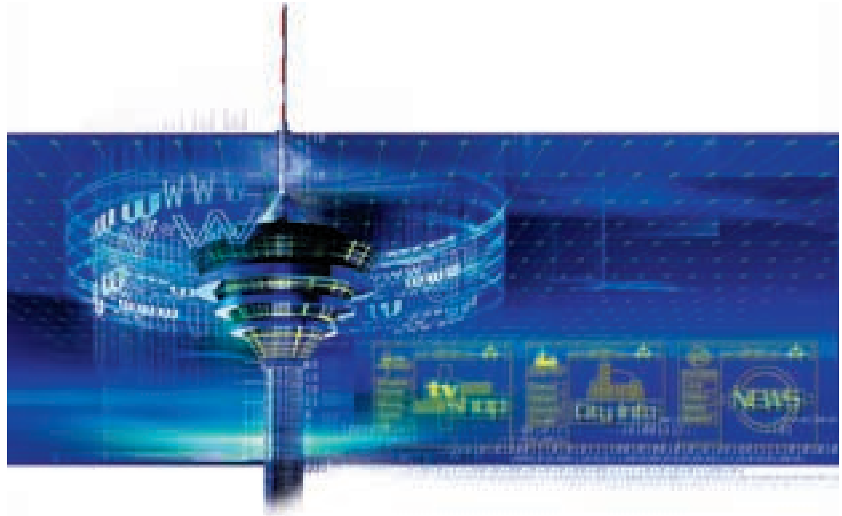

Photo 43694

Web over DTV is a convenient and cost-effective solution for distributing Internet resources to TV viewers, for example, and enabling TV providers to integrate extra services into their programs. Two articles, one with application example, show that new services and applications will make a major contribution to the success of digital TV (DTV) (pages 24 and 27)

Photo 43641/7

Rohde&Schwarz presents Base Station Tester CMU300 set up on the same platform as Universal Radio Communication Tester CMU200. This model was specially developed to meet the more stringent demands involved in RF parameter measurements on base stations (page 4)

Photo 43687/1

Two firmware options enhance the use of Miniport Receiver EB200 for coverage and field-strength measurements (page 12)

MOBILE RADIO

Photo: Author

Apparently, there was not much to do for this vendor on the market in Urumqi (China), quite in contrast to the DF experts from Rohde & Schwarz (page 43)

Photo: 43 439/4N

Optical measuring instruments from Advantest on page 48 ff. The article focuses on the new Optical Spectrum Analyzer Q 8384

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Universal Radio Communication Tester CMU 300

RF tests on base stations – comprehensive, fast and accurate

Photo 43 641/1N

FIG 1 CMU 300, specialist for base stations

15 months after the successful launch of Universal Radio Communication Tester CMU 200 [*], and set up on the same platform, Rohde & Schwarz presents Base Station Tester CMU 300 (FIG 1). This model was specially developed to meet the more stringent demands involved in RF parameter measurements on base stations.

Based on proven platform

Created from the same platform as CMU 200, CMU 300 offers all the highlights of this modern tester generation: maximum measurement accuracy and speed combined with extremely high reliability and repeatability. The new instrument from Rohde & Schwarz is tailor-made for tests on base stations in development, production, installation and service. The unit is intended for testing the U_M air interface of base stations and follows GSM specification 11.21 (ETSI TS 101087).

CMU 300 keeps pace with the evolution of modern digital mobile radio, supporting GSM (2G) and EDGE (2.5G), and an extension is planned to add 3G functionality.

Compact, top-performance tester

In bit-error-rate measurements, the capability of CMU 300 to generate and decode signals for different channels in realtime is of particular importance. This is the key prerequisite for automatic measurement of limit sensitivity, or for signalling at higher layers, e.g. to simulate the functions of mobile stations.

Another strong point of CMU 300 is its flexible adaptation to entirely different test environments. From the pseudo-random noise generator to the DUT to BER analysis, it supports a variety of test paths. For example, the test signal may be taken via various loops within the base transceiver station (BTS) – with or without channel coding – or via the A_{bis} interface. Plus, CMU 300 itself can act as an RF loop, likewise with and without channel coding (FIG 2).

In contrast to mobile radio tests, where a tester can control DUTs entirely via the RF interface, base stations need to be driven by an external controller. Like in a real network, this is done by a base station controller (BSC) via the A_{bis} interface or, when a PC is used, a base-station-specific interface. The external controller activates the RF channels to be tested in the BTS.

The base station is linked via its antenna or test connectors to the powerful front-end of CMU 300. The tester incorporates an RF switching matrix with four user-configurable inputs and outputs for optimum matching to the RF test environment. Two of the inputs/outputs are duplex-capable. The first (RF 1) is intended for connection to a high-power base station of max. +47 dBm output power, the second (RF 2) for micro base stations of max. +33 dBm output. CMU 300 additionally features a highly sensitive input (RF 4 IN) and a high-level output (RF 3 OUT).

Two operating modes

The instrument supports two operating modes. Non-signalling mode is particularly suitable for testing GSM RF boards/modules with little or no signalling activity. As soon as a GSM RF signal appears at the tester input, the transmitter parameters are measured. A GSM generator for stimulating the DUT is available too.

More important is signalling mode, however, because here the tester operates synchronously with the BTS, i.e. synchronized with the TDMA frame structure – vital for receiver bit-error-rate measurement. Transmitter parameters can also be tested separately for each timeslot. This function is necessary for testing base stations that support both GSM and EDGE.

The instrument can be synchronized to the base station in the following ways:

- If the BTS has a multiframe clock output, the signal can be used to trigger CMU 300. This requires an additional trigger line.
- If only the RF connection is used, the tester can synchronize to the C0 carrier of the base station, just like a mobile phone. This simplifies the test setup. However, a C0 carrier must be activated in the BTS before measuring the useful channel.

Tailor-made with options

CMU 300 already offers signal generator and spectrum analyzer functionality in its basic version. It is turned into a radiocommunication tester (transmitter and receiver measurements for GMSK modulation) by adding hardware option CMU-B 21 (signalling unit) and one of the five GSM software options (CMU-K 30 through CMU-K 34). In this way all GPRS channel coders are available as an essential feature in CMU 300.

The named GSM functionalities can be extended to EDGE (transmitter and receiver measurements for 3/4 π 8PSK modulation) by software option CMU-K41, which also adds EGPRS channel coders (FIGs 3 and 4).

FIG 2 For bit-error-rate measurements, a bit sequence can be selected from a list, or CMU 300 itself can be used as an RF loop if the DUT sends the data stream

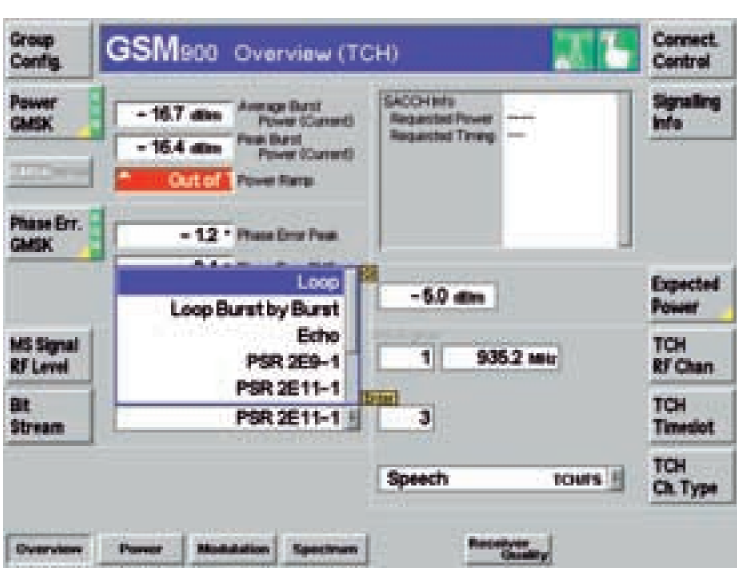
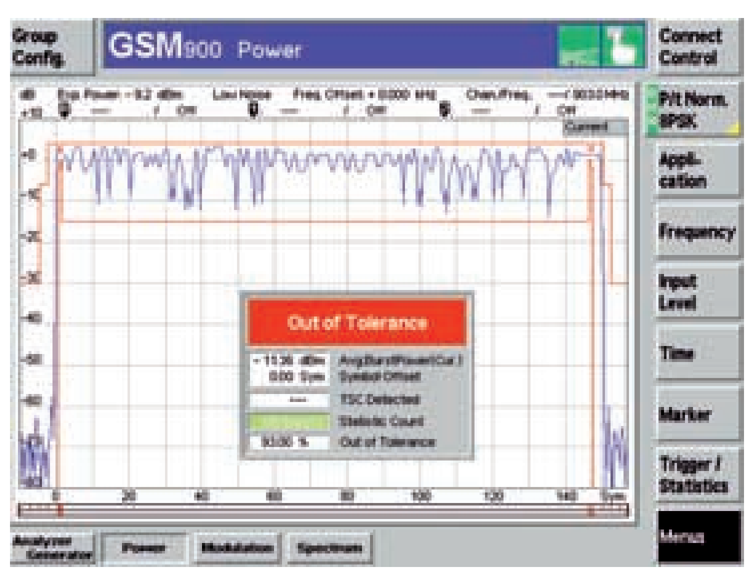


FIG 3 Power-versus-time measurement of an 8PSK-modulated burst showing the high crest factor typical of EDGE signals



▶ Software option CMU-K39 allows link setup using MOC/MTC (mobile originated/terminated call) standard signalling. This is necessary when you want to test the signalling software of the base station, too, and receive its measurement reports or measure in hopping mode. Software options CMU-K39 and CMU-K41 produce the functionality in each case for all installed GSM options.

Available hardware options include a highly accurate, oven-controlled crystal (CMU-B12) and an A_{bis} board (CMU-B71). The latter is needed for BER tests where the bit pattern sent by CMU300 cannot be returned via an internal loop of the BTS. The bit pattern is in this case returned to CMU300 via the A_{bis} interface between the BTS and BSC.

The tester is equipped as standard with two PCMCIA slots, but can also be supplied with a disk drive (CMU-U61).

FIG 4
List of traffic channel types including GPRS and EGPRS channel coders

CMU300 – a future-proof investment

CMU300 is a universal RF tester for all aspects of base station tests. It features unmatched speed thanks to the use of Probe DSP™ technology, innovative measurement algorithms and parallel test capability. The extremely high measurement accuracy and repeatability are the result of an optimized frontend coupled with sophisticated measured-value correction software that, in the event of variation of frequency, level range or board temperature, performs realtime compensation across the entire frequency and dynamic range. This is supported by three independent cooling circuits that keep instrument temperature at a constant low even in extreme operating environments. The concept of the tester ensures simple implementation of solutions for future measurement needs. For example, processor power can be boosted by pluggable DSP modules. All this shows that CMU300 is a reliable and future-proof investment.

Gerhard Götz; Henry Gropp

More information and data sheet at www.rohde-schwarz.com or enter 170/01 on reader service card

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

Universal Radio Communication Tester CMU 200

Adding CDMA now provides full 2G capability

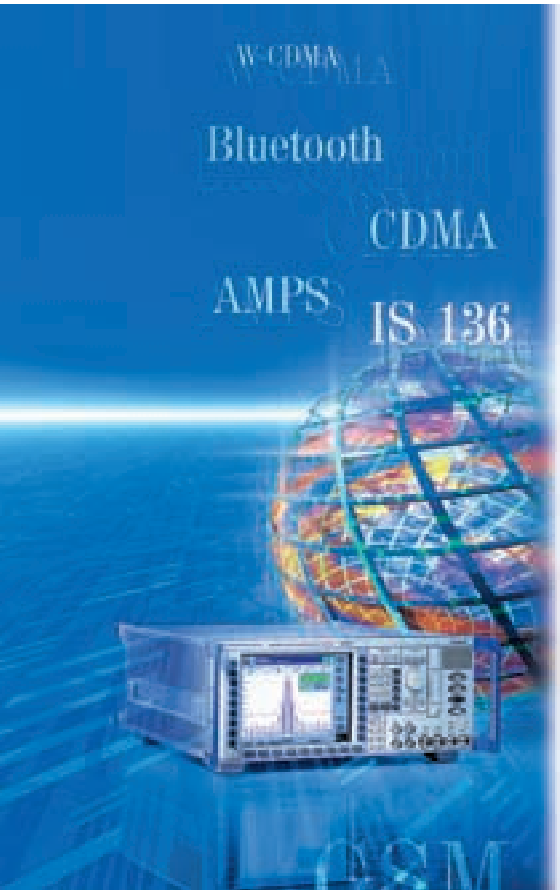


Photo 43 238/11

Since the first commercial CDMA network started up in Hong Kong in September 1995, this digital mobile radio standard has established itself internationally. With growth rates rocketing unabated, it today ranks – besides GSM – among the major standards of the second generation. New options now add CDMA test capability to CMU 200 [1].

Important standard – established worldwide

The CDMA digital mobile radio standard has advanced triumphantly far beyond the USA, its country of origin, Korea and Japan. It has established itself globally in various versions. The box on page 9 outlines its major features and development.

Now CMU 200 too can handle all major mobile radio standards of the second generation – in addition to GSM and TDMA (TIA/EIA-136). The CDMA options for CMU 200 (details in box on page 8) not only support the American versions to TIA/EIA-95A, TSB-74 and J-STD-008 but also the standards to ARIB-T53 (Japan) and Korean PCS.

The CDMA world is facing its next decisive step: the future CDMA version cdma2000 1x will enable data rates up to 144 kbit/s. So mobile radio producers require early on a platform affording high measurement accuracy and speed as well as multimode capability. CMU 200 is right in line with the requirement. With its flexible, modular concept it now offers CDMA test technology and a straightforward upgrade scheme for cdma2000 1x.

The menu structure and remote control interface of CMU 200 are largely horizontally compatible with the other standards of the tester, ensuring that users without any CDMA experience can operate the instrument without any problems. Existing remote control programs can easily be adapted to CDMA.

CMU 200 offers two main test modes, non-signalling and signalling. On the production line, a distinction is usually made between two test phases in which CMU 200 is used, module test and final test.

Non-signalling measurements

The module test – without complete call setup – serves for process verification and calibrating the DUT's receiver and transmitter. Measurements in non-signalling mode are used for this purpose. Here CMU 200 offers on the one

Photo 43 263/6

Rohde & Schwarz has broad experience in the field of CDMA testing: Digital Radiocommunication Tester CMD 80* – developed jointly with Tektronix – is one of the most successful CDMA mobile radio testers.

[*] Digital Radiocommunication Tester CMD 80 – CDMA, AMPS and IS-136 measurements with one unit. News from Rohde & Schwarz (1999) No. 161, pp 10–12

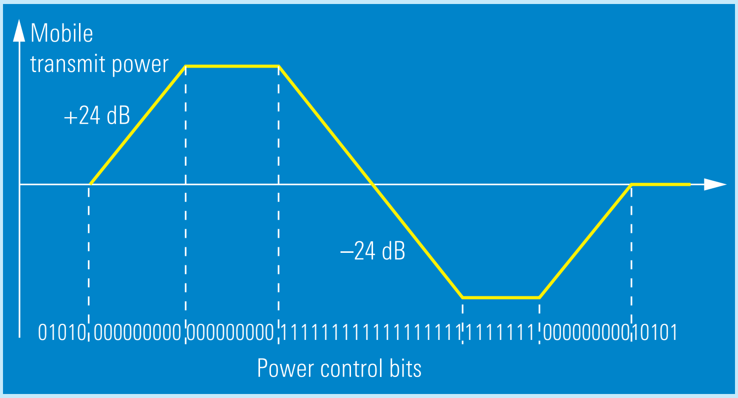


FIG 1 In closed-loop power control, the base station stimulates the CDMA mobile by power control bits to raise or lower its power every 1.25 ms

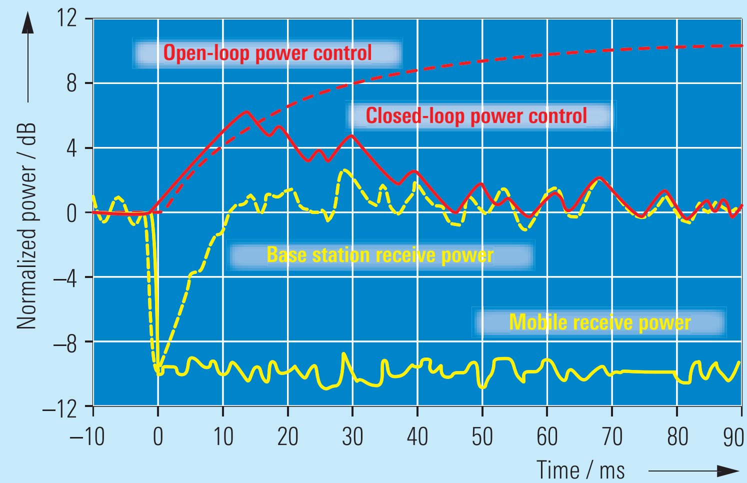


FIG 2 Open-loop and closed-loop power control are used simultaneously to ensure that a mobile sends only at the power actually needed. It also helps to reduce Rayleigh and lognormal fading

hand network-independent functionalities like spectrum analysis, power-versus-time measurement and frequency-selective power measurement. So in this phase of production it is possible to measure adjacent-channel power for example. On the other hand, CMU 200 also offers CDMA-specific measurements in non-signalling mode. It calculates waveform quality (rho factor), for instance, by correlating the measured DUT signal with an ideal reference. The rho factor is a scalar value indicating the quality of a mobile's transmitted signal.

Further non-signalling measurements include power, frequency error, transmit time error, carrier feedthrough and I/Q imbalance (a measure of unequal gain in the I and Q paths of the transmitter modulator).

Plus, CMU 200 incorporates a signal generator for non-signalling measurements that delivers CDMA-specific signals with pilot, sync, paging and traffic channel. All major parameters can be configured, like the relative levels of the individual code channels or the power control bits. The transmitter and receiver of CMU 200 can be set independently of each other and of the frequency bands, which allows analysis of intermediate frequencies for example.

Signalling measurements

In the final test, all major parameters of a mobile are checked with a call established. This is done in accordance with the TIA/EIA-98-C CDMA test standard. Here CMU 200 simulates a CDMA base station, allowing the mobile to be tested as in a real network. Signalling mode is not only needed in production but also in service and development.

The standard stipulates that certain test links be set up (service option 2/9) with defined test parameters in each case. Abundant test functionality is available for each of these loopbacks.

To check DUT voice quality, for example, the mobile first registers with the base station simulated by CMU 200. Then either CMU 200 or the mobile under test can establish a call with voice loopback. CMU 200 saves the audio data picked up via the mobile's microphone and returns them to the mobile after a delay of about 2 s.

CDMA options for CMU 200

Hardware option CMU-B 81 is the CDMA signalling unit for CMU 200, software option CMU-K 81 enables CDMA in the 800 MHz band (US cellular, China cellular, Japan cellular), and software option CMU-K 82 is for CDMA in the 1700/1900 MHz band (Korean PCS, US PCS).

Power measurements

The various power measurements play an important role in CDMA systems. All mobiles that have registered with a CDMA base station transmit at the same frequency - codes are used to distinguish between users. Efficient power control is necessary to prevent any mobile from drowning out others. TIA/EIA-95 provides two mechanisms for this purpose: **closed-loop power con-**

trol and **open-loop power control.** In the latter case, the mobile measures the received base station power and automatically adapts its own transmitted power accordingly. If the mobile is a good distance away from the base station, i.e. the received power very low, it will raise its transmitted power correspondingly.

In **closed-loop power control** the base station stimulates the mobile to raise or lower its power every 1.25 ms during a call (i.e. power control is effected at a frequency of 800 Hz). This is done by uncoded power control bits inserted into the data stream (FIG 1). The two mechanisms – open-loop and closed-loop power control – are always applied simultaneously (FIG 2). CMU 200 offers standard-conformant measurements to verify correct response of the mobile. To measure **open-loop time response**, the base station simulator (i.e. CMU 200) abruptly changes its output power, records the mobile's power response and enters the power characteristic in a tolerance mask (FIG 3).

Two further tests examine the **maximum** and **minimum output power** of a mobile. This is done by a combination of open-loop and closed-loop power control. To measure **minimum output power**, the base station transmits a sequence of power control down bits at high output level. This should stimulate the mobile to reduce its power below a certain level while maintaining adequate signal quality (rho factor). Measurement of **maximum output power** is the reverse of this.

When call activity is low, the mobile decreases its output power by sending not a continuous but a gated signal. The frame rate can be reduced from full to a half, quarter or eighth. CMU 200 checks the length of such a signal burst – a power control group (PCG) – **by a gated output power measurement**. The tem-

Digital mobile radio standard CDMA

CDMA[1] is based on the American TIA/EIA-95 standard and is also referred to as cdmaOne. CDMA is a spread-spectrum transmission method and was in the beginning mainly used for military applications. The CDMA spectrum is similar to a noise signal and so very difficult to detect, decipher or jam by hostile radio reconnaissance.

The availability of low-cost LSI circuits opened up commercial applications. The CDMA concept was first presented and successfully demonstrated in 1989 in San Diego. In 1993 the associated standard IS-95 was defined. In 1993 South Korea and 1997 Japan opted for CDMA as their network standard (FIG 7).

By 1999 there were as many as 50 million users with 83 network providers in 35 countries.

Compared with FDMA[2] (e.g. AMPS[3]) or TDMA[4] systems (e.g. TIA/EIA-136 or GSM), CDMA promises easier frequency planning, higher channel capacity and greater immunity to fading. It offers optimized handoff procedures. CDMA base stations use Walsh codes to differentiate between users. The coded voice signal (9600 bit/s or 14 400 bit/s) is spread to a chip rate of 1.2288 Mchip/s. On the forward link (base station to mobile), QPSK[5] modulation is used, on the reverse link (mobile to base station) O-QPSK[6].

1) Code-division multiple access
2) Frequency-division multiple access
3) Advanced mobile phone system
4) Time-division multiple access
5) Quadrature phase-shift keying
6) Offset quadrature phase-shift keying

FIG 7 **The success story of CDMA began in San Diego in September 1989**

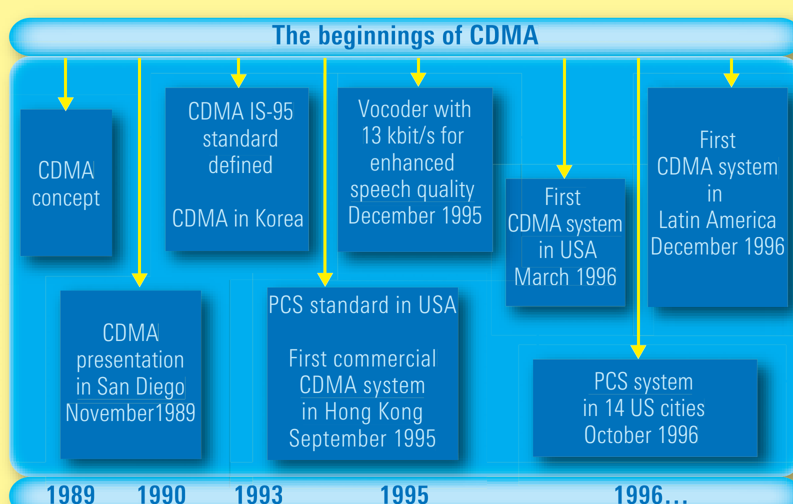


plate conforms to the TIA/EIA-98-C specification but can be modified by the user.

Modulation measurements

Assessment of modulation quality in CDMA is based on the above mentioned waveform quality. In addition to this, CMU 200 carries out in-depth modulation analysis of all essential parameters. It records, synchronizes and demodulates the test signal. From these data it generates an ideal reference signal and compares it with the DUT signal. From this it derives the error vector magnitude, the magnitude error and the phase error and presents them graphically versus time (FIG 4). These parameters as well as frequency error, carrier feedthrough and I/Q imbalance are statistically evaluated and the results displayed. Plus, a menu is available in which all scalar results are displayed in a list.

Receiver measurements

Receiver measurement is based on a comparison of the sent data stream with the data received by a mobile. A loopback is set up between CMU 200, acting as the base station, and the DUT. The mobile returns the incoming data to the tester. Any transmission errors occurring on the way from the mobile to CMU 200 can usually be neglected. In addition, any frames corrupted on this path are identified by a cyclic redundancy check and not taken into account.

CMU 200 comes with predefined receiver measurements. The **sensitivity test** determines at very low base station levels the sensitivity of the mobile's receiver, the **dynamic range test** examines at very high base station levels whether the mobile is overdriven. In the **traffic channel demodulation test** an additive white Gaussian noise (AWGN) signal is superimposed on the base station signal to simulate more mobiles transmitting at the same frequency.

For overview measurements, CMU 200 can run CDMA transmitter and receiver measurements simultaneously. The parameters can be set independently of each other. In this test mode, the long time taken by receiver measurements on the production line can be utilized for modulation or power measurements in parallel (FIG 5). Reducing this time is not possible as receiver quality measurements are realtime and a large number of frames have to be averaged to obtain conclusive results.

All relevant parameters of CMU 200 in its role as a base station simulator are user-configurable, for example traffic channel, PN offset, frame offset or the power control bits sent to a mobile.

