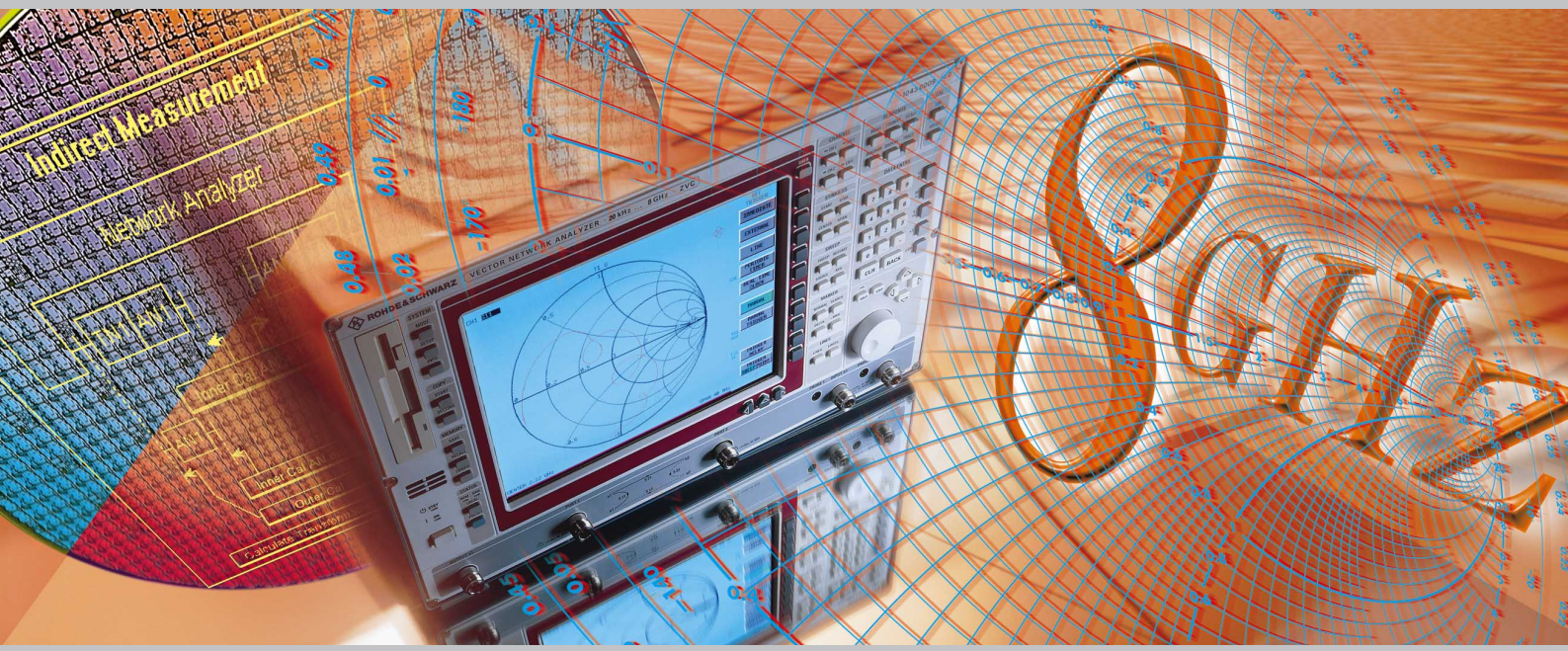
News from Rohde & Schwarz



Network analysis
now up to 8 GHz

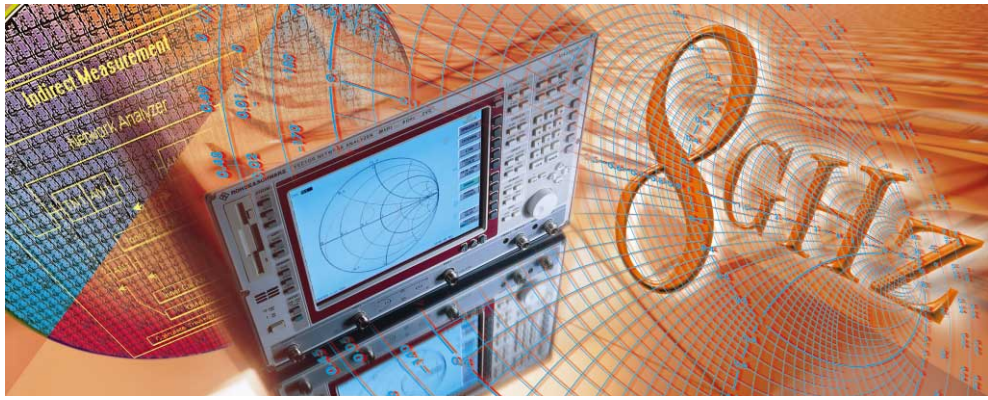
Digital audio broadcasting
– new transmitters for band III and L band

Digital scanning direction finders
detect broadband and short-term signals

1998 / II
158

ROHDE&SCHWARZ

Number 158 1998/II Volume 38



"Double frequency and benefit" is the slogan for the ZVR family of network analyzers. The two new members ZVCE and ZVC extend the frequency range from 4 GHz to 8 GHz, opening up a wide range of new applications (see article on page 4). Photo 42 126

Articles

Application notes

Software

Refresher topic

Panorama

Regular features

GSM + DECT – Digital Radio Tester CTS65 can handle both standards, which makes it a very economical tester for servicing, marketing and producing mobile and cordless phones (page 7). Photo 43 115/1

Imprint

Published by ROHDE & SCHWARZ GmbH & Co. KG Mühldorfstraße 15 D-81671 Munich Telephone (0 89) 41 29-0 · international (+49 89) 41 29-0 · Editors: H. Wegener and G. Sönnichsen (German) · English translation: Dept. 5CL4 · Photos: S. Huber · Artwork: N. Hofmann · Circulation 100 000 four times a year · ISSN 0028-9108 · Supply free of charge · State company or position · Printed in the Federal Republic of Germany by peschke druck, Munich · Reproduction of extracts permitted if source is stated and copy sent to R & S Munich

Vector Network Analyzers ZVC

Double frequency and benefit

The ZVR family of network analyzers is growing fast. The two new members ZVCE and ZVC extend the frequency range of the analyzers from 4 GHz to 8 GHz, opening up a wide new range of applications.

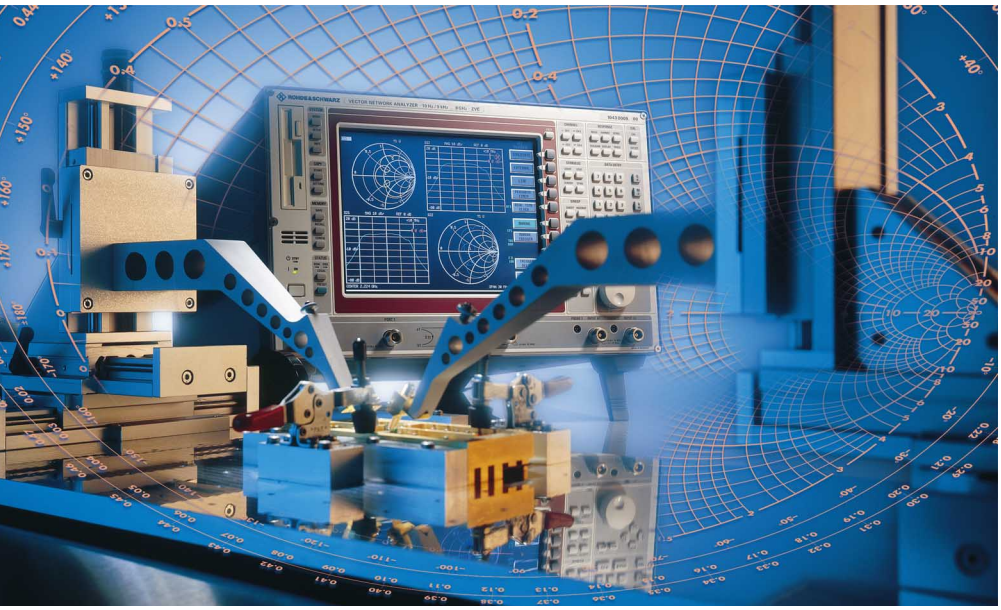


FIG 1 New addition to ZVR family: Vector Network Analyzer ZVC for frequencies up to 8 GHz
Photo 43 177

To date the ZVR family consisted of three members: unidirectional Network Analyzer ZVRL and bidirectional Analyzers ZVRE and ZVR [1]. These instruments allow complex transmission and reflection measurements (magnitude and phase) on two-port DUTs from 10 Hz, 9 kHz or 300 kHz, depending on the analyzer's configuration level. The upper frequency limit of these analyzers is 4 GHz. Now the two new models ZVCE and ZVC (FIG 1) extend this upper frequency limit by a factor of two, making it possible to measure satellite components in the frequency range up to 8 GHz for example. The lower frequency limit of the new analyzers is 20 kHz (FIG 2). Three-channel Network Analyzer ZVCE uses 12-term TOSM calibration for bidirectional two-port measurements, while Analyzer ZVC with four receive channels also allows use of modern 7-term calibration techniques such as TOM, TNA and TOM-X and thus offers solutions to really complicated measurement problems in development and production.

All five members of the ZVR family offer **excellent measurement accuracy, wide dynamic range and high measurement speed** in addition to their large frequency range. The instruments set up on an IBM PC-compatible computer kernel with the usual interfaces and peripherals. Results can be computed and converted by a variety of functions and displayed on the large colour monitor. They can then be handled on the network analyzer using conventional word processing and spreadsheet programs to create informative documents together with comments.

The versatility of the ZVR family of network analyzers is demonstrated by a list of **typical applications** ranging from antennas through to Z-parameter measurements (blue BOX).

All models of the ZVR family excel in a variety of **special features** relating to test procedures, data evaluation functions and display modes. For example, **implicit verification** is performed during calibration (TOM) of bidirectional four-channel Network Analyzers ZVR and ZVC by checking the consistency

Typical application	Special feature of ZVR family
Antennas for GSM and GPS	Fast data transfer by DDE
Antenna sockets	Optional four-port adapter [2] without further accessories
Audio systems	Lower frequency limit 10 Hz
Automotive engineering	Measurements on frequency-converting immobilizers
Cables	Logarithmic displays, phase unwrap function
CATV amplifiers	Multiport measurements
CATV transposers	Frequency-converting measurements with wide dynamic range
Circulators	Three-port adapter with electronic switch
Documentation	Data transfer to Word, Excel and CAE programs
GSM, base station filters	Segmented sweep without speed reduction
GSM/DECT, SMD amplifiers	Patented calibration methods for SMD adapters
GSM, ceramic filters	Fast sweep times for realtime adjustment
GSM, SAW filters	Virtual transformation for complex impedances
Multiports such as couplers, switches and filter banks	Four-port adapters with electronic switches, up to four separate, individually calibrated signal paths
On-wafer measurements	TOM-X calibration to eliminate crosstalk [3]
Pagers	Measurements with extremely low input levels
Quartz production	Fast detection of phase zero crossings
Satellite communication	Extremely wide linear range
Z-parameter measurements	Complex conversion of Z-parameters

of the calibration results with the characteristic data of the calibration standards. In this way the analyzer is even capable of distinguishing an open-circuit test port from a port correctly terminated with a standard open. Any calibration errors are automatically detected immediately after calibration. The user is warned and can correct to avoid measurement errors.

In **multiport applications** too, the user is supported by highly convenient calibration routines. Such applications normally require two-port calibration of many different signal paths. Here there are big time-savings because in modern 7-term methods only six (TOM) or four (TNA) connections have to be made in contrast to the classic TOSM 12-term method requiring four different calibration standards and eight connections.

A particular advantage in the evaluation of results is that conversion and formatting for the **test trace and marker values can be selected completely independently of each other.** For example, return loss may be selected for the test trace, and the corresponding phase or complex impedance of the DUT for markers. Using all four display channels, which can be decoupled from each other, up to eight measured quantities can then be displayed simultaneously. Backed up by this compact display, the user can see at a glance any interactive effects in complex alignments.

The network analyzers offer further interesting features in phase and delay measurements. These include the phase unwrap function, which allows **phase measurements beyond 180°.** This enables phase response analysis on DUTs like cables or multisection filters without the disturbing effect of phase discontinuities. The analyzers offer two functions for **group delay measurement.** First there is the conventional **step aperture,** where the aperture is set as an integer multiple of the spacing between the frequency points. The

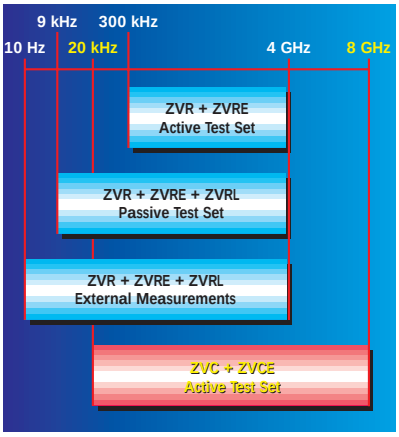


FIG 2 Frequency ranges of ZVR family

second function is **frequency aperture,** where a user-defined frequency value can be entered independent of the frequency grid. This guarantees a clearly defined aperture that is independent of the frequency spacing and exactly maintained, even with logarithmic sweeps. For group delay measurements too, the analyzers of the ZVR family thus provide a high degree of protection against operating errors and at the same time very convenient display of results.

The **phase delay** function offers additional measurement capabilities. It determines total phase deviation across the selected frequency range. It may be up to several thousand degrees depending on the DUT's electrical length. **Relative measurement inaccuracy is less than 0.1‰** thanks to the analyzers' high phase accuracy of typically 0.1°. This method is particularly suitable for highly precise measurement of electrical length on low-dispersion DUTs like cables. Alternatively the analyzer can indicate the phase delay or the electrical or **mechanical length** of the DUT.

Arbitrary zoom in Cartesian charts and especially **in Smith charts** makes it possible to expand not only the center of the chart but for instance also the short-circuit and open-circuit points. So the complex impedance of resonators or transistors can be displayed with high resolution for any part of the Smith chart. Scaling, especially in Cartesian charts, is elegantly solved with the **minimum and maximum scaling** functions. The intelligent graticule always yields even divisions, which greatly simplifies chart evaluation.

The high measurement accuracy and outstanding performance especially of the bidirectional four-channel Analyzers ZVR and ZVC, even with "awkward" DUTs, is based on **special calibration methods, patented by Rohde & Schwarz,** such as **TRM, TNA and TOM-X** [1; 3] and the **AutoKal** automatic calibration function. AutoKal offers the advantage that the associated adapter need not be connected and disconnected for each calibration but can remain permanently connected to the analyzer test ports (direct or via cable). Automatic calibration is completed in about 20 s.

The high versatility of the analyzers of the ZVR family is further enhanced by a variety of **options and accessories.** Measurements on three-ports or four-ports, eg diplexers, circulators, switches, directional couplers or filter banks, can be carried out fast and conveniently by means of the **three-port adapter,** the two **four-port adapters** and the **extra inputs four-port option** [2]. Switch-over between up to four ports of a DUT is effected fast and reproducibly by means of electronic switches. The analyzer always operates at full speed, offering up to four separate, simultaneous calibrations for the different signal paths. No loading or switching times need to be taken into account for the calibrations.

In conjunction with the **virtual embedding networks option,** special calibration methods [3] such as TNA and TOM-X allow the effect of parasitics to be reduced, which occur with test adapters, test beds or test probes. This enables production-oriented optimization of test equipment exclusively in terms of mechanical aspects, repro-

ducibility, service life and reliability. Electrical quality may be neglected as it is determined rapidly and accurately during calibration and then optimized, ie computed, with high precision. Moreover, the calibration standards employed in TNA are easy to generate and to use since requirements made on their electrical data are low.

Another strong point of the ZVR family is **measurements on frequency-converting DUTs,** which cover a wide range of important applications. Noteworthy in this context is fast measurement of the image rejection of single-sideband mixers [4]. DUTs such as **tuners or front-ends,** which perform multiple frequency conversion of the input signal, can be measured direct

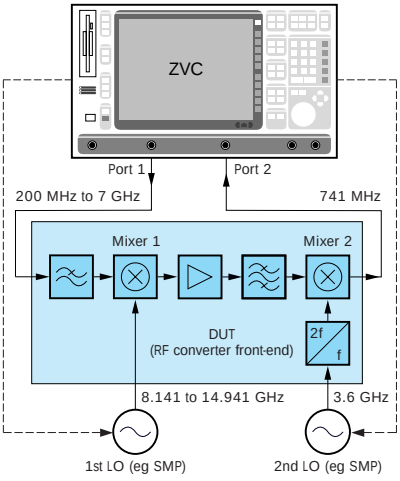


FIG 3 Test setup for double frequency-converting DUT (receiver front-end)

and conveniently with the arbitrary function of this option. FIG 3 shows the test setup for a double frequency-converting receiver front-end. Network Analyzers ZVR in conjunction with advanced Rohde & Schwarz signal sources, eg Microwave Signal Generator SMP, offer **fast remote control** capability (IEC/IEEE+TTL) using special TTL signals exchanged via rear-panel connectors of the two instruments. This allows the conversion losses of a double frequency-converting DUT to be measured and displayed (FIG 4) in quasi-realtime. It is also possible to make **group delay measurements on frequency-converting DUTs,** eg mixers or tuners, if an external reference mixer is connected to the two optional rear-panel connectors. **Nonlinear measurements** too, like determining the **compression point** of active DUTs, can be carried out simply and virtually in realtime [5].

Application notes are available on the topics of data transfer, group and phase delay measurements, measurement inaccuracy, AutoKal, multiport and frequency-converting measurements and are obtainable from all Rohde & Schwarz sales offices.

Dr Olaf Ostwald; Christian Evers

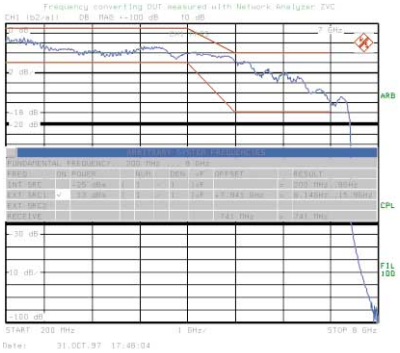


FIG 4 Measured conversion loss of double frequency-converting receiver front-end (superimposed: definition table for this mode)

REFERENCES

[1] Ostwald, O.; Evers, C.: Vector Network Analyzer Family ZVR – To the heart of the chart. News from Rohde & Schwarz (1996) No. 150, pp 6–9

[2] Ostwald, O.: Fast S-parameter measurements on four-port devices. News from Rohde & Schwarz (1997) No. 155, p 16

[3] Ostwald, O.; Bednorz, T.: Troika – die ZVR-Familie: Vektorielle Netzwerkanalyse schnell, präzise und komfortabel. Elektronik Praxis 31 (1996) No. 3, pp 116–119

[4] Simon, J.: Measuring image rejection of single-sideband mixers. News from Rohde & Schwarz (1998) No. 157, p 18

[5] Ostwald, O.: New option for fast compression-point measurements with Vector Network Analyzer ZVR. News from Rohde & Schwarz (1997) No. 154, p 33

Condensed data of Vector Network Analyzers ZVC

Frequency range	20 kHz to 8 GHz
Measurement time	125 µs/point
Dynamic range	>120 dB
Measurement bandwidths	1 Hz to 10 kHz (half-decade steps) and 26 kHz (full)
Amplitude uncertainty	<0.2 dB, typ. <0.025 dB
Phase uncertainty	<1°, typ. <0.2°
Calibration	TOM, TRM, TRL, TNA, TOSM, TOM-X, AutoKal
Display	26 cm colour LCD
Number of pixels	640 x 480 (SVGA)
Remote control	IEC 625-2 (SCPI 1994.0) or RS-232-C

Reader service card 158/01

Digital Radio Testers CTS65 and CTS60

All-rounders in servicing GSM and DECT mobile phones

In Digital Radio Tester CTS65, Rohde & Schwarz now offers a compact, favourably priced multimode service tester for GSM mobile phones and for cordless phones to DECT standard. CTS60 is available for pure DECT applications.

