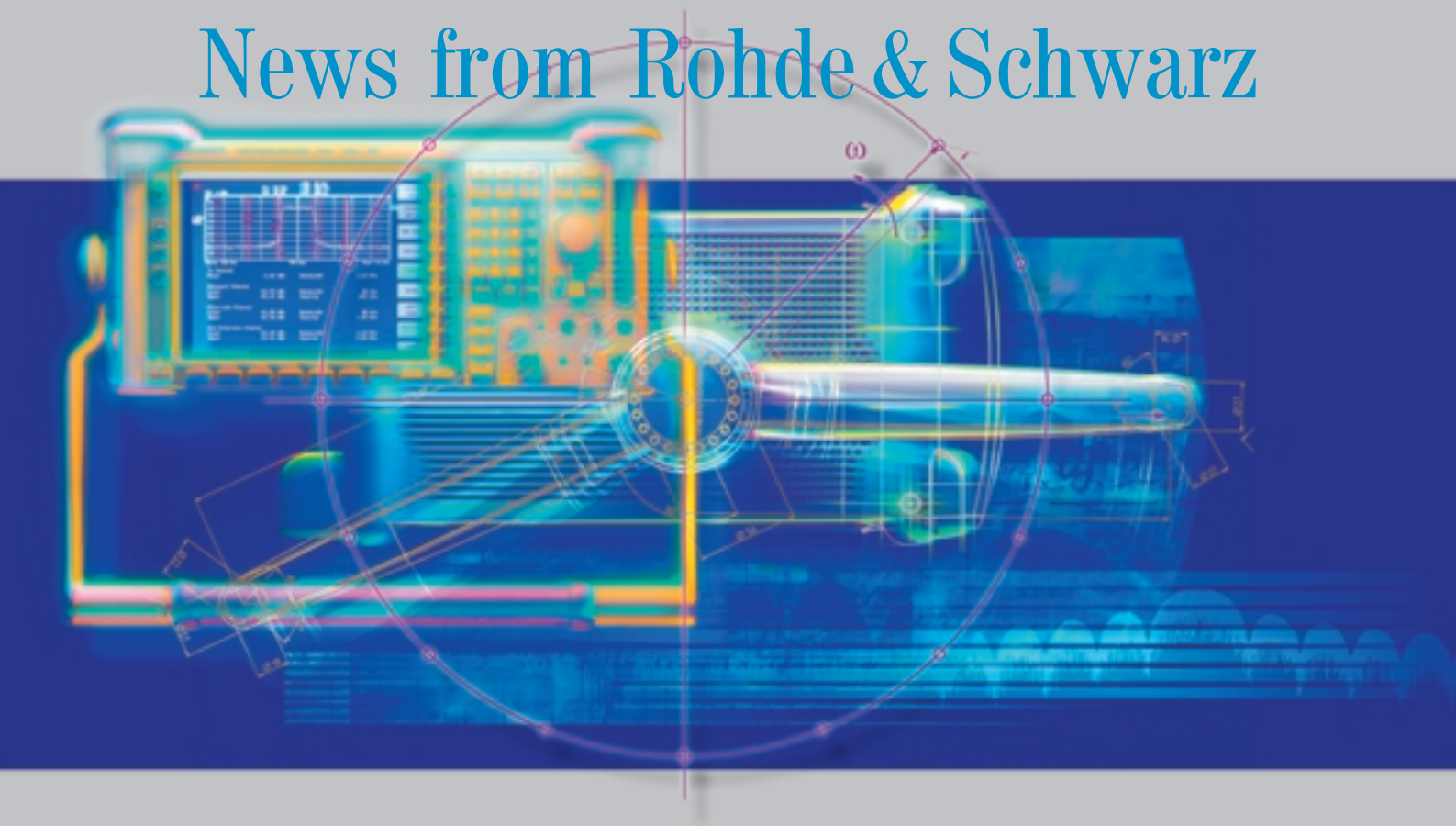
News from Rohde & Schwarz



In hot pursuit of the top performers:
new medium-class spectrum analyzers

Software-based radios
for professional use

Coverage measurements
supported by convenient software

2000/I
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ROHDE&SCHWARZ

Number 166 2000/I Volume 40

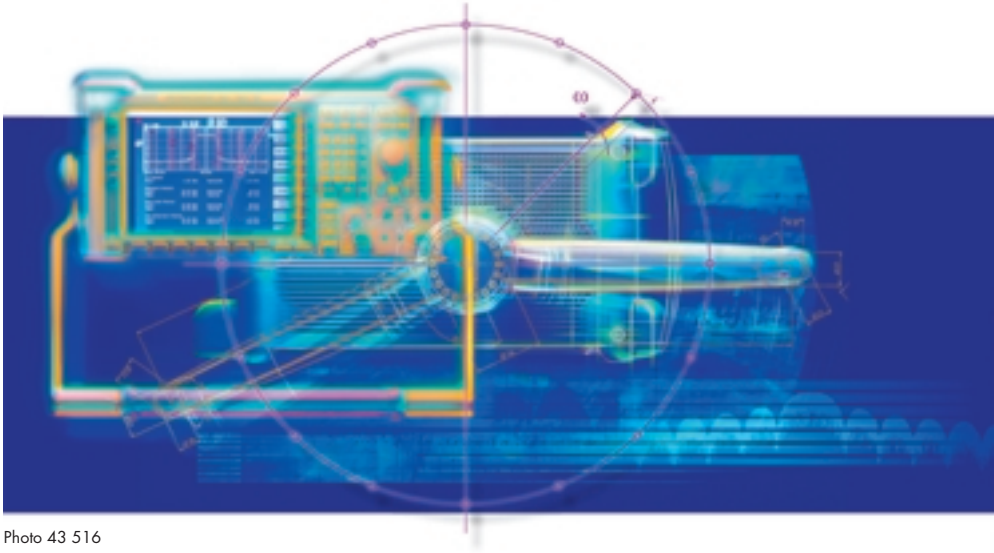

Photo 43 516

The new, attractively priced FSP spectrum analyzers, though medium class, offer similar performance as the high-end instruments FSE and FSIQ. In some respects they even outdo the top performers. With their high measurement speed and accuracy, the FSP analyzers are not only the right tool for general-purpose laboratory and service applications but also the ideal choice for production environments (page 4).

Articles

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Software

Panorama

Regular features

Web over DTV is a simple and cost-efficient solution for distributing Internet resources among TV viewers, for example, or for allowing TV providers to offer additional services with their programs. This service is implemented by means of the Rohde&Schwarz DTV IP Inserter and the DTV Web Carousel™ software (page 18).

Imprint

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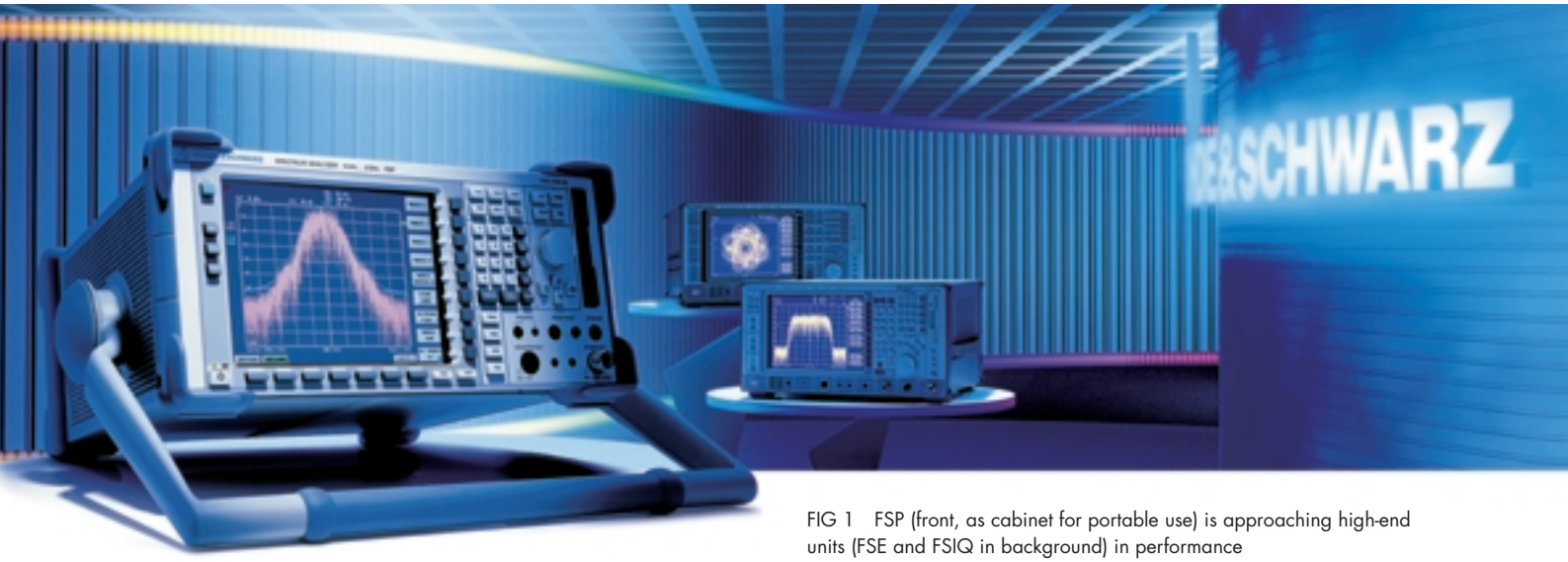

Photo 43 446

FIG 1 FSP (front, as cabinet for portable use) is approaching high-end units (FSE and FSIQ in background) in performance

Spectrum Analyzer FSP

Medium class aspiring to high end

Playing right at the top of the high-end class are Spectrum Analyzers FSE and Signal Analyzers FSIQ from Rohde&Schwarz. After all, their RF performance, measurement speed and accuracy plus flexibility make them suitable for even the most demanding applications. New on the scene are the attractively priced Spectrum Analyzers FSP (FIG 1) that, although medium class, are able to offer similar performance. And in some respects they even outdo the top performers.

High measurement accuracy combined with high speed

With its high measurement speed and accuracy, FSP is not only the right tool for general-purpose laboratory and service applications but also an ideal choice for production needs. Speed and accuracy are decisive for throughput and for investment in measuring equipment for a given production target. To significantly improve these key features, Rohde&Schwarz took a completely new approach in the design of FSP, making it fit for in-production measurements, for example on components and modules of radio transmission equipment, with maximum speed and reproducibility.

The basic prerequisite for high measurement throughput is high-speed remote control. A normal benchmark test determines the number of traces transmitted per second to a controller on the remote interface. FSP is fitted with an IEC/IEEE-bus interface as standard. With 10 MHz span and minimum sweep time it transmits up to 30 traces with 501 test points per trace. In the zero span mode, as many as 70 traces per second are possible. In manual operation, up to 25 pictures per second create the impression of an analog measurement and enable speedy alignment.

The FSP family comprises four analyzers with different frequency ranges:

FSP3	9 kHz	to	3 GHz
FSP7	9 kHz	to	7 GHz
FSP13	9 kHz	to	13 GHz
FSP30	9 kHz	to	30 GHz

Thus optimum frequency range can be offered for each application, whether RF or microwave.

Synthesizer set in next to no time

A VCO works as the first local oscillator. This offers considerably higher speed than the usual magnetically tuned YIG oscillator because it can be set much faster. You notice it in particular when resetting the frequency between two frequency scans. The sweep oscillator is always synchronized to the reference frequency, which results in excellent frequency accuracy even with large spans. The minimum sweep time of FSP is 2.5 ms. Plus, the FSP synthesizer features extremely low phase noise. The guaranteed figure at 500 MHz and 10 kHz carrier offset is –106 dBc(1 Hz). Typically, a figure as low as –110 dBc(1 Hz) is obtained (FIG 2). These good phase noise characteristics are maintained up to 7 GHz input frequency because there is no doubling of the oscillator frequency.

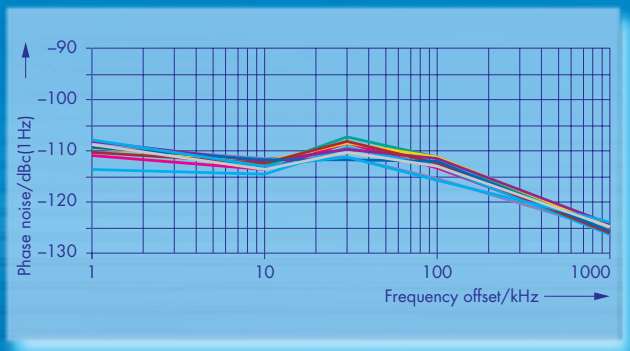

FIG 2 Phase noise of Spectrum Analyzer FSP at 500 MHz, measured on 10 units

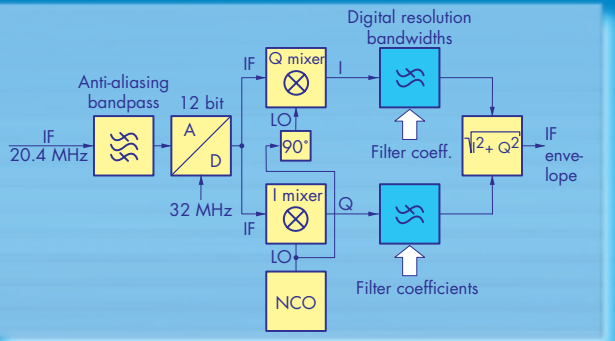

FIG 3 Block diagram of digital filters in FSP

Digital signal processing

Other important features contributing to the high measurement speed of FSP are the high sampling rate (32 MHz) for the last IF voltage or video voltage, and processing of the digitized signals in R&S-developed ASICs. So sweep times between 1 µs and 16000 s are possible at zero span. This concept benefits not only measurement speed but also accuracy and reproducibility.

To maximize measurement speed and simplify manual operation, FSP features internal routines, running markedly faster using the internal sequences than with external control. Frequent measurements in development, verification and production are those of power and adjacent-channel power on TDMA or CDMA signals for example. Here FSP offers preconfigured, particularly fast test routines for the major standards (W-CDMA, cdmaOne, IS-136 and TETRA).

Digital resolution filters are implemented for bandwidths between 10 Hz and 30 kHz (FIG 3). Switchover between the filters is effected by loading the corresponding coefficients into the ASIC. This digital implementation of the IF bandwidths not only allows use of Gaussian filters, common in spectrum analyzers, but also of steep channel filters and even root-cosine filters, stipulated by different standards for measuring channel and adjacent-channel power.

The digital concept is utilized in FSP to measure adjacent-channel power in the time domain. The FSP family comes with channel filters for the most common standards, including W-CDMA. For power detection there is the rms detector familiar from the FSE family. FSP sets the different channel frequencies one after the other according to the selected standards, and measures the power at each frequency using the specified channel filters. Because of the fast VCO synthesizer, the time required for channel frequency switchover is virtually insignificant. Using this method, measurements are speeded up by a factor of about 10 compared to the integration method common to date in spectrum analyzers (FIG 4).

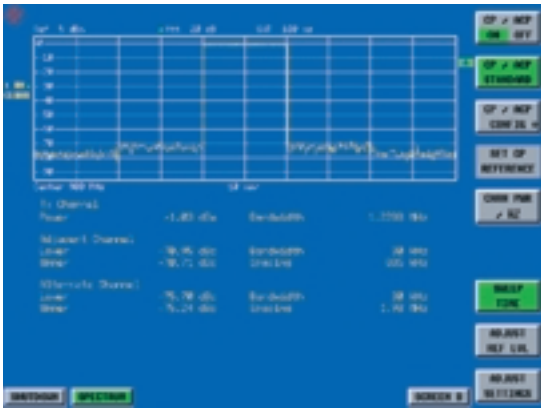

FIG 4 Adjacent-channel power measurement to IS-95 CDMA in time domain (Fast ACP). Measurements to this standard, for example, require a sweep time of approx. 800 ms when using the integration method so far common in spectrum analyzers, to be able to detect the power in the transmit channel and in two adjacent channels (above and below the transmit channel) with 0.25 dB standard deviation. Using the measurement method of FSP in the time domain, only 50 ms is required. Time overheads caused by frequency switchover, internal calculations and output of results via IEC/IEEE bus are only approx. 30 ms, so reproducible results are available within 80 ms.

Photo 43 389/10

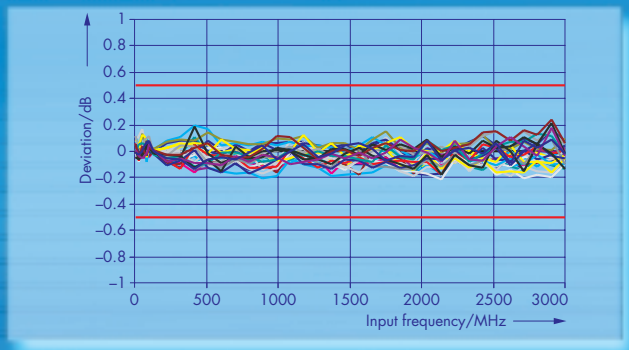

FIG 5 Frequency response of FSP up to 3 GHz, measured on 10 units at 0/25/50 °C. Red tolerance lines mark guaranteed limit values specified in data sheet. Calculated standard deviation of results is 0.135 dB

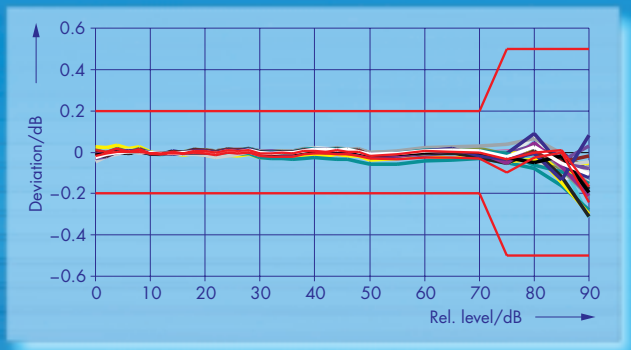

FIG 6 Linearity error of digital bandwidth filters between 10 Hz and 30 kHz in level range down to 90 dB below reference level, measured on 30 units. Red tolerance lines mark data sheet specifications (±0.2 dB down to –70 dB and ±0.5 dB below)

Measurement uncertainty reduced to a minimum

In FSP, Rohde&Schwarz presents for the first time a spectrum analyzer with a guaranteed total measurement uncertainty as small as 0.5 dB in the main communication range up to 3 GHz, and this over the specified temperature range, for all RF attenuator settings and with 70 dB level range on the display.

Due to the high measurement accuracy of FSP, higher tolerances can be allowed for the DUT and the number of rejects reduced, or measurement times can be reduced with correspondingly lower repeat accuracy.