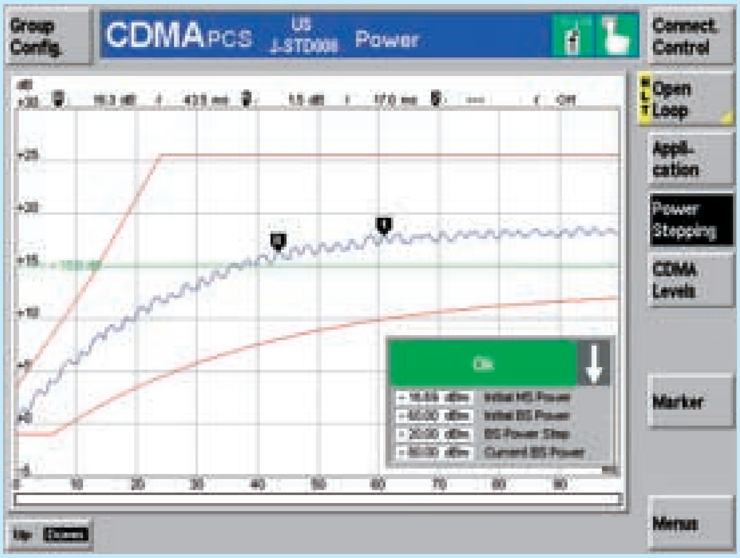


FIG 3 The open-loop time response measurement determines the CDMA mobile's reaction to sudden changes of output power from the base station

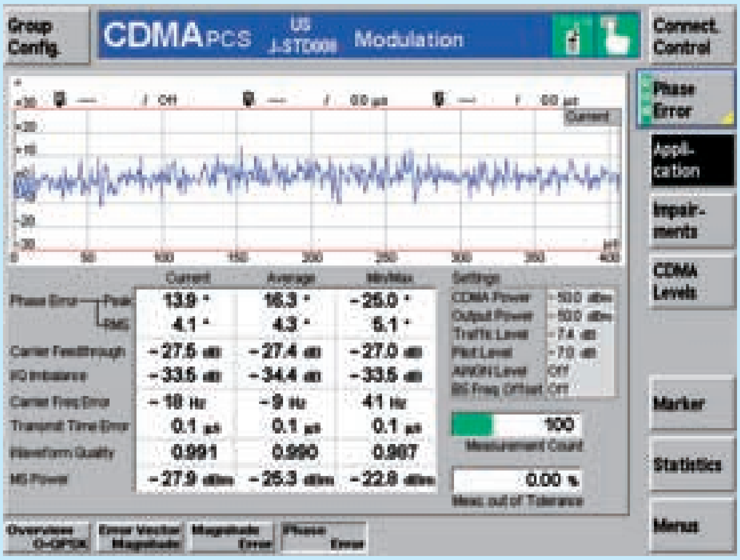


FIG 4 In modulation analysis, CMU 200 presents all results in clear-cut form. All scalar results are statistically evaluated and listed in a table, together with graphical presentation of phase error for example

CMU 200 of course performs implicit handoffs (e.g. RF channel, traffic channel, PN offset) during a call both within CDMA and to AMPS (FIG 6).

AMPS measurements

Especially in North America, practically all CDMA mobiles are offered with dual-mode functionality (CDMA and analog AMPS), so a radio communication tester like CMU 200 must also support this 1G standard.

AMPS functionality in CMU 200 features innovative concepts like multitone measurements to check AF frequency response at the mobile transmitter and receiver end [2].

CMU 200: test platform fit for future requirements

Thanks to their modular hardware and software concept, the CDMA options of CMU 200 today offer innovative technology on a test platform optimally prepared to handle future CDMA generations like cdma 2000.

Thomas Rösner

More information and data sheet at www.rohde-schwarz.com or enter 170/02 on reader service card

CD available free from your Rohde & Schwarz representative

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[1] Universal Radio Communication Tester CMU 200 – On the fast lane into the mobile radio future. News from Rohde & Schwarz (1999) No. 165, pp 4–7

[2] Universal Radio Communication Tester CMU 200 – Successful mobile radio tester now with US TDMA and AMPS standards. News from Rohde & Schwarz (2000) No. 168, pp 10–15

FIG 5 The overview menu allows simultaneous transmitter and receiver measurements

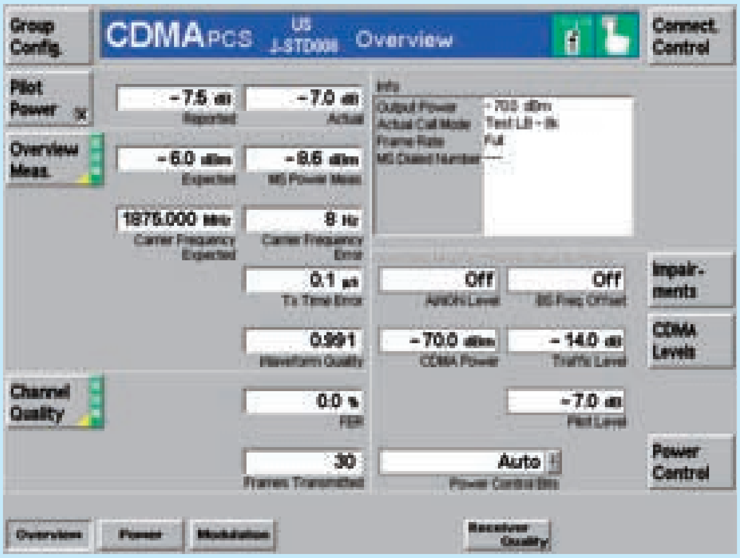
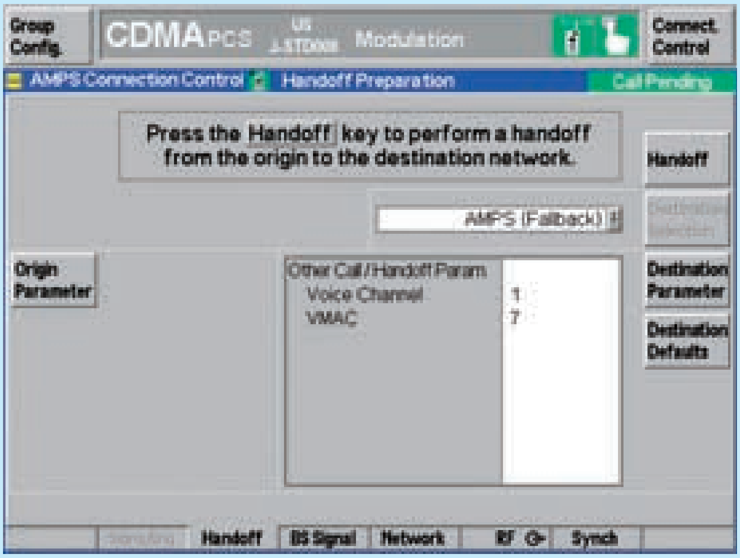


FIG 6 All parameters for handoff can be configured in a separate menu



Firmware options for Miniport Receiver EB 200

Coverage and field-strength measurements with the mini-receiver

Photo 43 687/1

FIG 1 EB 200 is ideally suited for indoor coverage measurements and mobile applications in vehicles

The optional DIGI-Scan enables Miniport Receiver EB 200 – the portable all-in solution for radiolocation [1] – to cover a wide RF spectrum from 10 kHz to 3 GHz. Two innovative firmware options now enhance the receiver's use for measuring field strength and coverage.

Highly versatile

Miniport Receiver EB 200 (FIG 1) and Handheld Directional Antenna HE 200 (FIG 2) make for easy radiolocation from 10 kHz to 3 GHz. Combined the two form a flexible, portable solution enabling the user to search for and monitor emissions, detect interference and locate the tiniest transmitters even in difficult terrain. Plus, EB 200 in a system rack is a favourably priced, compact handoff receiver for remote control on a LAN interface.

Besides the familiar EB 200 DS (DIGI-Scan), which detects even very short signals such as frequency hopping and bursts without difficulty, Rohde & Schwarz now presents another two firmware options: EB 200 FS for field-strength and EB 200 CM for coverage measurements.

Field strength

Together with suitable antennas, option EB 200 FS permits measurement of field strength. Besides level display in dBµV, EB 200 also indicates field strength in dBµV/m. All antennas with a known antenna factor in the useful frequency range are suitable. These factors describe the correlation between antenna output voltage into 50 Ω and electric field strength.

The antenna factors of the Rohde & Schwarz HE 200 antennas and of a half-wave dipole are already held in a data

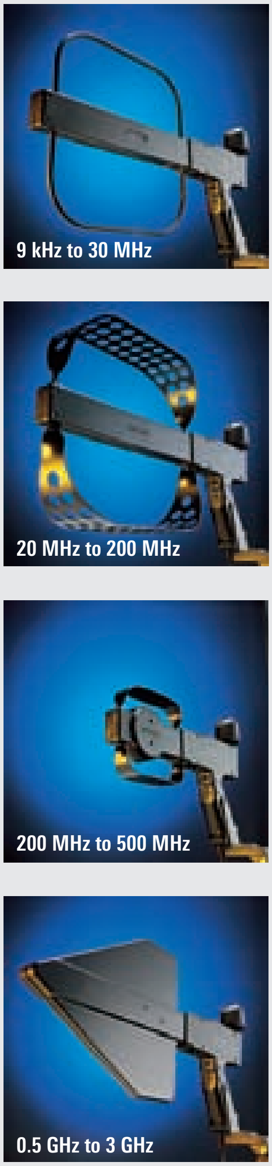


FIG 2 Active Directional Antenna HE 200 consists of four interchangeable RF modules

set in EB 200FS. The individual directional antenna modules can be operated both in passive and active mode. The halfwave dipole covers the range 9 kHz to 3 GHz.

If you select the number of an antenna for which there is already a data set, field strength in dBµV/m too is displayed on the left of the numerical level display. This presupposes that the receive frequency is within the range for which the antenna factors are defined (FIGs 3 and 4).

FIG 3 Field-strength display

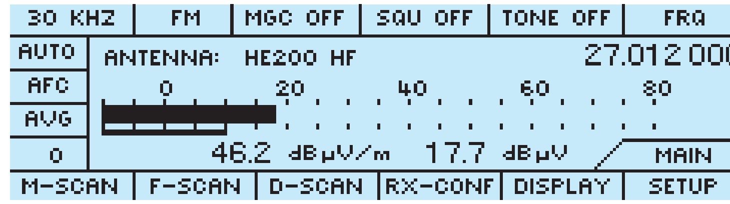
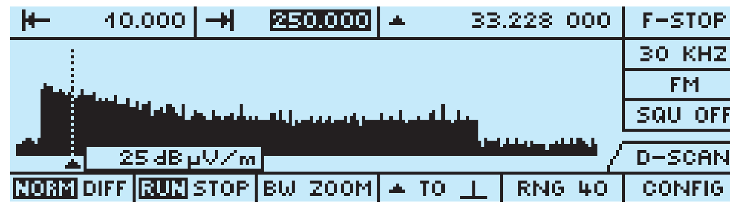


FIG 4 D-SCAN mode: levels are displayed in dBµV/m (Antenna HE 200, 20 MHz to 200 MHz)



User-defined antenna factors are entered on the remote-control interface using an Internet browser such as Internet Explorer or Netscape. You simply enter the IP address of the unit. After link setup, a Java application contained in the firmware is loaded via the browser from EB 200 to a PC or laptop and presents a straightforward menu (FIG 5).

Coverage

Firmware Option EB 200CM makes EB 200 a specialist for coverage measurements. This option is operated on the remote-control interface because such measurements involve a large volume of data.

In this mode EB 200 exhibits features far superior to those of common test mobiles:

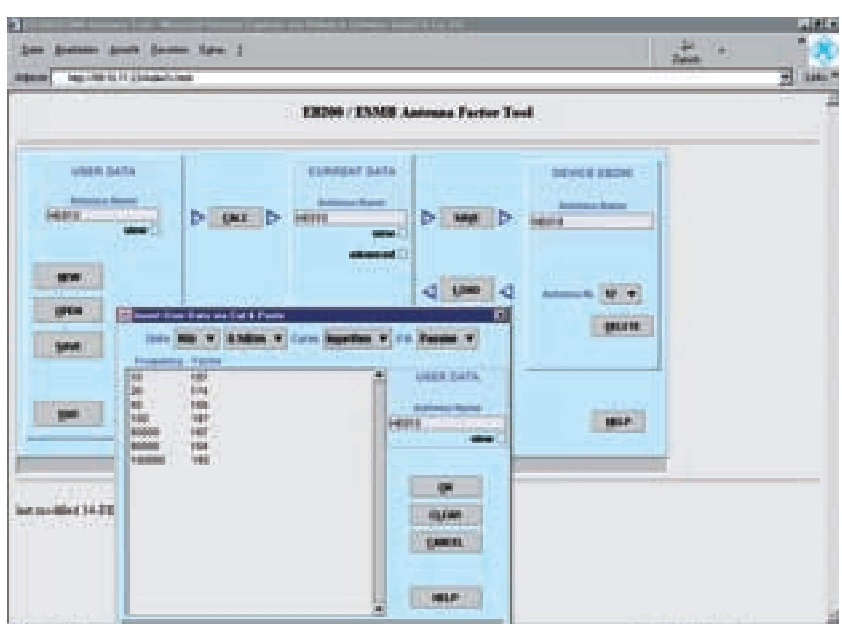


FIG 5 Menu for editing user-defined antenna factors

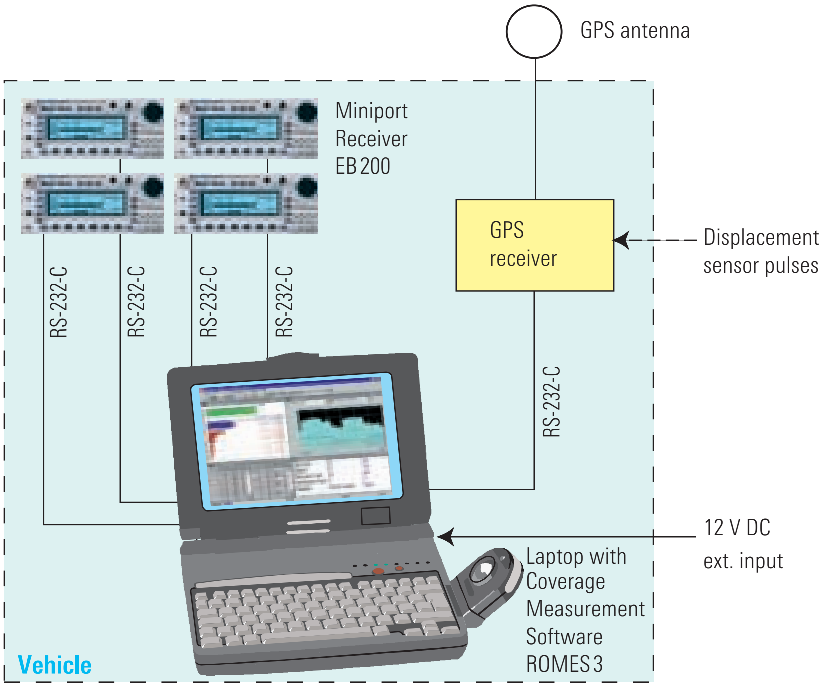


FIG 6 EB 200 is ideally suited for mobile applications too

- High measurement speed: test mobiles can handle two measurements per second; in single-channel mode EB 200 allows up to 2000 triggered level measurements per second on one frequency. In multichannel mode up to 200 measurements per second can be performed on a list of frequencies with any frequency hops.
- Minimum level error: test mobiles achieve approx. 4 dB; EB 200 is outstanding with approx. 1 dB.
- Many bandwidths: test mobiles provide one bandwidth only; with EB 200 up to 17 IF bandwidths can be set. This variety will play an important role in the future for narrowband measurements in the new UMTS (universal mobile telecommunication service) standard.
- The portable EB 200 is ideally suited for indoor coverage measurements. Other high-end test receivers are unsuitable for such purposes because of their size and weight.
- Settable measurement times (not possible with test mobiles).

EB 200 allows flexible adaptation to a variety of different measurement tasks. For this purpose it features two test modes, three level detectors and user-selectable measurement time.

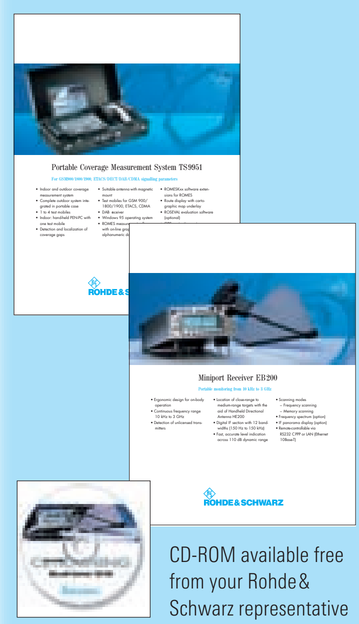
Level detectors for peak value (PEAK), average value (AVG) and realtime (FAST) can be activated in EB 200. In default mode, the preset times are selected so that precise measured values can be expected for the set IF bandwidth and level detection. In continuous mode, EB 200 queries and displays the current value of the level detector every 200 ms. In periodic mode, the measured values of the level detectors are deleted, new values determined and displayed, all in tune with the periodicity.

Bandwidth, demodulation mode, AGC, detector type and measurement time have to be set before embarking on single-channel measurements with the receiver. Up to 50 frequencies can be defined for multichannel measurements (triggered scan). All other parameters (bandwidth, detector type, etc) are set in the same way as for single-channel measurement. The trigger can be configured to external, internal or timer.

Together with Coverage Measurement Software ROMES 3 and Test System TS 9951[2], EB 200 with option EB 200CM is destined to play an important role as an allround receiver both for indoor coverage measurements and mobile applications in vehicles (FIG 6).

Theodor Fokken; Christoph Mügge

More information and data sheet at www.rohde-schwarz.com or enter 170/03 on reader service card



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[1] Miniport Receiver EB 200 and Handheld Directional Antenna HE 200: Radiomonitoring from 10 kHz to 3 GHz now with portable equipment. News from Rohde & Schwarz (1997) No. 156, pp 4–6
[2] Coverage Measurement Software ROMES3 – Acquisition, analysis and visualization of data in coverage measurements. News from Rohde & Schwarz (2000) No. 166, pp 29–32

Signal Analyzer FSIQ

Ready for all measurements on 3GPP base station transmitters

FIG 1
FSIQ offers extensive measurement functions in the frequency, time and modulation domain. With new options it can now handle all measurements on 3GPP base station transmitters

The selection of broadband CDMA for the third mobile radio generation created testing requirements that cannot or barely be met by conventional instrumentation. Signal Analyzer FSIQ (FIG 1) is now in shape for all measurements on base station transmitters defined by the 3GPP* standard.

EGDE measurements with Signal Analyzer FSIQ see page 21

* 3GPP: 3rd generation partnership project

Signal analyzer for all mobile radio generations

Measuring the power and transmission quality of individual subscriber signals is of particular importance in 3GPP systems. All subscribers use the same frequency and are only distinguished by different spreading codes, so the analyzer must first despread the individual channels to measure power and transmission quality. For these measurements – but also for all others on the base station signals specified by the 3GPP standard – the capabilities of FSIQ can be enhanced by adding a DSP and I/Q memory (option FSIQ-B70) and 3GPP application firmware (option FSIQ-K72).

The new firmware combines all important transmitter measurements to 3GPP TS 25.141 in one menu and extends the measurements configured with the basic unit by tests in the code domain. FIG 2 gives an overview of all 3GPP TS 25.141 measurements and of the appropriate equipment required in FSIQ.

Measurements in code domain

Power of code channels

Accurate measurement results in the code domain are essential for correct working of CDMA transmission systems because the signal quality depends not only on power, spectral purity and modulation quality, like in TDMA systems, but also on power parameters and the modulation quality of the other code channels. For this reason all subscriber channels have to be included in the measurement. With the new firmware, FSIQ supports all measurements in the code domain. It evaluates a signal section of 20 ms (corresponding to two WCDMA frames) under all relevant aspects. The only information the analyzer requires for this is the number of the scrambling code used for signal encryption. A trigger signal from the DUT (frame trigger) reduces the measurement time but is not essential.

FSIQ searches for a complete WCDMA frame in the stored signal section, measures the power of the individual code channels versus the timeslots and displays the result as a histogram over channel number. It automatically determines the symbol rate and a possible timing offset of the various occupied channels. The width of the histogram bar gives a fast overview of the symbol rate of a channel. But FSIQ also shows it as a numeric value together with the timing offset (FIG 3).

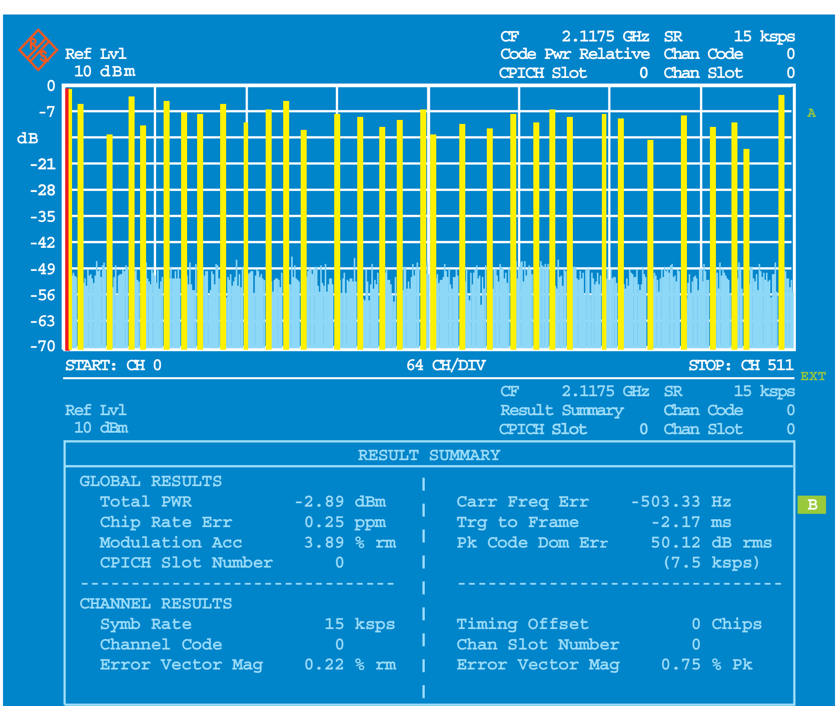
In addition to the slot-specific power histogram, measurement results for the global signal and a specific channel are numerically displayed. Thus, results for total power, modulation accuracy or EVM (error vector magnitude) and frequency error of the global signal as specified by 3GPP can be seen at a glance. In the default setup, the CPICH (common pilot channel) is selected as the code channel to be displayed so that its power can be determined with the aid of the marker. So FSIQ produces the major parameters of the global signal and the code channel to be investigated, e.g. the CPICH, at a keystroke.

Measurement	Section in TS25.141	FSIQ basic unit	FSIQ with FSIQ-K72
Base station maximum output power	6.2.1	✓	
CPICH power accuracy	6.2.2		✓
Frequency error	6.3 and 6.7.1		✓
Power control dynamic range	6.4.3		✓
Total power dynamic range	6.4.4		✓
Occupied bandwidth	6.5.1	✓	
Spectrum emission mask	6.5.2.1	(✓)	✓
Adjacent channel leakage ratio (ACLR)	6.5.2.2	✓	
Spurious emissions	6.5.3	✓	
Error vector magnitude (composite EVM)	6.7.2		✓
Peak code domain error (PCDE)	6.7.3		✓

FIG 2 Measurements to 3GPP TS25.141 supported by FSIQ alone (basic unit) or together with option FSIQ-K72

To simplify and speed up measurements, the channel models defined by 3GPP can be preset. As a result even special channels like the paging indication channel (PICH) are considered in the result calculation. This reduces the synchronization time because FSIQ need not search through the whole code range for occupied channels.

FIG 3 Display of code power and numeric parameters of global signal and user-selectable code channel



Power control in code channel

An important condition for high CDMA network capacity is accurate power control in the individual subscriber channels. Since all subscribers are potential interferers for a specific code channel, minimum transmitted power is aimed at for undisturbed operation. This is ensured in 3GPP WCDMA systems by the transmitter resetting the power in every time slot, i.e. every 625 µs. TS25.141 specifies very narrow tolerances for the relative power in a code channel. Since FSIQ always evaluates a whole frame (15 slots), it can determine the power levels of a channel from the same data record as all other parameters. A new measurement is not required.

FIG 4 shows the power levels of code channel 17 (marked in red in the code domain display) for one frame. The power-versus-slot measurement is ideal for analyzing the 1 dB or 0.5 dB power control steps specified in section 6.4.3 of TS 25.141.

Versatile, fast, accurate

Besides a whole variety of functions for code domain analysis, FSIQ is notable for its high measurement speed and accuracy. It takes less than 3.5 s to analyze a complete frame without external triggering and obtain all the results that can be derived. Results for the global signal and the code channels are calculated from the same data record. No recalculations are performed after switchover to another result display, only available measured values are shown. This guarantees high measurement throughput in production and convenient working in the design phase when looking at signals from various aspects.