The successful concept of Digital Radiocommunication Testers CMD [1; 2] continues in the CTS family of service testers, which has now been completed. Multimode Tester CTS65 (FIG 1) offers the user a wide range of functions in a single unit for the following networks: GSM900 (Europe), GSM1800 (PCN, Europe), GSM1900 (PCS, USA), DECT Europe and DECT Latin America. This adds extra versatility to the proven applications of CTS, which are at POS (point of sale), in servicing and the production of mobile phones.

The great ease of operation of CTS60/65 via six softkeys on the colour monitor has proven itself in CTS55 [3]. The main menu offers selection of network standards GSM900, GSM1800, GSM1900 and DECT. With DECT it is possible to choose PP (portable part) or FP (fixed part) tests. An external keyboard can be connected, if required, as with CTS55. Apart from the TFT colour display, an external monitor can alternatively be connected via the VGA interface. Intelligent menu guidance largely excludes incorrect entries.

Testing DECT telephones

DECT (digital enhanced cordless telecommunications) is now the established standard for digital voice transmission by cordless telephone also outside of Europe. The sharp decline in prices and the qualitative edge are driving analog systems out of the market. In addition to the cordless phones application, DECT offers the possibility of covering congested areas such as airports and railroad stations, thus getting round bottlenecks in GSM networks. Field trials are currently being conducted to investigate alternative linkup of private households to the telephone network by means of DECT (wireless local loop, last mile). Ten frequency channels in the 1900 MHz band are reserved for DECT, each channel allowing twelve simultaneous calls in TDMA (time division multiple access) operation. This means that 120 simultaneous calls are possible in a cell. DECT also uses TDD (time division duplex), in which calls are transmitted at a single frequency in both directions but offset in time. DECT cells organize themselves, ie transmission channels are selected so that there is no interference with any neighbouring cordless telephone systems.

Digital Radio Tester CTS60/65 measures DECT portable parts and DECT fixed parts. The DUT is switched to the test or loopback mode, causing the data received to be returned to CTS60/65 on the transmit channel. This mode is required for measuring BER, modulation parameters and frequency accuracy.

FIG 1
Multimode Service Tester CTS65 for GSM and DECT systems
Photo 43 115/3

The following parameters are determined in **DECT measurements:**

The **normal transmit power** is the average power during transmit time. With DECT it is max. 250 mW, which corresponds to 24 dBm.

The **power ramp** verifies compliance with specified timing parameters and power ranges during transmission. The graphic display shows any abnormal conditions at a glance.

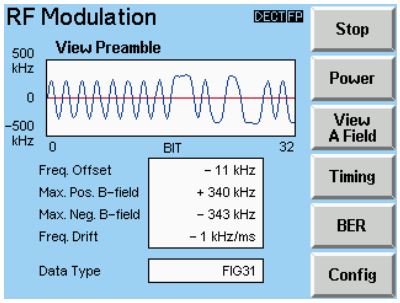


FIG 2 RF modulation menu

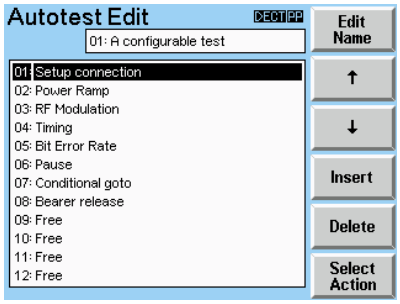


FIG 3 Free configuration of auto test

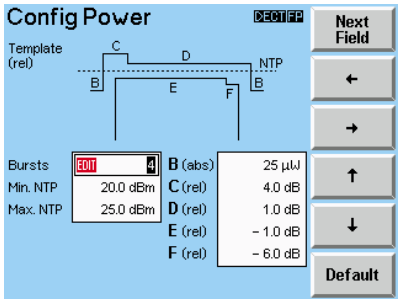


FIG 4 Configuration of single test step

GSM		DECT	
CTS-B1	OCXO reference oscillator for enhanced accuracy of all frequency-related parameters	CTS-B1	OCXO reference oscillator for enhanced accuracy of all frequency-related parameters
CTS-K7	GSM module test		
CTS-K6	Remote control via RS-232-C with GSM application software for Windows	CTS-K6	Remote control via RS-232-C
CTS-U56	Upgrade of CTS55 to Multimode Tester CTS65	CTS-U65	Upgrade of CTS60 to Multimode Tester CTS65

Options for Digital Radio Testers CTS55/60/65

Frequency deviation during transmission is another graphic display allowing fast diagnosis of frequency synthesis and modulation characteristics (FIG 2).

The **frequency offset** indicates inaccuracy of the center frequency.

Frequency drift is a measure of center frequency change during transmission.

Display of maximum positive and negative **modulation deviation** verifies compliance with specified modulation deviation and enables adjustment of deviation.

The **timing accuracy** gives the percentage deviation of the time frame from the specified figure of 10 ms.

Jitter is a measure of the irregularity of the time frame.

The **packet accuracy** measurement reveals if transmission of a PP starts exactly half a frame period after the FP.

The **bit error rate** (BER) is the ratio of errored bits received to all bits received. Unlike the foregoing, this is a receiver measurement.

The **frame error rate** (FER) is another parameter indicating receiver quality. It covers completely lost frames and frames with at least 25% BER.

The **echo test** allows a rapid check of DUT loudspeaker and microphone functionality. Voice signals sent by the PP to CTS60/65 are returned by the tester with a delay.

For each measurement, **tolerances** prescribed by ETSI are preset, but can be changed by the user as required. Out-of-tolerance values are highlighted by the coloured display of results. Coloured display increases information quality especially in the graphical measurement menus for the power ramp and RF modulation and makes CTS60/65 a valuable instrument for efficient troubleshooting.

Another feature enhancing the practicality of CTS60/65 in servicing is the configurable **auto test** familiar from CMD60/65. This allows user-defined combination of test steps such as call setup, power ramp, modulation, timing and BER measurements and call release (FIG 3). Measurement parameters and tolerances are freely configurable for each of these test steps (FIG 4). The auto test further provides interactive commands and conditional plus unconditional loops. Despite this outstanding performance, operation is extremely easy, making it as a rule unnecessary to consult the manual. Test report printouts provide information on all settings, measured values and out-of-tolerance conditions.

Digital Radio Tester CTS65 incorporates the modules of CTS55 and in addition a DECT module similar to the one in CMD60. The DECT module not only contains all the required RF hardware

(transmitter, signalling receiver and test receiver) but also the signalling and measurement unit including the software. The blue BOX lists the available options allowing application-oriented, cost-effective configuration of the digital radio testers. CTS55 is easily upgraded to CTS65 of course.

New test facilities in GSM mode

As with all mobile radio testers from Rohde & Schwarz, the GSM members of the CTS family are continuously expanded to cover new applications [4]. For example, new menus are provided for the selection of different display modes in **remote control;** either the window with the current device status or the remote-control commands together with device and error status can be displayed. Baud rate, start, stop and parity bits can be user-configured for the **RS-232-C interface.**

Fast power measurement (approx. ten measurements per second) and the narrowband spectrum monitor make CTS an ideal instrument for adjusting the transmitter power and modulation of GSM mobile phones.

An interesting feature is the **GSM application software** included in the optional remote control via RS-232-C. The software contains a configurable automatic test sequence that runs on an external PC under Windows 3.1, Windows 95 and Windows NT. Parameters such as network used, type and extent of measurements as well as tolerances can be selected by simple mouse clicks (FIGs 5 to 7). The straightforward measurement report allows further evaluation and archiving of test data. Results can be exported to other programs via data filters.

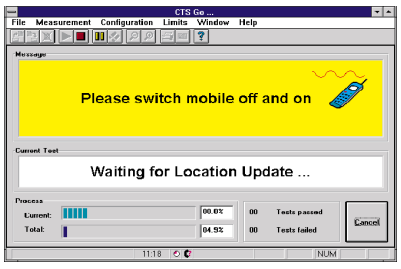


FIG 5 Call setup (registration) with user interface of GSM application software

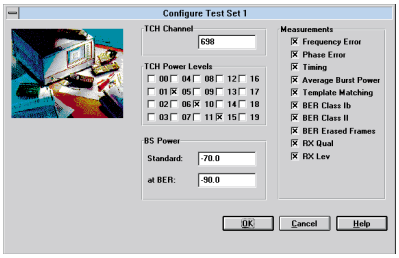


FIG 6 Configuration of measurements

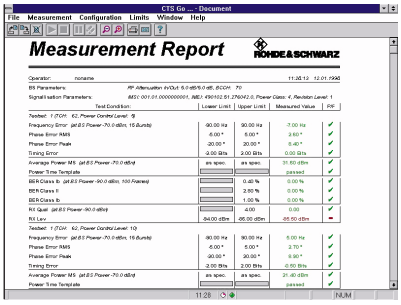


FIG 7 Extract from measurement report

Dr Klaus Gresser; Gottfried Holzmann

Condensed data of Digital Radio Testers CTS

	GSM mode (CTS55/65)	DECT mode (CTS60/65)
DUTs	GSM900, GSM1800, GSM1900 mobile phones	FPs and PPs for DECT Europe and DECT Latin America
Modes	quick test, manual test, auto test, module test, remote control via RS-232-C	loopback mode, manual test, auto test, remote control via RS-232-C
Functions	synchronization, location update, call setup and release, handover, power change, echo test	synchronization, call setup and release, echo test
Test parameters	power, power ramp, phase/frequency error, timing accuracy, sensitivity (BER, RBER, FER, RxLev, RxQual)	power, power ramp, demodulated frequency/offset/drift, modulation deviation, timing accuracy, jitter, packet accuracy, sensitivity (BER, FER)

Reader service card 158/02

REFERENCES

[1] Mittermeier, W.: Digital Radiocommunication Testers CMD65 and CMD80 – Multiband and multimode testers for mobile-radio telephones. News from Rohde & Schwarz (1997) No. 155, pp 6–8

[2] Maucksch, T.: Digital Radiocommunication Tester CMD60 – A favourably priced compact test set for series production of DECT mobiles. News from Rohde & Schwarz (1995) No. 149, pp 13–15

[3] Vohrer, M.: Digital Radio Tester CTS55 – All-in-one service tester for GSM, PCN and PCS mobile telephones. News from Rohde & Schwarz (1996) No. 152, pp 4–6

[4] Holzmann, G.: New measurement functions in Digital Radio Tester CTS55. News from Rohde & Schwarz (1997) No. 155, p 33

Multifunction Module AMV for Test Systems TSA and TSU

Analog measurements in module production now even more efficient

The increasing density of components on PCBs coupled with the difficulty of accessing internal nodes via bed-of-nails fixture have put functional and final tests at PCB level to the fore. Rohde & Schwarz meets this challenge with its brand-new analog measurement technology for in-production testing of modules.

conceive complete systems/projects right through to in-line production and to provide the required support throughout the world. In Multifunction Module AMV, Rohde & Schwarz continues to play its role as a pacemaker for system solutions. The new measurement technology for the well-known TSA and TSU families is not only an innovation in itself but also represents a milestone towards platform concepts for PCB testing (FIG 1).

FIG 1 Multifunction Module AMV makes in-production module testing with Test Systems TSA and TSU faster and more versatile.
Photo 43 122/1

A partner for in-production testing

Choosing a particular solution for in-production testing means choosing a long-term partner. The integration of solutions into a production line, the use of fixtures and programs absorb much more capital than the test system itself. So for a supplier of test solutions it is absolutely indispensable first to support a variety of general production tests, ie in-circuit, functional and optical tests [1 to 3], secondly to possess the special know-how and technology for the application on hand (eg mobile radio communications), and thirdly to be able to

Technology

Multifunction Module AMV (FIG 2) is a **complete test system on a module** for analog in-circuit and functional tests up to typically 1 MHz with associated interconnections and triggering. The module unites the functionality of seven test modules used up to now and two external IEC/IEEE-bus units, but only requires two of the 13 slots in Universal

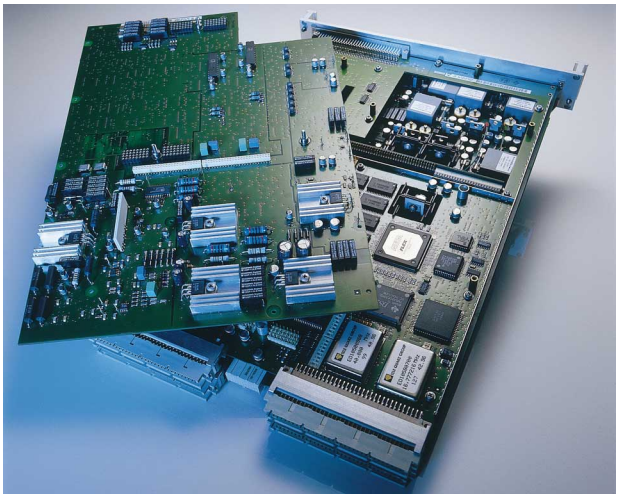


FIG 2
Analog Multifunction Module AMV requires only two slots in Test Systems TSA and TSU to enhance functionality considerably.
Photo 43 122/2

Test System TSU or two of the 23 slots in Board Test System TSA. This compactness leaves space for switching panels as well as driver/sensor modules. A 32-bit DSP controls coordination and communication between all internal units and evaluates test traces. Stimulation and recording can be run in parallel. Accuracy and clock rates are selected to comply with key production test requirements.

Fixture concepts and TSA/TSU system platforms remain compatible, so **existing systems** can be brought up to the latest status with an **upgrade.** Existing in-circuit tests are by and large compatible with the new versions and benefit from the higher throughput. The new facilities of functional testing cover a wide range of applications. The technician is not compelled to opt for a test strategy when purchasing the system. Such considerations can be left until programming, ie when detailed trimming instructions are available.

Standard instrument functions

It is possible to set up any combination of individual instruments. Up to five DC signals of different power rating can be stimulated at the same time and so voltages of up to ±100 V and currents of up to 200 mA can be generated. DC voltages from 20 µV to 500 V and currents from 500 pA to 1 A can be measured. Two integrated amplifiers allow DC and AC signals to be boosted to ±100 V and grounded signals to be converted into floating ones. The 32 digital input and output ports afford simple control of the DUT.

In-circuit measurements are performed by virtual units, which in turn combine several units of AMV. Among the in-circuit tests are resistance and impedance measurements, shorts, contact and continuity tests as well as IC check (node impedance method).

Waveform analysis and generation

A key unit for complex measurements is the **dual-channel waveform analyzer.** It can measure voltage and current at a sampling rate of up to 10 MHz and determine the DC average, rms or peak values (up to 500 V and 1 A). Time-related test parameters are frequency, period, time interval, pulse width, duty cycle, rise and fall time. The number and time of events (edges, relative maxima/minima) can be determined from the traces or the traces can be compared with a tolerance mask (FIG 3). While conventional storage oscilloscopes were essentially developed for interactive visual evaluation, the waveform analyzer of AMV is designed for automated, reproducible tests in production environments. Thanks to comprehensive triggering facilities, only those trace segments of interest are first saved in the 64-K memory and then searched for the desired criteria. With preset evaluation trigger thresholds and hysteresis it is possible to clearly determine the actual event from a signal impaired by noise or interference without the risk of misinterpreting any fluctuation as a maximum (FIG 4). These evaluations are run at optimum speed in the test unit under DSP control. Time-consuming downloading of traces is thus done away with.

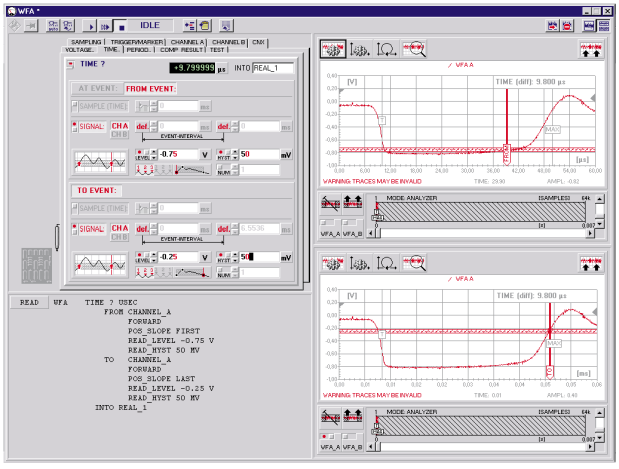


FIG 3
Virtual instrument panel of waveform analyzer with current settings can be called up in debugger.

The **dual-channel arbitrary waveform generator** of AMV generates periodic standard curves and freely programmable ones. One or more signals from the 64-K memory can be programmed

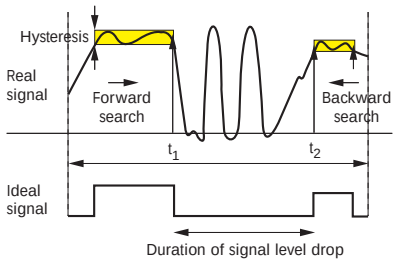


FIG 4 Measurement of duration of signal level drop between first falling below maximum level t_1 and reaching stable final value t_2. Preset hysteresis and forward/backward search allow real maxima to be filtered out of noisy signals.

in single-shot mode with a clock rate of up to 10 Msamples/s at an amplitude and offset of max. 10 V (V_{pp} = 20 V). A floating high-voltage signal generator with a peak-to-peak voltage of up to 200 V, as required in the telecommunications and automotive industry, can be generated by means of a high-voltage and isolation amplifier. Traces learned by the analyzer can again be stimulated by the generator.

Switching panel and trigger system

The individual units are integrated into the switching panel and the trigger system. They are connected to a 12-wire video bus that is routed direct to the twelve video pins of the fixture interface and to the 6-wire analog bus and thus to maximally 1088 pins in Test System TSA. In a similar way five local and three global trigger lines interconnect all internal units and so, for example, establish contact to the digital test unit and to external units (IEC or VXI). The specifications of the modules apply through to the fixture interface including the switching panel, while with other module-oriented concepts the user is required to interconnect the modules and establish connection to the DUT using relay modules and to evaluate the degraded system data. In AMV switchable video pins, direct signal inputs and outputs as well as trigger pins are applied to the fixture interface, so minor measurement tasks can be performed without the need for extra test or switching modules. This means a very low entry price for a one-module system in conjunction with TSU.