The outstanding precision of FSP is based on a concept that minimizes uncertainties right from the start:

- digital signal processing in ASICs,
- use of function modules with close tolerances, which are decisive for measurement uncertainties,
- correction of residual errors by integrated firmware.

To make it easier for the user to calculate the total measurement uncertainty, for example in a test system, the FSP data sheet for the first time specifies standard deviations of the individual uncertainties (FIGs 5 and 6).

Excellent RF performance

The RF performance of an analyzer is a decisive criterion as to whether complex measurements, for example of intermodulation or spurious, can be performed for a given DUT. Depending on the demands made for RF performance, a high-end spectrum analyzer like FSE or a medium-class instrument like FSP will be used. While FSP is not comparable with FSE or FSIQ in terms of RF performance, it excels in sensitivity and large-signal characteristics for an instrument of the medium class.

Sensitivity is usually specified as displayed average noise level (DANL) at the smallest resolution bandwidth. FSP achieves < –140 dBm at 10 Hz resolution bandwidth up to 7 GHz. Typical figures are –145 dBm (10 Hz) up to 3 GHz and –143 dBm (10 Hz) from 3 GHz to 7 GHz. The FFT filters (1 Hz to 30 kHz) fitted as standard not only improve DANL but also afford considerably higher speed than sweep filters.

But overall dynamic range is determined by DANL plus large-signal characteristics. The latter depend on the power-handling capacity of the input mixer (1 dB compression) and on intermodulation. With a 1 dB compression level of the input mixer of 0 dBm and a third-order intercept point of ≥7 dBm, FSP offers an overall dynamic range that is excellent in this medium class (FIG 7).

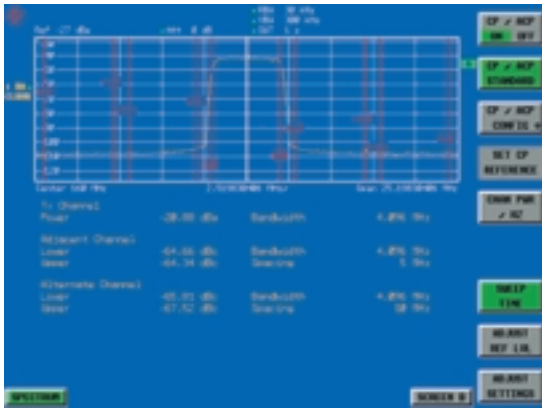

FIG 8 Adjacent-channel power measurement on W-CDMA uplink signal shows the excellent overall dynamic range of about 64 dBc of Spectrum Analyzer FSP

The outstanding dynamic characteristics show, for example, in adjacent-channel power measurements on uplink W-CDMA signals to ARIB standard with an overall dynamic range of approx. 64 dBc in the first adjacent channel (FIG 8).

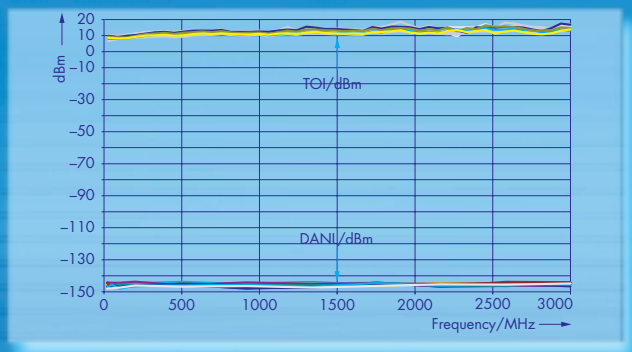

FIG 7 Displayed average noise level (DANL) at 10 Hz bandwidth and third-order intercept point (TOI) measured on 10 FSP3 units

Multitude of preconfigured measurement functions

The FSP family comes with a large number of preconfigured measurement functions for the wide range of applications to be covered by a spectrum analyzer (yellow box). With so many functions ready implemented, FSP's list of options is very short. An OCXO is available for enhanced frequency accuracy, a tracking generator for scalar network analysis up to 3 GHz, and an AM/FM demodulator with internal loudspeaker and headphones output for signal monitoring. The optional 100-base T-LAN interface allows not only networked control of FSP but also transfer of large amounts of data from FSP's IQ memory (2 x 128 kwords). Noise Measurement Software FS-K3 is available for measuring the noise figure of amplifiers and frequency-converting components and modules. The noise source is driven direct by FSP.

Josef Wolf

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[1] Wolf, Josef: Spectrum Analyzer FSEA/FSEB: New dimensions in spectral analysis. News from Rohde&Schwarz (1995) No.148, pp 4–8

Condensed data of FSP

Frequency range (FSP3/7/13/30)	9 kHz to 3/7/13/30 GHz
Amplitude measurement range	–140 dBm to 30 dBm
Amplitude display range	10 dB to 200 dB in steps of 10 dB, linear
Amplitude measurement error limit	<0.5 dB up to 3 GHz <2 dB from 3 GHz to 13 GHz <2.5 dB from 13 GHz to 30 GHz
Resolution bandwidths	1 Hz to 30 kHz, FFT filters 10 Hz to 10 MHz in increments of 1 and 3 EMI bandwidths 200 Hz, 9 kHz, 120 kHz, channel filters
Detectors	max peak, min peak, auto peak, sample, average, rms, quasi-peak
Display	21 cm (8.4") TFT colour LC display, VGA resolution
Remote control	IEC 625-2 (SCPI 1997.0) or RS-232-C
Dimensions (W x H x D)	412 mm x 197 mm x 417 mm
Weight w/o options (FSP3/7/13/30)	10.5/11.3/12/12 kg

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Preconfigured test functions

- Frequency counter with fast algorithm for digitally implemented bandwidths up to 30 kHz
- Measurement of noise and phase noise
- Measurement of AM modulation depth
- Measurement of third-order intercept point (TOI)
- Power measurement in time domain (mean, rms and peak power over selectable time periods)
- Power measurement in frequency domain, adjacent-channel power measurement preconfigured for major standards
- Gated-sweep function
- Versatile trigger functions (free run, video, external, IF power, pretrigger, trigger delay)
- Signal statistics (APD/CCDF) over definable number of decorrelated measured values
- Measurement of occupied bandwidth
- EMI quasi-peak detector (bands A, B and C/D) with corresponding EMI bandwidths 200 Hz, 9 kHz and 120 kHz
- User-definable limit lines (absolute or relative) with selectable margin and pass/fail indication
- Two independent test settings with fast switchover at keystroke
- Split-screen display with separate settings in two measurement windows

Photo 43465

Series 4400

Software-based radios for professional use

The new Series 4400 radio generation (M3SR for multiband, multimode, multifunction surface radio) (FIG 1) is based on a powerful uniform platform. The open system architecture surmounts the drawbacks of conventional LOS radios, characterized by different platforms and devices for various frequency bands and applications. Like its successful predecessors of Series 400U, the application range of Series 4400 radios covers air traffic control through air defence to complex naval communication systems.

Multifunctional platform

Complex transmission modes, digital modulation and straightforward integration into modern networks are the demands on today's radio systems. Plus, professional users insist on multiline capability, ie concurrent operation of several communication lines in a single radio.

In Series 4400, Rohde&Schwarz offers a concept that is implemented on a software-controlled, uniform platform with very large scale integration (VLSI) modules. This principle ensures truly versatile use and an extreme measure of radio-system standardization with all the accompanying potential for reducing cost of ownership.

Based on an embedded realtime operating system, the platform handles internal communication, interfaces with the outside world and takes care of AF signal processing as well as device control. Waveform modifications or additional data radio protocols can be implemented by simple software downloads. The customer can thus create flexible radio systems from hardware and software building blocks. The basic platform is identical for all applications. In tune with the philosophy of a universal platform, a variety of software and hardware extensions, called preplanned product improvements (P^3I), were conceived for the basic unit. These include extension of the frequency range and also integrated high-data-rate modems.

Series 4400 is equipped with VLSI components, so space requirements are reduced by up to 50% compared to conventional units. And this together with higher performance is a very marked advantage especially for shipboard applications.

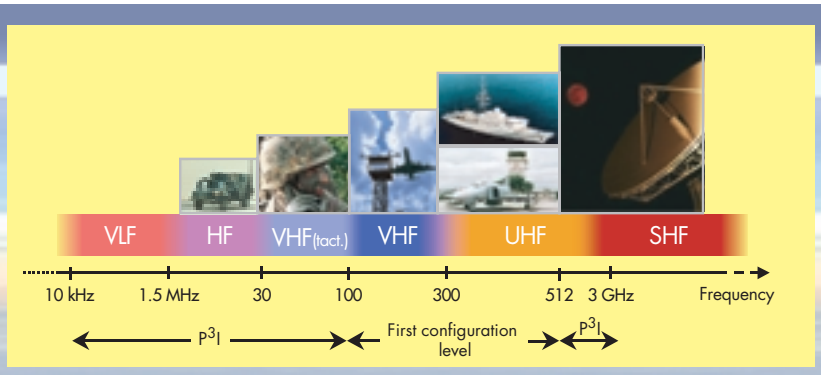


FIG 2
Multiband Series 4400 in its present configuration covers the frequency range 100 MHz to 512 MHz. Future modules with appropriate software will considerably extend this range – deploying the same platform

FIG 1
Thanks to their open concept, Series 4400 radios are easily integrated into complex communication scenarios. They fully meet requirements for future-proofness, flexibility and modularity

Condensed data of Series 4400 (VHF/UHF models)

Frequency range VHF/UHF	100 MHz to 512 MHz
Output power VHF/UHF	30 W AM/100 W FM
Operating modes VHF/UHF	simplex, half-duplex, duplex, EPM: HAVE QUICK I/II, SATURN, SECOS, UHF SATCOM DAMA various combinations of these modes
Number of parallel receiver/exciter lines	4
Number of parallel EPM lines	2
Remote-control interfaces	LAN, RS-232-C/485, ISDN, DTMF

Reader service card 166/02

Optimally integrated into modern networks

Network integration is simplified by a variety of standardized interfaces. The LAN hubs integrated into the radios provide for easy networking between installations and with other communication components. Plus, serial and ISDN interfaces are offered for controlling units from detached stations. A graded system of passwords for various user groups guards authorized access.

Real plug&play

To reduce the maintenance effort to a minimum, the individual modules are fully independent of each other. Meaning that if a module is replaced, neither hardware adjustment nor an exchange of platform software is required. The radios recognize the used hardware on booting and configure themselves appropriately.

Multiline and multimode

The multichannel radios of Series 400U already offered two parallel communication lines, with Series 4400 there are up to four. And the radios of Series 4400 occupy only three height units – an innovation in surface radios.

Two of these communication lines can be protected against jamming and interception for secure transmission (eg frequency hopping and encryption). Even waveform modifications or third-party data radio protocols can be implemented line by line by simple software downloads. Voice is digitized internally and can be routed to one of the communication lines by an integrated digital switch. In this way the open concept of Series 4400 can implement digital voice and/or data communication.

Multiband capability

Another outstanding feature of Series 4400 is the possibility of extending to extra frequency bands (FIG 2). The limits of traditional transceivers (eg VHF/UHF or HF) have been done away with. Thanks to the multiband capability of Series 4400, rigid assignments to a certain application or frequency band are a thing of the past.

Michael Fraebel; Robert Vielhuber

Signal Generator SMIQ

Fit for 3G with new options

Last year the frequency range of Vector Signal Generator Family SMIQ (FIG 1) was extended to 6.4 GHz [*]. This year the emphasis is on upgrading SMIQ for third-generation mobile radio (3G). The versatility of the successful generators has been boosted by extra options and especially by a new version of the modulation coder.

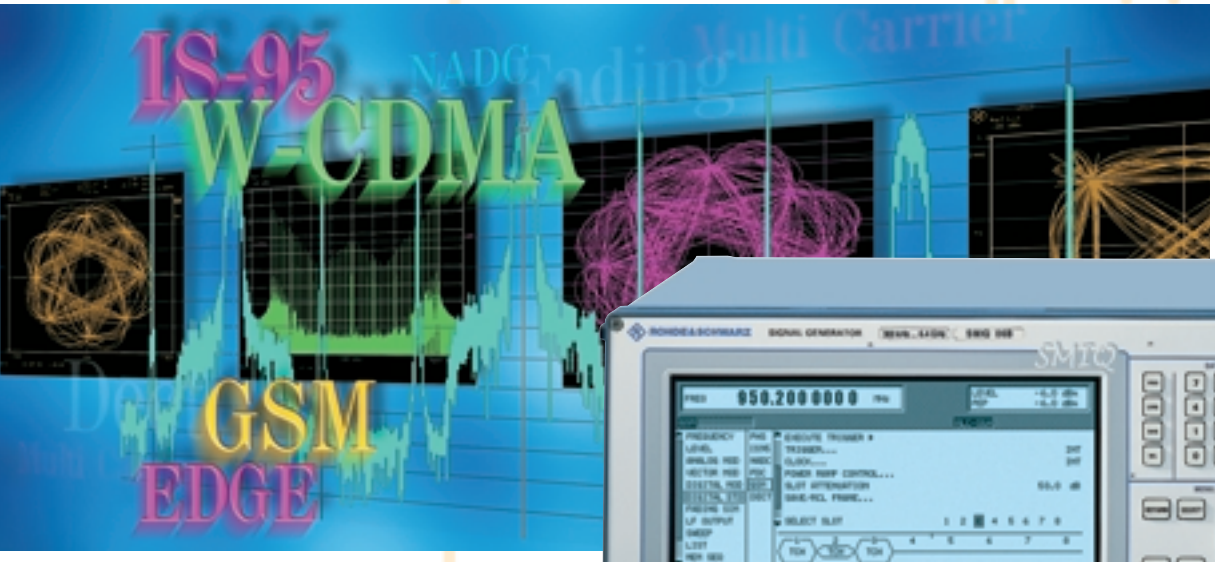


Photo 43 359/2

Photo 43 334

FIG 1
Signal Generator SMIQ is now ready to go for third-generation mobile radio

Modulation coder further improved

Like its predecessor, the new Modulation Coder SMIQ-B20 supports all relevant types of digital modulation from FSK to 256QAM and also all established mobile-radio standards. To meet future requirements, some of its specifications were improved and additional functions added (see box on right).

EDGE implemented

8PSK modulation as defined in the extension of GSM standard EDGE (enhanced data rate for GSM evolution) with $3\pi/8$ rotation and the associated linearized Gaussian filter are already implemented in the modulation coder. Especially worth noting is that SMIQ can process external data in real-time. Plus, SMIQ is the only unit on the market able to switch between GMSK and EDGE modulation from slot to slot, ie to simulate mixed GSM/EDGE signals like those to be processed by base stations if an old and a new mobile phone have to be operated at the same time (FIG 2). This unique feature saves a second signal source in such applications.

W-CDMA to 3GPP standard

Software option SMIQ-B45 supports generation of downlink and uplink signals to 3GPP standard (FDD mode)[1]. This means simulating the physical channels including their slot structure. The signals exactly conform to 3GPP standard in frame structure, spectral distribution and signal statistics, allowing correct testing of the particular components.

Versatile configuration

The current 3GPP standard is supported, stipulating a chip rate of 3.840 Mchip/s and 15 slots/frame as

1) Until the passing of the standard the functionality of the option will be adapted at regular intervals. Required software updates are free of charge. For users wanting to generate W-CDMA signals to NTTDoCoMo standard, option SMIQ-B43 can also be installed.

proposed by Operators Harmonization Group (OHG).

Up to four base stations or four mobile stations with separately selected scrambling code can be simulated. One BS may have up to 128 data channels in addition to special channels. An MS can be operated in the three modes PRACH only, PCPCH only and DPCCH + DPDCH (max. 6 DPDCHs).

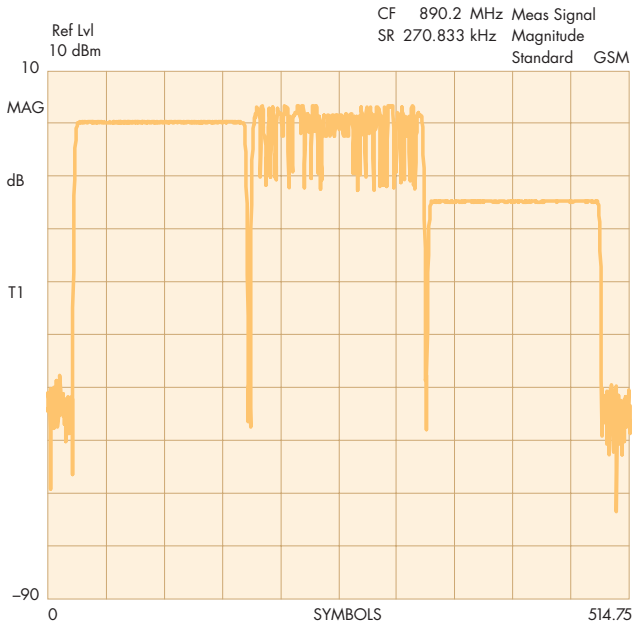
Symbol rate, channelization code, power (can even be varied in time) as well as data contents and timing offset can be selected for each code channel (timing offset can be used to influence signal statistics and thus crest factor).

P-/S-CPICH, P-/S-SCH, P-/S-CCPCH, AP-/CD-AICH, PDSCH, DL-DPCCH and DPCHs with their corresponding slot structure can be generated in the downlink. Transmit diversity is also already supported. The clipping function allows simple simulation of the clipping measures implemented in every base station.

Despite the large functionality of this option, W-CDMA signals can be generated fast by means of **assistant functions**. A W-CDMA signal is produced by a few keystrokes with the aid of predefined configurations, which may be varied through selection of the crest factor or the number of data channels. To avoid incorrect entries, overlapping of individual code channels (domain conflicts) can be displayed and even automatically resolved by a keystroke (FIG 3). The graphical display of constellation diagram, CCDF and occupied code domain serves to check generated signals for conformance. And this can be done far more easily than with an analyzer.

Oversampling is digital, so long signal lengths can be implemented (eg 13 frames with 3.84 Mchip/s), which allows much more realistic signals to be generated than by continuous repetition of the same frame.

