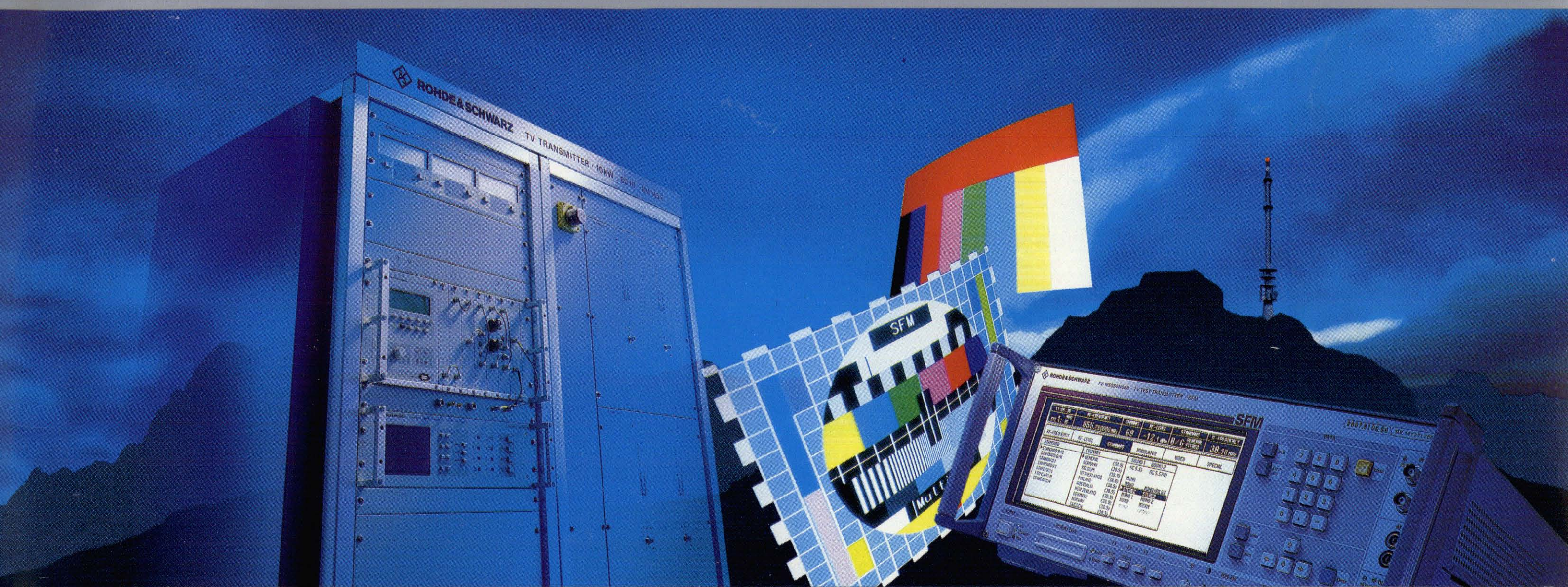
News from Rohde & Schwarz



Television
Broadcast and test equipment

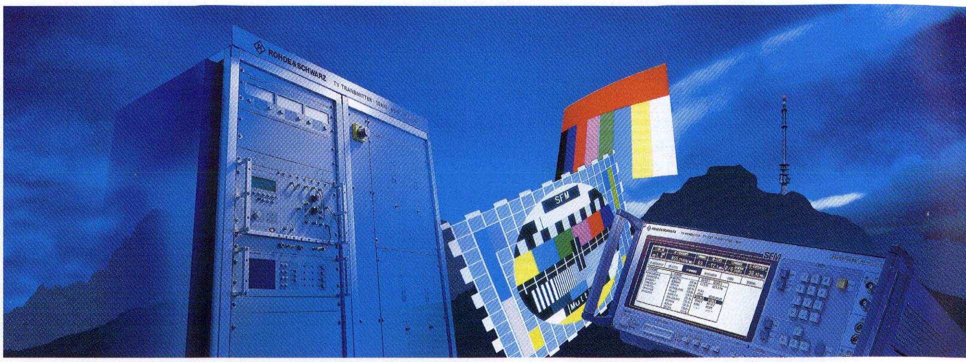
Digital mobile radio
New base-station testers

Radiomonitoring
Digital HF-VHF-UHF scanning
direction finder

146

ROHDE&SCHWARZ

Number 146 1994/III Volume 34



Two new TV transmitters from Rohde & Schwarz: NM 145 E is a transistorized 10-kW VHF transmitter that broadcasts the TV program, whereas SFM provides test signals in line with all common standards for the development, production and service of TV and CATV equipment. For more details see articles on pages 4 and 7.

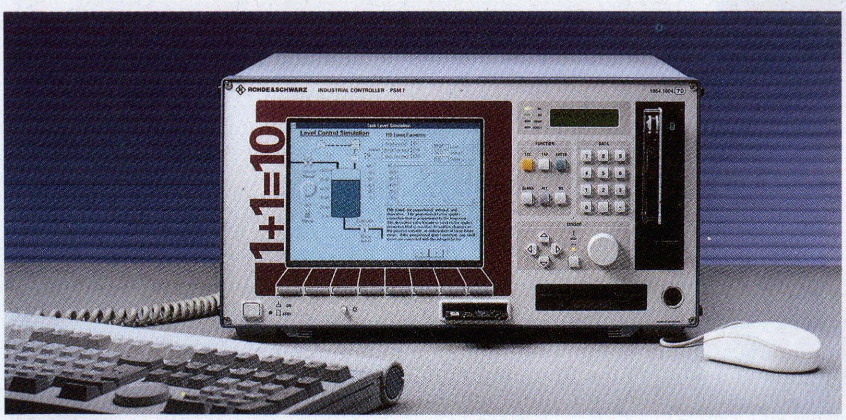
Articles

Application notes

Refresher topic

Panorama

Regular features



1 + 1 = 10 – this equation is not only valid in the binary system, but also for the new Industrial Controller PSM from Rohde & Schwarz. Rugged hardware and powerful software add up to ten arguments in favour of PSM: high quality, reliability, space for expansions, ease of maintenance, upward compatibility, rackability, user friendliness, RF screening, shock resistance and competitive price. These ten highlights are dealt with in detail on page 19. Photo 41 485

Imprint

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Transistorized 10-kW VHF TV Transmitter NM 145 E

The solid-state, broadband high-performance TV transmitter

In NM 145 E, Rohde & Schwarz is introducing a modern system concept for a new generation of fully transistorized VHF TV transmitters. With output powers from 1 to 20 kW, their main features are high availability thanks to an active output stage and passive exciter standby, long operating life, outstanding reliability and user-friendly operation.

10-kW VHF TV Transmitter NM 145 E is the first member of the new, fully transistorized band-III family with output power of 1, 2, 5, 10 and 20 kW [1]. The exciter used is SU 200 [2] with all-electronic tuning and designed for PAL, NTSC or SECAM colour-television transmission. High-gain power transistors and state-of-the-art manufacturing methods at Rohde & Schwarz allow solutions for power amplifiers and power couplers that make these transmitters a low-cost alternative to tubed models in the 10-kW and 20-kW power categories.

Transistorized transmitters have the following **main features:**

- clearly arranged modular rack configuration,
- exciter with output-stage precorrection, regulated output power for vision and sound, regulated modulation signals, synthesizer/precision offset, SAW vestigial-sideband filter, sync-pulse regeneration and dual-sound coding,
- broadband from 170 to 230 MHz,
- lightweight amplifier plug-ins,
- high-performance, bipolar double transistors,
- very high redundancy thanks to two levels of modularity,
- each amplifier plug-in has its own primary-clocked switch-mode power supply,

FIG 1 Transistorized 10-kW VHF TV Transmitter NM 145 E. Exciter SU 200, display panel and sound amplifier in lefthand rack, vision amplifier in righthand rack
Photo 41 610/1

- microprocessor-based transmitter control unit for operation, monitoring and remote control,
- very low heat dissipation to the ambient thanks to pressure and exhaust-air ventilation,
- separate vision and sound amplification,
- high efficiency,
- self-protection circuits in each amplifier and power-supply plug-in,
- for PAL, NTSC or SECAM transmission systems,
- self-engaging connection for amplifier and power supply,
- patented solutions for power combination, power regulation, manual phase control and microwave circuit [3–5],
- optional standby configurations and bit bus interface.

Description and operation

The transmitter is divided into two cabinet racks. The first accommodates the exciter, the transmitter control unit, the display panel, the sound amplifier with power supply and vision/sound diplexer. The second, the vision-transmitter section, comprises eight parallel vision-amplifier plug-ins and the associated power supplies (FIG 1). The amplifier plug-ins and power supplies are automatically connected (supply voltage, RF output, RF input, control and monitoring bus) and can be replaced without having to interrupt operation. After releasing a mechanical safety device, the RF power and the supply to the plug-in to be removed are blocked to prevent arcing.

High efficiency and optimized forced cooling of amplifier modules mean that heatsink size is reduced considerably. The RF power of pairs of vision-amplifier plug-ins is combined to give 2.5 kW with a two-way combiner. A four-way combiner using triplate technology combines four 2.5-kW power units to produce 10 kW. The RF power of the two sound-amplifier plug-ins is also added via a two-way combiner (FIG 2). A diplexer feeds vision and sound

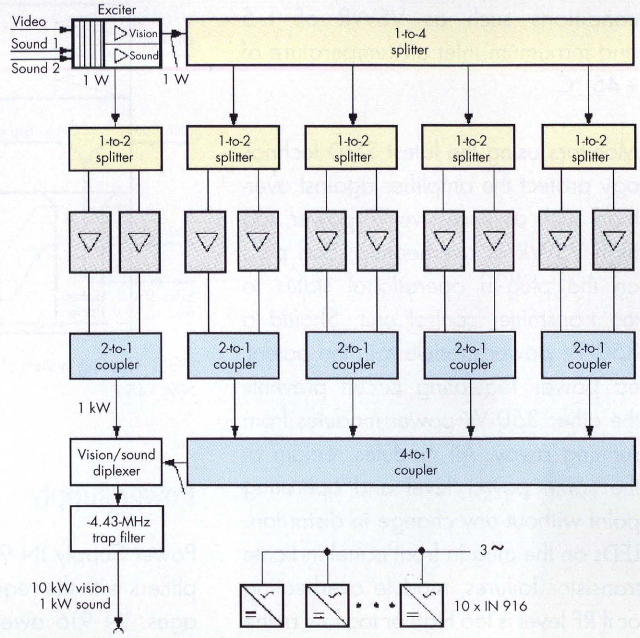

FIG 2 Block diagram of 10-kW TV transmitter

power to the common antenna. On its way to the transmitter output, the RF signal passes through a colour-subcarrier trap at – 4.43 MHz from the vision carrier. Transmitter lightning protection is integrated into the output RF line. The microprocessor-based transmitter control unit handles the power-up sequence, monitoring, display, LED indicators and remote control. The modular design makes it possible to implement single 20-kW transmitters, (10 + 10)-kW transmitters in active standby operation or single 5-kW transmitters as well as transmitter configurations for 1 or 2 kW.

Exciter

Exciter SU 200 is used to produce RF vision and sound signals that comply with relevant standards, to precorrect linear and nonlinear errors in the output stage and to regenerate the sync pulse. It is equipped for split or combined amplification and is also designed for dual-sound operation to the IRT method and Nicam 728. Setting the exciter is fully electronic. All parameters such as basic settings, levelling or output-stage-specific precorrections are set from the display unit using the keypad and rollkey and stored nonvolatile. For special operational states, such as operation with reduced power, or for repairs, four transmitter configurations can be defined for level, linearity and group delay for example, and the exciter sets to them by command.

1.4-kW amplifier plug-in

VHF Amplifier plug-in VU 311 A1 is used as a vision power amplifier up to 1.4 kW sync peak or as a sound amplifier up to 1 kW CW. It comprises a regulated predriver with integral input-power monitor, loop controller, a level and phase control as well as a driver stage with a 1-to-4 power splitter, a (4 x 350)-W pushpull amplifier, 4-to-1 power coupler, harmonics filter and control unit.

The predriver, the driver and the four output-power amplifiers are separate modules fitted with their own heatsinks; the modules can be replaced in seconds when the transmitter is serviced. The power coupler with integral directional coupler and harmonics filter forms a hybrid requiring no adjustment. The predriver module is class A, the driver and output-stage modules are class AB. The amplifier modules were designed to withstand severe conditions such as VSWR of 1.5 and maximum inlet air temperature of +45 °C.

Monitors using the latest SMD technology protect the amplifier against overload such as excessive RF power, too high VSWR or overheating, and pass on the plug-in operational status to the transmitter control unit. Should a 350-W power module fail, the patented power regulating circuit prevents the other 350-W power modules from running away. All modules remain at the same power level and operating point without any change in distortion. LEDs on the plug-in front panel indicate transistor failures, module overheating or if RF level is too high or too low at the input or output.

Control and monitoring

Transmitter Control Unit GS 125 [6] and a controller ensure that the ventilation system, the power supply and the control power are switched on in the correct sequence and monitor the air flow, the inlet and outlet temperature and the operational status of the power plug-ins, of the power supplies and of the whole transmitter.

A display panel with three separate displays shows three menu-selectable operating parameters, eg transmitter output power vision, output power sound 1 and outlet air temperature. During operation, RF vision output power, RF vision reflected power, RF sound output power, RF sound reflected power, diplexer absorber power, inlet and outlet air temperature can be interrogated. The display of the transmitter control unit indicates a momentary failure of the transmitter. Up to 40 transmitter failures can be stored in memory with their date and time of occurrence. All relevant messages and commands mentioned in standard specifications are available in parallel at the remote-control interface. An optional bit bus can be implemented for a serial command and message interface.

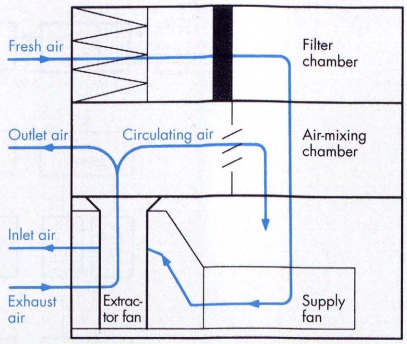

FIG 3 Cooling system of Transistorized Transmitter NM 145 E

Power supply

Power Supply IN 916 supplies the amplifiers with the required operating voltages. IN 916 owes its high reliability to two internal, primary-switched regulators connected in parallel. Size and weight were reduced to a minimum and efficiency of about 86% is obtained due to the high switching frequency of approximately 100 kHz. Built-in protection features protect the power supply against overcurrent, overvoltage and overtemperature. The plug-in can be replaced without any danger during operation when the mechanical locking device is released.

Ventilation system

The external ventilation system (FIG 3) consists of three parts. The lower one accommodates the fan section comprising the supply and extractor fan, the middle one the air-mixing chamber with flap control and servomotor, and the upper one the filter chamber fitted with a coarse and fine filter, designed for long operating life. A differential pressure gauge indicates the degree of filter contamination. If the inlet air is filtered and the annual lowest temperature is not below +1 °C, the air-mixing chamber is not required since the filter and inlet air pipes will not freeze under such conditions.

Hans Seeberger

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Condensed data Transistorized 10-kW VHF TV Transmitter NM 145 E

Frequency range	170 to 230 MHz
Output power/vision	10 kW
Output power/sound	500 W/100 W, dual sound 500 W or 1 kW, single sound
Output impedance	50 Ω
Standards	B/G, M/N, D/K, I (others on request)
AC line connectors	3 x 230/400 V, 47 to 63 Hz
Power consumption (without ventilation)	
100% APL	approx. 21 kW
50% APL	approx. 17 kW
Cooling air required	approx. 85 m^3
Dimensions (W x D x H)	1300 mm x 1500 mm x 2200 mm
Weight	approx. 800 kg
RF output	RL 58

Reader service card 146/01

TV Test Transmitter SFM

The multistandard platform for tomorrow's TV

TV Test Transmitter SFM supplies vision and sound signals to all common TV standards for the IF range from 32 to 46 MHz and the RF range from 5 to 1000 MHz. Thanks to its flexibility and compactness, it is ideal for use in development, production and servicing of TV and cable-TV equipment as well as in EMC test applications.

SFM is the successor to the successful TV Test Transmitter SBUF, which comprises the modulator and the transposer [1] as separate sections. Thanks to a completely new and very flexible modular concept, modulator and transposer are combined in one highly compact unit (FIG 1).

TV Test Transmitter SFM can be used for a wide range of **applications** thanks to its compact design and flexibility. There are numerous uses in particular in EMC measurements. In Europe, EMC requirements are set down in standards EN 50081 and EN 50082. The European conformity mark CE is only granted if limits are met. TVs, video recorders, TV transposers and their modules can be operated with SFM and checked for spurious emissions.

The most important **features** of SFM are:

- generation of TV signals to standards B/G, D/K, I, L/L', M and N, including stereo/dual sound and digital Nicam sound,
- double-sideband test modulator for all IFs between 32 and 46 MHz,
- internal test-signal generators for video, audio generator, stereocoder and Nicam generator,
- high frequency resolution of 1 Hz for precision offset,
- frequency locking for all oscillators,
- suitable for backward-channel operation in analog and digital modulation modes,
- modular concept expandable up to two main frames which are controlled from the front panel of the basic unit,
- retrofitting for digital TV standards, making SFM the ideal platform for the new, digital TV standard MPEG 2.

FIG 1 TV Test Transmitter SFM in TV-set production
Photo 41 763/2

Each SFM frame can accommodate up to ten plug-ins, so TV standards B/G, D/K, I, L/L', M, N can be implemented in a single SFM (FIG 2) [2].

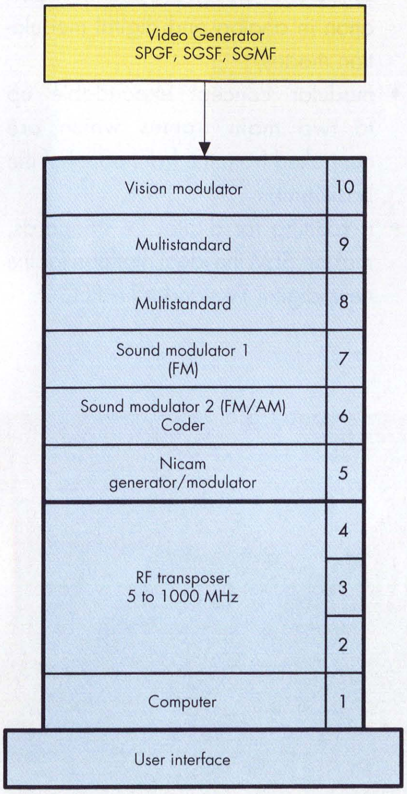


FIG 2 Example of SFM equipped for standards B/G, D/K, I, L/L', M and N

Modulation and RF conversion

The IF of the **vision modulator** (FIG 3) is set automatically when the standard is selected (eg standard B/G: IF = 38.9 MHz). The vision carrier is modulated with the residual-carrier setting determined by the standard. Hard or soft video clamping can be selected. If soft clamping is used, hum is not suppressed for example. This is required when testing the hum suppression of a TV receiver. The amplitude-modulation spectrum is limited by standard-dependent vestigial-sideband filters (high-quality SAW filters). A large variety of video group-delay precorrections can be implemented in SFM.

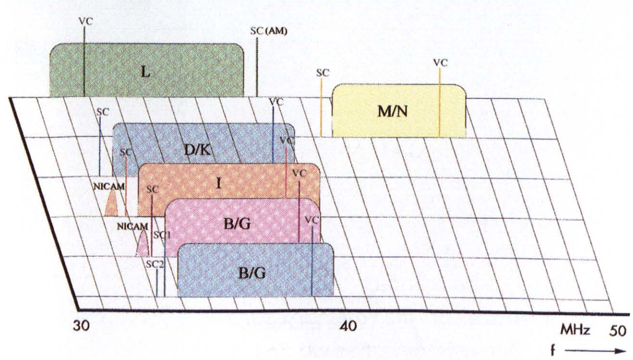
Like the vision carrier, the sound-carrier IF for the **sound modulators** is set automatically when a standard is selected. The country-specific features and the sound method used are also taken into account when the setting is made. Sound-carrier IFs can be varied over a wide range in 1-Hz steps. The sound method (mono, stereo, dual sound, mono + Nicam) is selected in the menu for standard settings. The appropriate AF coding is carried out automatically, eg stereo (L+R)/2 for sound modulator 1 and R + pilot for sound modulator 2 with the IRT dual-sound carrier method.

In dual-sound mode (standard B/G), it is possible to activate a deviation-difference calibration. This minimizes stereo crosstalk in the test transmitter so that receiver stereo crosstalk can be measured. A multiplex signal with a frequency up to 120 kHz can be used for the American BTSC method. The sound is amplitude-modulated for standard L (France). The frequency deviation and the output level of the sound carriers are also set automatically as per standard.

The **Nicam modulator** generates a standard QPSK signal together with the associated IF and cosine rolloff factor for standards I and B/G. A Nicam signal with the correct RF position can be generated for standard L. In this case the passband of the vestigial-sideband filter is reduced correspondingly. Since pulse filtering and the modulator are digital, an almost ideal signal is set, with the I and Q signals in perfect quadrature. The Nicam modulator has inputs for an external Nicam data stream and a clock signal. When the external Nicam data stream fails, the test transmitter automatically switches over to a pseudo-random bit sequence (PRBS). Modulation can be switched off (continuous wave) and a defined bit error rate set. An internal generator delivers a standard Nicam data stream which comprises frame-alignment word, control and additional data bits plus the digitally coded audio signals. These audio signals can be selected in three loudness levels from a large number of frequencies. The required signal coding can also be selected (stereo, dual sound, mono + data, data). The appropriate intercarrier is also available.

The **RF transposer** converts the IF signal (vision and sound) to an RF signal with frequency from 5 to 1000 MHz. It has an internal and an external IF input; the external one can be tuned to any IF vision-carrier frequency between 32 and 46 MHz. It is thus easy to convert any IF signal (eg 38.0 MHz, Eastern Europe) to RF. Either the upper or the lower sideband can be selected on the RF converter. At the vision/sound IF, the sound carrier is below the vision-carrier frequency (eg vision carrier 38.9 MHz, sound carrier 33.4 MHz), except for standard L. However, after RF conversion the order of the carriers is changed around in the upper sideband. It is possible to select the upper or lower sideband, so all standard-L channels can be

FIG 3 Intermediate frequencies and VSB filtering for various standards



generated correctly. When the lower sideband is selected, all TV standards at any IF can be accommodated. Multi-standard TV receivers often operate on a single IF (eg 38.9 MHz).

The RF output signal can be switched between 50 and 75 Ω (option) as well as between the settings Low Noise, Normal and Low Distortion. Special configurations for measuring intermodulation and linearity (static programs) can be called. Level combinations for vision, sound and sideband specified in measurement standards are set with the modulation switched off. Linearity measurements are performed by automatic vision-carrier level switching every two seconds.

Several parameters for the vision, Nicam and sound modulators can be set to non-standard values. The display outputs a warning that non-standard parameters are being used; however, compliance with the appropriate standard can be restored with a single keystroke.

Operation and module control

SFM outputs all information on a large LCD graphics display; if required an external monitor can be used. The display is divided into different areas. The most important, currently valid setting parameters are displayed in the upper area, these being frequency, TV channel, output level and the selected standard with the associated vision IF. Underneath there is the main selection line with menus such as frequency, level and standard. A special menu enables intermodulation measurements and sweep mode to be selected.

SFM is equipped with an IEC/IEEE interface to SCPI and also has an RS-232-C interface. Thanks to a PCMCIA adapter, settings can be loaded from or to a memory card. Software updates can be carried out via the serial interface or the memory-card interface. A newly designed computer system controls all SFM modules and the numerous setting functions. It controls modules via the serial SERBUS developed by Rohde & Schwarz. With SERBUS modules can be plugged into any slot.

Future extensions

SFM's serial bus concept was designed for expansions and future modules. Retrofitting the equipment is easy at any time, even for digital TV standards. As a result, SFM is the ideal platform for the new, digital TV standard MPEG 2 (transmitted via QPSK or QAM). For the near future, digital modulators and the associated channel coders are planned for CATV (QAM) and digital satellite television (QPSK). SFM is thus an absolutely sure investment for the future.

Erhard Kretschmer; Franz Neumann; Franz-Josef Zimmermann

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Condensed data TV Test Transmitter SFM

Frequency range	5 to 1000 MHz
TV standards	B/G, D/K, I, L/L', M, N
Vision	
Video test generator	625 lines
Video inputs	3, switch-selectable for external video generators
Type of modulation	C3F, negative (B/G, D/K, I, M, N), positive (L/L')
VSB characteristic	SAW filters to TV standards
Clamping	hard and soft
Sound	
Sound transmission	stereo/dual sound, coding to IRT or Korea, Nicam 728
Audio frequency	40 Hz to 15 kHz (internal with DSP)
Transmission characteristics (VF+IF+RF)	
Video S/N ratio	>60 dB unweighted
Sound S/N ratio	>68 dB (mono, parallel sound)
Static programs	unmodulated level combinations for intermodulation measurements

Reader service card 146/02

TV Inserter/Regenerator VIR

Optimum monitoring of ongoing television broadcasts

Interference-free, high-quality TV reception is now ensured by the new TV Inserter/Regenerator VIR from Rohde & Schwarz. With its excellent characteristics, VIR is not merely a successor to the successful ITS Inserter SPRF, it was also designed with the future in mind.

Characteristics and uses

TV Inserter/Regenerator VIR operates in the video baseband. It regenerates the sync signal during the ongoing program, regulates the level to nominal amplitude, and blanks and inserts signals in the vertical blanking interval. These signals may have very different contents: for example, test signals, teletext or station identification signals can

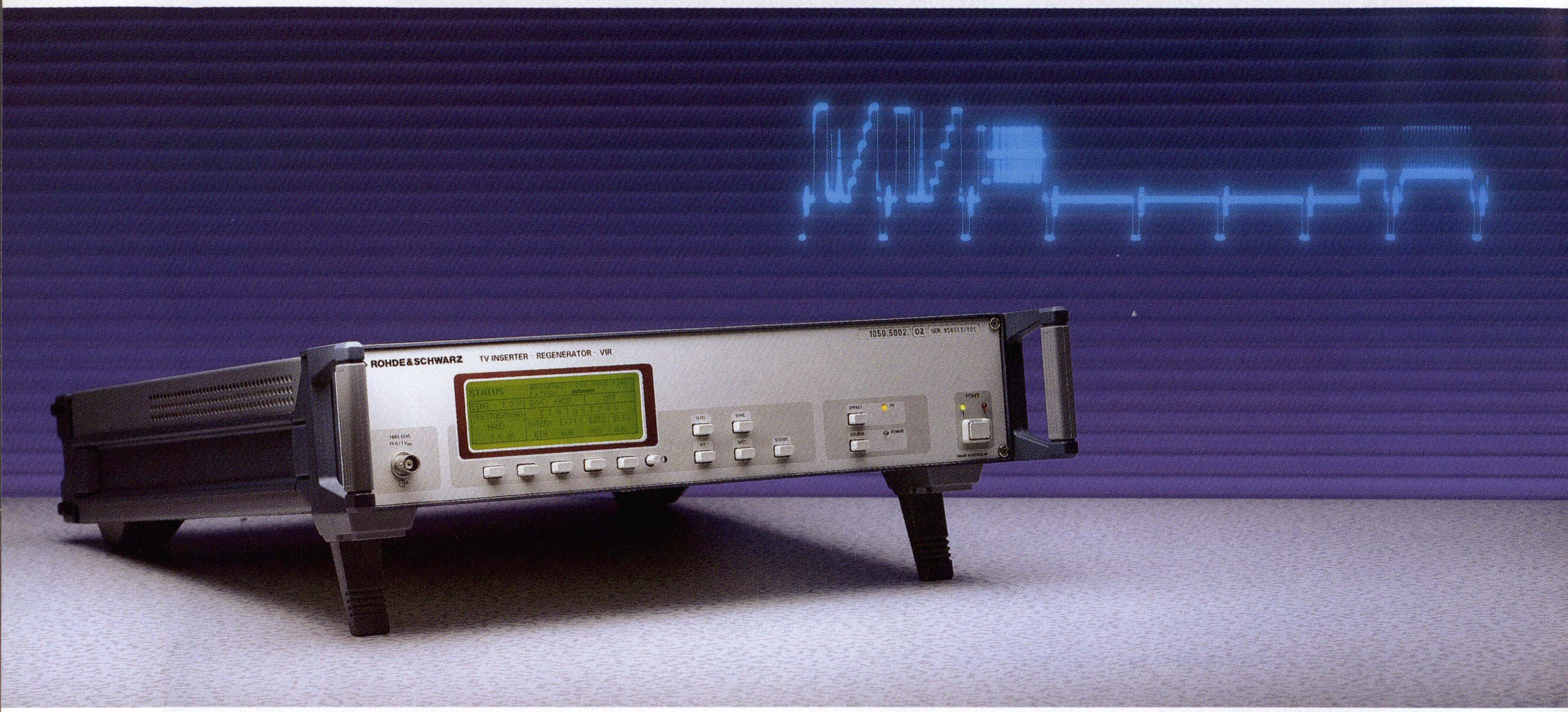

FIG 1 TV Inserter/Regenerator VIR for monitoring quality of ongoing TV broadcasts
Photo 41 699

Rohde & Schwarz participated right from the start when ITS measurement techniques were first being devised. Rohde & Schwarz developed test-line generators and analyzers for automatic measurements in the lab, in production and service. However, automatic measurements were not the real motive for developing this technique. The goal was to measure and monitor transmission quality during the ongoing TV program. There were mainly two reasons in favour of this technique: the ongoing program need not be interrupted for testing and, even more importantly, unexpected failures can be avoided by continuous monitoring, weak points be detected at an early stage by statistical analysis. To exploit these advantages, equipment for the insertion of test lines into the TV program is required. This is why SPRF was developed. It has given fine service for more than two decades [1]. Rohde & Schwarz is now launching its successor: TV Inserter/Regenerator VIR (FIG 1). It was type-tested by German Telekom, ie it complies with the latest purchasing conditions of Telekom [2], and it also meets the latest standard specifications of the broadcasting corporations [3].

be inserted. VIR is ideal for the continuous monitoring of TV equipment. This applies to the entire program transmission chain operating round the clock: studios, end points of transmission links, distributors/starpoints, interfaces with other networks (satellite, cable), transmitter input.

