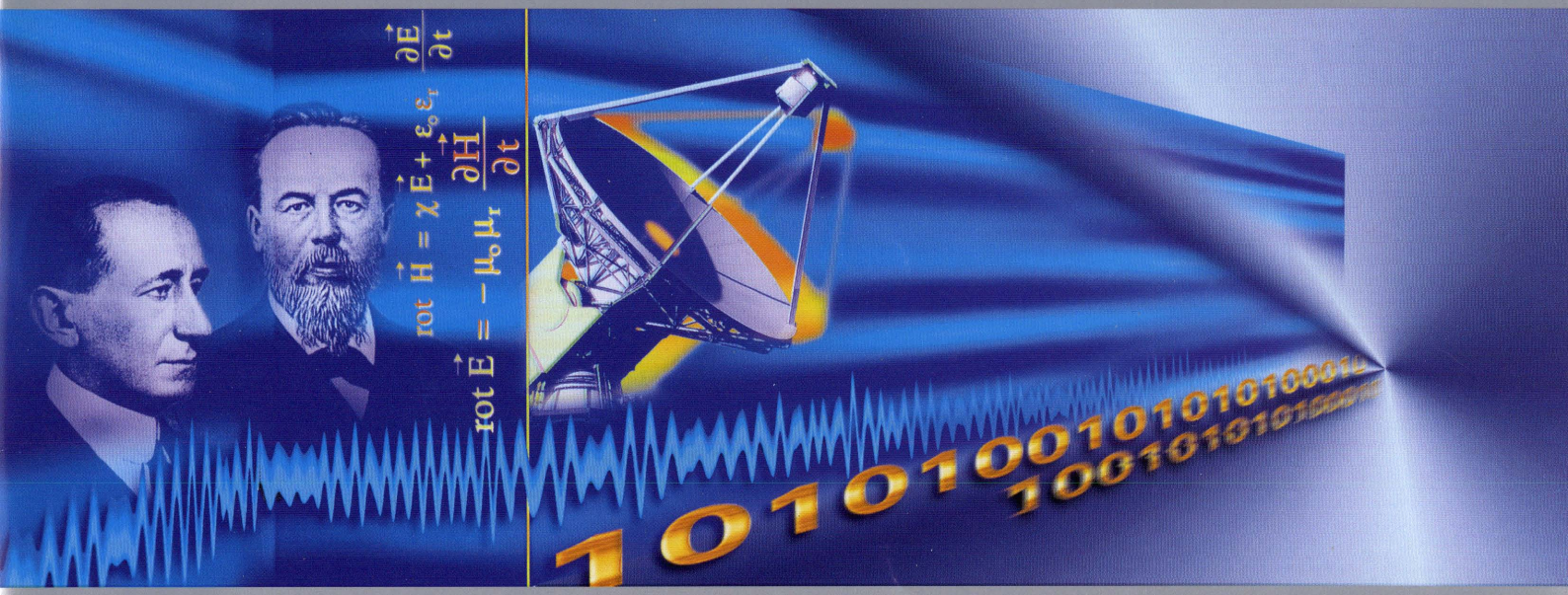
News from Rohde & Schwarz



100 Years of Radiocommunications

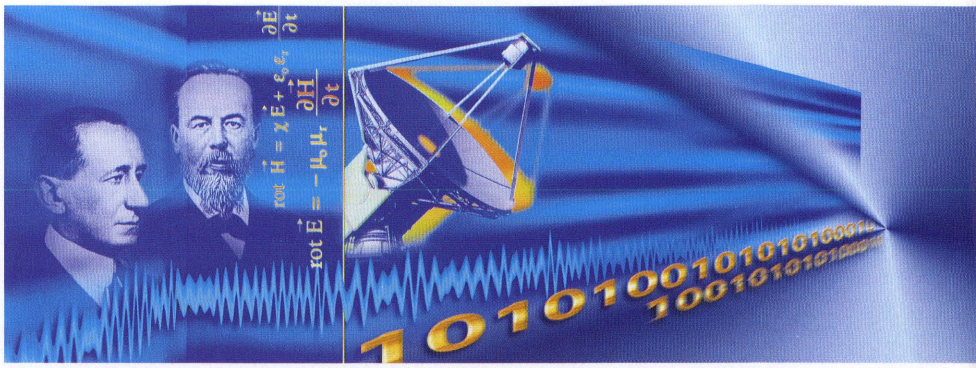
Radiodetection
Cost-effective standard solutions

New measuring equipment
for DECT and GSM/PCN/PCS mobiles

149

ROHDE&SCHWARZ

Number 149 1995/III Volume 35



100 years ago, the Italian Guglielmo Marconi and the Russian Alexander Popov discovered the possibility of using radiated electromagnetic waves to transmit messages. Rohde & Schwarz has been working in the field of radiocommunications for more than 60 years now and continues to contribute to present and future developments in telecommunications (see our editorial on page 4).

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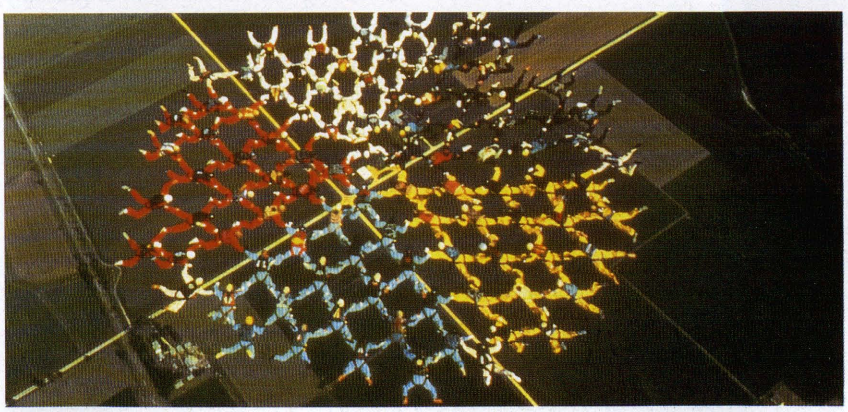

Always online with ACCESSNET®: The modular hierarchical system concept of the Rohde & Schwarz trunking systems guarantees custom-specific radio networks for company premises, regional and national areas. Digital Mobile Exchange DMX64 now enables the operation of digital radio base stations (see article on page 28).

Imprint

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100 years of radiocommunications – Rohde & Schwarz has been shaping it for more than 60 years

We are all used to picking up the phone and talking to a business associate overseas, whether he happens to be on a ship, in a car or aeroplane; television brings us live via satellite the boxing match that is just taking place in New York; via data highways scientists or businessmen can exchange data, drawings or expertise however complicated the subject. Thanks to radiocommunications, the pools of knowledge in the world can be made available at any location within seconds.

It is difficult to imagine that there was a time when battles were fought and country leaders did not learn about the victory or defeat until weeks or months later; a time when diplomacy and world trade depended on the physical presence of representatives or an exchange of documents by emissaries who very often never arrived at their destination. No wonder that the horizon of most people did not go beyond the place they lived in.

It is just 150 years since, after tiresome and what are sometimes looked upon today as rather bizarre experiments using optical means, wired communication first appeared; in 1843 Samuel Morse set up the first telegraph line between Washington and Baltimore. However it had the disadvantage of being fixed, and then there was the enormous investment and cost of maintenance for long-distance lines. Following the emergence of the coaxial cable and in particular fiber optics, wired communication is enjoying its second youth.

The era of radiocommunications began in the second half of the last century at a time when James Clerk Maxwell was formulating the fundamentals of electrodynamics and described the interaction between electromagnetic fields and electric charges and currents. Somewhat later Heinrich Hertz demonstrated the existence of electromagnetic waves and the possibility of transmitting electromagnetic energy in the form of free radiation (1887/88). The Italian Guglielmo Marconi and the Russian Alexander Popov discovered, independently of one another in 1895 and 1896 and using similar apparatus, the possibility of using radiated electromagnetic waves to transmit messages. In 1896/97 the two scientists were already able to communicate over distances from 250 meters to several kilometers.

It would take us too far to describe the early development of radiocommunications in all its details. But there is an interesting little anecdote according to which the beginnings in Germany go back to Emperor Wilhelm II. His Majesty attempted to send an urgent telegram from his yacht, equipped with the usual Marconi telegraph of those days, and became most upset when he was put on a waiting list. This incident supposedly led to the foundation of the Telefunken company in 1903 at the initiative of the Emperor. Then in 1906 the high-power wireless station in Nauen went into operation, allowing communication overseas.

A leap of about 20 years brings us to the times after the first world war, during which radio was used in the military sector to a great extent. The first radiobroadcast in Germany took place on 29 October 1923 from Vox house in Berlin. The opening concert lasting just an hour could be received only by a few. The listeners with headphones and all had to fiddle around with the detector, which was a point-contact diode with lead or pyrite crystal. There were some who were lucky enough to possess a more powerful and reliable tube receiver.

Not long afterwards, at the end of the twenties and beginning of the thirties, two fledgling physicists were studying in Jena under Professor Esau, who pioneered the field of ultra shortwaves. They were Lothar Rohde and Hermann Schwarz, who later founded a development laboratory from which the company of Rohde & Schwarz evolved. It is hardly surprising that the atmosphere at the notable institute induced the two physics student to the "wonderful world of the waves". While they were still in Jena, their first joint development emerged, namely an interference wave meter for 6 to 3600 m wavelength (approx. 80 kHz to 50 MHz) with accuracy unparalleled for those days. Instruments of this kind were used worldwide as a result of the first frequency allocation conference that took place in Washington in 1927. It became necessary to monitor the frequencies (wavelengths) allocated by the conference.

By 1932/33 the two young doctors had moved to Munich and founded the firm which soon received international acclaim. In addition to a variety of measuring instruments, especially those for communication, and the first portable quartz clock, a commercial shortwave transmitter with an output power of one kilowatt was developed for a German security organization in 1934.

The second world war, which directed all energies to the armaments industry, meant a turning point in the life of the young firm. Starting anew after the end of the war, maintenance contracts from the US Signal Corps contributed towards the survival of the firm. These contracts brought in tons and tons of radios of all different types to be dismantled, sealed, tested and put back into operation.

Soon however, as a result of the 1947 Wave Conference of Copenhagen, Rohde & Schwarz received the opportunity to build up a pioneering business field that still exists today. The conference, from which German representatives were barred, deprived the occupation zones in Germany of most of the mediumwaves; what remained had to be utilized repeatedly. The consequence of this was that 70% of the population in Germany could not receive broadcasting programs, especially in the evenings. The VHF band of 87 to 100 MHz offered an alternative, the "joy wave", a challenge and chance for the radiocommunication industry as a whole.

Already in 1948 Rohde & Schwarz started to work on VHF transmitters and antennas. On 18 January 1949 the company received from Radio Munich (later Bayerischer Rundfunk) a contract for a trial transmitter. The contract was worth the "astronomical" amount of DM 4000, 50% of which had to be borne by the company itself. The transmitter went on the air on 28 February 1949, Germany's and Europe's first VHF broadcast transmitter.

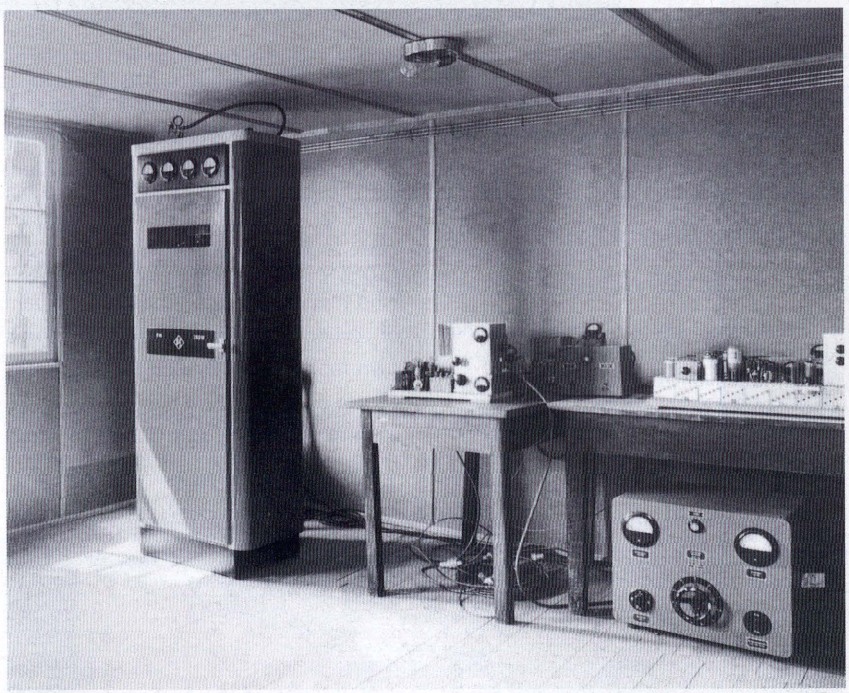
As the radio industry hesitated to build receivers for VHF, Rohde & Schwarz took the initiative and developed a suitable unit (type ESF), which was given away to decision-makers and also sold and made a name for itself because of the excellent tone quality. This clever marketing move, as it would be called today, led to a breakthrough for the company. The sector of television, which soon followed, meant a significant expansion in the field of transmitters and antennas and also in special transmitter test techniques.

There were also rapid developments, similar to those of sound and TV broadcasting with its "programs for all", in point-to-point radiocommunication. From the fifties product lines evolved at Rohde & Schwarz for shortwave (HF) as well as for ultra shortwave (VHF, later also UHF) that went to civilian and military customers employing the equipment on land, at sea and in the air.

The rapid spread of every kind of wireless service soon led to overcrowding of the transmission medium, ie the ether as it was called in the past, and caused interference for all. This made the creation of special bodies necessary such as radiomonitoring and RFI detection services that called for special measuring and DF equipment. Ever since the foundation of the company, Rohde & Schwarz has been supplying these authorities with modern and powerful units and systems, which are also employed in modified form by the military sector and security organizations alike. As a result of close cooperation with responsible organizations in the civil sector, a seminar was held in Munich in November 1983 with the participation of the German PTT to mark World Communications Year. 125 experts from 70 member states of the International Telecommunications Union (ITU) – founded in 1865 – attended the event.