FIG 2
Section of mixed GSM/EDGE signal generated with SMIQ (slots 1 and 3 contain GSM burst, slot 2 EDGE burst)



The new functions at a glance

- Generation of mixed GSM/EDGE signals
- Creation of multichannel, random configurable W-CDMA signals to 3GPP and power control of individual W-CDMA channels in realtime (with option B45/B48)
- Measurement of BER (with option B21)
- Optional two-channel arbitrary waveform generator

The new modulation coder enhances SMIQ by additional options and by various improvements:

- Maximum permissible symbol rate of 18 Msymbol/s, unrivalled and future-safe
- Amplitude shift keying (ASK) and split-phase filter are implemented. The special feature of this filter is that it generates Manchester-coded signals. These are signals where each symbol is represented by a signal change, ie the symbol adopts two states per symbol clock. Together with ASK modulation for example, this self-clocking code allows generation of signals for the Japanese ETC system (electronic toll collection) that is currently being developed
- Memory for storing user-specific modulation data per option can be extended up to max. 80 Mbits
- Improved resolution of digital filters. As a result, SMIQ can now achieve ACP values of –74 dB with TETRA standard
- The number of available filters was extended, the permissible range of their parameters widened and combination of filters with any modulation allowed. It is thus possible to simply simulate many applications outside the major standards

Second source for W-CDMA data

If SMIQ is equipped with Memory Extensions SMIQ-B11 and -B12, the modulation coder together with option B48 has a second means of generating W-CDMA data for up to four channels, called enhanced channels in SMIQ. These channels can be combined with the remaining channels and offer a variety of other applications:

- The maximum sequence length of enhanced channels is 200 frames. If only one channel is required, the maximum is even 800 frames. Very long signal sequences and endless PN sequences (eg PN9) like those often required for BER measurements can thus be implemented for the channel under test.
- The code power of enhanced channels can be varied **in real-time** by an external control signal. This enables testing the closed-loop power control function of a mobile station for example.
- To determine the performance of a W-CDMA receiver under real conditions, BER measurements have to be carried out in the presence of a large number of orthogonal adjacent channels. SMIQ can simulate this situation: the measurement channels are generated with the enhanced channels while up to 508 other channels simulate the OCNS (orthogonal channel noise simulation) signal. Due to the doubling of data sources in option B20, different periods can be selected for pseudo-random bit sequence (PRBS) and OCNS signals to avoid the same error occurring at the same point of the PRBS signal. This ensures measurements in realistic conditions.

Measurement of bit error rate

Option B21 enhances SMIQ for BER measurements at bit rates of up to 30 MHz. The DUT delivers the data to be tested and the related clock, while the BER tester compares them with the nominal data, calculates and displays the error rate. Selectable PRBS are used as nominal data. Status messages for missing clock and data or synchronization failure help in the event of problems. Signal sections of no interest can be blanked out by the Data Enable or Pattern Ignore function. Even non-continuous PRBS signals can be processed via a restart line (eg finite PRBS stored in an ARB).

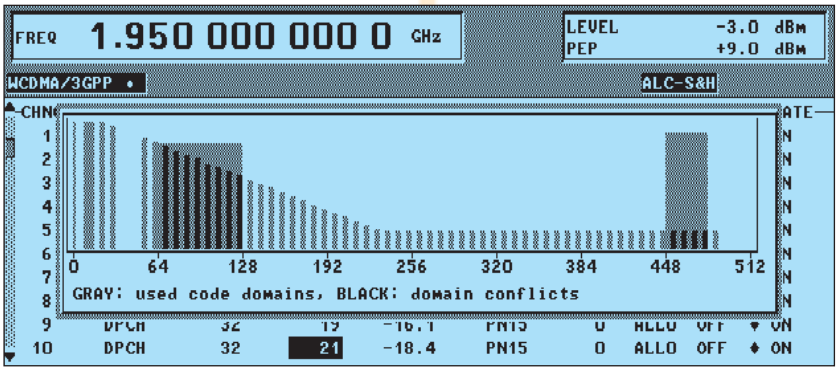
Two-channel arbitrary waveform generator

To further enhance the versatility of the modulation coder, a two-channel ARB generator with a maximum clock rate of 40 MHz is available (option SMIQ-B60). It can store up to 512 k externally computed I/Q values that are loaded into SMIQ. The supplied Windows Software WinIQSIM™ allows convenient calculation of I and Q baseband signals on a PC. Together with a convenient editor, the software can calculate any kind of TDMA frame configuration, simulate impairments by overlapping interference signals, generate multicarrier signals and much more. Ready computed data records can be saved in a nonvolatile memory four times the size of the output memory and need not be recomputed each time.

The two-channel ARB option (B60) and enhanced channels can easily be retrofitted by the user, as can the options BER measurement (B21) and W-CDMA (B45).

Wolfgang Kernchen

FIG 3
Display of occupied code domain of W-CDMA signal. Black areas indicate impermissible overlaps (domain conflicts)



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Reader service card 166/03

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.

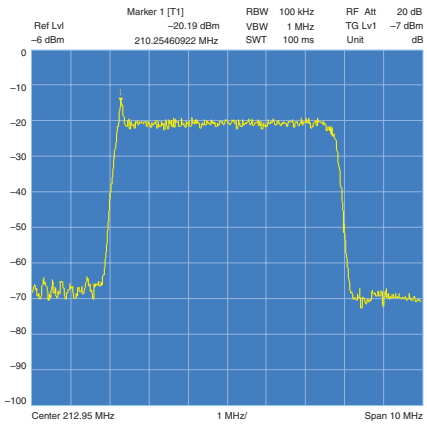

FIG 2 SFQ supplies RF output spectrum in conformance with standard

Data randomization ensures constant power density in the channel, and Reed-Solomon coding provides outer error correction (FEC). The subsequent interleaver performs convolutional coding and protects the signal from burst-type transmission interference. To deal with the difficult terrestrial transmission conditions, the outer error correction of the signal is complemented by inner error correction in the form of trellis coding of the data (for detailed description of the ATSC coder see box).

The transmitted data are organized in frames by means of segment and field sync signals. The segment and field sync information is transmitted in binary form and used in the receiver for clock recovery and as a training sequence for adaptive channel matching (equalizer). A pilot carrier whose power is very low in comparison with the sum signal power and which corresponds to the unmodulated carrier in frequency and phase is transmitted along with the signal for carrier recovery in the receiver.

Flexible input interfaces

The useful data are fed to SFQ byte-oriented in 188-byte transport stream packets. The system data rate is 19.39 Mbit/s in conformance with the ATSC standard. Deviating from the ATSC standard data rate, SFQ accepts a data rate variation by ±10%. The resulting linear bandwidth variation of the output spectrum causes violation of the upper and lower channel boundaries. A standard output symbol rate of SFQ can be attained for virtually any input data rate by means of the optional input interface, which allows the output symbol rate to be set independently of the input data rate [2]. A synthesizer on the input interface generates the precise symbol rate in the absence of an input transport stream. This option also provides additional input interfaces:

- synchronous parallel interface (SPI),
- asynchronous serial interface (ASI),
- externally clocked asynchronous serial interface (ASI ext. CLK),
- externally clocked parallel interface (SPI ext. CLK),
- SMPTE 310 interface (optionally with ext. CLK).

Versatile transmission tests

Standard-conforming signals are useful in go/nogo tests of equipment but in most cases do not reflect the real situation. SFQ can simulate the errors occurring in real transmission systems, thus enabling error limits to be determined. This also allows assessment of receivers through to their performance limits.

SFQ offers a wealth of functions for putting transmission systems through their paces:

- It can generate output signals with I/Q modulation, thus allowing sideband switchover (IF/RF inversion). Settable RF parameters: residual carrier, I/Q phase, I/Q imbalance and pilot amplitude.
- An internal, high-precision noise source (optional) allows BER characteristics of receivers to be recorded for quality classification. Bit-error measurement can be carried out by SFQ if the latter is fitted with the option B17.
- An optional fading simulator can be looped into the signal path to investigate the behaviour of transmission systems with multipath reception.
- The randomizer, Reed-Solomon coder and interleaver in the ATSC encoder path can be switched off. This is useful in the development of receivers and helpful in servicing.
- The data signal applied to SFQ can be replaced by internally generated test signals at various points of the encoder. The following test signals are available:
  - null TS packets,
  - null PRBS packets (2^{15}–1 or 2^{23}–1),
  - PRBS before/after trellis coding,
  - sync PRBS (2^{15}–1 or 2^{23}–1) for simple BER measurements in receivers.

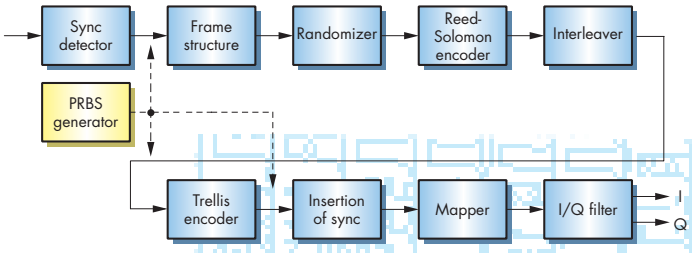

FIG 3 Block diagram of ATSC coder (see box)

REFERENCES

[1] Handl, Josef: TV Test Transmitter SFQ Model 20 – TV via antenna: digitally fit. News from Rohde&Schwarz (1999) No. 161, pp 4–6

[2] Schmidt, Peter: Optional input interface for TV Test Transmitter SFQ. News from Rohde&Schwarz (1997) No. 156, pp 34–35

The SFQ output frequency range from 0.3 MHz to 3.3 GHz enables tests far beyond the frequency range defined by the standard as well as measurements at any intermediate frequencies. The wide output level range of +3.2 dBm to –99.9 dBm allows measurements on high-sensitivity receiver modules but also transmission measurements at high levels.

New, yet tried and tested

Like the other successful SFQ models, the new model offers many proven features: user-friendly operation, messages indicating non-standard settings or operating states, status menus, online help, IEC/IEEE bus and RS-232-C interfaces as well as firmware updates from a PC. The future-oriented platform concept of the TV test transmitter has been designed to integrate coming modulation systems, so that SFQ is a profitable long-term investment.

Günter Huber;
Stefan Ritthaler

Operating principle of ATSC coder

The input signal at the coder (FIG 3) is an MPEG2-coded transport stream with a data rate of 19.392658 Mbit/s and a packet length of 188 bytes.

The sync detector at the coder input checks the input data stream for transport stream synchronization and, if the latter is in line with the standard, enables the output signal. The data are segmented to form the VSB data frame format, the frame structure being determined by segment and field synchronization. Each segment comprises 208 bytes, ie the sync byte, three header bytes, 184 payload bytes and 20 FEC bytes.

The randomizer links the data to a PRBS sequence to ensure constant power density in the channel. The data are block-coded in the Reed-Solomon encoder (207, 187, t = 10) for outer error correction. The 20 Reed-Solomon bytes of the FEC are calculated and added to each transport stream packet. The FEC bytes allow up to ten data bytes per transport stream packet to be corrected in the receiver.

Burst-type interference on the transmission path causes series of errored symbols. An interleaver at the coder end and a corresponding deinterleaver at the receiver end distribute the errors to many Reed-Solomon blocks, ensuring that the number of errors per block is kept small enough for the Reed-Solomon decoder to correct them.

Conversion of the data byte to the symbol to be transmitted takes place in the trellis encoder. Each byte is divided into four symbols, and the trellis encoder adds a parity bit for inner error correction to each dibit thus generated. This yields groups of tribits, each representing a symbol, which the mapper allocates to one of the eight amplitude levels. Vestigial sideband modulation is implemented by digital Hilbert transformation followed by analog I/Q modulation.

Condensed data of SFQ

Frequency range	0.3 MHz to 3.3 GHz
Level range	+3.2 dBm to –99.9 dBm
Input data rate	19.392658 Mbit/s ±10 %, in packets of 188 bytes
Output symbol rate	10.762 Msymbol/s ±10 %
Signal bandwidth	6 MHz ±10 %
Data inputs	TS parallel (LVDS), ASI, SMPTE 310
Modulation method	8T VSB
Error simulation	carrier suppression, I/Q imbalance, I/Q phase
Special functions (switch-selected)	scrambler, interleaver, Reed-Solomon, pilot, pilot amplitude variable
Test signals	null TS packets, null PRBS packets (2^{15} –1 or 2^{23} –1), sync PRBS (2^{15} –1 or 2^{23} –1), PRBS before/after trellis coding (2^{15} –1 or 2^{23} –1)

Reader service card 166/04

Digital Direction Finder DDF 190

Now from 0.5 MHz through 3000 MHz

Digital Direction Finder DDF 190 [*] was originally designed for the VHF-UHF frequency range covered by the two DF Antennas ADD 190 (20 MHz to 1300 MHz) and ADD 071 (1300 MHz to 3000 MHz) (FIG 1). In response to the great success of this DF family and the requests of many customers for a favourably priced and compact DF solution in the HF range too, Rohde & Schwarz has extended the direction finder accordingly.

Photo 43 393/1

FIG 1 Digital Direction Finder DDF 190 with the mast-mounted Antennas ADD 190 and ADD 071, covering frequency range 20 MHz to 3000 MHz. New is the Antenna ADD 119 (top) for range 0.5 MHz to 30 MHz. Bottom left: portable Miniport Receiver EB 200

Photo 43 455/2

New features at a glance

What is most conspicuous is the new HF DF Antenna ADD 119 (FIG 1) that covers the frequency range 0.5 MHz to 30 MHz. Extended firmware in DF Unit EBD 190 performs bearing calculations in this range. Connection Board GX 190 is responsible for automatic selection and power supply of the antennas, which may also work simultaneously. DDF 190 offers full remote control via the RS-232-C system interface of EBD 190 in the extended frequency range too.

Even in the shortwave range, Direction Finder DDF 190 can work with all receivers featuring an unregulated IF output of 10.7 MHz or 21.4 MHz, for example broadband Rohde & Schwarz receivers EB 200 (FIG 1) or ESMB, or ESMC plus Frequency Extension ESMC-FE. Test receivers can also be used of course, for instance those of the ESN or ESVN series.

In the VHF-UHF range, the direction finder operates on the principle of a correlative interferometer which, thanks to a patented Rohde & Schwarz method, requires only one receiver instead of the two of a conventional system. The Watson-Watt method employed in the HF range allows the use of very compact antennas.

New HF DF Antenna ADD 119

HF DF Antenna ADD 119 consists of two crossed, active loop elements and an active dipole housed in a flat, fiberglass-reinforced plastic radome. It permits direction finding with a maximum error as small as 2° (rms), allowing ITU class A to be attained also in the HF range assuming an environment with sufficiently low interference, adequate S/N ratio and vertical polarization. The directional patterns of the antenna elements make ADD 119 suitable for receiving groundwaves as well as flat skywaves. To obtain unambiguous bearings, the mast height should be no more than about 20 % of the shortest operating wavelength – higher masts, because of their self-resonance, lead to unduly large phase differences between the loop and dipole elements and thus to ambiguous results. ADD 119 has the same size and connectors as VHF-UHF Antenna ADD 190 and is ideal for mobile and stationary applications.

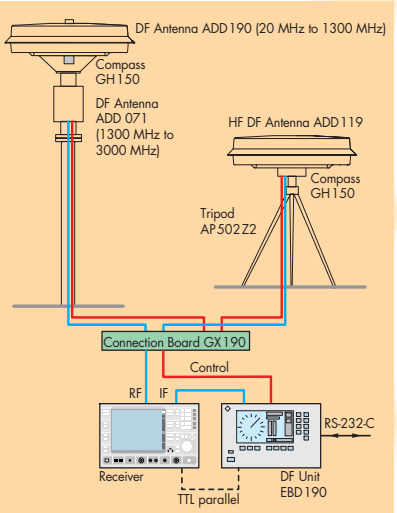

FIG 2 Typical configuration of mobile DF system for 0.5 MHz to 3000 MHz

System configuration

FIG 2 shows a typical system configuration for mobile applications in the HF and VHF-UHF ranges. Antennas ADD 190 and ADD 071 are mounted on a telescopic mast attached to the vehicle. To minimize mutual interaction, HF Antenna ADD 119 is set up on a tripod at a distance of about 40 m. ADD 190 and ADD 119 can be fitted with an electronic compass (option) for automatic north alignment.

To configure a system with only one mast – for example in stationary applications – with ADD 190 mounted at the top of the mast, the disturbing effect of the mast in the HF range can be eliminated by using two Antennas ADD 119 on opposite sides of the mast in conjunction with Combiner GX 119.

Connection Board GX 190 comprises a control-signal distributor plus an RF selector for 0.1 MHz to 3000 MHz, which connects one of maximally six antennas to the output. This is usually done by automatic control from DF Unit EBD 190, but the system can also be configured for control via an RS-232-C interface.

Special features

DF Unit EBD 190 comes with a front-panel keypad and LC display for convenient, straightforward operation. The receiver is operated separately; interfaces for antenna range selection are supported however. Sequential scanning of the antenna elements during the DF process leads to noise in the AF signal of the receiver typical of single-receiver direction finders. For undisturbed monitoring of the useful signal, the scanning function and thus direction finding can be switched off (AF/DF key).

In most cases DF accuracy can be substantially improved, especially with noisy or disturbed signals, by choosing an appropriate averaging time (between 0.1 s and 5 s) and performing signal-matched filtering in DDF 190 (from 0.5 kHz to 100 kHz). Three operating modes (NORmal, CONTinuous, GATE) and several display modes (polar, numerical, histogram) are available for further optimization of direction finding for various types of application. A newly implemented Q (quality) filter effectively suppresses wild bearings. A realtime clock allows a time stamp to be output together with each bearing. This makes for easier allocation of information in networked DF and location systems.

Franz Demmel; Ulrich Unselt

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[*] Demmel, Franz; Wille, Raimund: Digital direction finding from 20 to 3000 MHz to ITU guidelines. News from Rohde & Schwarz (1996) No. 152, pp 30 – 32

Condensed data of DDF 190

Frequency range	0.5 MHz to 3000 MHz with three antennas and suitable receiver
Polarization	vertical
DF accuracy	2° (rms) 0.5 MHz to 80 MHz 1° (rms) 80 MHz to 1300 MHz 2° (rms) 1.3 GHz to 3 GHz
DF sensitivity (<5° bearing fluctuation (rms), 5 s integration time)	0.5 MHz to 30 MHz: 5 µV/m to 15 µV/m (frequency-dependent) 20 MHz to 3000 MHz: 1 µV/m to 10 µV/m (frequency-dependent)
Bandwidths	HF: 0.25/0.5/1/3/5 kHz VHF/UHF: 1/2.5/8/25/100 kHz

Reader service card 166/05

Web over DTV

Cost-attractive service through DVB: Transmission of extra data in Web format

Web over DTV is a simple and cost-attractive solution for distributing Internet resources among TV viewers, for example, and for allowing TV providers to offer additional services with their programs. This service can be implemented by means of the Rohde & Schwarz DTV IP Inserter and DTV Web Carousel™ software. The underlying principle is to insert selected Internet data in IP format into the MPEG2 data stream of a DVB transmitter for broadcasting together with the TV signal via an antenna. The recipient can store this information in his PC and view it using a standard Web browser.