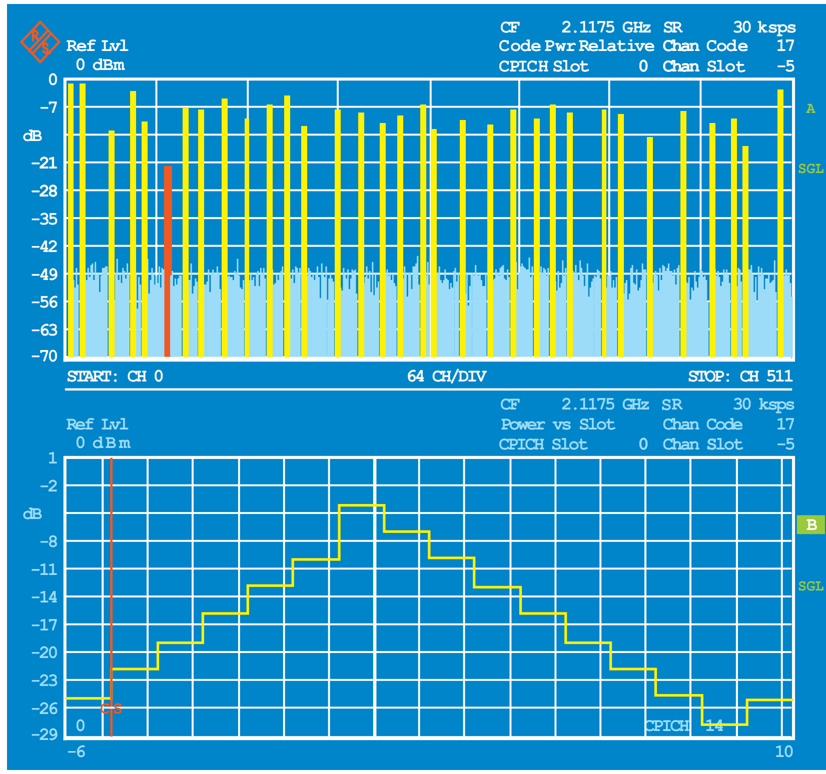


FIG 4 **Display of code domain power (top) and slot-specific power of code channel over frame**

With an absolute level measurement uncertainty of <0.7 dB for code power and a relative uncertainty of <0.1 dB, FSIQ surpasses 3GPP requirements. The wide dynamic range and low phase noise cause only slight errors in modulation measurements. Instrument inaccuracy for EVM measurement of the global signal is <1.5%, the display inaccuracy for the peak code domain error <–60 dB.

FSIQ also offers measurements in the code domain extra to those of the standard. This allows valuable signal examinations during design providing more insight into the functionality of base stations and their modules. It evaluates the various code channels, for example, and displays their symbol constellation, the error vector magnitude at symbol level (peak and rms) or bits over slot.

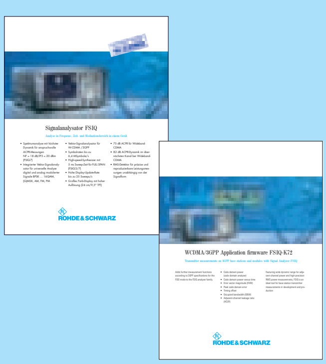
Multistandard

Wide dynamic range, high measurement accuracy and new functions make FSIQ the ideal analyzer for all mobile radio generations. It meets or even surpasses the most stringent requirements, even those for measurements on base station transmitters.

With option FSE-K11 it supports the 2nd generation, with FSE-K21 generation 2.5 and with FSIQ-K72 now 3G. All application packages can be simultaneously installed on FSIQ, producing a versatile multistandard platform.

Anke Pintschovius; Josef Wolf

More information and data sheet at www.rohde-schwarz.com or enter 170/04 on reader service card



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Spectrum Analyzers FSP/FSU

GSM and EDGE measurements with Application Firmware FS-K5

Photo 43615/1

FIG 1 With its high measurement speed and accuracy, Spectrum Analyzer FSP is not only the right tool for general-purpose applications but also an ideal choice for production needs

GSM, EDGE, HSCSD, GPRS, 3π/8 shifted PSK – GSM evolution calls for new or modified measurements on the RF signal. Application Firmware FS-K5 for measurements on transmitted GSM/EDGE signals keeps you firmly in touch with all the new developments. Plus FS-K5 combines flexibility for development with very high measurement speed in production.

Keeping pace with development

The increasing demand worldwide for bandwidth and attractively priced mobile communication means that there will be further expansion of GSM mobile radio networks over the next few years. Besides increased capacity through denser networking of base stations, developments point to higher data rates by expanding GSM to HSCSD (high-speed circuit-switched data) and GPRS (general packet radio services) and subsequently EDGE, which increases the bit rate by a better grade of modulation at the same bandwidth.

HSCSD and GPRS provide the user with several timeslots and so optimize data throughput. Instead of GMSK modulation, EDGE (enhanced data rate for GSM evolution) is based on an 8PSK method with the same symbol rate as GSM, but with three transmitted bits per symbol instead of one as in GSM.

Application Firmware FS-K5 for measurements on transmitted GSM/EDGE signals updates to match these developments. Plus, it combines plenty of flexibility for design needs with the very high measurement speed you need in production.

What the user expects

Both development and production are confronted with the need to design, manufacture and test more products faster and more cheaply. Measuring instruments for development purposes should feature intuitive operation, be preset for GSM standards, user-configurable and good value for money.

Production requires precise measuring instruments that are fast and flexible to remotely-control, and provide test routines at optimum speed. And these instruments must remain compatible in their remote-control command sets and operating philosophy over several generations.

This is exactly where Application Firmware FS-K5 comes in with its advantages for efficient GSM and EDGE measurements on modules and complete terminals.

Measurement	Explanation
Phase / Frequency error	With synchronization to midamble
Modulation accuracy	EVM, 95:th-percentile value, origin offset suppression and frequency error with synchronization to midamble
Carrier power	Without midamble reference
Power versus time	Carrier power versus time and carrier power itself with synchronization to midamble
Spectrum due to modulation	
Spectrum due to transients	
Spurious emissions	

These measurements are possible with FS-K5

Application Firmware FS-K5 "GSM mobile station test"

The newly developed Application Firmware FS-K5 is suitable for all spectrum analyzers of the FSP [*] and FSU * families. Thanks to their high measurement accuracy and reproducibility of results, these instruments ensure higher throughput in production and, last but not least, also in the laboratory.

* The new Spectrum Analyzer FSU will feature in the next issue.

FSP (FIG 1) is thus an excellent basis to perform ETSI-specific measurements on mobiles together with FS-K5. If you run the software on FSU, the outstanding features of this high-end analyzer, such as an extremely wide dynamic range, excellent noise figure and higher display resolution, go into the measurement.

Despite the variety of measurement functions, the user interface can be operated intuitively, the menu depth is very low (maximally one submenu), making familiarization fast and easy (example in FIG 2).

All measurements relevant to ETSI standards can be carried out on the physical layer at a keystroke, manually or via the IEC / IEEE bus. There is a softkey for each measurement that, when first activated, presents the parameters for each measurement ready set according to GSM standards (FIG 3).

The usual parameters available on spectrum analyzers are, as in the basic unit, user-configurable by hardkeys and softkeys. Manual setting of optimum level and trigger reference, which is time-consuming and requires lots of experience, is no more – the software sets them automatically and optimally at a keystroke.

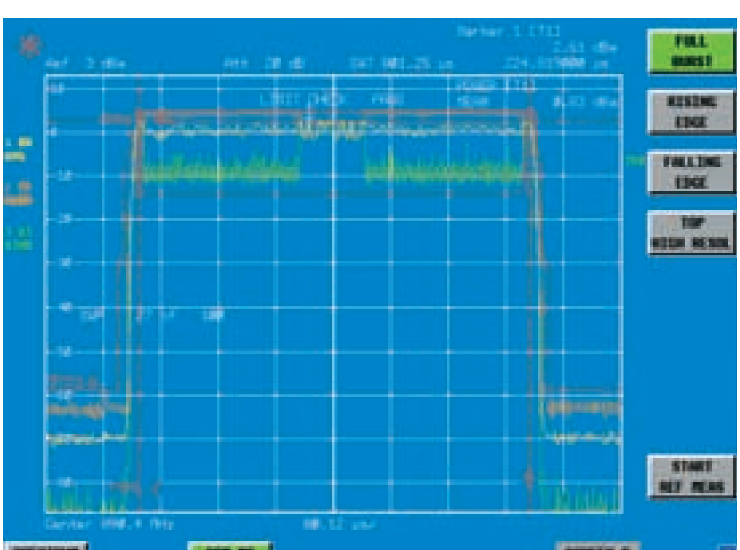


FIG 2 Power versus time measurement of EDGE burst

FS-K5 comprises the most important limit lines of the ETSI standards. You can modify them or add those you define yourself.

Multislot, speed and external trigger

Both single- and multislot measurements are supported (see table for overview). So it is possible to measure the phase/frequency error in one of four active slots of a mobile phone. Determining the spectrum due to modulation ▶

(ARFCN ±1.8 MHz, four active slots), which used to be a time-consuming procedure, is very much accelerated thanks to this feature (ARFCN: absolute radio frequency channel number).

Measurement speed in remote control is enhanced yet again compared to the already excellent high speed under manual control. The previously mentioned measurement of the spectrum due to modulation takes less than eight seconds by averaging over 200 bursts, which signifies a considerable increase in production throughput. The testpoints of measurement of the spectrum due to modulation can, of course, also be expanded beyond ARFCN ±1.8 MHz at 200 kHz spacings.

Mobiles do not usually provide any external triggers. But ETSI specifications say that measuring the spectrum due to modulation in the whole band has to be gated, i.e. triggered so that only a specific burst section is considered. Option FS-B6 (a broadband and sensitive RF power trigger) solves this problem: you no longer need an external trigger, even when measuring in the whole band and beyond. This applies both to GSM and EDGE.

The user can choose whether to display the results as a curve or in tabular form showing ETSI or user-specific limit values. Some measurements even allow both types of display. The software automatically compares measured results with the set limit values, displays PASS, MARGIN or FAIL and marks the associated values in a result table (FIG 4).

All this, plus the possibility to run the software fully compatible on several instrument series exploiting their individual characteristics, makes Application Firmware FS-K5 the ideal choice for every development lab and production line.

And FS-K5 is future-oriented – the evolution from GSM to 2.5G is already in there.

Johannes Steffens

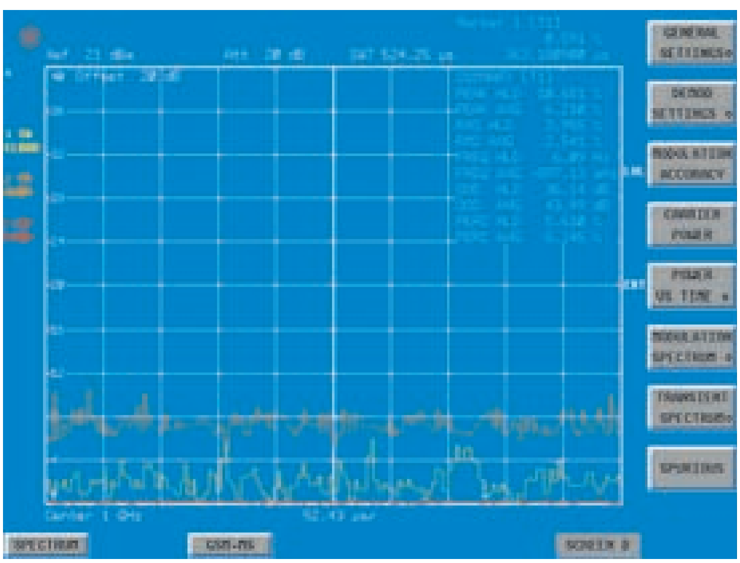


FIG 3
Measuring modulation accuracy

FIG 4
Display of results measured for spectrum due to modulation

More information and data sheet at www.rohde-schwarz.com or enter 170/05 on reader service card

REFERENCES

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

EDGE measurements with Application Firmware FSE-K20/K21

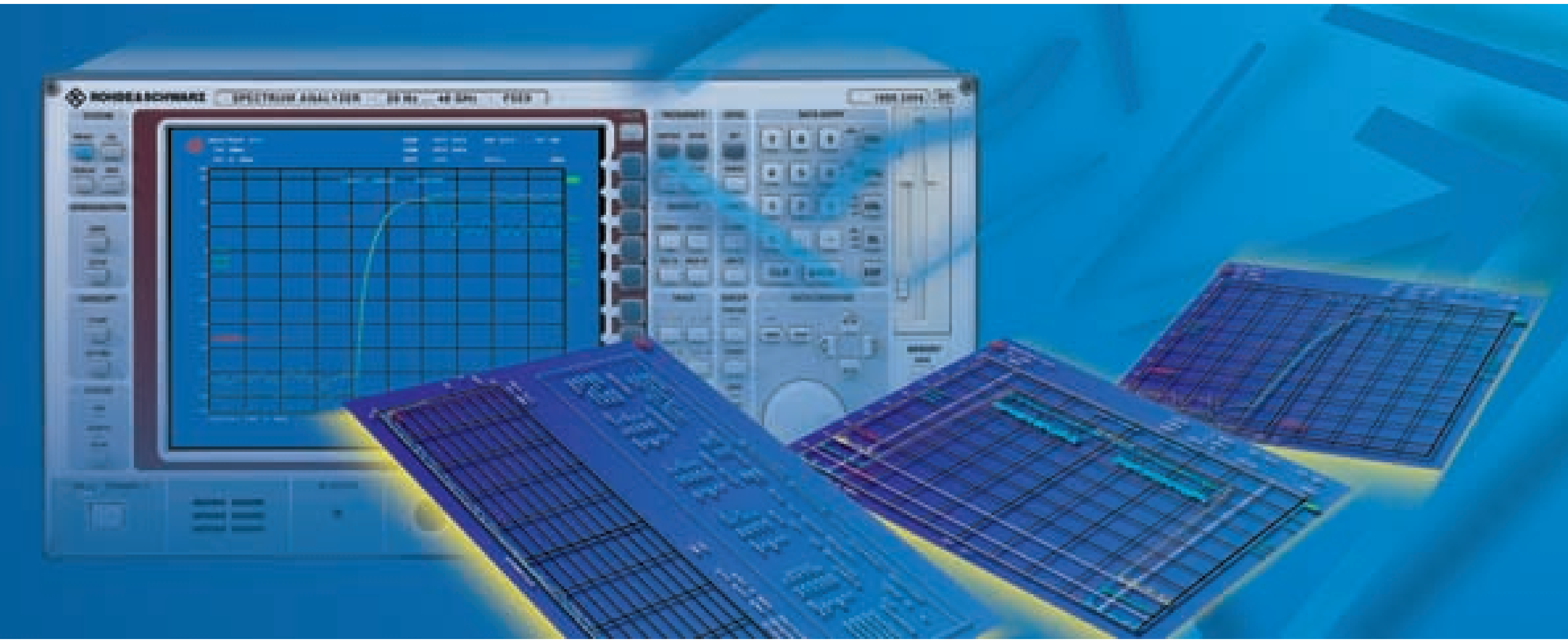


Photo 43636/1

FIG 1 New Application Firmware FSE-K20/K21 adds capability for measuring EDGE signals to Spectrum Analyzer FSE (photo) and Signal Analyzer FSIQ

Application Firmware FSE-K20/K21 adds capability for measuring EDGE signals to ETSI standards to Software FSE-K10/K11 [1] for instruments FSE (FIG 1) and FSIQ. FSE-K20 covers measurements on mobile phones, FSE-K21 is aimed at base stations.

New application firmware – moving up from GSM to EDGE

FSE-K10 (GSM measurement software for mobiles) and FSE-K11 (for GSM base stations) are used in many test setups in development and production and run on all Spectrum Analyzers FSE [2] and Signal Analyzers FSIQ [3]. This tried and tested software can now be enhanced by Application Firmware FSE-K20 and FSE-K21.

The new firmware adds capability for measuring EDGE signals to ETSI standards (EDGE is an extension of the GSM standard, see page 23). FSE-K20 performs measurements on mobile phones, FSE-K21 on base stations.

In terms of manual operation and remote control, the firmware integrates seamlessly into FSE-K10/K11, so virtually no familiarization is necessary.

Users of FSE-K10 for example, after installing the new firmware, will still find all the measurements they are used to: carrier power, power versus time, modulation spectrum, transient spectrum and spurious. Additionally, they are presented with a few softkeys to access EDGE-specific settings and measurements.

There will now be a softkey to select the modulation mode for example. If you choose EDGE, measurement of modulation accuracy is offered instead of phase and frequency error (see modulation accuracy example in FIG 2). All input options and configurations of FSE-K10 are also available for EDGE signals. This applies analogously to interplay of

EDGE – taking GSM further

EDGE (enhanced data rate for GSM evolution) is the follow-on development of the GSM standard to higher data rates while maintaining symbol rate, frame structure and occupied bandwidth. For this purpose, 8PSK modulation (8 phase shift keying with 3 bit/symbol) is used instead of GMSK modulation (Gaussian minimum shift keying with 1 bit/symbol), increasing the theoretical data throughput by a factor of 3. To avoid zero crossings of the PSK transmit signal in the complex modulation level, the coordinate system is shifted in the modulator by $3\pi/8$ after each symbol (phase offset modulation, FIG 3). The dynamic range of a signal is thus reduced to approx. 16 dB in the region of the useful symbols of a burst (FIG 4).

To estimate the channel impulse response in the running network, midambles are used. They are very similar to GSM midambles, but exhibit a reduced dynamic range of approx. 4 dB compared to its data symbols so that transmitter nonlinearities will not exert much influence on channel estimation at the receiver end.

FSE and FSIQ measuring instruments use an 8PSK demodulator after equalizing receive filtering. The EDGE signal is first synchronized and by means of post-filtering converted to a $3\pi/8$ shifted 8PSK-modulated signal free from intersymbol interference. Sampling the symbol times produces a constellation diagram typical of PSK with concentrated dots. This demodulation and display are particularly suited for initial overview measurements and troubleshooting on modules and components.

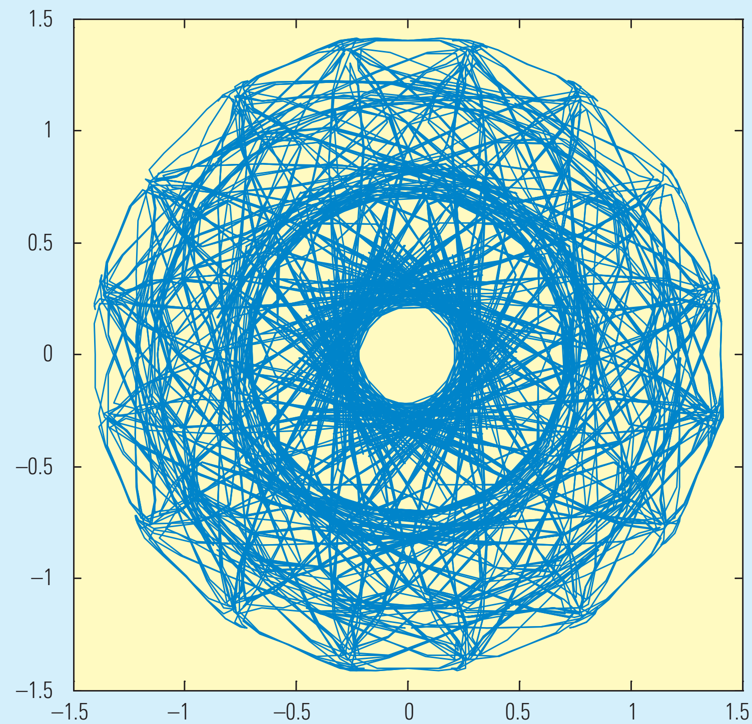
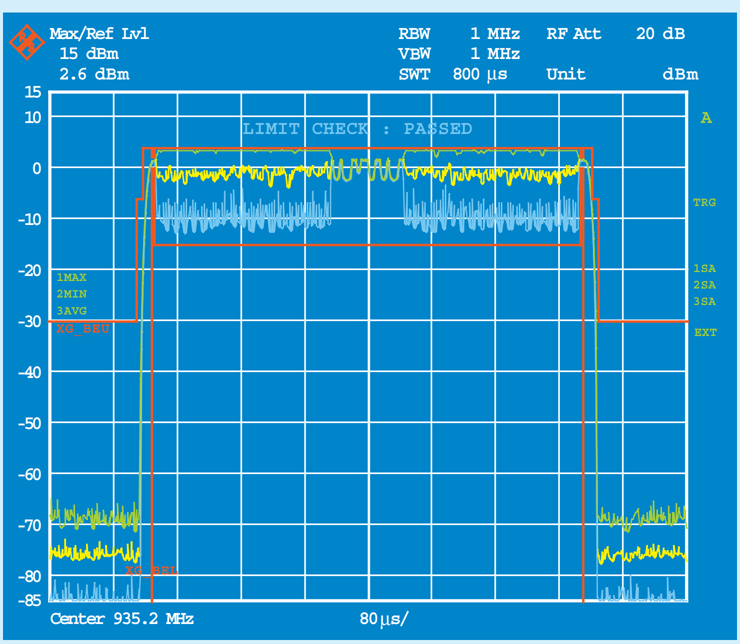


FIG 3 IQ diagram of transmitted EDGE signal

In contrast to measurements on GSM signals, the relevant measurement parameter for EDGE is error vector magnitude (EVM). This is the difference between the vectors of the measurement signal and an ideal reference signal regenerated by demodulating the receive signal.

For measurements to ETSI standard, the EDGE signal and the associated reference signal must be applied to an additional weighting filter [4] prior to a further phase in which other error parameters, besides the timing of the measurement signal, are optimized so that the rms value of the error vectors (weighted by average burst power) is minimized [5]. Despite such compute-intensive optimization, FSE and FSIQ produce a result with a length of up to 800 symbols for an EDGE or $3\pi/8$ shifted 8PSK signal.

FIG 4 Power versus time display of EDGE signal



the FSE-K11 measurement software for base stations with Application Firmware FSE-K21.

When you select the modulation mode, all limit values specified in the standards are of course selected too. The ETSI standards are integrated into the firmware, so all measurements with their limit values can be made to standard at a keystroke. The EDGE limit values of ETSI standards GSM900, 1800 and 1900 as well as their specific midambles are provided for instance.

The limit values to be used often depend on the current power. The firmware automatically measures this reference power and selects the standard-conformant limit values.

Like FSE-K10/K11, the new firmware is constantly matched to advances in ETSI standardization. This saves users a lot of time, because they do not have to read and interpret the standards or enter all the changed limit values in their instrumentation.

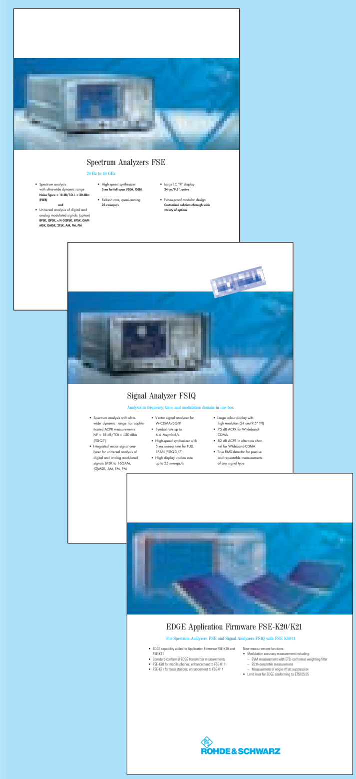
The results of the new measurements are displayed just as detailed and clearly as with FSE-K10/K11. It goes without saying that the instrument sets up automatically and optimally when starting a measurement.

Remote control, important in production, has been extended by EDGE functionality. The remote-control commands are fully compatible. The previous remote control will continue to work without any changes. Evolution from GSM to 2.5G is consequently now available for users of the FSE and FSIQ instrument series.

Hagen Eckert; Johannes Steffens

Further reading on FSIQ: Measurements on base station transmitters to 3GPP standard (page 15)

More information and data sheet at www.rohde-schwarz.com or enter 170/06 on reader service card



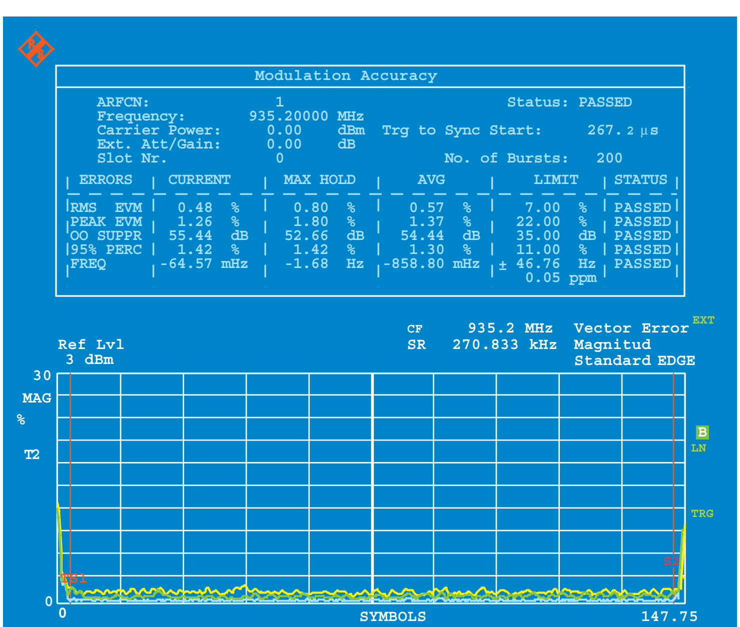


FIG 2
Measuring modulation accuracy

REFERENCES
[1] Application Firmware FSE-K10/K11 simplifies measuring RF parameters of GSM transmitters. News from Rohde&Schwarz (1998) No. 157, pp 29–30
[2] Spectrum Analyzer FSEM/FSEK – Fast spectrum analysis now through to 40 GHz. News from Rohde&Schwarz (1996) No. 152, pp 7–9
[3] Signal Analyzer FSIQ – The ideal analyzer for the third mobile-radio generation. News from Rohde&Schwarz (1998) No. 160, pp 4–6
[4] Draft ETSI EN300910 V8.5.0 (2000-07) 4.6.28: PSK Modulation
[5] Draft ETSI EN300910 V8.5.0 (2000-07) Annex G: Calculation of Error Vector Magnitude

Web over DTV

Broadcasting and the Internet: convergence through new applications

Photo 43693

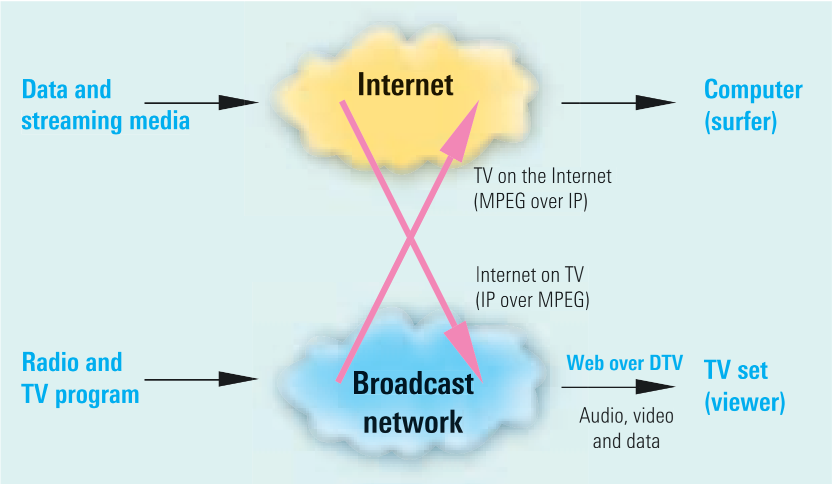
Web over DTV is a convenient and cost-effective solution for distributing Internet resources to TV viewers, for example, and enabling TV providers to integrate extra services into their programs [*]. This article describes a number of new services and applications that will make a major contribution to the success of digital TV (DTV).