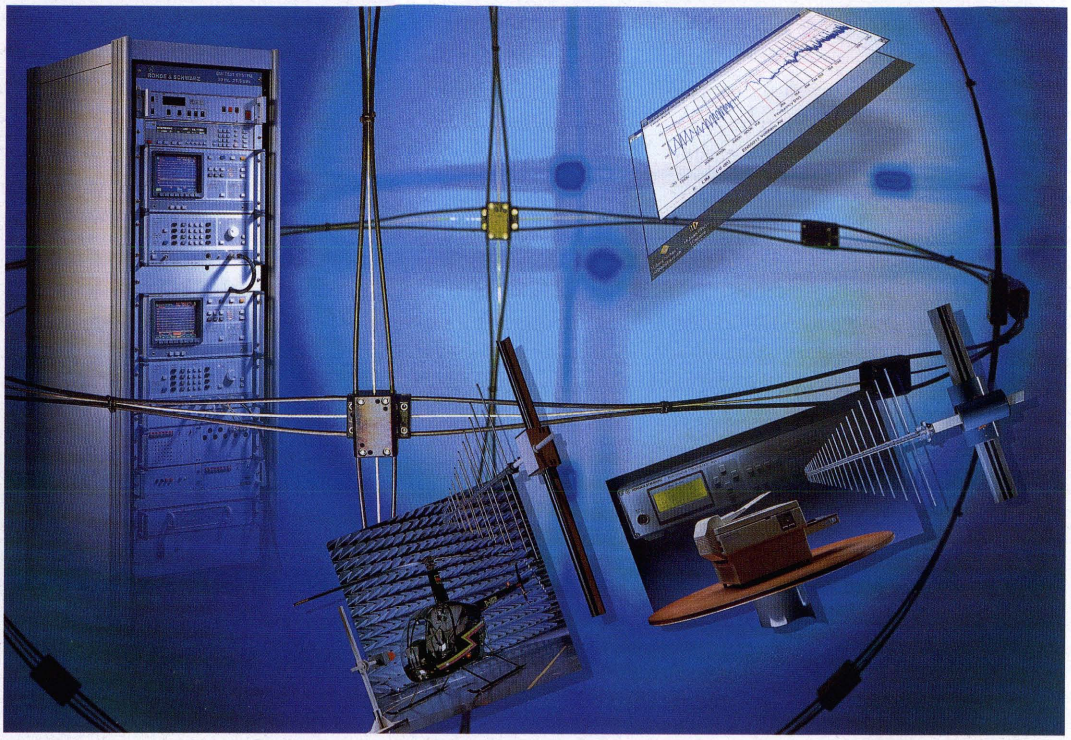
New dimensions were opened up from 1957/58 onwards with the advent of the first artificial satellites: satellite radiocommunication. Its unique advantage of expanding the radio horizon made very short waves useful for global radiocommunication. Rohde & Schwarz entered the scene very early with its satellite ground stations, mainly for scientific projects.

Round about this time semiconductors were introduced. They allowed first of all a radical reduction in the size of radio as well as other types of equipment, provided the decisive impetus for digital technology and brought on a completely new class of electronic equipment. Logic circuits of ever increasing complexity were soon to take hold in the field of measurement and radiocommunication. In 1967 Rohde & Schwarz developed the first automatic, computer-supported test system for integrated circuits, seven years later the first intelligent radio test set. In 1984 the first processor for the automatic set-up of shortwave links made its début. Rohde & Schwarz is also a pioneer in simulation and system test engineering for mobile phones both of analog and



In 1949 Rohde & Schwarz installed the first European VHF sound-broadcast transmitter (250 W) for Bayerischer Rundfunk in Munich.

Photo 7 507



Electromagnetic compatibility – an extremely important aspect of radiocommunication. EMC measuring equipment from Rohde & Schwarz is used worldwide. Photo 41 548

digital standards. The much-cited multimedia future coupled with its digital data highways will have a further strong impact on radiocommunication, at least in the mobile sector. Paging through the present issue of »News from Rohde & Schwarz« will reveal the extent to which digital measuring and system equipment is represented.

Anyone like the authors of this article who has experienced the development of radiocommunication and made his own modest contribution to shaping its course often will have made the mistake of thinking that progress had reached its ultimate limits but then had to admit that its rate if anything is quickening. May it be overlooked that no forecasts are made here for the future development of radiocommunication. They should be left to others at a later date. But one thing seems to be certain: there will be surprises in this field over and over again well into the next millennium.

Franz Reinhold Huber;
Vladimir Nedelchev

In 1992 Rohde & Schwarz supplied Bayerischer Rundfunk a modern VHF transmitter station (14 x 10 kW) for installation atop the Brotjacklriegel mountain in the Bavarian Forest. Photo 40 542/1

Search Receiver ESMA

The ideal frontend for VHF-UHF monitoring systems

The density of frequency occupancy in the VHF-UHF bands, which has grown enormously over the past years, calls for powerful detection and monitoring systems. The fast Search Receiver ESMA is ideal for these tasks. High detection probability in conjunction with high frequency resolution make it an indispensable core in radiomonitoring systems of any size.

With the fast Search Receiver ESMA (FIG 1) the user is able to configure cost-effective radiomonitoring systems in the range 20 to 1300 MHz. The key component of ESMA is a fast and continuously tunable receiver section with digital level weighting. It supplies occupancy data with accurate frequency and level and with reference to time to allow monitoring of complex scenarios. The detection threshold may either be defined as a constant or as a variable versus frequency. Due to the high scan rate of up to 5 GHz/s and the resulting abundance of occupancy data, efficient compression is essential and performed by a RISC processor. The parameters for the task-specific data-compression algorithm can be selected and enable differentiation between burst and CW signals for instance.

FIG 1 Search Receiver ESMA for VHF-UHF bands Photo 42 192

Features

Efficient monitoring not only requires fast scan rates and intelligent verification algorithms but also task-specific **processing and display of result data.** The search and verification process including data compression is performed almost alone by the ESMA, ie without interaction with the PC. So the CPU in the PC is free for controlling other processes such as result display, data recording and commanding of handoff receivers. Unlike units and systems of the lower performance class, ESMA uses a transputer link as a data interface. The data rate of 10 Mbit/s thus achieved enables display of the current occupancy status with virtually no delay at all.

The harddisk of the PC is used as mass storage for result and scenario data. This allows the user to employ cost-effective data backup media such as an

exchangeable disk and streamer. Any AT486 PC compatible with the industry standard is suitable for use as a process controller. To ensure low interference in the system environment it is advisable to choose a unit with appropriate shielding. The **operating program** supplied with ESMA runs under **MS-Windows 3.1** and enables fast familiarization with all operating modes. It allows handling of several frequency ranges or single-frequency lists including suppression of subranges. For medium-size and large systems, standard software packages are optionally available for networking several workstations as well as connection to a database. With the optional record/replay software package ESMA-EV, scenario data can be recorded and replayed at a later date for offline analysis of a specific situation.

For extending ESMA to a small system, commercial PC plug-in cards can be used to connect further system components. The basic model of the search receiver is sufficient to control detached receivers and direction finders.

Uses

Use of ESMA is recommended where even shortterm activities are to be detected with high probability, displayed and recorded. This is especially the case with national organizations and authorities in charge of monitoring the frequency spectrum as well as with customers in the military sector. The high search performance in conjunction with a powerful PC enables high-resolution activity identification over the frequency and time axis. Evaluation of occupancy patterns may be just as conclusive as identification of contents. Depending on the specific task, the user can therefore choose between two **operating modes.**

- In overview mode all detected emissions are continuously scanned and optionally recorded in the form of occupancy patterns or scenarios (FIG 2).
- In search mode the receiver stops on every active channel, allowing the user to capture the information contents (FIG 3).

With the aid of the recorded scenarios a network operator can for instance clearly document the utilization of certain channels over an extended period of time and thus prove the necessity of additional communication channels. For identification of contents it is essential that a message be intercepted right from the beginning. Therefore the search mode provides dwell times of 0.1 s to ∞. A user interface adapted to the operational routines supports fast identification especially in time-critical situations.

Due to its extremely short synthesizer setting times and optimized verification algorithms, ESMA achieves a maximum scan rate of several GHz/s (FIG 4), which is only surpassed by extremely elaborate filter-bank systems. Thanks to the high search speed together with high frequency resolution, activities can be classified according to parameters such as duration of message and offset from nominal channel center frequency. The local oscillator optimized for low phase noise allows signal analysis even close to the carrier. Moreover, weak signals close to strong interfering signals can also be detected. In conjunction with excellent intermodulation characteristics a wide, spurious-free dynamic range of more than 80 dB is obtained. Therefore ESMA is also a suitable frontend for digital post-processing.

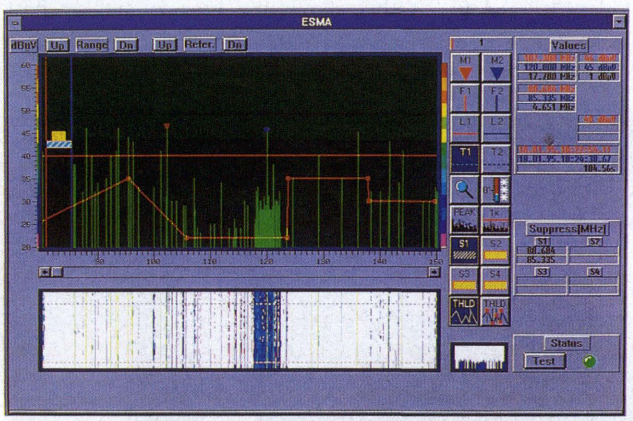


FIG 2
Display of ESMA in overview mode

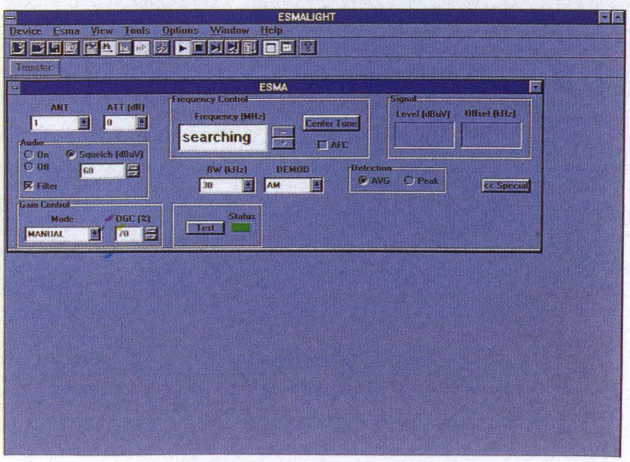


FIG 3
Display in search mode

System expansion

The frequency range of the basic version (20 to 650 MHz) can be extended to 1300 MHz by integrating an extra tuner. Further extension up to 3 GHz is planned. The current frequency infor-

mation is output in BCD on the rear panel and allows frequency-controlled operation of Antenna Selector GS050. Since an AT486 PC is used as a process controller as standard, ESMA is open-ended for future system expansion. A small system can be configured for instance by adding handoff receivers of type ESMC [1]. Should separation between search and intercept positions be desirable as an upgrade, the dependent search positions through to large systems. Cost-effective standard packages which may be combined to form a larger system are also available.

Erwin Oberbuchner

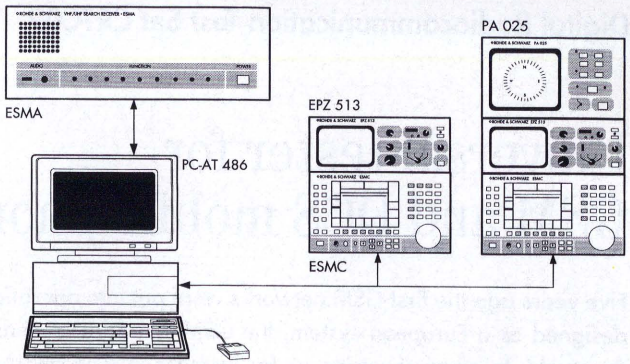


FIG 5
Example of monitoring system configuration with ESMC handoff receivers, Doppler Direction Finder PA025 and Spectrum Display EPZ513

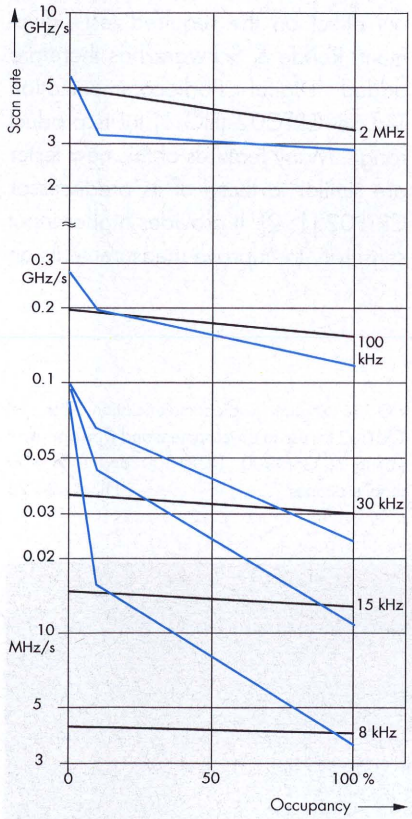


FIG 4 Scan rate of ESMA for resolution bandwidths from 8 kHz to 2 MHz as function of band occupancy (blue: standard mode, black: advanced precision mode)

ESMC previously used as a handoff receiver can be integrated into an intercept position with Doppler Direction Finder PA025 [2] and Spectrum Display EPZ513 [3] (FIG 5) for example.

Rohde & Schwarz also configures complete customized installations from in-

REFERENCES

[1] Boguslawski, R.: Egert, H.-J.: VHF-UHF Compact Receiver ESMC – easy radio detection in VHF-UHF range. News from Rohde & Schwarz (1994) No. 143, pp 11–13

[2] Stedler, M.: Small Doppler Direction Finder PA025 for VHF and UHF ranges. News from Rohde & Schwarz (1991) No. 134, pp 34–35

[3] Zirwick, K.: Panoramic IF with Spectrum Display EPZ513. News from Rohde & Schwarz (1991) No. 132, pp 32–33

Condensed data of Search Receiver ESMA

Frequency range	20 to 650/1300 MHz
Preselection	tracking filters
Noise figure	12 dB
Intercept point (IP_3)	+10 dBm
Tuning time	150 µs
Signal verification (selectable)	burst/shortterm/longterm signals
Detection threshold	constant or variable over frequency axis
Demodulation	AM, FM, LOG
IF bandwidths	8/15/30/100 kHz/2 MHz (standard), max. 8 MHz possible
Data interface	transputer link (10 Mbit/s)

Reader service card 149/01

Digital Radiocommunication Test Set CRTC02

Universal tester for GSM and DCS mobile phones

Five years ago the first GSM networks were put into operation. Although initially designed as a European system, the GSM standard is meanwhile used all over the world. In many countries, as for instance in Asia and Australia, the original 900-MHz and 1800-MHz bands are available. The United States will use GSM in the 1900-MHz PCS band. CRTC02 offered by Rohde & Schwarz is a new test set for mobile stations for testing signal parameters, signalling and supplementary services at all relevant frequencies in line with the latest specifications.