Software

Part of the new measurement technology is the new Test System Software TSS 5.0, a 32-bit Windows NT application. Operation is in the customary way as with other Windows-oriented applications. Data exchange with other NT applications is possible via clipboard or DDE. The combined editor/debugger simplifies and speeds up programming and debugging without time-consuming compilation. Switchover between edit and execute is performed at a simple mouse click. Various graphical tools such as virtual panels, statistics and trace displays for results or symbolic breakpoint displays make for transparent debugging. TSL (test system language) enhanced with the additional functions of the new units continues to be the programming language.

Outlook

Thanks to AMV measurement technology, users of in-production testers TSA and TSU are excellently equipped for all future measurement tasks. Time-critical measurement tasks can be implemented, if required, with customer-specific firmware. Due to the transparency of the hardware, software and fixture concept, the long-time user of a Rohde & Schwarz test system can simply modernize it without having to purchase a new, non-compatible system.

Dr Lothar Tschimpke

REFERENCES

[1] Tschimpke, L.; Kundinger, K.: Universal Test System TSU – Versatile test platform for production and service of electronic modules. News from Rohde & Schwarz (1995) No. 150, pp 13–15

[2] Tschimpke, L.: LaserVision System LV1 – Optical insertion testing combined with classic board test. News from Rohde & Schwarz (1995) No. 150, pp 10–12

[3] Tschimpke, L.: Low-cost continuity check in board testing using Cocheck II. News from Rohde & Schwarz (1997) No. 154, pp 24–25

Condensed data of Multifunction Module AMV for TSA, TSU

DC stimulation range	≤100 V, ≤200 mA
AC stimulation range	≤100 V, ≤2 MHz
DC measurement range	20 µV to 500 V, 500 pA to 1 A
AC measurement range	100 µV to 500 V, ≤2 MHz
Waveform generator (2 channels)	sinewave, triangle, squarewave, arbitrary, 1 channel floating, ≤200 V (V_{pp})
Waveform analyzer (2 channels)	voltage, current, frequency, time, 1 channel floating, ≤500 V
Switching panel/trigger bus	12-wire analog bus/8 trigger lines
In-circuit tests	R, L, C, Z, transistors, diodes, shorts, continuity, contact, IC check

Reader service card 158/03

DAB Transmitters NA6... and NL6...

Digital audio broadcasting – reliable and economical

Following numerous international DAB pilot projects, the actual introduction of digital audio broadcasting is now beginning. This means that existing transmitter networks will be expanded to provide full coverage. Rohde & Schwarz has developed new DAB transmitters for both VHF band III and L band that meet not only present but also future requirements and offer high transmission quality and profitability.

FIG 1 DAB Transmitters NA6... (band III) for 125 W to 2 kW are accommodated in 19-inch racks of 2 m height. Photo 43 070

The new DAB transmitters (FIG 1) are of modular design (FIG 2) and made up of the following **components:**

- DAB exciter,
- power amplifier,
- power supply,
- transmitter rack.

Band III transmitters are available with output power of 50 W to 2000 W (NA6... series), L band transmitters with output power of 50 W to 750 W (NL6... series). The entire DAB transmitter is controlled from a PC by means of software running under Windows or via a display on the exciter.

The **DAB exciter** with integrated COFDM modulator is able to process ETI (ensemble transport interface) input signals of the type ETI(NI, G703) and ETI(NA, G704) to ETS 300 799. The output generated is a DAB signal to ETS 300 401 at the RF (FIG 3). For monitoring purposes either the selected input signal can be output or the ETI(NI) signal after NA decoding and delay compensation. A FIFO in the input stage buffers input signal timing fluctuations with respect to the reference clock.

The subsequent NA / NI converter automatically detects whether an ETI(NI) or ETI(NA) signal is applied. An ETI(NA) signal requires deinterleaving and Reed-Solomon decoding. The time stamps contained in the signal are evaluated and used to control dynamic delay compensation (up to 1 s). The data stream can additionally be delayed by up to 750 ms by a static delay section. The ETI signal transports data channels, which may be used for configuration (TII, static delay, etc) of the transmitter network, in both the NA layer (NASC: NA signalling channel) and NI layer (MNSC: multiplex network signalling channel). These data are

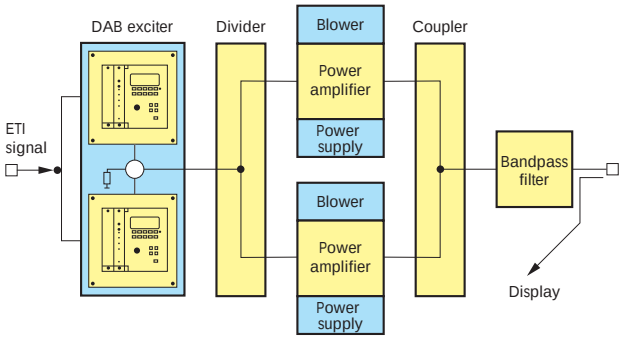


FIG 2 Layout of 500 W DAB transmitter (250 W redundant)

extracted from the data stream and taken to the controller for evaluation. The NA/NI converter then applies the delayed data stream to the next functional unit: the first DSP. This DSP analyzes the incoming signal, obtaining configuration information and detecting dynamic reconfigurations. If the error rate is too high in the checksums for control data and information, the modulator output signal is switched off. Then follow convolutional coding and time interleaving. For test purposes a PRBS (pseudo-random binary sequence) can be inserted in a subchannel.

The second DSP generates the transmission frame according to the DAB mode selected as well as the DAB time signal. It also produces the desired TII pattern in the null symbol and adds a guard interval to the computed DAB symbols. The subsequent FIR filters limit the spectrum and increase the sampling rate from 2.048 MHz to 32.768 MHz. The digital precorrector is able to correct the current amplitude and phase of the signal and to influence the frequency response. The time signal can thus be tuned optimally to the power amplifier characteristic. The signal is then converted to band III frequency by direct modulation (without IF). For output in L band the signal is upconverted to L band frequency. The reference frequency is derived from the integrated GPS receiver or applied externally.

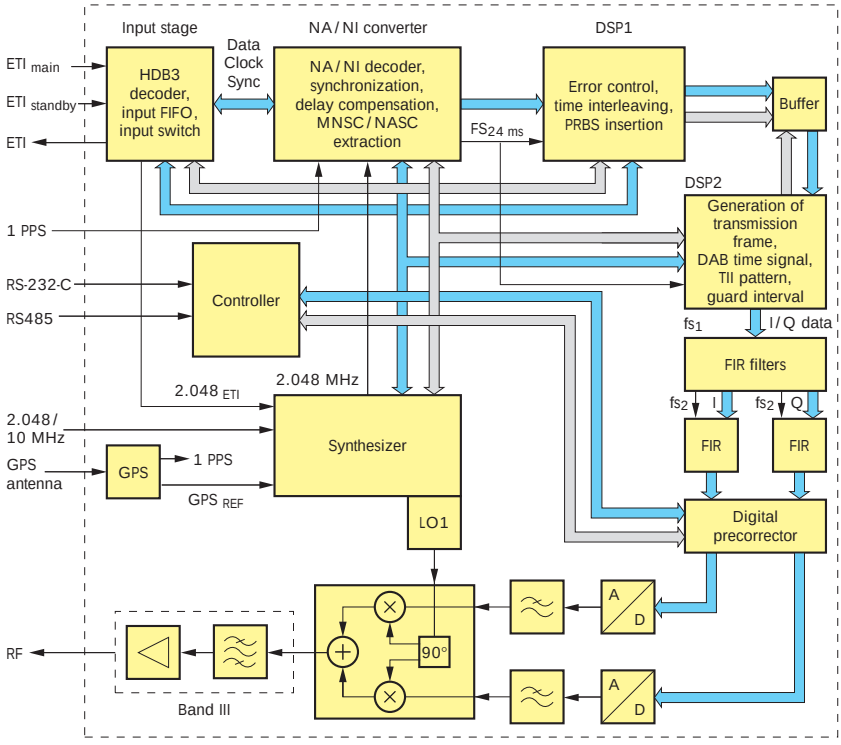


FIG 3 Block diagram of DAB exciter

The **power amplifiers** are characterized by high linearity and efficiency as well as compact design. The band III amplifiers are built with MOSFETs, those for L band with bipolar transistors. These power transistors feature high peak-power margins, so power peaks caused in the DAB signal through the use of the multicarrier method and phase shift keying will not cause intermodulation products or increased bit error rates of the DAB signal. A special feature is the circulator installed at the power amplifier output, preventing all kinds of slow or fast reflections that might destroy the power transistors. New, patented power couplers minimize power loss in the event of amplifier failure. With conventional couplers, transmitter output power is reduced by 6 dB for example if one of two amplifiers fails, but with the new couplers power reduction is only 3.5 dB.

Each complete amplifier plug-in of the new DAB transmitters has a separate **power supply,** and each plug-in forms a self-contained mechanical unit. This concept automatically ensures redundancy for the supply voltages of the amplifiers. To keep cabling in the transmitter rack to a minimum and to ensure high operational reliability, the power supplies are designed for one voltage only. The amplifiers generate all the other voltages they require internally, which again makes for redundancy. The power supplies are designed as short-circuit-proof, primary switched-mode regulators for three-phase or optionally single-phase operation depending on the total power consumption of the transmitter. Due to the high efficiency of more than 85%, a small built-in blower is sufficient to provide proper cooling. The power supplies can be replaced without interrupting the running program by undoing the plug-and-socket connection (provided that power supply and amplifier are redundant).

Transmitters with output power upwards of 125 W (band III) or 100 W (L band) are accommodated in **19-inch racks** 2000 mm high and only 800 mm deep. The output bandpass filter is integrated in the rack. For band III the transmitter and filter comply with the spectrum mask for critical areas. Where the amplifier and power supply are redundant, the air cooling system is redundant too. This means that two blowers are integrated in the transmitter rack. Cooling air can be taken from and expelled to the transmitter room or taken and/or expelled externally. Air intakes and outlets are provided for this purpose at the top and

bottom of the rack. The 50 W transmitters for band III and L band are accommodated in 19-inch racks 1000 mm high and 600 mm deep.

Rainer Steen; Cornelius Heinemann; Peter H. Frank

Condensed data of DAB Transmitters NA6... / NL6...

Frequency range	174 MHz to 240 MHz (band III) 1.452 MHz to 1.492 MHz (L band)
DAB modes	I, II, III, IV
Output power	50 W to 2000 W (band III) 50 W to 750 W (L band)
Input signal	ETI(NI) or ETI(NA)
Standard	ETS 300 401
Power supply	3 x 400 V ±10%

Reader service card 158/04

Method and equipment for transmission of digital sound signals in terrestrial broadcasting networks

The invention relates to and is based on a method and equipment used to transmit digital sound signals from recording studios to the individual stations of a terrestrial broadcasting network. In future systems for digital audio broadcasting it will be necessary to transmit a large number of programs from the recording studios of the broadcasters to the stations of the terrestrial networks that are planned nationwide.

It is the aim of the invention to create a simple method and equipment for the achievement of the above. This aim is established by a method according to the main claim. Further expedient developments according to this invention especially as far as the equipment for applying this method is concerned, namely in a DAB network, in a common terrestrial VHF FM transmitter network and other extended DSR methods result from the subclaims.

The assumption is made that the DS1/DSR method known for the supply of consumer broadcast receivers via a satellite transmitter is best suited for sending sound signals from a recording studio to the individual stations of a broadcasting network. A DS1/DSR method of this kind only allows transmission of 16 individual programs however, since the familiar DSR coder only offers 16 DS1 channels. As future broadcasting networks will have to send considerably more programs to the individual transmitter stations at the same time, the invention provides for additional data reduction of the sound signals to be transmitted in the recording studio in combination with this DS1/DSR method and by taking psycho-acoustic phenomena of the human ear into account. The MUSICAM method (masking pattern adapted universal subband integrated coding and multiplexing) for example is suitable for this. It is used to transmit sound signals on narrowband channels like telephone lines between recording studios and transmitters. Combination of a DS1/DSR satellite transmission method with such a familiar means of data reduction allows transmission of not just 16 programs to the individual stations of a DAB network, for instance, but even a multiple of this figure. The method according to the invention is highly economical too, since it can be implemented using commercial equipment. The method is also very suitable for supplying the individual stations of a DAB network since, depending on the degree of data reduction, three to seven times as many programs can be transmitted as with DS1/DSR, which is limited to one stereo program (or two mono programs) per DS1 channel and to 16 stereo programs per DSR channel.

Likewise, the method according to the invention is also suitable to supply a common terrestrial VHF FM transmitter network or a so-called compatible DAB network in which only one digital program signal is emitted per transmitter in the frequency band normally used for a VHF FM transmitter.

For the method according to the invention a common satellite transmission system is preferred as the broadband transmission system, but transmission can also be via a broadband cable network.

The method can also be used to extend the well-known digital sound-broadcasting system DSR (extended DSR, EDSR) by simply equipping the consumer receiver required for DSR satellite reception with a corresponding MUSICAM decoder chip comprising selection logic. The user of such a receiver can select the required data-reduced sound signals from the digital sound signals transmitted with the method according to the invention and listen to them. The known DSR transmission system can thus be expanded to a multiple of the programs offered up to now.

Extract from patent specification
EP 0 510 247 B1

Patent applied for by Rohde & Schwarz
on 02 August 1991

Issue of patent published on 12 June 1996

Inventor: Paul Dambacher

Used with DSR Modulator SFP (photo), Audio Coder DCA, Digital Sound Receiver DSRE, Digital Sound Converter DSRU, MUSICAM Codec MUSIC

Reader service card 158/05 for further information on units mentioned

Vehicle Location System VELOS

DGPS-supported vehicle location with fast radio data

Vehicle Location System VELOS is used to determine the position data of mobile objects and to transmit these data to a control center where the data are stored and displayed on a map and other user-defined tasks are performed. Data transmission is via a radio network that allows up to ten vehicles to be located per second. Alternatively, data can be transferred via a customer's own radio data network or GSM.

FIG 1
Components of Vehicle Location System VELOS: reference station, controller and mobile station (compact and $^1/_2$ 19-inch design)
Photo 43 112

The wide range of applications of Vehicle Location System VELOS (FIG 1) covers use by security transporters, police, fire brigades and local public transport enterprises, ground taxiing location at airports, vehicle location on factory premises or determination of ships' positions in ports. Thanks to the high location speed and the use of DGPS (differential GPS) the user can obtain accurate and current position data of his vehicles at any time, which is especially important in security-related operations.

The nucleus of the control center and also the mobile stations is a fast radio data module. Depending on the required accuracy of the position data, the **location system can be supplied in the following two versions:**

- without correction of position data (inaccuracy <100 m),
- with correction of position data by DGPS according to RTCM104 standard (Radio Technical Committee for Marine Services) with maximum inaccuracy of only 5 m.

The **control center** comprises a location controller with system software as well as a GPS reference station with integrated radio data module. The GPS receiver generates the RTCM correction signals. Transmission of these signals and data exchange with the mobile stations is effected via the radio data module. To increase system availability, the reference station can be implemented in a redundant configuration, ie master reference station and standby reference station each with their own location controller (FIG 2). The two controllers are interconnected either via an RS-232-C interface (in case of long distances via modem) or by an LAN. When the controller systems are configured as a server, the location results are made available to the customer's network or the particular application (eg via Ethernet with TCP/IP protocol). The radio network can be configured via the network interface, in particular the logging on and off of participating mobile stations. To calculate the position correction in a DGPS system, the GPS antenna positions of the two reference stations must be accurately determined in WGS84 coordinates (World Geodetic System 1984), while in a standard system without position data correction the GPS receiver is not required.

The main components of each **mobile station** are a GPS receiver and a radio data module for connection to the radio link (FIG 3). The GPS receiver of each mobile station outputs position data once per second via a serial interface (RS-232-C), which are however only transmitted to the control center if requested by the location controller.

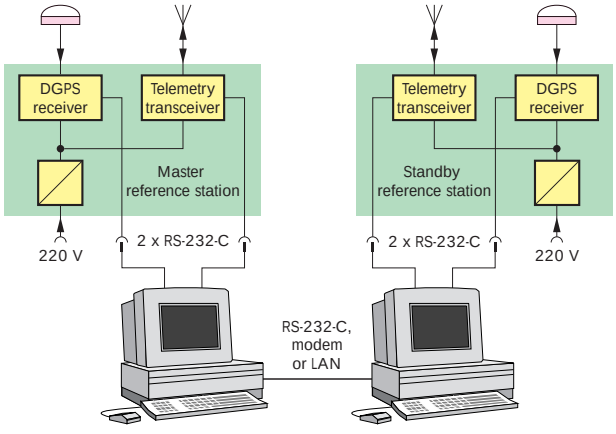


FIG 2
Layout of control center (redundant configuration)

For this purpose the location controller cyclically polls the position data of the mobile stations via radio, ie a TDMA (time division multiple access) method directed by the controller is employed. The transmission of RTCM correction data is also integrated into the TDMA structure, meaning that only one radio frequency is required for the transmission of correction data as well as position data.

The high data rate of the **radio data module** (9.6 kbaud) allows the position data of up to ten vehicles to be transmitted per second. The position data of mobile stations polled by the location controller can be stored in a database and displayed on a digital map. In the case of large fleets, vehicles are displayed by priority: vehicles with certain addresses or status messages can be displayed continuously, while the other vehicles are selected from the database for display. User-specific modifications or extensions of the system software allow transmission of additional, short user-defined messages from the mobile stations (eg alarms, other status messages), and position data transmission by a mobile station can be triggered manually by an emergency key for instance. The detection of alarms and other messages as well as the emergency key can be implemented on analog and digital inputs of the mobile station. Reduced location speed then has to be expected because the data messages are longer.

To maintain location during short interruptions of the GPS satellite signal caused by shadow effects, a **dead-reckoning sensor system** is available for the mobile stations. This system consists of two acceleration sensors mounted perpendicular to each other along the vehicle axis as well as a gyro sensor. The sensors can be installed with minimum effort and do not require any modifications to the vehicle, as with wheel-mounted speed sensors for example.

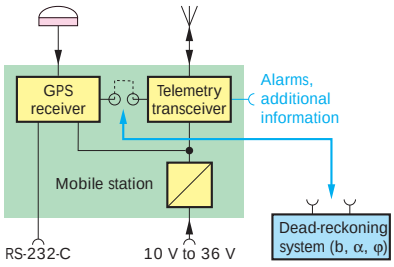


FIG 3 VELOS mobile station (options in blue)

In Germany **RTCM correction data** are provided by the satellite positioning service SAPOS within the realtime positioning service EPS. SAPOS is formed by the association of the survey offices of the different federal German states. The correction data are sent via VHF-RDS in cooperation with ARD broadcasters, on longwave with German Telekom, and in the 2 m band via geodetic surveying transmitters. Use of these correction data requires a special data receiver with decoder, operated instead of the GPS receiver in the VELOS control center. RTCM data output by the receiver can be transmitted to the mobile stations via radio data integrated in the system. This solution saves the user installation of the GPS reference receiver and determination of the reference point.