DTV IP Inserter

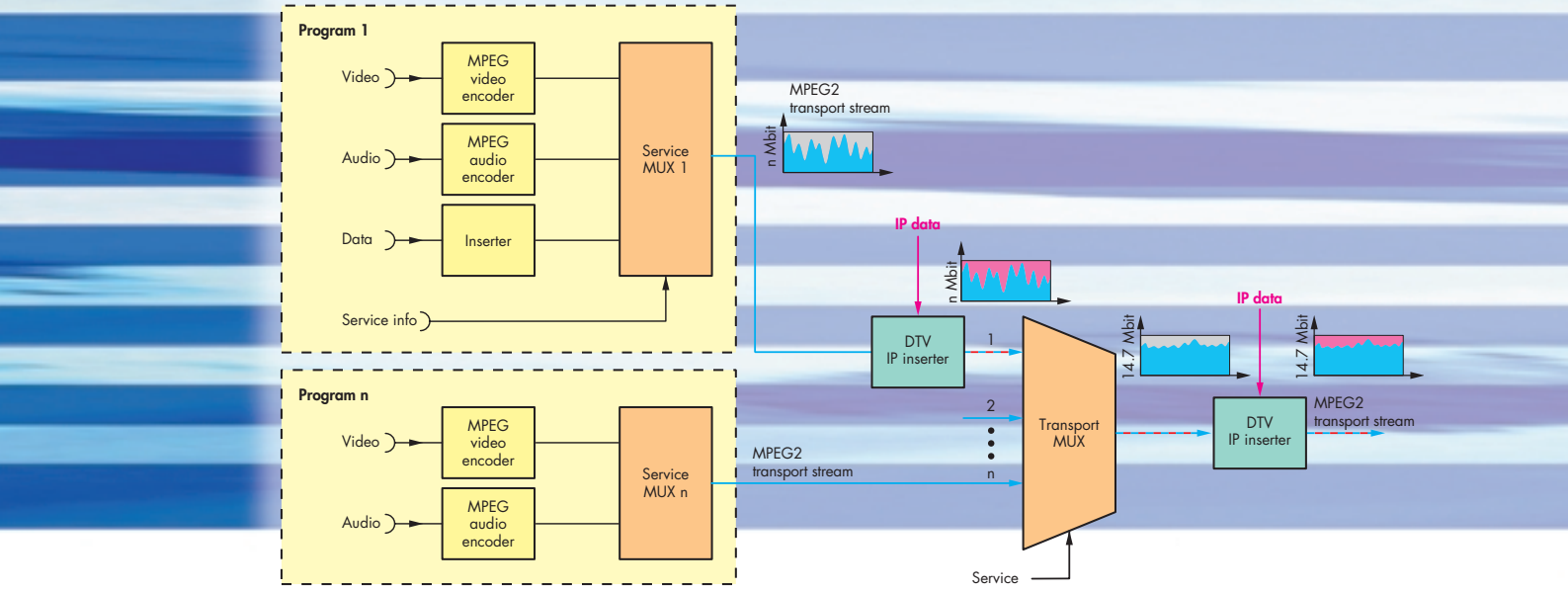
The DTV IP Inserter (FIG) allows transmission of additional data in Internet format (IP) with the DVB MPEG2 data stream. The DVB broadcaster can now offer an extra service to provide many viewers with the data. Transmission of these additional data is not subject to any restrictions and does not change the data rate of the programs contained in the transport stream, consisting of video, audio and service information. This is possible by utilizing unused resources (null packets) in the transport stream. A packet detector in DTV IP Inserter DIP identifies the null packets inserted in the transport stream for stuffing, which are then exchanged for IP packets and thus effectively utilized. Additional data can be inserted after the MPEG encoder or multiplexer by the multiprotocol encapsulation method defined for DVB.

If the available transmission data rate is constant, the DTV IP Inserter directly follows the MPEG encoder (see block diagram) and the variable part of the video and audio data is supplemented with additional data to form a fixed data rate. The clear advantage for program providers is the optimum utilization of the data rate. To make use of the resources available in the transport stream, the DTV IP Inserter is located after the multiplexer.

DTV Web Carousel™

Convenient use of the resources provided by the DTV Inserter is ensured by the DTV Web Carousel™ system solution. This software allows to transmit selected Internet pages via DVB to stationary and mobile subscribers and to view these pages after reception with a common Web browser.

Web Carousel™ sends the data without request, which exactly corresponds to the push principle used in teletext for example. The sense of transmission is unidirectional, communication is from transmitter to receiver.



Block diagram: use of free MPEG2 transport stream capacity with DTV IP Inserter DIP (see photo on right) in front of and after multiplexer

Photo 43 451/3

DTV Web Carousel™ then sends the provided information pool cyclically to an addressed subscriber group. Once the end of the buffer is reached, transmission starts again from the beginning. The software receives the sent information as a list with Internet addresses (URLs) in the form of a text file. Switchover to new contents is possible irrespective of the current transmission.

All applications with unidirectional transmission can be implemented with this system.

Elke Schulze;
Günther Zurek-Terhardt

Reader service card 166/06

Web over DTV at a glance

DTV IP Inserter

- Insertion of additional DVB-MPEG2 data in Internet format
- Data transmission irrespective of DVB-C, DVB-T or DVB-S standard
- Use of null packets that are not used in the transport stream
- Exchange of data already contained in the transport stream
- Insertion variants
  - Stuffing of remaining data rate
  - Dynamic stuffing to obtain fixed data rate
- Insertion of multicast applications
- Insertion both in Intranet and Internet

DTV Web Carousel™

- Emission of any Internet contents
- Convenient administration of contents to be sent
- Contents can easily be compiled
- Provision of data in IP format
- Modular and scalable architecture
- Secured unidirectional protocol for data transmission
- Runs on standard PC with MS Windows NT™

Content Management System eidonXbase

Database-supported information management

The technical documentation department of the service center at the Rohde & Schwarz Cologne plant offers allround solutions for the complete field of modern publishing [*]. Cooperating with eidon GmbH, the Cologne specialists offer software products for information management. The eidonXbase Content Management System is of primary importance for documents in *SGML*, *XML* and *CGM* formats, plus comprehensive services to create system solutions for complex documentation and information tasks.

More and more data

The penetration of technology into daily life and increasing product complexity mean that a company's documentation must observe a growing number of laws, standards and directives. It is not the piles of documents collected in a company that make for its success but mainly fast and proper access to the information required from case to case.

A large part of information management is handled by the technical documentation department: complex processes and products have to be documented and the vast quantity of electronic documentation has to be managed and maintained.

Throughput times must be reduced, all potential utilized and conditions created for optimizing documentation processes.

With the right database, the effort involved in creating, managing and publicizing technical documentation can be reduced and the increasing amount of data dealt with more efficiently. Stored information can be multiply re-used and generation costs reduced. eidonXbase is a powerful tool for information management of this kind.

Databases for a better grasp

The eidonXbase Content Management System supports joint documentation editing and ensures fast company-wide access to information. The systems integrated in the software map

FIG 1
Fast access even to extremely comprehensive documents with eidonXbase Content Management System

Glossary

CGM Computer Graphics Metafile; graphical file format

DTD Document Type Definition

JDBC/ ODBC Open DataBase Connectivity; interface allowing integration of data from any applications into a database

Oracle8i Database from Oracle

SGML Standard Generalized Markup Language; programming language for technical documentation

SQL Structured Query Language

XML Extensible Markup Language (part of SGML)

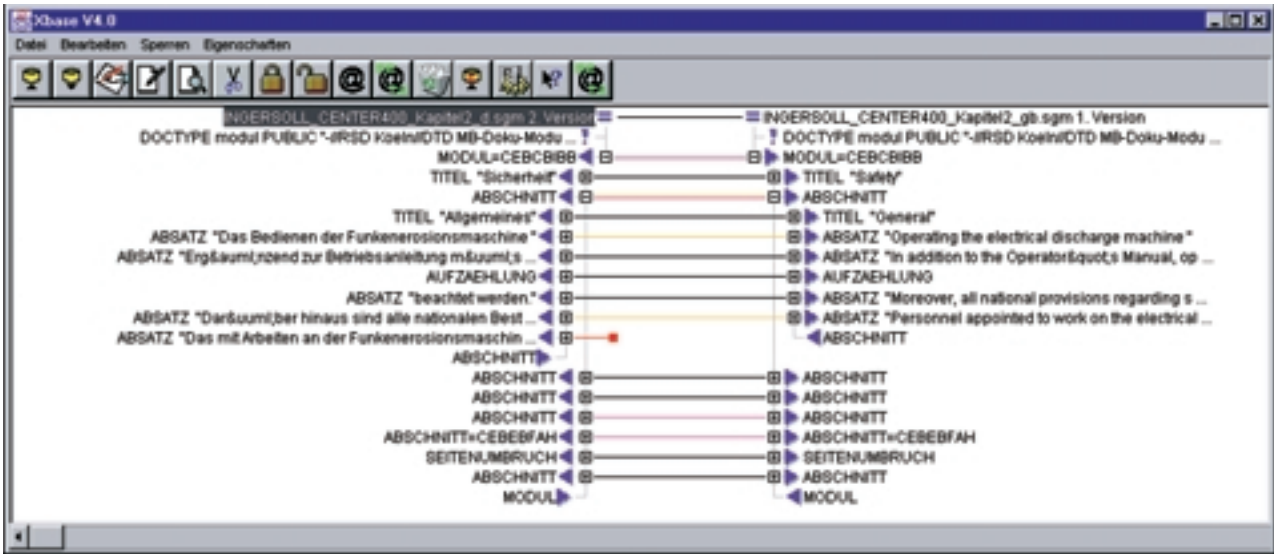


FIG 2 Convenient translation management for multilingual documentation

workflows and help technical writers coordinate wide-ranging projects in many languages. This system, especially designed to manage documentation on the Internet, offers many advantages and possibilities of application through extremely fast access to any documentation and its parts (FIG 1).

eidonXbase is extremely easy to handle despite high functionality and automation potential. Familiarization time is very short, adaptation to changing requirements is very easy and can be done by the user. The simply configured, graphical user interface allows user-specific views of the managed documents.

The degree of automation of steering and production processes in technical documentation can be intensified by the integrated Xript script language.

Architecture

eidonXbase stores and manages *XML* and *SGML* texts as well as *CGM4* graphics in the form of single data sets in a relational *SQL* database and thus allows extremely fast and precise access. The database also manages the contents of other documents but stores them in a special area of the file system. It is addressed through *JDBC/ODBC*. The software is implemented entirely as a Java application in a modern three-layer architecture and thus also fully Internet-compatible.

The content management system is standard-conformant throughout and can be used on virtually all platforms (hardware, operating system, *SQL* database). It makes optimum use of relational database characteristics, so it is very fast and highly scalable. Integration into corporate data processing is simplified enormously by setting up on tried and tested *SQL* technology. Operating eidonXbase on *Oracle8i*, for example, allows homogeneous implementation of document- and data-oriented *XML* applications.

Heinz-Peter Olbrück

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[*] Zorenböhmer, Jörg: Database-supported documentation – Technical documentation by high-tech methods. News from Rohde&Schwarz (1999) No. 162, pp 16–17

Reader service card 166/07

Functions

- Data memory in relational *SQL* database
- Powerful script language, programming interface (Java-API), *SQL* access
- User and group management
- Re-use of document contents
- Translation management (FIG 2)

Functions for documents

- Check in/out with version numbering
- Document families (topics)
- Trigger functions (import, export, delete)
- Access to documents and versions
- Protection against unauthorized or competitive access

Additional functions for subordinate documents

- Full support of *XML*, *SGML* and *CGM4* formats
- Meta data
- Access to any subordinate documents, part versions, attributes, entities, etc
- Import with/without *DTD* checking
- Entities and *DTD* management

I/Q Modulation Generator AMIQ

New models 03 and 04 as well as digital I/Q output option

Since its successful market launch two years ago, I/Q Modulation Generator AMIQ [1] has undergone intensive upgrading, which considerably increased its versatility [2]. Together with the WinIQSIM software [3], the previous model enabled generation of a huge number of waveforms covering a wide range of applications. The new models AMIQ03 and 04 (FIG 1) once again substantially widen the spectrum of applications.

Photo 43 419/2

FIG 1 New AMIQ04 model with differential I/Q outputs and digital I/Q output options

New features in brief

- Digital I/Q Output option AMIQ-B3: This option adds the associated digital control signals to the analog outputs. The new models 03 and 04 come ready for integration of the digital I/Q output option.
- Models 03 and 04 may also work with an external clock via their CLK connector. This allows generators to be synchronized to a central system clock and avoid interference due to clock beats.
- The resolution of output signals can be selected between 8 and 16 bits. So DACs (digital/analog converters) with different bit widths, for example, can be used with the digital I/Q output option.
- Model 04 has even larger storage capacity, enabling it to store and output complex curves of up to 16 Msamples.

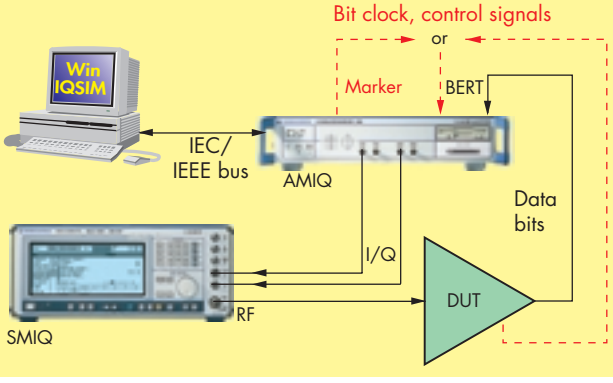
Digital I/Q output option

There is a marked trend towards digital signal processing. AMIQ's answer to this development is the new option AMIQ-B3, which makes digital control signals available together with the associated clock signals and offers highly convenient operation through WinIQSIM.

Example: bit-error-rate measurements on TDMA systems

Bit-error-rate measurements are normally performed using a pseudo-random binary sequence (PRBS). For a realistic test scenario, the PRBS to be evaluated must be continuously embedded in the TDMA data structure. Also, the PRBS should not be interrupted to guarantee smooth operation of the BER tester. This requires test signals with long data sequences. If a PRBS 9 sequence is used, 511 TDMA frames usually have to be generated (2^9-1). Its storage capacity of 16 Msamples makes AMIQ04 ideal for this kind of application. FIG 2 shows a typical test setup with AMIQ and the optional BER Measurement AMIQ-B1. AMIQ is also an excellent source of multicarrier signals, so signals in adjacent channels or other interference signals can be generated in addition to the useful carrier without the need for a second generator. This allows typical receiver tests like adjacent-channel rejection or blocking.

FIG 2 Measurement of bit error rate



This new option can supply a connected **DUT with a voltage of +3.3 V or +5 V**. The high levels of data and clock adjust automatically. A **special feature of the digital output** is that it outputs data and clock only for DUTs with the supply voltage applied. Otherwise all outputs are of high impedance to protect sensitive circuitry of the DUT.

To avoid reflection when operating AMIQ with clock frequencies >40 MHz, it is advisable to connect DUTs to the output using very short lines or to terminate them with the required impedance.

A host of new applications

The digital output allows a wide selection of applications. These range from measurements on DACs through tests of digital mobile-radio interfaces (see examples in boxes) to the use of low-voltage differential signalling (LVDS) links. With the latter, high-frequency digital links (several hundred MHz) can be made on long lines using differential signals of low amplitude. For this purpose AMIQ-B3 drives an LVDS transmitter component that converts the signals into a serial data stream of higher frequency. A cable up to 10 m long connects the transmitter output with an LVDS receiver, which converts the data back into their original parallel format. In this way the digital signals from AMIQ-B3 can be routed over long distances or the associated LVDS chips can be tested.

Through continuous product upgrading and especially thanks to the new AMIQ-B3 option, AMIQ once more emphasizes its role as a universal modulation generator meeting all requirements of the digital communication age.

Burkhard Küfner;
Dr Rene Desquiotz

Example: testing DACs

Digital/analog converters (DACs) link the digital to the analog world. High-resolution digital words at high sample frequency are needed to test new DAC designs. Its optional digital I/Q output makes AMIQ 03/04 ideal for this application due to word width of up to 16 bits per channel and a clock frequency up to 100 MHz (FIG 3).

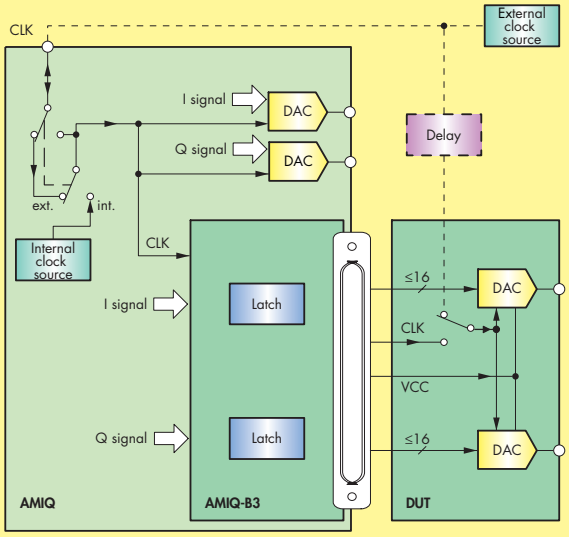


FIG 3 AMIQ with AMIQ-B3 option testing DACs

A critical aspect of these measurements is the spectral purity of the clock used. An impure clock signal causes a DAC to generate additional harmonics and nonharmonics, which in turn reduce the spurious-free dynamic range. To eliminate this source of error, the DUT can be supplied with a clock of extremely high spectral purity from an external source, eg a crystal oscillator or synthesizer, and the matching control signals obtained from the digital AMIQ output. AMIQ is driven by the same clock for the necessary synchronization of clock edges with the data from the option. For clock frequencies above approx. 40 MHz, the internal delay of AMIQ (max. approx. 25 ns) has to be taken into account by delaying the clock accordingly.

After loading of the desired trace into the AMIQ output memory by WinIQSIM (sinusoidal or multitone signal), a spectrum analyzer can be used to check the impact on spectral purity at the DUT output by varying bit width and clock frequency.

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Condensed data of AMIQ-B3

Output	68-pin connector (submin D, half pitch)
Number of channels	2 (one each for I and Q)
Resolution	selectable from 8 to 16 bits
Output impedance	approx. 50 Ω (typ.)
DC voltage output	selectable +3.3 V or +5 V
Clock frequency	max. 100 MHz (normal and inverted polarity)

Reader service card 166/08

Microwave Signal Generator SMR

SMR as tracking generator for Vector Network Analyzer ZVM

The four models of the SMR family of signal sources cover the frequency range up to 20 GHz (SMR 20), 27 GHz (SMR 27), 30 GHz (SMR 30) and 40 GHz (SMR 40, FIG 1). All have a lower limit frequency of 1 GHz, which can optionally be extended down to 10 MHz. The immediate advantages of SMR are small size, light weight, high performance and an extremely attractive price [1]. The brand-new Vector Network Analyzer ZVM extends the frequency range of the successful ZVR analyzer family up to 20 GHz. The two units together – SMR and ZVM – are an ideal combination to make complex RF measurements child's play.