The following **characteristics** make VIR an ideal choice for the above applications:

- Synchronization is highly reliable; VIR synchronizes to the program signal – even in the presence of high noise levels or PALplus signals. VIR supplies a sync signal for external equipment, and can also be synchronized externally.

- ALC can be set to the following: nominal CVS input signal of 0.7 V or 1 V, white reference bar in line 17, 18, 330 or 331, and manual or automatic control. If the insertion test line is absent or if limits are exceeded, a preset gain is automatically selected.
- The sync pulse is not regenerated but instead a new pulse is generated.
- ITS signals can be inserted or blanked in the whole ITS range in any of lines 6 to 22 and 319 to 335.
- All insertion test signals are internally generated with high precision. External ITS signals, too, can be inserted via three channels after undergoing a sync test.
- The integrity of the program path has top priority. If input signals strongly deviate from standards or if an internal alarm is triggered, the program signal is switched through to the main output as stipulated by the appropriate purchasing conditions and standard specifications. The signal with the suspected impairment is still available at the four other outputs.
- The selected gain and any other operational data are stored in nonvolatile memory. In all, nine complete setups can be stored.

Operating concept

A clear-cut display and a combination of menu keys and softkeys are the core of the simple but efficient **operating concept,** characterized by the following **features:**

- only five menu keys and two mode keys,
- straightforward, interactive user guidance in the selected menus (FIG 2),
- clear, informative status display (FIG 3),
- conspicuous, large warnings in the event of anomalous operating states (FIG 4).

Ignoring the auxiliary functions, there are just three menu keys to operate the VIR: gain, synchronization and insertion and blanking of signals. These keys are sufficient, as the user is conveniently guided and supported in each menu by means of softkeys. All remaining functions are performed automatically: regeneration of sync pulses, gain control and, if necessary, switchover to a bypass circuit to allow the program – it is the current TV broadcast – to pass to home receivers unimpaired. Anomalous operating conditions are indicated by conspicuous, large warnings. If a warning of this kind is output, the unit will still respond to operator control, allowing the condition to be removed. The warning will disappear while the unit is being operated and will appear again if the critical condition is not removed. Whenever a critical adjustment is made, a prompt is issued and confirmation required to prevent the broadcast program being impaired.

Remote control can be effected in two ways: Firstly, via single control lines and status indication via floating contacts to ensure compatibility and interchangeability with predecessor unit SPRF. Secondly, via an optional bit-bus control allowing operation from a PC to match future requirements.

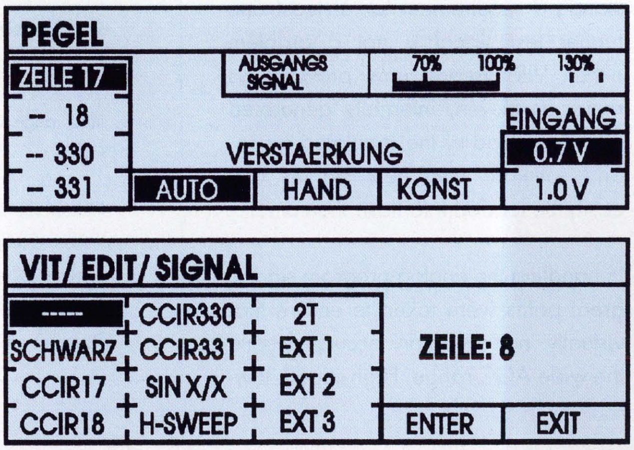

FIG 2 Clear-cut display and easy adjustment of level and reference (top); convenient assignment of new test signal to insertion line (here line 8) (bottom)

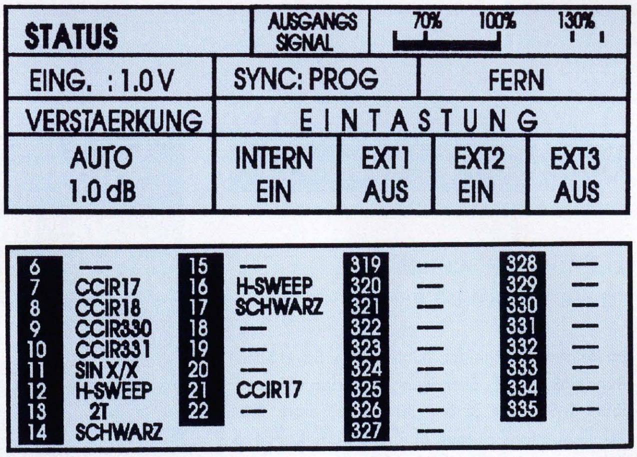

FIG 3 Status indication and overview of all test signals inserted

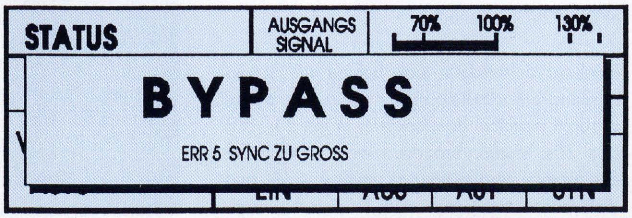

FIG 4 Conspicuous warning of anomalous operating state

Design concept

The design and technology of VIR is characterized by three elements: integration of tried and tested design and operating features, high-grade analog technology for handling analog program signals, and state-of-the-art highly-integrated digital technology for added precision and reliability.

To obtain the required reliability, a time-tested, technically up-to-date design concept was chosen. The mechanical design has proved its value with respect to reliability, stability and ease of servicing. The processor section has demonstrated its suitability as a base for the software, optimally supporting operator control as well as the interfaces. The standard requirement for at least one further test signal is not a problem either. VIR already now provides as many as eleven, internally generated signals instead of the stipulated seven, and software with new signals can easily be loaded into flash memory.

In handling the analog program signal, great pains were taken to ensure that virtually no distortion occurs despite the wide AGC range. High-speed, low-interference switches are used for the insertion and blanking of test signals. Non-intrusive samplers check level and sync.

The use of digital technology ensures high precision, temperature-stabilized behaviour and reliability. The level is measured with an accuracy of 12 bits and adjusted by means of a D/A converter. Digital control makes for highly accurate coupling of VIR to the program signal, and for high-precision timing of the new sync signal and the insertion or blanking of test signals. The high accuracy of the internal receivers can be summed up in a few words: digital generation, 20.25-MHz clock frequency, 12-bit resolution. In short, VIR not only has all the capabilities of its predecessor but is also well equipped to cope with new requirements (insertion of identification signals, handling of PALplus signals).

Josef Handl

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Condensed data TV Inserter/Regenerator VIR

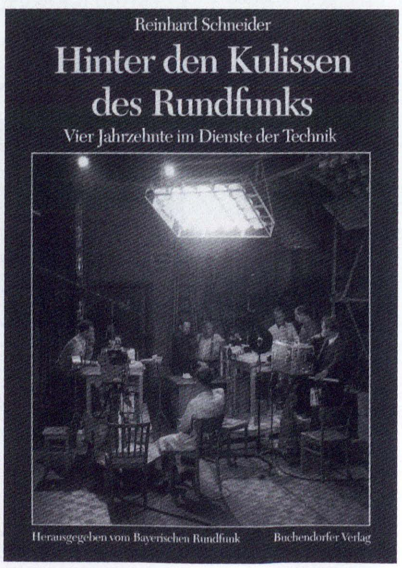
Inputs	program input, 3 external signals, sync signal
Input range (CCVS)	1 V/0.7 V (switch-selectable) ±30%
Outputs	program output, 4 additional outputs, sync signal
Internal signals	11
Insertion range	lines 6 to 22, 319 to 335
Frequency response	±0.1 dB up to 6 MHz
Signal generation	12 bits, 20.25 MHz

Reader service card 146/03

Booktalk

Behind the scenes in sound broadcasting

by Reinhard Schneider, published by Bayerischer Rundfunk, 1994, Buchendorfer Verlag, Munich. ISBN 3-927984-25-6. 130 pages, more than 70 illustrations – four of them from Rohde & Schwarz. Available in bookshops at a price of DM 22 (German only).



Reinhard Schneider's look behind the scenes in sound broadcasting makes the reader aware of rapid technical developments in the 50s, 60s and 70s: studio, broadcast and transmission equipment, introduction of mediumwave and VHF, monochrome and colour TV and the installation of transmitter stations in Bavaria. He tells of well-known personalities he met in the course of his work with Bayerischer Rundfunk, one of them being Dr Lothar Rohde, the "ingenious VHF specialist from Munich" as he calls him.

Not only the first VHF transmitter for Bayerischer Rundfunk (1949) came from Rohde & Schwarz, but also the nucleus of its time-signal transmitting system, an – at that time – state-of-the-art crystal clock, with which time signals were broadcast four times a day after 1946. The autobiography of Schneider, who worked with Bayerischer Rundfunk for almost 40 years and who has become well-known through many publications, is an interesting source of information on the history of Bayerischer Rundfunk. The book is written in a lively style, well edited, of appealing presentation and the right kind of book not only for technicians but everybody interested in sound and TV broadcasting.

wgr

TV Network Analyzer SOKF

Integral digital oscilloscope supports TV network analysis

With TV Network Analyzer SOKF, Rohde & Schwarz is setting new standards in TV transmitter measurements. The integral digital oscilloscope with video-analyzer features now enables comprehensive measurements of linear and nonlinear transmission characteristics in the time and frequency domain with just one compact unit.

TV transmission systems must meet stringent requirements with respect to linear and nonlinear transmission characteristics. The special structure and complexity of TV signals call for elaborate test equipment in development, production and maintenance [1; 2]. Depending on the parameter under test, measurements in the frequency or in the time domain may be more advantageous. An ideal solution is to combine the two methods (see table in blue box); this has been provided for by Rohde &

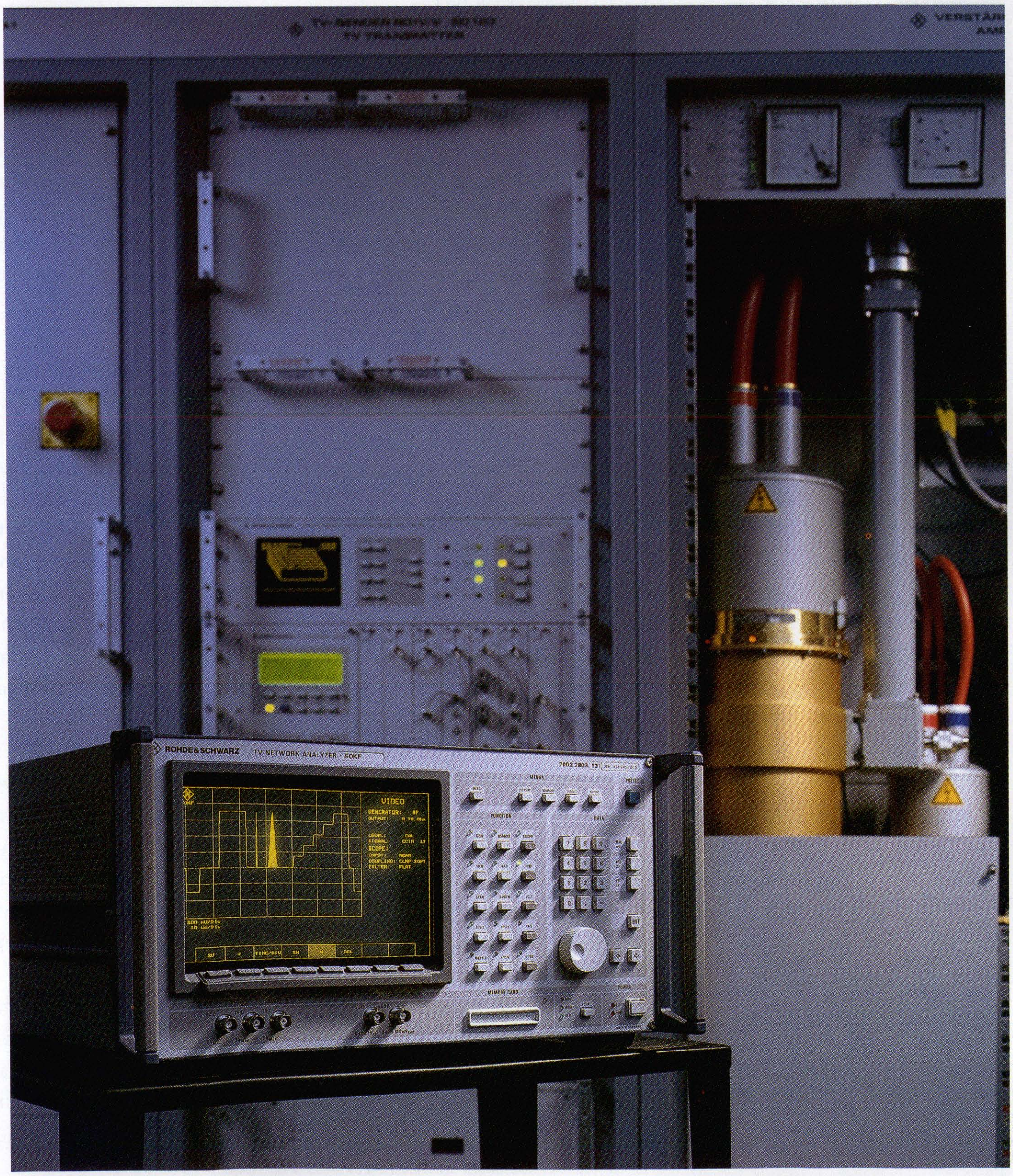


FIG 1 TV Network Analyzer SOKF for complete TV transmitter measurements in time and frequency domains
Photo 41 758

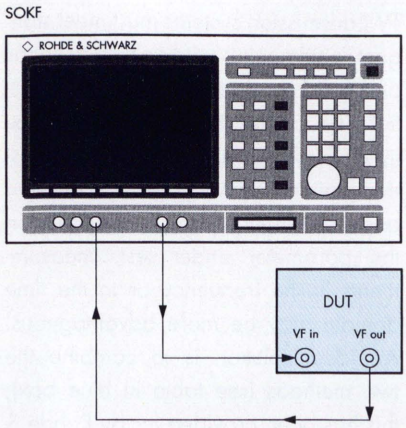


FIG 2 Video measurements with TV Network Analyzer SOKF

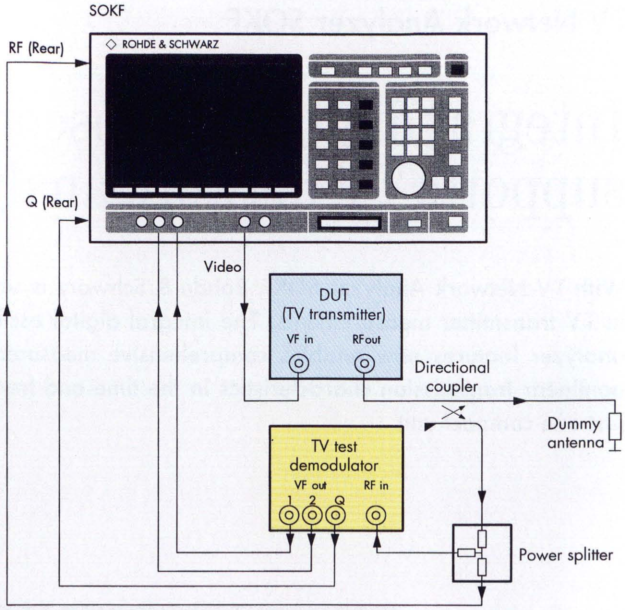


FIG 3 Measurements on TV transmitters with SOKF and Demodulator AMFS

Schwarz in the form of a compact, cost-effective unit – TV Network Analyzer SOKF (FIG 1).

Measuring capabilities

Measurements in the frequency domain are performed by the network and spectrum analyzer of SOKF. Thanks to its wide span and dynamic range, it is particularly suitable for continuous measurements of linear transmission characteristics inside and outside the transmission channel (amplitude and group-delay response, filter quality and spurious emissions of TV transmitters) and of some nonlinear transmission characteristics (luminance-dependent amplitude frequency response, intermodulation products).

Measurements in the time domain are performed using the oscilloscope function of SOKF, which is characterized by high time resolution, fine quantization with high linearity, and short measurement times. The oscilloscope function in conjunction with the built-in video generator and – for TV transmitter measurements – an external test demodulator (eg AMFS) enables in particular the measurement of TV-specific, nonlinear distortion, low-frequency linear distortion and interference, and signal monitoring during the ongoing program (FIGs 2 and 3).

The oscilloscope section of SOKF is specially designed for TV and video measurements. SOKF not only displays signals in the time domain, it also analyzes selected video parameters, providing the user with a highly compact, value-for-money solution for his measurement problems. Operation is just as easy as that of a general-purpose oscilloscope. The straightforward, menu-based operating concept using hardkeys and softkeys is logically integrated into the overall concept of the SOKF network-analyzer section.

Automatic test routines, like those already implemented in TV Network Analyzer SWKF [2], greatly facilitate standard measurements even in oscilloscope mode. Built-in special filters make it possible to carry out selective measurements on signal components (colour subcarrier, luminance signal, step size, hum). Moreover, time-domain signals can be measured easily and very accurately using the cursor functions.

Particularly noteworthy are the built-in **video-analysis functions** (FIG 4). They can be used to give graphs of differential gain and phase (simultaneously) as well as ICPM (incidental carrier phase modulation).

To determine the thermal characteristics of transistorized transmitter output stages, SOKF has special test signals and analysis routines (DG and DPH in selected lines as a function of luminance).

	Measurements in frequency domain	Measurements in time domain
Linear distortion	Amplitude and group-delay response Vision/sound ratio	Multiburst 20T pulse 2T pulse Transient response 250 kHz sin(x)/x Tilt
Nonlinear distortion	Luminance-dependent frequency response (black-white sweep) Intermodulation	Differential gain (DG) Differential phase (DPH) Luminance nonlinearity (LNL) Incidental carrier phase modulation (ICPM)

Design and characteristics

The versatile measurement capabilities of SOKF are combined with an elaborate signal-processing section and high measurement accuracy. The large signal bandwidth of 9 MHz in conjunction with a steep-skirted anti-aliasing filter makes it possible to process higher-frequency spectral components of test signals (eg 2T pulse) with aliasing effects being suppressed. The use of oversampling gives a flat frequency response and in particular a flat group-delay response right up to 9 MHz. A fast 10-bit A/D converter and a state-of-the-art floating-point signal processor ensure high accuracy and resolution.

SOKF has a 75-Ω video input (front/rear switch-selected) with high return loss and input sensitivity matched to the requirements of video technology (50, 100 and 200 mV/div, fine adjustment switch-selectable) as well as a Q input for the quadrature signal derived from a test demodulator (eg AMFS). Hard or soft video clamping can be selected depending on application (hum suppression, hum measurement, DC offset measurement), and clamping can also be switched off (AC, DC, GND).

The TV trigger function allows any line to be selected. The trigger signal can be phase-locked to the line frequency to suppress trigger jitter with noisy input signals. An external video signal can also be used for triggering. Triggering on the AC mains is also possible to identify any hum on the test signal. The timebase is oriented to the duration of the TV line for optimum utilization of display resolution and, of course, can be used to show user-selected line sections.

What makes the design of SOKF different from that of TV Network Analyzer SWKF is the built-in oscilloscope function. SOKF thus has the maximum configuration of the Rohde & Schwarz series of TV network analyzers (SWVF, SWKF, SOKF). Naturally, SOKF has the same sophisticated features as the other two analyzers, eg a large, high-contrast ELD with wide viewing angle (useful for TV transmitter alignment) and a variety of interfaces (IEC/IEEE bus, RS-232-C, Centronics, VGA monitor port).

Andreas Kinzel

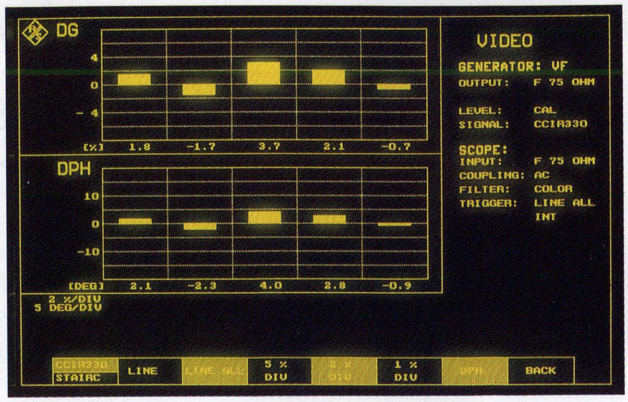


FIG 4 Display of differential gain and phase

REFERENCES

[1] Dürselen, A.; Ebersberger, G.; Fischer, W.: TV Network Analyzer SWKF, an expert for TV measurements. News from Rohde & Schwarz (1992) No. 139, pp 4–6

[2] Dürselen, A.; Ebersberger, G.; Osterloh, G.: State-of-the-art TV sweep measurements from 0.01 to 900 MHz. News from Rohde & Schwarz (1994) No. 144, pp 26–28

Condensed data Oscilloscope in TV Network Analyzer SOKF

Signal bandwidth	0 to 9 MHz
Sampling frequency	40 MHz
Quantization	10 bits
Frequency response	< 1%, < ±5 ns up to 5 MHz
Input sensitivity	50, 100, 200 mV/div
Timebase	5 ms/div to 100 ns/div
Inputs	front, rear, Q (all 75 Ω)
Coupling	AC, DC, GND
Clamping	hard, soft
Trigger	int., ext., mains coupling: direct or via PLL, any line selectable
Special filters	spike, colour, 1-MHz LP, 1-kHz LP
Video analysis	DG, DPH, ICPM

Reader service card 146/04

Digital Radiocommunication Testers CMD 54/57

GSM/PCN base-station testers for production, installation and service

A well-thought-out, user-friendly operating concept, compact size and low weight as well as rugged construction make the new testers an ideal choice for production, service and heavy-duty installation work: CMD 54 handles digital mobile-radio base stations to GSM standard and CMD 57 base stations to GSM and PCN (DCS 1800) standards.

In addition to **manual control,** which is the main operating mode in servicing, CMD 54/57 features remote control via the optional **IEC/IEEE-bus interface.** This mode of operation will be mainly used in production environments. As far as installation is concerned, the serial **RS-232-C remote-control interface** is the most interesting feature, as all laptops or notebooks commonly used in installation are fitted with this type of interface.

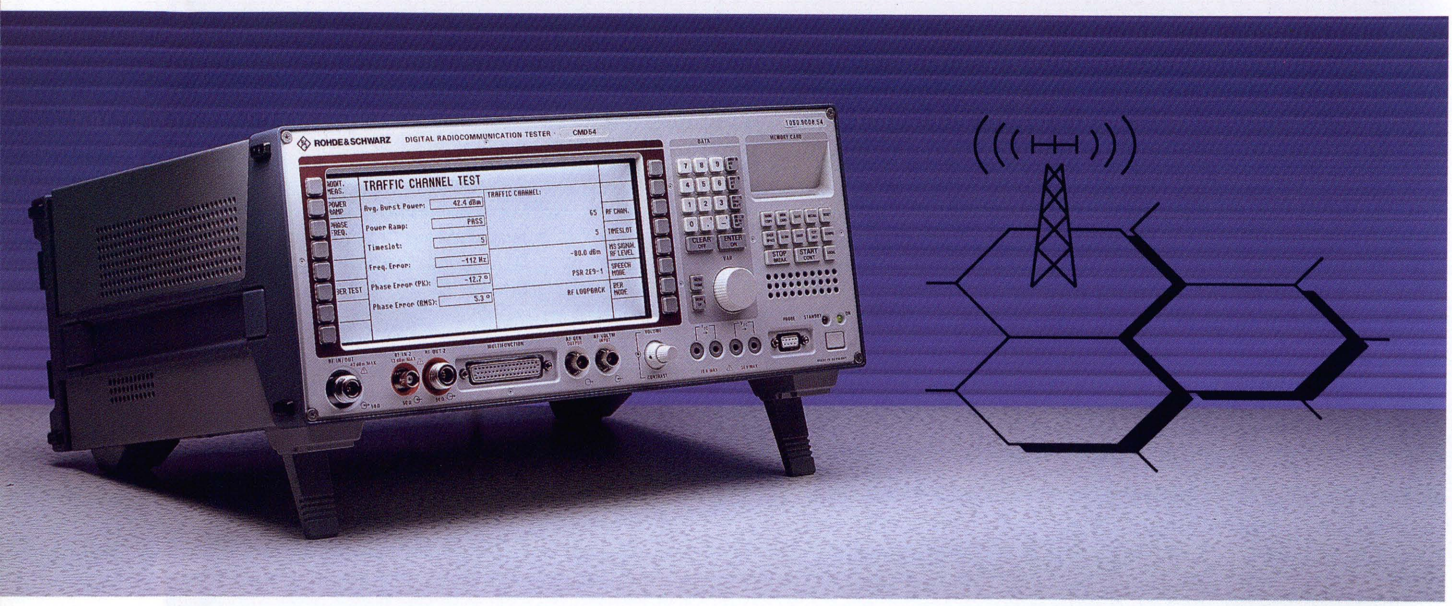


FIG 1 Digital Radiocommunication Tester CMD 54/57 – specialist for GSM and PCN base-station measurements Photo 41 582/1

Digital Radiocommunication Testers CMD 54 and CMD 57 join the successful CMD family, which can now provide testers for GSM and DCS 1800 base stations (FIG 1). The highly flexible GSM/DCS 1800 testers of the first generation were designed for use in development and quality management. CMD 54/57, the testers of the second generation, are tailor-made to meet the requirements of production, installation and servicing of GSM/DCS 1800 base stations. The new testers of course have all the well-known advantages of the CMD family [1–3].

Easy operation

With the user interface of Digital Radiocommunication Tester CMD 52 for GSM mobiles – the first member of the CMD family – Rohde & Schwarz set a standard for the operation of compact testers. CMD 54/57, too, has separate **test menus** and **configuration menus.** The test menus include only those functions that are needed for measurements. General parameters, eg for tolerance masks, are defined in configuration menus. This separation provides for an extremely clear-cut operating concept. CMD 54/57 checks results for compliance with user-definable tolerance limits. **Pass/fail indicators** make it easy to interpret results correctly, even if the operator has little experience with tests of this type (FIG 2).

Comprehensive measurements

The signalling requirements that have to be met by base-station testers are different from those to be fulfilled by mobile testers. In the case of mobiles the tester acts as a master and controls the mobile, while in the case of base stations the DUT (base station) is the master. Here it is not possible for the tester to set the base station to a particular RF channel via the air interface. Base-station measurements therefore require the use of special interfaces or control units.

However, the DUT not only acts as a master in terms of control, it also supplies the timing and frequency reference signals. A base-station tester therefore needs to synchronize to the base station. CMD 54/57 can use either the C0 carrier from the base station or an external trigger for synchronization. With the option Reference Frequency Inputs/Outputs CMD-B3, CMD can be synchronized to virtually any external reference frequency.

The **basic version** of CMD 54/57 can carry out all essential base-station **measurements:**

- Tx power level including power ramping with a large dynamic range (>72 dB),
- phase and frequency error,
- spectrum due to modulation,
- spectrum due to switching,
- bit error rate.

Thanks to a tailor-made concept providing a selectable average rate, extremely fast spectrum measurements (FIG 3) are possible: GSM modulation spectra averaged over 500 frames are available in less than 60 s.

Bit-error-rate measurements (FIG 4) on base stations involve some difficulty because, unlike mobile tests, there is no uniform test procedure specified by GSM/PCN standards. CMD 54/57 therefore provides various ways of determining the bit error rate of a base station:

1. Via loopback on base station
CMD 54/57 transmits a pseudo-random bit sequence in the speech frames. The base station returns this bit sequence to CMD 54/57 via a switchable loop. CMD 54/57 compares the pattern received with the pattern sent, and so determines bit error rate.

2. Via loopback on CMD
CMD 54/57 receives the speech frames sent by the base station and loops them back to the base station. Bit error rate is determined by the base station.

3. Via CMD remote-control interface
CMD 54/57 again injects a pseudo-random bit sequence in the speech frames. A number of the speech frames received by the base station is recorded by an external unit (eg a PC). The bit sequence is sent back to CMD 54/57 via the IEC/IEEE bus or the RS-232-C interface, and CMD calculates bit error rate.

4. Via optional A_{bis} interface
CMD 54/57 sends a pseudo-random bit sequence to the base station, monitors the bit sequence at the A_{bis} interface between the base-station controller and the base station and calculates bit error rate.

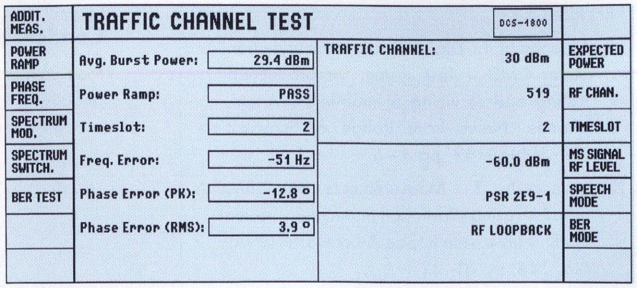


FIG 2 Main measurement menu presents all results in short, clear-cut form. Specific menus can be called via softkeys for more extensive, in-depth measurements.