Dr Rolf Springer; Dr Lothar Schirm

Condensed data of Vehicle Location System VELOS

GPS reference receiver	12-channel receiver, C/A code, frequency band L1, correction data generation to RTCM SC-104
Mobile GPS receiver	6-channel or 12-channel receiver, C/A code, frequency band L1, RTCM-compatible
Radio data module	
Frequency/transmitter power	170 MHz / 0.5 W (in line with FTZ 17 TR 2014), other frequency bands on request
Channel bandwidth	20 kHz
Modulation type	GMSK
Data rate (air interface)	9.6 kbit/s
TX/RX switchover	<50 ms

Reader service card 158/06

Antenna Systems AC090, AC120, AC180, AC300

Radiomonitoring in microwave range up to 40 GHz

Rohde & Schwarz has developed steerable Antenna Systems AC090, AC120, AC180 and AC300 with parabolic reflectors of 90 cm to 3 m in diameter for radiomonitoring applications in the frequency range 1 GHz to 40 GHz. In addition to selectable reflector diameter, a large variety of feeds with different polarization, frequency ranges and preamplification are available for numerous missions.

FIG 1 Microwave Antenna System AC090 with add-on Antennas AC308 Photo 40 577/2

Monitoring terrestrial emissions and signals from geostationary satellites calls for different antenna concepts in terms of gain, polarization and positioning accuracy. Antenna Systems AC090 to AC300 (FIG 1) meet these requirements, offering four different reflector sizes with corresponding gain (FIG 2) and matching rotators as well as a variety of feeds with and without preamplifiers.

Frequency ranges 1 to 18 GHz for linear and circular polarization and 1 to 26.5 GHz for linear polarization are covered by broadband feeds [1]. Low-noise preamplifiers integrated in the feed boost the detected signal, which is routed to the antenna feedpoint via low-loss cables for further processing. Frequency ranges 18 to 26.5 GHz and 26.5 to 40 GHz are handled by two add-on antennas flanged to the side of the main reflector for mechanically selectable linear polarization. Advances in amplifier technology and spectrum analysis towards increasingly higher frequencies [2] now allow direct preamplification and signal processing. If signal conditioning is limited at 18 GHz, optional downconverters are available for converting frequencies between 18 and 40 GHz to the range below 18 GHz. Another option available for Microwave Antenna AC300 is a frequency extension in the form of two logarithmic-periodic antennas for horizontal and vertical polarization in the range 80 to 1000 MHz.

The antenna systems can be positioned simultaneously in azimuth by ±180° at about 5° per second and in elevation from −5° to +95° at about 2° per second. Rotator control as well as selection of antenna and polarization are effected from a computer running under Windows NT 4.0 (FIG 3), which may be set up at a distance of up to 1 km. So cabling routed to the antenna systems is restricted to power supply, signal conditioning and a two-wire computer link.

Design

Antenna Systems AC090 to AC300 comprise the following **elements:**

- main reflector (90, 120, 180 or 300 cm),
- rotator,
- control unit for positioning and selecting antenna and polarization,
- supporting structure,
- set of cables,
- feed 1 to 18 (26.5) GHz,
- add-on antennas 18 to 26.5 GHz and 26.5 to 40 GHz.

The antenna systems are designed so that they can be retrofitted and feeds can be replaced without any modification to the system, for example to match the system to new monitoring tasks. Whatever the application, it is only necessary to modify the initialization and control software that comes with Control Unit GX300.

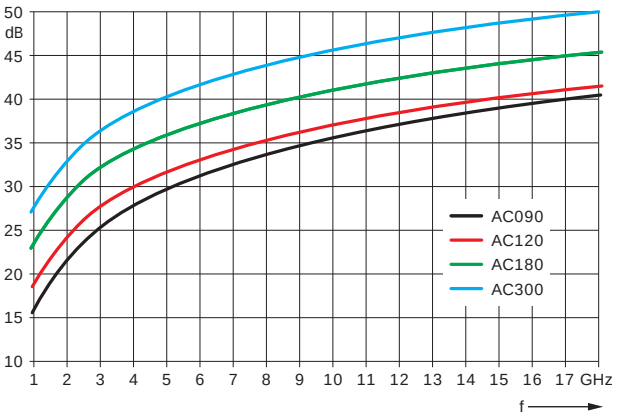


FIG 2
Gain of microwave antennas with Feed HL024A1

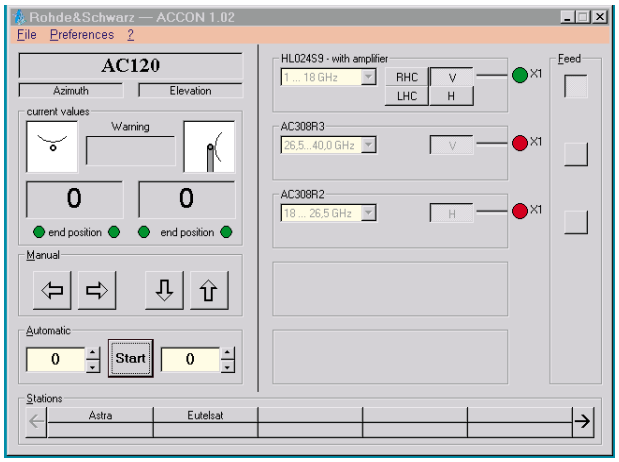


FIG 3
User interface (Windows NT) for Antenna AC120

Feeds and add-on antennas

Feeds include logarithmic-periodic broadband antennas in planar configuration for linear polarization with approximately identical radiation patterns in azimuth and elevation. The broadband antennas are also available in a crossed configuration for linear and circular polarization (FIGs 4 and 5).

Use of broadband feeds above 18 GHz is expedient mainly for monitoring tasks with a maximum reflector diameter up to 120 cm, since the half-power beamwidth of the radiation patterns may become too small with larger reflectors. To accommodate for larger diameters, Antenna AC308R2 for the frequency range 18 to 26.5 GHz is additionally available. An overview of available feeds and add-on antennas is given in the blue BOX.

Feed		Frequency	Polarization
HL024A1	Crossed log-periodic antenna	1 to 18 GHz	H or V
HL024S2	HL024A1 with passive polarization network	1 to 18 GHz	H or V
HL025	Log-periodic antenna	1 to 26.5 GHz	linear
HL025S	Rotatable HL025 with preamplifier	1 to 26.5 GHz	adjustable
HL024S5	HL024A1 with narrowband preamplifiers 2 to 4 / 4 to 8 / 8 to 12 / 12 to 18 GHz	2 to 18 GHz	H or V
HL024S7	HL024A1 with preamplifier	1 to 18 GHz	H or V
HL025S7	HL025 with preamplifier	1 to 26.5 GHz	linear
HL024S8	HL024A1 with two preamplifiers	1 to 18 GHz	H and V
HL024S9	HL024A1 with active polarization network	1 to 18 GHz	H, V, RHC or LHC
Add-on antennas			
AC308R2	250 mm reflector antenna, 29 to 33 dBi	18 to 26.5 GHz	H, V or 45°
AC308R3	250 mm reflector antenna, 33 to 36 dBi	26.5 to 40 GHz	H, V or 45°
AC300A4	Log-periodic Antennas HL023	0.08 to 1.3 GHz	H and V

Control

After installation, which can be carried out by the customer himself, the antenna system is initialized by means of the software supplied with Control Unit GX300. Following selection of the basic configuration (eg AC120), the

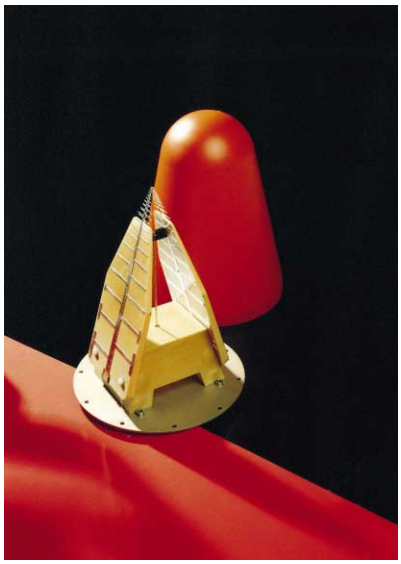


FIG 4 Feed HL025 (1 to 26.5 GHz) for linear polarization Photo 33 011

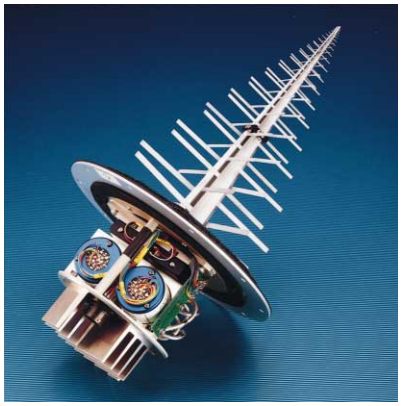


FIG 5 Feed HL024S5 (2 to 18 GHz) for linear and circular polarization
Photo 43 031/1

feed used and any add-on antennas and alignment to north, the system is ready for operation. The rotator can be controlled manually or moved to preselected or stored positions.

Klaus Friede; Ludwig Nielsen

REFERENCES

[1] Schiller, M.; Linhuber, E.: Logarithmic-periodic antenna for 1 to 15 GHz. News from Rohde & Schwarz (1971) No. 49, pp 22–24

[2] Evers, C.: 100 Hz to 26.5 GHz – new level of performance for microwave region with Spectrum Analyzer FSM. News from Rohde & Schwarz (1991) No. 133, pp 4–7

Condensed data of Microwave Antennas

	AC090	AC120	AC180	AC300
Reflector 1	∅ 0.9 m	∅1.2 m	∅ 1.8 m	∅ 3 m
Frequency range		1 to 18 GHz		
Gain	15 to 40 dB	19 to 42 dB	23 to 45 dB	26 to 50 dB
Half-power beamwidth	19° to 1.3°	16° to 0.9°	12° to 0.7°	6° to 0.35°
Reflector 2		∅ 0.25 m (AC308R2)		
Frequency range		18 to 26.5 GHz		
Gain		29 to 33 dB		
Half-power beamwidth		4.5° to 3°		
Reflector 3		∅ 0.25m (AC308R3)		
Frequency range		26.5 to 40 GHz		
Gain		33 to 36 dB		
Half-power beamwidth		3° to 2°		
Beamwidth rotator				
Range of rotation		azimuth ±180°; elevation –5° to +95°		
Speed		azimuth >3°/s; elevation >2°/s		
Inaccuracy	<±0.2°	<±0.2°	<±0.2°	<±0.1°

Reader service card 158/07

In brief

EMC Asia 97 – debut in Singapore

The EMC Asia symposium, held in Singapore for the first time last autumn and intended for all Asian countries, met with a very positive response. The symposium was combined with workshops and an exhibition. Like European EMC events of this kind, the symposium was organized by Germany's MESAGO Messe und Kongress corporation, which recorded 812 participants for more than 430 workshops and almost 50 exhibitors presenting their products in an area of about 1000 sqm. "Testing the Limits" was the motto of Rohde & Schwarz (FIG), whose product presentation focused around EMI Test Receivers ESCS30 from 9 kHz to 2.75 GHz and ESPC for 9 kHz to 2.5 GHz together with EMC Test Cell S-LINE. The stand was manned for the most part by specialists from the Rohde & Schwarz Support Centre Asia (SCA), newly set up in Singapore just a few weeks before. Although the majority of visitors came from Singapore, contacts to Korean, Taiwanese and Thai customers were established as well. SCA offers system solutions, calibration and service for all Asian countries, so travel and time will be reduced substantially for customers in the region.

The lectures and discussions held in the Westin Stamford & Westin Plaza Convention Centre underlined that electromagnetic compatibility is becoming more and more important for companies in Asia and will remain so in the future. With increasing globalization of markets, these companies are facing demanding international challenges and cannot only keep up with European manufacturers of electronic products but even have an edge in some market segments. As a consequence of the success of the first-time event, it was decided to stage it annually in future.

Volker Janssen

Photo: author

Digital Scanning Direction Finders DDF0xS

Fast direction finding of broadband and short-term signals

Digital Scanning Direction Finders DDF0xS are designed for extremely high search rates, making them ideal for interception and direction finding of broadband and short-term signals in the frequency range 0.5 to 1300 MHz. Multilevel data compression makes it possible to use these direction finders as automatic search tools in complex radiomonitoring and radiolocation systems.

FIG 1 Digital Scanning Direction Finder DDF0xS
Photo 43 123

Wireless communication is making increasing use of broadband techniques or time compression. Monitoring these signals calls for systems capable of simultaneous detection and direction finding of all emissions across a wide frequency range. Among the digital direction finders of the DDF series [1; 2], the new Scanning Direction Finders DDF0xS feature the highest scanning speeds irrespective of radio spectrum occupancy.

Design and function

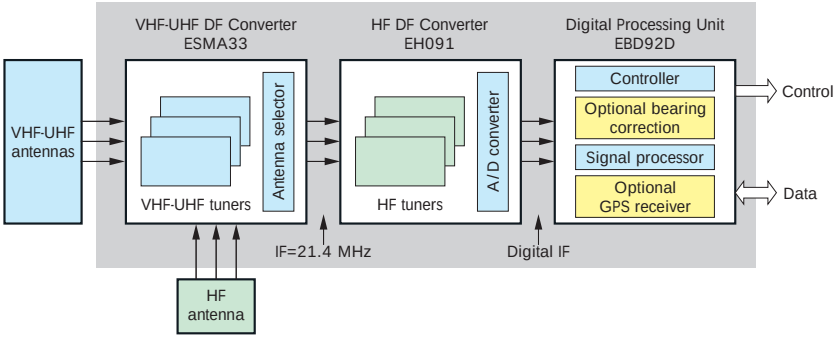
Digital Scanning Direction Finder DDF0xS (FIG 1) features excellent characteristics thanks to **digital signal processing** throughout. The IF signals of the triple DF converter are digitized and distributed to parallel frequency channels. Bearings are calculated simultaneously with filtering so that the direction of incidence is obtained quasi-parallel for all channels within the bandwidth analyzed.

Each DDF0xS is basically made up of HF DF Converter EH091, which includes three DF receiver modules and an A/D converter, and Digital Processing Unit EBD92D (FIG 2). In the VHF-UHF bands, VHF-UHF Converter ESMA33 is connected ahead of the direction finder in addition. The direction finders for the HF band (0.5 to 30 MHz) are designated DDF01S, those for HF plus the VHF-UHF bands (0.5 to 30, 30 to 650/1300 MHz) are named DDF06S.

The direction finders of the DDF0xS group have the algorithms for the **Watson-Watt method** and the principle of **correlative interferometer** implemented as standard. The Watson-Watt method is used where maximum scanning speeds are to be achieved and/or space is at a premium for DF antennas in the HF band. If, on the other hand, extremely high accuracy is required at unfavourably located antenna sites or the elevation of incoming signals is to be determined additionally in the HF band, the correlation method is the better choice.

The digital filter bank of DDF0xS allows **simultaneous signal processing across a frequency band of 200 kHz.** This bandwidth offers maximum dynamic range. Nonlinear distortion products at the output of the A/D converter are minimized by highly effective preselection filters (excellent large-signal behaviour) and by gain adjustment performed prior to each scanning cycle. For scanning larger frequency ranges, the 200 kHz window is rapidly incremented and fresh A/D conversion of the analog signal is performed (scan mode). DDF0xS requires approx. 3 ms to change frequency in the HF band and approx. 0.9 ms in the VHF-UHF bands; the time required for gain control of the analog receiver section is included in these figures.

FIG 2 Block diagram of Digital Scanning Direction Finder DDF0xS



Proper balance of preselection and gain is a basic requirement for optimum reception and direction finding, while the design of the digital filter bank determines the spectral selectivity of the direction finder. The skirt selectivity of filters and thus the achievable spectral selectivity are inversely proportional to the length of the analyzed signal segment. So a compromise had to be found to save the operator from having to adapt the window to the task in hand each time, but enabling fast scanning of short-term signals also in densely occupied bands. The use of a windowing technique, pre-averaging of scanning values and the selection of suitable

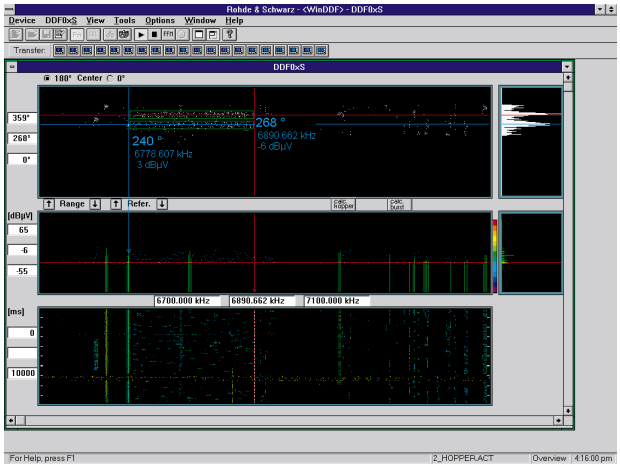


FIG 4 User interface with typical scenario of broadband emitters in HF band. Waterfall display (top) reveals frequency-agile emitters; histogram (bottom right) allows unambiguous identification of weak frequency-hopped signals from overlapping frequency bands of same azimuth sector.

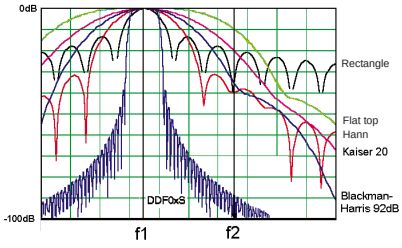


FIG 3 Selectivity of various windowing functions

bandwidths result in effective adjacent-channel rejection and high scanning speeds at the same time (FIG 3).

Operation and recording of results

An external controller incorporating the DF-specific control and display tools serves for operation of the direction finder and display of results (FIG 4). The well-devised **operating concept** is based on extensive testing and operational experience:

- The measurement windows occupy the largest area.
- Only those control elements that are constantly needed are permanently displayed.
- The user interface allows strain-free operation over an extended period of time.
- All important operational data are displayed within an easy viewing angle to prevent operator fatigue.
- Measurement windows can be arranged on the display as desired, and the configuration can be saved and recalled at a mouse click.
- Special tools provide semi-automatic help for fast detection, direction finding and analysis of agile signals (hoppers, bursts).
- Various options are available for data recording and evaluation.
- A variety of measurement windows can be chosen for results display: level vs time, azimuth vs time, azimuth vs frequency, level vs frequency, elevation vs frequency, azimuth histogram, level histogram, elevation histogram, alphanumeric display of DF results.

The direction finder offers the following functions for the **documentation and analysis** of detected signals:

- For short-term recording, all DF data collected during the past minute are saved at a keystroke to harddisk or a virtual drive.
- For long-term recording, DF data are permanently stored to harddisk or a virtual drive.
- Data analysis can be performed while recording is in progress using the scan replay or activity analyzer function.
- The volume of data saved depends solely on harddisk capacity. The data rate is 2 to 15 Mbytes per minute depending on the filter used.

For users who want to analyze signal contents with their own tools, the activity analyzer provides an export function that converts data to ASCII format (eg for Excel).