Photo 43 264/3

FIG 1 Microwave Signal Generator SMR 40: a sought-after signal source in research, development, production and EMC measurements

The ZVR family [2] already includes units for 9 kHz to 4 GHz (ZVR, ZVRE, ZVRL) and 20 kHz to 8 GHz (ZVC, ZVCE) and with the new member now also 10 MHz to 20 GHz. Like all vector network analyzers of the family, ZVM too has outstanding features (see box and FIG 2).

But why does such a versatile and sophisticated network analyzer like ZVM need one or even two external generators? After all, it is already fitted with a microwave source whose characteristics meet any requirements. The answer can be found in FIG 3, where a frequency-converting DUT is shown with a receive section for 200 MHz to 7 GHz and an output at the fixed IF of 741 MHz. The test setup allows measurement of mixer gain as a function of receive frequency, for instance, which is a standard measurement on receive units. The following frequency settings have to be made for the purpose (all RF levels have to be selected so that the DUT operates correctly of course):

- Set SMR at mixer 2 to fixed frequency of 3.6 GHz.
- Set receive section of ZVM to test frequency of 741 MHz.
- Set generator of ZVM to frequency sweep from 200 MHz to 7 GHz.
- Set SMR at mixer 1 to frequency sweep from 8.141 GHz to 14.941 GHz.

All these settings are performed via the convenient user interface of the vector network analyzer. This also applies to the generator settings, remotely controlled by ZVM via the IEC/IEEE-bus connection.

For a measurement to run properly, the ZVM generator and SMR have to be synchronously tuned at mixer 1. In the example this is done with a frequency offset of 7.941 GHz, corresponding to the first IF of the receive section. In the simplest case, ZVM sets SMR to the required frequencies at mixer 1 via the IEC/IEEE bus. But this method is too slow, especially if DUT alignments are to be made. Luckily things can be done much faster, the network analyzer only has to be fitted with option ZVR-B4, and terminals TRIGGER and BLANK on ZVM and SMR have to be linked with the appropriate cable. Using this special interface, SMR becomes a real tracking generator for ZVM, or any other network analyzer of the ZVR family, since the generator's maximum tuning speed of approx. 1 GHz/ms now comes into play. That is more than enough for all conceivable adjustments of common DUTs.

So where does this big boost in speed come from? You need look no further than the List mode provided in every SMR. For this mode, you first create a list with frequencies and the associated levels. SMR can subsequently step through this list, in the auto mode or externally triggered. If there are ascending frequencies for constant level, a digital step sweep of crystal accuracy is performed, which can be accomplished extremely fast. Up to ten lists can be created in SMR, either manually or via the IEC/IEEE bus. So a maximum of 2003 frequency points

can be stored (up to 2001 of them being used by ZVM to resolve the frequency axis). With SMR used as a tracking generator, ZVM automatically generates the required list and loads it in SMR via the IEC/IEEE bus – it is all done for you. ZVM then activates the List mode of SMR via the IEC/IEEE bus with the external trigger and sends a trigger pulse to SMR. Every time SMR finishes a frequency step, it acknowledges by resetting the BLANK signal, and then ZVM triggers again. This method also works with the microwave signal generators of the SMP family and the RF sources SME and SMIQ.

Wilhelm Kraemer

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– Application Note 1EZ31_0E: Measurements on Frequency-Converting DUTs using Vector Network Analyzer ZVR

Reader service card 166/09

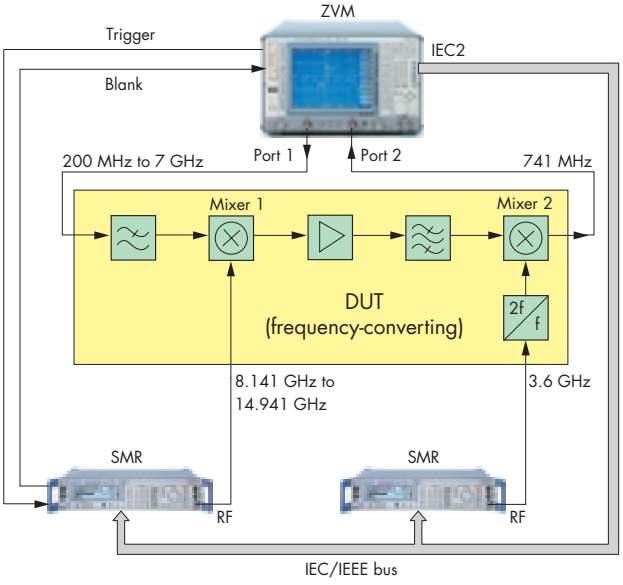

FIG 3
Measurement of double frequency-converting receiver front-end

The new Vector Network Analyzer ZVM

FIG 2
New Vector Network Analyzer ZVM in one of its special applications: patented calibration methods from Rohde&Schwarz allow easy and highly precise measurements on wafers

Photo 43 453/6

- **Frequency range**
  10 MHz to 20 GHz
- **Excellent dynamic range** >115 dB
  (IF bandwidth 10 Hz)
- **High measurement speed**
  <500 µs per test point
- **Short IEC/IEEE-bus access and transfer times**
  Transfer time <15 ms
  (200 test points)
- **Low inherent noise**
  <110 dBm
  (IF bandwidth 10 Hz)
- **Internal PC with Windows NT™**
  – Control and evaluation programs
  – Ethernet connection
  – Easy integration of peripherals (printer, streamer, etc)
- **Fundamental mixing**
  – Easy test setup and wide dynamic range
  – Ideal for mixer measurements
- **Universal calibration methods**
  – TOM, TRM, TRL, TNA, TOM-X
  – Precise calibration in test fixtures and on wafers
- **Embedding of virtual networks**
  – Compatible with CAE
  – Simulation of matching networks (eg with SAW filters and wafer probers)

Calculating measurement uncertainty of conformance test systems for mobile phones

Conformance tests on mobile phones call for utmost RF accuracy. ETSI test specification ETR028 [1], for example, deals with the subject of "uncertainties in the measurement of mobile-radio equipment". In conformance test systems a reasonable compromise has to be found between measurement uncertainty, costs, automation and test time. This article shows, by way of example, how measurement uncertainties in conformance test systems from Rohde&Schwarz can be determined.

Measurement tasks

Conformance tests on mobile phones not only comprise protocol and audio tests but, very importantly, also measurement of RF parameters for compliance with specifications. The RF parameters are measured in the frequency band of the particular mobile-radio standard (inband) as well as outside this range between 9 kHz and 12.75 GHz (wideband); the applicable test methods are defined by ETR027 [2]. System-specific test methods are described in the specifications for the individual mobile-radio standards, for example in ETS300607 (GSM 11.10) for GSM900/GSM1800, or in ETS300394 for TETRA.

The measurement uncertainties involved in laboratory test setups and in test systems are essentially attributable to the following factors (see also [3] and [4]):

- frequency response of instruments/cabling,
- linearity error of instrument levels,
- mismatch resulting from interconnection of instruments, cables and EUT.

Computation standards

ETR028 is applicable in Europe for determining measurement uncertainties in conformance testing. The official version dates back to 1994 and comprises about 128 pages. In 1997 a draft follow-up version appeared in two volumes with a total of about 420 pages. The later version appears to have been considerably improved in many aspects, so the examples given below are based on this version although it is not yet officially in force.

Strategies in dealing with measurement uncertainties

Advantages and disadvantages of switching matrix

All instruments in a test system are connected to the EUT via a switching matrix (signal switching and conditioning unit – SSCU). Measurement uncertainties caused by mismatch are greater than in a manual test setup unless special precautions are taken. But the major advantage of this method is that the EUT needs to be connected only once and the various test setups can be created by means of relays. This method does away with manual intervention during the test, saves considerable time and avoids operator errors.

Plus, it is possible to compensate the frequency response of instruments and cabling as well as linearity errors of the instruments in a test system – this method is employed, for example, in the path compensation software of Rohde&Schwarz conformance test systems.

Calibration with power meter

The frequency response and linearity error of the remaining instruments and the test setup can in addition be calibrated using a power meter with measurement uncertainty traceable to national standards. For this purpose the power meter, acting as a reference, is connected via relays to suitable test points in the SSCU. Without this calibration the linearity error and frequency response of the signal generators used is approx. 1.5 dB. Calibration of the complete system reduces measurement uncertainty to below 1 dB (at 95% confidence level).

Calibration of RF generators

As a rule, a signal with a known, fixed level and variable frequency is applied to the EUT in the test cases. For this, the generators have to be calibrated to the nominal levels required for the test cases in question to significantly reduce the effects of generator linearity and frequency error. To save the operator from having to screw the power sensors to the cable to the EUT prior to each test run, the difference between an internal test point and the end of the EUT cable is first measured as a function of frequency and stored. The resulting trace is independent of level and constant over an extended period of time. It is used to calibrate generators at different levels, which can be performed fully automatically and thus immediately before the actual test, thus avoiding errors caused by generator temperature drift. Neglecting uncertainties due to mismatch, the absolute error of 1.5 dB can be reduced to the repeat accuracy (approx. 0.1 dB) and the measurement inaccuracy of the power meter. Depending on frequency and level, this is only about 0.1 dB in the case of Rohde&Schwarz's NRVD with its Sensor -Z1.

Calculation of measurement uncertainty

Calculation example 1

All the above measurements involve uncertainties due to mismatch however. In ETR028, calculation of these uncertainties is discussed and demonstrated by many examples. The reflections of all RF components involved are added up according to statistical laws. If a large number of components are used, this leads to unnecessarily great measurement uncertainties.

This is demonstrated by an example based on the computation standard for measurement of an EUT that is connected to a spectrum analyzer ("specan" in the formula) via an SSCU (FIG 1) containing relays (K1 to K7) and a 10 dB attenuator (R1). The calculation of measurement uncertainties resulting from path reflections is shown in TABLE 1, where

Order Reflections between two neighbouring components are called 1st-order reflections, reflections between two components with one other component between them are called 2nd-order reflections, etc

u_i Standard measurement uncertainty due to ith-order reflections (see TABLE 1)

r_e Reflection coefficient of component e

a_e Transmission coefficient of component e

EUT Equipment under test

Result

The total standard measurement uncertainty due to mismatch is approx. 0.56 dB (standard uncertainty 1 σ) in this example. To obtain a confidence level of 95%, this value has to be multiplied by 1.96, which results in an expanded uncertainty of approx. 1.1 dB. The data of the components involved are taken from their data sheets.

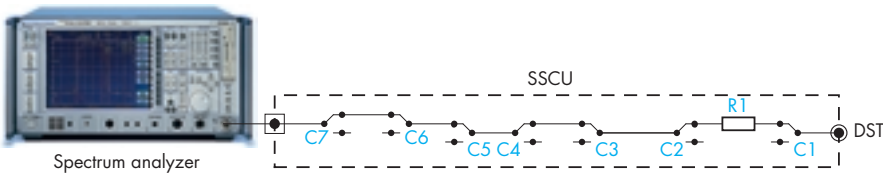

FIG 1 Part of SSCU used in Rohde&Schwarz conformance test systems

FIG 2 Measured reflection and transmission of SSCU

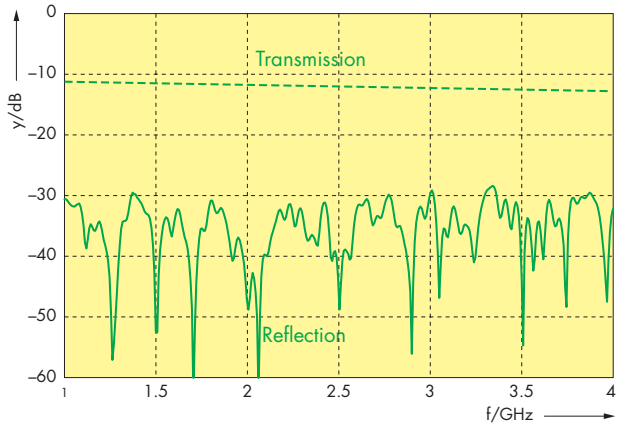

TABLE 1 Calculation of measurement uncertainty due to path reflections

Calculation example 1	Result
Reflections between neighbouring components (1st-order reflections)	
$u_{1,\,EUT-C_1}=\frac{r_{EUT}\cdot r_{C_1}\cdot 100\,\%}{\sqrt{2}\cdot 11.5\,dB}$	0.39 dB
$u_{1,\,C_1-R_1}=\frac{r_{C_1}\cdot r_{R_1}\cdot 100\,\%}{\sqrt{2}\cdot 11{,}5\,dB}$	0.039 dB
⋮	
$u_{1,\,C_7-specan}=\frac{r_{C_7}\cdot r_{specan}\cdot 100\,\%}{\sqrt{2}\cdot 11.5\,dB}$	0.11 dB
2nd-order reflections	
$u_{2,\,EUT-R_1}=\frac{r_{EUT}\cdot r_{R_1}\cdot a_{C_1}^2\cdot 100\,\%}{\sqrt{2}\cdot 11.5\,dB}$	0.27 dB
$u_{2,\,C_1-C_2}=\frac{r_{C_1}\cdot r_{C_2}\cdot a_{R_1}^2\cdot 100\,\%}{\sqrt{2}\cdot 11.5\,dB}$	0.00 dB
⋮	
$u_{2,\,C_6-specan}=\frac{r_{C_6}\cdot r_{specan}\cdot a_{C_7}^2\cdot 100\,\%}{\sqrt{2}\cdot 11.5\,dB}$	0.1 dB
⋮	
9th-order reflections	
$u_{9,\,EUT-specan}=\frac{r_{EUT}\cdot r_{specan}\cdot a_{C_1}^2\cdot a_{R_1}^2\cdot a_{C_2}^2\cdot\ldots\cdot a_{C_7}^2\cdot 100\,\%}{\sqrt{2}\cdot 11.5\,dB}$	0.039 dB
Total standard measurement uncertainty $\sqrt{\sum x_i^2}$	0.56 dB

Calculation example 2

According to [1], the scattering matrix of the SSCU can alternatively be measured by means of a network analyzer, the SSCU being treated as a complex component. In the example below, this yields a transmission coefficient of approx. 13 dB and a reflection coefficient of r = 0.04. FIG 2 shows the frequency response of the transmission coefficient and of the reflection coefficient at the input end.

Calculation is thus reduced to a few steps (TABLE 2). The total standard measurement uncertainty is only 0.18 dB, which corresponds to an expanded measurement uncertainty of 0.36 dB (confidence level 95 %).

Calculation example 2	Result
$u_{1,\,EUT-SSCU} = \frac{r_{EUT} \cdot r_{SSCU} \cdot 100\,\%}{\sqrt{2} \cdot 11.5\,dB}$	0.17 dB
$u_{1,\,SSCU-spec\,an} = \frac{r_{SSCU} \cdot r_{spec\,an} \cdot 100\,\%}{\sqrt{2} \cdot 11.5\,dB}$	0.49 dB
$u_{2,\,EUT-spec\,an} = \frac{r_{eut} \cdot r_{sscu} \cdot a_{12,\,SSCU} \cdot a_{21,\,SSCU} \cdot 100\,\%}{\sqrt{2} \cdot 11.5\,dB}$	0.04 dB
Total standard measurement uncertainty $\sqrt{\sum x_i^2}$	0.18 dB

TABLE 2 Calculation example with SSCU treated as complex component

Summary

Even with this simple example, the results obtained with the two computation models differ by more than 0.7 dB at 95 % confidence level. The values obtained for example 1, taking into account all SSCU components involved, are apparently too high. However, by measuring the test setup with a network analyzer and treating the SSCU as a complex component in accordance with [1], the measurement uncertainty stipulated by specifications can still be guaranteed for the same wiring.

Michael Manert

Reader service card 166/10

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[3] Minihold, Roland: RF Level Test System. Rohde & Schwarz Application Note 1999, 1MA21-1E

[4] Wolf, Josef: Level Error Calculation for Spectrum Analyzers. Rohde & Schwarz Application Note 1998, 1EF 036-0E

CD-ROM

Exploring the world of mobile-radio tester CMU

The endless universe, mobile phones flying through space. These are the visionary images that greet the viewer of the CD-ROM presentation for Universal Radio Communication Tester CMU. After the introduction come the details: a transparent, intuitive user interface invites the viewer to go on a discovery trip of CMU. And there is plenty to explore. Just one click and an animated CMU offers an overview of the characteristics and design of the tester as well as potential applications. This part of the presentation describes operation, available measurements and optional device configurations. The user can rapidly create his very own CMU with all the available options using a convenient tool. Configurations can easily be exported for consultation with colleagues or a Rohde & Schwarz sales engineer for example.

The CD-ROM contains the complete data sheet for those needing more in-depth information on the tester. The opening page contains not only CMU data and features but also general information on Rohde & Schwarz, CMU training courses plus a list of worldwide sales offices with addresses and contacts.

All in all this CD-ROM offers a highly practical approach for getting to know CMU and provides a good initial impression of the enormous performance and versatility of Universal Radio Communication Tester CMU.

Stefan Böttinger

Coverage Measurement Software ROMES3

Acquisition, analysis and visualization of data in coverage measurements

Communication with seamless coverage and without interference, reliable data transmission at an acceptable speed – these and many other quality criteria are decisive for the success of a mobile-radio network on the market. To enable network operators to provide the required quality – and thus be commercially successful – Rohde&Schwarz offers with its TS995x product line (FIG 1) hardware and software for all standards available today. Common to all systems is the modular and versatile Measurement Software ROMES3.

Complete solutions for communication networks

Coverage measurement systems from Rohde&Schwarz accommodate virtually all fields of application: from network planning, installation and optimization through to network servicing and monitoring. Measured-data acquisition, test signal generation and result analysis are carried out comprehensively, fast and with high precision. The new Measurement Software ROMES3 provides the platform for all these systems, which allow most network problems to be detected and analyzed. ROMES3 collects data fast and conveniently during test tours and offers versatile visualization to meet user's requirements.