Two media go new ways together

Telecommunication and digital broadcasting are growing closer. Internet providers are gearing up to distribute digital broadcast programs (Internet broadcasting). But digital TV networks are also able to transmit information and data from the Internet together with their programs (FIG 1).

Web over DTV is a versatile solution for adding data to digital TV programs.

FIG 1 Convergence of the Internet and broadcasting: the two media promise to match very well



The success of DTV will not only be advanced by the improved quality of digital transmission but also by new services and applications.

Numerous new applications

Internet-based techniques and contents linked to digital TV in various applications:

Digital broadcasting networks as a secondary distributor for Internet content
Digital broadcasting networks offer channels for distributing Internet content. In this way viewers can be reached who are not connected to the Internet. According to an online study by public broadcasters in Germany, these are as many as 70% of the TV audience.

Broadcasting Web-based program information
TV broadcasters could broadcast Web-based information together with their programs, e.g. electronic TV journals. An electronic guide for the programs of several broadcasters could also be transmitted. Broadcasters can add their own Web sites to their communication offering.

Combination of t-commerce and e-commerce
Extra information may be sent in parallel with topical programs or commercial spots. Interested viewers can call this information by a keystroke without long loading times. Access to the Internet is only required for online orders. The user may navigate through the selected information through what is called *local interactivity*.

Distribution of video and computer games
Games for consoles and computers enjoy increasing popularity. Why not send these games via DTV? Distribution channels can be optimized in combination with chargeable access codes or cards.

Localized advertising
The possibility of inserting data services between the play-out center and the transmitter system also allows implementation of local and regional advertising. Advertising can be adapted to customers and local factors. Local data service studios dynamically produce current information and content.

Localized information
Traffic reports, breaking news, local information, etc can be inserted into over-regional broadcasting.

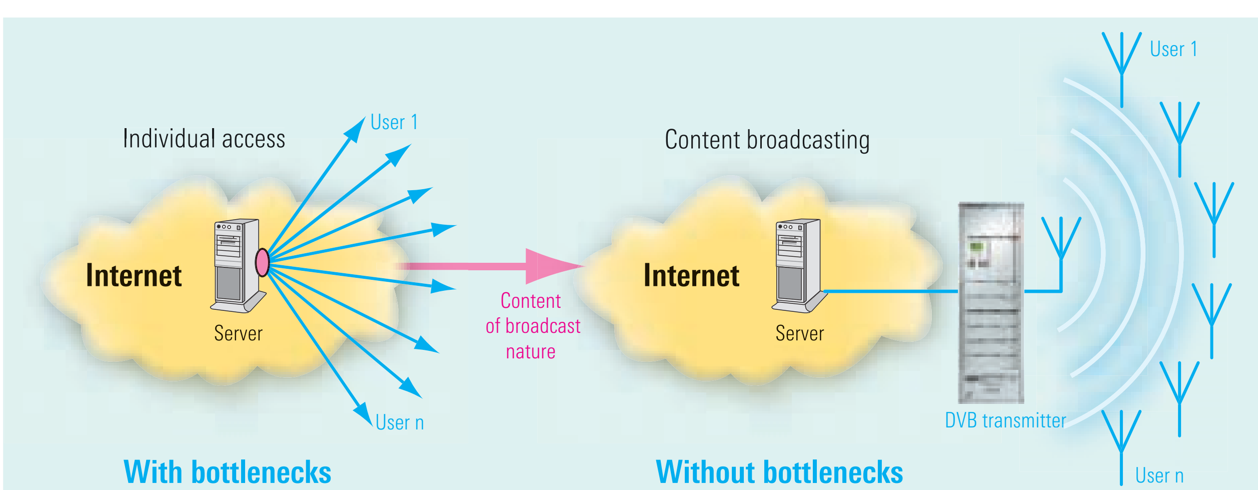
Seeing that terrestrial digital television (DVB-T) and digital radio broadcasting (DAB) are also suitable for mobile applications, the services and information can also be accessed from vehicles and public transportation.

Reception of streaming media from the Internet
Animated Internet video and audio programs can be broadcast in addition to static content. In this way Internet radio and TV stations can be received by radio and TV sets. Localized advertising and information can be enriched by short video clips added as Internet streaming.

Corporate networks with DVB
Corporations with many subsidiaries and offices in a region or city can use digital broadcast networks to supply information and updates (catalogs, price lists, etc) to their various sites.

Broadcasters themselves can use their infrastructure to distribute inhouse information and communicate with all their sites. The components of digital broadcasting systems can thus also be controlled and monitored like in a local network (see article on page 27).

FIG 2 **Broadcasting is more effective than the Internet for distributing broadcast content**



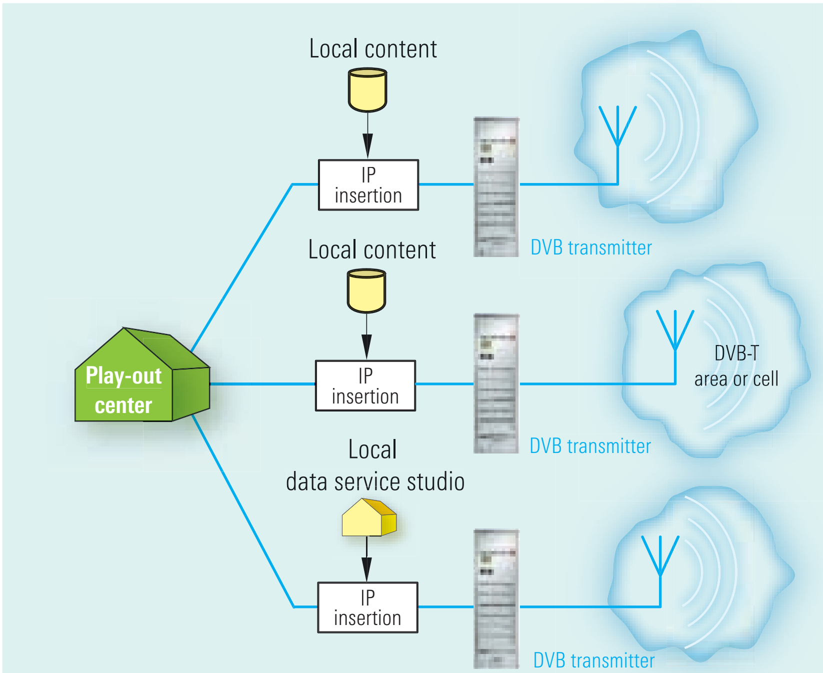


FIG 3 Local and regional data services using DVB-T

In future also over DAB

In Web over DTV Rohde&Schwarz offers a powerful and future-oriented system for datacasting that will be continually improved and produce solutions for other broadcasting techniques like DAB.

Torsten Jäkel

No backward channel required

A backward channel, like in Internet-based applications, is not absolutely necessary. If the emitted content is of a broadcasting nature and the terminal equipment has sufficient memory for storing the received content, such systems for transmitting Internet information can be optimally used (push service, FIG 2).

A backward channel can of course be integrated in these systems, e.g. existing solutions like the telephone or mobile radio network. But new methods like backward channels via terrestrial links (DVB-RCS) can also be used. Such a backward channel links a terminal to the central control element of a service, the data server. The actual insertion of data content (IP insertion) is independent of this.

Providing a backward channel does not mean pushing use of the broadcasting architecture for highly individualized communication (poll service) to the fore. The content and services offered and thus the kind of utilization (broadcasting versus individual point-to-point communication) are decisive for the success of the system, not the technical possibilities.

Regionalized services

Regionalized applications can be implemented particularly in terrestrial broadcasting (DVB-T) or Web over DTV in cable television networks (DVB-C) (FIG 3). The systems for adding the data need not necessarily be in a central studio anymore. They can be installed direct at transmitter sites and CATV headends or may even be part of local transmission equipment. In this case the Internet is used to distribute and feed the content. Since the sites can very easily be reached by the Internet, a powerful and integrated distribution structure results for services and content.

More information and data sheets at www.rohde-schwarz.com or enter 170/07 on reader service card

REFERENCE
[*] Web over DTV – Cost-attractive service through DVB: Transmission of extra data in Web format. News from Rohde&Schwarz (2000) No. 166, pp 18–19

NetLink

Remote control and monitoring of transmitters on the Internet

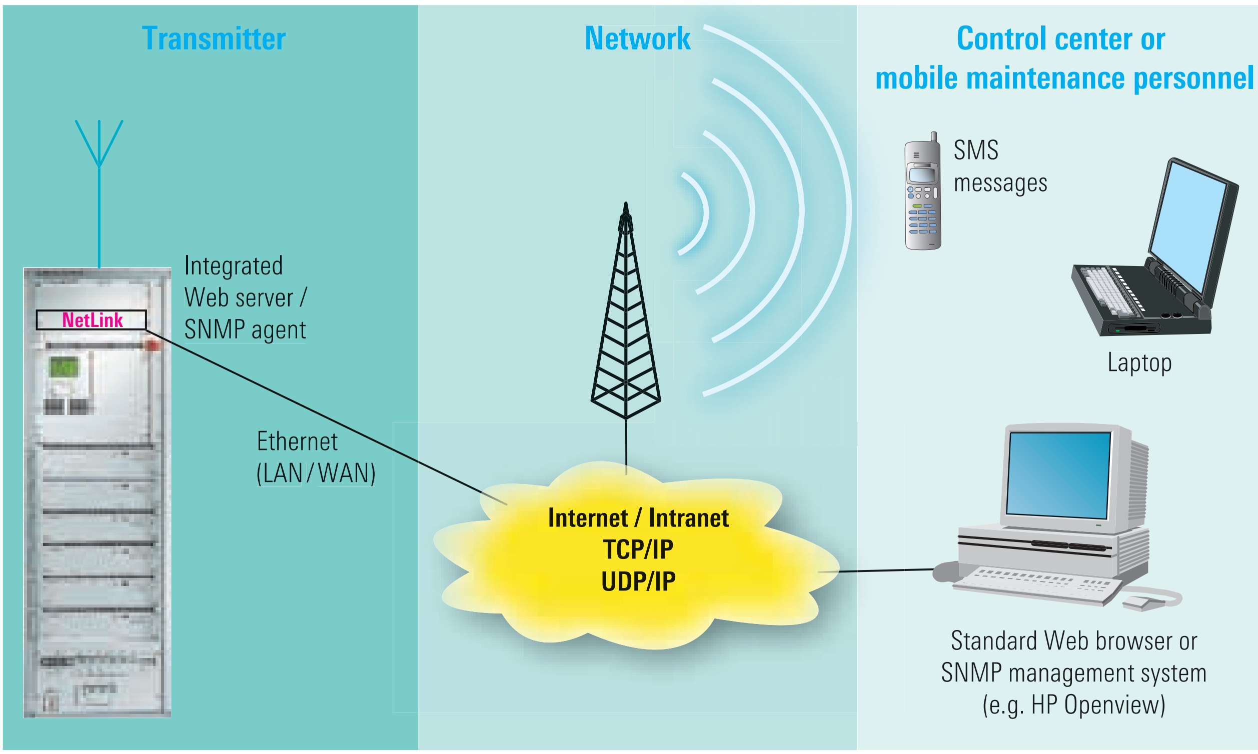


FIG 1 Example of linking a transmitter through the Internet

With NetLink, Rohde & Schwarz is worldwide the first transmitter manufacturer to offer an essential module for service-oriented, standardized remote control and monitoring of broadcast equipment units.

Access to all components

The future-oriented concept of NetLink meets both, the requirements of a control center and the expectations of decentralized mobile maintenance personnel. The integrated Web server allows access to components of broadcast equipment from the World Wide Web. An SNMP agent ensures connection to a full-coverage network management system and the powerful API (application interface) is the base for future tasks in component-based applications. NetLink is designed as an open platform, so it is the ideal solution even for other components of broadcast equipment in addition to analog TV, DVB-T, DAB and FM transmitters.

NetLink is perfectly integrated in the new TV transmitter family NX7000, which has established itself worldwide as a reference product for terrestrial broadcasting [*], in no small part because of features that guarantee 24-hour operation such as high reliability, integrated redundancy and ease of maintenance.

The new transmitter technology provides all the conditions required by network operators to fully meet all market requirements. Against a background of deregulation, the convergence of broadcasting and telecommunications and the rapidly advancing implementation of digital (DVB-T and DAB) transmitter networks, network operators are facing completely new challenges.

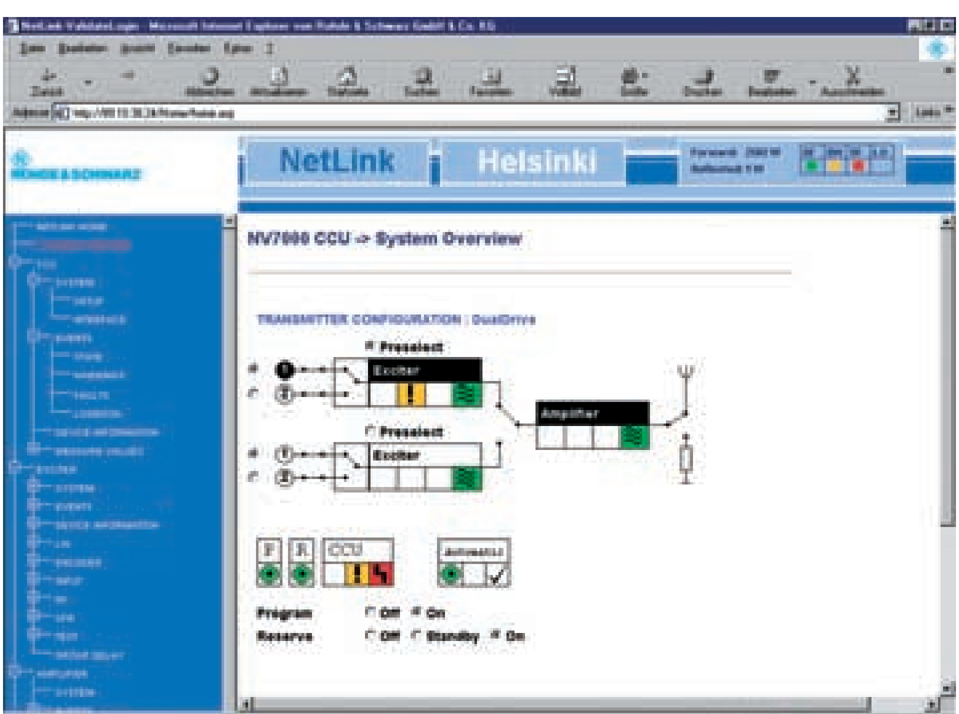
A growing number of stations are unmanned for reasons of cost, but content providers ask in more and more constrictive agreements for network availability that in unattended stations can only be achieved with a mature and future-oriented concept for remote control and network monitoring. In this connection one has to remember that as a result of liberalization different network operators often share one transmitter site, so monitoring a complete station may not always be the right solution.

Remote control and monitoring of transmitter systems concentrates on the following three basic requirements:

- Visualization of all components (globally for the control center and in detail for maintenance personnel)
- Reporting (availability data, error statistics, configuration)
- Information (event-triggered alarms from the transmitter to a control center or directly to maintenance personnel)

This is where NetLink comes in with its comprehensive solutions. Since most transmitter stations are at exposed locations and difficult to reach, automatic error signalling and the possibility of detailed remote analysis are essential requirements for a fast and efficient deployment of maintenance. Standard network protocols (TCP/IP and UDP/IP) running on the available infrastructure (LAN, WAN, Internet via analog or ISDN telephone lines or GSM) can be used for communication between the personnel (client side) and the system (server side). A major advantage of this is that standard software (Web browser or SNMP management platform) can be used at the client end instead of the previous proprietary solutions that require intensive development and whose reusability is low.

FIG 2 A standard Web browser gives access to all data of the transmitter system



NetLink is an important link to future-oriented Web over DTV technology. It is installed at the handover points to the broadcast networks and provides the availability information required for content transmission to subscribers (content routing). Further applications are described in the feature article on page 24 ff.

Web interface

The Web server integrated in NetLink enables direct access to system data through a conventional Web browser (FIG 1). This makes the user independent of platform and location, which is particularly important for mobile maintenance personnel. The structure of the Web interface allows accurate and fast navigation (FIG 2). Helpful links for online product description or a product hotline enhance the benefit for customers and pave the way for an integrative service concept.

An important feature when connecting a system to the Internet is security. Thanks to its extensive modular design, NetLink offers all mechanisms the user may require, from simple authentication through to complete encryption of data traffic to SSL (secure socket layer) standard. Any access to the network from the outside is recorded according to the CERN/NCSA standard for server log files and can be analyzed by the administrator.

SNMP interface

The SNMP (simple network management protocol) standard, which is well established in telecommunications, links a control center via the network to the

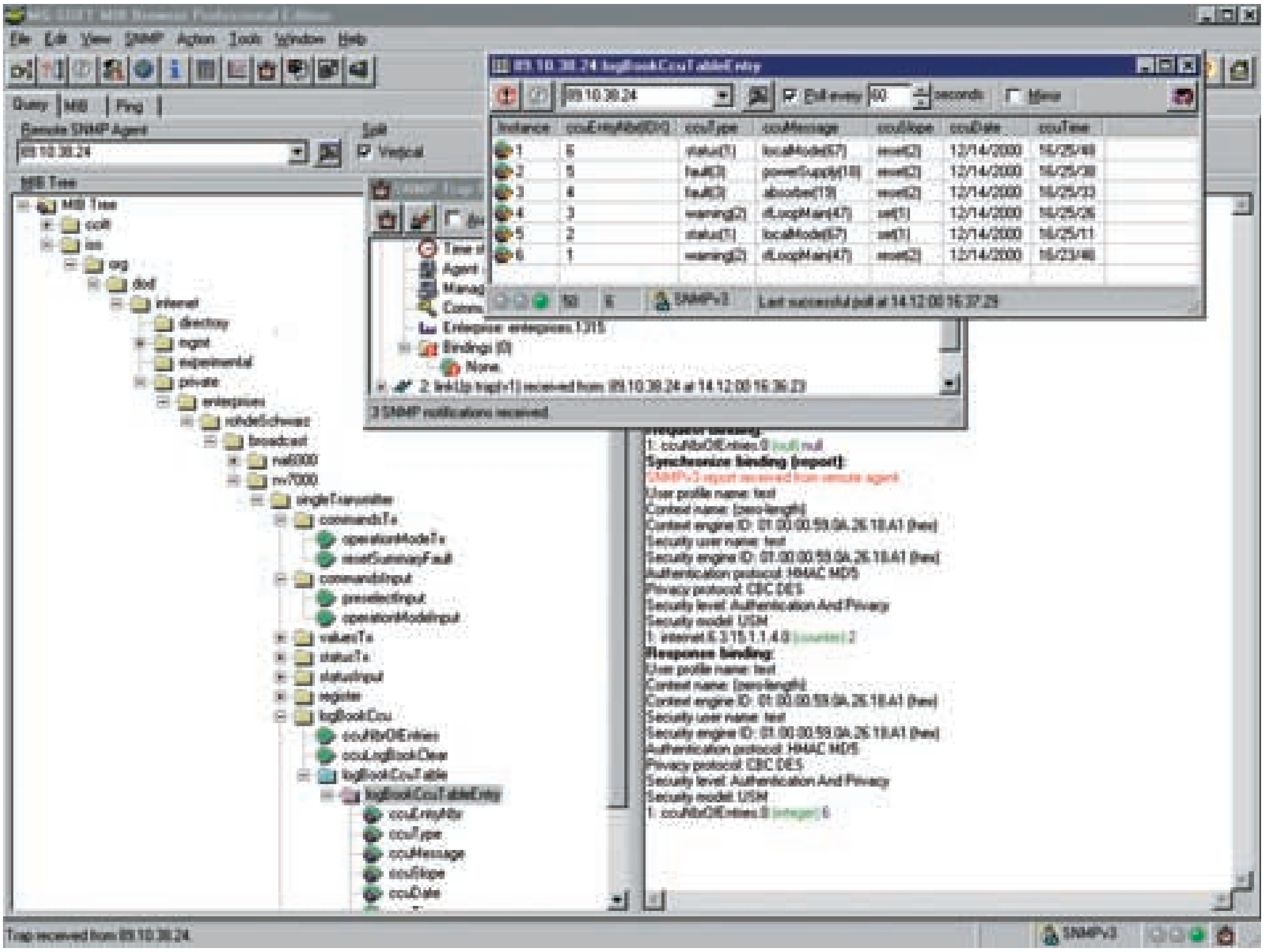


FIG 3 **Structure of SNMP MIB with logbook and traps**

transmitters to be monitored (FIG 1). The SNMP agent is the counterpart to the Web server in the system. Its task is to make data available by means of set and get commands and to automatically signal special events to the control center by way of traps. NetLink offers 32 specific traps that can be individually activated and deactivated from the control center.

The full functionality of the SNMP interface is defined in the management information base (MIB) in the form of a hierarchic tree structure and published using a method standardized by RFC 1066 (request for comments). New components can thus be integrated in the control center by simply loading the MIB file.

NetLink supports the three common SNMP versions v1, v2c and v3. The current version v3 now also takes security aspects into account: user authentication to MD5 standard and encrypted data transmission in line with DES (data encryption standard).

The modular design of the SNMP agent within NetLink simplifies system upgrades to the latest SNMP versions or new Internet standards (eg IPv6).

For all transmitters

The NetLink option provides network operators with a future-oriented and economical solution for system monitoring, remote maintenance and central logging of data measured in their networks. NetLink is available for the TV/DVB transmitter families NH/NV 7000/6000/500, for the DAB transmitters of the NA/NL 6000 family and on request also for FM transmitters from Rohde & Schwarz.

Manfred Reitmeier

Reader service card 170/08

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Coverage Measurement System ARGUS-FMTV

Optimum use of frequency thanks to reliable forecasts in planning

New transmitter sites for FM and TV broadcasting are planned with the aid of special software that predicts the wanted field strength of a planned transmitter and the interfering field strength of transmitters already existing in the coverage area by model calculations. To date, however, the real coverage area of a planned transmitter could not be measured until after it was commissioned. So leeway for optimum frequency utilization was not always recognized. With the new Coverage Measurement System ARGUS-FMTV, reliable conclusions can be drawn on the expected coverage limits of a transmitter in the planning phase already.

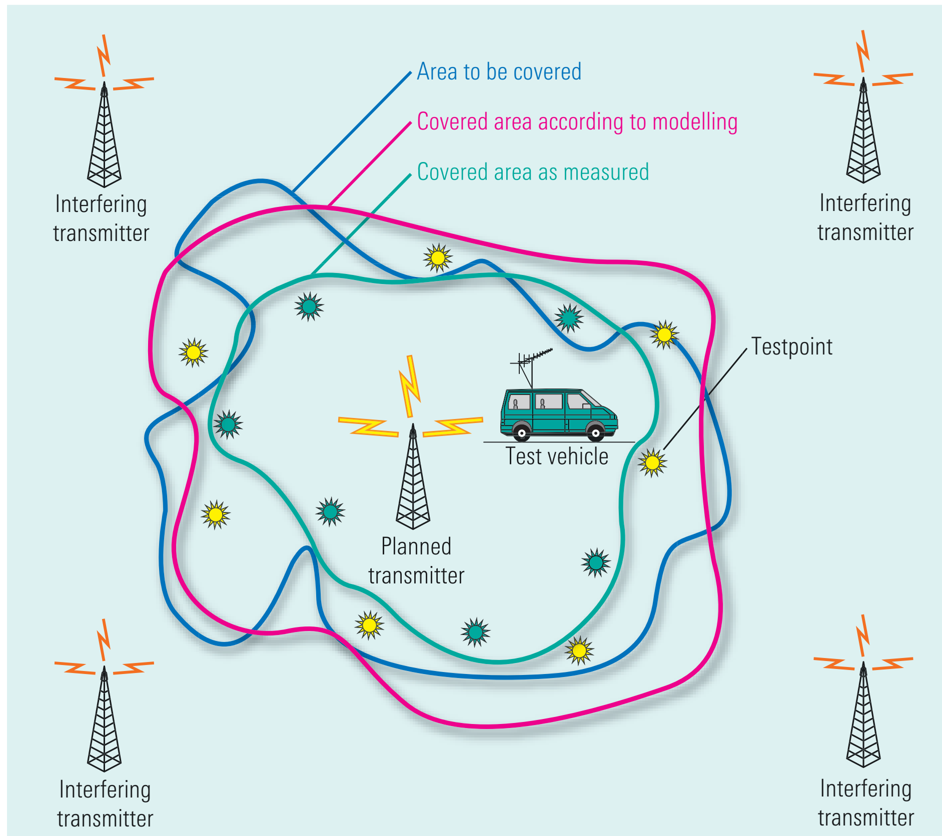

FIG 1 Areas covered according to planning, model calculation and measurement. ARGUS-FMTV calculates a reliable forecast in terms of range and compatibility of planned transmitters from the field-strength figures of existing transmitters and their characteristic features

Broadcast transmitter density impedes optimum frequency use

The intensive utilization of broadcasting frequencies is illustrated by the high density of transmitters in the FM and UHF TV bands. In Germany, for example, you find 8- to 12-fold occupancy per frequency in FM with approximately 1900 transmitters, and 160- to 250-fold occupancy per channel in UHF TV by some 9500 transmitters. The increasing need for frequencies or transmitters can hardly be satisfied in this limited frequency spectrum. What is more, only frequencies or levels of output power with short range are often authorized by national and international harmonizing procedures, because the protection of existing transmitters has priority.