Probability of intercept

The most important function of DDF0xS direction finders is interception of frequency-agile and burst signals. The suitability of emissions for interception and direction finding is judged by probability of intercept (POI). Reliable bearings of frequency hoppers, and in particular with low S/N ratios, are not possible until the emission has been intercepted a number of times. So it is best to consider the probability of a signal being intercepted at least n times. The signal of the frequency hopper is characterized by its dwell time, the frequency band covered and channel spacing. The example in FIG 5 shows the probability of intercepting a signal from a VHF or UHF frequency hopper at least ten times as a function of the time during which it is emitted. It can be seen that a signal of 300 hops per second will

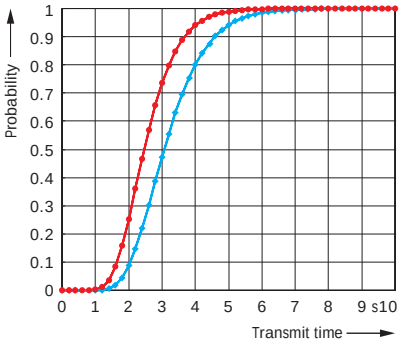


FIG 5 Probability of intercept of at least ten emissions of VHF frequency hopper (blue: 300 hops/s, red: 3000 hops/s) with Watson-Watt method; scanning range of DDF0xS 50 MHz, hopping span of emitter 30 MHz, channel spacing 25 kHz

be intercepted after only 3.5 s with a probability of 85%, whereas approx. 4.3 s are required for a signal of 3000 hops per second.

Antennas

Two types of DF antenna are available for the DF methods implemented in DDF0xS:

- Antennas ADD012, ADD115 and ADD155 have monopulse capability and are designed for maximum DF speed. Together they cover the range 0.5 to 650 MHz (Watson-Watt method).
- Interferometer DF Antennas ADD010, ADD011, ADD050, ADD150 and ADD051 are especially characterized by large bandwidth (only two antennas are required for 0.5 to 1300 MHz), high bearing accuracy and immunity to multipath propagation. In the HF band these antennas allow determination of the elevation angle of skywaves and thus position finding by means of the single-station location manager.

The direction finder can of course be operated on existing antennas if these are suitable for the Watson-Watt method. Adaptation is made by Antenna Interface GX060 (0.3 to 650 MHz).

Bearing correction and synchronization

To ensure highly precise bearings in environments with very strong interference, eg onboard vehicles, ships or aircraft, a **bearing correction** option (EBD92AK) is available for DDF0xS. It allows continuous correction of bearings in the frequency range 0.5 to 1300 MHz over an azimuth range of 360°. Rohde & Schwarz offers software and services for a large degree of automation in the collection and processing of correction data. The bearing correction option improves the RMS deviation of bearings in frequency and azimuth by a factor of three to four.

Position finding – especially of frequency-agile signals – places the most exacting demands on the **synchronization** of direction finders **in a radiolocation system** during the scanning process. For this purpose direction finders can be equipped with a GPS receiver (option EBD92GP), which supplies a highly precise sync pulse and the time stamp (1 µs resolution) required for position finding.

Use in systems

In addition to its scanning qualities, Direction Finder DDF0xS offers all the attributes of an excellent monitoring direction finder, which justifies its use as a stand-alone unit meeting the most stringent requirements. DDF0xS is especially suitable for integration into radiomonitoring systems incorporating intercept receivers, analyzers and data acquisition terminals. In a radiomonitoring system the DF component essentially serves for direction finding, assignment of occupancy data to their emitters and for determining the position of these emitters. Rohde & Schwarz has developed the ScanLoc system for locating frequency-agile emitters [3]. This system allows a precisely synchronized scan of up to six DF stations as well as realtime display of detected emissions on digitized maps.

Franz Demmel; Wilhelm Genal;
Ulrich Unselt

REFERENCES

[1] Demmel, F.; Unselt, U.; Schmengler, E.: Digital Monitoring Direction Finders DDF0xM – State-of-the-art monitoring direction finding from HF to UHF. News from Rohde & Schwarz (1996) No. 150, pp 22–25

[2] Demmel, F.; Wille, R.: VHF-UHF Direction Finder DDF190 – Digital direction finding from 20 to 3000 MHz to ITU guidelines. News from Rohde & Schwarz (1996) No. 152, pp 30–32

[3] Demmel, F.; Hinkers, G.: Networking digital direction finders for improving radiomonitoring efficiency and locating frequency-agile emitters. News from Rohde & Schwarz (1997) No. 156, pp 24–25

Condensed data of Digital Scanning Direction Finders DDF0xS

	HF band	VHF-UHF band
Frequency range	0.3 to 30 MHz	20 to 650 (1300 MHz)
DF method	correlative interferometer, Watson-Watt	
DF error	1° RMS with ADD011	1° RMS with ADD051
Sensitivity	typ. <1 µV/m with ADD011	typ. <2 µV/m with ADD051
Realtime bandwidth	200 kHz	200 kHz
Scanning speed	22 MHz/s (2 kHz bandwidth)	200 MHz/s (8 kHz bandwidth)
Minimum signal duration	4 ms	100 µs
Bandwidths	0.125 to 2 kHz in 5 steps	2 to 32 kHz in 4 steps
Displays	bearings and levels vs frequency histogram of bearings bearings and levels vs time (waterfall)	

Reader service card 158/08

Production test of RF modules with Universal Test System TSU, Radiocommunication Service Tester CMS and EMC test cell

The number of electronic devices in automobiles has increased dramatically in recent years. They have made inroads into virtually all parts of the automobile and are no longer limited to top-of-the-range models as used to be the case. Today electronic fuel injection, airbag and ABS are the standard minimum even in a small car. Considering that some 12 million vehicles are manufactured annually in Western Europe, with about a third coming from German plants, automotive electronic modules generally rank as typical mass products. But in contrast to other mass products, very high requirements are made where functional reliability and quality are concerned. This calls for comprehensive quality assurance in production besides all the necessary measures in design and development.

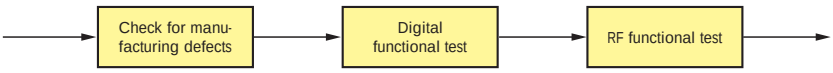


FIG 1 Multistage test strategy for receiver module

The German company Kiekert, an automotive electronics supplier, specializes in locking systems and is a market leader in the field, delivering to various car manufacturers. The remote-control locking systems, consisting of a transmitter and receiver, are manufactured on several automatic production lines at the company's plant in Düsseldorf. The signals from the remote-control unit to the receiver of the central door locking system used to be transmitted by infrared. A new production line was recently set up for units using high frequencies to transmit the signals. The electronic modules are designed in surface-mount technology and produced from panel boards. The small size means that the transmitter can be integrated into the car key.

To ensure high product quality, Kiekert chose a multistage test strategy, despite the enormous cost pressures on suppliers to the automobile industry (FIG 1). Following component insertion and soldering, modules are checked for manufacturing defects and then

FIG 2 Radiocommunication Service Monitor CMS54 (bottom left) together with Universal Test System TSU used for functional testing of receivers (in EMC Test Cell S-LINE 700/P) Photo 43 027/2

undergo a functional test. Defective modules are routed to a repair station, where they are corrected and then fed back into the production process. Rohde & Schwarz was responsible for the implementation of all functional testers, repair stations and the integration of these systems into the automatic production line.

Functional test of transmitters and receivers of remote-control locking systems

The functional test of the receiver circuit is divided into two separate tests: the digital functional test and the RF test. During the digital functional test, all inputs and outputs at the connector are checked. The tester also downloads data to the DUT's memory via its interface. The test system consists of Universal Test Station TSU [1] with digital test channels and a power supply for the DUT. A second test system comprising Radiocommunication Service Monitor CMS54 [2] performs the subsequent RF functional test, for which the DUT is placed in a shielded test cell (FIG 2). CMS54 tests the response and sensitivity of the receiver.

The transmitter in the key is only subjected to an RF functional test and a LED check. Again the measurements are performed in a shielded test cell. The measurements are all made within the cycle time of the production line.

RF measurements in EMC Test Cell S-LINE 700/P

Accurate and reproducible measurement of transmit and receive parameters is a very important requirement. To exclude interference from other transmitters, the receiver measurement has to be performed in a shielded environment. A conventional in-line fixture station could be modified so that external RFI is sufficiently damped, but the electromagnetic field within the shielded enclosure would not be homogeneous due to reflections from the installations and walls. So accurate and reproducible measurements would hardly be possible. Rohde & Schwarz solved the shielding problem with its S-LINE 700/P (a version of EMC Test Cell S-LINE 700 for use in electronics production [3]). Reproducibility of ±1 dB can thus be achieved in the frequency range 150 kHz to 1 GHz. To enable automated feed and interfacing of the DUTs, the modules are conveyed into the test cell through a bulkhead that opens and closes automatically.

FIG 3 Repair station for receivers based on Universal Test System TSU Photo 43 124

Defective modules are taken to a repair station equipped with a Universal Test System TSU and a spectrum analyzer (FIG 3). This station provides all the facilities required to test transmitter and receiver modules. No parametric measurements are performed here, so a test cell is unnecessary. All functional test systems are linked to Kiekert's quality management system. This means that all data and results generated during tests can be called up at the station to support repairs.

Ideal partnership

Rohde & Schwarz's wealth of experience and competence in production testing and RF measurements was the decisive factor in Kiekert's choice of the company as its partner for this application. It was possible to implement the project almost entirely with standard components from the Rohde & Schwarz product range. In contrast to an individualized solution, the required customer-specific adaptations were therefore reduced to a minimum, so the customer benefited from faster delivery, lower costs and better maintenance.

Klaus Kundinger

REFERENCES

[1] Tschimpke, L.; Kundinger, K.: Universal Test System TSU – Versatile test platform for production and service of electronic modules. News from Rohde & Schwarz (1996) No. 150, pp 13–15

[2] Hausdorf, R.: Mobile transceiver measurements with Radiocommunication Service Monitor CMS. News from Rohde & Schwarz (1989) No. 127, pp 4–7

[3] Göpel, K.-D.: EMC Test Cell S-LINE – Compact EMC test cell of high field homogeneity and wide frequency range. News from Rohde & Schwarz (1996) No. 151, pp 7–9

Reader service card 158/09

Applications in and around fading

FIG 1
Digital Radiocommunication Tester CMD and Signal Generator SMIQ with fading simulator – an ideal team for measurements on mobile radios under fading conditions
Photo 43 110

Modern communication systems for speech and data – mobile radio, cordless telephones and pagers – transmit information by means of digital modulation. This means that all the information is modulated onto the transmit signal in the form of bits. The quality of the receiver in the transceivers used for this purpose is judged by measuring bit error rate at low receive levels. For this purpose a link is set up to the mobile radio (or base station) and a known data sequence is transmitted. The transceiver then sends the data back to the measuring instrument in loopback mode. The incoming data sequence is analyzed and compared with the sequence originally sent. Since transmission from the mobile phone to the instrument is normally errorfree, any differences between the received sequence and the sent sequence are a measure of the quality of the receiver used in the mobile radio. The errored bits are counted and referred to the total number of sent bits to yield the bit error rate (BER). Digital Radiocommunication Tester CMD or CRTP/CRTC performs these BER measurements with ease at a keystroke [1].

Shadow effects, reflections and the movement of the receiver itself – being a mobile radio – result in varying degrees of distortion of the receive signal (multipath propagation, multipath fading [2]). Especially at fast data rates like in GSM (277.833 kbit/s) or CDMA (1.288 Mchips/s), the different delays of the signals cause bits sent earlier or later to arrive at the receiver simultaneously. This leads to serious demodulation problems, causing a sharp increase in BER.

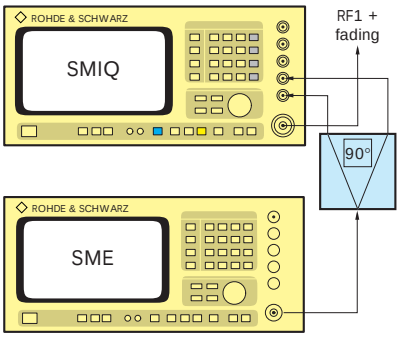


FIG 2 Fading of pager signals and signals with analog modulation with Signal Generators SME and SMIQ

Various measures are implemented in receivers to improve quality under fading conditions. In GSM for example, the distorted receive signal is corrected by means of the midamble. The midamble is a known data sequence in the transmit signal which always remains the same irrespective of the useful data but is of course subject to the same degradation as the useful data during transmission. Any distortions of the midamble are detected by an equalizer circuit in the receiver. This information allows correction of the useful data sent immediately ahead of and after the midamble and thus marked improvement of BER. Mobile radios using CDMA incorporate so-called rake receivers. A rake receiver operates like several receivers in parallel to analyze the receive signal with different delays. The resultant signals are then combined to produce an overall signal with the least possible error.

Of course it is necessary to test whether these measures really do improve receiver quality as intended. The various communication system standards specify BER measurements under conditions of fading. Combining Radiocommunication Tester CMD, CRTC or CRTP and Signal Generator SMIQ fitted with the fading simulator option [2] produces an ideal test system for the purpose (FIG 1). The radiocommunication tester sets up the connection to the mobile radio under test and carries out the BER measurement. But the transmit signal, which normally comes from the radiocommunication tester for this measurement, is supplied here by SMIQ. The SMIQ signal includes the stipulated fading profiles, allowing BER measurement under fading conditions.

Pager signals and signals with analog modulation (AM or FM) are of course also subject to the distortion caused in a fading channel. Such signals can be generated by a combination of Signal Generator SME or SMT and SMIQ

GSM Mobile Tests under Conditions of Fading, CRTP/CRTC + SMIQ
Application Note 1MA02_0E — Reader service card 158/10

BER Measurements on DECT Receivers under Conditions of Fading, CMD60/65 + SMIQ
Application Note 1MA03_0E — Reader service card 158/11

BER Measurements on GSM Receivers under Conditions of Fading, CMD55/57 + SMIQ
Application Note 1MA04_0E — Reader service card 158/12

BER Measurements on CDMA Mobile Radios under Conditions of Fading, CMD80 + SMIQ
Application Note 1MA05_0E — Reader service card 158/13

SMIQ as Fading Simulator for External Signals, SMIQ + SMIQB1+ SMIQB14
Application Note 1MA07_0E — Reader service card 158/14

Application notes on fading

(FIG 2). Rohde & Schwarz has published a number of application notes dealing with measurements under fading conditions (see list in blue BOX). They describe the test setups and instrument settings required for such measurements. For example, Application Note 1MA02_0E outlines measurements on GSM mobile radios using Digital Radiocommunication Test Sets CRTP and CRTC in conjunction with SMIQ. Combinations of the widely used Radiocommunication Tester CMD in its various versions (CMD 55/57/65/80) and Signal Generator SMIQ are described in Application Notes 1MA03_0E (DECT), 1MA04_0E (GSM) and 1MA05_0E (CDMA). Pager signals and signals with analog modulation are supplied by Signal Generators SME and SMT. Such signals can also be conditioned by Signal Generator SMIQ to yield the required fading profiles. Application Note 1MA07_0E shows various solutions to this measurement. The application notes are available from all Rohde & Schwarz representatives under the reader service card number.

Albert Winter

REFERENCES

[1] Mittermeier, W.: Digital Radiocommunication Testers CMD65 and CMD80 – Multiband and multimode testers for mobile-radio telephones. News from Rohde & Schwarz (1997) No. 155, pp 6–8

[2] Lüttich, F.: Signal Generator SMIQ + SMIQ-B14 – Fading simulator and signal generator in one unit. News from Rohde & Schwarz (1997) No. 155, pp 9–11

Reader service card numbers, see blue box

Valuables packed safely

State-of-the-art electronics from Rohde & Schwarz was shown safely packed in edition 10/97 of the customer journal "Knürr direct". The 19-inch racks and cabinets from Knürr keep out dust, water, heat and electromagnetic interference. Which makes them a safe and sure solution for the integration of high-grade electronics, like TETRA Test System TS8940 (photo far right) from Rohde & Schwarz, comprising TETRA simulator and TETRA protocol tester. This system was designed for verification, quality assurance and type approval to TBR35 (Technical Basis for Regulation) of TETRA base and mobile stations. In addition to determination of RF characteristics by the TETRA simulator, TBR35 also stipulates protocol measurements, which are performed by the TETRA protocol tester.

Knürr, with headquarters in Munich and production facilities in Arnstorf, is an internationally operating company and a major supplier of mechanical enclosures for electronics and of technical interior fittings. The company employs about 1000 persons and achieved turnover of nearly DM 245 million in 1997. Sö

COM2000 – the functional software tool for shortwave communication

Software package COM2000 is a versatile tool allowing data transmission with shortwave transceivers of the XK2000 family [1; 2] as well as configuration of radiocommunication processors from a PC. Transceivers XK2000 offer the most advanced features available for shortwave communication and are internationally recognized as representing the highest standard in quality and technology. Software package COM2000 with its extra features now rounds off the performance of this line of equipment.

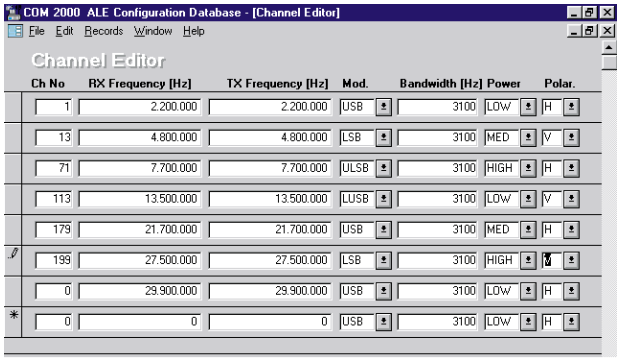


FIG 1
Frequency pool with frequencies available for link setup

Communication or data transfer by shortwave between two stations involves a number of complex processes which are handled automatically by radiocommunication processors specially designed for the purpose. Thanks to this development, shortwave has turned into a reliable transmission medium that can also be used by persons without any expertise in the field of radio. Radiocommunication starts with the setting up of a link to the opposite station.

Continuously changing environmental parameters such as position of the sun and sunspot activity or different geographical locations limit the use of fixed frequencies [3; 4], so special link setup procedures (automatic link establishment, ALE) were devised. These procedures employ automatic frequency selection based on various criteria and means of analysis. In recent years the American FED-STD 1045 [5] has established itself as the international ALE standard and edged most company-specific procedures out of the market. An exception is the ALIS procedure from Rohde & Schwarz [6], which continues to hold its ground as one of the few alternatives on the market. The shortwave transceivers of the XK2000 family offer both the FED-STD and the ALIS procedure.

A precondition for implementing one of the two ALE procedures is a database containing all the required information about other stations together with available frequencies as well as checking and control data. Previously such data had to be entered on the control panel of the transceiver. Now Software COM2000 allows convenient entry of data from a PC. Aided by the self-explanatory entry menus and detailed help function of COM2000, even a user with little experience will find creating an ALE database quite straightforward (FIG 1). The database can be stored as a file or loaded into the transceiver's radiocommunication processor. The database format is standard, so even computer-controlled modifications to the frequency pool are possible for example. COM2000 allows the generation of a database that, distributed to the other stations, ensures uniform, reliable operation. Different databases and custom control programs are obtainable within the COM2000 software package to suit the ALE procedure used.