Universal and future-proof

Modular concept

ROMES3 is based on a modular system concept, allowing any type of data to be collected and analyzed (FIG 2). Any sensor (eg test receiver, test mobile or GPS receiver) capable of result transfer to a PC can be used. This opens up a wide range of use,

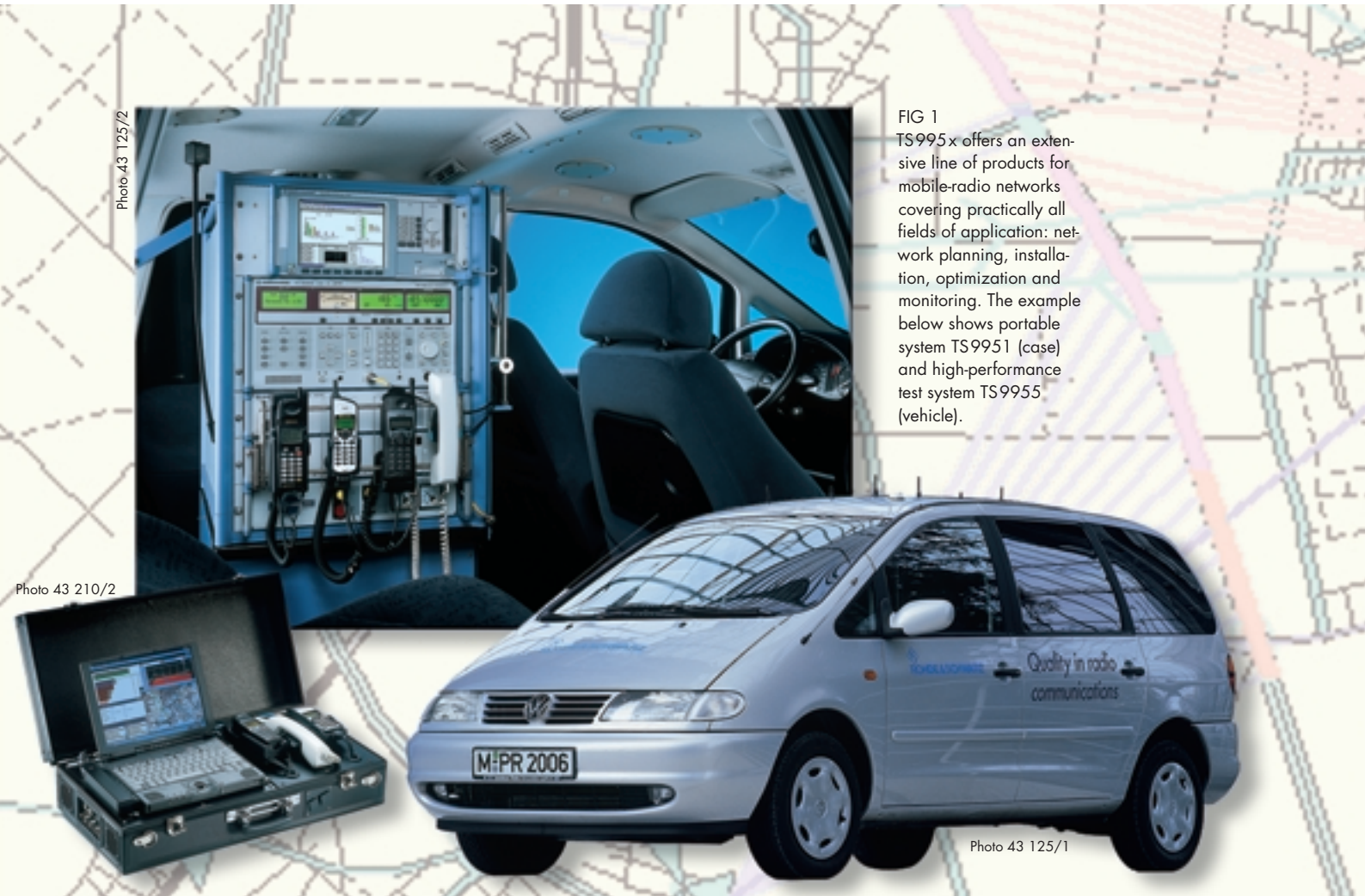


FIG 1
TS995x offers an extensive line of products for mobile-radio networks covering practically all fields of application: network planning, installation, optimization and monitoring. The example below shows portable system TS9951 (case) and high-performance test system TS9955 (vehicle).

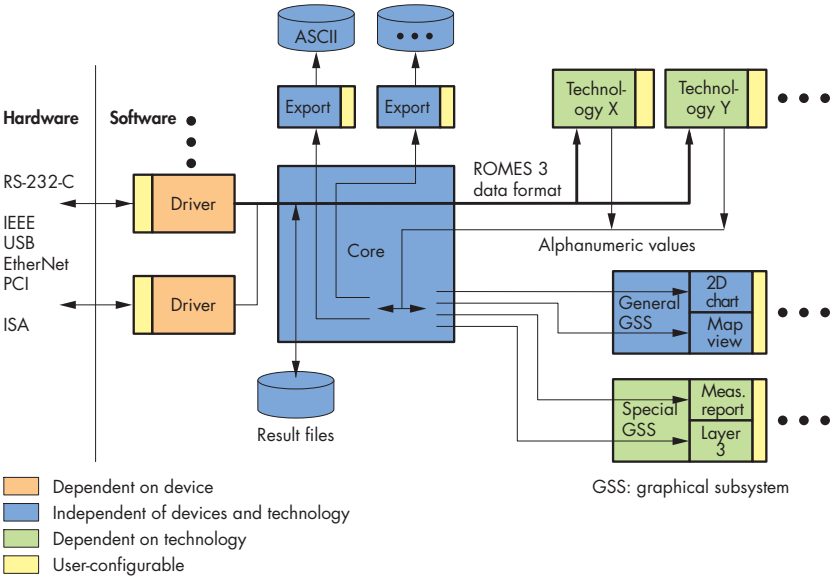


FIG 2 The modular concept of ROMES 3 allows both very small systems and complex high-performance test systems to be implemented

from measurements in mobile-radio and DAB/DVB networks through to almost any kind of exotic application. The modular concept enables the implementation of very small systems and high-performance test systems alike. And it makes the software future-proof, as it can easily be extended to accommodate upcoming technologies (eg W-CDMA).

The core of the application can handle any kind of data and routes the incoming data stream to the appropriate software modules. All signals detected are stored on hard disk immediately on arrival at the core and visualized in a form meeting the user's requirements.

Apart from the core, there are numerous modules by which software can be extended to suit a given application. The modules are all available as options, so custom solutions can be configured fast. For example, different transmission technologies can be combined and/or multiply provided in a measurement system (eg a CDMA, two GSM and an ETACS mobile, a test receiver and GPS).

Integrated database

ROMES 3 has an integrated database that allows customer-specific data to be included in result analysis. Results can be automatically linked to database contents, for example to a list of all base stations, from which the software then extracts the stations used.

Simple, intuitive user interface

The core of ROMES 3 also comprises the major part of the user interface, which offers many special features:

- Central configuration of all signals, events and modules known in the system
- Automatic loading of working environments last stored upon restart of the application
- Online configuration of views via context menus, so display parameters can be added or removed during measurement
- Multiview technique
- User-configurable shortcuts
- Context-sensitive online help etc

Pipes between modules enable new applications

ROMES 3 provides a simple yet efficient interface allowing communication between different modules via pipes (pipes are communication links between independent software modules). This is a precondition for master/slave operation, where one module drives another. The pipe concept opens up versatile applications, for example simultaneous testing of data or fax transmissions (see box) or recording of data measured with the test mobile.

Analysis tools of ROMES 3

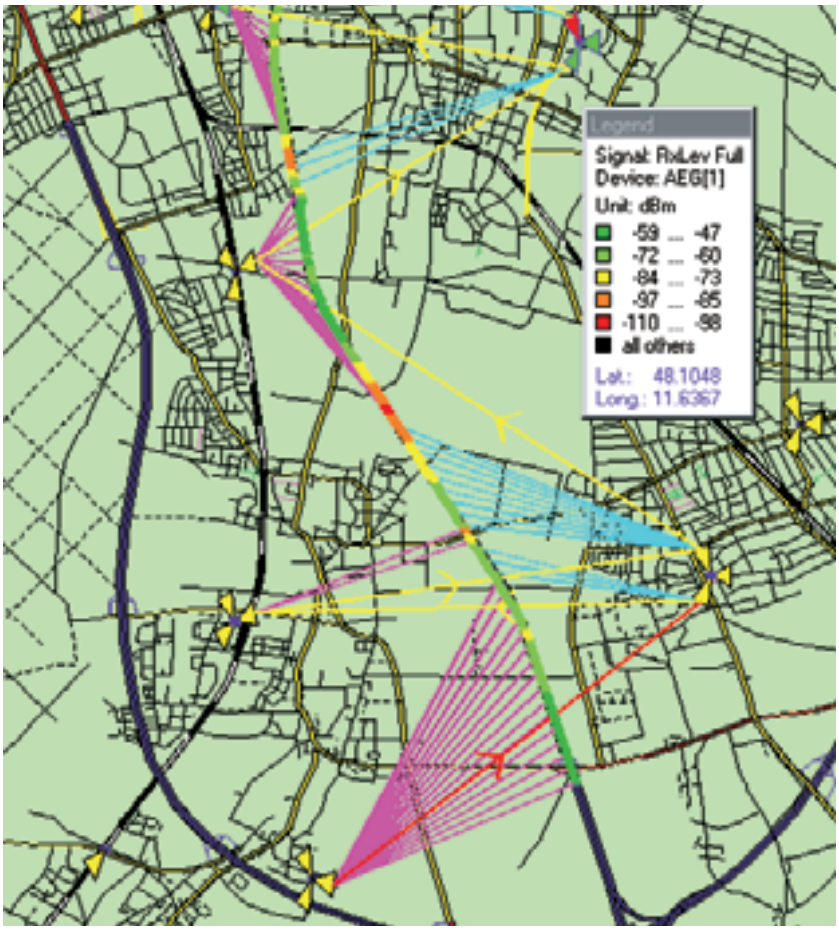
Apart from efficient measured-data acquisition, ROMES 3 offers comprehensive functionality for the localization of problems so that solutions can be found quickly.

Search functions

Replay, a powerful analysis and search function, is an integral part of the measurement software permitting fast and efficient analysis without extra software tools. Replay reproduces recorded measured data. It can be started and stopped at any point of the recording. To make it easier to find critical points, the user can jump to certain (predefined) events in the file. It is also possible to select how many seconds before and after the event the recording should be displayed in the replay window.

MapX for geographical evaluation

ROMES 3 uses the GIS (geographical information system) tool MapX for the display of measured data. This tool inserts colour-coded numerical data and base station locations into a road map (FIG 3). This type of measured-value display, which has become a standard, illustrates very clearly the radio network scenario. Both raster maps with pixel formats (BMP, JPG, TIF, etc) and vector maps can be used. Vector maps, as known generally, con-



tain position information allocated to the individual objects, whereas raster maps have to be adjusted first. For this, ROMES 3 offers a simple procedure: the unreferenced raster map is set up with reference to the test tour, ie specific points of the tour are assigned to specific points on the map. The rest is done by the referencing tool.

ROMES 3 also offers the possibility of creating separate modules to implement special representations for the different types of transmissions. Handovers between cells can also be displayed.

Diagrams and tables

ROMES 3 can display measured values versus time in any number of tables or 2D charts. The colours and time-axis resolution (1 min to 24 h) of diagrams can be freely configured at any time (even during a measurement) (FIG 6).

FIG 3
Display of level along a tour with indication of serving cells and handovers

Use of pipes

Example: simultaneous testing of data or fax transmission with recording of signalling

Network operators will in future have to test not only voice but, to an increasing extent, also data and fax transmission. Signalling is recorded along with data transmission, and time and location information is added. Since ROMES 3 stores all this information in one file correlated in time and location, analysis can be carried out immediately and efficiently without the need for combining the data first.

This is possible through the use of pipes. The test mobile acts as a master. It is connected with the slave, ie the fax or data driver, via a pipe (FIG 4). During measurement the test-mobile driver signals to the slave via the pipe when it is available for fax and data functionality. The slave can store data during measurement and route them to the test-mobile driver in analog form. ROMES 3 displays the results in a clear-cut representation (FIG 5).

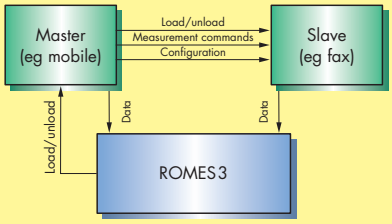


FIG 4 Operating principle of pipe concept

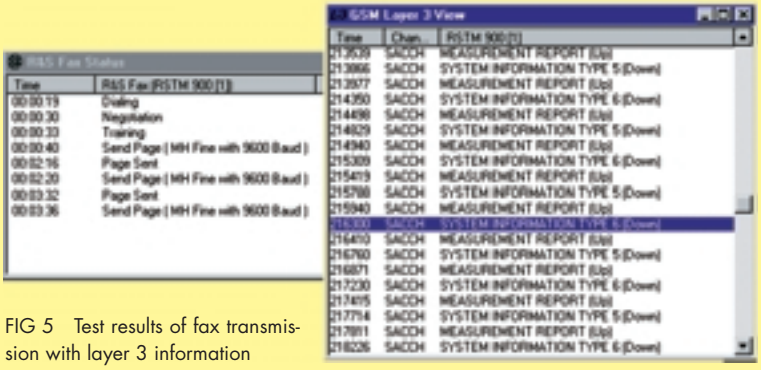


FIG 5 Test results of fax transmission with layer 3 information

Special views

To provide even more efficient analysis for the various transmission technologies used in a network, for example GSM or CDMA, ROMES 3 is able to process data for visual representation in special, straightforward views. For example, there are views presenting a GSM measurement report, GSM layer 2/3 messages or current GSM system information (FIG 7).

Unique feature: mobile interference measurements

ROMES 3 can very easily be adapted and extended for highly complex tasks such as interference measurements. To expand the measurement system for the acquisition of interference data (co-channel and adjacent-channel interference for both the C0 and the CX (traffic) channel), all that is needed is extra signal-processing hardware and driver software. A powerful tool is thus created that allows storage of a wide variety of measured data (from a test mobile, a test receiver, as well as interference data) in one and the same file and correlated in time and location. This eliminates the need for time-consuming combination of data from different files (FIG 8).

This unique feature of ROMES 3 will be described in detail in one of the following issues.

Johann Maier; Andreas Spachtholz

FIG 6
ROMES 3 displays measured values in any number of 2D charts or alphanumeric tables

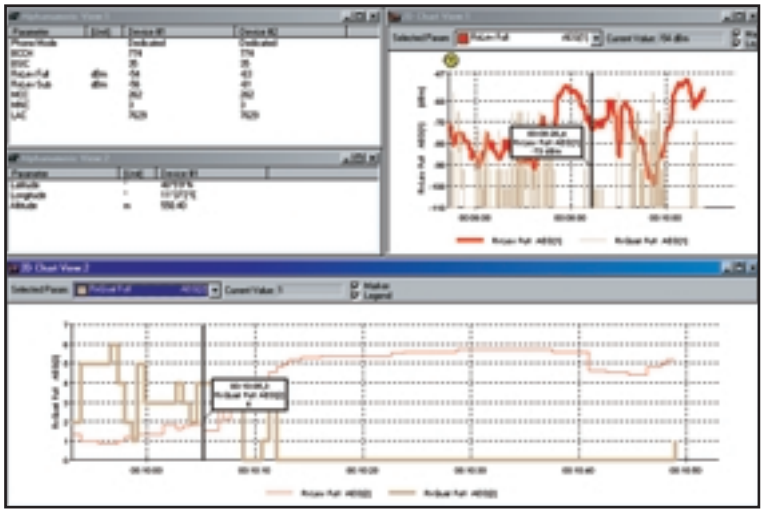


FIG 7
Special views for convenient analysis: here GSM measurements

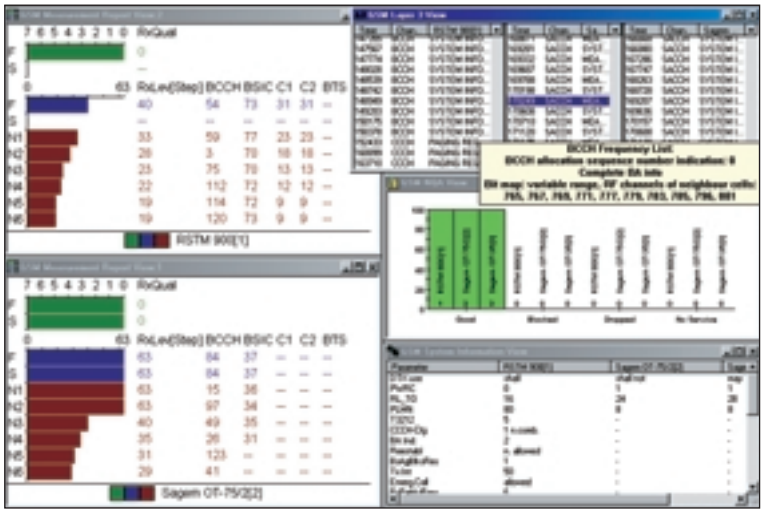
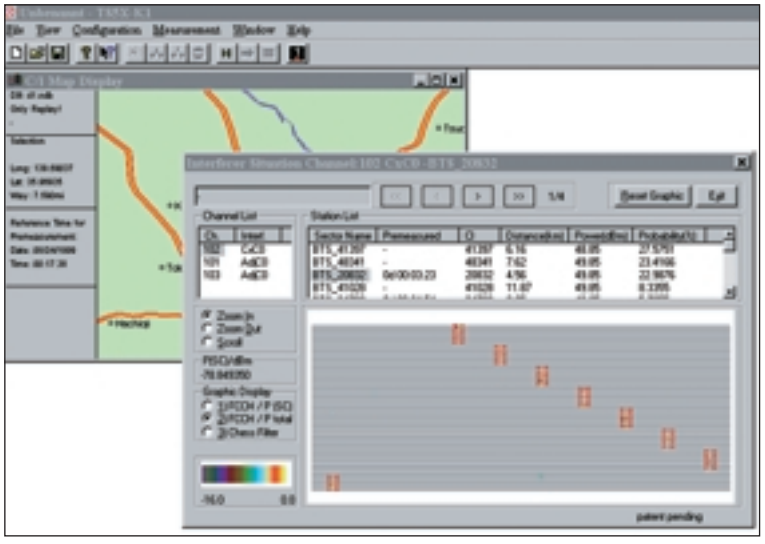


FIG 8
ROMES 3 can be expanded at minimum expense, eg to include mobile interference analysis



Reader service card 166/11

Enhanced accuracy in BER measurements by precise level calibration of CMD

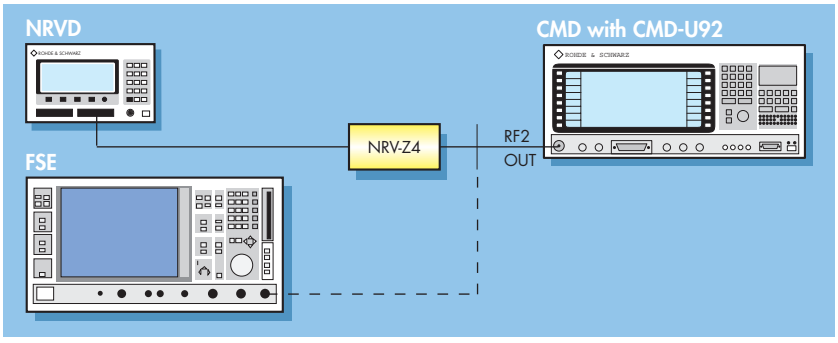


FIG 1 Test setup for calibration of BER level at RF OUT 2 output of Radiocommunication Tester CMD

The specification for static BER sensitivity in GSM base-station receivers calls for tight tolerances that approach the limits of what is physically feasible. The tolerable level uncertainty of the tester for BER measurements must therefore be reduced accordingly.