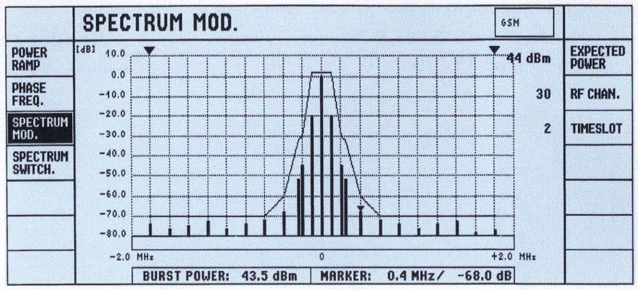


FIG 3 In spectrum measurement menu, spectral lines are shown as bargraphs. Detailed analysis is facilitated by markers and tolerance masks.

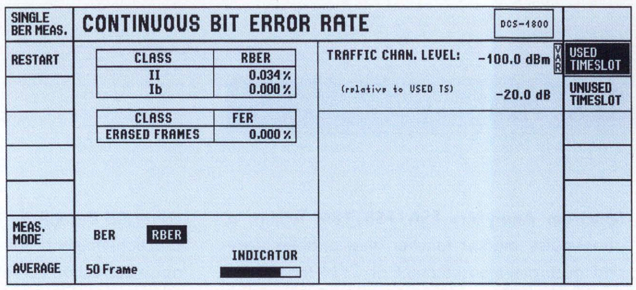


FIG 4 Menu for continuous bit-error-rate measurement provides fast overview of base-station receiver characteristics.

In addition to the GSM-specific measurements described above, CMD 54/57 features a **DC ammeter and voltmeter,** especially designed for pulsed signals to test power supplies. The ammeter measures maximum, minimum and average current.

A wide variety of **options** ensures that CMD 54/57 can adapt to any measurement environment easily. Beside the options referred to above, AF Measurement Unit CMD-B41 with frequency counter is particularly worth mentioning, as this adds an **AF voltmeter,** a **distortion meter** and a **frequency counter** that operates up to 60 MHz to the facilities already provided by CMD 54/57. Rohde & Schwarz is constantly developing new options in line with the latest standards and recommendations, thus providing an instrument that can handle tomorrow's requirements too.

Rudolf Schindlmeier

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[1] Maucksch, T.: Digital Radiocommunication Tester CMD – Test system for production testing and servicing of mobile GSM telephones. News from Rohde & Schwarz (1993) No. 142, pp 4–6

[2] Maucksch, T.: Measurements on GSM mobiles using Radiocommunication Tester CMD. News from Rohde & Schwarz (1994) No. 144, pp 31–32

[3] Mittermaier, W.; Holzmann, G.: Digital Radiocommunication Tester CMD 55 – GSM and PCN tester in one compact unit. News from Rohde & Schwarz (1994), No. 145, pp 18–20

Condensed data Radiocommunication Tester CMD 54/57

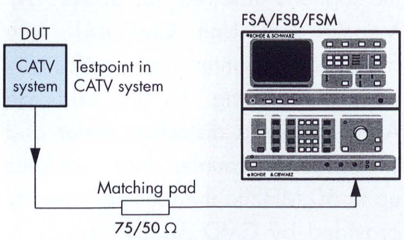
Measurements with basic unit	Base-station measurements to GSM standard (CMD 54 and 57), base-station measurements to DCS 1800 standard (CMD 57), synchronization to C0 carrier or by means of external TDMA trigger signal, peak power measurements, power ramping (dynamic range >72 dB), fast phase- and frequency-error measurements, spectrum due to modulation, spectrum due to switching, measurement of bit error rate in loopback mode or via remote-control interface, DC current and voltage measurements
Measurements with options	Bit error rate via A_{bis} interface, AF voltage, AF distortion, frequency up to 60 MHz

Reader service card 146/05

Test hint

Precise C/N measurements with spectrum analyzer

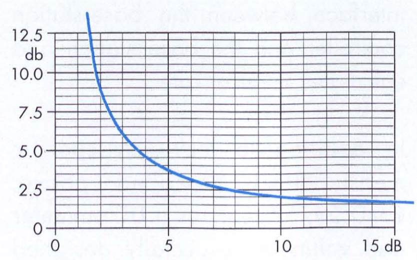
Spectrum Analyzers FSA/FSB/FSM feature a phase-noise marker function that enables easy and accurate measurement of C/N (carrier-to-noise) ratio, which is the logarithm of the ratio of signal power to noise power at the output of a DUT. Due to different definitions of C/N and phase noise, the sign of the displayed result must be inverted. Signal and noise powers are measured in the system bandwidth, which does not usually coincide with the test bandwidth. The result obtained with the phase-noise marker



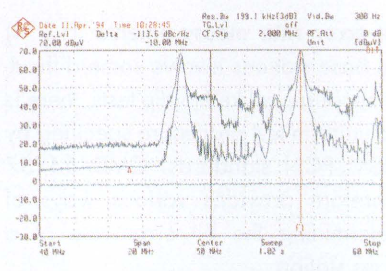
function, which determines noise power relative to carrier power in a 1-Hz bandwidth, must therefore be corrected by the bandwidth factor a_{bw} = 10 log (system bandwidth in Hz/1 Hz).

The phase-noise marker function measures the sum of the intrinsic noise of the analyzer and the noise of the DUT. If analyzer noise is of the same order of magnitude as the noise of the DUT, a measurement error will result. As DUT and analyzer noise are uncorrelated, the error can be corrected if analyzer noise is known. A simple, practical method for this purpose is to use a noise correction curve.

Example of measurement: The C/N ratio of a CATV network to standard B (7 MHz, Europe) is to be measured on the modulated vision carrier. As this standard uses negative amplitude modulation, meaning that bright picture spots correspond to low carrier amplitudes, the 4.7-µs sync pulse will produce the maximum carrier amplitude. This maximum carrier power, which is measured with MAX HOLD at a resolution bandwidth of 300 kHz and a video bandwidth of 3 MHz, provides the reference for the phase-noise marker. The marker is placed in an unoccupied channel. It allows direct measurement



Correction curve for intrinsic analyzer noise superimposed on DUT noise: if, for example, indicated noise goes down by 5 dB (X axis) when signal is removed, measured C/N value must be increased by correction value of 1.6 dB (Y axis).



Result: part of CATV network spectrum with sync peak value used as reference (F1) (upper test curve); middle curve: C/N ratio; lower curve: intrinsic analyzer noise

of C/N ratio referred to a bandwidth of 1 Hz (113.6 dBc).

The bandwidth factor a_{bw} is 10 log (7 x 10^6) = 68.5 dB, so the result referred to system bandwidth is worked out as follows: $C/N_{7\,MHz}$ [dB] = 113.6 – 68.5 = 45.1. When the signal is removed, the indicated noise decreases by 9.5 dB. The noise correction curve provides a correction factor of approx. 0.5 dB. With the intrinsic analyzer noise thus eliminated, a C/N value of 45.1 dB + 0.5 dB = 45.6 dB is obtained. The low intrinsic noise of the FSx series of analyzers yields high accuracy in C/N measurements, which makes the application of a noise correction curve in many cases unnecessary.

Ulrich Eckenberger

Reader service card 146/06 for further information on FSA/FSB/FSM

Industrial Controller PSM

Automated testing and control in production and lab

Industrial production is suffering from the effects of ever increasing price pressure due to more intense international competition. The way to achieve ongoing competitiveness is automation. Industrial Controller PSM from Rohde & Schwarz is a control center for automatic test facilities for use in production and test labs.

Thanks to this design, **seven expansion slots** can be provided, a feature that would be hard to find elsewhere with the same basic configuration. Inside PSM everything is neat and tidy – only a few cables – and Rohde & Schwarz quality (to ISO 9000) is plain to see. All this guarantees excellent reliability and low maintenance costs – two key factors for a production system.

FIG 1 Industrial Controller PSM helps production and test departments to cut costs and enhance efficiency. Photo 41 771/1

Basic configuration

Industrial Controller PSM (FIG 1) has everything you would expect from a PC and more, for example full compatibility with industrial standards and high processing speed, as well as rugged design, low EMI, rackability and a temperature range covering 0 to 50°C.

Thanks to its various interfaces and space for expansions, PSM is ideal for use in any complex test and production system (FIG 2). Modules most likely to need upgrading because of technological advances, the CPU or graphics card for example, are accommodated on separate plug-in cards, whereas the **base board** contains all the following **functions** required today and in future:

- four serial interfaces with FIFO modules,
- two bidirectional parallel interfaces (Centronics),
- floppy and hard disk controller,
- PCMCIA interface,
- front-panel control unit,
- factory user port.

PSM functions are rounded off by generous 8-Mbyte RAM (which can be expanded to 32 Mbytes), a fast 240-Mbyte hard disk, a graphics card for simultaneous control of the internal LCD and an external colour monitor. With regard to compatibility in control applications, the IEC/IEEE bus also plays an important role. The de-facto standard, AT-GPIB from National Instruments with a 16-bit ISA-bus interface, is used for PSM. This interface complies with IEEE standard 488.2 and directly supports many applications.

The hardware of a controller is not everything; appropriate **software** is also required. As PSM uses **Windows 3.1**

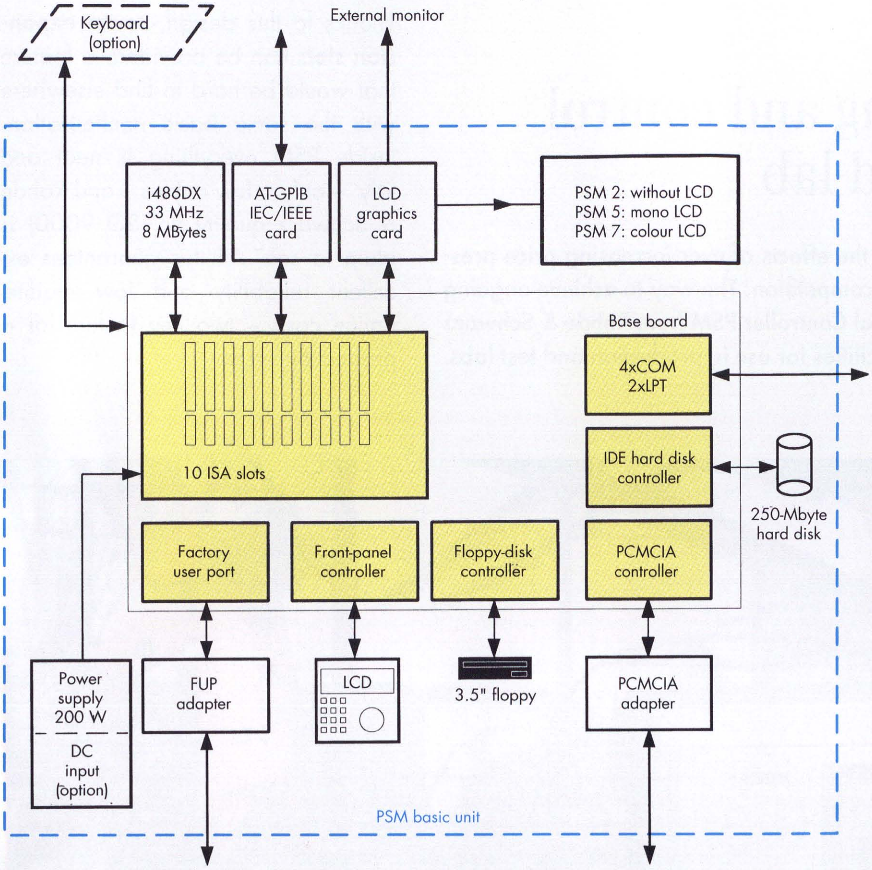


FIG 2 Basic circuit diagram of Industrial Controller PSM. Modules likely to be affected by advances in technology such as graphics cards and CPUs are accommodated on separate plug-in cards, whereas interfaces that are not likely to be changed are located on base board.

or higher in its basic configuration, this operating system has now finally entered the field of test technology. MS-DOS 6.2 or higher and many other **auxiliary modules and programs** are supplied:

- PCONF, a configuration program for PSM. Almost all functions of the base board can be completely configured (by software) and can be switched on and off as required.
- The R&S book manager, an online help system under Windows containing complete PSM documentation and its software. Moreover, other help texts can be written by the user and integrated into the book manager.
- Language interfaces with all expanded functions of PSM such as front panel and factory user port. Easy access to these hardware expansions is thus possible under Microsoft C, TurboPascal, Visual Basic, Quick Basic and Rohde & Schwarz Basic.

Compatibility also means that software for earlier controllers can be run on the latest ones. Thanks to R&S BASIC and the driver, specially developed for PSM and which is required for the new IEC/IEEE-bus card, such programs can be run directly on the system controller.

The **PCMCIA interface** (Personal Computer Memory Card International Association) is a standardized bus system which can accommodate expansions the size of a credit card and so gives a very high degree of flexibility and portability. The plug-in cards can provide mass storage with flash EPROMs or SRAMs as well as I/O cards such as modems, IEEE interfaces or even hard disks. Large data volumes are thus very easily transferred between mobile and analysis station.

Data security is becoming a more and more crucial issue in production and data acquisition. That is why special attention was given to access protection. The controller and each and every disk drive can be protected against illegal access by a password. Running unapproved software or trying to modify test data is practically impossible. An EEPROM which is already in PSM can also be included in the security package. It allows the storage of controller-specific details such as type number, date of production, test and service interval and can also be used as software copy protection.

The **front panel,** an auxiliary control and display unit, is another innovation. Not only does it allow operation of MS Windows or other programs without an external keyboard, but it can also be used for customer-specific solutions as all the available 23 keys and the two-line LCD are user-programmable. Programming is facilitated by supplied driver software.

The **factory user port** (FUP) provides the following functions in the basic unit:

- four 10-bit analog inputs (0 to 5 V),
- a pulse-width modulator (can also be used as an analog output via a lowpass filter),
- eight digital inputs and outputs,
- one optocoupler input,
- one optocoupler output,
- two relays,
- one 16-bit counter,
- power supply ±12 V and +5 V.

Thanks to these functions a variety of untypical tasks can be performed very elegantly and at an attractive price. The supplied driver software and sample programs make FUP operation even easier.

Expandability and options

Controllers such as PSM are needed for a wide variety of applications; features like expandability and configurative versatility are a must.

DC power supply (PSM-B3) allows flexible use of PSM in vehicles and on vessels. This module can be fitted alongside the AC power supply (ex works or retrofitted in a service center). The DC input-voltage range is 10 to 28 V, thus ensuring compatibility with common airborne supply systems. Switchover from AC to DC operation is automatic. Both inputs are available in parallel; when the battery and the AC supply are connected at the same time, non-interruptible operation of PSM is guaranteed, crucial for production systems with an unstable AC supply.

PSM also has comprehensive, local data-storage facilities for those who prefer local to central storage. The controller can be equipped with internal **hard disks with over 700 Mbytes of capacity** (PSA-B17/PS-B27). A 5 1/4-inch standard slot on the front of PSM can be equipped with a CD-ROM or streamer drive for example. In conjunction with an SCSI host adapter, which also provides the external SCSI interface, and the peripheral SCSI drive unit (three can be connected), local storage capacity can be expanded in 1-Gbyte steps.

105-Mbyte PCMCIA Exchangeable Hard Disk (PSM-B9) provides a particularly rugged and flexible storage medium especially for mobile measurements (FIG 3). This tiny hard disk (85 x 54 x 10.5 mm) is extremely tough, shock resistance being 300 g at rest and 100 g during operation. A wide range of diverse tasks can be performed, eg mobile test-data acquisition and stationary analysis afterwards.

Thanks to its expandability and configurability, there are practically no limits to what PSM can do. The 200-W power rating also speaks volumes. The unit is cooled by two temperature-controlled fans, so the seven 16-bit slots can be used for powerful (in every sense of the word) expansions.

FIG 3 PSM storage media; front left: PCMCIA exchangeable hard disk Photo 41 498/1

Further hardware options for PSM are: an **analog card** with eight to sixteen 12-bit analog inputs, two 12-bit analog outputs, digital interfaces and a programmable 16-bit counter (PS-B13), a **TTL I/O card** with 40 TTL lines, eight optocouplers and eight relays (PS-B11) as well as an **Ethernet card** for coaxial cables, thinwire or MAU connector (PS-B21). All common drivers for Novell NetWare as well as for SUN and DEC networks are provided.

Expandability also includes the software. A new Basic, **Visual Basic for Windows,** is available for PSM; this means that professional Windows programs can be written in simple, intuitive environments. Tedious disk changes or retrofitting of a CD-ROM disk drive are no longer necessary as Visual Basic is preinstalled and can be used immediately after powering on.

Dieter Bues; Joachim Stegmaier; Dietmar Vahldiek

Condensed data Industrial Controller PSM

Controller	
CPU	80486, 33 MHz, 8 Mbytes
Graphics	VGA 640 x 480, 1024 x 768 (external monitor)
Display	PSM 5: passive monochrome PSM 7: active TFT colour
Hard disk	240 Mbytes
Interfaces	
Standard input/output	2 x LPT, 4 x COM
PCMCIA	release 2.0, type III slot (10.5 mm)
ISA slots	7 x 16 bits
FUP	
A/D converter	4 x 10 bits
D/A converter	1 x 8 bits (via PWM)
Digital I/O	8 bits, bidirectional
Optocouplers	1 input/1 output
Relay	1 changeover relay
Power supply	+5 V, –12 V, +12 V, 100 mA each

Reader service card 146/07

Radiomonitoring System TS9965

Complete coverage up to 18 GHz

For many years radiomonitoring systems have been among the most successful products brought out by Rohde & Schwarz. Now the company has come up with a new, highly flexible system for fully automatic monitoring, measurement and analysis of field strength to CCIR up to 18 GHz. Configurations range from a mobile solution comprising a minimum of equipment to a large system for national coverage.

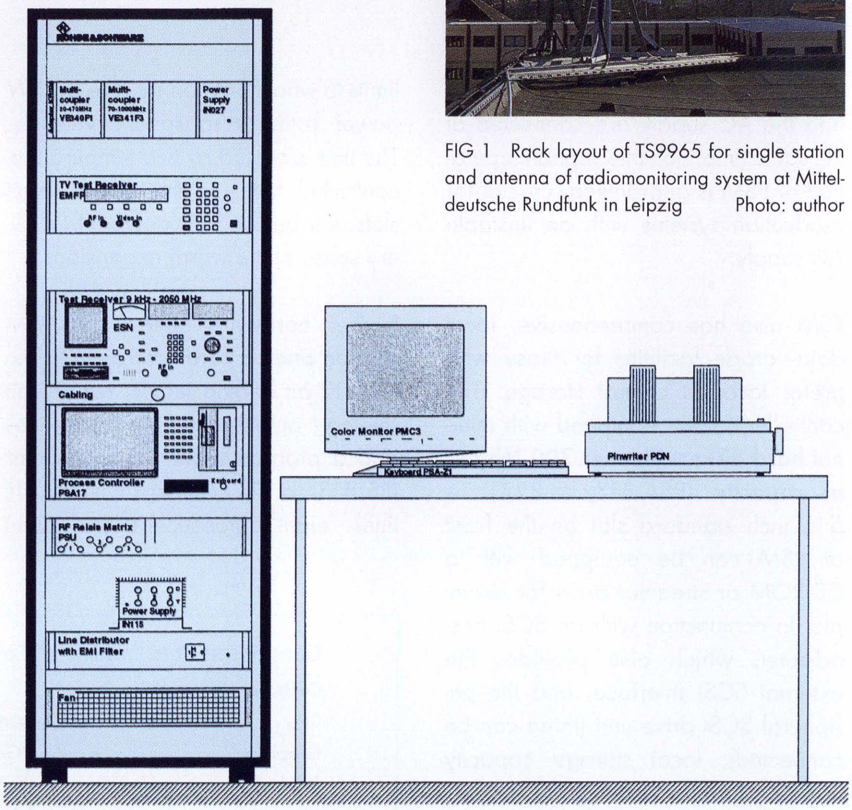


FIG 1 Rack layout of TS9965 for single station and antenna of radiomonitoring system at Mitteldeutsche Rundfunk in Leipzig Photo: author

Radiomonitoring is an internationally known term which is defined as

- detection and observation of electromagnetic emissions in the communication frequency band,
- identification of electromagnetic emissions by measuring field strength or power flux density, frequency, frequency offset, bandwidth, modulation index, FM deviation and phase deviation,
- automatic recording of individual-frequency or frequency-band occupancy over time as well as statistical analysis of individual-frequency or frequency-band occupancy,
- monitoring and assignment of electromagnetic emissions in the communication frequency band,
- recording of frequency-assignment data and statistical analysis,
- detection of interference in the frequency spectrum,
- identification of unauthorized stations,
- localization of emissions.

System concept

All these tasks are performed by Radiomonitoring System TS9965 from Rohde & Schwarz [1; 2]. Depending on requirements, TS9965 can be configured as a single station (FIG 1) or a large monitoring network providing national coverage or anything in between. A national network involves the creation of distributed systems from various monitoring and test stations over the country. The wide range of combinations includes permanently or temporarily unattended test stations and control stations for continuous operation and including several operator positions and measuring equipment.

Multiuser operation in monitoring stations usually implies integration of TS9965 into a local computer network. Monitoring systems access all test stations (also mobile systems) distributed over the country by using public data networks and can call results or messages from these stations. Modular design and flexibility allow Radiomonitoring System TS9965 to be tailored to new requirements. It can easily be retrofitted for new measurement methods or other networks.

The monitoring system is a complete solution enabling the user to familiarize himself with the equipment very quickly thanks to a comprehensive package of hardware, software and features. The system software is extremely user-friendly so that even a person operating the equipment for the first time can handle it confidently and so give his full attention to the problem in hand. For fast investigation of the communication spectrum, the software is designed for a variety of direct operator actions. An automatic test routine can be selected if repetitive measurements are to be made. Interfaces for data exchange are included in the software to enable further processing of the results with other programs. Repetitive calibration measurements are carried out automatically to ensure longterm accuracy.

Hardware

The hardware available ranges from a minimal configuration for mobile applications comprising a process controller, test receiver (eg ESN, ESVN or ESVS from Rohde & Schwarz) and a receiving antenna to large, stationary radiomonitoring systems comprising a whole number of antennas, receivers, relay switching matrices, TV analyzers, modulation analyzers, etc. The individual stations – whether attended or unattended – can be connected via the public network. FIG 2 shows a typical configuration for a single-station system.

Software

Radiomonitoring System TS9965 uses **TS9965/Win** software for measurements, **TS9965/Eval** for statistical analysis of results and **TS9965/Map** for displaying bearings on a map under Windows 3.1. The advantages of the Windows 3.1 GUI are uniform operation, multitasking and various facilities for integrating other programs.

The **TS9965/Win** software allows all radiomonitoring tasks to be performed in **five different measurement modes:**

1. **Automatic measurement mode** is mainly used for monitoring and observing system parameters such as bandwidth, field strength, modulation and frequency offset. This is carried out at certain times of the day and may last several days, months or years. Should a parameter be out of tolerance, an alarm is triggered, which in attended stations is displayed on the screen and in unattended stations transferred to the central station via a modem. All data are, of course, stored and can be reproduced and analyzed any time.
2. **Interactive measurement mode** enables fast detection and identification of electromagnetic emissions in the frequency band surveyed, fast detection of interference in the frequency spectrum as well as identification of unauthorized stations. It is also possible to start and interrupt measurements as well as to change settings and repeat measurements. Not only can measurements be made versus frequency but also over time at a particular frequency.
3. The user can write his own test routines by means of the **scripts,** which is a new macro language. He is thus able, for instance, to change the height, the horizontal or the vertical angle of the antenna between measurements and to take the altered value into account in the software. Debugging aids and test facilities are, of course, provided by the script development environment and make script generation and modification much easier.
4. **Virtual user interfaces** ensure fast device settings and fast measurements.
5. In the **DF mode,** bearings can be taken simultaneously by up to four direction finders from different radiomonitoring stations and the results returned, provided the direction finders are permanently connected (WAN or LAN). Otherwise connection is set up to each of the direction finders, the measurement carried out and the connection cleared down again. Direction finding takes place either continuously at a single frequency or successively at every frequency in a list. The bearings can be stored or transmitted

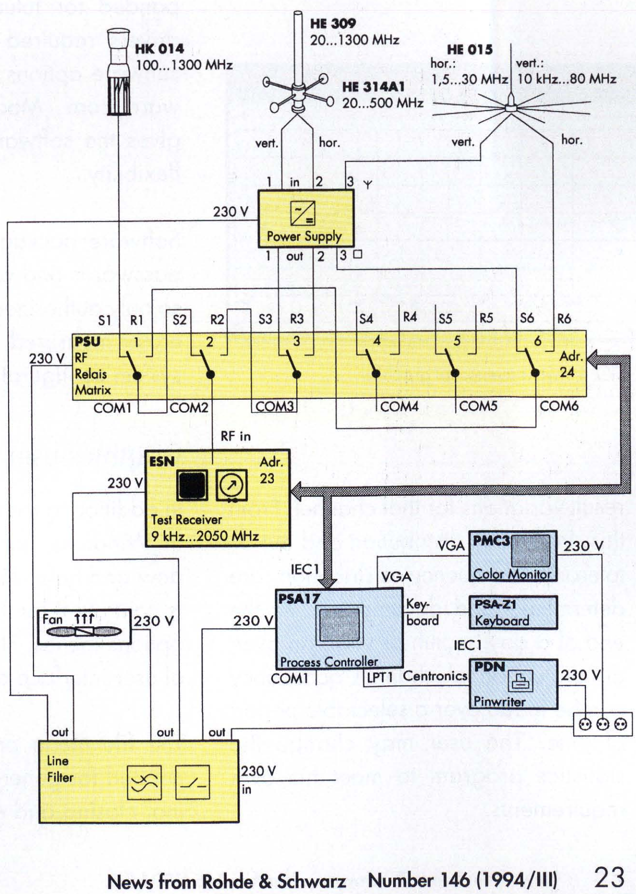


FIG 2 Typical configuration of single-station system

to another test site where the DF beams can be shown on a map for example (under TS9965/Map).

It is also possible to select different measurement modes at the same time. The automatic mode need not be interrupted when an interactive measurement is carried out.

A comprehensive **statistics program,** which can be run on an external database (TS9965/Eval in Microsoft Access format), is available. The operator can select a specific channel from the raw data and display and store result variations for that channel. From this, frequency distribution and out-of-tolerance frequency distribution are determined and documented. At the end of a day, month or year, an overall evaluation of channel occupancy can be made over a selectable period of time. The user may change the statistics program to meet his own requirements.

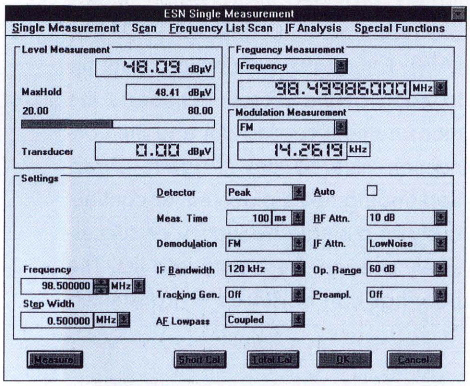


FIG 3 Virtual user interface of Test Receiver ESN

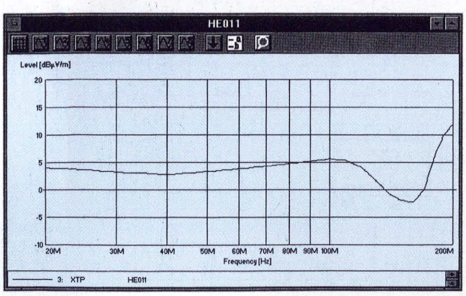


FIG 4 Two-dimensional graphics

Detailed **documentation** of the results is provided graphically or in tabular form by a printer and a plotter. Users can format the report to meet their own requirements.

Dynamic data exchange (DDE) allows data to be exchanged between various Windows programs. This is illustrated by the following three examples:

1. If the user does not want to use the standard report, he can transfer the data to Word for Windows by means of DDE and then produce his own report.
2. The results can be transferred to another database (eg Oracle) and stored in any format selected by the user. This is important when comparing results with data from a national frequency-management system or when sending messages to the IFRB (International Frequency Registration Board).
3. If the user prefers to carry out his own analysis, he can transfer results to the program of his choice.

Thanks to the **option concept** for TS9965, software can easily be expanded for future applications. The drivers required for equipment and software options are added to a software core. Modularity of this kind gives the software a high degree of flexibility.

Software packages are **protected** by passwords and various user priorities, so only authorized persons are able to erase measured data or modify the system configuration.

Graphics user interface

In addition to the menus normally used in Windows, such as file, edit, window and help, **TS9965/Win** software is controlled by the measurement and options menus. FIG 3 shows the virtual user interface of Test Receiver ESN.

The **file menu** provides all functions needed for generating, opening, storing, closing and erasing files. The following files are available in the software:

- results: results of measurements,
- list of frequencies,
- list of settings: settings for accessories (eg azimuth and elevation rotators, masts),
- limit line: setting limits for specified values,
- range configuration: configuration of equipment and settings to be made on this equipment for selected frequency range,
- measurement definition: definition of measurement task,
- timing definition: definition of timing for measurement definition,
- graphics: one-, two- or three-dimensional representation of results (FIG 4),
- transducer: antenna factor,
- correction: attenuation factors for paths to antennas (eg cables or relay switching matrices),
- sequence: definition of batch file to call one or more scripts with various parameters,
- script: definition of automatic measurement procedures in macro language,
- script parameters: definition of script calling parameters.