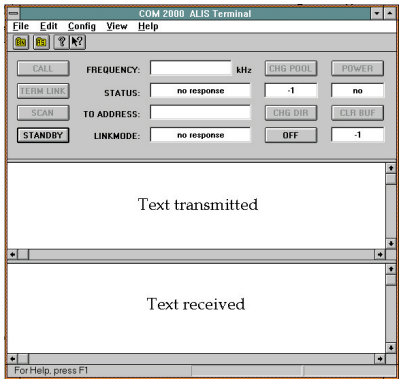


FIG 2 Terminal program for data exchange and dialog with opposite station

Data exchange with another station requires only a PC with a terminal program in addition to the radio installation. COM2000 offers a program with a straightforward user interface for reliable transmission and reception of ASCII and other binary files using Shortwave Transceivers XK2000. In particular, the program supports the input and output of fax files via a fax machine. Dialog windows are also provided for direct communication in text form with another station. The text entered on the keyboard is displayed in the top window and sent to the other station upon pressing the Enter key. The text received from the other station appears in the bottom window (FIG 2).

The messages and files sent are compressed prior to transmission and automatically decompressed by the receiver. This reduces transmission time and boosts data throughput. Additional data link protocols ensure error- and loss-free data transmission. The

Z-modem protocol is used, meaning that after any interruption transmission will continue from where it was interrupted, so that data already transmitted up to this point need not be sent again.

Software package COM2000 is specially tailored to the XK2000 family of transceivers and is a useful tool for data transmission by shortwave. It is ideal support for ALE and designed for data exchange between individual stations. Despite all the capabilities offered by COM2000, preference should be given to the PostMan [7] for operating large networks with higher data volumes.

Thomas A. Kneidel

REFERENCES

[1] Helmke, B.; Wachter, G.: HF Transceiver XK2100 – Digital shortwave for future-proof, long-haul communication. News from Rohde & Schwarz (1994) No. 144, pp 4–7

[2] Träger, R.: HF Transceivers XK2500 and XK2900 – The new members of HF Transceiver Family XK2000. News from Rohde & Schwarz (1997) No. 153, pp 12–13

[3] Waibel, H.; Maurer, P.: PropWiz – Windows program for shortwave link prediction. News from Rohde & Schwarz (1996) No. 152, pp 46–47

[4] Kneidel, T.; Waibel, H.: New PropWiz software makes shortwave link prediction even more convenient. News from Rohde & Schwarz (1997) No. 156, p 28

[5] Wicker, G.; Schippan, E.: International ALE (automatic link establishment) standard for HF Transceiver XK2000. News from Rohde & Schwarz (1997) No. 155, pp 19–21

[6] Greiner, G.: Reliable shortwave with ALIS. News from Rohde & Schwarz (1987) No. 116, pp 47–50

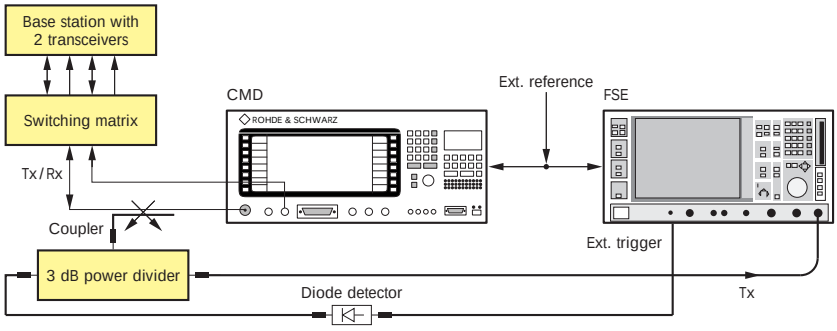
[7] Kneidel, T.: When the PostMan rings on Internet. News from Rohde & Schwarz (1997) No. 153, pp 28–29

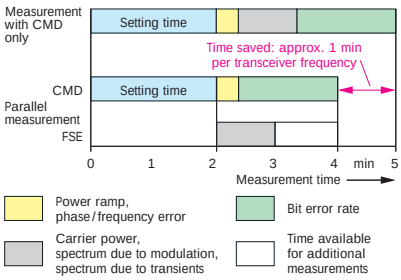
Reader service card 158/15

Reducing time to test GSM base stations

Besides high accuracy and reproducibility of results, speed is of vital importance for in-production testing of GSM900/1800/1900 base stations. The following transmitter measurements are specified for the transceiver module of a base station: phase/frequency error, carrier power, power ramp, spectrum due to transients and spectrum due to modulation. For the receiver, the bit error rate is to be determined.

Measurements must be carried out at different channel frequencies (usually three). **Digital Radiocommunication Tester CMD** performs these measurements sequentially, taking about 5 min per test frequency including the setup time for the base station. If **Spectrum Analyzer FSE with GSM Application Firmware FSE-K11** is used in addition, the total measurement time for a base station can be considerably reduced by parallelization of test sequences. Prior to starting measurements, the base station is configured by means of CMD, which then performs the time-consuming BER measurements. To obtain reproducible results, a sufficient number of frames must be evaluated due to the random distribution of bit errors. Assuming that 3000 frames are evaluated, which makes for sufficiently low fluctuation, the measurement time of CMD will be about 1 min, or 2 min in the case of two receiver inputs (normal and diversity). During this time FSE can perform the transmitter measurements of carrier power, spectrum due to transients and spectrum due to modulation.





By optimizing the test sequences with Software FSE-K11, a measurement time of 64 s is achieved for the measurements carried out by FSE. This is only slightly longer than the time taken by CMD but it does not contribute to the total measurement time. The remaining time window allows additional measurements to be carried out, for instance partial measurement of spurious emissions or spectrum due to modulation in the transmit frequency band. This makes for enhanced test depth without extending the total measurement time. The high sensitivity of FSE makes it possible to measure spurious emissions or the spectrum due to modulation in the transmit frequency band without the use of any additional equipment (eg bandstop filters) in line with GSM11.20/11.21 limit values. For further information see Application Note 1MA06_0E, "Reduced Measurement Time for Testing GSM Base Stations through Parallel Use of CMD and FSE/FSE-K11", which is available from all Rohde & Schwarz representatives.

Roland Minihold

Reader service card 158/16 (CMD), 158/17 (FSE + FSEK11)

Correct usage of quantities, units and equations (II)

Quantities

Physical phenomena are described qualitatively and quantitatively by physical quantities. Every value of a quantity can be represented as the product of numerical value and unit. Any variation of the unit (eg prefix added to unit) yields a different numerical value. The product of numerical value and unit remains constant as it is invariant towards a variation of the unit. Example: V = 0.1 V and V = 100 mV denote the same value of quantity.

Letter symbols for physical quantities are stipulated by DIN 1304 and other standards. Letter symbols are to consist of one letter only, since the use of groups of letters would lead to their misinterpretation in equations as the product of several quantities. For the same reason, abbreviations of names made up of several letters are not to be used to denote a quantity either. To signify the special meaning of a letter symbol, an index in the form of letters or numerals may be added to it.

Quantities of the same kind are given in the same unit. They are distinguished by using different letter symbols or the same letter symbol with index. TABLE 5 shows some examples of quantities of the same kind.

Quantity		SI unit	
Name	**Letter symbol**	**Name**	**Symbol**
Length	l	Meter	m
Width	b	Meter	m
Height	h	Meter	m
Frequency	f	Hertz	Hz
Resonance frequency	f_r, f_{rsn}	Hertz	Hz
Bandwidth	B, f_B	Hertz	Hz
Electric voltage	V	Volt	V
RMS value of voltage	V_{rms}	Volt	V
Power	P	Watt	W
Signal power	P_s	Watt	W
Noise power	P_n	Watt	W
Active power	P, P_p	Watt	W
Reactive power	Q, P_q	Watt	W (also Var)
Apparent power	S, P_s	Watt	W (also VA)

TABLE 5 Examples of quantities of same kind

Equations

The German expressions for quantity equation (Größengleichung), scaled quantity equation (zugeschnittene Größengleichung), numerical-value equation (Zahlenwertgleichung) as well as the relation value_of_quantity = numerical_value_·_unit are based on the work of Julius Wallot between 1922 and 1933. Discussions on this topic culminated in the first edition of standard DIN 1313 (1931): Notation of physical equations.

Quantity equations (DIN 1313) are equations where the letter symbols represent physical quantities or mathematical symbols (numerals, variables, functions, operators). Quantity equations are independent of the units chosen. When evaluating quantity equations the letter symbols are to be replaced by the products of numerical values and units. Numerical values and units in quantity equations are treated as independent factors. Example: the equation

$$V = R \cdot I$$

always yields the same result irrespective of the units used for resistance R and current I, provided the associated products of numerical value and unit are substituted for R and I.

Scaled quantity equations (DIN 1313) are quantity equations where every quantity appears with its unit in the denominator. Example:

$$V/\text{kV} = 10^{-3} \cdot (R/\Omega) \cdot (I/\text{A})$$

The parentheses can be omitted if the assignment of quantities and units is unambiguous, as for example on the left of the equation above or when horizontal bars are used.

$$\frac{V}{\text{kV}} = 10^{-3}\,\frac{R}{\Omega}\,\frac{I}{\text{A}}$$

The scaled quantity equation has the advantage that the quotients of quantity and unit represent the numerical values related to the given units. The equations remain correct if the products of numerical values and units in some other units are substituted for the quantities. In this case however, the units must be converted. The scaled quantity equation is mainly used for representing results.

Numerical-value equations should not be used any more since they have been considered outdated for over 60 years. According to DIN 1313 they need to be specially marked as numerical-value equations and units must be specified for all quantities.

According to the standards, units in brackets are not to be added to the quantity symbols within equations. Unfortunately, bracketing is widely spread – it can even be found in manuscripts of university and college teachers. Example not to be followed:

$$V\,[\text{kV}] = 10^{-3} \cdot R\,[\Omega] \cdot I\,[\text{A}]$$

☹ *wrong*

DIN 1313 rules out this notation. If the quantities in this equation are expressed as products of numerical values and units, the equation does not make sense, since the units appear twice as factors. The scaled quantity equation should be used whenever the relation between numerical values is to be shown.

Logarithmic quantities, attenuation and gain

Logarithmic quantities relate to **logarithmic ratios** of powers or field quantities that define the characteristics of an object (twoport, eg transmission element) [8]. Decibel (dB) is the unit used.

Definition for field quantities (eg for the complex amplitudes of AC voltages):

Voltage attenuation

$$A_V = 20 \lg \left| \frac{V_1}{V_2} \right| \text{dB}$$

Voltage amplification, voltage gain

$$G_V = 20 \lg \left| \frac{V_2}{V_1} \right| \text{dB}$$

Definition for real power quantities (eg active power):

Power gain

$$G_P = 10 \lg \frac{P_2}{P_1} \text{dB}$$

The arguments of the logarithm are quantities of dimension 1 (numerical values). The unit dB is also of dimension 1 and is therefore designated as a pseudo unit. It is not an SI unit. The function lg designates a logarithm to the base 10, log stands for the general logarithmic function.

To be continued.

Dr Klaus H. Blankenburg

REFERENCES

[8] DIN 5493-2: Logarithmische Größen und Einheiten, Logarithmierte Größenverhältnisse, Maße, Pegel in Neper und Dezibel (09/94)

Correction: Table 3 of part I of this refresher topic erroneously gives Θ as the symbol for magnetic flux. The correct symbol is Φ.

Digital terrestrial television broadcasting

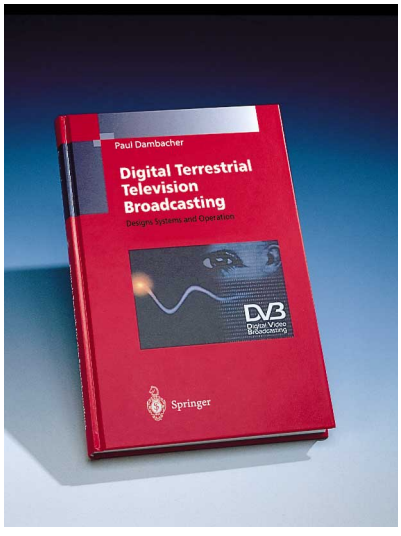
by Paul Dambacher, responsible for strategic marketing of broadcasting, paging and broadband communications at Rohde & Schwarz. The book was published at the end of 1997/beginning of 1998 by Springer of Berlin, Heidelberg, New York. ISBN 3-540-62681-6, 244 pages, 130 illustrations, available in English and German. Price approx. DM 98.

The practice-oriented book focuses on all aspects of digital terrestrial television broadcasting. The author describes its development, the state of analog technology, fundamentals of digital technology and specifications. Implementation with a view to operation and testing is described in detail and technological scenarios of the future are discussed.

The book comprises the following ten chapters:

1 History of the development of digital transmission techniques in TV broadcasting
2 Present state of the terrestrial television broadcasting service
3 Basic principles of digital television transmission
4 Basic parameters of the specification for the digital terrestrial TV transmission
5 Program feeds to the digital terrestrial transmitting stations
6 Technology of terrestrial DVB transmitters
7 Test methods for the digital terrestrial television transmitter
8 Synchronization of the DVB transmitters in a single-frequency network
9 Techniques of measuring the coverage of digital terrestrial television networks
10 Outlook

A detailed list of references and sources ("News from Rohde & Schwarz" in many instances) as well as a table of abbreviations, formulas and terminology round off the publication. The book gives a comprehensive overview of this current topic and is extremely useful for the technical novice and the media and broadcasting expert alike. Wgr



Signal Generators SME03A and SMIQ03A – two milestones on the way to faster measurements

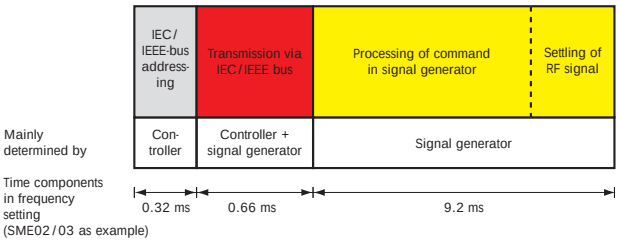


FIG 1
Timing diagram for IEC/IEEE-bus setting of signal generator

The overall time required for a computer-controlled measurement is normally made up of the setting time for the signal source, the DUT settling time, the measurement time of the instrument, the time for data transmission and the time for the controller to run the program. Analyzing the individual components reveals weak points and provides clues for improvements.

In the following, the time response of signal generators controlled via an IEC/IEEE bus is investigated. The time periods of interest are shown in FIG 1. In a comparison of RF signal generators, the time required for setting the carrier frequency (with and without FM) and the carrier level was taken as a typical application. The results are illustrated in FIGs 2 and 3.

The time needed for **IEC/IEEE-bus addressing** was approximately the same for all signal generators; it depends essentially on the controller and its IEC/IEEE-bus interface.

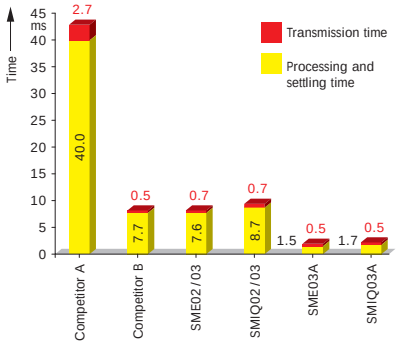


FIG 3 Measured level setting times (variation by 20 dB)

The time for **command transmission via the IEC/IEEE bus** is insignificant in the instruments examined. So any attempts to reduce this will only make a modest contribution to faster measurement time.

The major part of measurement time is taken up by **internal data processing** in the generator (command interpretation, limit checks, calculation of settings) and by **RF signal settling** (the two processes are represented as a single bar in the diagram).

Results confirm the **leading position of Signal Generators SME and SMIQ** from Rohde & Schwarz [1; 2] with respect to short setting times, which is essentially due to the fast synthesis of these units.

Development of a new microprocessor module with a modern 32-bit RISC processor, integrated in the **new SME03A and SMIQ03A models,** has meant a further substantial reduction of setting times, as FIGs 2 and 3 show. The speed advantage makes itself felt in all IEC/IEEE-bus commands and in sweeps as well. The new models are fully compatible with the previous ones. All SME models and SMIQ02/03 can be upgraded.

For applications requiring only a limited number of generator settings, there are two interesting modes for extremely fast setting time: the list mode (in all SME models and in SMIQ02/03/03A) and the new fast restore mode (in SME03A and SMIQ03A), which enables random

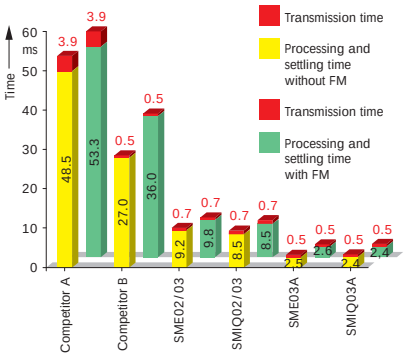


FIG 2 Measured frequency setting times

	SME02/03	SMIQ02/03	SME03A	SMIQ03A
List mode				
Setting time for frequency and level after trigger pulse	480 µs	570 µs	410 µs	410 µs
Fast restore mode				
IEC/IEEE-bus transmission time			40 µs	40 µs
Setting time (complete setup)			800 µs	600 µs

Setting times (measured) of signal generators in list mode and fast restore mode

accessing of up to 1000 stored settings via the IEC/IEEE bus (see table in blue BOX). SME03A and SMIQ03A rank as the fastest units worldwide among all IEC/IEEE-bus-controlled RF signal generators.

Kurt Lainer

REFERENCES

[1] Lüttich, F.; Klier, J.: Signal Generator SME: The specialist for digital communications. News from Rohde & Schwarz (1993) No. 141, pp 4–7

[2] Klier, J.: Signal Generator SMIQ – High-quality digital modulation up to 3.3 GHz. News from Rohde & Schwarz (1997) No. 154, pp 4–6

Reader service card 158/18 (SME), 158/19 (SMIQ)

Twenty-four complete mobile-radio coverage measurement systems for China

FIG 1 Coverage Measurement System TS9955 configured around Test Receiver ESVB
Photo 43 125/2

Guangdong Mobile Communication Corporation (GMCC), the network operator in China with the largest number of mobile-radio subscribers per province at present, contracted Rohde & Schwarz to deliver 24 complete Coverage Measurement Systems TS9955. With this project GMCC is taking an important step towards fast expansion of its mobile-radio networks. The coverage measurement systems are used to plan, optimize and monitor the quality of GSM900/1800, CDMA and ETACS (extended total access communications) networks. High quality, universal measurement capabilities, the advanced platform and modular system concept were the decisive points in selecting the Rohde & Schwarz solution.

FIG 2
Coverage Measurement System TS9955 installed in vehicle (VW Sharan)
Photo 43 125/1

The entire instrumentation of the coverage measurement systems is accommodated in a 19-inch rack and installed in a vehicle (FIGs 1 and 2). The systems are equipped with ultramodern Test Receivers ESVB for highly precise and fast mapping of field strength. Interference and reflection measurements in the operational GSM network are also possible. Signalling parameters are determined by special test mobiles simultaneously with field strength and stored in realtime together with position data collected by a satellite navigation system (GPS). The systems are controlled by versatile, easy-to-operate software running under Windows 95. Powerful evaluation software is in place for subsequent processing of measured data.