The level of Radiocommunication Tester CMD 54/57/59 at the RF OUT 2 output can now be calibrated much more precisely with the new option CMD-U92 and a simple test setup (FIG 1), consisting of Power Meter NRVD, Power Sensor NRV-Z4 and Spectrum Analyzer FSE fitted with option FSE-B22.

Calibration is performed using the sensitive Spectrum Analyzer FSE under the conditions stipulated by GSM 11.21 with a modulated signal at +50 dB higher level in the unused timeslots (FIG 2). The user can also carry out calibration. The absolute measurement uncertainty of FSE is eliminated by means of a reference measurement performed with the accurate Power Meter NRVD in the presence of a non-pulsed CMD output signal. In the subsequent measurement with a pulsed CMD output signal, the small linearity error of FSE (<0.2 dB with option FSE-B22) alone contributes to the total calibration uncertainty of CMD-U92 (<0.5 dB).

Calibration of CMD is performed between –85 dBm and –91 dBm at a +20 dB higher level to obtain sufficient signal/noise ratio for measurement with FSE. The exactly calibrated BER level of CMD can then be reduced to the level required for BER measurements (–105 dBm to –111 dBm) by means of a precision 20 dB attenuator.

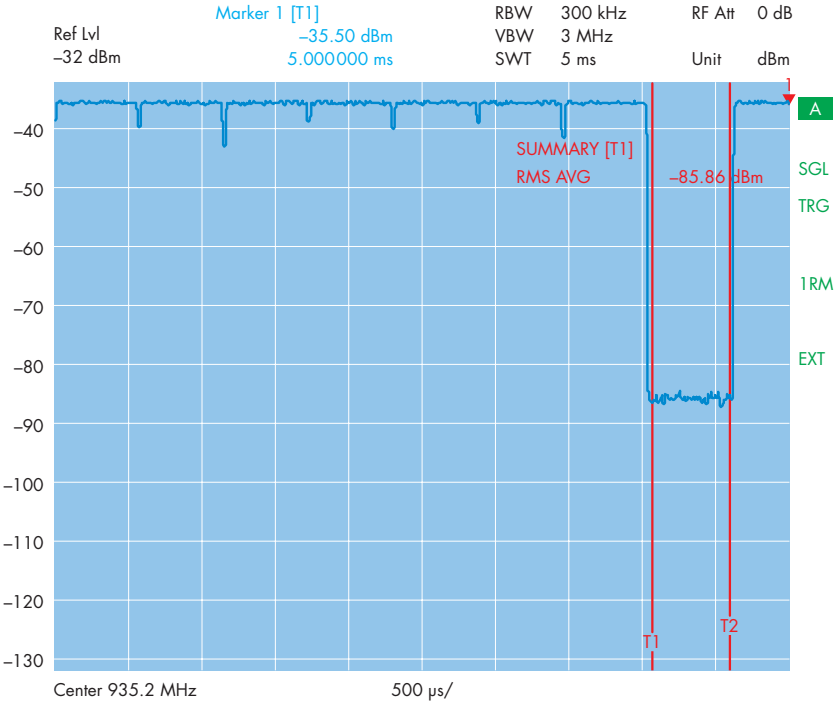
Roland Minihold

REFERENCES

– Calibrating CMD output level for static BER measurement. Rohde & Schwarz Application Note 1MA24_0E
– CMD-U92 – Special calibration for CMD 57, output level –85 dB to –91 dBm at 50 dBc ADJ.TS. Technical Specification, Stock No. 1129.0906.02

Reader service card 166/12

FIG 2 Measurement of used timeslot with Spectrum Analyzer FSE in time domain



Encryption Software SafeIT

Sensitive data? Play it safe

Despite all the advantages of electronic data transfer, one has to bear in mind that public communication paths such as PSTN, ISDN and especially the Internet are at a very high risk as far as the confidentiality and integrity of transmitted data are concerned. An effective solution to this problem is encryption of sensitive data, eg by the user-friendly and cost-efficient Encryption Software SafeIT from the Rohde&Schwarz subsidiary SIT.

Photo 43 426/2

In recent years the traditional exchange of information by letter or fax has increasingly been replaced or even edged out completely by electronic data exchange. Despite all the advantages of electronic data transfer by e-mail or data carrier, public communication paths such as PSTN, ISDN and especially the Internet are subjected to high risks in terms of data confidentiality and integrity. But also data on notebooks or PCs that can be accessed by a number of users may run these risks.

File encryption with SafeIT

SafeIT encrypts one or more files or whole directory trees with a powerful encryption algorithm. For this purpose a new key is generated for each file. Encrypted data can only be read again if the correct encryption key is known. To save space, files are automatically compressed before encryption as this is no longer possible afterwards.

Operation is straightforward. SafeIT is integrated into the context menu of the Windows Explorer and other applications and can be called up from there (FIG 1). SafeIT runs under Windows™ 95/98/NT4.0/2000. The program may optionally be integrated into other applications such as e-mail programs and Lotus Notes.

To perform the encryption operations, the user logs into SafeIT and gains authorized access by entering the password. To increase protection against unauthorized access, the loaded encryption program can automatically be terminated after a set period of time.

In addition to encryption, SafeIT also allows files or directories to be deleted by overwriting. The original files are then gone and can neither be restored within the operating system nor by means of disk editors.

Key to security

An integrated management tool with graphical user interface serves for managing the encryption keys and configuring other parameters of the program (FIG 2).

Encryption keys can be generated by means of a PRBS (pseudo-random binary sequence) generator or can be entered directly by the user. To exchange keys between sender and receiver of encrypted data, the keys can be exported or imported via files. These files are protected by means of a password or an exchange key.

User keys in SafeIT are protected by passwords. Furthermore file keys can

also be generated from passwords. We should like to point out that the user plays a key role in overall system security, since the security of passwords – like in any other system – plays a decisive role in SafeIT.

No chance for intruders

One drawback of passwords is the fact that they are often changed and that users have to keep their sequence of characters in mind as there are no additional aids provided. In other words, the most powerful encryption is useless if an intruder can easily find out the password that is supposed to protect the encryption program. There are two possible ways of finding out passwords: the trial and error method (brute force) and the use of dictionaries. As for the brute force method, any combination of characters with the length 1, 2, 3, 4 etc. are checked. Passwords should therefore have an adequate length to protect them against such kinds of attack. At least eight characters comprising both digits and special characters are therefore recommended. The dictionary method tries all character sequences from a prepared dictionary.

A good password can easily be memorized but is difficult to guess.

Names of users, initials, names of accounts, vehicle registrations and other personal information and simple variations of them (reverse order, changing upper and lower case characters) are not suitable for passwords. Words in pairs or triples separated by special characters are more suitable for passwords as such combinations make it very difficult for intruders of the dictionary method to crack the password. Also initials of a sentence that can easily be remembered form a powerful password (eg "The sky above Munich was high and blue" becomes "TsaMwhab").

The quality of passwords has to be judged quite critically if an encryption key is to be generated from them. To provide comparable encryption security for a 128-bit key, a random password from a pool of 62 characters would have to have a length of at least 22 characters.

Additional security through PC card

To meet even higher security requirements Rohde&Schwarz SIT offers an encryption product with hardware support as an option. This product is a PC card (PCMCIA) that has the same user interface as SafeIT. In addition to the encryption component the hardware also has a physical PRBS generator for key generation and a secure key storage.

Ralf Dittmar

Reader service card 166/13

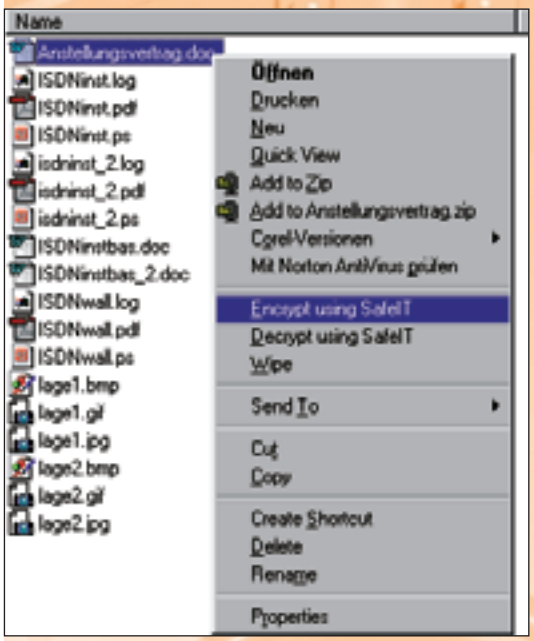


FIG 1 Convenient encryption via context menu

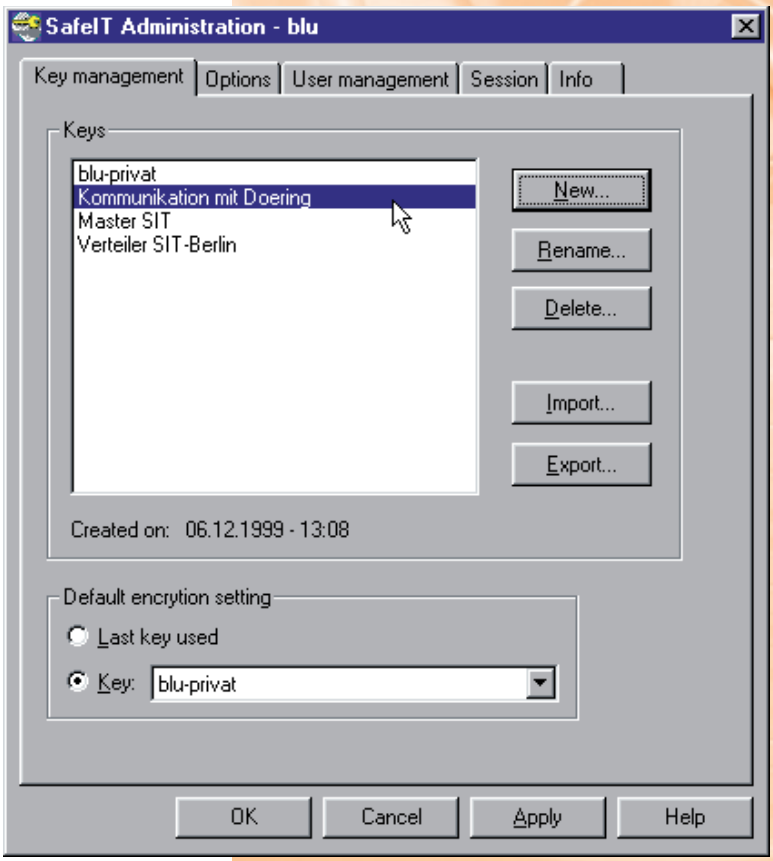


FIG 2 Key management with SafeIT

Photo 42 935

FIG 1
Full functionality for mobile use: Power Reflection Meter NRT with Sensor NRT-Z44

Power Reflection Meter NRT

Fit for 3G digital mobile radio

Power Reflection Meter NRT [*] has firmly established itself as a tool for testing digital mobile radio equipment, especially in the role of measuring the transmitted power of base stations during production, in service and for commissioning and installation. Major factors in its success are the high accuracy of Power Sensors NRT-Z43 and NRT-Z44, the simpler handling compared with a terminating power meter, plus the possibility of operating the two sensors directly from a PC or laptop. Now NRT has been upgraded to measure components of third-generation mobile radio (3G).

The challenge of 3G

With digital mobile radio, Power Reflection Meter NRT (FIG 1) is a preferred tool for GSM applications. Of late, measurements on third-generation base stations have increasingly been in demand. Where power meters are concerned, the essential difference between the generations is that in 3G the envelope of the transmitted signal is modulated, with peak powers of up to 13 dB above the mean. This signal characteristic not only makes measuring mean power with conventional diode detectors more difficult, it also calls for completely new functions beyond the scope of classic power measurement: peak power, crest factor (peak to mean power ratio) and CCDF (complementary cumulative distribution function).

NRT was able to handle these tasks in the past, but only at chip rates of 1.23 Mc/s for IS-95CDMA. 3.84 Mc/s and 4.1 Mc/s are presently required for W-CDMA, meaning a totally different hardware concept for power measurements. But Rohde&Schwarz chose a different approach to maintain the attractive price/performance ratio of its sensors. The microprocessor in the NRT sensor uses mathematical models

of the whole signal path to calculate the deviation to be expected for the particular waveform and corrects the result accordingly. In addition to improved calibration of the sensor by means of even more accurate equipment, these corrections lead to an uncertainty for the measurement of mean power that is hardly above that of an unmodulated sinusoidal signal. The deviation for the crest factor is below 1 dB.

So what must the user do to enjoy the benefits of higher measurement accuracy? Simply enter the signal type – eg W-CDMA – and the chip rate. The sensor takes care of the rest.

Not forgetting cable loss

Another NRT innovation that makes working with it easier is that cable losses between sensor and source or sensor and load are fully taken into account. This new correction function allows virtual shifting of the measurement plane along the connecting cables, as if the sensor were directly at the source or the load. This enables not only correction of the power value but also a VSWR indication exactly at each measurement point.

Example: given cable loss of 1.5 dB between sensor and antenna, a directional power meter indicates return loss with reference to the antenna connector that is 3 dB too high; an error of this size is quite common and is normally disregarded in everyday measurements. With the new NRT, this error can be avoided by simply entering the cable loss.

All new NRT features are available on the basic unit as well as via the Windows™ "Virtual NRT" user interface (FIGs 2 and 3).

Thomas Reichel

Reader service card 166/14

FIG 2 "Virtual NRT" user interface offers all functions of a power reflection meter and more on any laptop or PC

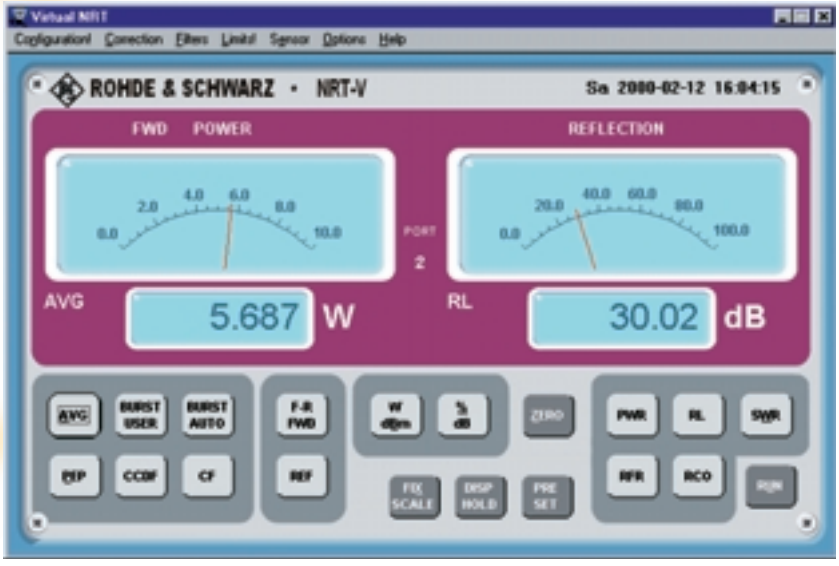
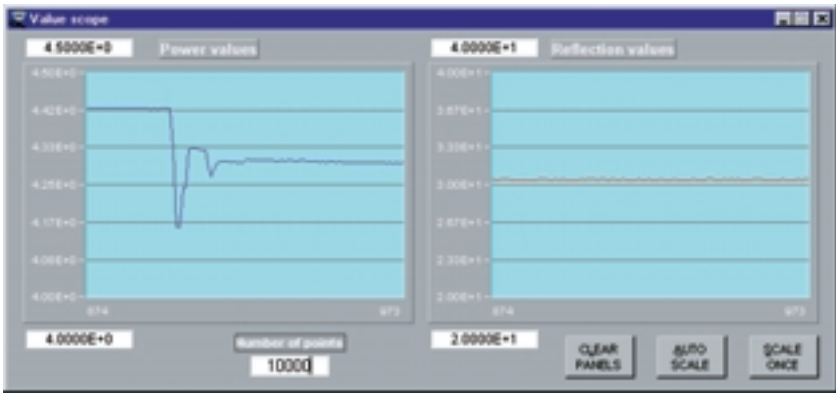


FIG 3 No problem thanks to "Virtual NRT" – recording one-shot or long-term events. Results can also be stored in a file with date and time



REFERENCES

[*] Reichel, Thomas: Power Reflection Meter NRT – The next generation in directional power meters. News from Rohde & Schwarz (1997) No. 153, pp 7–9

Optimizing digital TV networks – QoS maintained automatically

Network operators are naturally interested in offering as many programs as possible in one transmission channel. But the limits are reached when high compression starts producing visible artifacts that degrade picture quality. Digital Video Quality Analyzer DVQ (FIG 1) automatically detects such defects and helps to maintain quality of service (QoS).

Photo 43 396

Photo 43 318/3

FIG 1
Digital Video Quality Analyzer DVQ needs no original picture as reference and offers extensive possibilities of application not only in network monitoring but also in development, production and quality assurance

The future is digital

The creation and expansion of digital TV networks is in progress worldwide. Everything started with satellite-supported systems because of the comparatively small retrofit effort. Meanwhile, terrestrial operators have followed up and are now establishing completely new networks for digital TV. Cable operators too are now beginning to trim their infrastructure for the digital age.

What are the driving forces behind these activities? The most important reason – besides the high quality of digitally coded signals and the advantage of simple insertion of additional information accompanying the program – is the possibility of simultaneously transmitting several programs in one channel. This is profitable for the network operator since more programs usually mean more viewers and thus bigger earnings through advertising. Where to date only one program could be transmitted at a bandwidth of 6, 7 or 8 MHz, it is now possible to combine the picture, sound and additional information of several programs using time-division multiplexing provided that the picture data (to MPEG2 standard) are suitably compressed.

The limits of this compression process are reached if the compression rate is too high and picture quality suffers from visible artifacts. And that is exactly what has to be prevented: nobody wants to lose customers because of inferior QoS.

Ensuring service quality

To maintain constant quality of service, an instrument is needed to measure, quantify and monitor QoS. Digital Video Quality Analyzer DVQ from Rohde&Schwarz was developed for precisely this purpose. It can evaluate picture quality in realtime according to subjective criteria and monitor and record vision and sound errors in a digital TV program [1; 2]. If a set picture-quality threshold is underranged, it responds so that immediate remedial actions can be taken.