The GSM standard is continuously being adapted to the ever more demanding requirements placed on modern communications. In 1996 networks will for the first time offer enhanced services in line with **GSM standard phase 2.** Since the phase 2 standard is compatible with previous phase 1 networks, phase 2 mobiles can also be operated in them. The same holds true the other way round of course. Some of the new features such as improved data and short message service are transparent to the subscriber. Other new features include optimized signalling methods for more efficient utilization of networks. Moreover, the transmitter power of phase 2 mobiles can be further reduced, if required, to facilitate multiple use of frequencies by smaller cells. The resulting lower power consumption saves on batteries, which then give more hours of operation before they have to be recharged.

In addition to the new features, GSM phase 2 specifications include many elucidations of phase 1 features and provide a much clearer description of the GSM system. The test specification for mobile stations (TS GSM 11.10) has also been thoroughly revised, errors were eliminated, tests enhanced and new ones added. The extent of the test specification has more than doubled. This development will not remain without effect on the required test equipment. Rohde & Schwarz has therefore added Digital Radiocommunication Test Set CRTC02 (FIG 1) to its product range. Many features of this new tester are similar to those of its predecessor CRTP02 [1; 2]. It provides higher input sensitivity to improve measurements on

FIG 1 Digital Radiocommunciation Test Set CRTC02 for use in development and type-approval testing of GSM900, DCS1800 and DCS1900 mobile phones Photo 42 223

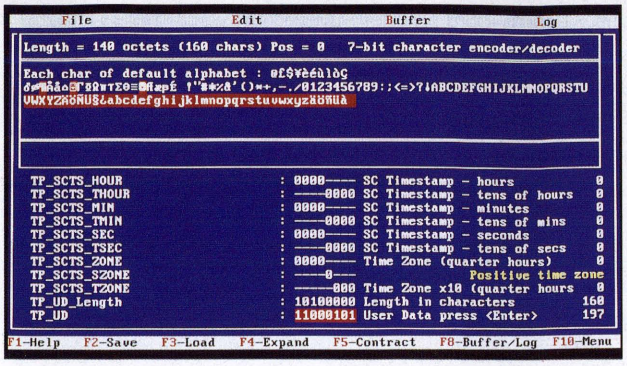


FIG 2
Display of short messages

low-power mobiles however, and an expanded frequency range. In addition to **GSM900** and **DCS1800,** CRTC02 also supports the US standard **DCS1900.**

Uses

CRTC02 will mainly be used in development and type-approval environments. Thanks to an analog I/Q interface in the baseband and TTL inputs/outputs at bit level, CRTC02 is ideal for testing special GSM ICs. Its two independent generator/receive channels as well as comprehensive analysis and test capabilities make it an indispensable tool for the development of signalling software in mobile stations.

CRTC02 can test almost every GSM feature that is relevant to communication between base and mobile stations. The basic model of CRTC02 supports the most frequently used, normal voice service. A large variety of options, which can also be used with predecessor CRTP02, allows the tester to be configured for other services too:

Short message service

In the short message service (SMS), brief text messages similar to those in existing paging services can be exchanged between mobile station and fixed network. These messages are displayed in plain text on CRTC02 (FIG 2).

Supplementary services

Supplementary services include for instance call diversion/forwarding and, as a special phase 2 feature, advice of charge. The network will thus be able to inform the mobile station of the current call charges and directly book the amount from the SIM card inserted in the mobile. This makes the billing procedure for rental mobiles easier, shorter and safer.

Transparent data service

This service allows data transmission in a similar way to that via modems in fixed networks, which has existed for a long time already.

Non-transparent data service

By using the radio link protocol (RLP), data can be transmitted with an error rate even lower than in transparent service.

Half-rate channel coding

With the half-rate speech coder, two mobile phones can make a call apparently at the same time, at the same frequency and in the same time slot. With a given number of base stations, network operators can thus provide service to twice the number of subscribers.

Enciphering to A5-1 and A5-2

CRTC02 supports both the previously used A5-1 algorithm as well as the new, less complex enciphering algorithm which has been defined for countries not wishing or not allowed to use the previous algorithm.

Operation of test set

CRTC02 features three different user interfaces matched to the relevant measurement tasks. **Menu-driven operation** providing the essential RF measurements and signalling procedures is intended for simple function tests and fast checking of RF characteristics under continuously changing test conditions (FIG 3):

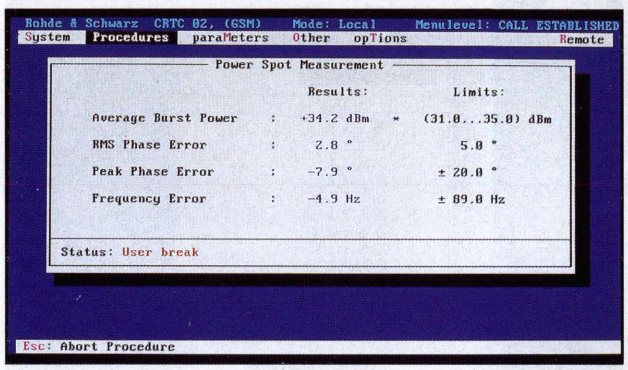


FIG 3
User interface of CRTC02

- synchronization of mobile,
- location update,
- call setup by base or mobile station,
- power-level control of mobile,
- bit error rate in loopback mode,
- channel change,
- call clearing by base or mobile station,
- speech loopback.

Ready-to-use test programs complying with TS GSM 11.10 can be selected from a list and called up (FIG 4). They are intended for in-depth analysis of the signalling functions implemented in the mobile. These test programs are available for GSM900 and DCS1800/1900 both phase 1 and phase 2. They are supplied in C source code and can be modified by the

customer for instance to locate software errors in the mobile. The required tools such as compiler and editor are supplied with the programs.

The test programs have been written in particular to enable automatic operation; instructions for the user – for instance to switch on the mobile, dial a number or observe the indication on the display of the mobile – are included in a single software module. Manufacturers of mobiles can easily integrate their own remote-control software for operating the keys and reading a mobile's display, thus replacing the test personnel through software. Instead of weary manual operation of the mobile station test by test, a great number of tests can be carried out overnight without any supervision. In case of a fault, the test result plus error report and detailed log containing the signalling procedure can be stored on disk and evaluated next morning. Regression tests can thus be performed with little effort and inadvertent side effects of software modifications in the mobile be detected at an early stage.

In the third operating mode of CRTC02 the user can generate his **own test programs.** This is supported by clearly structured program examples which may be used as a basis for user-defined programs. An important tool is the built-in signalling analyzer which, irrespective of the test program, records both received and sent messages and displays them in plain text. The user can thus easily check any time whether his program comes up to expectations.

Outlook

GSM phase 2 software of CRTC02 will continuously be adapted to the latest requirements of the GSM standard, thus allowing thorough preparation for phase 2 type approval. Over 170 phase 2 test cases are available at the moment, with more to come.

Roland Steffen

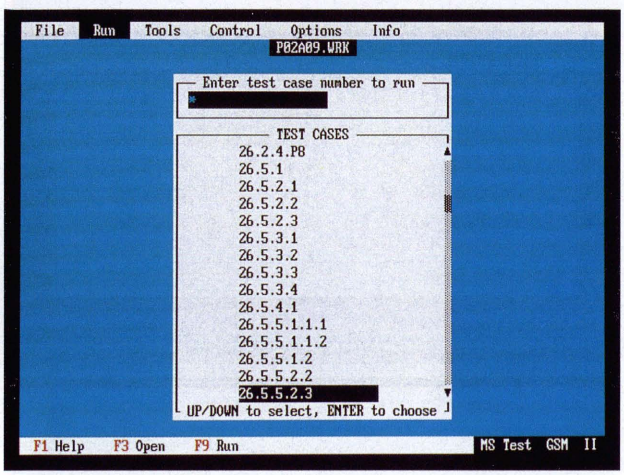


FIG 4
List of selectable ready-to-go programs

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[1] Mittermaier, W.; Holzmann, G.: Digital Radiocommunication Test Set CRTP02 – the ideal test set for PCN mobile telephones. News from Rohde & Schwarz (1993) No. 140, pp 11–13

[2] Steffen, R.: Testing new GSM services with Radiocommunication Test Sets CRTS and CRTP. News from Rohde & Schwarz (1994) No. 144, pp 35–37

Condensed data of Digital Radiocommunication Test Set CRTC02

Signal generator	
Frequency range	890.2 to 914.8 MHz (GSM) 1710.2 to 1784.8 MHz (DCS1800) 1930.2 to 1989.8 MHz (DCS1900)
Level	–127 to +13 dBm
Modulation mode	GMSK
Analyzer	
Frequency range	935.2 to 959.8 MHz (GSM) 1805.2 to 1879.8 MHz (DCS1800) 1850.2 to 1909.8 (DCS1900)
Input level (full dynamic range)	
GSM	+13 to +47 dBm ($RF_{in/out}$) –17 to +19 dBm (RF_{in2})
DCS1800/1900	+9 to +36 dBm ($RF_{in/out}$)

Reader service card 149/02

Digital Radiocommunication Tester CMD60

A favourably priced compact test set for series production of DECT mobiles

As cordless phones based on DECT standard are on the best way of becoming mass-produced articles, Rohde & Schwarz is now providing a tester which is tailored to the special requirements of volume manufacture of these phones. CMD60 measures RF and audio parameters extremely fast and is exemplary in price. For the production of mobiles to different standards, it can be retrofitted at a later stage with GSM, DCS1800 and DCS1900 measurement technology.

The production of DECT communication systems (Digital European Cordless Telecommunication) is being launched about the same time all over Europe and Asia. Focal applications for such systems are mobiles for use at home, cordless voice communication for the office and, in the near future, telepoint, local loop and wireless LAN. These are mass markets for which favourably priced products with a relatively simple technical concept are required. But widespread use causes high traffic density. To allow troublefree communication of many subscribers in a limited frequency band, it has to be ensured through the right measurements that only reliable items are introduced to the market.

Rohde & Schwarz, as market leader in the field of DECT testing, has since the beginning of the 90s been offering a variety of measuring instruments and systems for DECT: signal generators, compact digital radio test sets [1] and type-approval test systems [2; 3]. The new production tester CMD60 (FIG 1) is based on the broad experience gained at Rohde & Schwarz and, due to the intensive exchange of information with leading manufacturers of DECT equipment, it can be guaranteed that CMD60 incorporates all the features required for production and service.

Measurements

Digital Radiocommunication Tester CMD60 performs RF measurements in compliance with CTR06 (Common Technical Regulation). To achieve a favourable price, CMD60 is thus confined to those measurements within the

FIG 1 Rapid, precise and complete measurements by Digital Radiocommunication Tester CMD60 are prerequisites for cost-effective volume production of cordless telephones in line with DECT standard. Photo 42 204

No.	Test case	Clause	Comment
1	Accuracy and stability of RF carrier	7	Fulfilled
2	Timing jitter	8.3	Fulfilled
4	Reference timing accuracy of RFP	8.4	Fulfilled
5	Transmission burst	9	Fulfilled
6	Transmitted power: PP and RFP with integral antenna	10.2	Fulfilled
7	Transmitted power: PP and RFP with external antenna connector	10.3	Fulfilled
8	RF carrier modulation Part 1,2,3 Part 4, frequency drift	11	Fulfilled Fulfilled
9 10 11 12	Emissions due to modulation Emissions due to transmitter transients Emissions due to intermodulation Spurious emissions when allocated transmit channel	12.2 12.3 12.4 12.5	Output for external spectrum analyzer integrated
14	Radio receiver sensitivity	13.1	Complies, except for 50 kHz offset
15	Radio receiver reference BER	13.2	Fulfilled
16 17 18	Radio receiver interference performance Radio receiver blocking case 1 Radio receiver blocking case 2	13.3 13.4 13.5	Input for external signal generator and output for triggering signal generator
19	Receiver intermodulation performance	13.6	With second CMD60 or SME03

TABLE RF measurements by CMD60 in DECT channel in line with CTR06

DECT channel (see TABLE) which are important for production and service. The RF measuring devices in CMD60 not only determine RF parameters but also convert the RF signal into the audio range (and vice versa). CMD60 can analyze these audio signals at its audio interface. A cordless DECT mobile is thus tested completely by a single compact test set.

Requirements for production and in-line service

Mass production is usually characterized by several production lines and a fast cycle. Moreover, the mobiles to be tested are frequently equipped with an integrated antenna but without an antenna connector. Thus, special precautions have to be taken for the measuring equipment **to avoid mutual interference.** By synchronizing several CMD60s to a common frequency and time reference, measurements at different lines and locations can be coordinated such that a transmit signal on the one line is separated from the measurement on the neighbouring line in time and frequency. Normal DECT mobile traffic should not take place in production. However, this may not always be the case. Interference caused by normal DECT mobile traffic on the measurements can be avoided by using the extended DECT frequency channels provided by CMD60.

Measurement speed is an important aspect of mass production. All transmitter measurements can principally be performed very quickly. The measurement data of a burst is recorded in less than a millisecond. Evaluation of measurement data according to different aspects such as power, frequency, drift, timing and modulation can be carried out in a short time thanks to the high computing power of CMD60 even if averaging algorithms are used. This is quite different for a receiver test, which is based on BER measurement. Measuring over the prescribed 100 000 bits takes 3 s. If receiver sensitivity on different frequency channels and diversity antennas is to be measured accurately, the test time takes a multiple of 3 seconds. The time of measurement can be reduced with some tricks, for example the DUT is fed with a signal below the sensitivity limit. In this case it is possible to measure with less than 100 000 bits. This is quite useful and CMD60 has a number of such appropriate facilities. If the DUT can operate on more than one time slot, the measurement time of CMD60 can be reduced by a factor that corresponds to the number of time slots used (multibearer).