Conventional planning methods are time-consuming and inaccurate

New FM and TV broadcast transmitters are usually planned by computing tools that define a model of the future coverage area and compatibility with the existing transmitter network. The theoretical calculations reflect trends relatively well but do not produce sufficiently accurate delimitation of the areas covered or affected by interference. Such a procedure cannot exclude the possibility of misplanning. The actual result of planning a transmitter cannot be measured until it goes into operation, i.e. some 12 months after planning starts. If the inevitable inaccuracy in planning is unacceptable, optimization measures will be necessary to eliminate interference with other frequencies or to supply areas that are not covered. Improvements, planning and renewed harmonization again take time, delaying startup of the modified transmitter.

Another way of planning a transmitter is to perform test emissions during measurements at the future site. But this method involves relatively high costs.

Reliable forecasts in planning with ARGUS-FMTV

To benefit from leeway for frequency utilization in the planning phase, it is essential to know the future actual coverage ranges and the effect of interference between transmitters, especially to avoid unacceptable impairment of existing coverage areas.

The large number of FM and TV programs means that the broadcasting frequencies concentrate on a relatively small number of transmitter sites, for technical and economical reasons. This fact is used in the new method by which Coverage Measurement System ARGUS-FMTV works. The propagation conditions usually vary little for the different frequencies at a transmitter site. So based on their field strength measured at different points, concrete conclusions can be drawn on the suitability of a planned frequency or transmitter as well as on the area to be covered and the area impaired by interference. Comparison of the results from the frequencies already transmitted at a site with the predicted results of the planned broadcasting frequency yields a remarkably good match if the different characteristics of transmitters, e.g. their effective radiated power and radiation pattern, are taken into account.

Coverage Measurement System ARGUS-FMTV allows all required measurements and the linking of results to transmitter data in an analysis. This produces more reliable forecasts regarding the range and compatibility of planned transmitters with those existing in a network (FIG 1). The validity of a forecast depends for the most part only on the quality of the available transmitter data. There are also advantages when it comes to the assessment of interfering transmitters on a co-channel and adjacent channel, which are very difficult to detect, if at all, without shutting a transmitter down.

Measurement and analysis

The system is operated in the FMTV measurement mode (FIG 2) of Measurement Software ArgusMon [1], also used by Rohde&Schwarz in the proven Spectrum Monitoring and Management System ARGUS-IT [2].

First the transmitter lists are composed of the planned transmitter, the interfering transmitters and (if existing at the planned site) the reference transmitters. In this connection, it is usual to access a transmitter database already used for model calculations. The first testpoint obtained from model calculations is then set and the measurements and analyses are performed. Analysis is possible in line with international ITU guidelines and German FTZ guidelines. Basically, the guard margins for the planned useful frequency are calculated to provide information on compliance with them. The results must be checked for plausibility. Single post-measurements

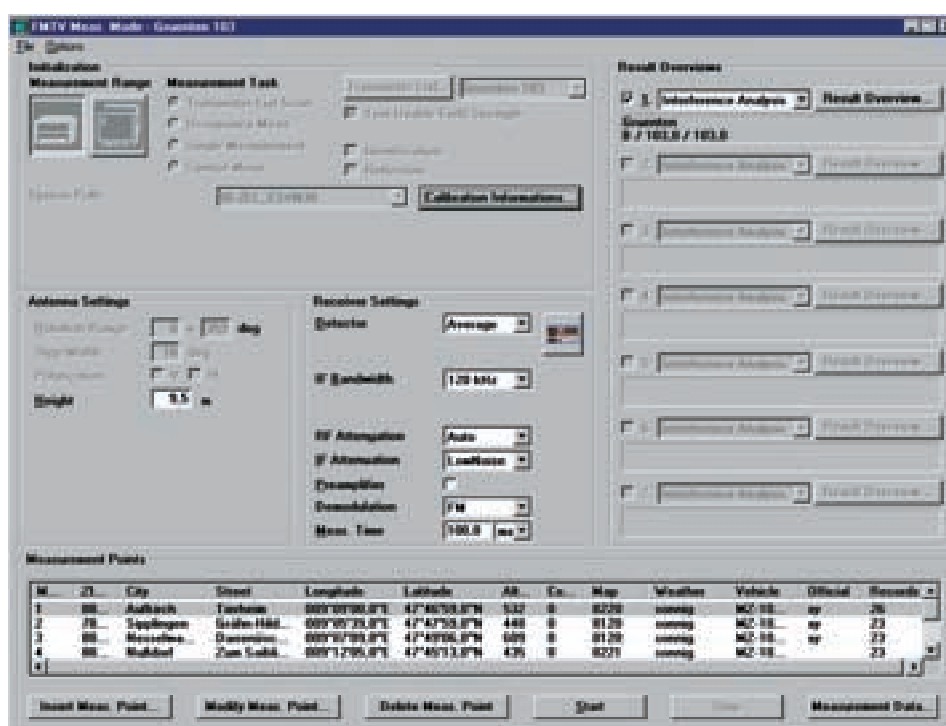

FIG 2 FMTV mode in Measurement Software ArgusMon

Basic structure of ARGUS-FMTV

The coverage measurement system is installed in a vehicle. The nucleus includes the following units (FIG 5):

- Antennas for the frequency range 47 MHz to 860 MHz, rotated by an azimuth and polarization rotator and mounted on a mast adjustable in height
- Test receiver for the measurement of field strength to determine coverage quality using the minimum wanted field strength and the guard interval, for the measurement of frequency offset and FM deviation to check measured data for plausibility as well as for orientating measurement of reflections in the FM range
- RDS decoder for decoding the program identification code and tone identification of FM transmitters
- Stereo measurement decoder for subjective assessment of the signal quality of FM transmitters with the same frequency or when no reference transmitters are available
- Data line decoder for decoding the program of TV transmitters
- Video measurement system for measuring reflections in the TV band
- Video monitor for subjective assessment of the signal quality of TV transmitters (co-channel and reflection interference)
- Compass and global positioning system for determining vehicle direction and location
- System controller for operating the system
- Printer to output lists and results

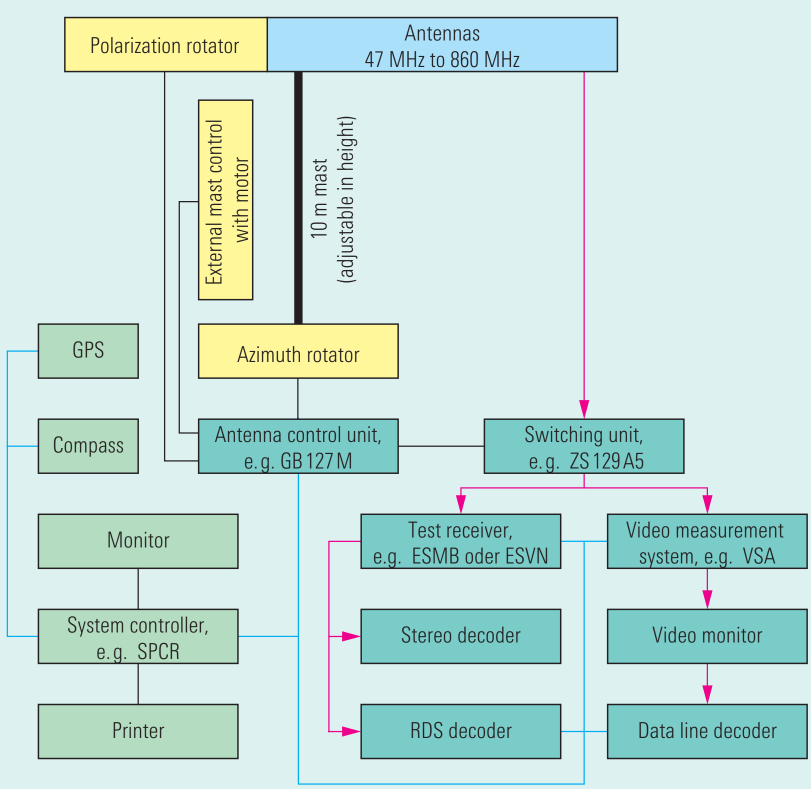

FIG 5 Structure of Coverage Measurement System ARGUS-FMTV

may be necessary to verify questionable results or identify interfering transmitters of very low field strength. All other testpoints selected from the results and model calculations are then set for measurement and analysis.

ArgusMon displays the vast amount of data on various transmitter characteristics and the results obtained at different testpoints in the form of easy to manage lists (FIG 3). The results can also be displayed on digital maps using the geographical information software MapView from Rohde & Schwarz (FIG 4). The result overview is the basis for further optimization measures.

The individual results can be evaluated under various aspects. This is useful for modifying the planned transmission parameters or planning another transmitter, for example. For this purpose, seven different result overviews are available in one measurement.

Further possibilities with ARGUS-FMTV

- This measurement procedure can also be used when no reference transmitter is available at the planned site. The field-strength figures from the model computation tool can be used instead of measured references. This detracts somewhat from the performance of the method, but it is still much more accurate than pure calculation.
- If no transmitter lists are available, omnidirectional measurements are a help. The direction with the maximum field strength is the direction to the transmitter. This method is much more elaborate since you have to measure at all points round 360° for every possible frequency and identify as many transmitters as possible.
- Occupancy measurements on operative transmitters to check that coverage areas are maintained and other

broadcasting frequencies are not interfered. These measurements can also be used to correct model computing tools.

- Monitoring of FM and TV transmitter networks, e.g. to check that important transmission parameters such as FM deviation, frequency offset and bandwidth are in tolerance.
- Control measurements to check the measurement facility and propagation conditions.

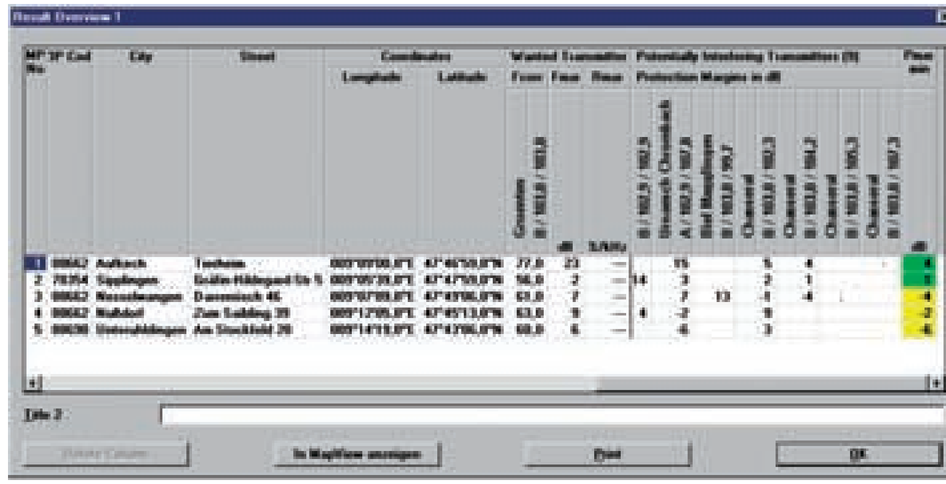

FIG 3 Tabular result overview in ArgusMon

Summary

Coverage Measurement System ARGUS-FMTV is a powerful tool for regulatory authorities, national media and broadcasting corporations as well as providers planning their transmitter operations. As early as planning FM and TV transmitters, they obtain more reliable information about expected coverage and the impact on the existing transmitter network, and can better utilize margins with existing transmitters.

ARGUS-FMTV allows more efficient utilization of scarce frequency resources on the basis of current transmitter data and actual measured values.

Jörg Pfitzner

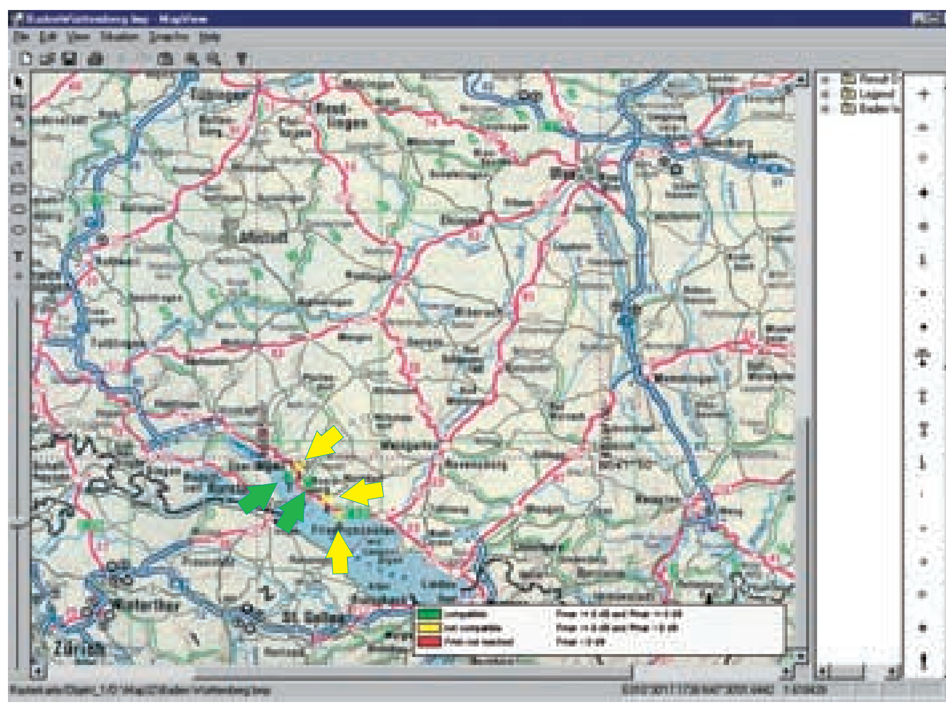

FIG 4 Result overview in geographical information software MapView. The software marks the transmitters with a cross (highlighted here by arrows)

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

[2] 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

Further information upcoming under www.argus.rohde-schwarz.com or enter 170/09 on reader service card

TV Test Transmitter SFQ

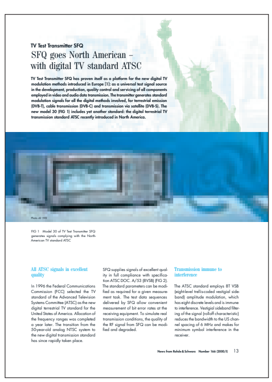
Now signals to digital cable standard ITU-T / J.83 B

Rohde & Schwarz proves again the innovative and universal concept of TV Test Transmitter SFQ. Equipped to match the North-American terrestrial ATSC standard a year ago (FIGs 1 and 2), SFQ now comes with a coder for the North-American cable standard ITU-T / J.83 B.

Excellent signal quality

SFQ provides a signal at maximum quality that conforms in all functions to standard ITU-T / J.83 B [2]. This makes it an indispensable test modulator for all companies involved in American cable broadcast. All standard parameters can be modified as required for a given measurement task. Selectable coder-internal test data sequences, which substitute the transport stream input signal in the different function blocks of the FEC (forward error correction), enable comprehensive quality classification of receiving equipment. A BER option allows measurement of the system failure limit even when the program is running without extra equipment. The SFQ-Z17 adapter card is especially useful. It enables BER measurements by using any consumer set-top boxes even without transport stream output, provided they have a common interface.

To simulate real transmission conditions, the quality of the RF signal from SFQ can be specifically modified and degraded (e. g. by fading or noise).


TV Test Transmitter SFQ

SFQ goes North American – with digital TV standard ATSC

TV Test Transmitter SFQ has proven itself as a platform for the new digital TV modulation methods introduced in Europe [1]: as a universal test signal source in the development, production, quality control and servicing of all components employed in video and audio data transmission. The transmitter generates standard modulation signals for all the digital methods involved, for terrestrial emission (DVB-T), cable transmission (DVB-C) and transmission via satellite (DVB-S). The new model 30 (FIG 1) includes yet another standard: the digital terrestrial TV transmission standard ATSC recently introduced in North America.

Photo 42 592

FIG 1 Model 30 of TV Test Transmitter SFQ generates signals complying with the North-American TV standard ATSC

All ATSC signals in excellent quality

In 1996 the Federal Communications Commission (FCC) selected the TV standard of the Advanced Television Systems Committee (ATSC) as the new digital terrestrial TV standard for the United States of America. Allocation of the frequency ranges was completed a year later. The transition from the 50-year-old analog NTSC system to the new digital transmission standard has since rapidly taken place.

SFQ supplies signals of excellent quality in full compliance with specification ATSC DOC. A/53 (8VSB) (FIG 2). The standard parameters can be modified as required for a given measurement task. The test data sequences delivered by SFQ allow convenient measurement of bit error rates at the receiving equipment. To simulate real transmission conditions, the quality of the RF signal from SFQ can be modified and degraded.

Transmission immune to interference

The ATSC standard employs 8T VSB (eight-level trellis-coded vestigial sideband) amplitude modulation, which has eight discrete levels and is immune to interference. Vestigial sideband filtering of the signal (rolloff characteristic) reduces the bandwidth to the US channel spacing of 6 MHz and makes for minimum symbol interference in the receiver.

News from Rohde & Schwarz Number 166 (2000/I) 13

FIG 1
Number 166 of News from Rohde & Schwarz reported on SFQ for ATSC [1]

Quadrature amplitude modulation

The selection of the transmission method depends to a large extent on the transmission medium. Cable channels (including glass fiber) are assumed to be band-limited and linear, with the system prone to white noise, interference and echoes. The quadrature amplitude modulation (QAM) selected in standard J.83 B is ideal for these media.

Depending on the application, SFQ allows selection between two formats: 64 QAM and 256 QAM (FIGs 3 and 4). Root-raised cosine filtering (transmitter and receiver use the same filtering) carried out at symbol level with subsequent I/Q modulation limits the output spectrum to the US channel spacing of 6 MHz and minimizes symbol interference in the receiver.

Structure of coder

The ITU-T / J.83 B coder consists of five processing blocks: checksum generator, Reed-Solomon encoder, convolutional interleaver, randomizer and trellis coder.

Photo 42 591/2x

FIG 2
Keeping pace with developments: TV Test Transmitter SFQ now also supports the digital cable standard to ITU-T/J.83B

New optional noise generator for SFQ see page 37

Standard ITU-T / J.83 B

ITU-T / J.83 B is the prevailing standard for digital TV program distribution through cable networks in North America. Its outstanding features have convinced prestigious organizations to standardize it as the physical layer also for data services via cable. Among them are the Society of Cable Telecommunication Engineers (SCTE DVS-031), Multimedia Cable Network Systems (MCNS-DOCSIS) and the IEEE 802.14 Committee. The SFQ coder extends far beyond TV broadcast applications via cable – data broadcast has also been readied.

All these standards were defined, besides TV applications, for equipment that provides data services via broadband cable networks (e.g. cable modems).

The coder processes input data in MPEG2 transport stream format in the TV mode. In J.83B systems however, transport stream synchronization is completely independent of the FEC synchronization procedure. This allows for instance the application and transmission of ATM (asynchronous transfer mode) packets in data mode without interfering with the ATM synchronization procedure.

When feeding MPEG2 transport stream data, the checksum generator allows in the TV mode, in addition to packet data synchronization, detection of errored data in the block (by specifically modifying the sync byte). This function block can be switched off for broadband data services (cable modem).

The Reed-Solomon encoder as outer error protection operates – like all other function blocks in the FEC – in symbols (7 bit) and calculates six parity symbols for a block of 122 input symbols. The receiver can then correct up to three faulty transmitted symbols per block.

The configurable interleaver (13 different operating modes) performs convolutional coding adaptable to current transmission conditions and protects the signal from burst-type transmission interference.

The randomizer ensures efficient and secure synchronization of the receiver as well as constant power density in the transmission channel. Trailer symbols, which perform framing via data symbols, help the receiver to synchronize and transmit information about the current interleaver mode.

The trellis coder forms the inner error protection block. It improves the signal/noise ratio (and so reduces the system failure limit in case of poor S/N) by adding redundant information. This enables the receiver to increase decoding security by means of a probability evaluation (maximum likelihood). A differential encoder is part of the trellis coder and performs differential coding of data prior to the generation of trellis output symbols. This feature forms an excellent basis for the development of robust receivers.

The mapper handles the output symbols of the trellis coder, assigning a defined point in the signal constellation to every possible output symbol.

The sum of the successive coding blocks means an excellent coding gain of the system, i.e. high immunity to noise while simultaneously protecting against burst-type transmission interference.

Every kind of useful data

The ITU-T / J.83 B coder in SFQ accepts the input data byte by byte. In the TV broadcast mode, i.e. if the checksum generator and transport stream data feed are activated, the coder accepts the input data in packets of 188 bytes in line with the data structure.

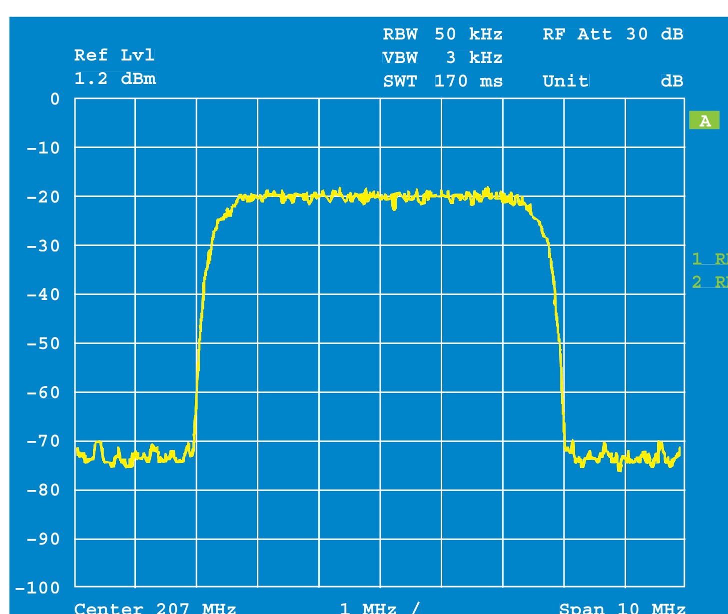


FIG 3 Standard output spectrum in 64 QAM mode

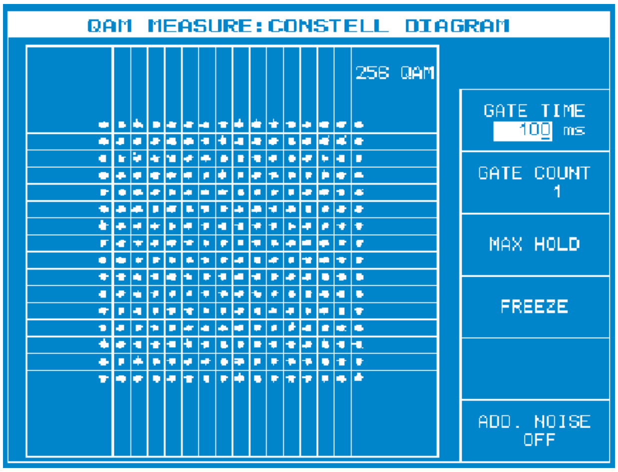


FIG 4
Constellation diagram for 256 QAM

The system data rate is 26.90735 Mbit/s in the 64 QAM mode and 38.81070 Mbit/s in the higher-order 256 QAM mode in conformance with the standard. Deviating from the standard, the SFQ coder accepts data rate variation by ±10%. This results in a linear bandwidth variation of ±10% compared to the standard 6 MHz system.

The input interface ensures that the required output symbol rate is always available, independently of input data rate [3]. For this purpose, the coder data stream is filled with null blocks up to the required symbol rate. Plus, the user receives a warning if the permissible useful data rate is exceeded at the input. The input interface comes with comprehensive interfaces for the coder data:

- synchronous parallel interface (TS parallel and SPI),
- asynchronous serial interface (ASI),
- externally clocked asynchronous serial interface at the output (ASI ext. Clk),
- externally clocked parallel interface at the output (SPI ext. Clk).

Simple upgrade of ATSC SFQ

Upgrading SFQ to the new standard is very cost-effective and easy for owners of SFQ 02 with ATSC coder (option SFQ-B12) and optional input interface (SFQ-B6). ATSC and J.83 B are implemented in the same coder hardware, so both standards can be activated simply by enabling the software without having to make any modifications in SFQ. Switchover between the two standards takes just a few seconds.

Wide range of test capabilities

Standard and high-quality signals as generated by SFQ are useful in functional tests on receivers and transmission facilities, but in most cases do not reflect the conditions prevailing in real transmission systems [4]. SFQ consequently offers numerous features for simulating all signal degradations occurring in practice [1].

Looking ahead

With the ITU-T / J.83 B coder, the innovative concept of SFQ proves itself once again. New, low-cost upgrades for the test transmitter will in future also ensure that SFQ keeps pace with rapid developments and pays back longterm on the investment (see next page).