Johann Maier

Reader service card 158/20

Rohde & Schwarz – a partner for in-production testing of mobile phones

Mobile and cordless phones are high-tech products that are expected to operate reliably and errorfree to standards such as GSM, CDMA, TETRA or DECT. The manufacturer has to perform extensive tests during production to guarantee compliance with the above requirements. In general terms, the following steps make up the production of mobile phones (FIG 1): component insertion and soldering of modules, functional test of modules at PCB level, assembly of enclosure, final test of mobile. The test strategy for series production of mobile phones calls for test cycles that are as short as possible and involve minimum effort and expenditure. The objective is to detect production errors caused by incorrect component placement, soldering faults or defective components. To keep repairs to a minimum, errors should be detected and eliminated as soon as possible, ie at the end of each production step.

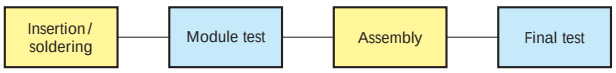


FIG 1
Steps in mobile phone production

The following typical parameters of the individual modules are determined for a GSM mobile phone during **RF functional testing and RF alignment:**

Oscillators	frequency and phase
VCO circuit	voltage
AFC stage	frequency
RF transmitter stage	RF power, power time template, frequency and phase error, adjacent-channel interference
RF receiver stage	bit error rate

Parameters to be checked during the **final test** are:

RF stage	AGC adjustment for power stages
GSM signalling	location update, call setup and cleardown, control channel (eg RxLev and RxQual)
Audio section	frequency response
Display	optical features of display matrix
Keypad	mechanical functions

Design-specific features usually have to be tested, too. For cordless phones, a test of the wired telecommunication interfaces is also required.

As a market leader in the field of digital mobile radio testers, Rohde & Schwarz offers solutions for all these tests and to all common standards (FIG 2). Complete system solutions for the production of mobile and cordless phones are also available, ranging from the transport line with fixture stations for contacting the module through test system hardware to special software for performing the required tests. Rohde & Schwarz assumes overall system responsibility. This means definition of a test concept together with the customer, delivery of test system hardware, provision of software with standard test cases and customer-specific test cases, on-site system engineering, adaptation to the conveyor system, service, remote maintenance and calibration. Support for such systems is provided throughout the world.

Erwin Böhler

FIG 2 Digital Radiocommunication Testers CMD have their notch in mobile phone production to any standard. Photo 42 944/1

Reader service card 158/21

200-A Four-Line V-Network ENV4200 for measuring RFI voltages at high currents

200-A Four-Line V-Network ENV4200 is the latest of Rohde & Schwarz's V-networks for measuring RFI voltages on power lines that carry very high currents (FIG). This joins the widely used 25-A Four-Line V-Network ESH2-Z5 covering the frequency range from 9 kHz to 30 MHz [1] and the smaller V-Networks ESH3-Z5 (two-line V-network, 16 A, 9 kHz to 30 MHz) and ESH3-Z6 (single-line V-network, 150 A, 0.1 MHz to 200 MHz) [2].

V-Network ENV4200 for measuring RFI voltages on line connectors with very high currents
Photo 42 884

V-Network ENV4200 is in line with the requirements of CISPR 16-1, VDE 0876 and ANSI C 63.4 for V-networks with an impedance of 50 µH || 50 Ω in the frequency range 150 kHz to 30 MHz. It is based on air-core inductances and contains an artificial hand.

Background: CISPR 16-1 specifies two types of V-networks for the frequency range 150 kHz to 30 MHz, one with an impedance of 50 µH || 50 Ω (type 1) and another with an impedance of (50 µH || 5 Ω) || 50 Ω (type 2). The latter is also suitable for the frequency range 9 kHz to 150 kHz but not for very high currents, since it requires an isolating choke of 250 µH. V-Network ENV4200 corresponds to type 1, whereas V-Networks ESH2-Z5 and ESH3-Z5 are type 2. The maximum current of the V-network is limited by the voltage drop at the standardized inductances (CISPR 16-1 limits the voltage drop to 5% of the line voltage) and by unavoidable heat generation.

The maximum continuous current on all four ENV4200 terminals is 100 A with the fans switched off and 200 A when they are switched on. If the internal power supply is used and the temperature limit is exceeded, the fans switch on automatically.

Key data of V-Network ENV4200 in brief:

- frequency range 150 kHz to 30 MHz,
- V-network to CISPR, EN, VDE, ANSI,
- impedance 50 µH || 50 Ω,
- built-in artificial hand,
- continuous current up to 4 x 200 A,
- DC resistance per path 6.7 mΩ,
- line frequency range 0 to 63 Hz,
- maximum permissible line voltage 260 V (voltage to neutral; corresponds to 450 V line-to-line voltage in three-phase system),
- air-core design,
- built-in pulse limiter,
- remote control with TTL levels (compatible with Rohde & Schwarz receivers),
- calibrated to CISPR (draft) and ANSI C 63.4.

For connection to the line and DUT, ENV4200 is provided with all-insulated screw terminals for taking up cable clamps of sufficient current-carrying capacity.

The phase can be manually selected by means of a front-panel switch or automatically via TTL control inputs compatible with the latest Rohde & Schwarz test receivers. Commercial standard cables (wired 1:1) with 25-pin Cannon connectors can be used as control cables for test receivers of the ESxS family (ESHS, ESS, ESPC and ESCS) [3]. Special control cables are required for test receivers of the ESxI family (ESAI, ESBI and ESMI).

Manfred Stecher

REFERENCES

[1] Brogl, P.: Artificial-mains network ESH2-Z5 for measuring interference. News from Rohde & Schwarz (1981) No. 92, pp 30–31

[2] Stecher, M.: Artificial-mains networks for EMC measurements. News from Rohde & Schwarz (1987) No. 117, pp 15–19

[3] Janssen, V.; Weidner, K.-H.: EMI test receivers from 5 Hz to 26.5 GHz – Concept of EMI instrumentation has proven itself. News from Rohde & Schwarz (1997) No. 156, pp 10–12

Reader service card 158/22

Design 2000, the new enclosure system

FIG 1 Design 2000 is a systematic solution: a variety of enclosures can be formed from just a few basic elements. Photo 42 980/3

Rohde & Schwarz is synonymous with electronic precision and mechanical perfection. This means a commitment to unite quality and value in a product. Based on this guiding principle the fifth enclosure generation – design 2000 – was developed. The new design meets all the criteria that modern electronic packaging has to fulfill, making it fully in tune with the wide range of T&M and communication products from Rohde & Schwarz beyond the year 2000.

FIG 2 Swivel keyboard – only one example of large number of accessories and special fittings available for design 2000 Photo 42 980/1

Design 2000 is a standardized enclosure system well suited for desktops, for mobile applications and for mounting in 19-inch racks to standard DIN 41494. With only a few basic elements, a wide range of enclosures can be formed, from one to five height units and in different widths and depths (FIG 1).

The new system is far more than just packaging. Besides high stability and all-round protection against severe mechanical stresses, the designers paid particular attention to air-conditioning the equipment-specific modules and to shielding against electromagnetic interference. With the objective of achieving low weight, only aluminium and plastic are used as basic materials. The installation-friendly concept is the result of close cooperation between designers and specialists from prefabrication and final assembly.

The designers proved their ecological awareness in the development of design 2000. All current environmental and recycling criteria for product design were systematically taken into account. This is attested by a certificate awarded for the enclosure system by a well-known recycling enterprise.

A wide range of accessories and special fittings add to the versatility and flexibility of design 2000. Besides the 19-inch adapters required for rack-mounting, the enclosures can also be equipped with swivel keyboard (FIG 2), extra side-grips and carrying straps. This is all rounded off by carrying handles and robust shock-absorbing elements, equipment-specific transit cases and carrying bags.

Harmony between engineering and design was the objective mapped out for the creation of design 2000, based on the design rule "Form follows function" and ergonomic aspects. Its individual look without any frills but with an aura of technology makes design 2000 really striking. The interplay of hard edges and soft contours expresses both technical precision and dynamism. Pleasant, light RAL colours in traditional greys and blues underline Rohde & Schwarz corporate identity. Together with the new front-panel design, a new enclosure generation has been created that will be fit for many years to accommodate all innovations from Rohde & Schwarz.

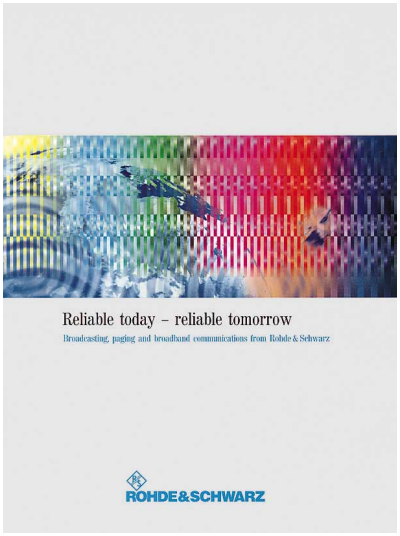
It remains to be mentioned that design 2000 received the coveted *iF Product Design Award 1998* and *iF Ecology Design Award 1998* from the Industrie Forum Design Hannover. The iF seal for excellent design is a prize recognized throughout the world for industrial products. For the consumer it is a reliable indicator of outstanding product quality.

DESIGN AWARD WINNER 1998 iF INDUSTRIE FORUM DESIGN HANNOVER

Hans-Dieter König; Helmut Hingrainer

Reliable today – reliable tomorrow Broadcasting, paging and broadband communications – no matter whether analog, digital, terrestrial, via cable or satellite – are fields in which Rohde & Schwarz is a partner offering anything from individual components to complete paging networks, so all the operations and test equipment required can be obtained from this single source.

Info PD 757.3663.21 enter 158/23



Vector Network Analyzer Family ZVR The updated data sheet presents the new analyzers for bidirectional measurements **ZVC** and **ZVCE** (20 kHz to 8 GHz) offering largely the same features as ZVR and ZVRE. It also contains the modified order numbers of the ZVR models including the separate ZVR and ZVRE active and passive test sets. New options: virtual embedding network for ZVR and ZVC (with computer function) and two four-port adapter models.

Data sheet PD 757.1802.23 enter 158/01

Portable Industrial Controller PSP Extended RAM/mass memory (16 Mbyte/≤1 Gbyte). New option: 16-Mbyte Memory Extension PSP-B2.

Data sheet PD 757.2515.22 enter 158/24

Application Firmware FSE-K10 and FSE-K11 enables complex standard-conforming GSM measurements on mobile and base stations at a keystroke.

Data sheet PD 757.3592.21 enter 158/25

EMI Package EMI-LINE (150 kHz to 1 GHz) The complete solution for EMC precompliance measurements consists of EMI Test Receiver ESPC, Shielded TEM Line S-LINE 700, Software ESPC-K1 and cabling; separate US model available.

Data sheet PD 757.3834.21 enter 158/26

Quality Management System QUOTIS allows evaluation of test data and offers repair support with learning capability as well as paperless repair. Specifications are listed on insert sheet.

Info PD 757.3757.21
Data sheet PD 757.3763.21 enter 158/27

DVB Modulator/Transmitter CT100QT (47 MHz to 862 MHz) modulates IF carriers with MPEG2-coded data streams (16QAM to 256QAM, selectable) and converts them to a fixed RF. ASI and LVDS interfaces and filter module (RF range) available as options.

Data sheet PD 757.3786.21 enter 158/28

System Service for T&M and Communications Products Maximum availability of instruments and systems is guaranteed by **R&S Cologne Plant,** the ideal partner for any service requirements.

Info PD 757.3570.21 enter 158/29

Don't let your DECTective story remain a mystery. For optimum solution of problems occurring in communication with DECT equipment, Rohde & Schwarz with its test facilities, service and support is the choice on hand.

Info PD 757.3986.21 enter 158/30

New application notes

GSM Mobile Tests under Conditions of Fading
Appl. 1MA02_0E enter 158/10

BER Measurements on DECT Receivers under Conditions of Fading
Appl. 1MA03_0E enter 158/11

BER Measurements on GSM Receivers under Conditions of Fading
Appl. 1MA04_0E enter 158/12

Level Error Calculation for Spectrum Analyzers
Appl. 1EF36_0E enter 158/31

Measurement of Modulation Spectrum on GSM/DCS/PCS Mobiles acc. to GSM 11.10-1
Appl. 1MA01_0E enter 158/32

Synchronization of the Data Rate of TV Test Transmitter SFQ with an External Clock
Appl. 7MGAN16E enter 158/33

PostMan delivers e-mail messages to places the milkman would never go! This poster presents the message handling software serving as a wireless link to international networks.

Poster PD 757.3670.21 enter 158/34

Schz

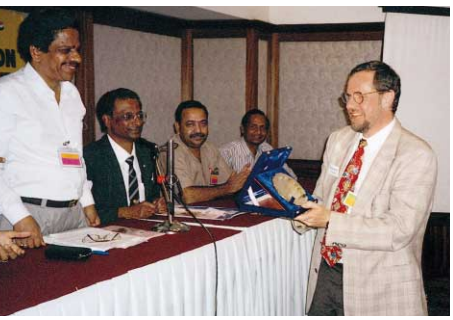


Photo: Müller

EMC symposium in India

An EMC symposium, organized by the Indian institute of EMC engineers, was held in Hyderabad in early December 1997. INCEMIC 97 opened with a song in Sanskrit interpreted by A. R. Sharma, the content of which unfortunately remained inaccessible to the European participants. Following this Dr Abdul Kalam, parliamentary under-secretary and scientific adviser to the defense ministry, spoke of the increasing importance of electromagnetic compatibility, in particular in the military sector.

During the following three days the subject of EMC was treated from many different angles before the 230 persons attending. Rohde & Schwarz in Munich contributed two lectures. Dr Klaus-Dieter Göpel spoke about his invention, EMC Test Cell S-LINE, which means a considerable simplification for measurements of electromagnetic susceptibility (EMS) and interference (EMI). Karl-Otto Müller expounded the application of Europe's EMC directive in member states. It was particularly rewarding for Rohde & Schwarz when the twelve-man jury selected Dr Göpel's lecture as the best of all 95 contributions and presented him the "Best Paper Award" (photo above).

In the small exhibition accompanying the event, Rohde & Schwarz India was the only one of eleven firms present that not only distributed literature but also demonstrated modern EMC instrumentation on its stand. The fact that Rohde & Schwarz co-sponsored INCEMIC 97 and invited all participants to lunch in true Indian style on the second day of the symposium all left a very positive impression of the Munich company. AS

Rohde & Schwarz – European service partner for Netro of the USA

Rohde & Schwarz Cologne Plant and Netro Corporation of Santa Clara in California signed a cooperation deal in January 1998. Netro designs, produces and sells radio relay equipment. Its products are suitable for creating both point-to-point and point-to-multipoint links using asynchronous transfer mode (ATM). ATM is the most advanced way of implementing bandwidth-intensive data communication in a network. This high-speed data transmission serves new network operators, for example, who support applications in municipal networks and offer standard user interfaces for local network access or a direct link through to the customer.

Rohde & Schwarz Cologne Plant is one of Europe's biggest service centers for electronic test and communications equipment. It offers maintenance and repair, training, system integration and interfacing plus various other services for information and communication projects. The deal with Netro covers radio relay project management, on-site installation and engineering support, technical documentation, training, warranty services and repairs.

PI

Expo Comm China South 97

Asia's leading telecommunications and computer show was staged in early December last year at the Guangzhou China Foreign Trade Center. It is an event comparable to CeBIT in Germany. As many as 10 000 visitors per day came to find out about what is new in the sector, and especially in mobile communication. Mobile phones of every size, shape and colour were presented in animation and performance shows. Computer software that transmits and detects script, Internet access, creation of home pages and video conferencing were also at the focus. International post and telecom corporations – primarily China Telecom, German Telekom, France Telecom, Nortel and Telital – wooed the favour of the visitors, plus big-name producers like Ericsson, Nokia, Motorola, Alcatel, Qualcom and Lucent of course.

Attending from Germany, besides Telekom, were Siemens, Wandel & Goltermann and Rohde & Schwarz. Li Xunsheng, Liu Albert and Xue Sydney of Rohde & Schwarz China (from left in the photo below) were able to welcome many visitors at the company stand. The communications market in China is booming and there seems to be no end in sight. V. Janssen

Photo: Janssen

Rohde & Schwarz faculty prizes in Jena

The two founders of Rohde & Schwarz completed their scientific education in 1932 when they received their doctorates from the physics and astronomy faculty of Friedrich Schiller University. This faculty awarded Dr Hermann Schwarz an honorary doctorate in 1992 (sadly Dr Lothar Rohde did not live long enough to be honoured in the same way). Because of his close ties with the university in Jena, Dr Schwarz instituted prizes to be awarded annually for the best dissertation and the best thesis in the physics and astronomy faculty. The recipients are selected solely by the university, without any influence on the part of Rohde & Schwarz. In January 1998 the prizes, for the best work during 1997, were presented for the seventh time. The event, presided over by the dean of the faculty, Prof. Roland Sauerbrey, took place within a festive colloquium in the renovated auditorium 1 of the Abbeanum in Jena. In his laudatory speech for winner Dr Wolf Gero Schmidt, the dean emphasized that the latter, in his dissertation on "The influence of thin metal and passivation layers on the surfaces of III-V compound semiconductors", had produced results far beyond what had been expected. They have great economic significance for the manufacture of modern components from such semiconductors because they help to increase production yield through better understanding of atomic structures.

Photo: Müller

The second prize winner, Falk Ziesche, investigated whether equilibrium potentials, like free energy, contain information about the rate of decay of instable states. Although Ziesche was only able to get close to the answer, his exceptionally thorough research produced other new findings that are being received with great interest in scientific circles.

The faculty prizes, presented to Dr Schmidt (left in photo above) and Falk Ziesche (right) by Karl-Otto Müller, demonstrate Rohde & Schwarz's interest in promoting scientific education. AS

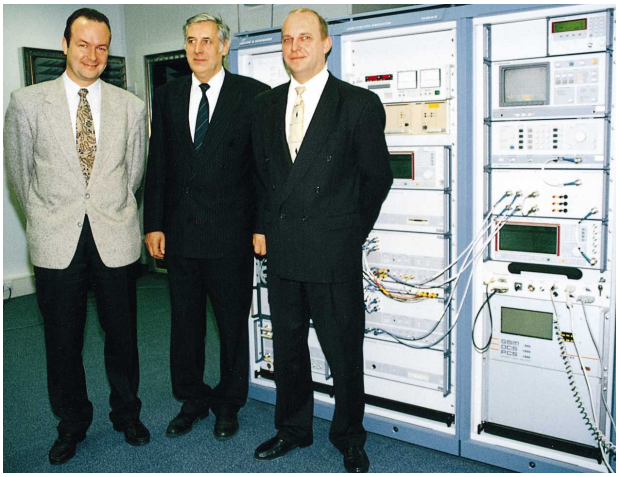


Photo: Blask

Rohde & Schwarz delivers type approval test system to ETS

Within a week of the opening of the new technology center of the firm Electronic Technology Systems (ETS) in Reichenwalde near Berlin at the beginning of December 1997, Rohde & Schwarz had delivered a GSM System Simulator TS8915 (see News from R&S No. 157, p 28) and put it into operation. The photo above shows the two directors of ETS, Dr Dietmar Genz (right) and Norbert Kaspar (center), and the system in the background. ETS is now in a position to carry out standard tests and type tests on GSM900/1800/1900 mobile radio stations. The company has been successful internationally since 1995 through its capability to perform approval tests for DECT, ISDN and analog cordless phones as well as tests in the EMC sector. D. Blask

ACCESSNET® trunked radio systems cover India's big cities

R&S BICK Mobilfunk recently received an order from Jasmine Telecom India Ltd in New Delhi for ACCESSNET® trunked radio systems to provide coverage in eight of the country's biggest cities, including New Delhi, Bombay and Calcutta. "We're very proud that our mature and proven ACCESSNET® system, with its unmatched variety of functions and features, should have been selected by Jasmine Telecom to expand its offering of radio services to the public," said Heinz Bick, the company's president. "This success in India marks a major milestone in our global marketing strategy."