The file menu includes import and export functions for data exchange between the users of TS9965/Win software. The entire software configuration can be stored and reloaded so that the device and path configuration once generated can easily be transferred to another processor or quickly restored in case of a hard disk crash.

Functions for configuring graphics are available in the **edit menu.**

In the **measurement menu,** the individual units can be set and controlled interactively. For this purpose a virtual interface is available for each unit. From this interface the automatic test routines defined by means of scripts as well as the automatic and interactive measurement modes can be started.

The **options menu** is used to specify the device configuration (test receiver, antennas, relay switching matrices, etc) including the appropriate interface (eg IEEE bus, RS-232-C, TTL, AT bus) and the path configuration including the antenna, path and test receiver. Selection of the remote-control channel is also possible. In radiomonitoring it is particularly important that alarm, error and query messages in remote-control stations are not displayed on the screen but transmitted, for example, via a modem to the central station, which then takes appropriate action. Another possibility is to write the messages to a log file. This menu also allows the assignment of user levels and code words.

In the **window menu** the layout of the active windows can be selected.

Information on the program can be obtained via the **help menu.** It provides context-sensitive assistance, a search mode using terms or an index as well as a hypertext-type reference function. So the required information is readily available any time and need not be looked up in the manual.

Services and system performance

The manufacturer's pre- and after-sales service is an important prerequisite for the efficient use of a system. Expert advice is required to guarantee optimum customization of the system. Comprehensive performance tests, correct commissioning and specific training make for fast system availability. Besides these services, which are a matter of course, Rohde & Schwarz offers longterm assistance as part of a customized maintenance package.

Jörg Pfitzner

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Condensed data Radiomonitoring System TS9965

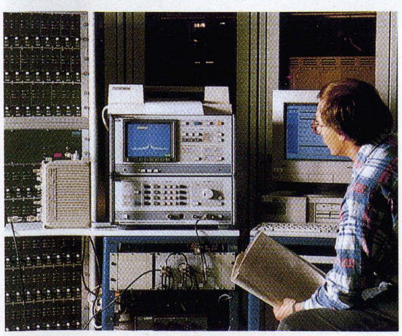
Frequency range	9 kHz to 18 GHz
Measurement modes	automatic, interactive, direct, script, direction finding
Software (under Windows 3.1)	
for measurement	TS9965/Win
for statistical analysis	TS9965/Eval
for displaying DF beams on map	TS9965/Map
Interfaces	IEEE bus, RS-232-C, TTL, AT bus

Reader service card 146/08

Reference

Advanced multichannel measurements at FUBA

With its Communications and Spectrum Analyzer FSAC, Rohde & Schwarz has made an essential contribution to what is probably Europe's most advanced multichannel test system, put into operation by FUBA Hans Kolbe & Co. in late 1993 at their plant in Bad Salzdetfurth in Lower Saxony, Germany. Although the system carries out measurements relatively fast, the main emphasis in this application is not on measurement speed but on accuracy. FSAC with built-in tracking generator, RF filters and RF preamplifiers is integrated in the multichannel test system and is a high-end analyzer for virtually all tasks of radiomonitoring and radio measurements, antenna and cablemeasurements and selective scalar network analysis, thus meeting the high requirements called for in this application.



FUBA, with headquarters in Hildesheim, Germany, is engaged in the field of communications technology with emphasis on automotive electronics, as well as on transmission and radio systems. PCB production is another main field of activity of the company group, which is the biggest manufacturer of PCBs in the Single European Market.

Digital Direction Finder DDF

Modern scanning direction finding from 0.5 to 1300 MHz

The techniques commonly employed today for special radio transmissions, such as bursts and frequency hopping, require extremely high scanning and direction-finding rates. This requirement is met by intercept systems which use digital signal processing and the Fast Fourier Transform. These methods are used in the new scanning direction finders from Rohde & Schwarz: DDF 011 for the HF range 0.5 to 30 MHz, DDF 051 for the VHF-UHF range 20 to 1300 MHz and DDF 061 for the complete range 0.5 to 1300 MHz.

FIG 1 Digital HF-VHF-UHF Direction Finder DDF 061 for 0.5 to 1300 MHz Photo 41 765

Interception is the basis of radiomonitoring and communications intelligence. So those involved in this field need equipment that provides efficient scanning, direction finding, monitoring, location, analysis and identification of electromagnetic emissions in the frequency bands used for radiocommunication. Due to increasing signal density and LPI (low probability of intercept) transmission methods, the requirements for interception probability in scanning and direction finding have become much more stringent. The classic method of commanding a direction finder as a function of the results of a scanning receiver is no longer feasible.

Many services have changed their communication links from analog voice or simple teletype transmission to digital data transmission. Digital transmission methods can in most cases only be demodulated and decoded by the authorized receiving station. Today, time-consuming manual signal analysis is doomed to failure because of the great variety of techniques and the high number of personnel required.

Under these circumstances, radio direction finding and radiolocation are the primary evaluation criteria for signal preselection to reduce workload for further evaluation steps. Equipment with analog signal-processing modules throughout have features whose reproducibility no longer meets the new requirements despite the highly sophisticated analog technologies used. Moreover, analog implementation of signal processing and evaluation methods is no longer feasible.

Rohde & Schwarz's new direction-finder series DDF takes account of this evolution (FIG 1). DDF stands for digital direction finder, meaning that all important signal-processing and bearing evaluation functions are performed using DSP and special algorithms.

Description

DDF is a three-path scanning direction finder – in other words an approach that integrates a scanning receiver and DF unit – which analyzes a frequency band with a 200-kHz realtime bandwidth simultaneously for energy (FFT) and direction. The direction finders are for remote control only. In standalone operation they are controlled from an external PC with standard direction-finder software and, when integrated into a system, by the controller via the remote-control interfaces.

There are **three DDF models:**
- HF Direction Finder DDF 011 (0.5 to 30 MHz)
- VHF-UHF Direction Finder DDF 051 (20 to 1300 MHz)
- HF-VHF-UHF Direction Finder DDF 061 (0.5 to 1300 MHz)

The main processing block is formed by the HF direction finder including the HF DF converter and the digital processing unit. The VHF-UHF version is obtained by adding a three-path VHF-UHF converter.

After each scanning step and Fast Fourier Transform, the magnitude and phase of the complex antenna voltages are available for the DF processor at each frequency for the selected bandwidth. Since the information is digital, theoretically any DF principle can be implemented by calculation. The DDF series and their antennas normally support both correlation/interferometric bearing evaluation and the Watson-Watt method [1]. The bearings and the levels for each frequency are selected according to predefined criteria and the DF results output in this compact form.

Thanks to the wide realtime bandwidth of 200 kHz, the DF converter can be set in large frequency steps of 200 kHz so that a scanning speed many times higher than that of analog scanners is achieved. After every scanning step, the next antennas in the array are scanned and then the next frequency step initialized. So the direction finder cyclically scans the frequency band of interest, determining a bearing for each frequency. Up to 50 frequency subranges with different filter bandwidths or different channel resolutions can be entered.

The criteria for reducing the number of intercepted signals are evaluated separately for each frequency. It is possible to enter noise thresholds and exclude strong signals from processing. If signal duration is specified, unwanted signals can be suppressed. This allows the direction finder to be accurately set for detecting and taking bearings of frequency-hopping transmitters and shorttime signals or suppressing shortterm interference by means of time averaging. If appropriate entries are made, single frequencies or frequency ranges as well as azimuth and elevation sectors can be excluded from analysis and reporting. In this case, for instance, the direction finder only picks up signals from preferred directions or – mainly in the HF range – from defined elevation sectors, so discriminating between sky and ground waves. A special function detects broadband signals occupying several adjacent channels and combines these signals to form a single signal.

DF methods and applications

DDF direction finders provide maximum flexibility as far as DF methods and DF antenna selection are concerned, since the bearing is analyzed by the DF-controller software using digital signal processing. This makes it possible to implement not only standard methods of analysis but also customized procedures, particularly with HF DF antenna systems already installed. This feature is supported by programmable control of the antenna switching matrix.

The standard DF methods, ie evaluation by correlation/interferometer and Watson-Watt, are the main applications of DDF direction finders.

The **Watson-Watt method** uses HF and VHF-UHF antennas, the HF antennas primarily being suitable for mobile applications. A maximum DF rate, which is required to intercept shorttime signals and to reduce the number of intercepted signals in automatic DF and analysis systems, can be achieved with a Watson-Watt or interferometer direction finder with a small baseline.

The **correlation method** using a nine-element wide-aperture circular array allows the direction of incidence to be determined very accurately even in the presence of reflections. To determine the bearing line, the measured complex antenna voltages are compared (correlated) with the nominal values for the corresponding direction. The correlation method is also suitable for correcting (fixed) environmental effects by determining the nominal values with the aid of a test transmission (site calibration) and not by way of calculation. The complex antenna voltages thus obtained are the basis for the calculation of DF values (vector matching). With the correlation method it is possible to determine the elevation so that the direction finder can be used for SSL (single-station location). Analysis is carried out by the process controller, in particular taking into account the ionospheric data in the shortwave range. Stationary antenna systems are based on monopoles or crossed-loop antennas for taking bearings of high-angle radiators.

Operation and system integration

In the standalone mode the DDF direction finder is operated via a program that can be run on a PC under MS-Windows™ and contains all characteristics of the direction finder. After the DF commands have been entered, the DF results are output on the **scan display** (FIG 2). Cursor functions are provided to read off single bearings and frequencies. These functions allow azimuth sectors to be excluded, zoom functions for azimuth and frequency ranges to be activated as well as level limits and signal duration to be entered while the system is operating. Small resolution bandwidths make it possible to show co-channel interferers on the scan display. With the different spectral occupancy of useful and interfering signals the two

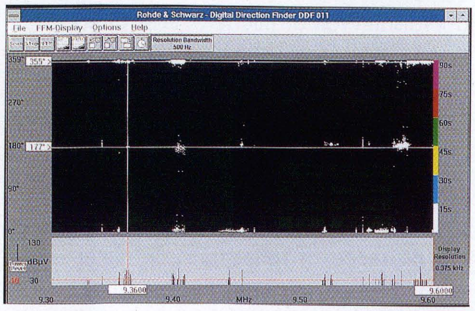


FIG 2 DDF scan display: DF values versus scan frequency range and spectrum with level versus frequency

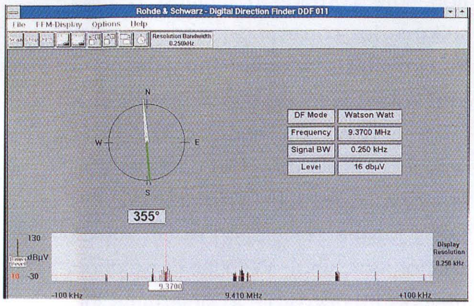


FIG 3 Fixed-frequency display, bottom: level spectrum from which frequency is selected using cursor

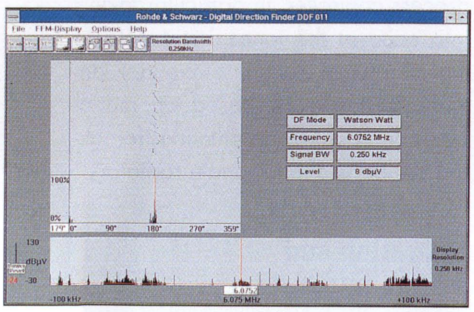


FIG 4 Fixed-frequency display with azimuth histogram

different bearing lines can clearly be identified by summing up the bearings over the individual signal components.

In the **fixed-frequency mode** (FIGs 3 and 4) the DF ellipse obtained from the Watson-Watt direction finder or the bearing line evaluated by correlation is displayed for every selected frequency to determine DF quality. A waterfall and azimuth histogram (plus the elevation if the correlation method is used) can be displayed additionally. The small analysis bandwidth of 250 or 125 Hz makes it possible to intercept and carry out direction finding on weak signals in the vicinity of strong signals. With the fine analysis bandwidth, certain frequency components in signals with a wider bandwidth can be measured with high accuracy.

As it is a remotely controlled unit, the DDF direction finder is **system-compatible.** Its fast data interface makes for realtime readout of the bearings, for which a small computer may be required to act as a buffer in remote operation. This PC is able to operate a great number of remote system interfaces (eg telephone modem, ISDN, LAN or radio modem). The standard DDF is designed for integration into the WinLoc direction-finding and radiolocation system [2]; the control interfaces of the standard user interface, which are run under MS-Windows™ and VMS™, are also available. System integration can further be supported by directly connecting a GPS receiver to the direction finder, enabling synchronization of the scanning process in the individual DF stations of a radiolocation network. It is thus also possible to determine the position of the direction finder (within GPS accuracy). In mobile systems the direction finder is also able to read compass values and so correct alignment of the DF platform.

Since intercept and DF parameters can be set individually and independently in every scanning range, the DDF is suitable for (quasi) multiuser operation. Every user can access the direction finder while scanning in the ranges assigned to him. Due to the high DF scanning speed the operator is not aware that he is sharing the direction finder with other users.

Rainer Bott

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Condensed data Digital Direction Finders DDF

Frequency range	
DDF 011	0.5 to 30 MHz
DDF 051	20 to 650 MHz/1300 MHz
DDF 061	0.5 to 650 MHz/1300 MHz
DF method	correlation, Watson-Watt; adaptation to other antenna systems/DF methods possible
DF speed	200 MHz/s (32-kHz bandwidth), independent of frequency occupancy
Sensitivity	0.2 to 6 µV/m (typ.), depends on antenna and frequency range
Error	< 1° to < 3°, depends on antenna and frequency range
Realtime bandwidth	200 kHz
Resolution bandwidth	125/250 Hz to 32 kHz
Dynamic range	80 dB inband (200 kHz) referred to noise, 130 dB total dynamic range

Reader service card 146/09

Secure data transmission with 2700 bit/s on shortwave links

In the early days of shortwave radio, data transmission played an important role in the form of Morse telegraphy. Who has not seen pictures of radio operators skilfully keying Morse onto a carrier to send a possibly vital message round the globe. Due to an extremely narrow transmission bandwidth of about 100 Hz combined with the selectivity of the human ear and the experience of the operator permitting the correction of errors, a data transmission rate of about 15 Bd could be obtained. In the early 50s teletype transmission came along with data rates of 50 Bd, and later on, when error-correction devices (FEC = forward error correction, ARQ = automatic repeat request) were introduced, rates of 200 Bd could be reached. However, because of the multipath effects encountered in practical applications, a data transmission rate of 200 Bd was the upper limit.

Techniques to obtain higher transmission rates were known in the 50s but could not be implemented economically. It was the arrival of digital signal processors that made it possible to implement the algorithms. Two different methods are now well-established.

With the aid of parallel-tone modems the sideband is modulated with a large number of carriers (up to 48), each of them phase-modulated at 50 to 75 Bd. By transmitting them simultaneously, a total data rate of 48 x 50 = 2400 Bd could be obtained for instance. The disadvantage of this method is that, because of the fading common in multipath propagation, the bit error rate (BER) is of the order of 10^{-3}, so there is a large error-correction overhead which reduces the effective data rate.

The second method uses phase modulation (single-tone method) and is employed by **HF Data Modem GM 857 C4** from Rohde & Schwarz, the latest development in state-of-the-art modem technology (FIG 1). The modem is designed to provide reliable data communication over a 3-kHz voice channel at a rate of 2700 bits per second and is ideal for automatic error correction (ARQ), TDMA operation or for use in packet radio systems that perform adaptive matching of packet length to channel conditions.

FIG 1 HF Data Modem GM 857 C4 for transmission rates of 2700 bit/s Photo 41 754

GM 857 C4 uses **8PSK symbol modulation** of an 1800-Hz subcarrier at a symbol rate of 2400 Hz. This type of modulation reduces the peak-to-average signal level to a minimum so that higher average power can be transmitted without distortion. A transmitted packet consists of a 192-symbol preamble sequence (80 ms) followed by 64-symbol frames (26.67 ms). Each transmitted frame, except the last one, contains 72 bits of information, a 72-bit error-correction code and 48 bits of test data. The last frame holds a 72-bit stop-code sequence instead of information data. The receiver modem uses the pseudo-random test data for updating adaptation to the HF channel. This update is performed every 26.67 ms, so the demodulator can adapt rapidly to varying channel conditions. A convolutional code (length 7, rate ½) ensures highly reliable error correction. Because of the narrowband interference common in shortwave transmissions, the demodulator of GM 857 C4 contains a special interference-suppression facility which eliminates single sources of interference in the 3-kHz band quickly and using adaptive techniques.

The modem's design naturally allows it to be **integrated into radio systems.** GM 857 C4 is ideal for use with Rohde & Schwarz HF Transceivers HF 850 and XK 2000 (FIG 2), with or without a MERLIN system processor

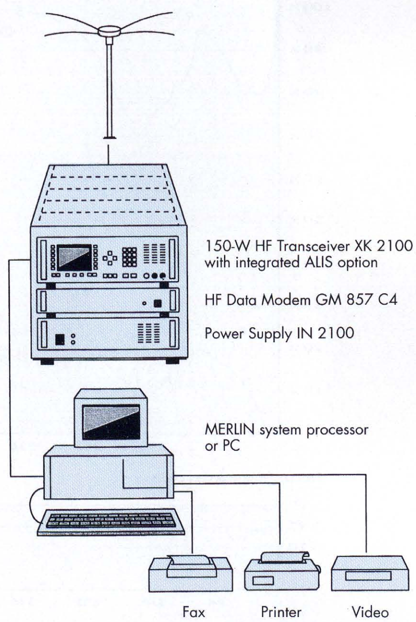

FIG 2 Shortwave radio system with GM 857 C4

	Typical data volume non-compressed	Typical data volume compressed	Data reduction	Transmission rate	Transmission time
Text	2.5 Kbyte/page	0.9 Kbyte/page	65%	2000 bit/s	4 s
Fax	30 Kbyte/page	24 Kbyte/page	10%	2000 bit/s	100 s
Video	490 Kbyte/image	15 Kbyte/image	94%	2000 bit/s	70 s

Table: Transmission times with HF Data Modem GM 857 C4

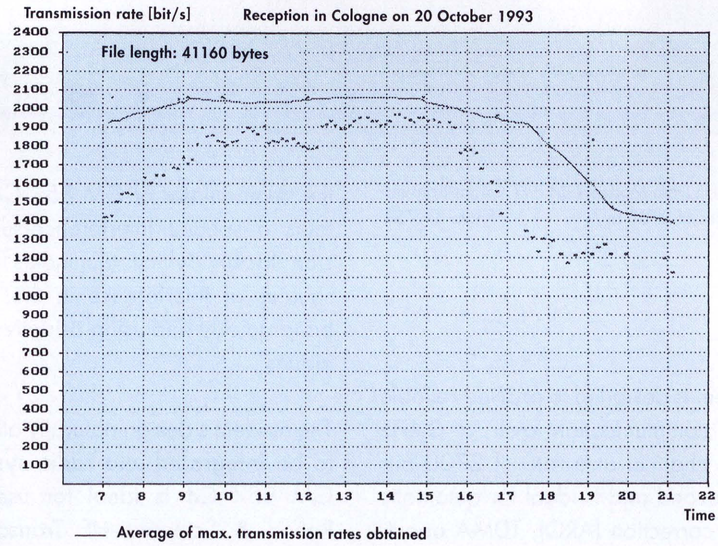

FIG 3 Data transmission rates from trial on Cologne – Munich link on 20 October 1993

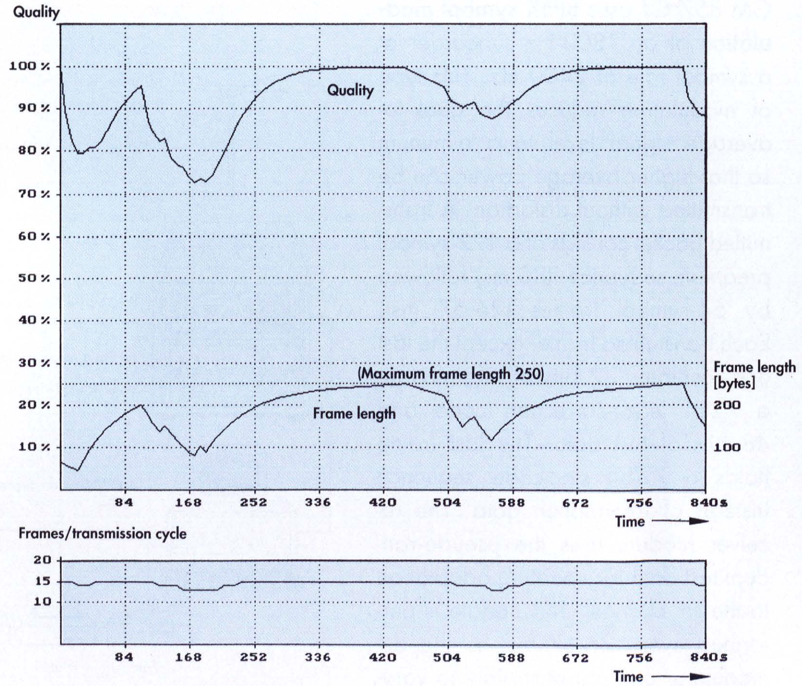

FIG 4 Adaptive behaviour of protocol parameters as function of channel quality

[1–3]. The main component of the radio station is the ALIS processor [4], which guarantees automatic link setup and handles **data protection** using an adaptive **ARQ protocol** (RSX.25). The outstanding characteristics of this protocol are:

- the length of data packets is matched to radio-link quality and to the FEC characteristics of the modem,
- memory ARQ also stores errored frames and combines them to form errorfree packets,
- adaptive frequency changes without a new link setup, therefore no loss of data and minimum delay,
- adaptive bandwidth reduction to 300 Hz and 228-Bd FSK modulation for poor radio links.

All these techniques were tested and optimized in the HF simulator and in longterm trial transmissions over various distances. So the user of the system can be sure of completely **errorfree transmission of text, data files, faxes and video stills** with an effective data rate of up to 2150 bit/s (2690 Bd with PC interface using start and stop bits).

Combined with the data-compression procedures of the MERLIN processor, which are optimized for the required data structure (text, fax, video), **very short transmission times** are obtained (see table in blue box). When transceivers of the XK 2000 family are used, link setup in line with FED-STD 1045 or MIL-STD 188-141 A is also possible. Existing radio stations may be extended by connecting an HF Data Modem GM 857 C4 to the transceivers used and by integrating a facility for data protection (RSX.25 protocol) in the data terminal (PC or Merlin). So existing networks can be upgraded economically in stages, although without the advantages offered by ALIS such as automatic link setup, adaptive frequency change and bandwidth matching.

The modem characteristics and protocols mentioned were proven on various radio links, for instance Munich – East Africa, Munich – Cologne and Munich – Washington. Data rates were determined with the aid of automatic test programs and analyzed graphically (FIGs 3 and 4). **Result of practical tests:** with the aid of HF Data Modem GM 857 C4, users of HF radio links are able to benefit from transmission rates which, up to now, could only be obtained on PTT lines or satellite links. The great advantage for HF network operators is the wide range of system integration facilities, opening up new fields of application.

Hans Hackl

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Reader service card 146/10 for further information on GM 857 C4

RFI field-strength measurements in GTEM cell using EMI Software ES-K1

The Rohde & Schwarz software package ES-K1 is a powerful and user-friendly tool for a variety of EMI measurements using EMI test receivers and accessories from Rohde & Schwarz [1]. A wide spectrum of EMI test methods complying with both commercial and military standards is thus available for the user. The following **measurements** are supported:

- **commercial EMI measurements:**
  RFI voltage
  RFI power
  RFI field strength
  (electrical and magnetic)
- **military EMI measurements:**
  conducted emissions
  radiated emissions

RFI field-strength measurements to CISPR (open-area test site or semi-anechoic chamber) are extremely laborious and thus time-consuming, as the maximum of the field strength has to be measured at all turntable positions and antenna heights in two polarization planes. This measurement also makes high demands for infrastructure. The GTEM cell (Gigahertz transverse electromagnetic cell) offers an interesting alternative [2]. On the one hand, costs for a GTEM cell are much lower than those for a semi-anechoic chamber and, on the other, the measurement sequence is much easier and thus quicker. The emitted power from a DUT can be determined in only three measurements. Based on this power, the corresponding field strength at the location of the test antenna is calculated without any further measurements being required (FIG 1). Cumbersome measurement of maximum field strength by varying turntable angle, antenna height and direction of polarization is no longer necessary.

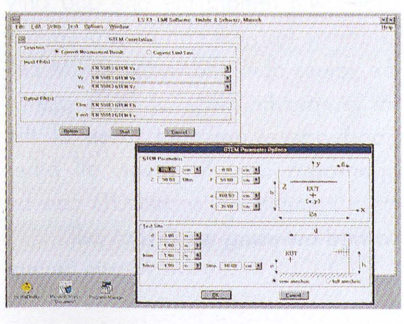

FIG 1 Correlation of GTEM test results. Result obtained is electrical field strength at 3-m open-area test site.

The basic idea of the correlation method described is to derive a value for the total emitted power of the DUT by making measurements in all three directions. As the DUT is turned [3], its axes are to be interchanged in sequence (FIG 2):

+x axis ⇒ +y axis ⇒ +z axis,
+y axis ⇒ +z axis ⇒ +x axis,
+z axis ⇒ +x axis ⇒ +y axis.

The total power emitted by the DUT is obtained from the quadratic sum of the three measured voltages V_x, V_y and V_z. For calculating the field strength it is assumed that the DUT has the radiation pattern of a dipole precisely aligned to the test antenna. The alignment of the dipole is taken to be horizontal in the determination of electrical field strength in the horizontal polarization and vertical in the vertical polarization (worst-case calculation). With this model the electrical field strength and its maximum can be calculated for any height of the test antenna [4].

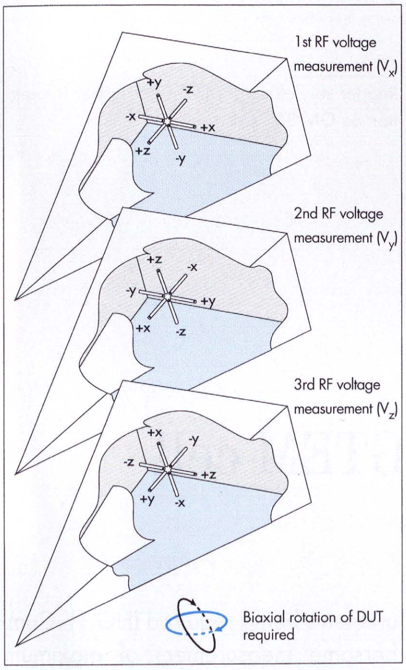

FIG 2 Rotation of DUT in GTEM cell (source: EMC Test & Design)

With this correlation, field-strength measurement to CISPR is greatly simplified, as shown by the following **measurement sequence:**

1. Preview measurement; measurements in three directions (peak detector) and determination of electrical field strength by correlation.
2. Data reduction; determination of the critical frequencies for the final measurement.
3. Final measurement; measurement of the critical frequencies again in three directions (quasipeak detector) and determination of the corresponding electrical field strength.

Similar to field-strength measurement with a remotely controllable mast and turntable, this measurement can also be completely automated.

The outlined measurement sequence can be simplified and speeded up even more if, rather than correlating the measured values (voltage → field strength), a direct approach is adopted working with a limit line recorrelated to voltages (field strength → voltage). The measured voltages can then be directly compared with this limit line, calculated only once. Software ES-K1 supports both **directions of correlation** (FIG 3): 1. Convert measurement result; the measured voltages V_x, V_y and V_z are converted into values of electrical field strength whereby horizontal and vertical polarizations are distinguished. 2. Convert limit line; the given limit line of the electrical field strength is converted into a limit line for the voltage $V_{x,y,z} = \sqrt{V_x^2 + V_y^2 + V_z^2}$. A distinction is made whether the given field-strength value is stipulated for horizontal polarization, for vertical polarization or for both directions of polarization.

For RFI field-strength measurements, **EMI Software ES-K1 supports** the **CISPR test with mast and turntable** as well as the similar **test with the GTEM cell.** The latter test is much faster and places less demands for infrastructure. However, it is not yet officially accepted as an alternative for type-approval measurements as not every DUT meets the assumptions of this correlation algorithm (see blue box), which is why higher deviations than those encountered with CISPR measurements may occur. So the open-area test site measurement to CISPR will remain the one and only reference test. If it can be proved that the values obtained in the GTEM cell for a specific class of DUTs are in good agreement with those of the open-area site, however, all other measurements on such DUTs can be carried out using the GTEM cell.

Martin Stumpf

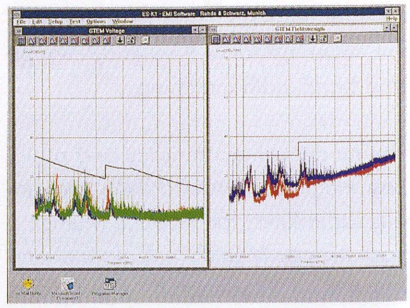

FIG 3 Comparison of two directions of correlation; GTEM voltage: correlation of limit line, GTEM field strength: correlation of test result

Summary of GTEM algorithm

Assumptions

1. DUT is electrically small
2. Test antenna in far field

Algorithm

1. Measure voltages V_x, V_y and V_z
2. Calculate total power emitted by DUT
3. Replace DUT by dipole radiator of same power
4. Calculate maximum electrical field strength at all heights of test antenna

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Reader service card 146/13 for further information on ES-K1

Digital traffic information by RDS

For many years broadcasting companies in Germany have been sending out traffic information and warnings to motorists using the ARI system (broadcast information for motorists) in addition to their standard audio programs. However, this well-proven (national) service does not meet the requirements of a future traffic information system. In view of increasing traffic density in the countries of the European Union, and as a consequence the greater transit traffic volume and mobility at all levels of society, there is a need for far more powerful systems that are able to cope with regional as well as national and cross-border traffic situations. To reach this goal, several European countries began to carry out regional/national, partly EU-sponsored, research projects and field tests which take into consideration international traffic requirements and cover all main fields of activity from automatic traffic monitoring through processing, transmission and reception of messages to the integration of traffic management and navigation systems.