Günter Huber

More information and data sheet at www.rohde-schwarz.com or enter 170/10 on reader service card

CD-ROM "DTV Dream Team" available free from your R&S representative

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[1] TV Test Transmitter SFQ: SFQ goes North America – with digital TV standard ATSC. News from Rohde & Schwarz (2000) No 166, pp 13–15
[2] International Telecommunication Union, Recommendation J.83, Digital Multiprogram Systems for Television, Sound and Data Services for Cable Distribution
[3] Optional input interface for TV Test Transmitter SFQ. News from Rohde & Schwarz (1997) No. 156, pp 34–35
[4] TV Test Transmitter SFQ Model 20 – TV via antenna: digitally fit. News from Rohde & Schwarz (1999) No. 161, pp 4–6

TV Test Transmitter SFQ

High-precision internal noise source enhances measurement functions

TV Test Transmitter SFQ can now be fitted with an optional noise generator (SFQ-B5) with internal self-calibration ensuring high carrier/noise ratio (C/N) for all modulation modes (FIG 1). In addition, any number of TV test transmitters featuring this option can be interconnected to produce RF signals of the same and coupled frequency with different interference. Diversity reception of mobile DVB-T receivers can be tested in this way.

Exact settings of carrier and noise power are essential

Signal degradation due to interference on the transmission link is inevitable in the broadcasting of TV programs. To simulate this and test a receiver's subsequent behaviour, impairments are added to the test signal, noise being among the most important ones. The associated setting parameter is the C/N ratio, the spacing measured in dB between carrier power (C) and noise power (N).

Both carrier and noise power require exact settings in the TV test transmitter. The carrier power does not only consist of the power of a single carrier but that of the entire spectrum. The spectrum width in turn varies within large limits, depending on modulation mode and symbol rate for example. As a consequence, the RF level has to be set anew with each modification of these parameters to provide the required output power. The noise power has to be adapted to the particular setting. The setting accuracy of carrier power and noise power, however, is subject to tolerances because TV test transmitters for DVB / DTV with vector modulation operate with an automatic level control (ALC) due to the high crest factor. And although internal potentiometers are temperature-compensated, level changes of the carrier of several tenths of a dB are inevitable due to temperature variations and aging of components. Despite all these unavoidable tolerances, TV Test Transmitter SFQ has so far always been reliable for high accuracy when setting C/N ratio.

When do you need a highly precise C/N?

Is higher accuracy necessary in the first place? Certainly not for analog TV transmission (AM). The lower the C/N ratio, the more distorted the picture. The human eye can barely perceive a difference of 1 dB in C/N, so a failure limit cannot be precisely defined.

At first glance the digital transmission chain – this applies to antenna, cable and also satellite reception – does not

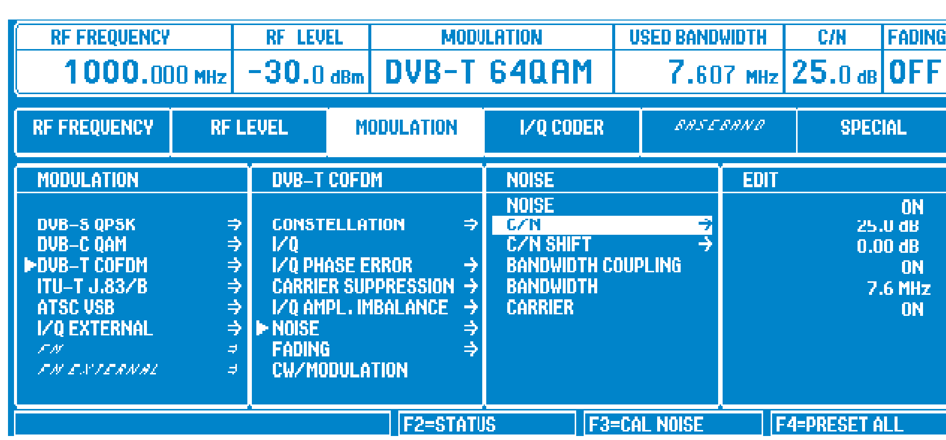


FIG 1
The new noise generator option presents itself on the display of TV Test Transmitter SFQ

Retrofitting SFQ

SFQ can be retrofitted with the new noise generator. And by using new software*, the previous noise generator (model 02) can be calibrated in the same way as the new noise generator. A PC and a spectrum analyzer are all the equipment required. The power ratio is not measured internally but externally; the calibration values are transferred to SFQ and ensure precise C/N setting.

* More details available from your nearest Rohde & Schwarz representative

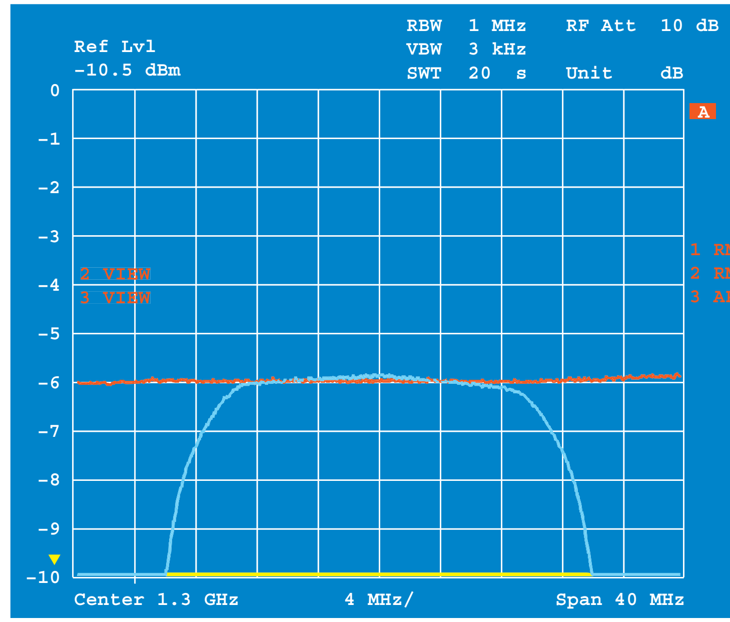


FIG 2
Modulation DVB-S, symbol rate 27.5 Msymbol/s, C/N = 0 dB; blue: DVB-S spectrum, red: noise

seem susceptible to noise. As long as digital information can be clearly identified, problems do not occur; error correction eliminates the odd errors. Socalled blocking in the picture indicates the limit of possible error correction, inevitably leading very fast to total picture loss. The better the receiver, the later such total loss will occur.

The failure limit is defined by equivalent noise degradation (END), an important parameter arrived at through the bit error ratio (BER). END is determined at the quasi errorfree (QEF) point. With a BER of 2×10^{-4} (measured before the Reed-Solomon decoder) the following Reed-Solomon error correction can eliminate almost all transport stream errors up to a BER of $<1 \times 10^{-11}$ (quasi errorfree). To find the C/N ratio at which the QEF point is reached, white Gaussian noise is superimposed on the DVB/DTV signal to be transmitted and its level varied up to a BER of 2×10^{-4}. The deviation of the found C/N from the theoretical limit line – BER as a function of C/N – corresponds to equivalent noise degradation.

Defining END by this method places very high demands on absolute C/N accuracy. To ensure this, the new noise generator for SFQ comes with an internal calibration feature that allows measurement of carrier and noise power under exactly the same conditions and storage of the calibration factors. FIG 2 shows a DVB-S and a noise signal for C/N = 0 dB.

Testing diversity reception

The hardware for a new application is also implemented on the board of the noise generator to test receivers with several antenna inputs for diversity reception according to DVB-T standard. Development and testshop require test sets to provide several RF signals with the same and coupled frequency, but with different interference simulation. An active power splitter on the board applies the I/Q baseband signals to the rear of SFQ, from where they can be fed into the IQ-EXT input of a second SFQ. The DVB-T transfer level of the I/Q baseband signal is predefined in SFQ. The IQ correction value can be edited for other DVB/DTV standards or different applications. Using the fading simulators and noise generators of both test transmitters, simulation of two independent transmission paths of a transmitter is possible for two receiving antennas. A third SFQ can use the IQ baseband signals of the second SFQ for a third receiving antenna. This configuration can be cascaded as required.

Erhard Kretschmer

More information and data sheet at www.rohde-schwarz.com or enter 170/11 on reader service card

More SFQ news in the article starting on page 34

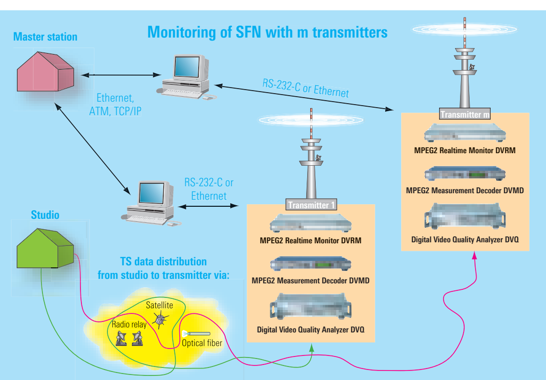
Condensed data of Noise Generator Option SFQ-B5

Bandwidth	1 MHz to 60 MHz (settable)
C/N variation range	50 dB
Resolution	0.1 dB
C/N error	<0.3 dB (after calibration), typ. <0.2 dB

Continued from No. 169

Measurements on MPEG2 and DVB-T signals (3)

Part 3 of the refresher topic continues the discussion of measurements on DVB-T transmitters. This time the focus is on masks for out-of-band components and measurement of the shoulder distance.



To refresh your memory: part 2 of this topic (No. 169) dealt with measurements on DVB-T transmitters (the picture above shows monitoring of the transmitter input in a single-frequency network). In this contribution, the emphasis is on measurement of the shoulder distance

Shoulder distance

Mask for out-of-band components

During the transition from analog to digital transmission, the protection channels between the present analog channels are used to start with DVB-T operation. Especially in Central Europe, there are hardly any other frequencies available.

FIG 15 shows a possible spectral configuration during the transition from analog TV to DVB. The DVB-T spectrum in the upper adjacent channel will have only little effect on the PAL signal if the PAL vision carrier frequency and the DVB-T center frequency conform to the standard. At most, the DVB-T shoulder in the lower adjacent channel may impair the second sound carrier of the B/G PAL signal, whereas in the upper adjacent channel it superimposes on the vestigial sideband like noise.

To prevent any interference to adjacent analog TV channels, EN 300744 defines masks for the DVB-T spectrum. These are tables listing levels in the range ±12 MHz from the center frequency f_c of the DVB-T channel when the upper and the lower adjacent channel are occupied by analog RF signals emitted by UHF transmitters at the same site. The selected levels and frequencies orient on important points within the analog channels. FIG 16 and TABLE 1, for example, show the values of the DVB-T mask when the upper and the lower adjacent channel are occupied by a G/PAL/A2 signal.

In critical cases, for example where channels adjacent to DVB-T channels operate in special modes (e.g. low-power analog TV transmission), the out-of-band DVB-T components may have to fulfil more stringent requirements. For such cases a critical mask is defined by EN 300 744 (FIG 17 and TABLE 2).

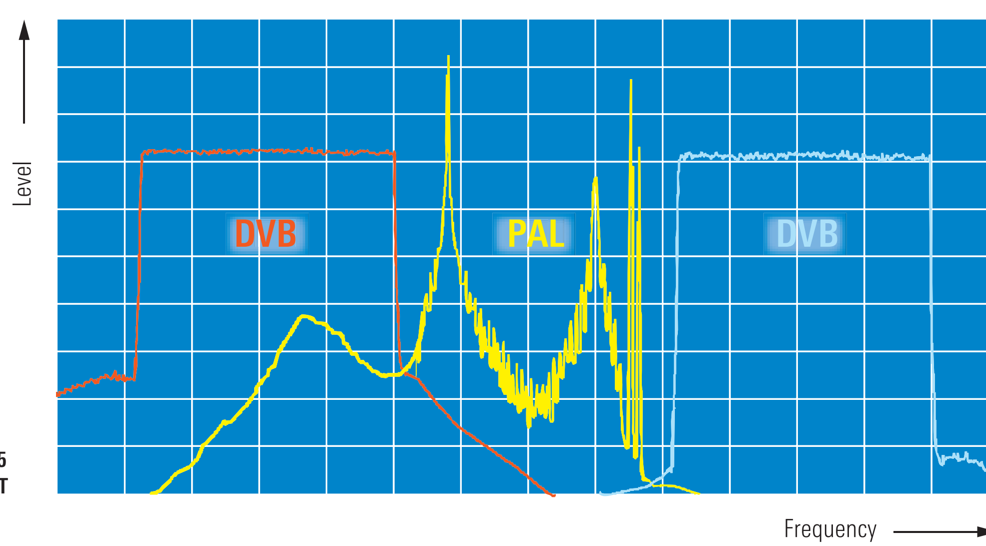


FIG 15
Adjacent-channel occupancy, PAL and DVB-T

Frequency relative to center frequency f_c (MHz)	Explanation of frequency	Level (dB)
–12.00	**Lower adjacent channel:** lower end	–100.0
–10.75	**Lower adjacent channel:** vision carrier	–76.9
–9.75	**Lower adjacent channel:** vision carrier +1 MHz	–76.9
–5.75	**Lower adjacent channel:** upper end of (upper) sideband	–74.2
–4.94	**Lower adjacent channel:** upper end of RF bandwidth of second sound carrier (IRT A2)	–69.9
–3.90	**DVB-T signal:** lower end of RF bandwidth	–32.8
+3.90	**DVB-T signal:** upper end of RF bandwidth	–32.8
+4.25	**Upper adjacent channel:** vision carrier –1 MHz; lower end of vestigial sideband	–64.9
+5.25	**Upper adjacent channel:** vision carrier	–76.9
+6.25	**Upper adjacent channel:** vision carrier +1 MHz	–76.9
+10.25	**Upper adjacent channel:** upper end of (upper) sideband	–76.9
+12.00	**Upper adjacent channel:** upper end	–100.0

TABLE 1 DVB-T mask for out-of-band components with standard G/PAL/A2 signals in the adjacent channels (level measured with 4 kHz resolution bandwidth)

Frequency relative to center frequency f_c (MHz)	Level (dB)
±12.0	–120
±6.0	–95
±4.2	–83
±3.8	–32.8

TABLE 2 Breakpoints for critical mask (UHF); level measured with 4 kHz resolution bandwidth

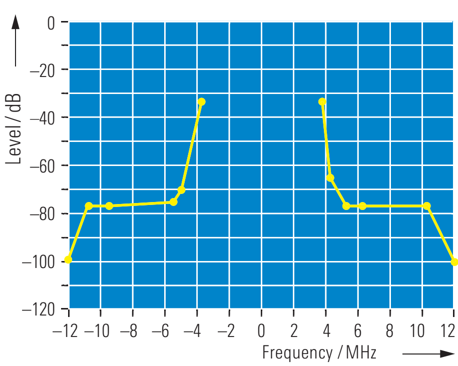


FIG 16 Mask for out-of-band components

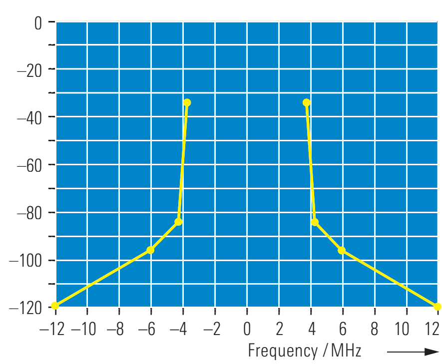


FIG 17 Critical mask for more stringent demands on DVB-T signal

Both diagrams: frequency relative to center frequency f_c of 8 MHz DVB-T channel; level measured with 4 kHz resolution bandwidth; 0 dB corresponds to average output power

Photo 43421/2

FIG 23
Member of a big family [1]: Spectrum Analyzer FSEM 30 (20 Hz to 26.5 GHz), data sheet PD 757.1519

Increasing shoulder distance

The output signal of the exciter of the DVB-T transmitter has a shoulder distance of about 50 dB. But this is reduced to values of near 30 dB by intermodulation products resulting from nonlinearity of the transmitter amplifiers. The effect is in part compensated by the exciter's digital linearity precorrector, producing intermodulation suppression of about 40 dB in the useful spectrum.

From FIG 10 ("The DVB-T spectrum" in part 2 of the topic) it can be seen that the spectrum has to be additionally bandpass-filtered to meet the requirements defined in the masks outside the useful spectrum. For the normal mask a six-cavity filter is sufficient (FIG 18), whereas for the critical mask at least eight cavities are required. The filter is connected between the transmitter power output and the antenna. With the bandpass filter a shoulder distance of >36 dB is achieved. This corresponds to the difference of 69.9 dB – 32.8 dB = 37.1 dB required at frequencies ±4.94 MHz and ±3.90 MHz in the normal mask. For the critical mask, the required shoulder distance is correspondingly higher, i.e. 83.0 dB – 32.8 dB = 50.2 dB.

Very stringent demands are made for the out-of-band components of COFDM signals for DVB-T, which can be seen from the limit values of the relevant mask.

As mentioned above, the shoulder distance at the transmitter output is not sufficient and so it is increased by bandpass filters. Filter attenuation rises especially close to the limits of the passband. The very steep attenuation characteristic in the stopband causes a correspondingly steep increase of group delay. The amplitude frequency response and the group delay shown are largely compensated by the digital precorrectors of the exciter. Depending on the degree of suppression in the stopband of the bandpass filter, an extra filter may be required to suppress local oscillator harmonics.

In the absence of detailed specifications from official standardization bodies regarding the permissible residual deviation from the ideal filter, preliminary values were laid down in 1998 in Great Britain for the installation of a multi-frequency network. These can be seen in FIG 19.

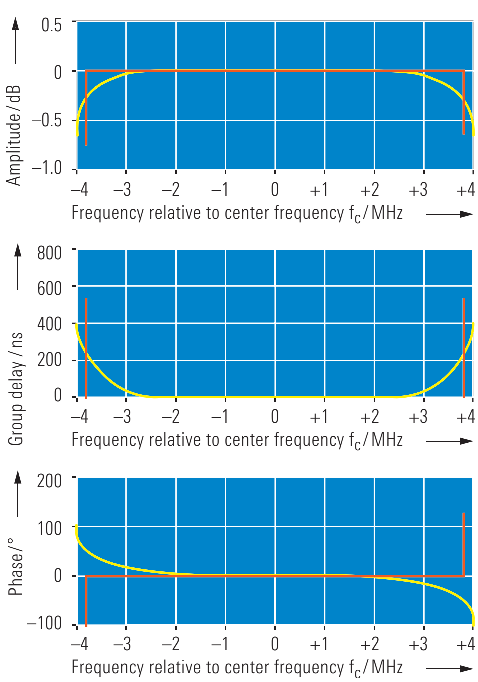
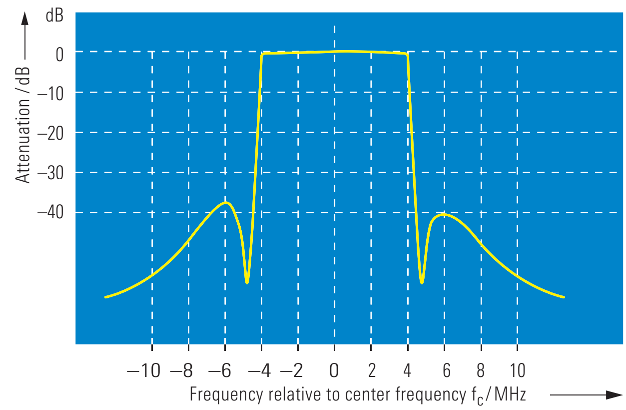


FIG 19 Proposal for bandpass characteristic to increase shoulder distance (corrected amplitude frequency response with ripple ≤0.3 dB and group delay ≤250 ns (!)

FIG 18 Bandpass filter for DVB-T transmitter; typical attenuation characteristic of coaxial filter with six cavities



Measuring shoulder distance

Convenient measurements with Rohde & Schwarz instruments

Instruments suitable for this measurement are Spectrum Analyzers FSEx (FIG 23) and FSP (FIG 12 in part 2) and models 40 and 43 of DVB-T Test Receiver/Demodulator EFA (FIG 24).

Test Receiver EFA offers particularly convenient measurements. Softkey AMPL/PHASE or AMPL/GD (group delay) opens the menu for measuring amplitude and phase frequency response of the COFDM spectrum. The softkey also allows switchover to display of amplitude frequency response and group delay in the channel (FIG 20).

The FREQUENCY DOMAIN/FFT function simplifies determining the shoulder distance. For an 8 MHz DVB-T channel with frequency range –4.48 MHz (start frequency) to +4.48 MHz (stop frequency), for example, the shoulder distance can immediately be read from the spectrum and the values displayed under SHOULDER ATTEN LOWER: / UPPER: (FIG 21).

According to European Technical Report ETR 290, the shoulder distance is to be measured between the maxima of the useful spectrum (approx. –26 dB in FIG 21) and the (weighted) maxima of the out-of-band components at 300 kHz to 700 kHz from the last useful carrier (approx. –66 dB in FIG 21). The MAX DETECTOR function facilitates determining this value.

Determining shoulder distance to ETR 290

ETR 290 describes a method for determining the shoulder distance that is rather time-consuming. Test Receiver EFA delivers identical values provided that out-of-band components starting 300 kHz from the last COFDM carrier have a flat characteristic. This is almost always the case in COFDM.

FIG 24 TV Test Receiver EFA [2], data sheet PD 757.5514

Photo 43 310/6

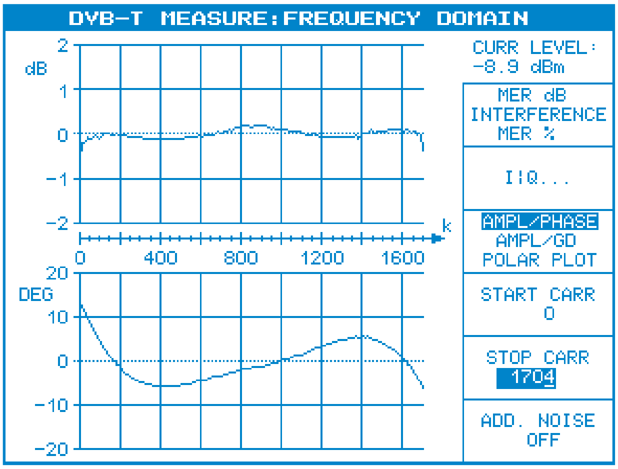


FIG 20 **Measurement of amplitude frequency response and group delay**

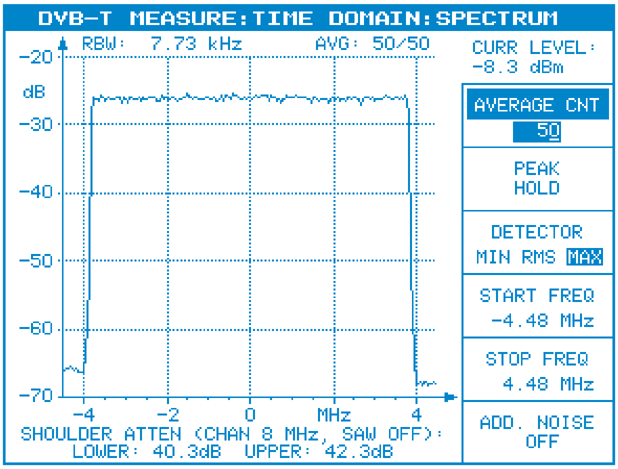


FIG 21 **Shoulder distance of COFDM signal**

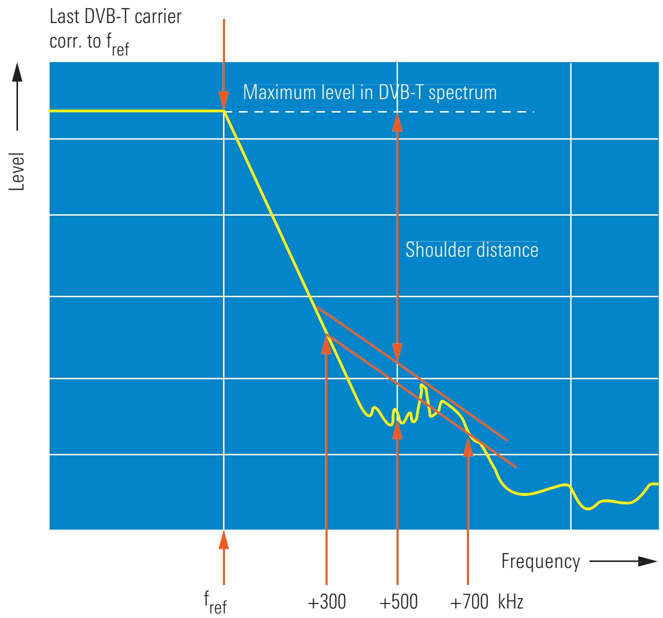


FIG 22
Measurement of shoulder distance to ETR 290

This method requires a hardcopy of the spectrum as well as a protractor and ruler, so its use will tend to be the exception. Minor deviations between this method and direct measurement with Test Receiver EFA will rarely occur, i.e. where strong interference is superimposed on the out-of-band components. But even then, Test Receiver EFA supplies sufficiently accurate results because the FFT frequency range of –4.48 MHz to +4.48 MHz about the channel center frequency exactly corresponds to the range specified by ETR 290.

Sigmar Grunwald

(to be continued)

▶ Measurement to ETR 290 using a spectrum analyzer works as follows (illustrated in FIG 22):

1. Determine the maximum level of the DVB-T spectrum (Max Hold).
2. Draw a line between the level value of the spectrum 300 kHz above (below) the frequency of the last (first) carrier in the DVB-T spectrum and the level value of the spectrum 700 kHz above (below) the frequency of the last (first) carrier in the DVB-T spectrum.
3. Draw a parallel to the above line that goes through the maximum of the DVB-T spectrum in the range 300 kHz to 700 kHz above (below) the frequency of the last (first) carrier of the DVB-T spectrum.
4. Measure the difference between the maximum level of the DVB-T spectrum and the level of the parallel line at 500 kHz above (below) the frequency of the last (first) carrier of the DVB-T spectrum. The lower of the two values is the valid shoulder distance.