While the picture quality of analog TV is mainly determined by signal degradation along the transmission path, encoding quality and data rate are the decisive criteria for digital TV. However, the quality of the picture is not a constant quantity, it can fluctuate a lot depending on the program material (newscasts, documentaries, sporting events, etc). So testing the transmission equipment with still pictures or short test sequences is not very informative.

The transmission of *real* program material with long-term logging of quality as in DVQ is a superior solution. This can be done either at the output of the encoder or at the multiplexer (FIG 2). The quality profile acquired over an extended period of time provides lots of information about the settings of the operating units, eg compression parameters, data rate, multiplexing characteristics, and parameters can consequently be optimized.

Due to the extremely high measurement speed of DVQ (only 400 ms per measured value), the data rate may be set or spread depending on the desired quality by considering the measurement results in a statistically operating multiplexer.

Presenting such advantages, DVQ helps network operators and broadcasters utilize available bandwidth with utmost efficiency, ie with as many programs as possible, while maintaining the required quality of service.

Alexander Wörner

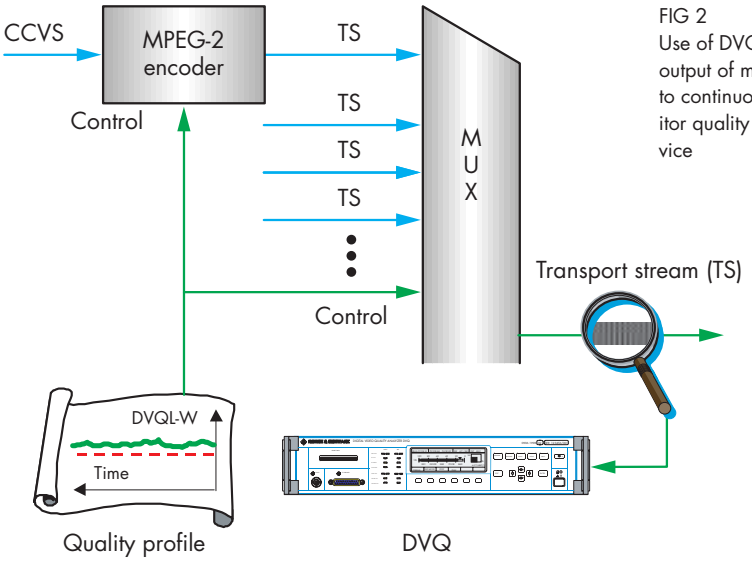


FIG 2
Use of DVQ at output of multiplexer to continuously monitor quality of service

Reader service card 166/15

REFERENCES
[1] Ibl, Harald; Wörner, Alexander: Picture quality measurements for digital TV. News from Rohde&Schwarz (1999) No. 161, pp 41–43
[2] Wörner, Alexander: Digital Video Quality Analyzer DVQ – Getting the picture on picture quality. News from Rohde&Schwarz, (1999) No. 163, pp 4–7

Have a go – puzzle competition on Internet with individualized main prize

To mark the new millennium, Rohde&Schwarz is inviting puzzle enthusiasts the world over to show how good they are at problem solving. Every month a new puzzle will appear on the Internet. One of Germany's best-known puzzle masters was called in to shape the competition, which means that it is bound to be thrilling and challenging from start to finish. All the questions will have to do with communications and electronics in line with Rohde&Schwarz's field of activities. This gives you a first clue, which should prove to be quite useful when the going gets tough. The best way of finding the correct answers is by talking to colleagues or friends, since your imagination, skills of combination and deduction will be stretched to the full.

Twelve questions in all have to be answered to find the solution. You may join in the competition at any time, because the questions from past months are still available on the Internet and can be called up. The main prize is an adventure trip worth 5000 Euro. This prize money may be divided up as the winner wishes, and here really the sky is the limit. You could attend the opera in Verona just as well as see Mika Hakkinen close up in a formula 1 race. And there are plenty of other prizes for the runners-up.

Monika Roth

Visit the millennium puzzle at www.rohde-schwarz.com

△

Universal Radio Communication Tester CMU 200 (100 kHz to 2700 MHz) is **the** number-one tester for development, production, quality control and high-end service in the mobile radio networks of today and tomorrow: multiprotocol test platform – easily upgradable for new standards, extremely high measurement speed, high accuracy, future-proof modular design, RF analyzer with selective power meter, universal spectrum analyzer; optional audio generator and analyzer, many other options.

Data sheet PD 757.4318.21 enter 166/16

Digital Radio Analyzer PCSD detects and analyzes interference in GSM and DAB networks and is available for both stationary and mobile use; CIR, C/I or general analysis, frequency range extendable up to 2050 MHz.

Data sheet PD 757.5150.21 enter 166/17

Microwave Signal Generator SMR The new model SMR 30 (10 MHz to 30 GHz) is now included in the data sheet.

Data sheet PD 757.4418.22 enter 166/18

RF Performance Test System TS 9970 measures the RF characteristics of wireless communication equipment (radiation and receiving characteristics) – especially with integrated antennas – and receive parameters like S/N and BER; both analog and digital radiocommunication standards are covered by the system.

Data sheet PD 757.5189.21 enter 166/19

Spectrum Analyzer FSP (9 kHz to 3/7/13/30 GHz) is available in four medium-class models offering all important functions and options as standard – including RMS detector and CCDF routine; the only extras that may be required are AM/FM demodulator, OCXO reference or a casing for portable use.

Data sheet PD 757.5137.23 enter 166/20

Shielded Test Cell M-LINE (800 MHz to 40 GHz) for EMC measurements and type approval is available with or without a climatic box and is suited for the use of climatic equipment.

Data sheet PD 757.5295.12 enter 166/21

MPEG2 Measurement Decoder DVMD, Stream Explorer DVMD-B1 Their extension for ATSC is included in the new data sheets.

Data sheets
DVMD: PD 757.2744.23 enter 166/22
DVMD-B1: PD 757.3628.23 enter 166/23

Quality Explorer™ DVQ-B1 enables comprehensive analyses of quality and MPEG2 elementary streams, detects coding errors and presents quality results in a user-friendly way.

Data sheet PD 757.5450.21 enter 166/24

Probe Set HZ-11 (100 kHz to 2 GHz) Text and specs of this data sheet were revised to reflect the latest developments.

Data sheet PD 757.0158.22 enter 166/25

Active Rod Antenna HE011 (50 kHz to 30 MHz and UHF) Modified specs made a new edition of this data sheet necessary.

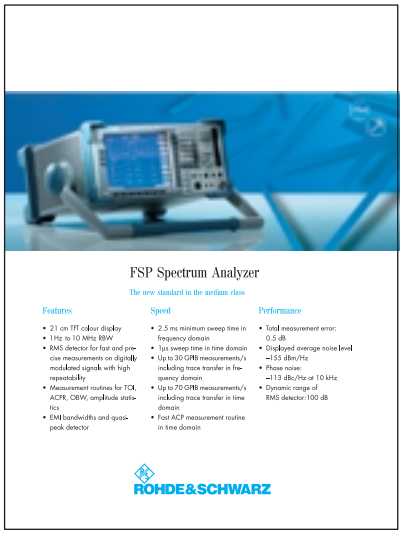
Data sheet PD 757.0764.22 enter 166/26

LaserVision LV3 The remaining models available are LV3/S (stand-alone system) and LV3/IL (inline system with base software, extended software and/or enlarged working area).

Data sheet PD 757.3311.22 enter 166/27

File Encryption Software SafeIT This software from **SIT** offers cost-efficient protection of confidential data combined with convenient operation; data compression, physical deletion.

Data sheet PD 757.5272.21 enter 166/28



Posters

Digital Broadcasting – ready to make you take off
Image poster on DTV technology

Poster PD 757.5372.21 enter 166/29

DVB solutions from Rohde & Schwarz – solid as a rock

Poster PD 757.4518.21 enter 166/30

Antennas – built for the extremes
Image poster on monitoring & com antennas

Poster PD 757.5389.21 enter 166/31

EMI measurement – ESI does it quick and easy
EMI image poster with focus on ESI

Poster PD 757.5420.21 enter 166/32

FSP – features, speed, performance
Spectrum analyzer

Poster PD 757.5214.21 enter 166/33

Hit the fast lane (CMU)
Motif from the CMU ad as poster

Poster PD 757.5437.21 enter 166/34

Superior productivity by high-speed testing
Image poster on board test equipment

Poster PD 757.5343.21 enter 166/35

T&M innovations ... for 3G mobile radio
Image poster on 3G mobile radio measurements

Poster PD 757.5366.21 enter 166/36

New application notes

Creating Test Signals for Bluetooth with AMIQ/WinIQSIM and SMIQ

Appl. 1GP38_0E enter 166/37

AMIQ-K2 Application Software for the Transmission of I/Q Data of Different Formats to I/Q Modulation Generator AMIQ

Appl. 1MA10_3E enter 166/38

RF Level Test System +20 dBm to –130 dBm

Appl. 1MA21_1E enter 166/39

Schz

Efficient tool for guaranteeing quality of service

The European "Telecom Product News" showed the new MPEG2 Realtime Monitor DVRM on its title page. The magazine also described the instrument's advantages:

It monitors MPEG2 transport streams to DVB and ATSC in realtime for ETR 290 or similar errors. Additional realtime monitoring is integrated for networks. This makes DVRM an efficient tool for guaranteeing quality of service.

Software radio for initial equipment or as a retrofit

The Hungarian journal "TECHNIKA" recently reported in a title story on the new Series 6000 multiband transceivers from Rohde&Schwarz. In a detailed description of the products it said:

The units are designed as software radios and are capable of handling several EPM techniques: Have Quick I/II, SATURN and SECOS. These methods enable reliable and secure transmission of voice and data at high rates in the UHF, VHF and VHF/FM bands. With its compact dimensions and weighing less than 4 kg, Series 6000 is ideal as an initial equipment or retrofit for aircraft radiocommunications in the range 30 MHz to 400 MHz.

Third generation

The Chinese technical journal "Foreign Electronic Measurement Technology" put the new Mobile Radio Tester CMU on the title page of its year-end edition. The characteristics of the tester were explained in detail in this issue:

The instrument is a very secure investment for the future because it can easily be upgraded or converted with further standards such as IS-95, IS-136, AMPS or Bluetooth on top of GSM. In addition, the test time has been considerably reduced: single measurements by CMU are up to ten times faster than those performed by the present generation of mobile radio testers. Thus the throughput in production can be boosted enormously.

Newsgrams

Further DVB-T network extension with Rohde&Schwarz TV transmitters

As part of creation of a DVB-T network in Spain, Rohde&Schwarz received an order for 32 high-power DVB-T Transmitters NV7100 and 150 Modulators SD100D.

Rohde&Schwarz is thus supplying about 100 high-power DVB-T transmitters and more than 250 DVB modulators to the Spanish network operator Retevision. During the first phase 50% network coverage was provided by the end of 1999. With the extra equipment, 75% of the DVB-T network is due to be on air by the end of July this year. What tipped the scale in favour of this decision was the modern technology and above all the reliable implementation on schedule of the network during the first phase.

Digital video quality analyzers for SES/Astra

The leading European satellite operator SES/Astra will in future monitor the quality of its TV channels with the aid of Rohde&Schwarz digital video quality analyzers.

For this purpose, an order was placed recently for the supply of DVQ analyzers. With DVQ, digital TV channels can for the first time be monitored for quality of service in realtime and without a reference signal. SES/Astra, offering its viewers more than 400 digital TV channels, will be using the DVQ units to improve quality of service through continuous monitoring.

Stefan Böttinger

Reg TP renews VHF-UHF DF network

The German Regulatory Authority for Post and Telecommunication (Reg TP) has the task, among other things, of controlling compliance with technical parameters stipulated for radio emissions and of locating and eliminating radio interference. Reg TP fulfils this task with the aid of comprehensive test facilities including mobile and stationary radio direction finders. In 1995 the authority, which cooperates with many organizations abroad within the framework of ITU, started a program to replace its VHF-UHF DF network.

Following two invitations to tender, it procured a total of 14 Digital VHF-UHF Monitoring Direction Finders DDF05M from Rohde&Schwarz, each covering the frequency range 20 to 3000 MHz. All direction finders have now been installed and put into operation except for one site where matters relating to infrastructure need to be clarified.

Three of these direction finders were installed in the Berlin area. At an event on the premises of the Berlin Radio Measurement Center, Reg TP officially commissioned the new VHF-UHF DF network together with representatives from Rohde&Schwarz and invited guests.

The importance of a well-functioning DF network was pointed out, in particular with a view to the government's move to Berlin and the associated increase in radio traffic.

Rohde&Schwarz has been supplying the authority with VHF-UHF DF systems for more than 25 years – starting with the Rotating Direction Finders NP 12, then proceeding to the PA005 and PA055 generations of Doppler Direction Finders and finally to the state-of-the-art Digital Monitoring Direction Finders of the DDF0xM family, which now form the new VHF-UHF DF network of Reg TP. This shows the importance of the authority as a reference customer for Rohde&Schwarz.

A practical demonstration convinced the guests of the speed and accuracy of remotely controlled direction finding and location. The connections were established via ISDN and GSM.

Ulrich Unselt

▽

Photo Author

Gerhard Geier (right), Executive Vice President of Radiomonitoring and Radiolocation Division, handing over to Peter Keul (left), head of the Berlin Radio Measurement Center, a map produced by means of MapView DF and Radiolocation Software

Photo Author

△

International 3GPP meeting at Rohde&Schwarz

From 21 to 25 February 2000 Rohde&Schwarz hosted a 3GPP meeting with some 55 participants (3GPP = 3rd Generation Partnership Project, in which the most important specification bodies in the world, such as ETSI in Europe, are formulating the specifications for third-generation mobile radio).

The conference was staged by the TSGTWG1 group (TSGT = Technical Specification Group Terminal, WG1 = Working Group for Terminal Conformance Testing) with its three subgroups T1RF (Radio Conformance Testing), T1Signalling and T1EMC.

Rohde&Schwarz is particularly active in the T1RF subgroup, where the company provides the editor for the UE (user equipment) conformance test specifications TDD (time-division duplex).

The conference rooms at Rohde&Schwarz were equipped with a LAN. This allowed each participant to connect his laptop to the network for exchanging the documents to be discussed. The LAN server was connected to the Internet and the ETSI central server in Sophia Antipolis in southern France so that all documents and contributions prepared until then were accessible. The Internet connection was used by many guests to keep contact with their company per e-mail.

An invitation to the rotating restaurant in the Munich Olympic Tower for all participants formed the pleasant conclusion of the meeting.

Thomas Maucksch

GSM World Congress 2000

Mobile-radio coverage test technology, radio testers and protocol analyzers – these were the Rohde & Schwarz exhibition highlights at the GSM World Congress 2000 in Cannes.

In particular the new Radiocommunication Tester CMU was the focus of interest of the development and production experts.

Photo Rohde & Schwarz

A live demonstration of Protocol Analyzer CRTC with a GPRS DUT was a special draw for developers of products for third-generation mobile radio (3G). In a mobile test with the new Interference Test System PCSD-K6 (photo) interested visitors could convince themselves of the various test possibilities. Co-channel and adjacent-channel interferers can automatically be detected, located and recorded as a function of interference power. This method is unique on the world market and protected by several patents.

Johann Maier

Rohde & Schwarz selected as the supplier of radio equipment for Gripen fighter aircraft

The Swedish manufacturer Saab has selected Rohde & Schwarz as the supplier of radiocommunication equipment for the modern Gripen fighter aircraft (photo). A first order was placed for 168 airborne transceivers of Series 6000.

According to Saab, Rohde & Schwarz won the order against worldwide competition because of the highly modern software radio concept of Series 6000, the low weight, compact design and attractive price/performance ratio.

With its integrated digital avionics system and multirole capability, Gripen is the first fighter aircraft of the fourth generation. It is ideally complemented by the modern radiocommunication equipment from Rohde & Schwarz. The compact VHF-UHF transceivers operate in the frequency range 30 to 400 MHz and, thanks to the software radio concept, electronic protection measures can subsequently be integrated by a software download. After the Eurofighter Typhoon and the Tiger helicopter, Rohde & Schwarz again won out as the supplier of radio equipment of the latest generation in another modern aeronautic program.

Stefan Böttinger

Photo Saab

First Bluetooth test system worldwide

At CeBIT 2000 Rohde & Schwarz presented the first test system worldwide for Bluetooth equipment and components.

Test System TS 8960 fully complies with the current Bluetooth standards and enables all RF measurements laid down in the standards for the prescribed qualification of Bluetooth components, which is the prerequisite for official certification and for using the designation "Bluetooth". Great interest was shown at the new stand. But it offered more. True to the motto "Committed to Communication" a lot more solutions were shown for radiocommunications and T&M, among them the new Spectrum Analyzer FSP and Mobile Radio Tester CMU, TETRA trunked-radio systems, solutions for Internet access via TV antenna as well as new TV test equipment. On a separate stand, Rohde & Schwarz subsidiary SIT presented new encryption solutions for ISDN and data transmission. The large number of visitors and their interest in Rohde & Schwarz solutions showed that the company benefits very much from the fact that CeBIT changed from an IT to a communications show.

Stefan Böttinger

Rohde & Schwarz exhibited on a new high-tech-design stand at this year's CeBIT. 165 sqm on the ground floor and 40 sqm on the first floor offered sufficient space for an application-oriented presentation of products and for intensive talks with visitors and journalists.

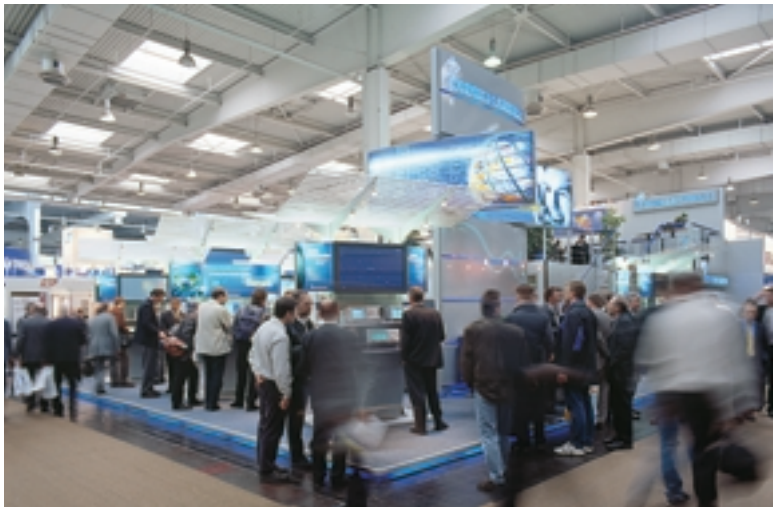


Photo 43 477/4

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