An important step in this direction is the **transmission of digital traffic information on the Traffic Message Channel** (TMC) of the radio data system (RDS), which has been introduced and installed throughout Europe. RDS information is broadcast together with VHF FM programs. The required VHF network infrastructure is already available, so an almost blanket coverage can be guaranteed for traffic information. Digital traffic information is transmitted in RDS group 8 using a data telegram specially devised for this purpose.

An information system is only as good as the information content of its messages – this also applies to digital traffic information. For this reason traffic conditions and other parameters (eg weather) are detected and recorded automatically over wide areas using considerable hardware (traffic counters, sensor systems) and forwarded to state centers, which are of course networked for data transmission (FIG 1). All authorities and organizations involved (police, highway authorities, automobile associations, etc) are linked to the monitoring system and add their own information to the messages that are generated automatically. The messages arriving at the information centers are processed, completed and then forwarded to the transmitter stations for broadcasting.

The messages are processed, distributed and transferred using the **RDS ALERT-C protocol** (RDS Advice and Problem Location for European Road Traffic). This protocol is used throughout Europe and allows uniform coding of specific traffic events and their duration, of weather conditions and other relevant information items using a standardized message catalog. Place names are also coded and transmitted with the message so that events can be exactly located. The message catalog is also stored in the RDS TMC car-radio receiver, so incoming coded messages can be converted into plain text and in the national language. Selective evaluation of messages from a specific area is also possible. Stationary TMC receivers providing traveller

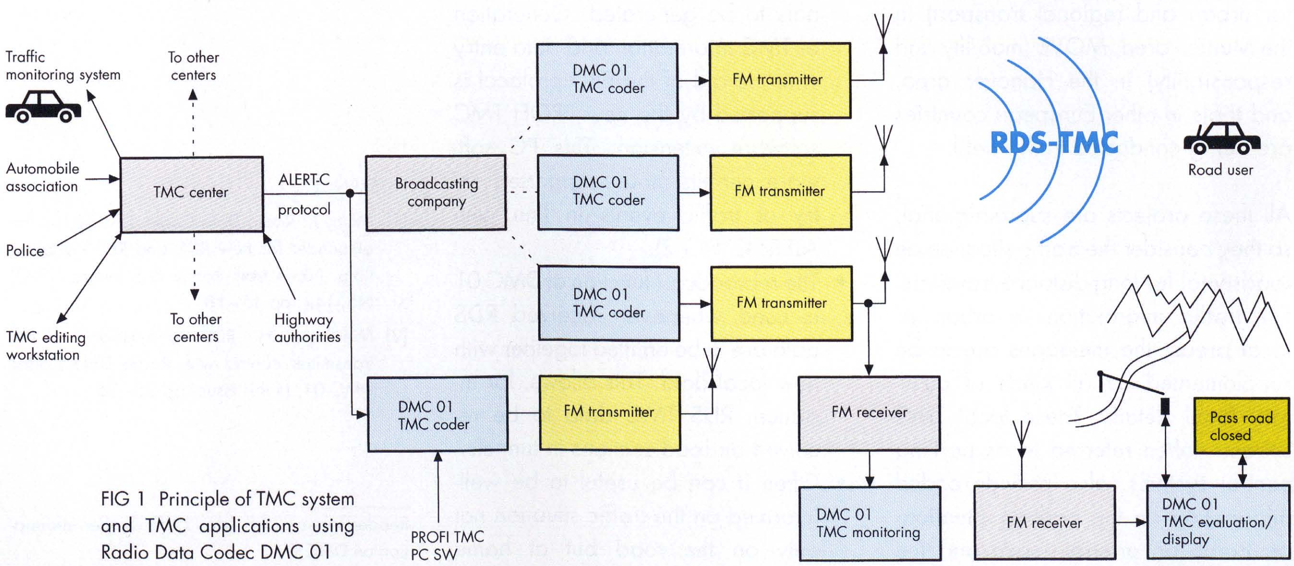

FIG 1 Principle of TMC system and TMC applications using Radio Data Codec DMC 01

information (eg in highway service areas) are planned as well. Digital transmission and coded messages also make for the control of traffic warning systems such as changeable signs and overhead signs, combined with information on road diversions or recommended routes.

The interplay of all subsystems and pertaining operational aspects are being tested at present in large-area field trials and optimized. In Germany the BEVEI (better traffic information) project has been running since 1991 in the Rhine-Ruhr area in cooperation with the German broadcasting services WDR and Südwestfunk. Other projects, for instance STORM (Stuttgart transport operation by regional management) in the Stuttgart area, COMFORT (cooperative management for urban and regional transport) in the Munich area, MOVE (mobility and responsibility) in the Hanover area, and trials in other European countries are being conducted in this field.

All these projects are supra-regional, so they consider the traffic situation on roads vital for long-distance travellers. For traffic information in urban or local areas, the messages are to be supplemented by all kinds of auxiliary local details. These local TMC systems, often referred to as parking control systems, also provide coded information on the parking situation, on traffic on arterial roads and the capacity of public transport utilities. There have also been tests with special systems (eg City Pilot) for transmitting, in addition to the traffic data, commercial information (eg calendar of events, tourist information) to all users of a special receiver similar to a paging receiver.

Radio Data Codec DMC 01 [1; 2] serves for transmitting and evaluating these RDS TMC data. The various models available make DMC 01 ideal for use as a stationary TMC compact coder or decoder. Its great versatility can be illustrated by a few examples:

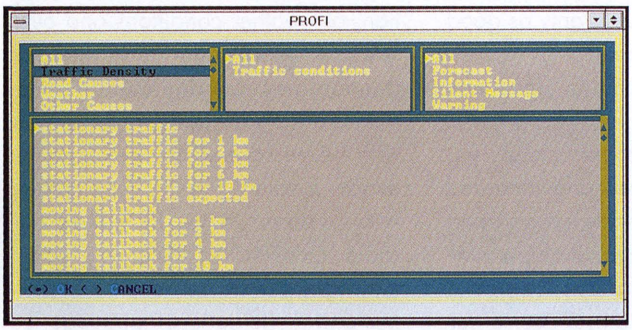

FIG 2 Screen display of PROFI TMC extension

- DMC 01 used at the VHF FM transmitter allows all ALERT-C TMC data to be entered using various protocols (ARD line protocol, EBU protocol) and RDS TMC transmitter signals to be generated. Generation of TMC information and data entry with the aid of the EBU protocol is supported by the new PROFI TMC software extension. This PC software permits mouse-supported entry of traffic events in line with ALERT-C (FIG 2).
- The rebroadcast function of DMC 01 is used whenever received RDS data are to be emitted together with new local data. This allows, for instance, RDS TMC data to be received on road sections in tunnels.
- Often it can be useful to be well-informed on the traffic situation not only on the road but at home already before setting out on a journey, so that decisions can be made and precautions taken. This becomes possible when RDS TMC data are fed into broadband communication networks with the aid of a DMC 01.
- At a later date with full-coverage broadcasting, TMC transmissions will have to be monitored to some degree, eg to prove that the information really has been transmitted and to check transmitter systems for proper functioning with TMC. DMC 01 with a TMC decoder function, probably together with a computer for data evaluation, is ideally suited for these tasks and can easily be integrated into monitoring systems.
- Specially coded RDS TMC data are transmitted for controlling traffic signs and active traffic-jam warnings. A local TMC decoder (eg at highway overhead signs) must not only be able to reliably decode the received information but also to set the required signs. For this purpose DMC 01 is provided with RS-232-C interfaces and remote-control switching lines. So it can be used, for instance, to indicate whether a pass road is open or closed, for opening and closing barriers, for indicating traffic holdups caused by flood or landslide, as well as for signalling adverse weather conditions.

Johann Mayr

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[2] Mieslinger, H.: RDS transmission and FM transmitter control with Radio Data Codec DMC 01. In this issue, pp 35–36

Reader service card 146/12 for further information on DMC 01

RDS transmission and FM transmitter control with Radio Data Codec DMC 01

DMC 01 – an RDS coder and decoder in one unit [1] – with configurable firmware characteristics provides the customer with an instrument that is exactly tailored to his requirements. DMC 01 offers all presently defined services of the Radio Data System RDS (EBU) and of the Radio Broadcast Data System RBDS (NRSC, US) and was designed with the necessary margin for future expansions. It largely complies with the standard specifications of German public transmitter operators, is of unrivalled compact design and ideal for both simple and advanced RDS solutions. DMC 01 is used by DB Telekom and international private and public network operators.

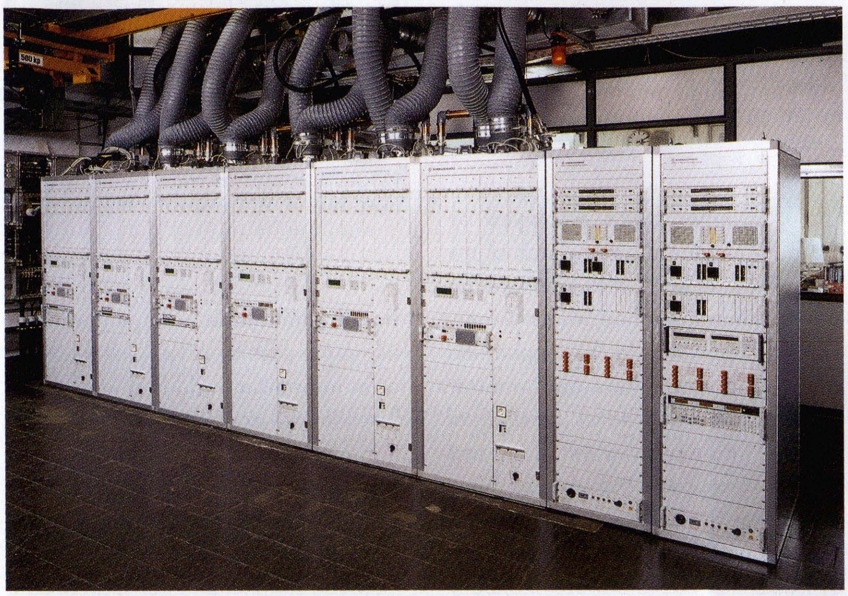

FIG 2 10-kW FM transmitter system for Shanghai Tower equipped with RDS, monitoring and remote-control facilities Photo 41 532/1

The codec provides all **basic RDS functions** such as PS (program service name), PIN (program item number), PTY (program type), MS (music/speech) identification, TP (traffic program) identification, TA (traffic announcement) for one's own program, and with EON (enhanced other networks) also for programs without their own traffic information service, as well as an automatic AF (alternative frequencies) function for the car on the road. Thanks to its flexibility DMC 01 provides **additional services** like paging, traffic management including parking information (traffic message channel TMC) [2], program-enhancing information such as title, performer, program item identification, radiotext (RT), as well as control of advertising media with text and warnings (emergency warning system EWS) and is ready for further tasks in the future.

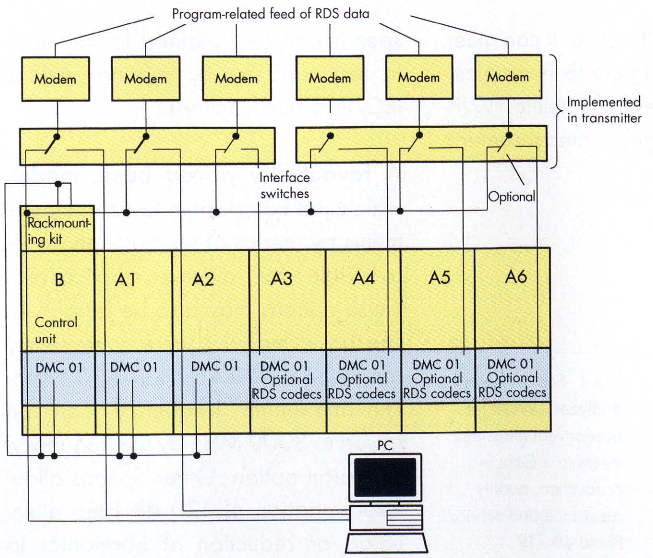

FIG 1 (6+1) FM transmitter system with Radio Data Codecs DMC 01 for RDS transmission and transmitter remote control

With the aid of the **multifunction remote-control interface** consisting of signalling relays and debounced input signal lines, the user can solve a great variety of control problems. To be able to use conventional remote-control systems based on relay contacts, DMC 01 settings (data records, operating status, traffic announcements) may be controlled via the remote-control inputs. The status is signalled back via the relay interface. However, all commands and messages of DMC 01 transferred via a remote-control system can also be transferred via serial computer interfaces.

Since more and more FM transmitters are being equipped with a DMC 01 as standard, the idea of combining RDS functions and **remote control of an FM standby transmitter** is a matter of course. For instance, DMC 01 is able to monitor and control up to six active transmitters and one detached standby transmitter from a control center (FIG 1). This principle is used at the Shanghai Tower for five FM programs, ie for five active transmitters and one standby transmitter (FIG 2). Status signals from the FM transmitters are applied to the remote-control inputs of the codec and, **independently of the RDS functions** of DMC 01, output via serial interfaces to a PC for evaluation. With the aid of a special RCS (remote control system) program, all messages from the transmitter system are displayed on the PC. RCS also enables the PC to send commands to the transmitters.

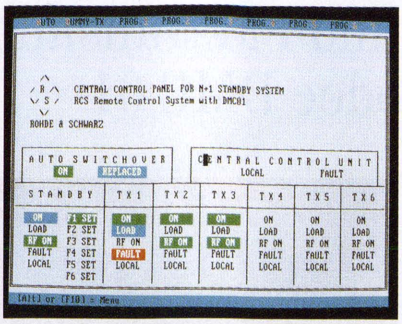

FIG 3 Display of complete transmitter system status on PC thanks to RCS software Photo 41 534/4

The **transmitter status displayed** on the PC (FIG 3) indicates which of the transmitters is on, which is operating on the dummy antenna, which is generating RF power, is faulty or operating in the local mode, and also whether the automatic switchover function of the (n+1) transmitter system is on and whether program output has been taken over by the standby transmitter. After automatic switchover, the standby transmitter has to be reset manually before it is ready for an automatic program switchover again.

Since the operating status of all transmitters in the system is known to the PC, the RCS software can also be used for controlling RDS data records of the standby transmitter. This is necessary as, in the case of a fault, all functions of a transmitter including RDS coder functions are transferred to the standby transmitter. Each program has its own modem link for transferring ongoing RDS data such as traffic announcement, radio paging, radiotext, traffic message channel and transparent data channel to the transmitter site. If automatic switchover has taken place, the program-related dynamic RDS data are switched to the RDS coder of the standby transmitter. Depending on the program switchover, the RCS software selects at the same time the data record of the RDS coder of the standby transmitter. The program-related static data records include permanent RDS information such as program service name, program identification or alternative frequencies. Thus the RDS coder of the standby transmitter is informed during an automatic switchover about the program to be broadcast.

The great advantage of this combined control compared to a separate transmitter control is that, in addition to reduction of costs, control of RDS and transmitter functions is carried out by one unit, ie the RDS Radio Data Codec DMC 01 with RCS software optimally combines the tasks of RDS transmission and transmitter control.

Hans Mieslinger

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Reader service card 146/12 for further information on DMC 01

New applications for Polyskop ZWOB through higher frequency and measurement speed

Thanks to new software, a faster control processor and extended frequency range to 3 GHz, scalar network analyzer Polyskop ZWOB (FIG 1) has become even more attractive. It can meet the requirements of new technologies, especially in the field of satellite TV/IF. Considerably higher measurement speeds can be obtained for automatic test runs by optimizing special IEC/IEEE-bus functions.

FIG 1 Scalar network analyzer ZWOB for economical measurements to 3 GHz in production, quality assurance and service Photo 40 719

A **favourably priced basic model,** which can be adapted to new requirements by means of various **options,** is available for diverse applications. These options may also be retrofitted. The basic model covers a frequency range from 100 kHz to 1600 MHz. The maximum frequency can be raised to 3000 MHz by the frequency-extension option. Other options allow level variation of 120 dB (step attenuator) or reduction of harmonics to

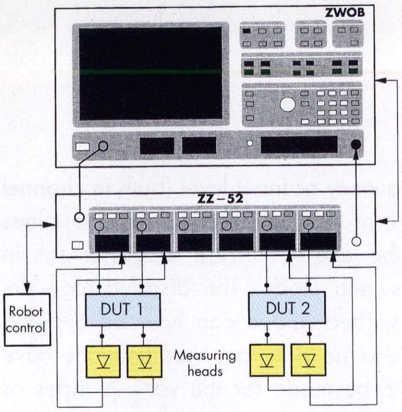

FIG 2 Setup for automatic testing of antenna wall outlets with Polyskop ZWOB and Switch Unit ZZ-52

<–60 dB (harmonics filter). With the optional computer function, automatic test runs can be programmed, if required, in interactive mode. If group-delay variations in the transmission channel of cable network components or systems are to be determined, the group-delay measurement option (ZWOB-B5) is the answer. The great benefit of this option is that measurements can also be carried out on frequency-converting DUTs.

With frequency-converting DUTs it is necessary to display and evaluate frequency markers that are referred to the output frequency (IF markers). For this purpose ZWOB has a counter input into which the output signal can be fed. Signals up to 400 MHz can be evaluated as standard. With the optional frequency counter, the counter frequency range is extended to 1.2 GHz.

Thanks to all these facilities, ZWOB can perform any task in the test department, production as well as in quality control and incoming goods inspection. Due to the **higher measurement speed** in particular – time halved per testpoint – all requirements for level, transmission and reflection measurements can be met. The known drawbacks of scalar analyzers in comparison with vector measuring systems (no phase measurement, low dynamic range and selectivity) do not apply to ZWOB. In most cases the phase is needed for system error correction (especially because of reflection measurement accuracy) or for group-delay measurements. ZWOB solves these tasks with the use of precision SWR bridges or by a modified test method with the advantage that it also includes frequency-converting measurements. The new active demodulator for 1 MHz to 3 GHz offers an attractive dynamic range from +5 to –80 dBm. Thanks to its compact size (diameter 20 mm, length 150 mm) this measuring head is ideal for measurements on multi-range amplifiers or cable distribution units with inputs and outputs often being close to each other and where connecting cables cannot be used. Reception selection becomes an unimportant factor if the harmonics suppression is very high – that is where the optional harmonics filter comes into its own. The broadband measurement system offers the advantage of uncomplicated measurements on frequency-converting DUTs.

Of course, the new Polyskop also solves standard tasks such as measurements and adjustments of reflection, transmission and, if required, group delay of filters (lowpass, bandpass and highpass as well as bandstops with attenuation of >60 dB), amplifiers (antenna amplifiers, CATV amplifiers, multi-range amplifiers and IF amplifiers), cables, attenuators, converters, tuners and receiving sets including the demodulation output. With its top frequency limit of 3 GHz and high measurement speed, ZWOB continues to be ideal for measurements on components of satellite TV/IF technology.

A **good example** is the **automatic testing of antenna wall outlets** (FIG 2). Here, further features are required in addition to high measurement speed: fast change of test settings with tolerance data, immediate pass/fail assessment and the availability of signals for control of test adapters and conveyance of the antenna outlet on a production line, depending on whether the DUT is faultfree or, if faulty, on the type and range of tolerance violations. The complete automatic run (FIG 3) is based on a Basic program (computer function option). Thanks to the new firmware, the tolerance-evaluation data of any testpoint can be calculated from the tolerance data stored with the setup (in CMOS RAM or on floppy disk) and then saved in main memory for subsequent recall at any time.

Assembler routines in the Basic control program allow very fast error evaluation in line with preselected frequency ranges. Appropriate signals are available at the user port to control the sorting process of the defective DUTs. The sorting criteria are defined to enable immediate repair without any further troubleshooting or to reveal obvious weak spots in production.

Peter Kraus

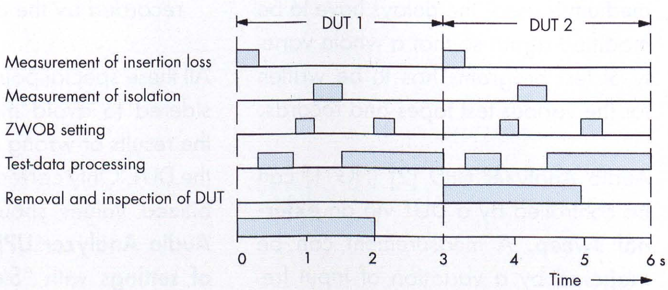

FIG 3 Sequence of individual test and evaluation processes

Reader service card 146/11 for further information on ZWOB

DUT controls Audio Analyzer UPD via external sweep

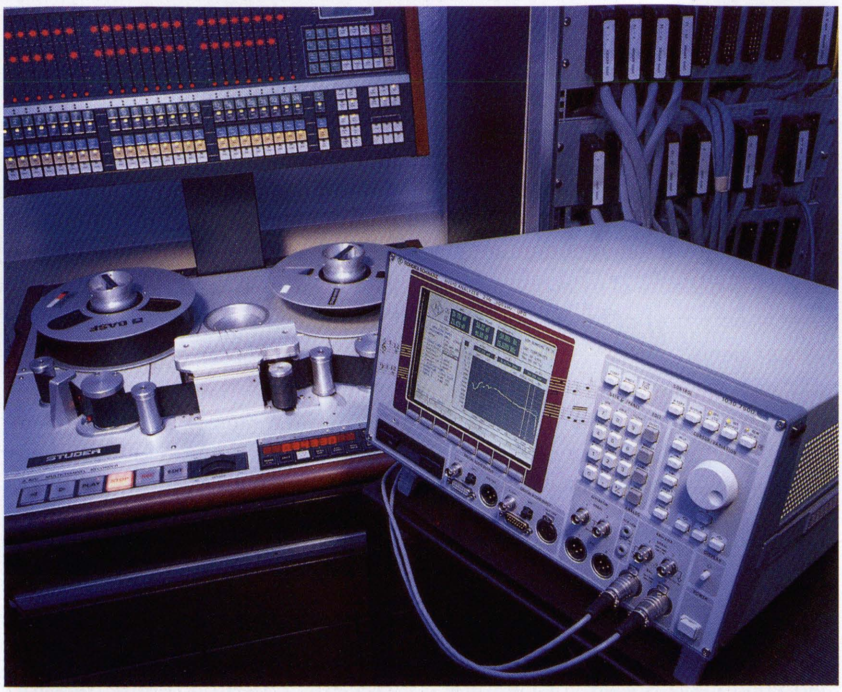

FIG 1 Audio Analyzer UPD brings a new level of versatility to the analog and digital world of audio technology (photo by courtesy of Pilot Studios, Munich). Photo 41 751/1

A frequent task is that of measuring the specifications of audio recording devices. The built-in generator of an audio analyzer cannot be used here; instead equipment (possibly meeting certain standards) such as tape decks/cassette recorders with test tapes or record players/CD players with the corresponding records or CDs are used. The recording medium provides the signal and thus determines the sequence of the measurement procedure and the speed. A similar problem is measuring signal transmission over audio lines.

There are three **possibilities** for performing such measurements:

- A controller determines the measurement procedure by means of a test program depending on the sound-recording medium and controls the audio analyzer [1].
- The audio analyzer controls the measurement procedure taking into account the sequences and timing on the sound-recording medium (internal sweep).
- The DUT itself controls the entire measurement procedure and the analyzer via an external sweep.

The main disadvantage of the first two methods is evident. The control program has no influence over the DUT, so synchronization between the test signals and the measurements cannot be guaranteed. This means that time-consuming matching of the delays within the program to the specific measurement sequence has to be undertaken. If signal length changes when a different sound-recording medium is used, the delays have to be modified again so that a whole variety of test programs has to be written for the various test tapes and records.

Audio Analyzer UPD [2] (FIG 1) can be controlled by a DUT via an **external sweep.** A measurement can be triggered by a variation of input frequency or input level (both in channel 1 or 2). The input signal determines the course of the measurement in sweep mode. The disadvantage described above can now be avoided and no program modifications have to be made for the various tapes or records. This means an enormous saving of time when changing to other sound-recording media with unknown signal sequences.

The following example outlines **measurement of the frequency response of a tape deck** with frequency variation as the trigger parameter. For measurements carried out on recording devices some **special points** have to be considered:

- The level on tapes is often relatively low, so the low S/N ratio causes considerable difficulties when results are analyzed.
- Due to the varying pressure of the test tape on the playback head, the audio signals to be measured are in effect amplitude-modulated. This and the low S/N ratio produce a wide spread in results.
- As the speed is not 100% correct, the measured frequency does not exactly agree with the recorded test frequency (tape or record is running too slow or too fast) and is frequency-modulated because the speed is not constant (wow & flutter).
- In addition to standard audio frequencies, some tapes carry speech signals between the audio signals – these speech signals should not be recorded by the analyzer.

All these special points have to be considered to avoid misinterpretation of the results or wrong conclusions about the DUT. Only correctly settled and stabilized values should be evaluated. **Audio Analyzer UPD** offers a **variety of settings** with "Start Cond." in the analyzer panel so that any measurement can be handled:

Min Volt; to prevent any spurious signals on the tape causing unwanted triggering it is a good idea to enter an input level that must be exceeded for a measurement. The spurious signal could be hum, for example, which is noticeable in the pauses between the test tones.

Start, stop; selecting the start and stop frequency determines the frequency range over which the recording is performed and prevents unwanted triggering due to spurious frequencies outside the given limits.

Variation; variation indicates the minimum amount by which the input parameter has to be changed to cause retriggering. Difficulties caused by frequency fluctuations are avoided.

Tolerance; the entered value indicates the maximum difference between the current settled value and its ultimate value and so determines readout accuracy.

Settling; various algorithms ensure that only settled and stabilized measured values are displayed (FIG 2).

Exponential; the criterion for a measured value being considered settled is for a selected number of readings to lie within an exponential tolerance band.

Flat; the measured value must be within a flat tolerance band to be considered stable.

Resolution; in the resolution field, it is possible to prevent fluctuations in measured values at the lower measurement limit of the UPD, caused by poor resolution or high noise, and which produce measurement errors outside the tolerance window (FIG 3).

Unlike other audio analyzers, the UPD's settling function not only works in the sweep mode but also in the manual and remote-control mode. This has two advantages:

1. Before starting the time-consuming sweep, the user can test the settling parameters required for the DUT and then start the sweep.
2. The settling function can also be switched on in the normal measurement mode to stabilize the displayed reading (eg using the average mode).

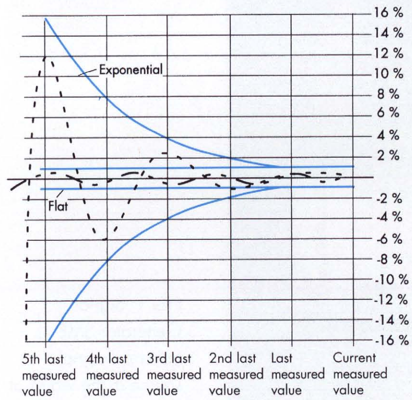

FIG 2 Tolerance characteristic of settling algorithms "Exponential" and "Flat"; samples 6, tolerance 1.0%

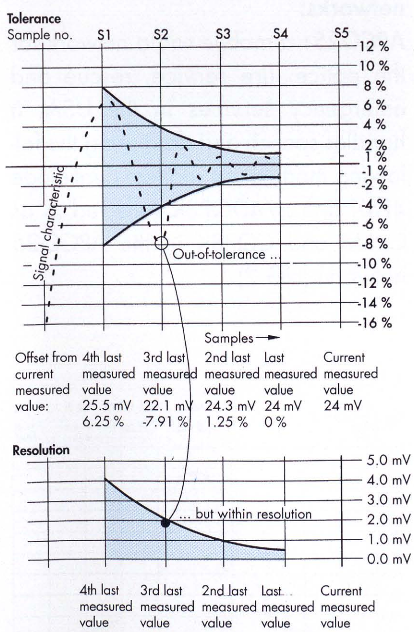

FIG 3 Relationship between tolerance and resolution (blue: valid range). UPD setting: Settling "Exponential", samples 5, tolerance 1.0%, resolution 0.5 mV

When performing measurements with DUTs featuring completely different settling time constants for frequency and level variations (eg hearing aids), there is an **additional settling algorithm** for the selected **test function.** Frequency settling alone in no way means that the input level to be measured would be stable. After settling to the changed input frequency (1st settling), the user can select an additional settling condition for the input level to be measured (2nd settling). Any of a number of settling algorithms can be chosen.

It is not so much the measurement of relatively pure signals that is the challenge but the correct handling of impaired measured values. As the DUT can take over control and various settling algorithms have been implemented, Audio Analyzer UPD can handle the most difficult of measurement tasks.

Burkhard Küfner

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Reader service card 146/14 for further information on UPD

Extensions to Signal Generator SME for testing new digital networks

FIG 1 Signal Generator SME – universal signal source in the world of digital modulation

In the past few years, digital communication has gained increasingly in popularity. New digital modulation and coding techniques are under development worldwide with the aim of using channel capacity as efficiently as possible. Digital transmission is basically not a new thing, just think of Morse telegraphy. What is new is the fact that better use is made of available channel capacity, approaching more and more what is theoretically possible.

With Signal Generator SME (FIG 1), Rohde & Schwarz is offering an instrument that is always "up-to-date" in the fast-moving world of digital transmission. When SME was launched on the market in early 1993, it was already equipped with a variety of network-specific digital modulation modes that had just been introduced at that time [1; 2]. Now, in the middle of 1994, the standard modulation modes offered by SME have tripled and cover the following, **recently introduced networks:**

APCO25: a mobile-radio network for the police, fire service, rescue and emergency services in the USA. It handles speech and data using the following modulation modes: dual-mode 4FSK and $\pi/4$DQPSK (referred to as C4FM and CQPSK in the APCO25 network) (FIG 2).