The test mode stipulated by ETSI (European Telecommunications Standards Institute) is ideal for a **final test.** In this case, call setup to the DUT is via the air interface and the test mode is then set by means of some commands on the precondition that the DUT is basically operational. The **module test mode** of CMD60 provides other facilities for the early production phases or for repair. A DECT signal generator in CMD60 transmits a signal that can be widely varied by the user with regard to frequency, level, modulation, data contents and timing. Thus, a receiver module which is not yet fitted with "intelligence" or which cannot participate in signalling due to a defect or misalignment can be tested and adjusted (FIG 2).

CMD60 can also analyze a transmit signal of the DUT without having set up a call to the DUT beforehand via signalling. After the user has selected the expected frequency, more or less the expected power, a measurement time

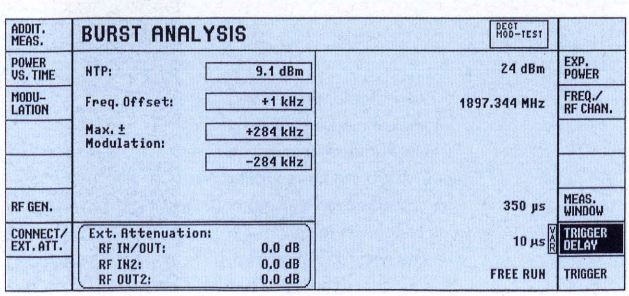

FIG 2 In module test mode (Burst Analysis and RF Gen menus), DECT modules not yet equipped with "intelligence" and thus not able to participate in signalling can be checked for proper functioning.

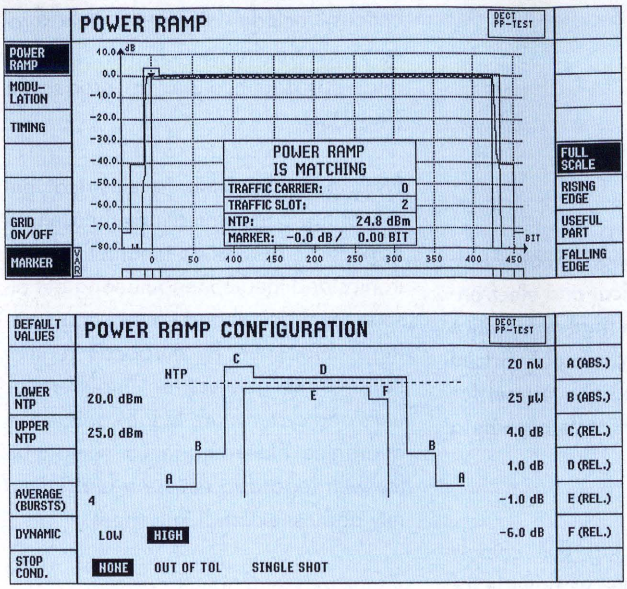

FIG 3 Menu operation of CMD60: power-ramp menu analyzes power bursts sent from portable or fixed part of DECT mobile. User-defined tolerances for power-ramp menu can be entered in configuration menu.

window and a trigger condition (power ramp or external trigger signal), CMD60 measures the power and modulation curve of the signal as a function of time. The following measurement values are obtained: modulation peak, frequency and mean power. CMD60 provides some DECT-specific signals such as data, clock and frame timings which can be beneficial in support of the module test.

Operation

Similar to all other members of the CMD family from Rohde & Schwarz, there are also three levels of operation in CMD60: manual control, SCPI-compatible remote control via the IEC/IEEE-bus interface or the serial RS-232-C interface and internal autorun control. Examples of manual control (FIG 3) demonstrate how easy the measuring instrument can be operated. Manual control is divided into simple measurement menus and configuration menus. User prompting through the measurement menus is so easy that no DECT-specific knowledge is required to perform the measurement and analyze results. The configuration menu is reserved for the user who is familiar with DECT and his DUT. Here limits can be entered that distinguish between "pass" and "fail" during the measurement, or the multibearer mode in the BER test mentioned above can be configured.

Outlook

Large-scale volume production has to be flexible enough to respond to fluctuations in demand without immediately becoming uneconomical. Where mobiles are concerned, this might be the case when there is a shift in the production volume of items for the different radio networks. A measuring instrument can effectively be utilized in such a scenario, ie in the production of mobiles of different networks and by fast switchover from one mobile to another. CMD60 as a DECT tester is ready to perform measurements to GSM, DCS1800 (PCN) and DCS1900 (PCS) standards. It is also possible to retrofit most members of the CMD family performing GSM/DCS measurements with the DECT measurement facilities of CMD60.

Thomas Maucksch

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[3] Gloger, M.; Riedel, P.: DECT Protocol Tester TS1220 – Type-approval measurements on DECT fixed parts (FP) and portable parts (PP) to TBR22. News from Rohde & Schwarz (1995) No. 148, pp 9–11

Measurement facilities of Digital Radiocommunication Tester CMD60

	Fixed part and portable part tests	
	RF loopback mode (with signalling)	Module test mode (without signalling)
Transmitter test		
Normal transmit power	x	x
Power ramp	x	x
Modulation	x	x
Frequency	x	x
Frequency drift	x	–
Timing accuracy	x	–
Jitter	x	–
Receiver test		
BER	x	–
Audio test (optional)		
Microphone	x	x
Loudspeaker	x	x

Reader service card 149/03

EMI Test Receiver ESPC

EMC precertification measurements for everyone

In the whole of Europe, the CE conformity mark is regarded as a sign of EMC quality. From 1 January 1996 it will be compulsory for every electrical and electronic unit. Manufacturers of such units who do not want to carry out final acceptance tests and certification can make use of ESPC – a new and very favourably priced EMI test receiver from Rohde & Schwarz. It is the ideal, easy-to-use test set for EMC measurements during production. Thus, external final EMC tests become a mere formality.

Rohde & Schwarz, the market leader in the field of classic EMC test receivers with all kinds of accessories – from coupling networks and antennas, remote-controllable mast and turntable systems to software – , offers in its well-known models ESHS, ESVS, ESS as well as ESAI, ESBI and ESMI equipment for final acceptance testing (full compliance) that is a reference worldwide for all approval centers, accredited test labs and test houses [1; 2]. Based on these high-quality units for final acceptance testing, a new EMI test receiver for small budgets is now available under the designation ESPC. Its applications include diagnostic measurements on the lab bench, but also pre- and post-qualification in production (FIG 1).

EMC precertification in electrical engineering, communications, household appliances as well as automotive electronics and medical engineering but also in mechanical and control engineering is supported by European regulations. Manufacturers or importers of units and systems are legally obliged to guarantee electromagnetic compatibility with regard to emission and immunity against external influences.

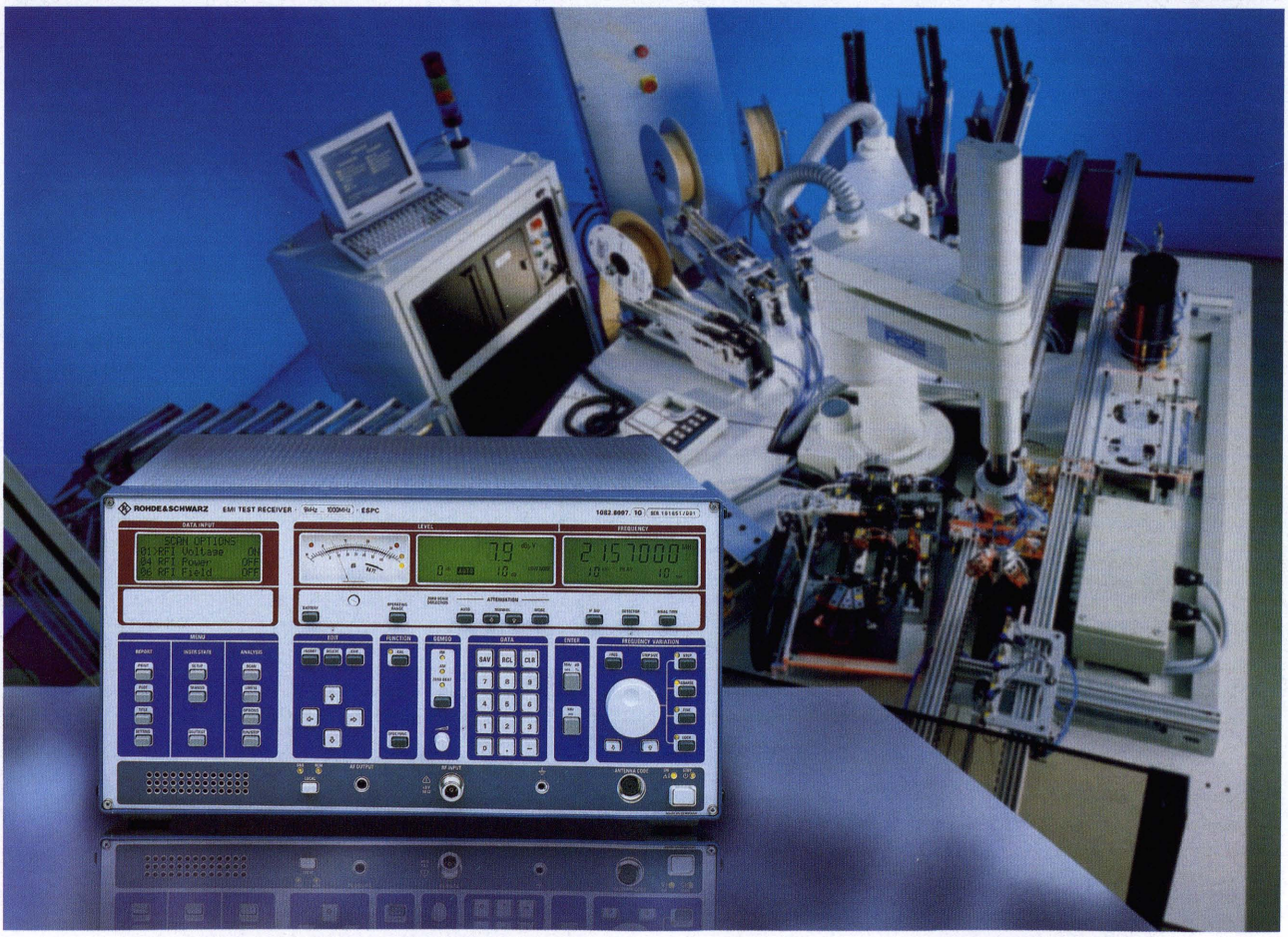


FIG 1 Machines with electronic control circuitry employed in production are also subject to EMC laws – this is an application for EMI Test Receiver ESPC.

Photos 38 992 + 42 091

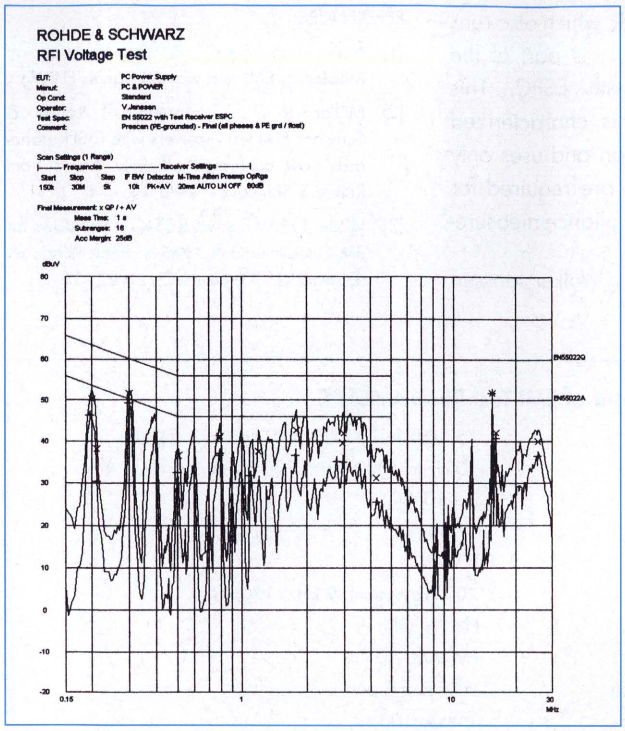
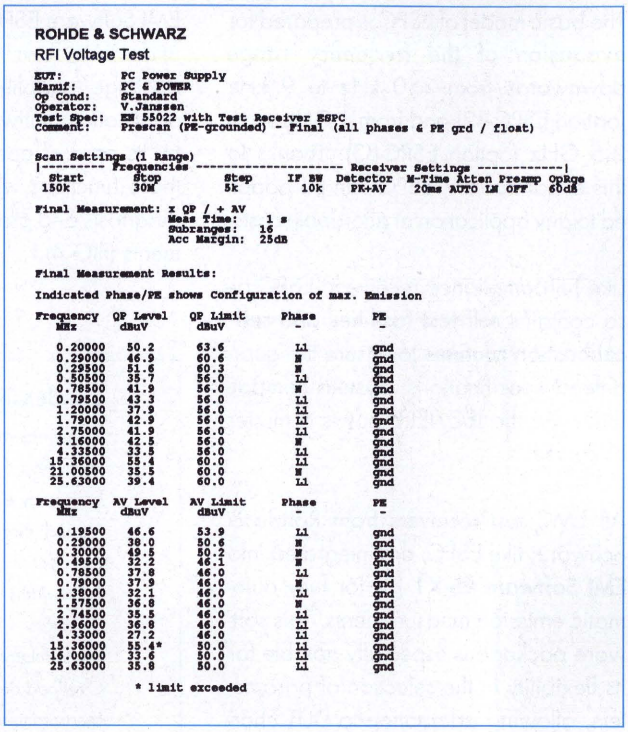


FIG 2 Test report of measurement using ESPC



ROHDE & SCHWARZ
RFI Voltage Test

EUT: PC Power Supply
Manuf: PC & POWER
Op Cond: Standard
Operator: V.Janssen
Test Spec: EN 55022 with Test Receiver ESPC
Comment: Prescan (PE-grounded) - Final (all phases & PE grd / float)

Scan Settings (1 Range)

Frequencies Start	Stop	Step	Receiver Settings IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	20ms	AUTO	LN OFF	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 16
Acc Margin: 25dB

Final Measurement Results:

Indicated Phase/PE shows Configuration of max. Emission

Frequency MHz	QP Level dBuV	QP Limit dBuV	Phase -	PE -
0.20000	50.2	63.6	L1	gnd
0.29000	46.9	60.6	N	gnd
0.29500	51.6	60.3	N	gnd
0.50500	35.7	56.0	L1	gnd
0.78500	41.9	56.0	N	gnd
0.79500	43.3	56.0	L1	gnd
1.20000	37.9	56.0	L1	gnd
1.79000	42.9	56.0	L1	gnd
2.75000	41.9	56.0	L1	gnd
3.16000	42.5	56.0	N	gnd
4.33500	33.5	56.0	L1	gnd
15.36000	55.4	60.0	L1	gnd
21.00500	35.5	60.0	N	gnd
25.63000	39.4	60.0	L1	gnd

Frequency MHz	AV Level dBuV	AV Limit dBuV	Phase -	PE -
0.19500	46.6	53.9	L1	gnd
0.29000	38.0	50.6	N	gnd
0.30000	49.5	50.2	N	gnd
0.49500	32.2	46.1	N	gnd
0.78500	37.8	46.0	L1	gnd
0.79000	37.9	46.0	N	gnd
1.38000	32.1	46.0	L1	gnd
1.57500	36.8	46.0	N	gnd
2.74500	35.5	46.0	L1	gnd
2.96000	36.8	46.0	L1	gnd
4.33000	27.2	46.0	L1	gnd
15.36000	55.4*	50.0	L1	gnd
16.00000	33.6	50.0	L1	gnd
25.63000	35.8	50.0	L1	gnd

* limit exceeded

FIG 3 Table of final measurement values

ESPC (basic model from 150 kHz to 1 GHz) is a compact solution at a very favourable price. ESPC is the ideal test tool in the production phase for all those companies that do not want to be burdened with the high costs of acceptance test measurements and certification with a manufacturer declaration. With regard to technical features, ESPC also beats by a large margin the low-cost spectrum analyzers commonly used for precertification. Its **characteristic features** are:

- integrated preselection,
- overload detection and correction circuit,
- IF bandwidths conforming with CISPR,
- detectors for PK, AV and QP (parallel detection possible),
- demodulation path for FM, AM and A0,
- high dynamic range,
- low inherent noise.