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[1] Spectrum Analyzer FSEM/FSEK – Fast spectrum analysis now through to 40 GHz. News from Rohde&Schwarz (1996) No. 152, pp 7–9
[2] TV Test Receiver Family EFA – Top fit for digital television. News from Rohde&Schwarz (1996) No. 152, pp 17–19

Rohde & Schwarz direction finder convinces Chinese authority on site

Last year China's State Radio Monitoring Center (SRMC), the national authority responsible for radiomonitoring to ITU guidelines, issued an international ITB for three broadband HF direction finders. This was the first step towards establishing a nationwide shortwave DF network. Rohde & Schwarz won out against strong competition.

Photo: author

FIG 2 Improvisation – the antenna cables were too short to reach the station so the DF equipment was promptly set up outdoors

The tendering applicants had to answer extensive catalogs of technical questions. Prior to reaching a decision, a Chinese delegation visited Rohde & Schwarz headquarters in Munich and the production facility in Memmingen. The company used this opportunity to demonstrate remote control of a Digital Direction Finder DDF01M in Memmingen from Munich on an ISDN line.

But that was not enough for the Chinese authority. It wanted to put DDF01M through its paces on the spot, in Urumqi, the capital of Xinjiang province in north-west China (FIG 1). The local monitoring station is on a mountain ridge bordering the city. HF DF Antenna ADD010 was set up on a plateau next to the station building, and because the antenna cables taken along were too short to reach the building, it was decided there and then to install the DF equipment outdoors (FIG 2). With this configuration the Chinese specialists carried out various measurements for three days, like taking bearings of different shortwave stations in different directions and at different distances by day and night, including single station location (SSL).

Although the conditions were not the best for direction finding (there were metallic water pipes running above ground through the antenna field and numerous obstacles round about), the Rohde & Schwarz direction finder produced excellent results. That obviously convinced the specialists on the job. At the end of 2000, SRMC placed an order with Rohde & Schwarz for three HF Direction Finders DDF01M plus three HF/VHF/UHF Direction Finders DDF06M.

Ulrich Unselt

FIG 1 Market in Urumqi, the capital of Xinjiang province in north-west China, the city where the Chinese authority tested Rohde & Schwarz's direction finder

Photo: author

Remote Monitoring and Remote Control System ARCEMIS

Central control of radio systems for air traffic control and air defense

Air traffic control and air defense require full-coverage ground-to-air communication. This is why VHF/UHF ground radio equipment is normally distributed countrywide. Frequently, transmitters and receivers are located at separate sites (split-site operation) to prevent collocation interference. ARCEMIS ensures remote-control access to any number of transmitters and receivers from one control center.

Countrywide distribution – central control

ARCEMIS (advanced remote control enhanced monitoring & information system) is able to monitor extensive communication networks and query the status of radios while they are in operation (FIGs 1 and 2). The system is matched to the new M3SR software radio generation [1], to location and navigation systems and to the VHF/UHF radio equipment of Series 200 and 400 U [2], which are being used for ground-to-air communication in ATC [3] and air defense in more than 80 countries worldwide.

To enable remote control of radio equipment, it is possible to vary parameters such as frequency or modulation (operative control) or to start programs, e.g. for fault diagnosis (maintenance control). The system always ensures extremely fast response times.

Different transmission media are used for system setup depending on the distances to be covered, the available infrastructure and the requirements. ARCEMIS supports leased and dial lines, mobile radiocommunication, LAN, WAN, Internet, microwave and satellite links.

The system logs all actions and messages received about settings and device states in event and error logbooks for statistical evaluation as well as for control and classification of error messages.

ARCEMIS is highly flexible and platform-independent. It runs under UNIX and Windows™ NT, the most common operating systems. TCP/IP, by now an international standard and supported by all software and hardware manufacturers, is used as the transmission protocol.

Security with a capital S

Due to its use in security-relevant areas, ARCEMIS meets exacting requirements for failsafety and protection against unauthorized access. Key controllers can be installed in a dual configuration so that the second controller automatically takes over all duties if the first one fails. Multichannel radios are provided as a standby for ATC communication, which is normally handled by single-channel equipment, to immediately close any communication gap.

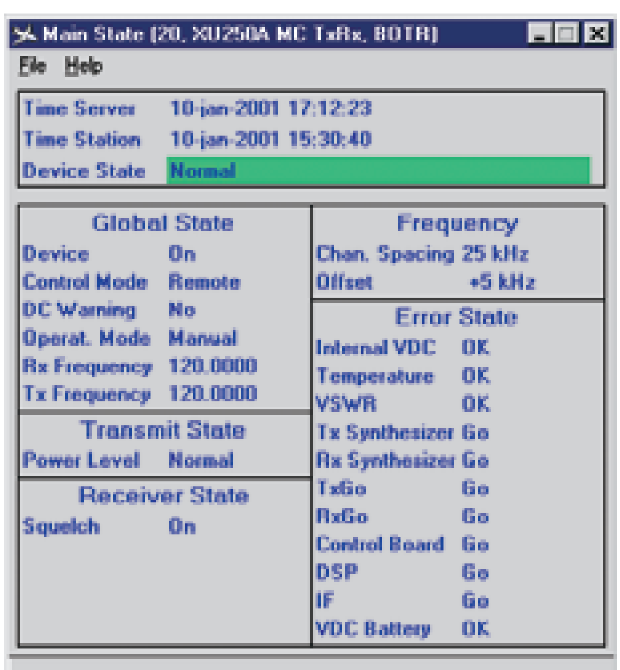

FIG 1
Query of transceiver status from control center

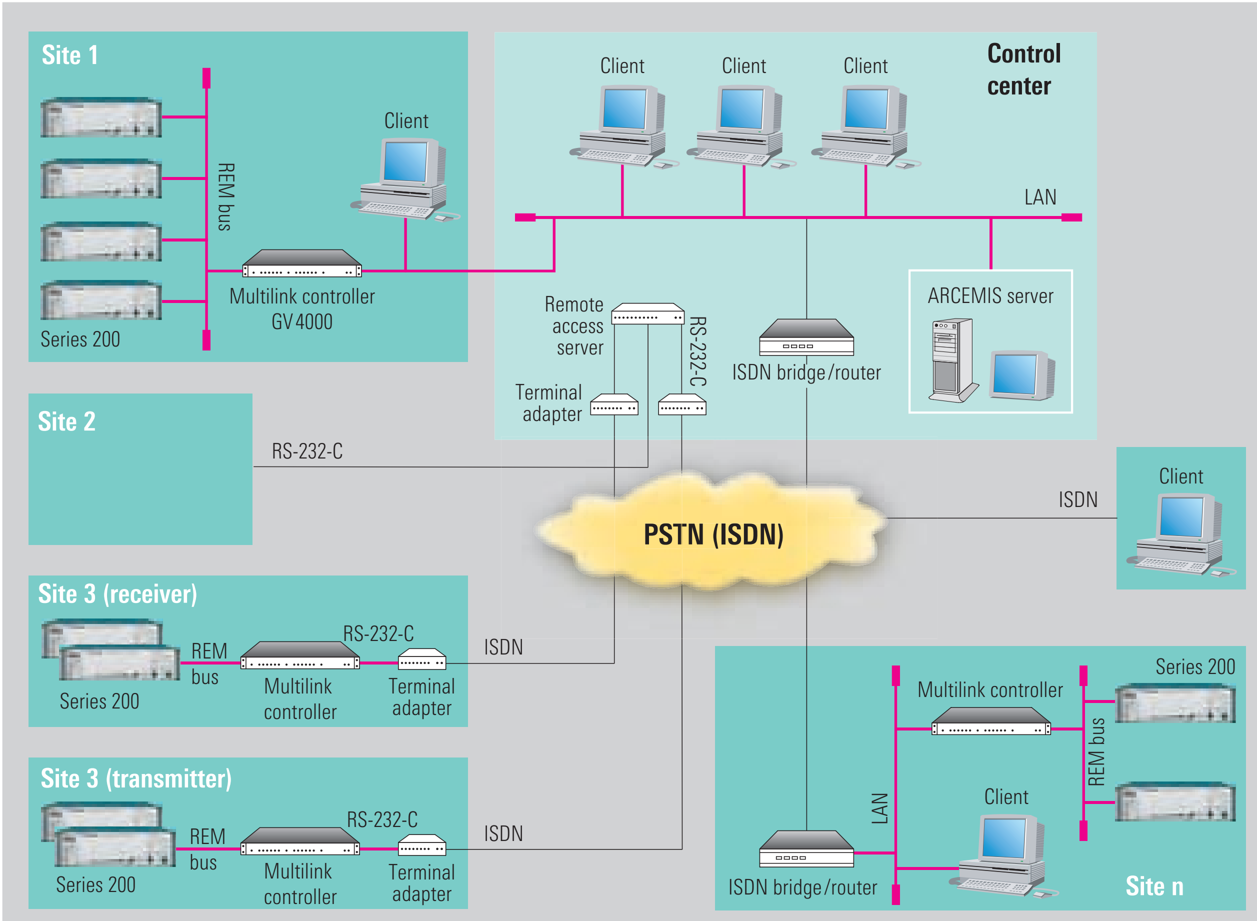

FIG 2 Countrywide system with control center and several remote stations

Call-back mechanisms, password protection and firewalls prevent manipulation from the outside. Access to the overall system can be restricted with the aid of user-specific rights and privileges. Thanks to TCP/IP, commercial encryption programs and security products are easily added to the system.

As a rule, all data are encrypted in air defense with its high security requirements. The available security features (IPsec) are fully utilized on the remote-control lines. EPM (electronic protective measures)/ECCM (electronic counter-countermeasures) as well as special devices for crypto key generation, management and distribution are used on the radio links.

Key and frequency management centers, for example, can generate keys and sets of frequencies for orthogonal networks that apply SECOS EPM. ARCEMIS transmits the generated, encrypted information to the particular radios. This information is decrypted in the radio equipment itself for utmost security. Units that cannot be accessed via ARCEMIS, e.g. airborne equipment, are manually loaded with this information by key distribution devices (KDD).

Conclusion

ARCEMIS is a reliable and secure system for air traffic control and air defense. It combines distributed remote radio equipment into a countrywide network that can be accessed centrally or decentrally as required.

Thomas A. Kneidel

Reader service card 170/12

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[2] Series 200 multichannel radio equipment – VHF-UHF ATC radiocommunications go multichannel. News from Rohde & Schwarz (1997) No. 154, pp 10–11

[3] Airspace safety and Austro Control – an excellent combination. News from Rohde & Schwarz (1998) No. 158, pp 41–43

Control Unit GB 208

Reliable radiocommunication with minimum manpower

The operators of small airports cannot afford whole teams to handle their radio traffic. Consequently they need fast and flexible assignment of radio channels to the operator positions. The new 8-channel Control Unit GB 208 is specially matched to the requirements of regional or corporate airfields.

Front-to-end enhancement

Rohde & Schwarz claims to offer users of professional communication systems a complete solution from the microphone through to the antenna. A new control unit reinforces this reputation. Safe operation and reliability were the focus in its development. Connection of radio sets from other suppliers is quite straightforward.

The new 8-channel Control Unit GB 208 (FIG 1) is tailored to the requirements of regional or corporate airfields that use Series 200 radios. A further important application is the control of emergency transceiver systems at large airports. Such radio installations act as a standby should the main system fail. They must be a reliable option in case of an emergency.

In both cases, controllers share the available radio channels, and are constantly informed about their current assignment and use.

Optimized for the job

Each controller can handle up to eight radio channels from his operator position with one GB 208. Several control units can simply be connected in parallel, enabling flexible addressing of radio equipment from as many as ten operator positions.

Photo author

FIG 2
Tower at Grenchen regional airport, Switzerland, where GB 208 is used

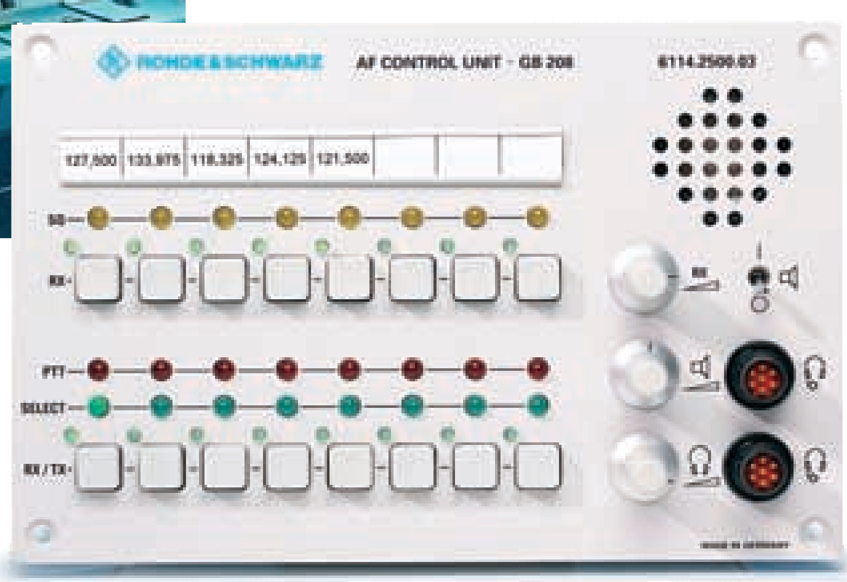


Photo 43 674/1

FIG 1
Control Unit GB 208

A special feature of GB 208 is the availability of one control output for each channel. These outputs serve to mute external loudspeakers for the selected transceiver, as for instance at the Grenchen airfield in the Swiss Jura (FIG 2). Each controller hears all radio channels through loudspeakers in the ceiling of the tower, and can use GB 208 to select the channel on which a radio message is coming in. He puts the incoming call through to the loudspeaker or headphones of his operator position and the ceiling loudspeaker is automatically muted. This signals to the other controllers that the particular channel is already being served. When selecting a channel, the user can activate receive mode (Rx) or transmit plus receive mode (Rx + Tx) by pressing a button.

Rx means that the controller can listen in, keying the transmitter by PTT is disabled; Rx + Tx allows listening in and PTT. Each access to a radio channel is also displayed on the controller's own unit.

More than one receive path can be chosen at the same time. The configuration enables the user to determine whether only one transmitter at a time (mutually releasing) or several transmitters simultaneously can be put on the air.

At home in bigger systems too

For use in larger systems, GB 208 comes with an extender port enabling it to work with 16 or 24 channels by adding further control units. In this case, the extra control units only contribute their selection keys. However, all 24 transceivers are connected to the headset of the first control unit.

The unrestricted selection of receive paths and mutual release when a number of GB 208 units are cascaded is a particular asset.

The control unit includes an internal AF amplifier and a loudspeaker. An external loudspeaker can also be connected. It can be operated through an external power supply from the 230 V line of the airport and, in addition, connected to a backup battery on a separate 24 V DC input. This guarantees uninterruptible operation in the event of a power outage.

GB 208 can be completely recessed into a desk thanks to a depth of only 90 mm. The necessary connectors are on the side of the unit. A different version for use as a desktop or for 19" rackmounting is also available with the connectors arranged at the rear. GB 208 is half of 19" in width and only three units in height.

Rohde & Schwarz offers a large choice of system solutions for mechanical and electrical integration of the control units.

Peter Schmitz

GB 208 at a glance

- Compact, flat design, integration into a desk or 19" rack
- Control of up to eight radio channels from a single operator position
- Capacity expandable to 16 or 24 channels by simple cascading of two or three units; all functions of the single unit remain available
- Random access of up to ten operator positions to the available radio channels; up to ten control units can be connected in parallel
- Internal loudspeaker (on/off) and connector for external loudspeaker
- Two connectors for headset
- Either aural monitoring or aural monitoring and talking on one or more channels
- Clear operation thanks to separate LED indicators
  - Transmitter put on air (PTT, red LED)
  - Radio signal is received (squelch, yellow LED)
  - Controller has selected radio channel (green LED)
- On selecting a channel (button), a control output can be activated (e.g. to mute loudspeaker or as alarm relay for distress frequency)

Reader service card 170/13

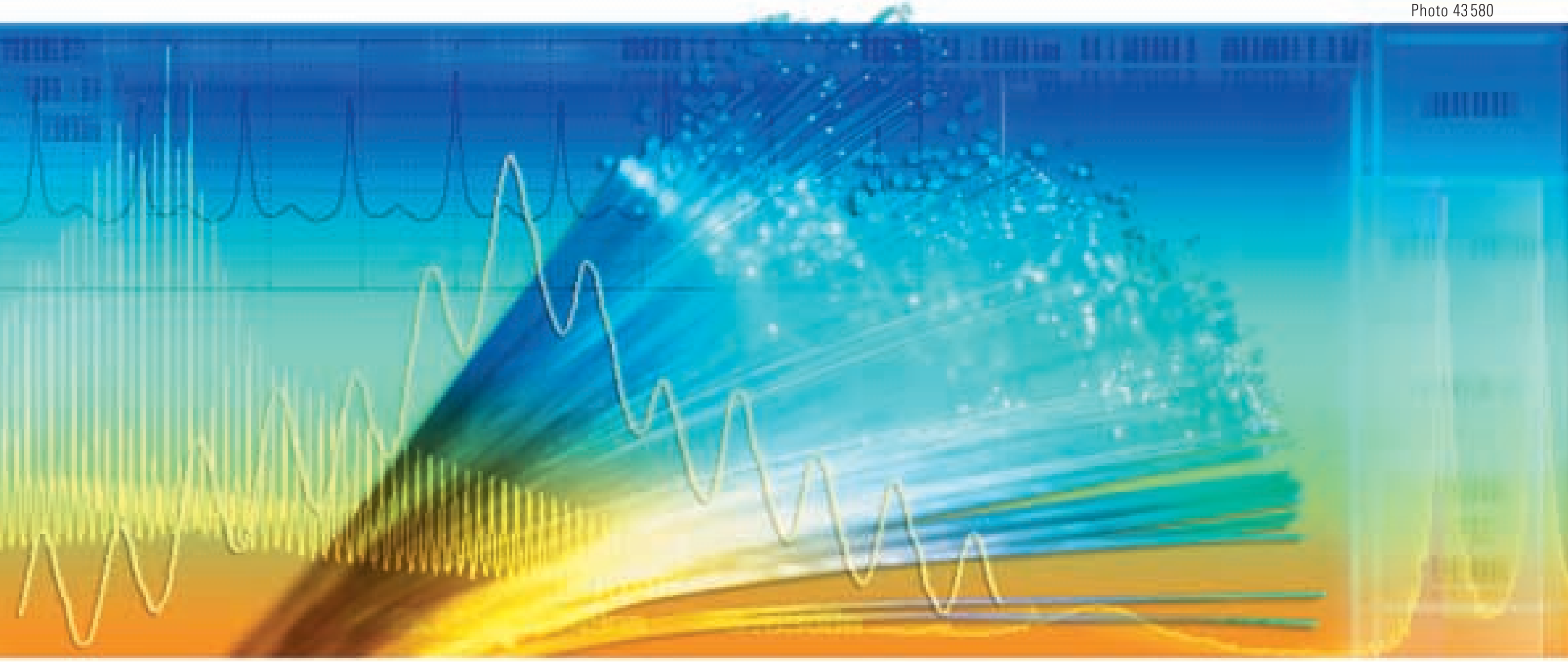
Condensed data GB 208

Frequency range	300 Hz to 4000 Hz
Number of inputs/outputs	8, expandable to 16 or 24 channels by cascading two or three units
Distance to transceivers	max. 500 m without intermediate amplifier
Operating temperature range	0 °C to +50 °C
Power supply	230 V AC with external supply unit, 24 V DC with automatic switchover
Dimensions (W x H x D)	202.2 mm x 131.8 mm x 90 mm
Weight	approx. 0.5 kg
Colour of front panel	telegrey 2, RAL 7046

Optical Spectrum Analyzer Q8384

Highly accurate measurements in optical communication

Photo 43580



Advantest, a longtime cooperating partner of Rohde&Schwarz, has developed and produced measuring instruments for optical communication for almost 15 years. In the design of Optical Spectrum Analyzer Q8384, the focus was on accuracy and speed for laboratory applications.

The future lies with the glass fiber

The exponential increase of data transmitted in electronic communication – e.g. on the Internet – calls for a powerful infrastructure able to handle all the growing requirements.

The technical prerequisites are there: modern DWDM (dense wavelength-division multiplex) systems with very high data rates that can simultaneously transmit several and in the near future even up to 100 wavelengths with ITU channel spacing on a single-mode glass fiber. Thus enormous data rates of several Tbit/s can be achieved. This would be sufficient, for instance, to transmit today's worldwide telephone and data traffic on a single glass fiber as fine as a human hair. That is why fiber-optic cables are set to oust the copper line.

The technical principle of data transmission on fiber-optic cables is quickly explained. Laser diodes at the transmitter end generate the optical signals as a function of the required channels. The signals are then modulated with the bit stream. Multiplexers feed the modulated signals with different wavelengths into the glass fiber. At the end of the optical line, demultiplexers distribute the signals to the receivers. These demultiplexers use PIN or avalanche photodiodes to convert the optical signals back into electrical bit streams.

DWDM systems with a channel spacing of 100 GHz or 0.8 nm are being used in modern submarine cables and terrestrial long-haul networks (a channel spacing of 50 GHz will soon be possible). They use transmission rates of 2.5 Gbit/s and 10 Gbit/s. Systems with a transmission rate of 40 Gbit/s will be implemented by 2002.

Optical Spectrum Analyzer Q 8384

In Q 8384, an analyzer of the third generation using monochromator technology, and a number of other unique measuring instruments, Advantest underscores its outstanding position as a producer of high-grade equipment for signal analysis in DWDM transmission systems for development, production and quality assurance.

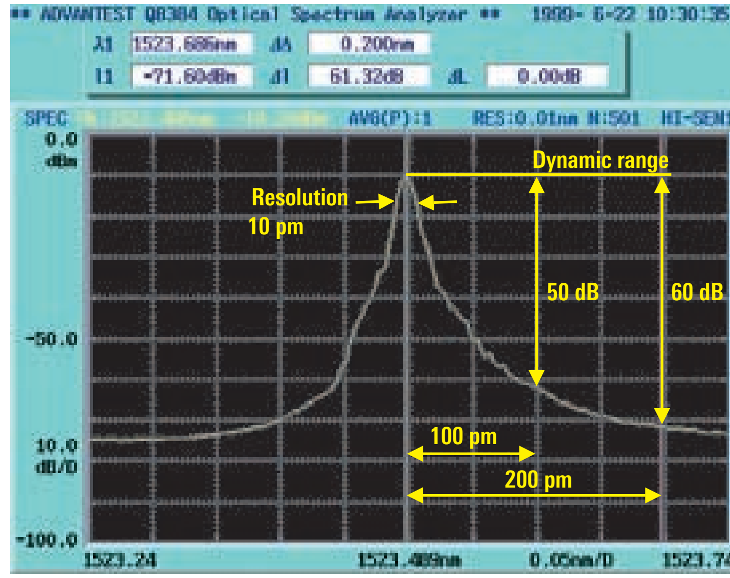


FIG 2 Excellent specifications: resolution and dynamic range of Q 8384

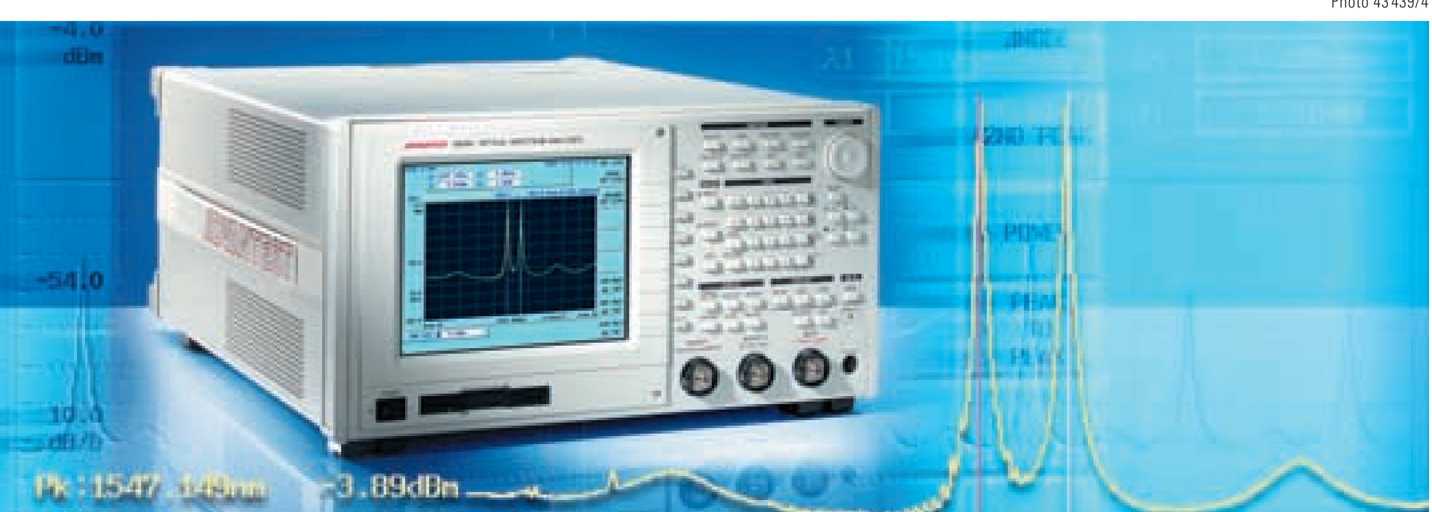
Optical Spectrum Analyzer Q 8384 (FIG 1) with a wavelength range from 600 nm to 1700 nm is ideal for these applications. Optimized for the currently used wavelengths from 1530 nm to 1620 nm in the C band and the L band and featuring a dynamic range of 60 dB, it is optimally suited for measurements with a signal spacing of 200 pm in the vicinity of the carrier (FIG 2). Its excellent resolution bandwidth of 10 pm is due to an entirely new quadruple monochromator system. These specifications predestine the analyzer even for measurements on future systems. A resolution bandwidth of 10 pm at 1550 nm corresponds to about 1.25 GHz, which means that measurements on modulated signals with a 10 Gbit/s data rate are possible with high accuracy even in the optical range.