PI

Car radio test systems from Cologne

At the end of 1997/beginning of 1998 two new car radio test systems from Rohde & Schwarz Cologne Plant started operation at Micronas Intermetall in Freiburg and VDO Car Communication in Wetzlar. At Intermetall the fast and precise test system will be used primarily for design optimization. A Signal Generator SMIQ in the system produces digitally modulated World-space data. Use of the Rohde & Schwarz car radio test system is nothing new for VDO, there are already two systems working in quality assurance. The new test system is intended for the planned Car Communication Service Center in Knoxville, Tennessee in the USA. Activities here will focus on digital signal processors and navigation systems in addition to car radios.

Extra to car radio testing, the system software supports acquisition of audio quality criteria as well as RDS and VRF parameters on AM and FM receivers and amplifiers, CD, DAT and CR units. Combined recording/replay tests, where the signal can be applied through the FM receiver or a CD unit, allow checks of compact sets. The audio test system can be configured with one, two or three signal sources and customized for the application.

Further test systems of this kind are already in use with Karstadt, Delco Electronics, Interconti and Opel for quality assurance and design optimization. H. Heussen

Reader service card 158/35

Manuals on CD-ROM

Customer documentation from the Rohde & Schwarz Test and Measurement Division is now being produced on CD-ROM. To begin with, manuals are available for the spectrum analyzers of the FSE family including the vector signal analyzer option, with an application note on operation of the IEC/IEEE bus and a number of application programs. All editions are in English. The CD-ROM is a complement and alternative to the printed manual. Integrated user guidance helps the reader find items and chapters speedily and simply, and there is a full text index for tracing key terms. The CD-ROMs are produced in pdf format; an installation version of the viewer (Acrobat Reader) is included. Contents can easily be printed out on A4 or US letter paper. CD-ROMs for other equipment families are in preparation. Dr M. Jetter

30 DAB Analyzers FD1000 for German Telekom

German Telekom has procured itself more than 30 transport frame decoders FD1000 from Rohde & Schwarz to ensure optimum availability of its new transmitter network for digital audio broadcasting. FD1000 is used to analyze, monitor, log and record data streams on the ETI (ensemble transport interface) and STI (service transport interface). ETI and STI data streams serve for transporting audio signals in CD quality from a studio via satellite or radio relay link to the transmitter site.

Other broadcasters like Westdeutscher Rundfunk are set to use FD1000 as a key component in operating and monitoring their networks. FD1000 can work as a stand-alone or be integrated into the TS6100 monitoring system.

C. Christiansen

Reader service card 158/36

TV Monitoring System TS6120 in use at NDR

Following years of working successfully with the UPKF and TOPAS TV monitoring systems, broadcaster Norddeutscher Rundfunk (NDR) again chose tried and tested Rohde & Schwarz technology for an upgrading of its systems. At its 17 largest sites NDR will now monitor and evaluate the availability and quality of terrestrial transmissions with the TS6120 system (photo below). This system comes with a graphical user interface that is extremely easy to work with and runs under the MS Windows operating system. NDR is the latest member in the community of providers worldwide who use this system to monitor both digital and analog sound and television programs to ensure their customers constant availability.

TS6120 is a modular, flexible and future-oriented system offering capability for monitoring upcoming digital program packages.

C. Christiansen

Reader service card 158/37

The title spread of edition 1/98 of "hf-praxis", a specialist magazine for RF and microwave engineering, showed a combination of portable Miniport Receiver EB200 and Active Handheld Directional Antenna HE200, a powerful duo for radiomonitoring from 10 kHz through 3 GHz while on the move.

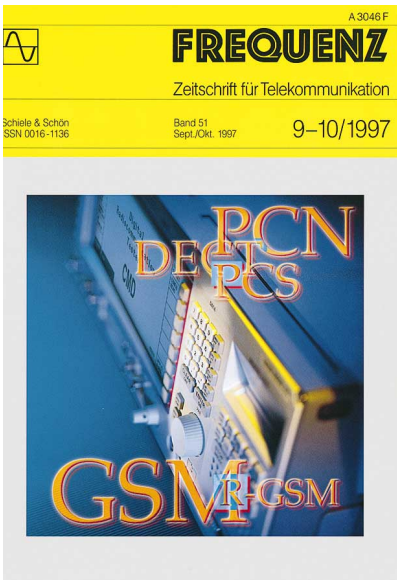
The cover theme of issue 4/97 of the electronics journal "HF-Report" was measurement of crystal filter skirt selectivity. The photo showed Signal Generator SMY (with Spectrum Analyzer FSEB), whose spectral purity and high carrier frequency accuracy produce an optimum solution to the application.

Perhaps not the prettiest of testers, but the only one with a dream 19-inch waistline. That was how "Markt & Technik" presented the small and compact Test Workstation TSA on the title page of its special electronics production issue. It fits perfectly into any 19-inch environment and satisfies all the demands made on an advanced test system.

Are you secure?

Frank Backasch, senior editor of "IK – Ingenieur der Kommunikationstechnik", a magazine for information and communication technology appearing in Berlin, asked his readers this question in his editorial on the subject of ISDN in issue 6/97:

In "a good handful" of cases in the past the BSI (German Information Security Agency) assumes that there have been determined attempts to penetrate telecom systems. The BSI was not prepared to stand by any longer without doing anything about it, especially where sensitive applications like the Berlin – Bonn information link are concerned. In an invitation to bid, SIT (corporation for information technology systems, a subsidiary of Rohde & Schwarz) won out against seven competitors and was contracted to design the ISDNWall for the BSI.



Focus on R&S spectrum analysis

Spectrum analyzers from Rohde & Schwarz hit the headlines last November in two major US electronics magazines. "Microwave Journal" presented Spectrum Analyzer FSEK, while "Microwaves & RF" took a look at the FSE family with its FSE-B7 option:

FSE plus vector signal analyzer option FSE-B7 is the first high-grade spectrum analyzer whose RF characteristics and the spectral purity of its synthesizer allow you to measure all parameters in the spectral or time domain and all modulation parameters in the 3.5 and 7 GHz bands.

Multiband and multimode

Measurements in mobile radio continue to be a focal topic. The telecommunications magazine "Frequenz" looked at the subject, and in particular Digital Radiocommunication Tester CMD65, in its 9-10/97 edition:

The spread of multimode cell phones and the wish of service shops as well as producers to be able to test to different network standards on a cost-efficient basis mean that there is a need for test sets with multistandard capability. Rohde & Schwarz is in place to satisfy the demand. Digital Radiocommunication Tester CMD65 can perform measurements on GSM, PCN, PCS and DECT mobile phones, while model CMD80 supports CDMA in several frequency bands as well as analog AMPS.

DECT product testing

In its title story "Testing DECT products", the European edition 10-11/97 of "Test & Measurement" presented T&M technology for DECT from Rohde & Schwarz:

The protocol testers from Adherent and Rohde & Schwarz demonstrate interesting versatility. To speed up time to design and satisfy current market demands for a protocol tester, Adherent uses as much standard hardware and software as possible in its ST2002 model. Rohde & Schwarz chooses a different approach. The compiler accepts standard test cases in TTCN and allows the user to write new ones in TTCN or C. Holger Jauch of Rohde & Schwarz sees compiling time as being of secondary importance compared to the time engineers need for debugging their own programs: "Most engineers are not familiar with programming in TTCN, so we've opted for C language as an intermediate code. In this way customized test programs can be edited and cleared of errors both in TTCN and in the C intermediate code."

Airspace safety and Austro Control – an excellent combination

More than 700 000 instrument flights were safely directed through Austria's airspace by Austro Control in 1997, with up to 2700 flight activities every day. Austro Control, with headquarters in Vienna, emerged from the Austrian Federal Office of Civil Aeronautics in 1994 and has been kept really busy ever since: "We do everything that in Germany is done jointly by air traffic control, the German Meteorological Service and the Federal Office of Civil Aeronautics", says Johann Rausch, Chairman of the Board of Directors of Austro Control (FIG 1) who shares his love of flying with Dr Lothar Rohde, the co-founder of Rohde & Schwarz. Controlling Austrian airspace means a variety of, in part, very complex tasks: surveillance of air traffic, control of compliance with air traffic regulations, aeronautical meteorological service, approval of civil aircraft and equipment, supervision of aircraft maintenance, installation and operation of air traffic control systems, operation of one of the two meteorological databases existing in Europe, and much more. To handle all this, Austro Control employs a staff of about 1000 working at ten different locations (FIG 2). About 300 employees are qualified air traffic controllers – modern-day guardian angels so to speak.

FIG 1 Johann Rausch, President of the Austrian Federal Office of Civil Aeronautics from 1982 to 1994, is Chairman of the Board of Directors of Austro Control in Vienna.

Photo of building: Austro Control

Austro Control is highly regarded internationally, and for good reason, because its ATC outfit is among the most advanced in the world. It has already integrated short-term conflict alert for example, which to date has only been introduced by five or six other ATC bodies worldwide. Air traffic controllers can draw on special support from VAS (Vienna Air Traffic Control System). Mainframe computers with dual redundancy and uninterruptible power supplies collect all relevant data and combine them to what is known as the label on radar screens (FIG 3). Austrian airspace is controlled by three medium-range radar systems located at Buschberg, Feichtberg and Koralpe (FIG 2).

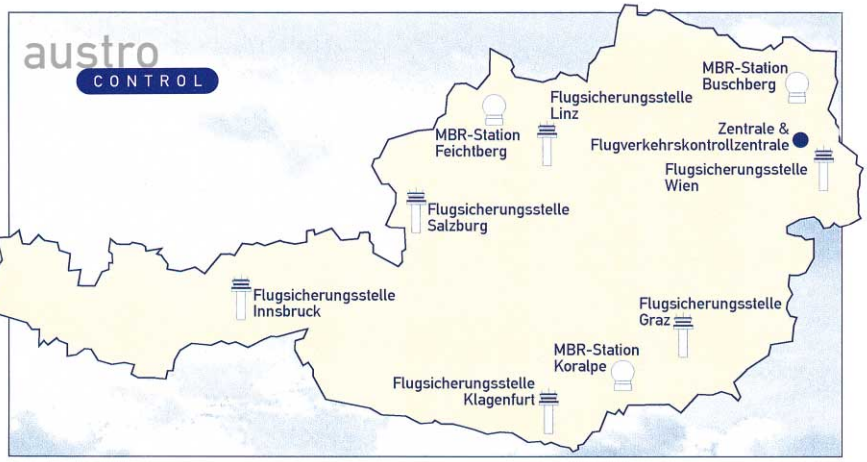


FIG 2 Austro Control is not only installed at the ATC center in Vienna but also at Austria's six major airports. It operates three medium-range radar stations (MBR).

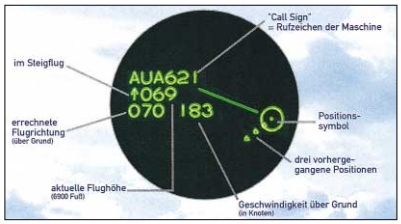


FIG 3 The calculated label shows the air traffic controller the call sign of the aircraft (top), the current and three previous positions (right), climb or descent with current flight altitude (center), flight direction above ground (bottom left) and ground speed.

FIG 4 Engineer Friedel Geiger, head of telecommunications at Austro Control, had his first contacts with Rohde & Schwarz in the early 60s when he began working in the field of ATC.

In such a scenario, reliable radiocommunication is of vital importance. Engineer Friedel Geiger (FIG 4), head of telecommunications at Austro Control and responsible for everything in any way related to voice communication, thinks that the best is just good enough. To cope with the tremendous increase in air traffic – roughly 9% per annum during the last ten years – alone in terms of communication, an extensive replacement program is currently under way for all single- and 6-channel Aeronautical Transmitters SU151 and SU156 from Rohde & Schwarz procured in 1979. State-of-the-art single-channel transmitters, receivers and transceivers of series 200 (FIG 5) will be installed in their place for ACC (area control center), approach control and in the control towers, this being necessary among other things because of the newly introduced 8.33 kHz channel spacing [1]. Rohde & Schwarz won the order not only because it submitted the best offer. In Geiger's opinion: "Series 200 is highly versatile; it's almost incredible what it's capable of." He takes his responsibility very seriously, so he tests all incoming equipment not only to relevant standards but also in an "unconventional way". "Of course it's all very well if everything works according to specifications, but for me it's especially important that transmitters, receivers and transceivers should show their mettle in real conditions" (FIG 6). He and his staff are supported in their work by Rohde & Schwarz test equipment: Radiocommunication Service Monitors CMS54 and CMS57, Modulation Analyzers FMAV, Network Analyzers ZVR and Spectrum Analyzers FSE [2].

About half of the several hundred units had been replaced by the end of 1997, priority being given to sites that especially need capability for 8.33 kHz channel spacing, for example control stations for upper airspace. The private broadcast stations set up in recent years are a particular headache for Geiger because of the critical intermodulation that they produce in the ATC band. "Unfortunately the special intermodulation computing program hasn't been around as long as the frequency allocation plan. It's not enough just to tell a radio operator that he's causing interference, we've got to prove it." With VHF-UHF Receivers ESM500 or Spectrum Analyzers FSE from Rohde & Schwarz he is able to gather watertight evidence, "but being right and getting your rights are two different things." As a result Untersberg (Salzburg), a first-class site for reception, had to be abandoned because of interference and the station moved to Feldkirchen. All receiving sites must now be coordinated, installed, operated or moved to avoid broadcast stations in the immediate vicinity. From headquarters in Vienna all receiving sites can be monitored and operated by a telecontrol system (FIG 7). At the time of our visit, Geiger and his colleagues were busy adapting the interfaces of this system to the new series 200 equipment.

Geiger and his department have a reliable partner in Rohde & Schwarz Austria (RSÖ). Equipment and software from Munich are adapted in close cooperation with RSÖ to produce the desired, tailor-made solution. Deliveries are being made continuously, and commissioning follows straight on. "We've set up an action plan with all steps exactly defined so that the replacement process runs as smoothly as possible. RSÖ takes care of any problems and finds solutions rapidly and with a great deal of commitment."

FIG 5
A glance into the North transmitting center at Vienna's Schwechat airport: series 200 wherever you look.

FIG 6
Model transmitting/receiving system with series 200 radio equipment at Austro Control headquarters for approval of voice communication system

Austro Control is a nonprofit organization that operates to cover its costs. Rohde & Schwarz direction finders also make a contribution here to the demanding challenges of airspace and air traffic control (FIG 8). In the air too, Austria is a transit country with increasing volume of traffic. Forecasters see further growth of 46% during the next five years, so Austro Control is not likely to complain of little to do in keeping things up (in the air) and going.

Christian Rockrohr

REFERENCES

[1] Klarl, H.-G.; Kessler, M.: Series 200 and 400U radio equipment – Innovations in ATC radiocommunications: RCMS and 8.33 kHz channel spacing. News from Rohde & Schwarz (1996) No. 152, pp 14–16

[2] Rohde & Schwarz: Test & Measurement Products Catalog 1996/97 (PD 756.3501.25)

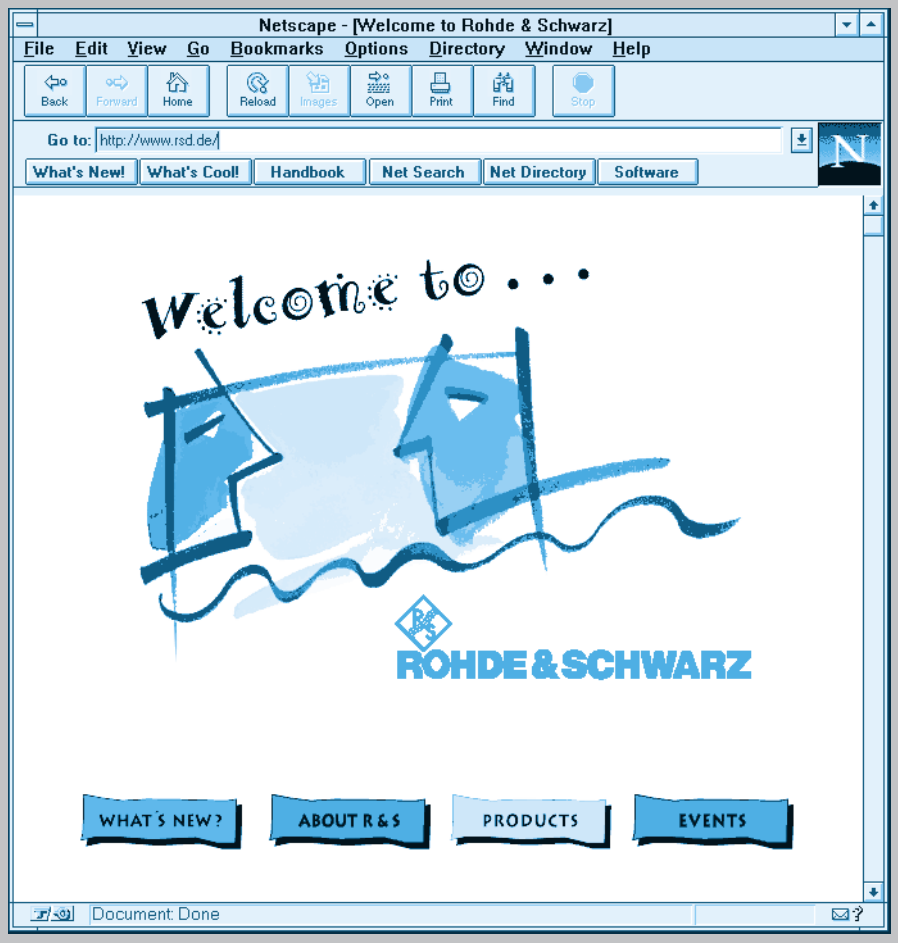
FIG 7
All receiving stations throughout Austria are monitored and operated through a telecontrol system from workstations like this one.

FIG 8 Two direction finders from Rohde & Schwarz at Vienna Schwechat: the old PA007, still working well after 21 years, and the new PA100

Photos: author

Reader service card 158/38 for further information on series 200 radiocommunication equipment

Visit us on Internet at www.rsd.de



ROHDE&SCHWARZ

ROHDE&SCHWARZ GmbH & Co. KG · Mühldorfstraße 15 · D-81671 München
P. O. B. 80 14 69 · D-81614 München · Tel. (+49 89) 41 29-0 · Fax (+49 89) 41 29-21 64

News from Rohde & Schwarz 158 (1998/II) · PD 757.3870.21 · B42622