Moreover, the integrated firmware routines include correction values of frequency-dependent sensors used to increase measurement accuracy. With defined acceptance values and selected subranges, the routines also reduce the amount of data to a level where only critical ranges undergo final measurements. As a result, measurement time is minimized and thus the measurements themselves become significantly more cost-efficient. Test results are precise and reproducible.

Even as a stand-alone unit (can also be used with a battery) ESPC shows its strength. It contains **internal test routines** for

- RFI voltage measurements,
- RFI power measurements,
- RFI field-strength measurements.

Test routines can be started by pressing a button and carry out completely reproducible measurements (eg for different phase and protected earth conductor settings for line-impedance stabilization networks).

Being a small-sized and portable RFI test set, ESPC provides all required information in the form of a comprehensive **test report** with comments, test-receiver settings, graphics and tabulated lists of final measurement values where too high level values found in comparison tests with limit values are marked (FIGs 2 and 3).

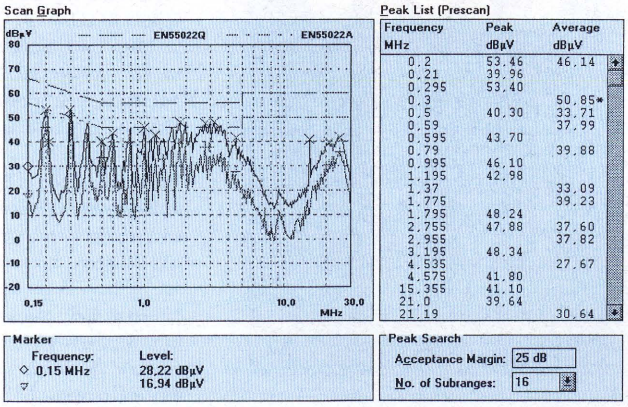


FIG 4 Test results and frequency list obtained with ESPC-K1 application software

The basic model of ESPC is prepared for **expansion of the frequency range** downwards from 150 kHz to 9 kHz (option ESPC-B2) and from 1 GHz up to 2.5 GHz (option ESPC-B3). Thanks to this expandability, ESPC can be adapted to any application at affordable costs.

Like full-compliance receivers, ESPC also contains **self-test facilities and self-calibration routines** to ensure the guaranteed specifications. System compatibility via the IEC/IEEE bus is a matter of course.

All EMC test receivers from Rohde & Schwarz, like ESPC, are integrated into **EMI Software ES-K1** [3] for fully automatic emission measurements. This software package is especially notable for its flexibility in the selection of parameters, allowing adaptation to DUT characteristics while guaranteeing highest measurement accuracy and minimizing the total measurement time.

EMI Software ESPC-K1, which also runs under Windows™ 3.1, is part of the package supplied with ESPC. This application software is characterized by its ease of operation and uses only those functions which are required for diagnosis and precompliance measurements (FIG 4).

Volker Janssen

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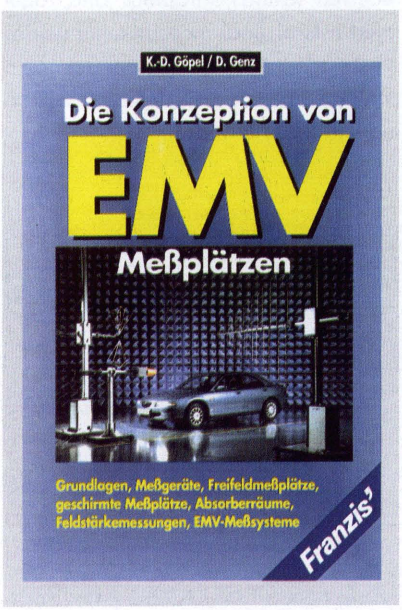
[2] Müller, K.-O.: Conformity of Rohde & Schwarz EMI test receivers with CISPR standards now confirmed officially. News from Rohde & Schwarz (1995), No. 147, p 51

[3] Wolle, J.: EMI Software ES-K1 – Windows for EMI measurements. News from Rohde & Schwarz (1993) No. 142, pp 22–23

Condensed data of EMI Test Receiver ESPC

Frequency range	150 kHz to 1000 MHz (9 kHz to 2.5 GHz)
Resolution	10 Hz to 1000 MHz, 100 Hz above 1000 MHz
Frequency error	3×10^{-6}
Noise figure	17 dB
Preselection	8 filters
Bandwidths	200 Hz (option), 9 kHz, 120 kHz
Detectors	PK, AV, QP
Demodulators	FM, AM, A0
Overload detection	in RF and IF path
Measurement time	1 ms to 100 s
Output of test results	on printer, plotter or via PC (software)

Reader service card 149/04



The conception of EMC test positions

by Dr. Klaus-Dieter Göpel and Dr. Dietmar Genz. Dr. Genz is chief of branch at the Federal Office for Approvals in Telecommunications in Kolberg, Dr. Göpel is head of the development department for EMC systems and projects at Rohde & Schwarz. German edition published in 1995 by Franzis-Verlag GmbH, Poing near Munich; ISBN 3-7723-7971-0, 255 pages, 141 illustrations (many from Rohde & Schwarz), 18 tables, available in bookshops, price DM 78.

With the adoption of EMC law, high demands are set for the electromagnetic compatibility of electrical and electronic products. Development engineers and designers, system technicians, service personnel, etc have to get acquainted with the problems caused by EMC. Measurements are required for determining the EMC. The quality of the test equipment used and the environment are decisive for the accuracy and reproducibility of measurement results.

The book introduces concepts for EMC test equipment and provides theoretical background knowledge. After explaining fundamentals and definitions of EMC, it deals with the following subjects:

Instruments for measuring spurious emissions and immunity to interference
Open-field test systems
Test systems in shielded rooms
Shielding components
RF absorbers
Anechoic chambers
Automation and software for EMC test systems

The detailed description of these subjects imparts the practician with a thorough knowledge on theoretical relationships and also gives a survey of the field of EMC. Thus the book may be used as a basis for estimating the outlay involved or for planning one's own test-equipment needs.

Comparative Test System TS9958V

Simultaneous coverage measurement in three digital mobile-radio networks

Comparative Test System TS9958V – a portable compact case system – allows the network quality of up to three digital mobile-radio networks to be analyzed simultaneously. With a minimum of time and cost, the user can collect quality data from his own network as well as competitive networks to ensure economical use of his base stations. The system can be fitted with any combination of test mobile stations for GSM900, DCS1800 (PCN) and DCS1900 (PCS) standards.

Main **fields of application** of the test system include:

- objective comparison of different networks (network quality analysis, NQA),
- detection of gaps in coverage and interference in several networks at the same time,
- simultaneous measurement with various antennas within the same network (eg measurement with the antenna inside the vehicle and with roof antenna at the same time).

Efficient measurement of coverage in mobile-radio networks is the basis of economical network planning and maintenance. Comparative Test System TS9958V (FIG 1) now provides a new possibility of gathering data from other networks. It offers quality comparison between one's own network and two other networks. This is a simple way of obtaining conclusive information about one's own "market value".

FIG 1 Comparative Test System TS9958V for simultaneous analysis of network quality of up to three digital mobile-radio networks. The complete system consisting of transit case and accessory bag can be carried by a single person.
Photo 42 076

Since the system can be fitted with any combination of GSM, PCN and PCS test mobiles, matching to the various measurement tasks is easy.

The following **features** make TS9958V the ideal system for comparative measurements in mobile-radio networks:

- full compatibility with Portable GSM Coverage Measurement System TS9951 [1],
- network-quality determination with selectable parameters,
- easy configuration through optional fitting with GSM, PCN and PCS handies as test mobiles,
- 12-V powering allowing use in any vehicle with 12-V onboard supply (optionally 230-V power supply),
- easy to transport by a single person,
- all connectors are provided on the outside of the transit case to give ease of operation,
- external navigation system can be connected in addition to the internal one (second GPS receiver, Travelpilot or multimode navigator),
- future-oriented design with simple software updates by floppy.

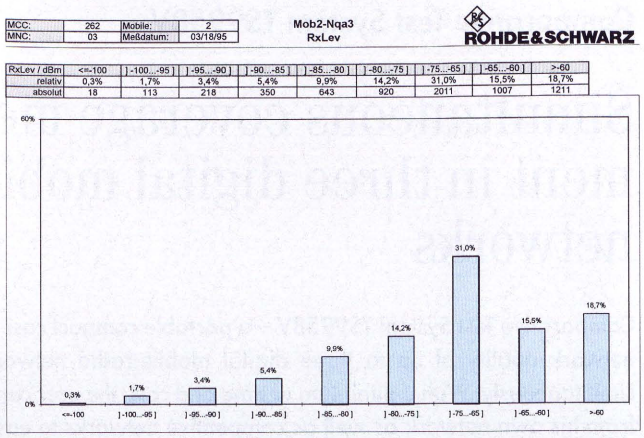


FIG 3 RxLev worksheet of Quality Analysis Software TS9954-NQA under Excel with statistical distribution of received field strength

Function

For an objective comparison of several mobile-radio networks, the individual measurements have to be carried out simultaneously so that the results can be referred to the same position information of the GPS receiver. For comparative measurements in mobile-radio networks the signalling data are not required for all networks. Test System TS9958V has been designed so that complete signalling can be recorded in one network while network-quality parameters are simultaneously measured in all three networks. The network-quality parameters are the result of automatically made calls. Each call is analyzed and the result stored in a test file. All signalling data as well as NQA data are stored on the harddisk of a laptop or notebook PC. NQA data require much less storage capacity than signalling data.

System configuration

Comparative Test System TS9958V contains three test mobiles as well as one GPS receiver for navigation (FIG 2). A microcontroller controls the interfaces to the test mobiles and the GPS receiver as well as to an external navigation system. It allows data to be preprocessed before they are stored in the laptop. The system further includes an accessory bag with antennas and cables, which also provides space for the laptop, power supply for 230 V (optional) as well as the measurement software with online graphics (MS-DOS 6.2, MS-Windows 3.11) and the optional NQA software running under Excel 5.0.

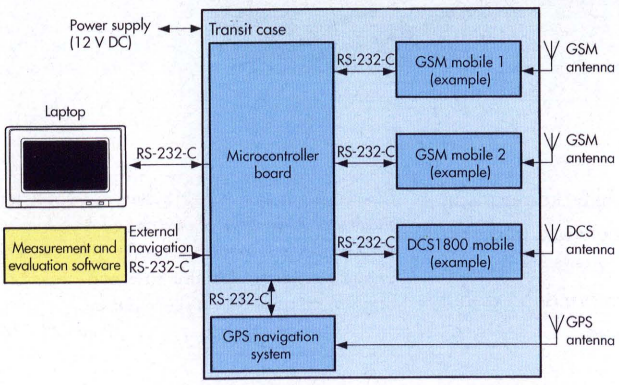


FIG 2
Block diagram of Comparative Test System TS9958V

Measurement capabilities

The **standard measurement functions** of System TS9958V **for one test mobile** include:

- recording of GSM signalling together with OSI layer-3 information [2],
- online display of current signalling for a mobile,
- graphic online display of the GSM measurement report (RxLev and RxQual of serving cell, RxLev of neighbouring cells),
- decoding of basic layer-3 messages such as SYSTEM_INFO_TYPE_1...4.

The **following functions** are available **for all three test mobiles:**

- NQA data for up to three mobiles,
- automatic call setup and hangup with separate telephone numbers for each mobile and with call duration and idle time jointly adjustable for all mobiles,
- continuous measurement mode with automatic data backup during the measurement,
- manual operation giving the user the possibility of direct access,
- input of seven predefined events and an additional event for marking critical measurement situations (eg tunnel, high-rise building).

The **network-quality data sets** consist of an ASCII text line per automatically made call. Each line contains information about time of day and position, lists of the RxLev and RxQual values, the number of the mobile generating the values as well as further test data characterizing the call.

The **test results** are evaluated either by the Evaluation Software TS9954 for signalling data, the High-Performance Software OPAS for signalling and quality data or the Quality Analysis Software TS9954-NQA under Excel 5.0 for graphical representation of network-quality data. Statistical evaluation by TS9954-NQA includes a number of worksheets which can be called up in the form of tables and graphs (see adjoining box). FIG 3 shows an example of an RxLev worksheet with statistical distribution of the received field strength.