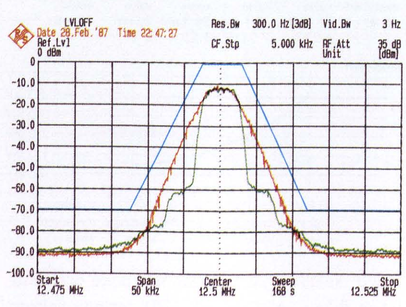

FIG 2 Spectrum of US mobile-radio network APCO25

FLEX: a flexible pager network in the USA. The modulation modes are 2FSK and 4FSK with bit rates of 1.6/3.2 and 6.4 Kbit/s.

The table on the right gives a complete overview of the standards provided by SME. The wide variety of digital modulation modes offered makes SME a universal signal source for use in the development and production of digital mobile-radio receivers. The data signals for modulation can be applied externally or produced by an internal data generator. The data generator supplies PRBS signals and user-programmable data sequences with a length of 8 Kbits. Frequency and level hopping can be programmed to be bit-synchronous with the data signal. To program very long data sequences, data memory can be expanded to 8 Mbits by means of Memory Extension Option SME-B12, which allows even highly complex signalling to be performed.

Operating SME is extremely easy thanks to menu guidance and a large LCD display. All available parameters and actual settings for a specific function are arranged in a single display. Direct access to standard modulation modes in the operating menu means that the user can select appropriate settings rapidly. Also, parameters can be user-defined over wide ranges. This makes it possible to test the limits of a receiver using non-standard parameters or to inhouse standards. User-definable settings are indicated in the table as "Standard, USER".

SME is constantly being adapted to keep pace with the latest developments in digital mobile radio and so is a future-proof instrument capable of handling the requirements of a rapidly changing digital world.

Johann Klier

Overview of SME digital modulation modes			
Modulation	**Standard**	**Data rate**	**Notes**
GMSK	CDPD	19.2 Kbit/s	Cellular Digital Packet Data
	DCS 1800 (PCN)	270.833 Kbit/s	Digital Cellular System
	DSRR	4/16 Kbit/s	Digital Short Range Radio
	GSM	270.833 Kbit/s	Global System for Mobile Communications
	MC9	8 Kbit/s	French communication network
	MD24 to MD192	2.4 to 19.2 Kbit/s	ETSI standards
	MOBITEX	8 Kbit/s	Mobile data system
	USER	2.4 to 1000 Kbit/s	User-defined settings with B x T = 0.2/0.3/0.4/0.5 possible
GFSK	CT2	72 Kbit/s	Cordless Telephony
	CT3	640 Kbit/s	Cordless Telephony
	DECT	1152 Kbit/s	Digital European Cordless Telephony
	USER	10 to 585 Kbit/s 640 to 1170 Kbit/s	User-defined settings do not need to meet any standards
FSK	Cityruf	0.512/1.2/2.4 Kbit/s	German paging system
	FLEX	1.6/3.2 Kbit/s	Flexible High Speed Paging System
	POCSAG	0.512/1.2/2.4 Kbit/s	Post Office Code Standardization Advisory Group
	USER	0.05 to 1900 Kbit/s	User-defined settings possible Deviation range 10 Hz to 400 kHz Max. deviation depends on carrier frequency
FFSK	POCSAG	1.2 Kbit/s	Post Office Code Standardization Advisory Group
	USER	0.05 to 90 Kbit/s	User-defined settings possible AF1 = bit rate; AF2 = 1.5 x bit rate
4FSK	APCO25	9.6 Kbit/s	Association of Public Safety Communications Officers, Project 25
	ERMES	6.25 Kbit/s	European Radio Message System
	FLEX	3.2/6.4 Kbit/s	Flexible High Speed Paging System
	MODACOM	9.6 Kbit/s	Mobile Data Communication
	USER	1 to 24.3 Kbit/s 27 to 48.6 Kbit/s	User-defined settings possible Available filters: $\sqrt{\cos 0.2}$, cos 0.2 and Bessel
QPSK	MSAT	6.75 Kbit/s	Mobile Satellite
	USER	1 to 24.3 Kbit/s 27 to 48.6 Kbit/s	User-defined settings possible Available filters: $\sqrt{\cos}$ and cos 0.2/0.35/0.4/0.5/0.6
O-QPSK	INMARSAT M	8 Kbit/s	International Maritime Satellite
	USER	1 to 24.3 Kbit/s 27 to 48.6 Kbit/s	User-defined settings possible Filter: $\sqrt{\cos 0.6}$
π/4QPSK	USER	1 to 24.3 Kbit/s 27 to 48.6 Kbit/s	User-defined settings possible Available filters: $\sqrt{\cos}$ and cos 0.2/0.35/0.4/0.5/0.6
π/4DQPSK	APCO25	9.6 Kbit/s	Association of Public Safety Communications Officers, Project 25
	NADC	48.6 Kbit/s	North American Digital Cellular
	PDC	42.0 Kbit/s	Pacific Digital Cellular
	TETRA	36.0 Kbit/s	Trans European Trunked Radio
	TFTS	44.2 Kbit/s	Terrestrial Flight Telephone System
	USER	1 to 24.3 Kbit/s 27 to 48.6 Kbit/s	User-defined settings possible Available filters: $\sqrt{\cos}$ and cos 0.2/0.35/0.4/0.5/0.6

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Reader service card 146/15 for further information on SME

Fully automatic signal detection and analysis with standard WinAnalyse software

WinAnalyse software controls a workstation for detecting and analyzing FSK and PSK signals in the shortwave band. WinAnalyse is run on PCs under MS-Windows® 3.1 and has an easy to operate user interface for the receiver and analyzer, longterm data storage with flexible methods of data evaluation as well as the facilities to set up larger systems by networking.

VLF-HF Receiver EK 890 from Rohde & Schwarz [1] is the most suitable receiver but other receivers can also be used. Signal Analyzer GA 101 [2] performs signal analysis. Its main features are automatic modulation detection and accurate measurement of transmission parameters such as baud rate and shift; it recognizes the built-in standard transmission methods as well as user-defined methods. In addition to signal data, GA 101 also provides the bit stream (bits buffered to prevent loss!) and the plain text when a conversion rule (code and alphabet) has been defined and recognized. A spectrum processor with resolution of 0.6 Hz is available as an option. It can be used to generate spectra manually or automatically for specified transmission methods.

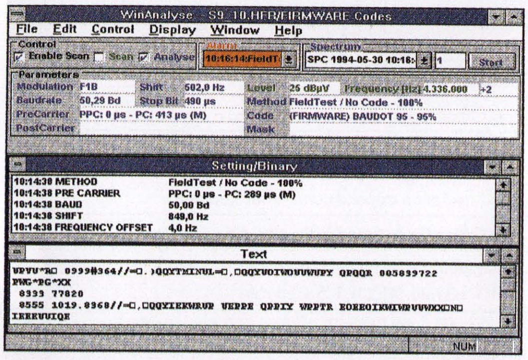

FIG 1 Display of test results with bit stream and plain text. Current parameter set and chronological order of measurement are displayed (green: receiver, violet: analyzer).

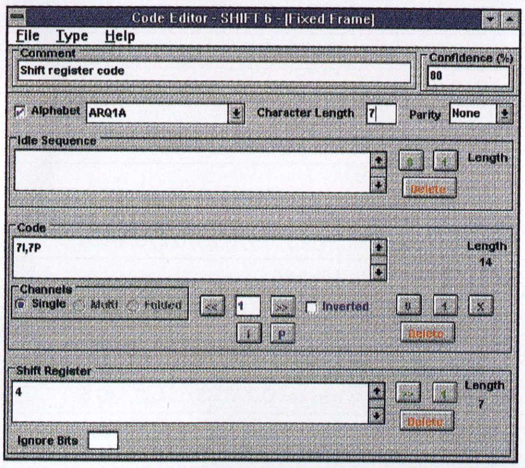

FIG 2 Code editor shows structure of transmission frames.

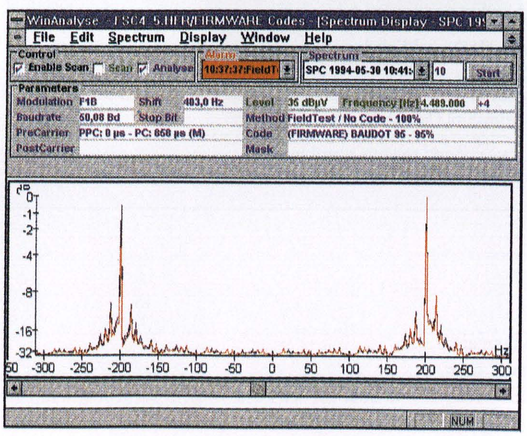

FIG 3 Spectrum display (red: current spectrum, violet: reference spectrum)

WinAnalyse sets parameters such as frequency and bandwidth for the **receiver** and controls the frequency or channel scan as a function of the analysis. If the receiver is manually operated, WinAnalyse determines the setting parameters when the analyzer detects a signal so that signal data can be correctly stored in the results database.

WinAnalyse supports several **analyzer** functions:

- WinAnalyse controls the analysis. The „Control" field is used to display the system state (scan or analysis on/off) and also for system operation. By clicking "Analyse" for example, the analyzer can be started or stopped. WinAnalyse automatically starts the analyzer if an active frequency has been found. It displays signal parameters as well as the bit stream and plain text (FIG 1) and – if programmed to do so – triggers acoustic and optical alarms for identified methods. All data are stored in a database in chronological order.
- It allows versatile analyzer programming. Programming the GA 101 is easy and intuitive. The transmission parameters mod-

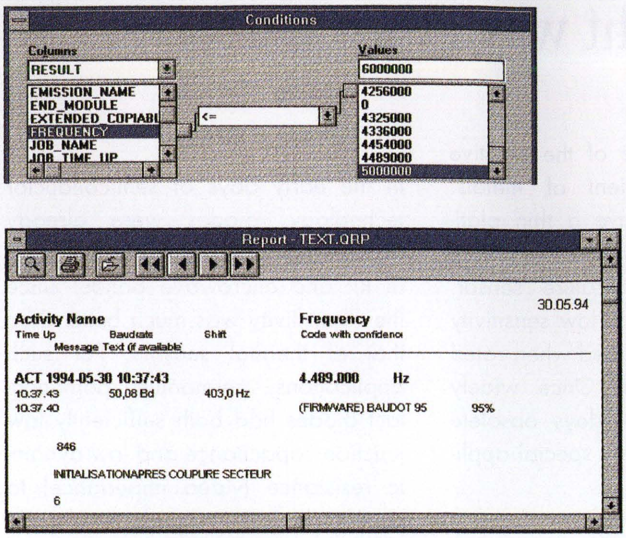

FIG 4 Report is defined by database query (conditions) and printout format (here text.QRP).

ulation, baud rate, block length, code as well as start and stop masks are defined as methods. The codes and the associated alphabets can be firmware or user-defined codes. Masks are always defined by the user. GA 101 can simultaneously load 100 methods, masks, codes and alphabets – settings of this kind are stored as job definitions by the system. Once the job definition has been defined, it is loaded into GA 101 by means of a menu command. Learning how to operate the editors is very easy; FIG 2 shows the code editor as an example. The context-sensitive help system provides a comprehensive introduction as well as explanation of each command.

- WinAnalyse manages the spectra generated by GA 101. Spectra are either generated by clicking the spectrum start button or generated automatically during analysis. A generated spectrum is automatically displayed when it has been sent by GA 101. The user can now call up another spectrum from the database and can display it as a reference (FIG 3). Level display can be switched over from linear to logarithmic and the frequency resolution can be varied in several steps between maximum resolution and display of the whole spectrum. In addition to the spectra, the most important signal parameters such as frequency, shift or baud rate can be added to the display.

Data storage is based on the relational database system GUPTA and QUEST®, an analysis tool. WinAnalyse continuously stores all the results obtained from analysis together with their time and frequency so that system operation can be fully automated. The results can be analyzed afterwards. QUEST has the following facilities:

1. Some predefined printout formats are available – the user opens the format file and the report is generated automatically (FIG 4).
2. The user can modify the predefined formats, eg to add queries according to user-defined codes.
3. The user can also define his individual printout formats – no special programming knowledge is required.

In addition to the above-mentioned spectrum comparison, there is also an editor for post-editing the bit stream. The bit-stream editor and the spectrum editor can be called directly from QUEST. The editor can display the bit stream in different formats making it easy to determine the frame length of a code. It also calculates the autocorrelation and counting functions on the bit stream.

WinAnalyse has a number of **system networking** features. It uses a Windows communication concept developed by Rohde & Schwarz. Devices can then be controlled via a NOVELL network, ie the workstation and the controller proper can be at different locations. Other types of device can be connected and integrated into the analyzing system (eg for IF recording). Moreover, WinAnalyse can be combined with other R&S standard systems to produce a larger system, eg a DF system controlled by standard WinLoc software.

The use of a common database controller is also possible. GUPTA offers multiuser servers based on NOVELL. Several WinAnalyse clients can use the same setting data and can store the results, thus supporting central evaluation and creation of new job definitions. It is also possible to add a database server to the workstation to provide more capacity for time-consuming data evaluation.

Johannes Meidert

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[2] Rohde & Schwarz data sheet: Signal Analyzer GA 101, PD 757.0535.21

QUEST is a registered trademark of GUPTA, Microsoft Windows is a registered trademark of Microsoft.

Reader service card 146/16 for further information on WinAnalyse

RF power measured the right way (V)

3.1.1.2 Bolometers

The term bolometer is used to describe power meters which are based on the variation of electrical conductivity as heat is absorbed by the termination. There is a variety of bolometer types, the best known of which are thermistors and barretters.

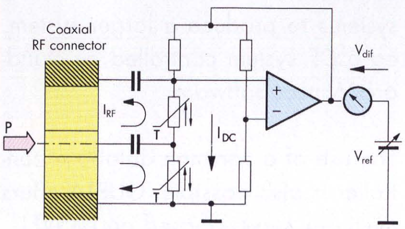


FIG 23 Principle of thermistor power meter. Absorbed RF power can be calculated from measured voltage difference V_{dif}. With RF power switched off, V_{ref} is adjusted to give no voltage difference (zero adjustment).

In the **thermistor power meter,** two semiconductor resistors with high negative temperature coefficient (thermistors) combine the function of termination and temperature sensor all in one. They absorb at the same time the RF power to be measured and a DC power (FIG 23). In a bridge circuit, the DC resistance is measured and kept constant by varying the DC power. Any increase of RF power is thus always compensated by an appropriate reduction of DC power and vice versa. DC power can easily be measured. Due to the substitution principle employed, thermistor power meters feature extremely high longterm stability and their effective efficiency can be measured with very low uncertainty. For general applications, these instruments have however become of little interest because of their narrow measurement range from 10 μW to 10 mW.

Barretters make use of the positive temperature coefficient of metals. Common models have a thin platinum-wire filament to act as an RF absorber and temperature sensor. They feature relatively low sensitivity and are easily damaged when rated power is exceeded. Once widely used, they are nowadays obsolete and employed for very special applications only.

3.1.1.3 Calorimeters

Calorimeters in the original sense are instruments for measuring quantities of heat, ie energy/power is calculated from the temperature increase of a material of known specific heat capacity such as water. To enhance measurement accuracy, commercial calorimeters operate on the substitution principle. Due to their high stability, they are used as primary standards. They are also used for the direct measurement of very high powers without attenuators or directional couplers connected ahead. For such applications, flow calorimeters are used (FIG 24), partly with direct absorption of RF energy in the cooling medium water.

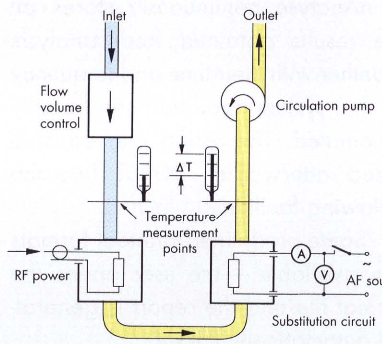


FIG 24 Flow calorimeter using substitution method. Measured temperature difference is proportional to absorbed power P. Calibration is made via substitution circuit.

3.1.2 Diode sensors

In the early days of semiconductor technology, diodes were already being used for power measurements in RF and microwave bands, since their sensitivity was much better than that of thermal sensors. For such applications, germanium point-contact diodes had both sufficiently low junction capacitance and low dynamic resistance (video impedance) to enable low-noise measurement of the rectified voltage. Because of the fabrication technique involved, however, these detectors exhibited large spreads in their electrical characteristics and instability, so that for a long time diode power meters were regarded to be inaccurate.

Today, zero-bias Schottky diodes produced on a silicon substrate or GaAs diodes are mostly used. Their electrical characteristics are similar to those of germanium point-contact diodes, but their longterm stability is as high as that of thermocouples. Diode power sensors cover the power range from below 10 μW down to about 100 pW. They are indispensable for measuring the peak or envelope power of modulated signals. Where very high measurement speed is required, they are used instead of thermocouple sensors even in the power range from 10 μW to 100 mW. The measurement error that may occur in this range must be traded off in each case against measurement speed and zero stability. Diode sensors are made for frequencies up to about 110 GHz, often with plug-on attenuators for higher powers and for improved matching.

In addition to the termination, the sensor contains a halfwave or fullwave rectifier and a matching network for compensation of the junction capacitance and lead inductance of the diode (FIGs 25 and 26). Due to the

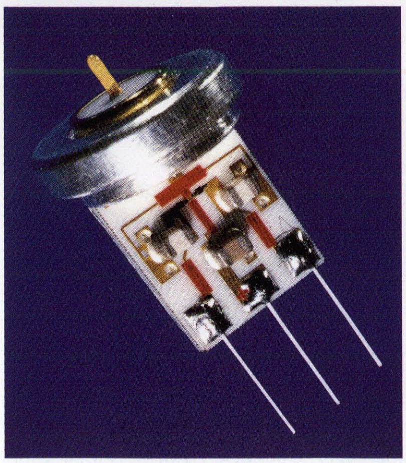


FIG 25 Diode sensor of Power Sensor NRV-Z4
Photo 41 133

parasitic circuit elements, matching is somewhat poorer than that of a comparable thermocouple sensor. To improve it, the coupling capacitor between RF connector and termina-

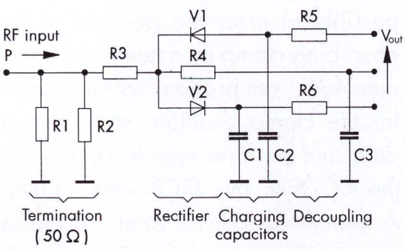


FIG 26 Simplified block diagram of sensor shown in FIG 25

tion is sometimes omitted. The output voltage is then not referred to ground but against the inner conductor or second rectifier so that the superimposed DC voltage is suppressed.

Even with DC coupling to the measurement circuit, diode sensors cannot be used at very low frequencies. The frequency range is always limited by the charging capacitor, which in conjunction with the DC resistance of the diode, forms a highpass filter for the tapped RF voltage. Due to the unfavourable RF characteristics of high capacitances, very large frequency ranges can only be covered by several sensors. The measurement accuracy of a diode sensor is not only determined by the quality of calibration and matching, but to a considerable extent also by the magnitude of the power applied.

3.1.2.1 Square-law region

At very low powers, diodes behave very much like thermal power sensors. They measure the true RMS power and indicate neither dynamic nor frequency-dependent linearity errors. Harmonics are weighted according to their power, and the average power is indicated in the case of envelope modulation. In this range the diode behaves like a weakly nonlinear resistance (FIG 27). In addition to the linear component (video impedance), the current-voltage characteristic also has a square term which causes RMS rectification. This section of the transfer characteristic is therefore also referred to as the square-law region. The output DC voltage is approximately proportional to the input power (about 800 µV/µW) and the temperature coefficient is constant, its order of magnitude being the same as that of thermocouple sensors.

There is no fixed upper limit for the square-law region. With sinusoidal signals the upper limit is usually drawn at a crest value of 30 mV, corresponding to 10 µW PEP in 50-Ω systems. At the lower measurement limit, with input powers between 100 pW and 1 nW, diode sensors output a very small DC voltage of a few hundred nV only. Superimposed thermal noise and zero drift caused by local heating of the sensor set a limit to practical use of the diode.

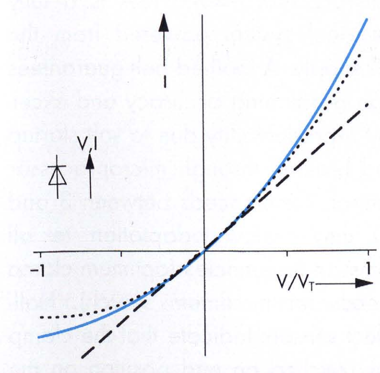


FIG 27 Current-voltage characteristic of Schottky diode in square-law region (blue); dotted: square approximation; dashed: $I = V/R_0$, where R_0 is video impedance without external bias; V_T = temperature voltage (25 to 35 mV)

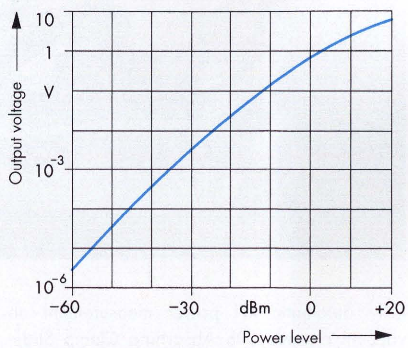


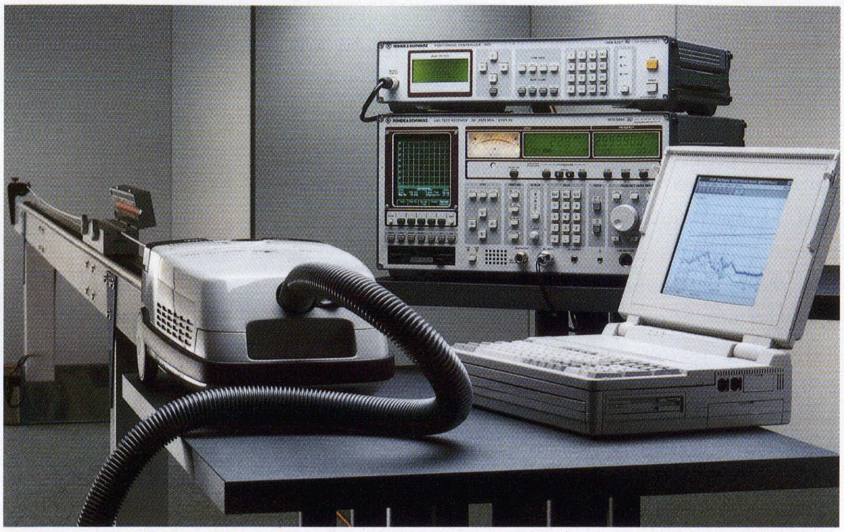
FIG 28 Static transfer characteristic of diode sensor with no-load output (fullwave circuit)

3.1.2.2 Peak weighting

With increasing power level, the diode sensor changes from RMS weighting to peak weighting of the RF voltage, exhibiting the well-known behaviour of a diode rectifier. Highly stable, noise-free measurements are possible due to the relatively high output voltages of about 10 mV to a few V outside the square-law region. Measurement speed is extremely high. Since the static transfer characteristic (FIG 28) is nonlinear and the temperature coefficient a complex function of power and temperature, power measurements outside the square-law region are not possible with older types of power meter. Modern sensors can be appropriately calibrated so that residual errors become negligible. Problems may be caused by effects which cannot be corrected subsequently and therefore cause measurement uncertainties.

To be continued. Thomas Reichel

Absorbing Clamp Slideway HCA for automatic RFI power measurement



Fully automatic RFI power measurement on vacuum cleaner with Absorbing Clamp Slideway HCA and Test Receiver ESVS 30
Photo 41 351/2

RFI from domestic appliances and electric tools can be assessed for compliance with CISPR 14, EN 55014 and VDE 0875 part 14 by measuring the RFI voltage from 150 kHz to 30 MHz using a LISN and by measuring the RFI power from 30 to 300 MHz using an absorbing clamp (MDS clamp). When RFI power is measured, the ferrite rings of the clamp encircle the line being tested. The current flowing in the line is measured with a built-in current transducer. By moving the absorbing clamp along the line by at most half the wavelength (eg 5 m at 30 MHz), maximum RFI power can be found. The DUT and the absorbing clamp are placed on a non-metallic surface at a distance of at least 40 cm from the floor and from any metallic objects.

This is the main application of Absorbing Clamp Slideway HCA (FIG). Future applications could be measurements of spurious emissions from smaller DUTs classified as ITE (Information Technology Equipment) where limits for RFI power measurement are also defined (CISPR/G(Sec)69), a draft for the amendment of CISPR 22) as well as measurements of spurious emission and shielding in cabled distribution systems to EN 50083-2 (draft). Moreover, RFI power measurements can be used to speed up RFI field-strength measurements.

Absorbing Clamp Slideway HCA is used to position the clamp 80 cm above the floor. It supplements the antenna positioning mast and turntable system consisting of Masts HCM, Turntables HCT 12 and Controller HCC (see News from Rohde & Schwarz No. 140). HCA is a fully electrical system powered from the AC supply. A toothed belt guarantees high positioning accuracy and excellent reproducibility due to soft startup and braking through microprocessor control. Nine speeds between 3 and 40 cm/s allow adaptation to all common frequencies (optimum clamp speeds for maximum search). Hall-effect sensors indicate that the clamp has reached an end position on the slideway and the controller stops moving the clamp. As with the mast and the turntable, automatic calibration of the clamp position is possible.

HCA is prepared for Absorbing Clamps MDS-21 (30 to 1000 MHz) and MDS-22 (0.3 to 2.5 GHz) from Rohde & Schwarz. The cable to be tested is fixed by clamping jaws at the beginning and the end of the slideway, particular care being taken to move the absorbing clamp close to the DUT. When using Absorbing Clamp MDS-22, the spacing of the clamping jaws may be reduced to 1.5 m because of the shorter clamp path. HCA complies with the EC directive on machinery 89/392/EEC and, because of the complete lack of RFI and its RFI immunity, with EMC directive 89/336/EEC, so thoroughly earning the right to bear the CE conformity mark.

Positioning Controller HCC makes it possible to enter the position of the absorbing clamp as a number, trigger automatic calibration, preset limits for the clamp position, store setting data and perform remote control via the IEC/IEEE bus (SCPI compatible). A handheld control unit facilitates manual RFI power measurements with the test receiver. Manual measurement may be required for unstable interference. One low and one high speed in each direction of movement can be selected at the press of a button. Moreover, stepwise operation with user-selectable step sizes for the clamp position is possible.

Manfred Stecher

Reader service card 146/17

ERMES coders for Radiocommunication Testers CMS, CMT and CMTA

In addition to the European standard for mobile-radio networks (GSM), a new standard has been established for Europe-wide radiopaging: European Radio Message System (ERMES). This standard covers tone-only, numeric and alphanumeric messages to be transmitted in digital form. For tests on paging receivers operating to the new standard, Rohde & Schwarz can supply Signal Generator SME [1] as well as an ERMES coder, which comes as an accessory to analog Radiocommunication Testers CMS, CMT and CMTA [2]. The testers can thus operate as signal generators for ERMES pagers. The ERMES coder allows the signalling and message transmission of an ERMES base station to be simulated.

The coder is intended for operation with a computer compatible with the industry standard. It consists of a plug-in board for generating the modulation signal and the associated operating software. The data to be transmitted undergoes four-level pulse-amplitude modulation and is filtered by a Bessel lowpass. The modulated signal is fed to the radiocommunication tester, which operates in the 'receiver test with external FM' mode. To ensure the high bit-rate accuracy specified for ERMES base stations, the coder is also locked to the 10-MHz reference frequency of the tester.

The operating software features a convenient, menu-guided user interface which can be controlled via keypad or mouse. All system parameters and pager addresses can be set via this interface (FIG 1). Numeric and alphanumeric messages can be entered as user-defined strings (FIG 2). Data transmission under the ERMES standard uses 30-bit words. An integrated error generator makes it possible to combine a user-definable error mask with a data word at any position desired. The software further calculates the signalling from the selected parameters and outputs the transmit data in realtime.

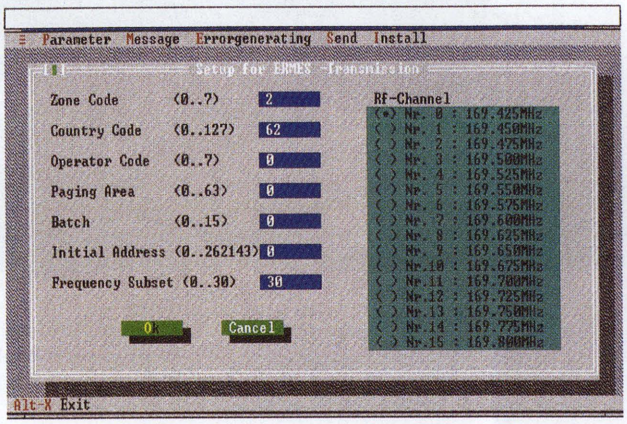


FIG 1 Operating software for ERMES coder: setting system parameters and pager address

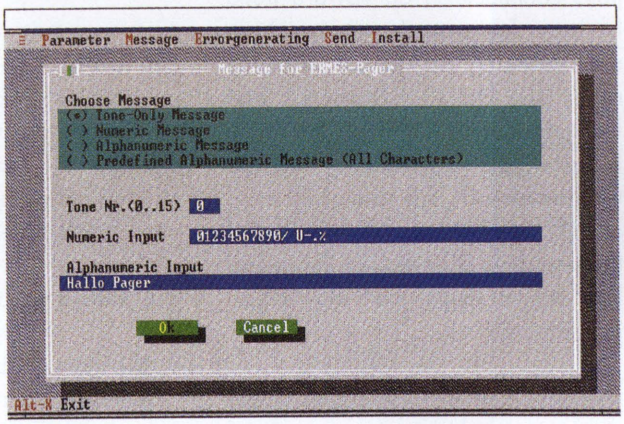


FIG 2 Entering message to be sent

The ERMES coder is not only suitable for fast function tests on ERMES pagers but also for simulating interference from the ERMES system on existing RF systems using the RF spectrum of the modulated signal. Furthermore, the modulation signal of the coder can be directly applied to the output stage of an ERMES base station. In conjunction with the radiocommunication tester, it is thus possible to perform a complete transmitter test on the RF module.