High resolution minimizes the wavelength error. In Q 8384 this is ensured by a servomotor system that moves the diffraction grating with a minimum step width of 8×10^{-6}/rotation. The wide amplitude measurement range with high input level serves among other things for direct measurement on optical EDFAs (erbium-doped fiber amplifiers) and their pump lasers. The polarization response is typically 0.02 dB.

RF measurement engineers will quickly familiarize with instrument operation. The parameters to be set on Q 8384, such as center frequency / wavelength, deviation, reference level, are well-known from RF spectrum analyzers. Only the keys labelled "THz", "µm" and "nm" ▶

FIG 1 New Optical Spectrum Analyzer Q 8394 with numerous automatic evaluation functions

Photo 43 439/4



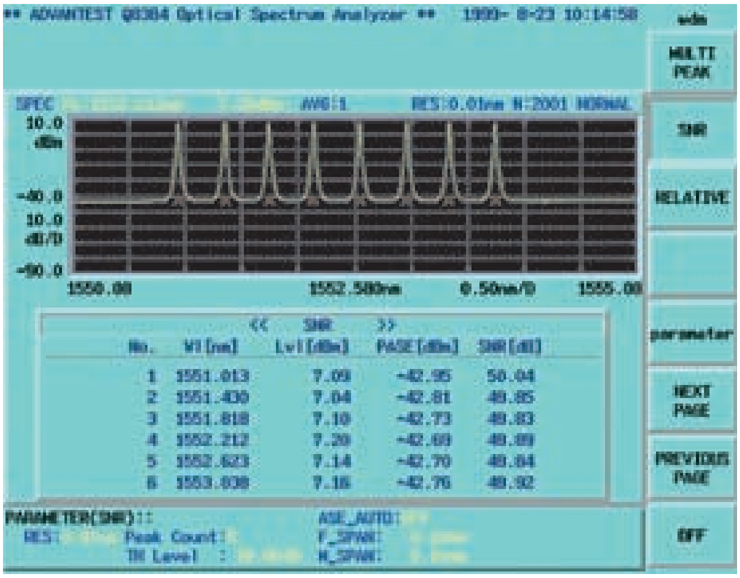


FIG 3
Clearly displayed: wavelength, level and S/N ratio of six channels

indicate that Q8384 measures in the region of infrared light.

In addition to basic applications like measuring energy distribution versus wavelength on light sources like LEDs and laser sources, Q8384 features complex evaluation functions that simplify operation even for the untrained user:

- side-mode suppression ratio (SMRS) on distributed feedback laser diodes at a keystroke,
- noise figure of optical amplifiers,
- signal/noise ratio,
- measurement of various spectral bandwidths (e.g. 3 dB bandwidth like with RF measurements),
- signal analysis with numerical listing of wavelength, level and S/N ratio for up to 256 channels (FIG 3).

These macros and automatic routines are also available for operation from a PC and guarantee high measurement throughput.

Measurements with Q8384 in DWDM systems and their components include:

- selective power measurement of single carriers and their wavelength (deviation) from the rating,
- total power,
- intermodulation effects (four-wave mixing),
- deviation of channel spacing,
- optical S/N ratios.

In the fast sweep mode, a sweep can be performed in 0.5 s, which increases the measurement time as a function of the required dynamic range. Sweep times of the order of milliseconds, common in RF technology, cannot (yet) be achieved.

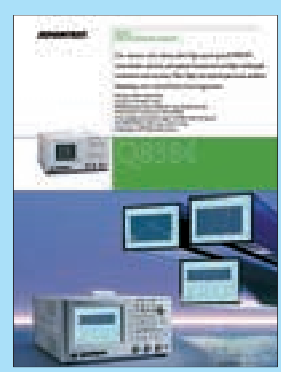
With the aid of the gated sweep function, even pulsed signals can be measured with Q8384. Marker functions like in RF spectrum analyzers, split-screen display, 3D presentations of signal traces and trend analyses – e.g. level or wavelength stability as a function of time – are other features offered by Q8384.

The analyzer comes with a 21 cm TFT display, offers up to 10001 selectable sampling points and provides a floppy disk drive, IEC/IEEE bus and printer interfaces, a VGA connector and has a built-in thermal printer. ST and SC connectors can be fitted in addition to the optical FC input connector provided as standard. An integrated edge-emitting LED source is provided for attenuation measurements on optical filters such as fiber bragg or arrayed waveguide gratings. An acetylene gas cell is also built-in for wavelength calibration.

Joachim Heinze

Other optical measuring instruments available through Rohde & Schwarz are described on the next page.

More information and data sheet at www.optical.rohde-schwarz.com or at www.advantest.co.jp or enter 170/14 on reader service card



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[2] Global players under the sea: market leader for fault location in submarine cables. News from Rohde & Schwarz (1999) No. 163, pp 42–43

Optical measuring instruments from Advantest

Rohde & Schwarz markets a number of other optical measuring instruments and test sets from Advantest besides Optical Spectrum Analyzer Q 8384.

Q 8347 is a spectrum analyzer based on the Michelson interferometer principle for general applications up to the visible range at 350 nm. The program thus includes analyzers for both kinds of optical spectrum analysis, the dispersive and the interferometer principle.

Analogously to RF technology, **Optical Network Analyzer Q 7760** measures s-parameters on components and in system tests with the aid of the parameters amplitude, group delay, chromatic dispersion and polarization mode dispersion – and all in a single sweep [1]. Measurement speed is faster by multiples than in conventional test assemblies, only a few seconds for narrowband DUTs.

Optical Wavelength Meter Q 8326 and its predecessor have for years been standard equipment in many optical calibration laboratories. Thanks to a Michelson interferometer and internal HeNe reference laser, the calibration standard is already included; wavelength resolution is 0.1 pm.

Instruments for measuring specific optical parameters are also available: **Optical Chirp Test Set Q 7606** and **Optical Polarization Scrambler Q 8163** for determining polarization losses.

The **coherent optical time domain reflectometer (C)OTDR** for fast fault location in submarine fiber-optic cables up to a length of 15 000 km is able to measure even across intermediate optical amplifiers [2].

Photo 43 684/1

FIG 4 Transmission Analyzer D 3371 for data rates up to 3.6 Gbit/s

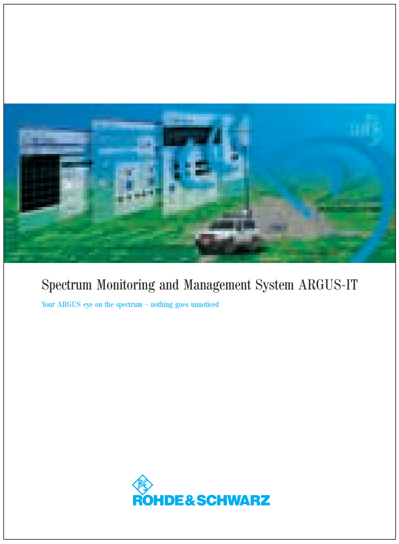
Brand-new and intended especially for fiber manufacturers: the unique **dispersion optical time domain reflectometer (D)OTDR** for determining chromatic dispersion in single-mode glass fibers as a function of fiber length. The dispersion in the form of a nonlinear distortion is an essential and critical quality criterion, particularly at an operating wavelength of 1550 nm and increasing data transmission rates.

Q Monitor D 3281 automatically determines the Q factor online from BER measurements.

BER test sets with data rates of 3.6 Gbit/s and 12.5 Gbit/s are another program highlight besides purely optical instrumentation. These test sets with electrical inputs are indispensable for measurements on high-speed switching circuits on the datacom and telecom market with signal rise / fall times of a few picoseconds. They enable you to search for a single errored bit in a data stream of 100 billion bits (10^{-11}) even in frames with a defined bit pattern (FIG 4).

The **handheld and desktop Optical Multi Power Meters Q 8210 and Q 8221,** of modular design and equipped with a large selection of power sensors and light sources, complete the line of general optical measuring instruments.

All instruments named are optimized for measurements in DWDM systems at 1550 nm and guarantee fast and accurate results.



Spectrum Monitoring and Management System ARGUS-IT Compared to the first issue of May 1999, the data sheet has been completely revised. 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 757.4818.22 enter 170/15

TV Trigger/RF Power Trigger FSP-B6 Option FSP-B6 makes the Spectrum Analyzers FSP suitable for analog TV measurement applications and provides a settable RF level trigger for measurements on pulsed RF signals that are used in TDMA transmission systems.

Data sheet PD 757.6433.21 enter 170/16

Harmonics Mixers FS-Z60/-Z75/-Z90 extend the frequency range of Spectrum Analyzers FSEM and FSEK, of EMI Test Receivers ESI26 and ESI40 as well as of Signal Analyzer FSIQ26. The mixers feature standardized waveguide flanges for the following waveguide bands:

- FS-Z60: 40 GHz to 60 GHz (band U)
- FS-Z75: 50 GHz to 75 GHz (band V)
- FS-Z90: 60 GHz to 90 GHz (band E)

Data sheet PD 757.6310.21 enter 170/17

GSM/EDGE Application Firmware FSE-K5 for FSP The new firmware, which can be integrated in all spectrum analyzers of the FSP family, offers the most important GSM and EDGE transmitter measurements at a keystroke.

Data sheet PD 757.6185.21 enter 170/18

EGDE Application Firmware FSE-K20/K21 The firmware modules FSE-K20 and FSE-K21 enhance the measurement functions of firmware modules FSE-K10 and FSE-K11 by modulation measurements on $3\pi/8$ shifted 8PSK-modulated signals in line with the EDGE standard.

Data sheet PD 757.6304.21 enter 170/19

WCDMA/3GPP Application Firmware FSIQ-K72 for transmitter measurements on 3GPP base stations and modules using Signal Analyzer FSIQ.

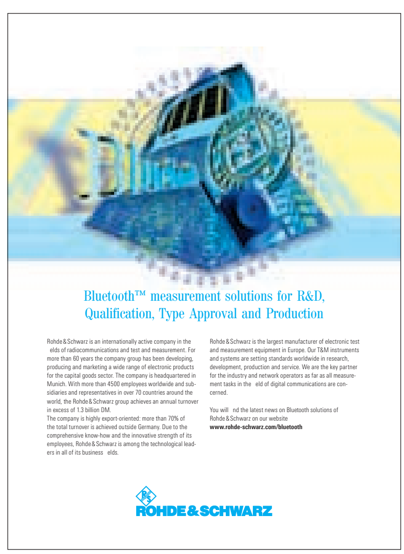
Data sheet PD 757.6391.21 enter 170/20

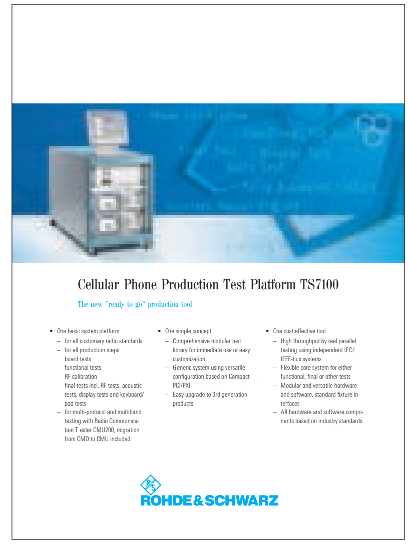
Cellular Phone Production Test Platform TS7100 is a highly compact, all-in-one solution for testing mobile phones. Although the system has only a height of about 80 cm and can be placed under the conveyor belt of a production line, it includes all the essential components for the simultaneous testing of two mobile phones.

Data sheet PD 757.5737.21 enter 170/21

Bluetooth™ measurement solutions for R&D, qualification, type approval and production Compilation of the most important T&M instruments and systems from Rohde&Schwarz to perform measurements on Bluetooth™ equipment.

Flyer PD 757.5489.22 enter 170/22





Facts and Figures 2001 The most important figures all around Rohde&Schwarz on 32 pages: business fields and products at a glance, plants, subsidiaries, partners plus the addresses and phone numbers of the sales offices in Germany and abroad.

Brochure PD 757.1431.27 enter 170/23

New application notes

Generating Bluetooth™ RF Test Signals with Signal Generator SMIQ

Appl. 1MA31 enter 170/24

Transmitter Measurements on Bluetooth™ Modules with Spectrum Analyzer FSP

Appl. 1MA26 enter 170/25

New catalogs

The new catalog **"Test & Measurement Products 2001/2002"** will be published in German and English at the beginning of April. Both versions will also be available digitally on the enclosed CD-ROM. Well over 300 products are described on 472 pages. The focus is on innovation for mobile radio measurement: from multi-platform Radio Communication Tester CMU through a series of new generators, spectrum and network analyzers with mobile-radio-specific modulation and analysis features to test systems for the development and production of third-generation mobile radio equipment including UMTS and Bluetooth. (PD 756.3501.27 or reader service card 170/26)

The new CD-ROM **"Sound and TV Broadcasting 2001/2002"** will be available as a bilingual German-English version as of March, focusing on digital broadcasting technology: Rohde & Schwarz provides a complete range of products from TV and sound broadcast transmitters of all power classes through innovative measurement technology and datacasting (Web over DTV) to coverage measurement systems for setting up digital transmission networks. A comprehensive technical annex completes the CD-ROM which can be obtained free from all local Rohde & Schwarz representatives.

NEWSGRAMS | International

T & M technology and security solutions for telecommunications and data transmission at CeBIT 2001

At CeBIT 2001, which took place in Hanover from 22 to 28 March 2001, Rohde & Schwarz presented its innovations in communications and T & M technology at stand D 48 in hall 15. Plus, the company offered solutions for IT security at a separate stand (CEFIS) in hall 23. The focus was on T & M technology for Bluetooth, UMTS, GSM-GPRS and EDGE. New test equipment for optical, EMC and general-purpose measurements were also on show. Further highlights were TETRA systems, Internet access via TV as well as data and telecommunications security.

Rohde & Schwarz offers a wide variety of T & M equipment for new and future mobile radio technologies. CRTU-G and PTW 60 for instance are protocol testers for GSM, EDGE and Bluetooth. A mobile radio coverage measurement system for interference measurement plus a complete test vehicle were on show. For optical measurements, Rohde & Schwarz exhibited several innovative devices of its cooperation partner Advantest, such as optical network and spectrum analyzers. ESPI, an EMC test receiver for the medium class, was introduced. SITLink from Rohde & Schwarz SIT GmbH is an effective tool for the encryption of communication on leased lines. Plus, a solution for accessing the Internet via digital television technologies was exhibited. Trunked-radio equipment (TETRA) rounded off the Rohde & Schwarz presentation.

Rohde & Schwarz at EMC in Zurich

At this year's EMC in Zurich, the focus was on the new pre-compliance EMI Test Receiver ESPI (photo below). ESPI combines the precision of a test receiver and the high speed of a spectrum analyzer in a single unit. It allows

Photo 43 665/10

precompliance and diagnostic measurements in development to be carried out fast and precisely to ensure that products are developed in line with EMC standards.

The new EMC Test Software EMC32 was also on show. It represents a completely new operating philosophy: a single graphical user interface ensures both full control of measuring equipment and accessories as well as monitoring of measurement sequences. Numerous predefined test routines and a configuration tool to integrate the measuring equipment used also facilitate EMS measurements.

New office in Dubai for enhanced TETRA service in the Middle East

R&S BICK Mobilfunk has founded a new office in the Jebel Ali free-trade zone in Dubai, United Arab Emirates. Worldwide, digital trunked radio systems are increasingly being used in the professional mobile radio applications of police forces, fire fighters and rescue services as well as in public transport and major industrial enterprises. Within just a few years, TETRA has established itself as one of the leading technologies in this field. The global market for digital trunked radio solutions has a potential of some DM 40 billion over the next 10 years. Local presence is paramount.

With this new office the company offers its numerous customers and partners in the Middle East intensified on-site support and service. Workrooms for the technical integration of the TETRA systems as well as comprehensive training and workshop facilities have been provided, plus the number of staff responsible for project management and sales and service has been increased.

Danish DeTeWe development team adds development capacities for measurement technology

Rohde & Schwarz has taken over the development staff of Danish CorTech A/S from DeTeWe AG & Co., Berlin, as of 1 February 2001. All employees will be integrated in the newly founded Rohde & Schwarz Technology Center A/S with headquarters in Pandrup, Denmark.

In future, the specialists for wireless communication products will develop test solutions for mobile radio. This expansion of development capacities enables Rohde & Schwarz to respond faster to new mobile radio standards and to consolidate its position as the world's leading supplier of test and measurement equipment for mobile radio.

The mobile communication market is progressing continuously. While CDMA, GSM, GPRS, EDGE and Bluetooth are establishing themselves as today's modern wireless communication systems, the new generations UMTS and cdma2000 are already waiting in the wings. Manufacturers of T & M equipment have to be always one step ahead to provide the market with the fundamental technology essential for the development of instruments.

The newly founded technology center will focus on the development of test and measurement solutions for mobile communication. "Especially in the field of new mobile communication standards, we as T & M manufacturers provide the socalled enabling technologies, i.e. the basis for product development", says Michael Vohrer, Executive Vice President of the Test and Measurement Division at Rohde & Schwarz. "That's why we take part already in the definition phase of mobile communication standards, to be able to design multi-functional measurement instruments for use in development as well as fast customer-specific test equipment for use in production. Founding the Rohde & Schwarz Technology Center allows us to expand these development capacities and so to strengthen our leading position on the world market."

Basic contract for the delivery of GSM base station testers concluded with Lucent

Rohde & Schwarz and Lucent Technologies Network System concluded a basic contract for the delivery of GSM Base Station Testers NetHawk. Over the next five years, and optionally every following year, Lucent will buy these testers exclusively from Rohde & Schwarz for use worldwide. In addition to central coordination and maintenance, Lucent will make use of the possibility of implementing functionality of its own as well as new technologies in the software.

Base Station Tester NetHawk, a product of the Finnish company X-Net and marketed by Rohde & Schwarz, consists of a plug-in card for use on notebooks and associated software (photo below). NetHawk enables the installation and maintenance of base stations at minimum measurement effort. If necessary, the results of protocol measurements can be e-mailed to a central station and analyzed. Central software updating and maintenance guarantees identical software versions and measurement routines for all users. Lucent also intends to use the tester for worldwide initialization and startup of the new generation of GSM base stations.

Germany's first public TETRA mobile radio network provided by R & S BICK Mobilfunk

The Hamburg service provider RegioCall Mobilfunk GmbH has awarded R&S BICK Mobilfunk GmbH, a subsidiary of Rohde & Schwarz, a contract for the supply of a TETRA mobile radio network *ACCESSNET* ™-T. The system will first operate in the Hamburg port area and later

Photo 43 3368/9

Crowds at the high-tech day at the Memmingen plant

cover the entire city. Logistics and security companies as well as courier services and other enterprises will then benefit from a powerful and individually adaptable professional mobile radio solution.

At the first stage the mobile radio network will cover the port of Hamburg with TETRA base stations DSS-500 in the frequency range 410 MHz to 430 MHz. After the test phase, which started in December 2000, the network went into operation at the beginning of 2001. By mid-2001 further base stations will be added to the system. The *ACCESSNET* ™-T TETRA network will then cover the entire city of Hamburg, the port being the focus of coverage.

RegioCall has Germany's first public TETRA network based on *ACCESSNET* ™-T. Thanks to the system's adaptability, users can even incorporate their specific solutions such as accounting or GPS systems and dispatcher services into the radio network.

High-tech day at Rohde & Schwarz Memmingen plant

Rohde & Schwarz Messgerätebau GmbH in Memmingen issued a successful invitation to its technology day on 27 January 2001. More than 1200 visitors came to inform themselves about the latest developments in mobile radio, communications and T & M technology. For Rohde & Schwarz this event was also a new approach to human resources marketing since the Memmingen plant alone has 200 vacancies to fill.

A guided tour of the plant, talks on topics such as UMTS and various workshops were offered during each three-hour program. The experts clearly and comprehensibly conveyed their knowledge about tomorrow's technologies. Plus, all visitors could get active themselves and prove their skill at inserting miniature components or testing modules. Many visitors seized the opportunity of a personal talk at the information stands where skilled workers, engineers, human resources managers and the plant management were ready to answer questions.

In November 2000, the company launched specific measures to acquire new staff and organized the first technology day. As a result, twice as many job applications as usual were sent in. Since then, quite a number of employees were taken on. Plant Manager Jürgen Steigmüller is pleased to continue this successful development. A decisive factor lies with his own staff: "Our employees convey the pleasure working for Rohde & Schwarz means to them. Only their commitment and genuine enthusiasm made the event such a success."

WAP access to Rohde & Schwarz intranet

Easy and convenient access to the inhouse intranet is now available to Rohde & Schwarz employees, even while away. Via the T-D1-W@P intranet access and the Lotus Domino Everyplace Quickstart software, e-mails can be called up and sent as well as schedules and to-do lists prepared and adjusted via WAP mobile or PDA (personal digital assistant).

"Many of our staff dial to the intranet via their laptops to check their e-mails and appointments", says Wolfgang Ludwig, Head of Data Processing and Information Technology at Rohde & Schwarz. "The WAP access ensures fast and easy use of these services now also directly via WAP mobile or PDA."

A sales cooperation of T-Mobil, IBM and Lotus makes this latest development possible. Within the cooperation the partners defined starter offers for fast mobile access to Lotus applications. The offers are based on existing products of all three companies for mobile data applications.

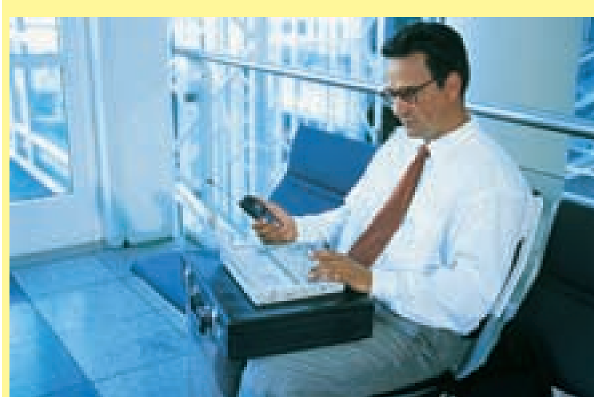


Photo 43 505/5

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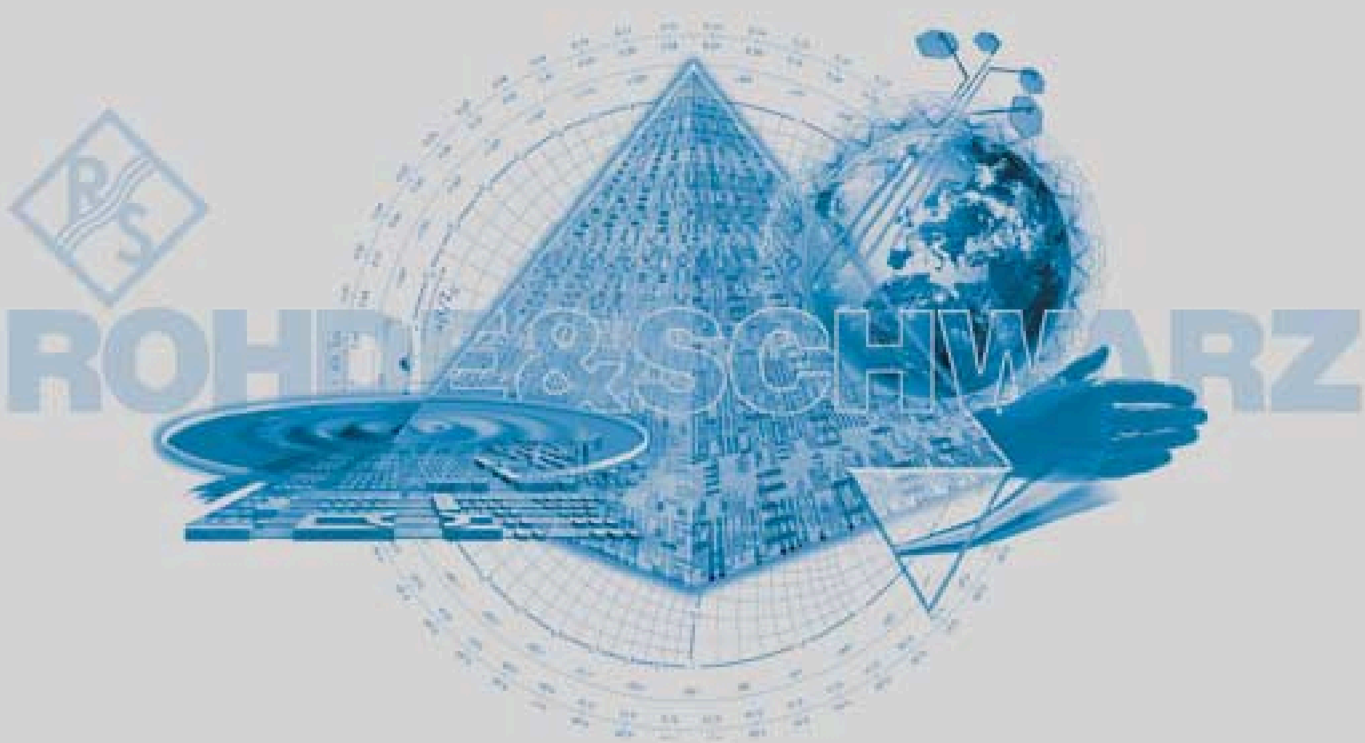

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