Robert Edmaier

Worksheet	Contents
Overview	Overview of test parameters, type of mobile, network
Call statistics	Number of good, blocked, dropped and no-service calls (absolute/relative values), pie chart
RxQual	Statistical distribution of RxQual values
RxQual (coarse)	Statistical distribution of RxQual values according to user-specific RxQual value categories
RxLev	Statistical distribution of RxLev values
PWR time	Statistics of power up and system times
HO information	Number of handovers, intercell/intracell
SysResptime	Distribution of system response times
CallResptime	Distribution of call response times
Noisy	Number of noisy calls (noisy RxLev/noisy RxQual)
SucRate	Number of good, blocked, dropped, no-service calls (absolute/relative values)
SucRate 100%	Number of good, blocked, dropped, no-service calls (absolute/relative values)
SucRate (logically combined)	Rate of successful calls as function of user-defined parameters

REFERENCES

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[2] Picken, D.: The GSM mobile-telephone network: technical features and measurement requirements. News from Rohde & Schwarz (1992) No. 136, 137, 138

Condensed data of Comparative Test System TS9958V

Test mobiles	GSM900, DCS1800, DCS1900
Dimensions of transit case	562 mm x 178 mm x 332 mm
Weight of transit case	15.5 kg
Supply voltages	11.0 to 15.6 V
Current drain	typ. 5.9 A at 13.2 V, max. 8 A at 10.5 V
Power supply 230 V (optional)	13.2 V/20 A

Reader service card 149/05

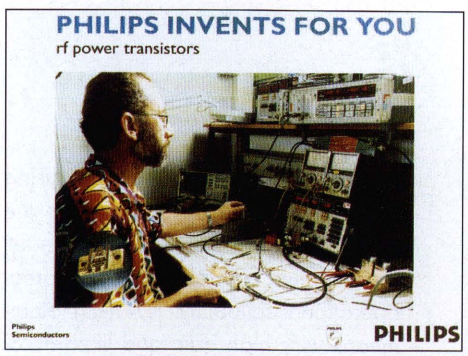
Philips invents for you

It was with this slogan that Philips started a publicity campaign to motivate its staff. The multinational company employing 250 000 people worldwide in a wide variety of business fields is one of the biggest manufacturers of electronic equipment and can now, after restructuring, present very good figures.

The photo shows a test assembly for evaluating the characteristics of high-power transistors. The main components of this test assembly come from Rohde & Schwarz (Signal Generator SMS and Vector Analyzer ZPV). The special field of the semiconductor department in Nijmwegen is the matching of input and output impedance so that customers can smoothly integrate components into their units and systems.

The development labs of Philips Nijmwegen work with a large number of signal generators and high-quality RF power meters from Rohde & Schwarz. For testing multi-standard video chips, Philips technicians use CCVS + Component Generator SAF, a multi-standard generator for all TV applications.

Sö



High-power TV Transmitters NH242, 342, 442

UHF transmitters in IOT technology – TV transmitters of the future

Rohde & Schwarz has developed a new generation of high-power TV transmitters for covering large areas in bands IV/V: NH242 with an output power of 20 kW, NH342 with 30 kW and NH442 with 40 kW. An inductive output tube (IOT) ensures particularly efficient operation.

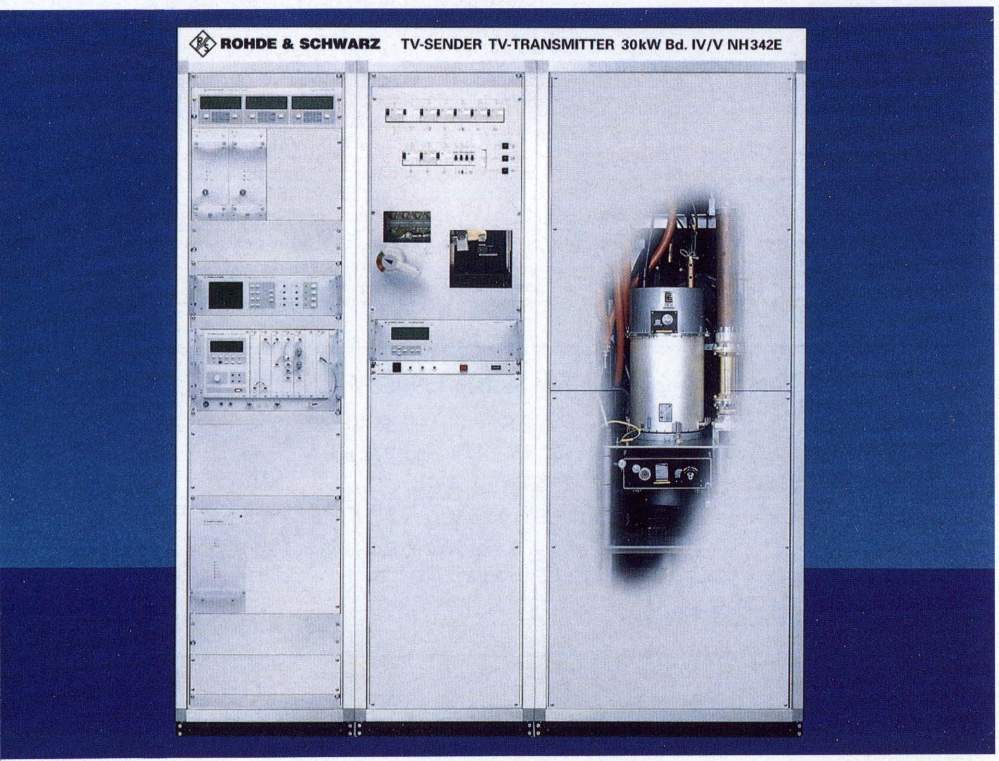


*FIG 1 30-kW TV Transmitter NH342 in IOT technology Photo 41 736

TV Transmitters NH242 to 442 using IOT technology, which combines the advantages of the klystron and the tetrode, feature high efficiency and great operational reliability. IOT technology means very high gain and linearity of the output stage, allowing clear overall circuit design with combined vision/sound amplification. The low power consumption and maintenance costs of the transmitters produce considerable savings in operating costs. The transmitters are designed for TV colour transmissions to PAL, PALplus, NTSC or SECAM as well as for dual-sound transmission. Since these IOT transmitters from Rohde & Schwarz are also prepared for the transmission of digital TV signals, they are an investment for the future.

Special features of the IOT transmitter:

- ultra-high efficiency,
- combined vision/sound amplification,
- suitable for dual-sound transmissions to IRT and NICAM (external modulator),
- high isolation to adjacent channels,
- VF regulation, sync-pulse regeneration and test-signal insertion,
- sync-pulse-controlled AGC at RF output,
- synthesizer tuning for quick channel change and precision offset capability,
- correction of all nonlinearities at the IF,
- convenient and simple operation through graphic displays,
- storage of all parameters and full reproducibility of settings,
- rapid change of transmitter configuration using stored operating parameters,
- simple single-circuit cooling system,
- modular design cutting down spare-part storage costs for the whole transmitter network,
- safety standard to IEC-215.

Description

The transmitter consists of an exciter rack and a two-part output-stage rack (FIG 1). The exciter rack accommodates the exciter, transmitter control unit, driver amplifier, associated power supply units as well as a digital display unit for power indications. The output-stage rack houses the IOT amplifier with all power supply units (including high-power transformer), AC supply distribution, crowbar and IOT monitor. The exciter rack is prepared for accommodating a second exciter so that a configuration with passive exciter standby can be realized.

The transmitters operate on the principle of combined vision/sound amplification (FIG 2). In **Exciter SD100*** the

* Herwerth, T.R.: TV Exciters SD 100/200, SU 100/200 – New exciters for new TV transmitters. News from Rohde & Schwarz (1993) No. 143, pp 17–19

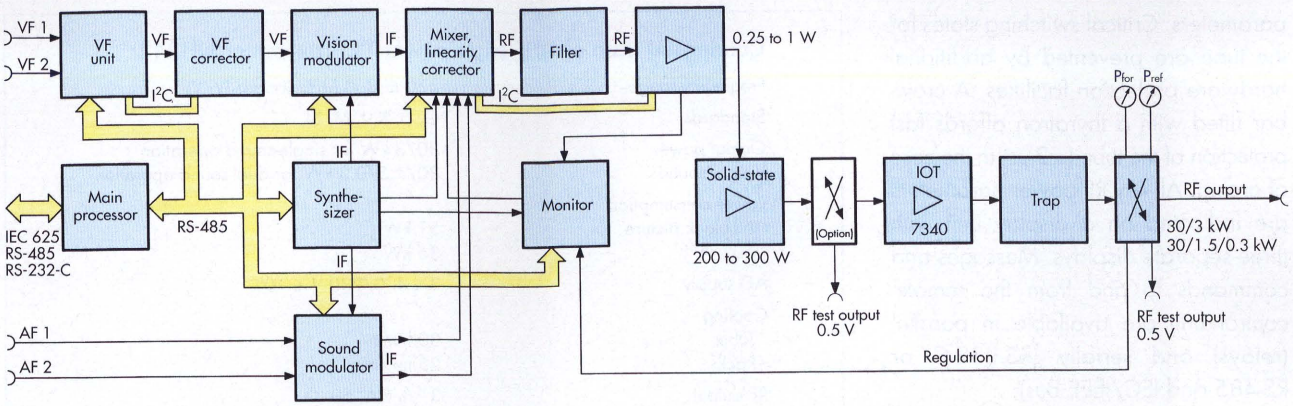


FIG 2 Block diagram of High-power TV Transmitter NH342

signal is converted from the VF and AF to the RF. The microprocessor-based exciter allows menu-guided electronic setting of all parameters required for aligning the transmitter. Set parameters and switching states are stored in a nonvolatile memory. A state-of-the-art equalizer allows optimum correction of complex nonlinearities in the IOT phase and amplitude characteristic.

The exciter output signal is applied to a broadband **transistor amplifier** (FIG 3). Each amplifier comprises a driver, an exciter and four output stages operating in AB mode. Failure of an amplifier module or a temperature fault is indicated on the amplifier front panel via a monitoring circuit and signalled to the transmitter control unit. The output power (150 to 300 W) of the two drivers is routed via a circulator to the input circuit of the IOT amplifier. The signal amplified by beam-density modulation (20 to 23 dB) is coupled out via a two-section output circuit. The –1-dB bandwidth is about 7 MHz (for standard G). The IOT amplifier is followed by an absorbing notch filter and, if required, by a harmonics filter for suppressing spurious.

The driver amplifiers are powered from **Power Supply IN 916,** which consists of two primary switch-mode regulators with a switching frequency of approx. 100 kHz. An integrated monitoring circuit protects the unit against excessive current, voltage or temperature. All IOT supply voltages are electronically stabilized. This ensures high operation stability for the transmitter.

The waste heat of the IOT collector is dissipated via a **single-circuit water cooling system.** Except for the water-air heat exchanger all components are accommodated in one compact unit. An external forced-air cooling system is used for cooling transistor amplifiers, power supplies and IOT amplifier resonators.

Control and monitoring

The control and monitoring system switches the transmitter on and off as required, collects all information from the transmitter, provides the required displays and takes necessary actions in the case of faults. Control and monitoring are based on the master/slave principle. The transmitter control unit functions as a master, whereas the exciter and the tube monitor operate as slaves. Depending on the control status, the tube monitor switches on the supply voltages and the cooling system of the output stage. It also monitors the tube

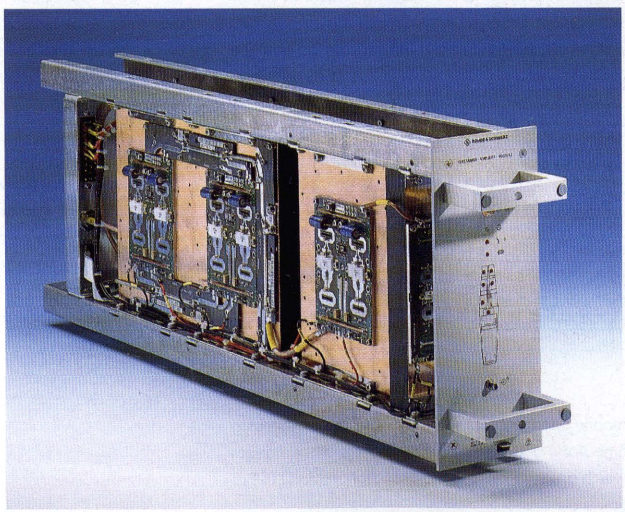


FIG 3
Solid-state amplifier
Photo 41 851

parameters. Critical switching states for the tube are prevented by additional hardware protection facilities. A crowbar fitted with a thyratron affords fast protection of the tube (≤ 2 µs) in the case of arcing. All key RF power parameters are indicated on a display unit with three separate displays. Messages and commands to and from the remote-control unit are available in parallel (relays) and serially (RS-232-C or RS-485 and IEC/IEEE bus).

Valentin Sarreiter

Condensed data of UHF High-power TV Transmitter NH342

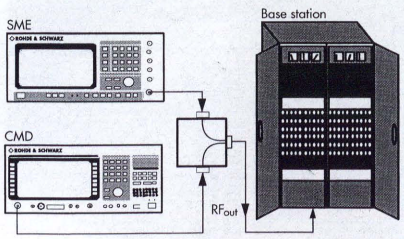
Frequency range	470 to 860 MHz (bands IV/V)
Standards	G, D, K, I, M, N
Output power Vision/sound	30/3 kW for single-sound operation 30/1.5/0.3 kW for dual-sound operation
Power consumption	
All-black picture	51 kW
50% APL	36 kW
AC supply	3 x 400/230 V ± 10%
Cooling	
Tube	30 l/min
Racks	25 m^3/min
RF output	3 $^1/_8$ EIA, 50 Ω

Reader service card 149/06

Test hint

Measuring adjacent time slot on mobile-radio base stations

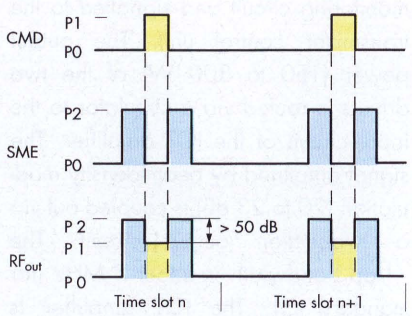
In mobile-radio networks based on TDMA (TDMA = time-division multiple access) methods such as GSM, PCN (DCS1800) and PCS (DCS1900), reception and demodulation of the transmitted data of a time slot can be impaired considerably by signals and data in adjacent time slots. This may be the case if a mobile operated far away from the base station uses time slot 4 and, at the same time, two other mobiles which are very close to the base station make use of time slots 3 and 5.



To achieve high suppression of spurious signals originating from adjacent channels during operation, limit values are prescribed for base-station receivers. The GSM specification (ETSI/GSM 11.20), for example, stipulates BER tolerances for measurement of the user channel in the presence of a signal 50 dB stronger in the adjacent channel with all other time slots switched off.