Hermann Langer

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Reader service card 146/18

Integration of modern data terminals in radioteletype networks

FIG 1 MERLIN system processor, data terminal for top-quality radioteletype networks (here with HF Transceiver XK 2100) Photo 41 268/2

Radioteletype networks are operated worldwide by the police, armed forces, embassies, the press and similar agencies. The volume of communications continues on an upward trend because, for example, organizations are expanding, markets are becoming more and more international and the general demand for information is growing. Conventional teletype technology with maximum data rates of 200 Bd and transmission rates of likewise only 200 Bd on shortwave links can no longer meet the increasing demand.

Modern computers with digital signal processing and fast processing speed and radio modems with secure data transmission at up to 2700 bit/s in the shortwave band are far better tailored to today's demands. Rohde & Schwarz is active in all these fields and can provide the right hardware and software solutions.

Either commercial PCs are used as **data terminals,** or – if the quality requirements are more stringent – the MERLIN system processor (FIG 1) [1; 2]. MERLIN emits minimal compromising emanations (Tempest) and can even be used under extreme environmental conditions. It uses standard modules with system-specific accessories and ensures excellent future-oriented expandability due to its network interfaces and its peripherals.

The **software** comprises three modules:

- automatic logbook entries, archive functions, access protection and easy message-file tracing,
- modern windows-oriented editor with a message-formatting aid for easy generation, preparation and transmission of messages,
- automatic handling of transmission/reception, encryption/decryption, routing and printing.

Rohde & Schwarz provides the appropriate software packages for a variety of customer-specific message formats such as the military format ACP 127 or the police format PDV 810. This ensures straightforward operation without time-consuming training and also future-proof expandability.

On the **system side,** the Rohde & Schwarz data terminals allow connection from and to a wide variety of networks (teletype network, datacom network) and transmission media; SatCom, X.25, ISDN or radio are linked and integrated, for example. Various gateway functions are used to link up with other networks, eg conversion of an ACP message into a X.400 message format. Data security is provided by internal and external encryption.

In the military sector, Rohde & Schwarz products range from the "simple" ACP 127 teletype set to complex message-handling systems using

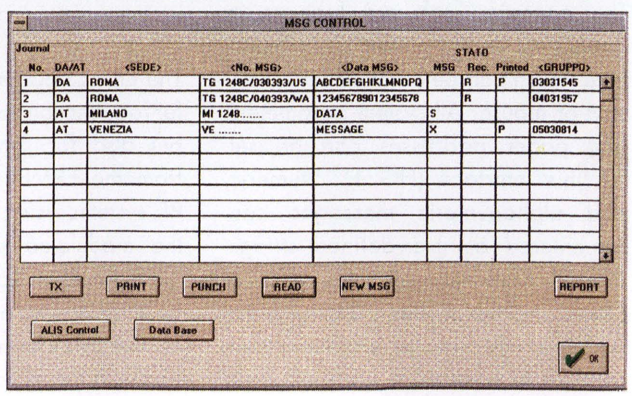

FIG 2 Easy menu operation of MERLIN system processor (here main menu)

a wide range of transmission media. A large number of customer-specific systems is already used worldwide in diplomatic communication networks. Rohde & Schwarz has the extensive experience in the fields of hardware, software and systems that is necessary to provide the right solution for any communication network.

Peter Maurer; Klaus Völker

Reader service card 146/19 for further information on MERLIN

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[2] Maurer, P.; Völker K.: Multimedia communication with MERLIN system processor. News from Rohde & Schwarz (1993) No. 142, pp 27–28

Audio monitor for Audio Analyzer UPD

Audio Analyzer UPD is an extremely versatile test and measuring instrument for the analog and digital audio fields [1;2]. Especially in digital applications, aural monitoring of the signals is often desired by the user to be able to better assess the influence of different digital parameters. With the use of the audio monitor option (UPD-B5) of Audio Analyzer UPD, test signals become audible via an external headphone or a built-in loudspeaker (FIG). The audio monitor can either be switched to the original signal at the input or to the residual signal after a filter. Such filters can easily be implemented in UPD by entering the corresponding filter parameters. The user can thus blend out different spectral lines of a signal and so analyze the tone characteristics of the residual signal with a weighting characteristic. For this purpose the audio signal can be varied in a range of ±120 dB so that even extremely weak, residual signal components are audible after filtering. The subjective impression of the sound can also be determined by reducing the number of bits used for coding, which can be simulated by the digital generator of UPD. Thus an analog output is available on UPD allowing any input signal to be monitored irrespective of sampling rate and data format. The option, which can easily be installed by the customer, also offers a parallel interface to operate a checkpoint selector (scanner) on UPD. The menu-guided user interface for the selector allows individual test channels to be configured easily and clearly for a variety of tasks. It is also possible to retrofit earlier UPDs with the option. In this case, however, aural monitoring of the analog input signal cannot be made directly but only with the filter switched off.

The audio monitor option of Audio Analyzer UPD offers the exacting customer acoustic weighting of the test signal at the input (photo by courtesy of Pilot Studios, Munich). Photo 41 751/3

Herbert Schanzer

REFERENCES

[1] Kernchen, W.: Audio Analyzer UPD generates and measures analog and digital audio signals. News from Rohde & Schwarz (1992) No. 139, pp 13–15

[2] Küfner, B.: DUT controls Audio Analyzer UPD via external sweep. In this issue, pp 38–39

Reader service card 146/14 for further information on UPD

Sony – very well prepared for Europe 96

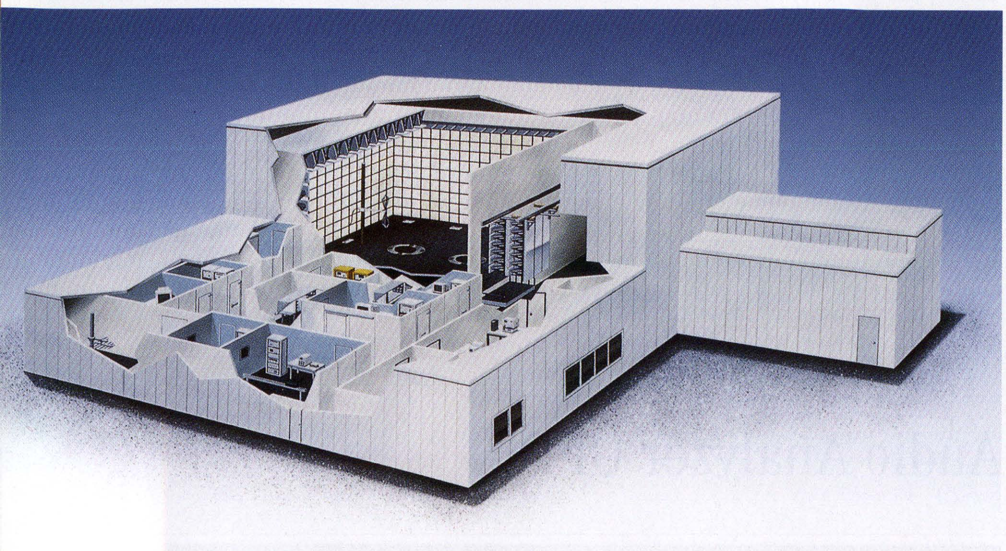


FIG 1 Sony's EMI test center, the largest worldwide, on the roof of the design center in Fellbach near Stuttgart Photo: Sony

Since 1994 the EMC directives adopted by the European Council of Ministers in 1989 have been in force throughout Europe. From 1996, consumer electronics and telecommunications equipment must meet these directives and display the CE mark, which is valid all over Europe, to demonstrate their conformity.

Sony's response to this new situation was the investment of ten million DM to establish a state-of-the-art **EMC test center for consumer electronics** in Fellbach near Stuttgart. The test center, covering an area of 1000 m^2 on the roof of Sony's head office (FIG 1), is the largest of its type anywhere in Europe and also the largest Sony EMC test center. At the official inauguration in November 1993, Sony's vice-president Nobuo Kanoi pointed out that he sees the benefit of this center not only in attaining the CE mark to promote free trade but also with regard to operational reliability and quality assurance.

Kenji Okazaki, responsible for this field referred to as Product Compliance Europe (PCE), explains the reason for choosing Fellbach as the site of the test center: "Here, a Sony design center has already been set up and EMC measurements are not made on the finished product. An EMC test center should always be in the neighbourhood of the design center. We are in charge of all Sony products sold in Europe, ie an equipment throughput of about 350 different models for PCE in 1994."

At present, mainly acceptance tests are carried out, followed by random measurements made on units from the current production of the plants in France and Spain. The development departments, of course, also make use of the EMC test center, for example if new boards are to be tested for their electromagnetic compatibility.

Initial discussions about the necessity of building such an EMC test center began in mid-1990. Besides the structural measures that had to be taken, great importance was attached to the measuring equipment to be provided: "We are using two multistandard test systems for EMS measurements to EN 55020 (FIG 2). Furthermore, two EMI test systems have been implemented for measurements to EN 55013, EN 55022 and EN 50081-1 (FIG 3). We had a number of choices open to us as far as equipment and manufacturer were concerned. The contract was awarded to Rohde & Schwarz, since no other company was able to submit an offer for the very special EMC test systems and the configuration required by us. Moreover, Rohde & Schwarz has many years of experience in the design and implementation of EMC test systems."

Not much time passed between discussions and completion of the project, ie ten test cages and a large anechoic chamber, so that Rohde & Schwarz was in a position to deliver the ordered test systems as early as August 1993. After successful auditing, the Federal Office for Type Approval (BZT) handed over the type-examination certificate on the day of the official inauguration; the BAPT certificate, which is the prerequisite for the CE mark, followed at the beginning of 1994.

Sony intends to provide EMC labs for all design centers. The first project has been completed in Fellbach, now the question is how satisfied Sony is with Rohde & Schwarz's performance.

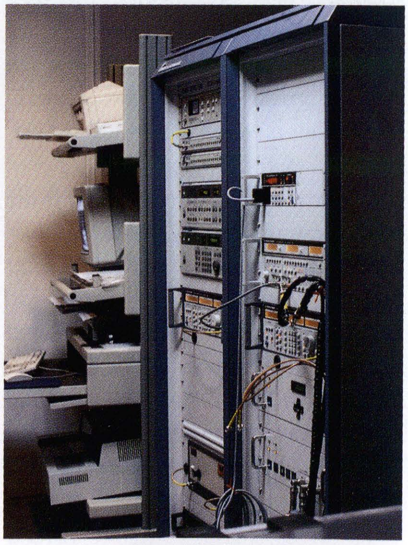


FIG 2 Multistandard test system for EMS measurements to EN 55020

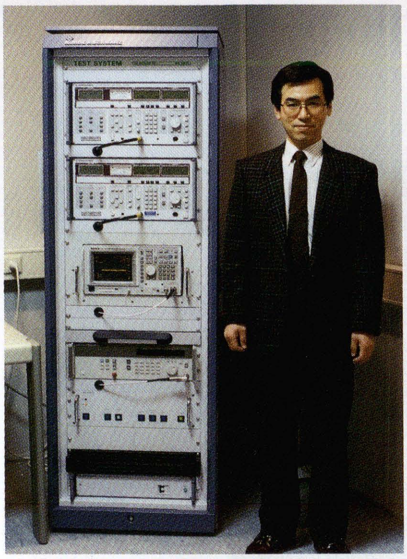


FIG 3 EMI test system to EN 55013 and EN 55022, proudly presented by senior manager Kenji Okazaki

Kenji Okazaki has a clear answer to this: "We will be going for Rohde & Schwarz measuring equipment again as soon as further projects are under way."

Besides Sony Europe's EMC test center, other Fellbach plants are **Sony-Wega Produktions GmbH** and a **design center for Sony TV equipment.** In this center, highly sophisticated TV units are developed and manufactured. Since Sony-Wega's most important challenge is to design equipment that fully meets EMC requirements, the center includes a special department which carries out EMC measurements to support development as well as other tasks. Harald Wendt, who has been involved in FTZ work since 1977, is head of this department.

When, between 1979 and 1981, it became clear that EMC would have to become a subject for detailed, indepth study, major investments were made. The first large test cage, the first EMI measuring equipment and the well-known "Jacky" went into operation. Even then, the way was cleared for both an approval service to procedure II and a design department in Fellbach, including similar equipment.

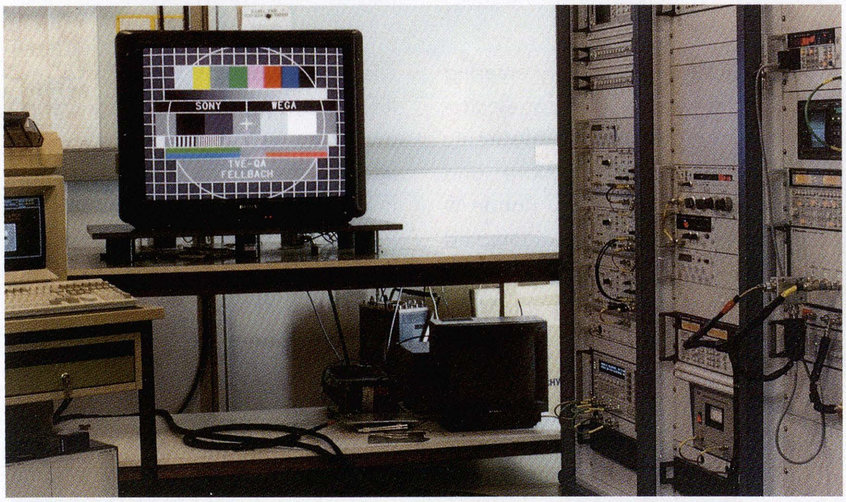


FIG 4 Sound and TV broadcasting EMS Test System TS 9980 from Rohde & Schwarz in operation at Sony-Wega Photos: author

"For about two years we have been using a sound and TV broadcasting EMS Test System TS 9980 from Rohde & Schwarz (FIG 4), which is under fully automatic control by software via an IEC/IEEE bus. We thus meet all standards used in Europe, including D2-MAC and 1st satellite IF." Since only lab equipment is measured, it is not possible to determine the throughput per unit of time. "Measurements on units to VDE or EN last about three days or more. The time needed depends on how many connectors the unit has, which standards can be received and how many 'weak points' are detected in this development stage." While sound measurements are fully automatic, the video part can only be automated to a limited extent. "In most measurements, reliable assessment of the picture can only be carried out by visual inspection even if all parameters have been set by the program or software."

Radiated immunity measurements are made with the assistance of Sony-Wega and the EMC test center. On the basis of their results and their own analysis, the equipment is successively improved during the development process. According to Harald Wendt, this is the EMC team's main task. "Before it comes to the acceptance and approval tests of the accredited test center, a lot of other things occur between development prototypes, prototype series and finally the series production. Changes have to be made at all stages; these have to be agreed with the production center just before series production begins. Typical examples are board modifications or reworking components on the back of the board. Prototype lab units, naturally, are not like the final product, and the effect of wiring or board design on EMC is considerable. We also check series equipment to get such effects under control."

The EMC team found they could work together very well with Rohde & Schwarz. „We were always on the same wavelength. When we decided to purchase a new measuring system, there were two likely candidates. The contract was awarded to Rohde & Schwarz, since they already had available a complete system, including the software, which meets all our requirements or has been specifically adapted to our design-oriented needs."

Christian Rockrohr

New RF screening production technology at Rohde & Schwarz

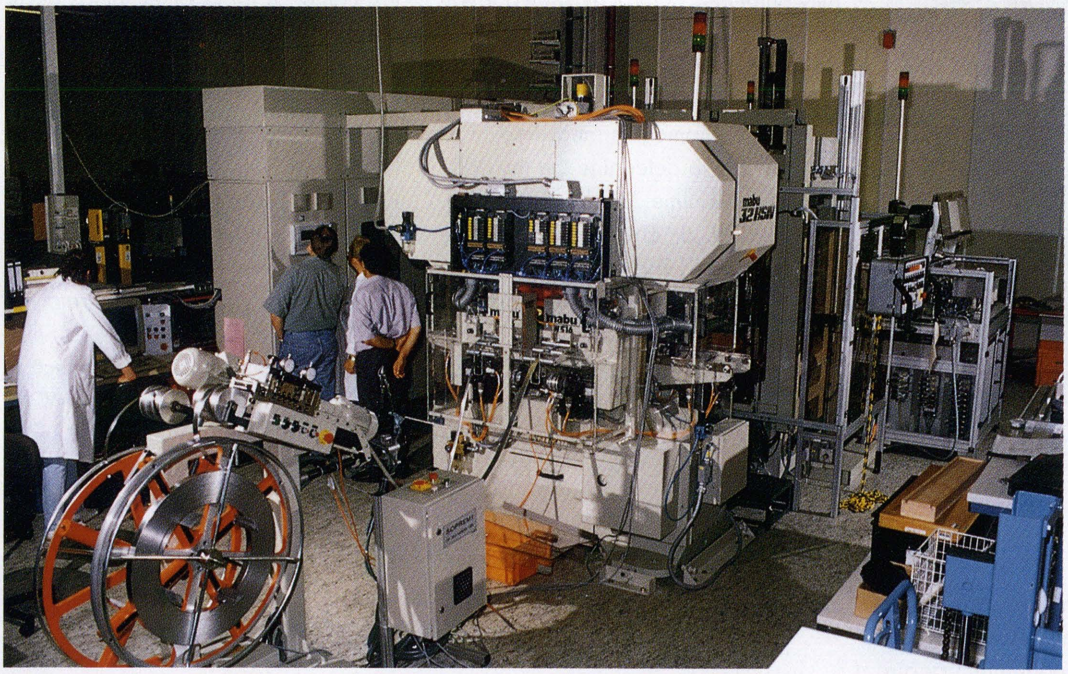


FIG 1 Flexible production cell for RF screening at Rohde & Schwarz Memmingen

With electronics increasingly entering daily life, the requirements for electromagnetic compatibility of electronic products are becoming more and more stringent. This is why Rohde & Schwarz set up a fully automated production system for EMC screening using its own design. The complex process of PCB manufacture at Rohde & Schwarz now encompasses every stage from CAE/CAD to the finished PCB including EMC screening.

The production cell (FIG 1) is a revolution in production engineering. Screening is only produced if and when it is required for a particular PCB. Thus, logistics effort is reduced to a large extent, previous production methods with transport and elaborate packaging, storage and supply are no longer required, defect rate tends to zero and the parts are at the right place at the right time. Even complete development prototypes are ready for volume production in a very short time.

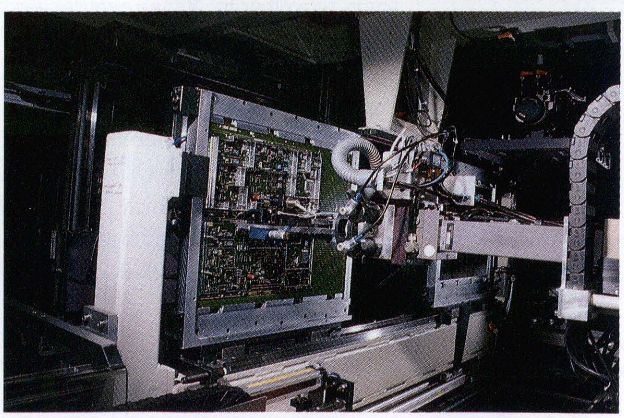


FIG 2 Automatic screen mounting on PCB
Photos : MB

A pair of screening walls is mounted every 20 s by the cell. The walls can be any length between 10 mm and 400 mm, any height between 4 mm and 18 mm and stamped to produce any shape (FIG 2). The threaded sleeves for fitting the covers (which are automatically produced elsewhere) are available in five standard heights; a maximum of 100 pairs of screening walls can be mounted per PCB.

It goes without saying that automatic monitoring and statistical analysis are part of the production process. All the facilities of the new production system are fully automated and no modifications are required. With this new system offering excellent stamping techniques and simultaneous mounting, Rohde & Schwarz has created a highly efficient symbiosis between preproduction and final production which ensures higher productivity, ie cuts the time to market and benefits the customer.

Walter Kesel

Radiocommunication Service Monitor CMS (0.4 to 1000 MHz) All CMS models are described in one data sheet; among them also CMS 54 (high-end tester) with full-span spectrum monitor from 10 to 1000 MHz, 80-dB display range, bandwidth from 150 Hz to 3 MHz and sensitivity of –110 dBm.

Data sheet PD 757.1031.21 Enter 146/20

Industrial Monitor PMC 4 (80 MHz; 75 Ω) with 15-inch flat-face CRT (274 x 205 mm; P22) for composite RGB and non-composite RGB, resolution 1024 x 768 pixels; horizontal synchronization 30 to 62 kHz (automatic), vertical synchronization 48 to 100 Hz (automatic).

Data sheet PD 757.1260.21 Enter 146/21

Digital Radiocommunication Tester CMD 52 (935.2 to 959.8 MHz GSM) and the new **CMD 55** (1805.2 to 1879.8 MHz in addition) for PCN networks are included in the revised issue of the data sheet.

Data sheet PD 757.0306.23 Enter 146/22

Digital Video Component Analyzer VCA (8 and 10 bits, 525/625 lines) combines the characteristics of a monitor (signal display at bit level by means of numeric dump) and an analyzer to standards CCIR 601/656 and SMPTE 125M/259M; remote control (option).

Data sheet PD 757.1202.21 Enter 146/23

Current Probe EZ-17 (5 Hz to 100 (200) MHz) New release: model 04 (5 Hz to 2 MHz) with balanced connector; load capacity up to 300 A (RF) and 1 A (EMS).

Data sheet PD 756.9539.22 Enter 146/24

EMI Test Receivers ES.I A new data sheet covers the high-grade EMI Test Receivers ESAI (20 Hz to 1.8 GHz), ESBI (20 Hz to 5 GHz) and ESMI (20 Hz to 26.5 GHz, with external mixer 110 GHz); they combine the advantages of R&S spectrum analyzers and meet the requirements of CISPR 16-1 (08.93) and VDE 0876.

Data sheet PD 757.1302.21 Enter 146/25

EMI measurement packages EP Volt, EP Field and EP Comp comprising R&S hardware and software are designed for automatic RFI voltage and field-strength measurements as well as for combined measurements to EC standards.

Info PD 757.1290.21 Enter 146/26

Polyskop ZWOB (100 kHz to 3 GHz with option, selectable up to 3.2 GHz) The data sheet reflects modifications in hardware and firmware (including improved modular design, double sweep speed, extended frequency range and programmable softkeys).

Data sheet PD 756.9716.22 Enter 146/11

VHF Low-power Transmitter Systems SR 216 K1, SR 126 K1 and SR 226 K1 (20/100/200 W) are made up of modules of the NU 200 system; they are weatherproof and designed for installation on masts, walls and roofs; special functions by integrating system plug-in RDS Codec DMC 01.

Data sheet PD 757.1283.21 Enter 146/27

VHF Solid-state TV Transmitters NM 135 to NM 535 (1/2/5/10/20 kW) are fully transistorized and the modular design allows accommodation in two racks only; great ease of operation and service friendliness; all common standards for colour systems and sound broadcasting; split vision and sound amplification, active and passive standby options.

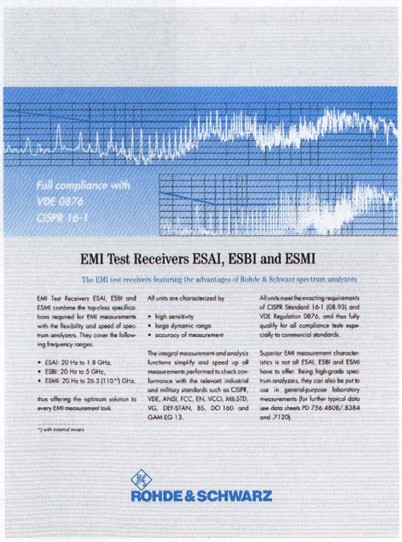
Data sheet PD 757.1277.21 Enter 146/01

VHF/UHF Low-power TV Transmitters NM... (band III) **and NH...** (bands IV/V) (models 115 to 515; 2/10/20/50/100/200 W) for local and regional coverage to all common standards for colour systems and sound broadcasting; they are of modular design and can be equipped for any kind of audio or video signal feed, (n+1) or passive standby systems; power supply even by solar energy.

Data sheet PD 757.1319.21 Enter 146/28

High-power TV Transmitters NH 242, NH 342 and NH 442 (20/30/40 kW; bands IV/V) using IOT technology and featuring excellent efficiency, high operational reliability, low power consumption; transmission to all standards (incl. PALplus); combined amplification; prepared for digital TV and HDTV.

Data sheet PD 757.1354.21 Enter 146/29


Full compliance with
VDE 0876
CISPR 16-1

EMI Test Receivers ESAI, ESBI and ESMI

The EMI test receivers featuring the advantages of Rohde & Schwarz spectrum analyzers

EMI Test Receivers ESAI, ESBI and ESMI combine the top-class specifications required for EMI measurements with the flexibility and speed of spectrum analyzers. They cover the following frequency ranges:

- ESAI: 20 Hz to 1.8 GHz,
- ESBI: 20 Hz to 5 GHz,
- ESMI: 20 Hz to 26.5 (110*) GHz,

thus offering the optimum solution to every EMI measurement task.

*) with external mixers

All units are characterized by

- high sensitivity
- large dynamic range
- accuracy of measurement

The integral measurement and analysis functions simplify and speed up all measurements performed to check conformance with the relevant industrial and military standards such as CISPR, VDE, ANSI, FCC, EN, VCCI, MIL-STD, VG, DEF-STAN, BS, DO 160 and GAM EG 13.

All units meet the exacting requirements of CISPR Standard 16-1 (08.93) and VDE Regulation 0876, and thus fully qualify for all compliance tests especially to commercial standards.

Superior EMI measurement characteristics is not all ESAI, ESBI and ESMI have to offer. Being high-grade spectrum analyzers, they can also be put to use in general-purpose laboratory measurements (for further typical data see data sheets PD 756.4808/.8384 and .7120).

ROHDE&SCHWARZ

150-W HF Dipole HX 002 A1 (1.5 to 30 MHz) offers reliable transmission links through automatic adaptive operation; integrated tuning unit, silent tuning, no control line required, 50 Ω, SWR typ. 1.3.

Data sheet PD 757.1160.21 Enter 146/30

Active VHF/UHF Receiving Antennas HE 202, HE 302, HE 309, HE 314 A1 and HE 402 (20 to 1300 MHz) suitable for monitoring and usable as test antennas (calibrated); small size and high sensitivity, large bandwidth and wide dynamic range; power supply IN 115.

Data sheet PD 757.0429.21 Enter 146/31

Digital VLF-HF Receivers EK 895 and EK 896 (10 kHz to 30 MHz) from the EK 890 family feature new functions such as preamplifier, noise blanker, squelch, notch filter, and passband tuning.

Data sheet PD 757.1225.21 Enter 146/32

Satphone SP 1600 (1530 to 1660.5 MHz) to Inmarsat-M standard is compact, handy and can be used worldwide; three models available; interfaces for language: IMBE, for fax: CCITT, for data: RS-232; transmit power 16 W, sensitivity –139 dBm, operation with AC supply or battery.

Data sheet PD 757.1083.21 Enter 146/33

Radiocommunications Coverage Measuring System This brochure promotes Rohde & Schwarz systems for universal and fast mobile coverage measurements in planning and operation of digital mobile-radio networks (using Test Receiver ESVD).

Info PD 757.1060.21 Enter 146/34

New application notes

VOR/ILS testing with Signal Generator SMT
1GPAN09E Enter 146/35

VOR receiver tests using Signal Generator SMT
1GPAN10E Enter 146/36

ILS receiver tests using Signal Generator SMT
1GPAN11E Enter 146/37

External sweep and adaptive measurement of DUTs with extreme transients using settling function of UPD
1GPAN12E Enter 146/38

Applications of Audio Analyzer UPD used with an audio switcher
1GPAN13E Enter 146/39

Simulation of the BCCH channel of a GSM/PCN base station with Signal Generator SME
1GPAN14E Enter 146/40

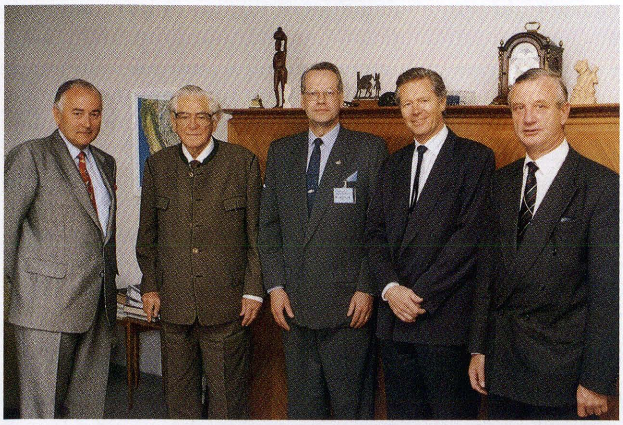
Protocol analysis on digital audio interfaces with Audio Analyzer UPD
1GPAN15E Enter 146/41

Loudspeaker measurements with Audio Analyzer UPD and UPD-K1, including associated program
1GPAN16E Enter 146/42

Analysis of broadband FM signals
1EPAN10E Enter 146/43

Remote control program to test GSM mobiles with CMD 52/55, including associated program
1CPAN01E Enter 146/44

Schz



Secretary general of ITU visits Rohde & Schwarz

The secretary general of the International Telecommunication Union, Dr Pekka Tarjanne, recently visited Rohde & Schwarz in Munich. After talking to the company executive, he toured the development laboratory for test receivers. He then met with the company's ITU liaison man, Karl-Otto Müller, and a number of departmental managers to discuss tasks and problems of frequency management and radiomonitoring, as well as new solutions devised for these purposes by Rohde & Schwarz. The photo above shows Dr Tarjanne in the center, with the company executive and engineer K.-O. Müller (right).