The ideal combination of equipment for this BER measurement consists of **Signal Generator SME,** synchronized to **Radiocommunication Tester CMD** (see also article on page 44 in this issue: New signal-generator characteristics to satisfy needs of digital mobile radio). This test setup provides a much wider dynamic range than demanded by the GSM specification.

Mathias Leutiger



Level characteristic of TDMA frame signal. Radiocommunication Tester CMD generates useful time slot, Signal Generator SME adjacent time slots with level that is 50 dB higher than wanted signal.

Reader service card 149/07

VHF Direction Finder PA030

Small on size but big on performance

Where there is a will there is a way. Seeing as classic DF systems with a wide-aperture antenna offer high precision but also involve high costs, many customers with a low budget shy away from buying a Doppler direction finder. This is where the new VHF Direction Finder PA030 comes in. With its high precision, in spite of the small antenna base, and excellent price/performance, PA030 addresses exactly this customer group.

Alongside radar, GPS and other navigation aids, direction finders using the Doppler principle have a firm place in traffic control applications on land, in the air and at sea. While GPS is victoriously marching through to cockpits, dashboards and the bridges of ships, direction finders and radar are required for fixing the position of objects that are not able to determine it on their own or wish to conceal it. Doppler direction finders like radar mostly involve elaborate technology and require a lot of space and infrastructure. But the new DF system from Rohde & Schwarz is different. VHF Direction Finder PA030 (Rhotheta system RT1000) with its extremely compact antenna system (FIG 1) enters sectors that up to now were the domain of much larger systems.

The compact antenna base is a precondition for a favourably priced DF system, and the high-speed antenna rotation (3 kHz) permits extremely fast detection of radio signals. Thus extremely short signals can also be determined exactly. The cw/ccw rotating system of the DF antenna completely compensates bearing errors caused by signal delay variations.

Saving costs by separating antenna and bearing evaluation

For physical reasons the accuracy of direction finders largely depends on the antenna position. Only at sites where the received signal is not disturbed by reflections can the direction finder operate with full accuracy. Consequently the antenna is best set up on open ground as far away as possible from built-up areas – and therefore also from the air-traffic controller.

The antenna and direction finder of conventional DF systems are set up close to each other because of the problematical RF connection, and bearings have to be transferred in an elaborate way from the antenna site to the monitor at the position of the air-traffic controller. This not only involves additional costs for the display, but in most cases the direction finder itself has to be accommodated in an air-conditioned shelter. Not so with the Rohde & Schwarz VHF Direction Finder PA030, where the antenna and receiver are set

FIG 1
VHF Direction Finder PA030 with compact, sturdy antenna and detached bearing display for wide field of application at airports
Photo 42 216/2

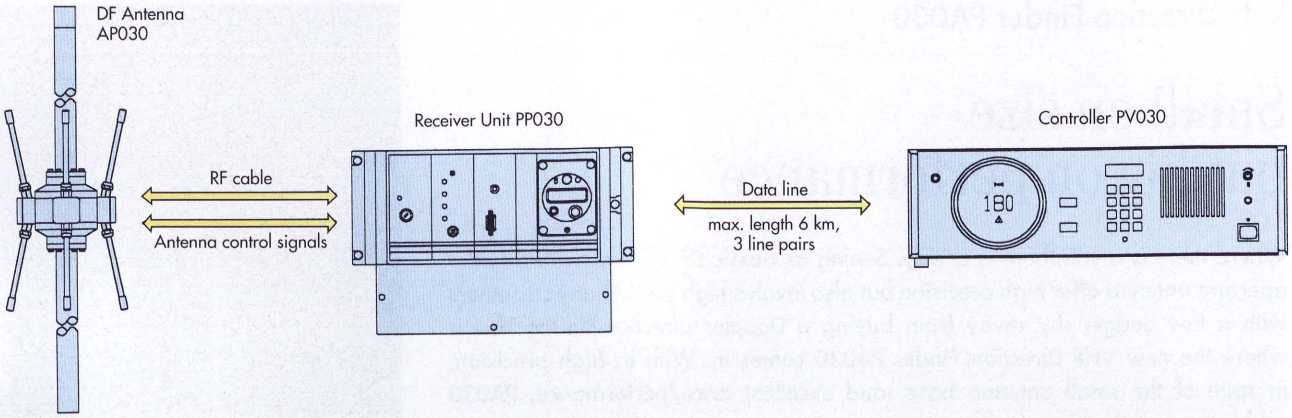


FIG 2 Components of VHF Direction Finder PA030

up detached from the bearing unit (FIGs 2 and 3). The receiver unit is housed in a weatherproof cabinet fixed to the antenna mast and comprises synthesizer receiver, demodulator and antenna control unit. Connection to the controller is via a commercial 6-wire telephone line which may be up to 6 km long. Thus the ideal antenna site for taking bearings can be chosen without having to bother about permissible RF cable lengths.

The DF antenna – compact and powerful

An essential part of PA030 is the new, small-aperture DF Antenna AP030. With a base diameter of only 250 mm the antenna requires four dipoles only. The sturdy, corrosion-protected and completely watertight construction takes full account of the fact that direction finders are expected to have an operating life of 20 years and more. This makes the antenna ideal for use in a harsh maritime climate as, thanks to the small dimensions, there is little surface to be attacked by wind and snow. A 1.5-m-long rod in the center protects the antenna against lightning.

The receiver unit – a brand-new concept

A new concept was also devised for the Receiver Unit PP030. It comprises a VHF multichannel receiver (synthesizer) with demodulator and interface plus the antenna control unit but is not equipped for evaluating bearings. Since the receiving unit is usually fixed to the antenna mast in the open, it is accommodated in a dust- and waterproof cabinet for protection against weathering. The electronics is designed for operation within the temperature range of –40 to +60°C.

The link to the operator position is analog and delay-free via three lightning-protected line pairs. Because of the clockwise/counterclockwise DF rotation, no bearing errors occur on the transmission line in spite of the phase shift. For this reason an inexpensive telephone line can be used for an errorfree signal transmission between receiver unit and controller.

The controller – an efficient analyzer

The signals from the receiver unit are processed in Controller PV030, where bearings are evaluated and displayed. The controller is accommodated in a 19-inch cabinet with a front panel carrying the indication and control elements. A phase meter derives the azi-

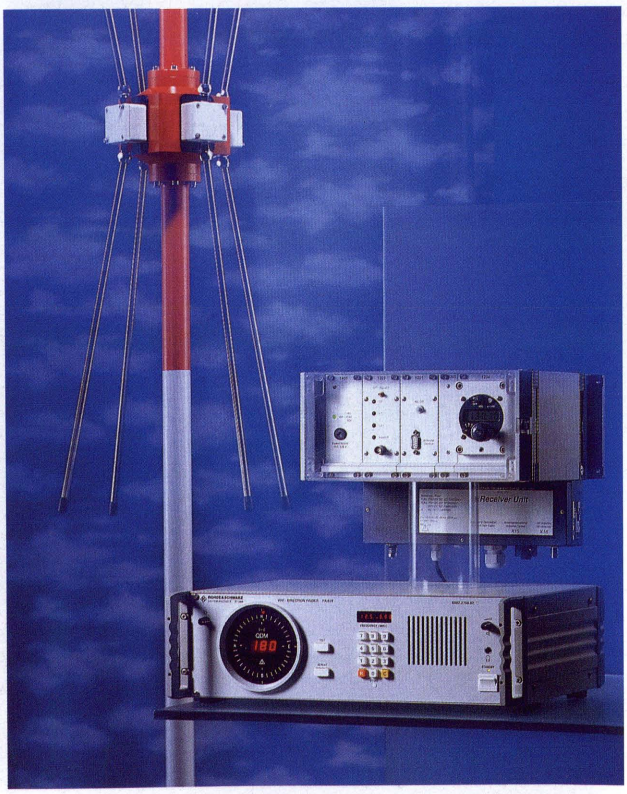


FIG 3
Compact DF system consisting of Controller PV030 (front), Receiver Unit PP030 and DF Antenna AP030
Photo 42 216/1

muth value from the bearing signal. The data are read by a microprocessor and converted to a QDR value shown by 36 green light spots on a compass rose. The display is refreshed every 21 ms. At the same time the bearing signal is averaged in a patented phase-signal summing integrator and the azimuth determined with the aid of a second phase meter. The averaged values are again read by the microprocessor, displayed as a three-digit QDM value and as 36 red light spots on a second compass rose. While the green compass responds to bearing fluctuations, the red one shows a bearing averaged over 250 ms. This double compass rose (FIG 4) made up of red and green luminous circles is also patented and ideal for analyzing the bearing quality.

To ensure that useful bearings are obtained, the evaluation is controlled by several squelch criteria. The microprocessor also sets the receiver frequency. Any single frequency or ten preprogrammed channels can be selected. Operating functions such as digit test, display refresh, luminance and volume control as well as the output of error codes are available in addition. A headphone connector too is standard equipment.

The AF interfering tone (3-kHz scanning tone) generated by the antenna scanner at the receiver output is eliminated by a special notch filter in the AF amplifier so that the air-traffic controller can hear the voice signal undisturbed while bearings are being taken. The high rotating speed makes the direction finder insensitive to the various types of modulation. As a result even overmodulated AM signals like those emitted by emergency transmitters (ELT) and narrowband FM signals can be processed without any problems.

As expected of a modern instrument, the controller is equipped with two interfaces and therefore fully system-compatible. The RS-232 interface is used as an output for bearing information and for remote control of operating functions. An add-on, customized display may be connected to the parallel interface.

Use – new flexibility

Thanks to the special design – a combination of state-of-the-art technology and a new concept – PA030 is a high-performance unit in spite of its moderate price, meeting the requirements of almost any present-day applications. The system is highly suitable for classic air-traffic control tasks such as homing and identification, for instance. When a receiver with a frequency range of up to 163 MHz is used, PA030 may also be employed in coastguard stations for controlling waterways.

FIG 4 Display of direction finder with double compass rose for bearing quality analysis

Thanks to its compact antenna, PA030 is ideal for mobile applications. It could be used, for instance, in mobile towers, for detecting emergency transmitters or as a mobile unit in triangulation networks.

Antenna supporting system

Antenna Support KM030 completes VHF Direction Finder PA030. The sturdy, pyramid-shaped construction does not use any cumbersome guy ropes. The antenna is fixed 4 m above ground, an optimum position for the vertical radiation pattern. A segmented circle permits the antenna to be rotated exactly in 10° steps for rapidly checking the functions of the DF system. With the aid of a folding device and a few manipulations the antenna can also be tilted to operator level. A weatherproof steel cabinet with lightning arrester is provided at eye height to accommodate the receiver unit.

Wolfgang Pichl

Condensed data of VHF Direction Finder PA030

DF method	Doppler
Frequency range	118 to 136.975 MHz
Number of channels	760, any 10 of which may be stored
Channel spacing	25 kHz
Detectable type of modulation	A3E, F3E, A2X (ELT)
Max. system error	±2° (with antenna)
Sensitivity	<6 µV/m
Polarization	vertical
Interfaces	serial V.24 (RS-232), parallel
Bearing indication	
Response time	≤0.3 s
Bearing output	3-digit LED display, resolution 1° double compass, resolution 10°

Reader service card 149/08

Radiocommunication System ACCESSNET®-D

Trunked radio goes digital

Wireless communication in industry and administration via ACCESSNET® is becoming even more flexible. The new digital exchange allows simultaneous operation of analog and digital trunked-radio channels. The network operator can thus continue to use his existing ACCESSNET® infrastructure and integrate step by step a modern digital system.

FIG 1 Trunked-Radio System ACCESSNET®-D with Digital Mobile Exchange DMX64 and radio base station Photo: Bick

Trunked-Radio System ACCESSNET® (FIG 1) has achieved an outstanding market position in recent years. In Germany alone, over 350 radio cells with about 2000 radio channels using the proven technology to MPT 1327/1343 standard have been supplied by Rohde & Schwarz to ten network operators. In addition to German Telekom (DeTeMobil) and its affiliate Chekker ProRegio, the company's customers include private network operators RegioKom, Thüringer Mobilfunk, Überlandwerke Unterfranken, Koblenzer Energieversorgungs-AG, Quickfunk, Telesystem, Regiofunk Saarland/Pfalz, Arbeitsgemeinschaft Bündelfunk as well as private, local network operators like Daimler-Benz. On the international market Rohde & Schwarz has also gained a strong foothold [1; 2]. Recent successes were scored among others with the Swiss PTT, in the United Arab Emirates (FIG 2), the Czech Republic, Belgium, Syria, Egypt and in Russia.

The "career" of ACCESSNET® began in 1989 (FIG 3) when the first test systems with the MMX24 exchange (for regional trunked-radio networks with up to 10,000 subscribers) were supplied to Germany's Telekom. At the low end, the budget-priced ACCESSNET®-Mini system (with MMX8 exchange), which was especially designed for local networks and for very secluded and mobile radio cells, followed in 1991/92. In 1993 MMX64 was introduced as the first main exchange with a digital core, which today is the heart of networks with 10,000 and more subscribers. From this basis, Rohde & Schwarz has now made the first step towards TETRA (Trans-European Trunked Radio), the future standard for digital trunked radio. The Digital Trunked-Radio System ACCESSNET®-D and its Digital Mobile Exchange DMX64 already allow a stepwise change to

digital fleet communication with listening protection, previous investments being safeguarded to a high degree. Depending on the requirements, the radio cells of a large city can for instance be digitized while the boundary cells still remain fully analog.

Analog and digital together

Digital Mobile Exchange DMX64 was designed as a dual system. It supports both analog radio base stations in line with the proven MPT 1327/1343 standard and digital radio base stations with the new 4.8-kbit/s FSK modulation mode. Moreover it allows the connection of a dual 50-W radio base station which, depending on operational requirements, can be configured either with analog or digital channels. Signalling is made as before via the control channels with 1200 bit/s FFSK modulation. The handheld Transceivers 360HE from Rohde & Schwarz can be operated as analog or digital units as desired. Depending on the subscriber's licence, DMX64 decides whether the requested call will be switched to an analog or a digital traffic channel and in which mode the handheld is to be operated. If 360HE is to set up a call with an ordinary analog unit for instance, the transceiver is simply set to the conventional operating mode with phase modulation.