HW

Series 200 VHF radio systems go into action worldwide

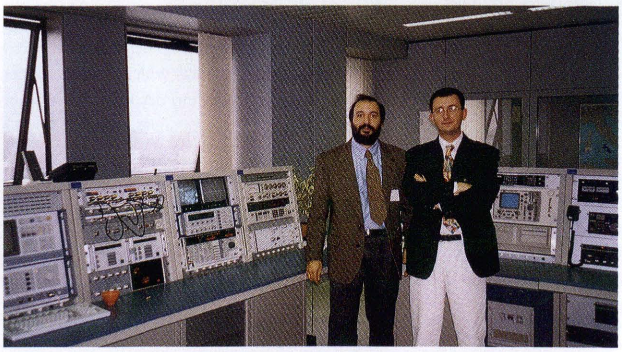
Large-scale air-traffic-control systems incorporating single-channel VHF radio sets from the 200 series are starting up worldwide. Rohde & Schwarz planned an entire system for the ATC organization in the Czech Republic, which was recently handed over. The receivers and 50-W transmitters work in the frequency band 118 through 144 MHz and are spread among various stations for nationwide coverage. The complete system is supervised by a newly devised remote-control and display system, based on MS-DOS 6.2 and Windows 3.1, which can be worked from PCs in the control center in Prague or locally on the job. A number of similar series 200 radiocommunication systems are ready for handover. These are destined for nationwide use in Slovakia and China.

F. Wagner

Radiomonitoring system for PTT Venezia

In March of this year, the PTT Venezia inaugurated a new control station for sound-broadcast and television signals in Mestre. The antennas of the station and the monitoring system – with Communications & Spectrum Analyzer FSAD plus Test Receivers ESVP, ESVN and EMFP for the frequency range 9 kHz through 1.8 GHz (photo) – was delivered, installed and commissioned by Rohde & Schwarz Italia. An XSRM Rubidium Frequency Standard serves as a reference to enhance measuring accuracy. Automatic monitoring is controlled by two high-performance computers. The stationary monitoring system works together with mobile units: a test vehicle for determining field strength and frequency-band occupancy, and a direction-finder and monitoring unit for locating illegal stations.

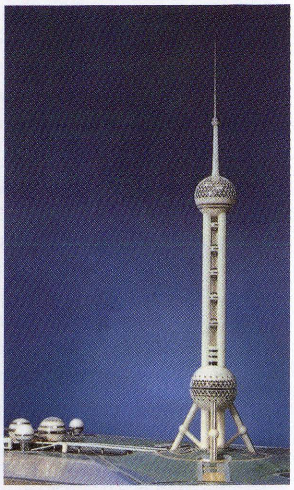
M. Riva

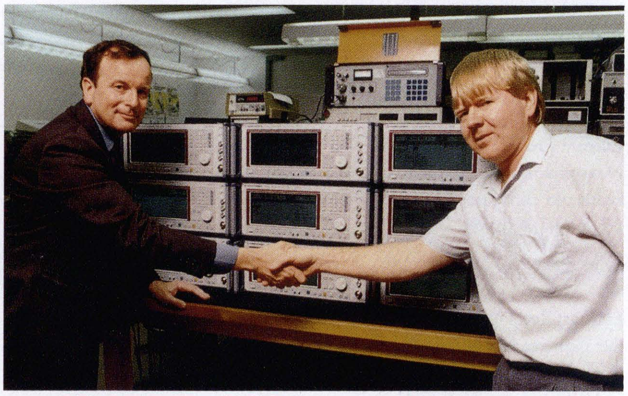


Rohde & Schwarz in Asia's highest tower

Shanghai's new radio & TV tower, soaring up 460 m into the sky, is the highest tower in Asia (photo). Rohde & Schwarz won an order to supply six 10-kW FM transmitters in an (n+1) configuration for it. The entire transmitter complex, including RDS, monitoring and computerized remote control, is being installed on the top platform of the tower, shaped like a globe, and clearly visible behind a glass wall so that visitors can watch the transmitters in action. The system is due to go on the air this year, broadcasting sound programs to the more than twelve million inhabitants of the city of Shanghai. At the same time many Chinese will then be able to pick up the latest RDS-paged information on small, portable receivers.

J. Beckmann





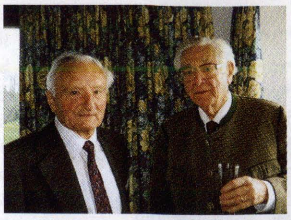
SMT Signal Generators for Australian airports

Australia's Civil Aviation Authority (CAA) placed an order with Rohde & Schwarz Australia for ten SMT Signal Generators. They will be stationed at each of the country's major airports and used for maintenance, alignment and checkout of the integrity of the beacon monitor that verifies the performance of localizer and glide-path transmitters of the instrument landing system. Use of SMT, with its calibrated ILS test signal, does away with any need to monitor the performance of the test signal with extra instruments. Due to its stability and reliability, SMT only has to be (re)calibrated at the earliest every three years. An optional feature, called for by the CAA, is an IEEE-488 PC-driven diagnostic and adjustment program, which allows automatic evaluation and logging of instrument status. Adjustment is thus possible, rapidly and easily, without the need for additional test equipment. Firmware updates for the instrument can be loaded simply via its RS-232-C interface. SMT also offers simulation of VOR (VHF omni range) signals for calibration of this flight-navigation aid.

The photo shows Graham Higgs, sales manager for measuring instruments at Rohde & Schwarz Australia (left), presenting the SMT Signal Generators to David Martin, manager of the CAA's Test Equipment Maintenance & Calibration Center (TEMACC) in Brisbane. TEMACC was commissioned by the CAA to evaluate suitable signal generators for the airport application.

PI/Aus

Albert Habermann's second departure from R&S



In June it was 60 years since Albert Habermann (left in the photo with Dr Schwarz) became the first employee of the, as it was then called, Physicotechnical Development Laboratory Dr Rohde & Dr Schwarz, not so much because of the salary – that was a fairly uncertain matter anyway – but because "his head was full of radio" (in the words of Prof. Baumgartner of the Munich TU) and it was a must for him to be able to work there. A lot has happened in the life of Albert Habermann since those days, ranging from authorship of the first manuals, through being – for decades – Dr Schwarz's right hand in all matters of production, instrument sales and materials management, and to becoming executive secretary and company director. The transition of Messgerätebau Memmingen from a war-time evacuation works into Rohde & Schwarz's modern production plant was largely due to him. And he played a major role in creating the Teisnach plant before handing everything over shipshape to his successor in 1976. That was his first departure. But in "zeitzeichen", the inhouse magazine for Rohde & Schwarz employees, he found a new task that he managed with great pleasure and very successfully for another 17 years. Now, at his own wish, this has come to an end too, and it only remains to hope that this second departure will mark the beginning of the real retirement that Albert Habermann, with all his remarkable vigour and mental alertness, has truly deserved. ro

TV broadcast and test engineering at Broadcast Asia 94

At the beginning of June, in the World Trade Center in Singapore, a big event was staged, composed of Communic Asia 94, Network Asia 94, Mobile Com Asia 94 and Broadcast Asia 94. Rohde & Schwarz attended Broadcast Asia, presenting TV broadcast and test technology on a 25 m² stand. Focal products on show were exciters for the new generation of TV transmitters and digital test instruments for video.

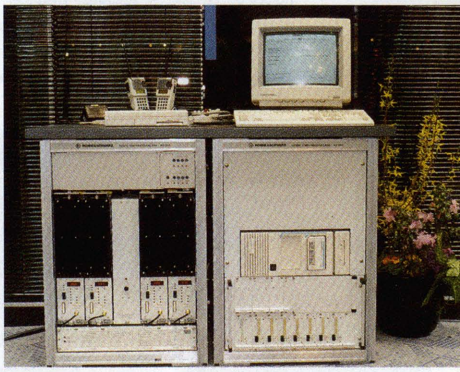
The stand – open on three sides and with transparent inner walls bearing all related details behind the exhibits – met with a very positive response. Attendance was comparable to that of the shows in Montreux, Amsterdam (IBC) or Las Vegas (NAB), even though Broadcast Asia does not yet quite share the same importance. The interest shown by customers reinforced us in our commitment to presenting broadcast and test engineering side by side to develop contacts with people working in both spheres and further propagate the name of Rohde & Schwarz in the Asian region as a supplier of broadcast and test systems. Customers will not have to wait until Broadcast 96 in Singapore to see Rohde & Schwarz again (and R&S test engineering at Communic 96 too). The company will be attending the TV show at the end of October this year in Beijing, where there will no doubt be more contact with customers from northern Asia.

T. Fokken

Trunked-radio systems successful all along the line

R&S BICK Mobilfunk has rapidly expanded its trunked-radio activities internationally in recent months. The latest successes of the Rohde & Schwarz affiliate are reported from Syria. Here a turnkey Accessnet® trunked-radio system is being set up for the fire-fighting service in the capital city Damascus that, besides the technology, radio sets, PC dispatchers, power generators and emergency power supplies, also involves supplying pagers to MPT 1327. Also going to Syria is another Accessnet with four radio cells to begin with, which will be used by civil defense and expanded shortterm all over the country. Entering the final phase of installation is a national trunked-radio system for the United Arab Emirates, which will cover the major cities with the 20 radio cells initially planned. This radio network is primarily for communication between civil defense, fire-fighting services and the coast guard; ambulance and other public services are to be integrated later. For this Accessnet Rohde & Schwarz is the turnkey supplier as well as being responsible for the entire planning of installation locations and radio coverage.

In addition to these and other successes in the Near and Middle East, Accessnet is also establishing itself in Europe. It has been working reliably for a number of years at Amsterdam's airport in Schiphol. Recently a network was completed for a transport utility in Stockholm, in which a multi-user dispatcher system (ONSys) is used with special alarm functions and control interfaces with peripheral local-transport facilities like bus-stop cameras, emergency calling points and a passenger information system. Combined with Accessnet, the ONSys computer and software package offers users in systems to MPT 1327 standard the new feature of dynamic group call. Last year already, an Accessnet with ONSys was installed for the British rapid-transit operator Tyne & Wear Metro in Newcastle. The latest order from a transport utility comes from Brussels, where a trunked-radio network will provide coverage of the entire terrain of the railroad station in the south of the capital. Accessnet is not only being chosen by industry and administrations. More than half of the engineering that has gone into public trunked-radio networks in Germany, for instance, came from Rohde & Schwarz. In addition to Telekom, the company's customers include ABF-Bündelfunk, the power utility Koblenzer Energieversorgung, Quickfunk, RegioKom (an affiliate of Lufthansa), Telesystem, Terrafon, Thüringer Mobilfunk, Regiofunk Saar/Pfalz and Überlandwerke in Lower Franconia. Alone the network of Thüringer Mobilfunk, with more than 40 base stations, covers the whole state of Thuringia and a large part of Saxony. And just the compact Accessnet Mini system (photo) suffices for trunked-radio coverage of a factory terrain or small town. K.-H. Wagner



Denmark renovates its FM broadcast network

The Danish PTT has long been a customer of Rohde & Schwarz. Solid-state FM transmitters for 1.5, 3 and 5 kW were supplied at the end of the 70s. These were followed in the mid-80s by a large number of UHF television transmitters for up to 40 kW. Now the FM broadcast network is to be modernized step by step. Responding to an international request for proposals, Rohde & Schwarz was once again able to win through in the face of the usual tough competition and was awarded a contract for renewal of a large part of the transmitter network. This will involve a large number of solid-state VHF FM transmitters for 3.7, 5 and 10 kW. Besides the excellent technical standard of Rohde & Schwarz's FM transmitters, the success must also go to the credit of the design team, which cooperated so well with the customer on the definition of transmitter control and PC-supported remote control. W. Kalthoff

All aboard

In "ElektronikPraxis" 11/94, published in Würzburg, Volker Janssen, product manager for reception and signal-analysis test engineering/ EMC, issued a warning that any investment halt in EMC was bound to put your business off track:

EMC investment is unavoidable. The earlier the right signals are given for EMC in product design, the smaller the overall design effort and manufacturing costs are. ...EMC is now a focal aspect of all electrical/electronic equipment that shapes our everday lives or has become an indispensable part of them, whether in industrial production, in medicine, telecommunications, automobiles, in the consumer sector or the many other areas. Manufacturers and suppliers of these products should guarantee EMC, on the one hand as a quality feature, and on the other for purposes of product liability. If you set about ensuring the EMC of your products in good time, you can keep your business on track.

On the cover of its 8/94 issue, the magazine for long-distance broadcast reception „Radio-Welt" showed VLF-HF Receiver EK 895, attesting in its report on the HAM-Radio 1994 show the unit's incredibly attractive price/performance.

"Production Partner", the magazine for professional studio and stage engineering, focussed on Audio Analyzer UPD from Rohde & Schwarz three times in its 4/94 edition. The cover showed an electronic montage of two UPD displays, the test-engineering column looked at practical use of the unit in a professional work environment, and editor-in-chief Dr Walter Wehrhan spoke out in favour of purchasing UPD in his editorial:

The unerring tests tell you a lot about the quality of the systems and units examined. The digital UPD from Rohde & Schwarz – acclaimed and uncontested in specialist circles – has been added to the equipment pool of "Production Partner" to optimize our test procedures.

Tools of the trade

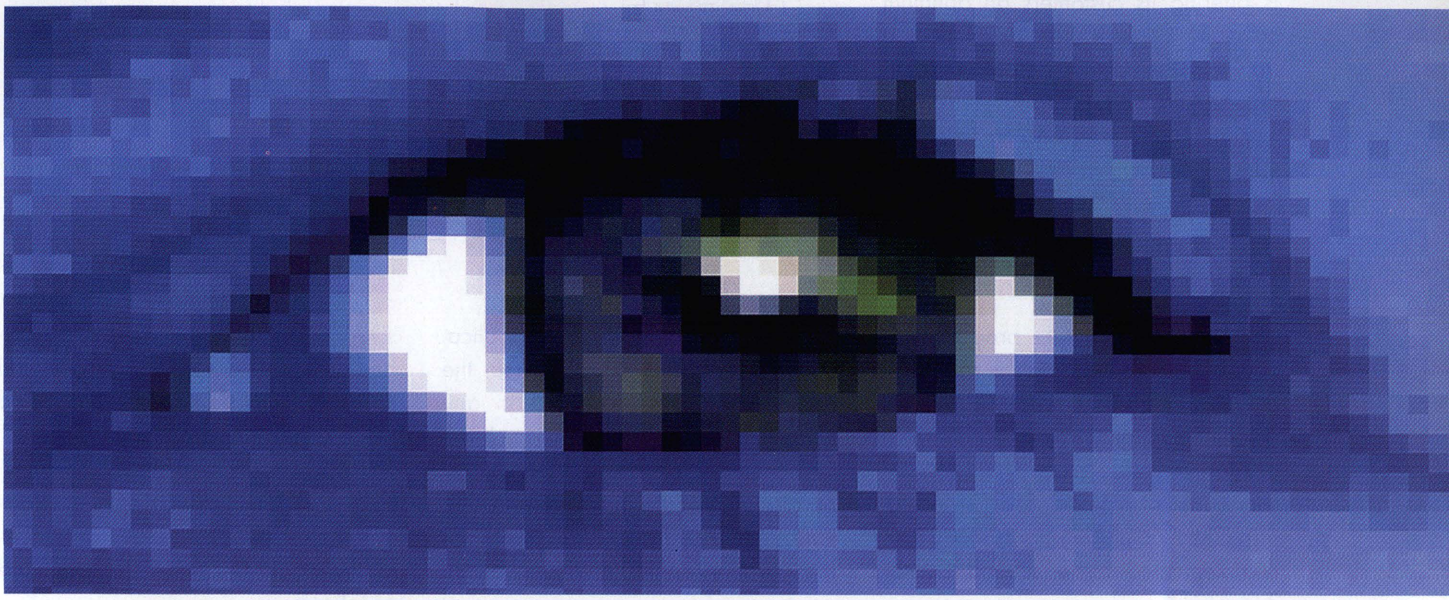
In the test & measurement column of its 13/94 issue, "der elektromeister + dt. elektrohandwerk", the organ of the central association of the electrical-engineering trade in Germany, presented instruments and test sets for everyday practice:

... for installing and checking mobile phones, Rohde & Schwarz offers an installation tester called CIT that is notable for simple handling, high flexibility and good price/performance. If any complaints are received, you can find out, with virtually no effort round and about, whether the phone or hands-free device is defective, whether the antenna is damaged, or the power supply is not working properly. For tests on GSM mobile phones the same producer has a compact set named CMD 52. This incorporates all the signalling, generator and test functions used for type approval. That gives you indepth analysis of the unit being examined. Or you can carry out a rapid go/nogo test.

How to measure power in the RF and microwave region the right way was the subject of an article by Thomas Reichel, designer of voltmeters, power meters and frequency standards at Rohde & Schwarz, which appeared in issue 5/94 of the British magazine "New Electronics", accompanied by illustrative examples from Rohde & Schwarz's wide selection of power meters, like NAS in the photo below.

The star in the title spread of edition 8/94 of the Argentinian electronics magazine "Mercado Electronico" was EMI Test Receiver ESS. A specialist for EMI tests to civil standards CISPR, CENELEC, ETSI, FCC, VCCI and VDE as well as military standards like MIL, VG, and DEF STAN, it produces fast results of utmost accuracy.

Digital terrestrial television – tomorrow's vision comes true



Tomorrow's television will be digital. This statement, still questioned a year ago, has meanwhile gained such significance that all doubts have disappeared. In Europe, the DVB project (Digital Video Broadcasting), in particular, has substantially contributed to the shift in opinion. This project, which involves the cooperation of about 140 organizations, institutions and companies, has gathered momentum that will lead to very fast development of digital television.

Situation in Europe

Based on the methods laid down in the MPEG2 standard for video coding, audio coding and multiplexing, the European DVB project has defined methods for transmission via satellite and cable within a short period of time. The system for terrestrial transmission will also be largely defined by the end of 1994. A major part of the preliminary work concerning the terrestrial transmission of digital TV signals has been handled in various research projects, promoted or funded either by European or national authorities. There are three projects that have emerged as the most important ones in Europe in the last few years: dTTb, HD-DIVINE and HDTV-T. Transmission methods have been developed and undergone thorough **simulation tests.** As far as simulation is concerned, the terrestrial transmission channel is more complex than the transmission channels for the media satellite and cable. And of course, the expenditure involved for simulation is correspondingly higher to ensure that useful results are obtained.

The knowledge, experience and results gained from the various research projects will surely be reflected in the specification for a **baseline system.** But, since the frequencies are limited in number, this system will have to solve the problem of useable channels. Indeed, digital television has no frequency band of its own. The density of occupancy in TV bands IV and V (470 to 862 MHz) varies from country to country. Channels that could not be used until now for analog TV broadcasting may be the first ones in which digital terrestrial television will first be tested. Thus the transmission method must be specified to avoid interference between digital and analog services.

However, such investigations can only be carried out in the form of **field trials** since the configurations of parameters are extremely complex and simulation analyses are limited in their performance. This is the key to the planning of new services. At this juncture, the degree of network coverage will be assessed. And ultimately, field trials will make it possible to determine by a selection of specific parameters whether undisturbed reception is possible under certain topographic conditions. But what is also evident is that analog television will continue to exist in its well-known form at least for 20 years after the introduction of digital terrestrial television. For this reason, investment in transmitters for field trials is a critical matter. One of the questions which is often asked from the point of view of economy is on the possible use of transmitters after completion of the field trials.

In this connection, Rohde & Schwarz is offering its customers an optimum solution, since it has developed a transmitter which can be used for both cases. And on top of that, it can be switched over from analog to digital television.

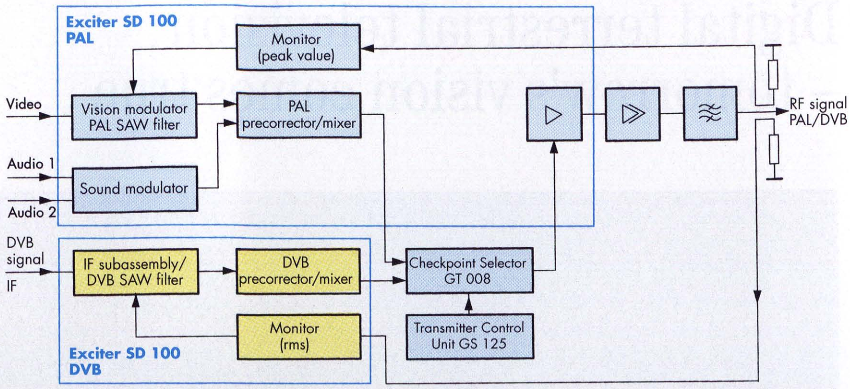


FIG 2 Block diagram of PAL/DVB transmitter

1-kW TV transmitter for PAL and DVB

The Rohde & Schwarz broadcasting system for DVB field trials is based on a 1-kW TV transmitter for PAL signals and is also highly suited for the transmission of DVB signals. The 1-kW TV transmitter of type NT 315 [1] including Checkpoint Selector GT 008 is complemented by a second Exciter SD 100 [2] modified for DVB applications (FIGs 1 and 2). Of course, the transmitter can be adjusted to any channel in bands IV and V, since it will be necessary for the field trials to be performed on different channels in the various European countries. Depending on geographic conditions, extensive investigations will have to be carried out to find out reliably how digital terrestrial television can be integrated in the existing environment.

Here are some technical specifications on the transmitter. The interfaces for the modes PAL and DVB were fixed as follows:
PAL transmitter video and audio input, RF channel output for bands IV and V, bandwidth 8 MHz,
DVB transmitter IF signal input (in normal and inverted position), IF center frequency eg 34.7 or 36 MHz, RF channel output for bands IV and V, bandwidth 8 MHz.

The second **exciter** modified for **DVB mode** comprises a frame with a display unit, power supply, processor, synthesizer and a filter. These five modules are of the same design as those of the PAL transmitter; in addition, there is the DVB IF module, the DVB mixer and the DVB monitor. Checkpoint Selector GT 008 is used for switching over from PAL to DVB mode. It is driven via Transmitter Control Unit GS 125 or the IEC/IEEE bus. The transmitter output filter is equally suitable for both modes – PAL and DVB – without any modification.

The **shoulder distance** for the 1-kW PAL transmitter is typically **46 dB at 400 W DVB power** (thermal power). When the requirement for a shoulder distance of 40 dB is met, the transmitter can typically produce 520-W DVB

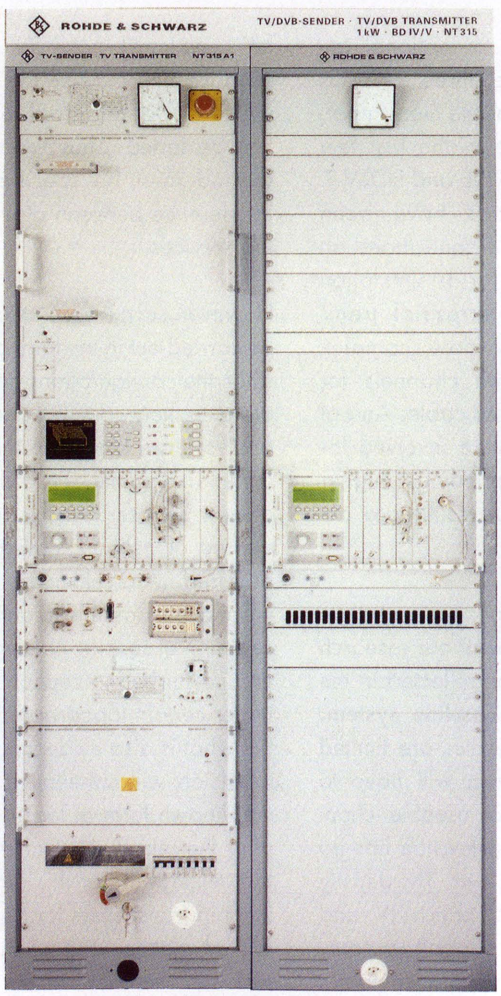


FIG 1 TV Transmitter NT 315 for DVB signals, switchable to PAL signals
Photo 41 715

power. For the measurements, Signal Generator SMHU 58 and Dual Arbitrary Waveform Generator ADS were used to produce a signal with 1024 carriers [3], each of them 64QAM-modulated (FIG 3).

The **settings of the IF precorrection** are **stored** as data and can be called and modified via the processor whenever required. Four complete settings can be saved so that the optimum precorrection state for the four output-power values can be stored in and called from the DVB exciter.

It is useful in field trials to be able to switch between optimally precorrected output-power values (eg 0/–3/ –6/–10 dB) in a reproducible way. This **output power switchover** can also be **remotely controlled** by means of a modem, for example from a test vehicle via a mobile telephone.

Since Checkpoint Selector GT 008 can also be remotely controlled via a modem, **remote switchover between PAL and DVB mode** is possible.

In the two modes, the transmitter consumes approximately the same AC power. With the PAL transmitter, the average RF power emitted is calculated by adding the RF power for the video component (approx. 320 W at APL 50) and the RF power for the two sound carriers (50 W + 10 W with a 1-kW transmitter and dual-sound operation). It is somewhat lower than the RF power output by the DVB transmitter. It therefore follows that the **efficiency** of the transmitter system is somewhat **higher** in the **DVB mode** than in the PAL mode.

Bearing in mind the described features, the transmitter system is an **ideal solution for DVB field trials.** It is possible to switch over the output power from the test vehicle and select between PAL and DVB mode. Thus, a direct comparison between PAL and DVB mode is possible with coverage measurements, and this under the

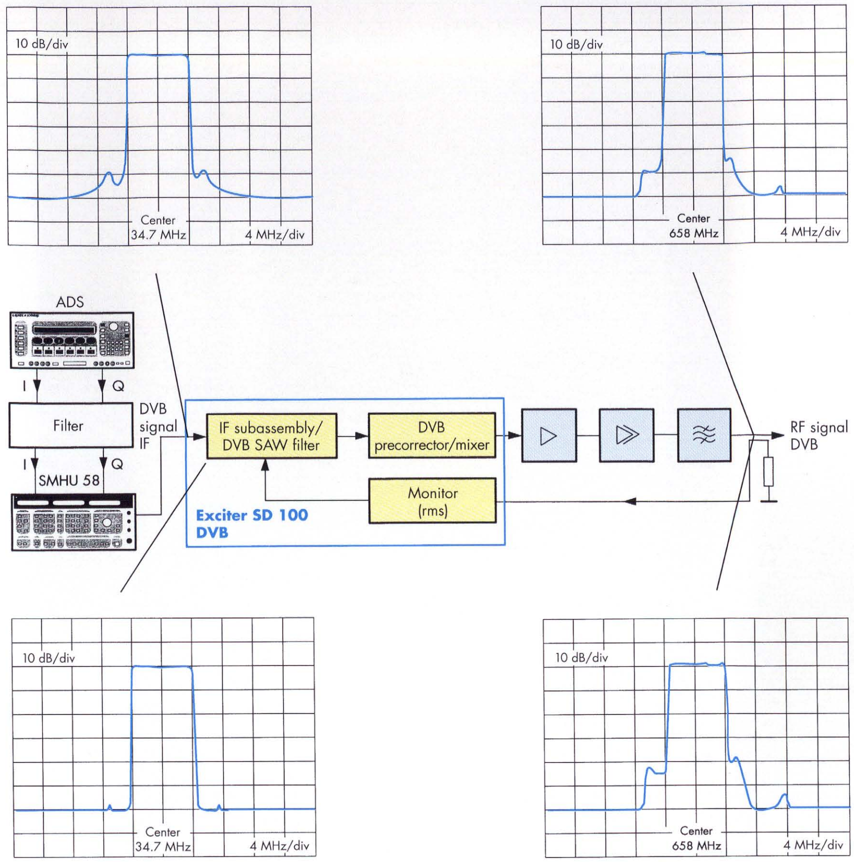


FIG 3 Test setup for field trials in DVB and/or PAL mode with 1-kW TV transmitter plus test results

same propagation conditions since switchover is very fast. Variations in the transmission channel due to weather changes, for example, have no influence. Another plus is that the transmitting station can be unattended during field trials. A system offering such flexibility in use enables field trials to be performed at a relatively early stage. It should also be noted that a great variety of signals can be applied to the IF input of the DVB transmitter. All the parameters that will be defined by a baseline system will have no influence on the channel bandwidth of 8 MHz in the UHF range. The Rohde & Schwarz transmitter system will be able to process the signal whatever its final form. With this system, information on propagation behaviour, field-strength values in the coverage area and similar important parameters can be gathered in time and any new specified system can undergo fast and comprehensive verification. And this is exactly what is required for the prompt and smooth introduction of digital terrestrial television.

Dr Jürgen Lauterjung

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Reader service card 146/45 for further information on NT 315

News from Rohde & Schwarz 146 · PD 757.0606.21

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