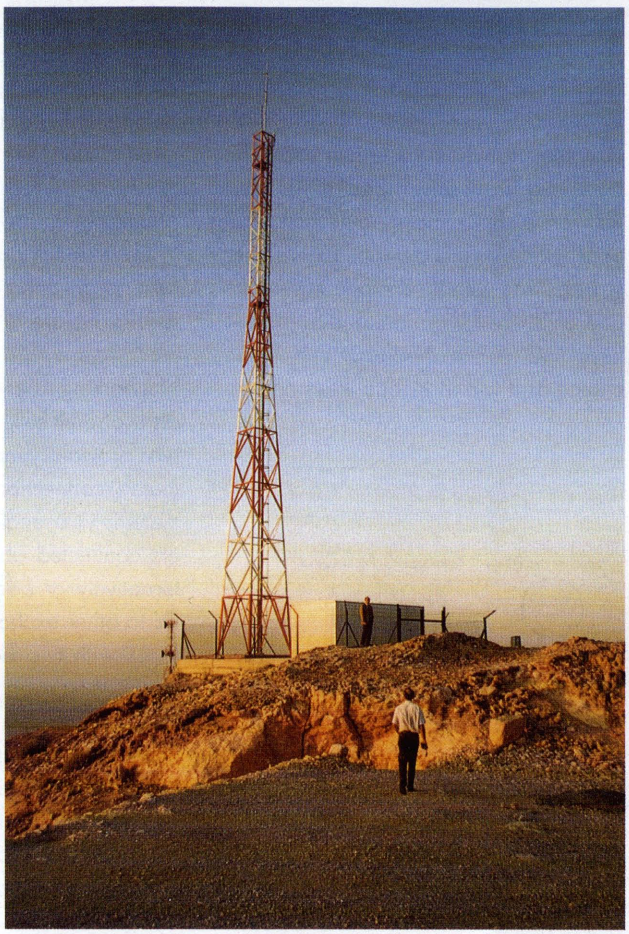


FIG 2
One of nearly 40 sites of national ACCESSNET® trunked-radio system in United Arab Emirates
Photo: Schütte

For digital operation the Improved Multiband Excitation Coder (IMBE) was chosen by DVSI. On the basis of an advanced DSP (digital signal processor) the speech to be transmitted is digitized and compressed to 4 kbit/s. Another 800 bit/s contain error-protection and radio-channel synchronization information. The total data stream of 4.8 kbit/s is transmitted with FSK modulation and requires the same bandwidth of only 12.5 kHz per radio channel as analog phase modulation in line with MPT 1327/1343. Thanks to forward error correction and reconstruction of faulty or missing bits during reception, the coverage of a digital radio cell could be designed exactly as for an analog system, with the great advantage that speech quality at the cell boundary is much better however (FIG 4).

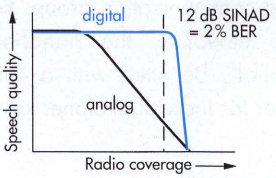


FIG 4 Advantage of digital over analog transmission

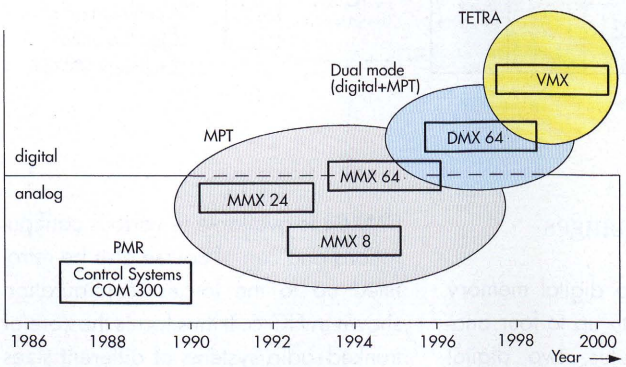


FIG 3
Migration steps of ACCESSNET®. Control systems for private mobile radio (PMR) were followed by first trunked-radio exchanges MMX24, MMX8 and MMX64. DMX64 allows digital radio base-station operation as first step towards TETRA.

Enciphering

Digital modulation already provides end-to-end enciphering for ACCESSNET®-D customers to whom security is vital. The handheld Transceiver 360HE is fitted with an enciphering module as standard. The software determines whether you operate without enciphering or use one of 3.4×10^{38} independent cipher keys (FIG 5). In the 360HE a basic choice of 3 x 8 individual keys can be stored. The key selected can even be changed during ongoing communication. This change is automatically communicated via radio to all transceivers of the communication group. For even more flexibility, the handheld can optionally be fitted with a chip card reader for individual cipher keys.

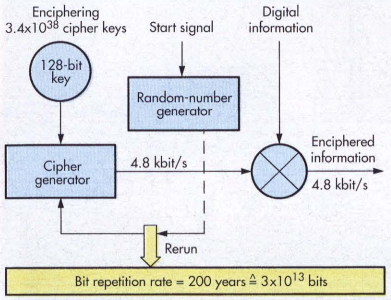


FIG 5 Enciphering principle of ACCESSNET®-D system

Networking

With ACCESSNET®-D communication is not restricted to the radio path, but can be extended via interfaces to telephone systems or to the public switched telephone network (PSTN). For bidirectional telephone access DMX64 can be retrofitted with an analog PSTN interface adapter or an ISDN adapter. ISDN has the great advantage that a caller from the landline network need not redial via DTMF (dual-tone multifrequency) but can use direct dialling. In addition to much better voice quality and distinctly faster call setup, ISDN also provides automatically two telephone accesses per interface card. For each subscriber it can individually be determined via the OMC (operating and maintenance computer) terminal of the system whether access to the telephone network or telephone system is to be activated in outgoing and/or incoming direction and any time or area restrictions are to be defined.

Networking between ACCESSNET® and a multicell trunked-radio system was previously made via four-wire dedicated connections or via microwave systems with analog channel multiplexers connected ahead. DMX64 can alternatively or additionally be connected to other exchanges via ISDN (interfaces with two basic access channels each). Moreover, networking with other DMX exchanges via microwave or PCM30 links is possible by means of direct primary multiplex interfaces. The trunked-radio network thus becomes much more flexible and efficient than the conventional analog system.

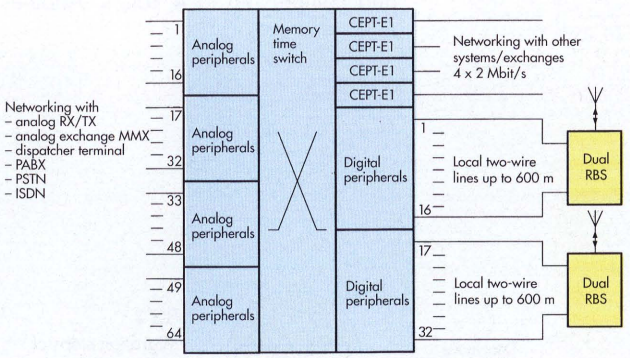


FIG 6 Configuration of Digital Mobile Exchange DMX64

Dual-system exchanges

DMX64 consists of a digital memory time switch (MTS) with up to four analog exchange modules, two digital exchange modules and four primary multiplex interfaces (FIG 6). Depending on the configuration, the MTS is based on four to 16 PCM highways with clock rates from 4 to 8 Mbit/s. In an analog exchange module up to 16 four-wire interfaces for the connection of analog radio base stations, analog exchanges, wired operator's stations, PSTN and PABX interfaces can be operated simultaneously. Alternatively, up to eight PID (phone interfaces digital) modules each with an ISDN-S_0 connector (two B channels plus D channel) can be operated. A digital exchange module allows the operation of 16 DSI cards for switching digital radio channels in dual radio base stations. Each base station allows analog and/or digital radio channels to be operated. The primary multiplex modules (CEPT-E1) are the prerequisite for networking several DMX64 exchanges via dedicated connections or microwave links with a capacity of 2 Mbit/s. Each of these connections can carry up to 30 calls including the signalling simultaneously.

DMX64 is available in various configurations and can of course also be retrofitted up to the largest configuration shown in FIG 6. It thus forms the core of trunked-radio systems of different sizes

with subscriber numbers ranging from a few hundred to several ten thousands.

All set to go

The dual radio base station ND960, the basic version being available already, forms the basis of a multifunctional communications system. It supports the analog standard MPT 1327/1343 and allows 4.8-kbit/s FSK modulation. Moreover, it is already open to digital standards such as Mobitex 8k and TETRA. Following the implementation of the digital MPT system, stepwise migration towards TETRA is planned for the fully digital exchange core of DMX64. Thus the first TETRA networks can be built as early as 1997.

Ulrich Schinke; Wolfgang Klier

REFERENCES

[1] Wagner, K.-H.: Trunked-radio systems successful all along the line. News from Rohde & Schwarz (1994) No. 146, p 55

[2] Wagner, K.-H.: Trunked-radio systems for emergency services in Syria. News from Rohde & Schwarz (1995) No. 148, pp 50–51

Condensed data of ACCESSNET®-D Digital Mobile Exchange DMX64

Core	MPT 1327/1343
Analog ports	4 x 16
Digital ports	2 x 16
Microwave ports	4 x 2 Mbit/s (CEPT-E1)

Reader service card 149/09

Standardized software for Rohde & Schwarz test and measurement systems

Rohde & Schwarz has developed a new generation of software products for test and measurement systems. They are based on a common software kernel and are characterized by uniform operation and look. The **product group** comprises:

- **ES-K1** system and application software to perform measurements of spurious emissions (EMI) in compliance with standards [1],
- **EMS-K1** system software to perform susceptibility measurements (EMS) in compliance with standards [2],
- **TS9965/Win** system software for radiodetection systems to monitor, measure and analyze wanted field strength in compliance with CCIR [3],
- **DECT-K1** system software for the type approval of DECT phones,
- **CT200** user interface for realtime monitoring, error signalling and control of all the functions of a cable headend for feed-in of sound and TV broadcasts.

When selecting system software for controlling complex test systems, criteria such as processor hardware, operating system, operation, test routine, data management, interfaces, drivers, protective facilities, report generation as well as extendibility and configurability of the software play a major role in addition to the test functions.

Regarding the processor hardware and operating system, all software products mentioned were implemented for **PCs with the operating system MS-Windows,** which is nowadays a de-facto standard.

The **interactive operating mode** of the software allows manual control of individual complex test routines. For ES-K1 this can be a complete scan together with automatic consideration of the correct switching path and the corresponding frequency-dependent cable attenuation. Each driver has a virtual user interface in the form of a dialog box via which the unit can be directly operated (FIG 1). The context-sensitive online help common for all Windows programs provides information on how to operate the currently active dialog or menu by the push of a button.

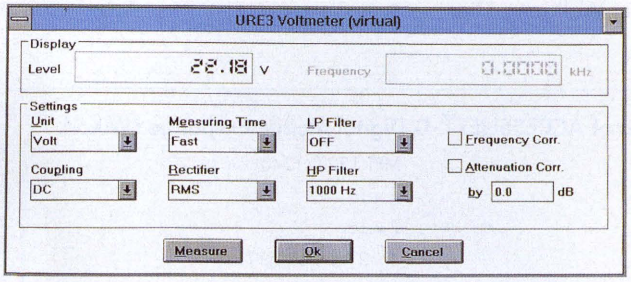


FIG 1 Example of virtual user interface

Automatic measurement and test routines are implemented with the aid of scripts similar to a macro (FIG 2).

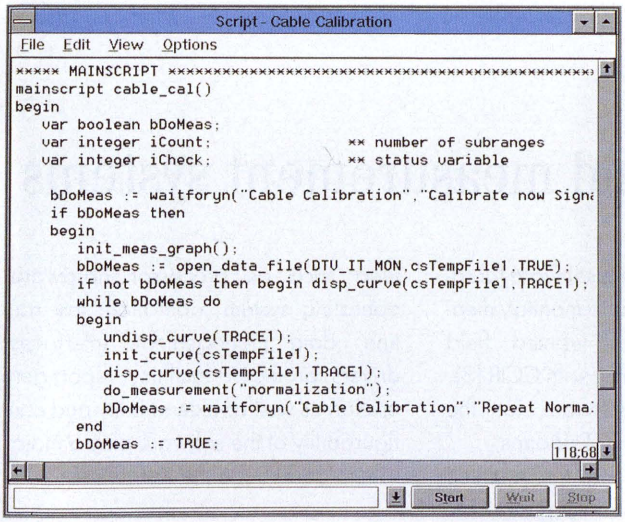


FIG 2 Example of script program

Scripts can be generated, modified or reloaded any time also by the customer by means of tools that are easy to handle (eg editor, debugger, sequencer).

An internal database serves for the **administration and organization of data records** such as test results, reports, graphics and script programs. The data record is identified by a data type (eg test result) and data-record name. The data-record name can comprise more than eight characters and may also contain blanks. Useful names such as "cable calibration" for a script program are possible. A brief description of the data record can be stored additionally.

Thanks to a number of **open interfaces,** the individual software products become more and more flexible with regard to extendibility. The MS-Windows operating system provides DDE (dynamic data exchange) for data exchange with other programs running at the same time. The DDE server function can be used by any DDE client such as WinWord, Excel or any other programs generated by tools such as LabWindows, LabView or Visual Basic. In this case, the client has read access to the data of the internal database such as test results, limit lines or graphics. Frequently occurring applications are report generation by means of WinWord or further processing of test results in other, user-specific programs or purchased databases. During report generation with WinWord, test-result tables and complete graphics can be integrated at the required places into a drafted form comprising logo, header, footer and comments.

FIG 3 gives an example for the DDE client function with MS-Windows as server. The script allows write and read access to the texts of the open document. FIG 4 demonstrates convenient handling of the DDE client function by means of the LabWindows-generated simulation of an RPM meter. The functions Run, Stop and Reset can either be manually controlled using the mouse or remote-controlled via the script. The actual value of the pointer can also be read from the script.

The user can extend the functional scope of the script by his own routines in C. The functions of a DLL (dynamic link library) especially generated for this purpose can be directly called up from the script. Possible applications are, for example, the extension of scripts by mathematical routines, string operations, dialog boxes for input or output or user's evaluation functions.

The range of **device drivers** is continuously being extended and currently comprises mainly test receivers, spectrum analyzers, power meters, generators, direction finders as well as accessories and different control units. A special feature is the IEC/IEEE-bus driver enabling direct read and write access from the script via the IEC/IEEE bus so that devices can also be controlled for which a driver is not available.

For simulation purposes, device drivers can also be operated in a virtual mode.

In this case, access to the device via the IEC/IEEE bus is not possible, ie the complete software including the script programs can also run without devices.

requirements. Data required for the report such as test results, graphics or report header can be compiled by means of report configurations. Use of the DDE

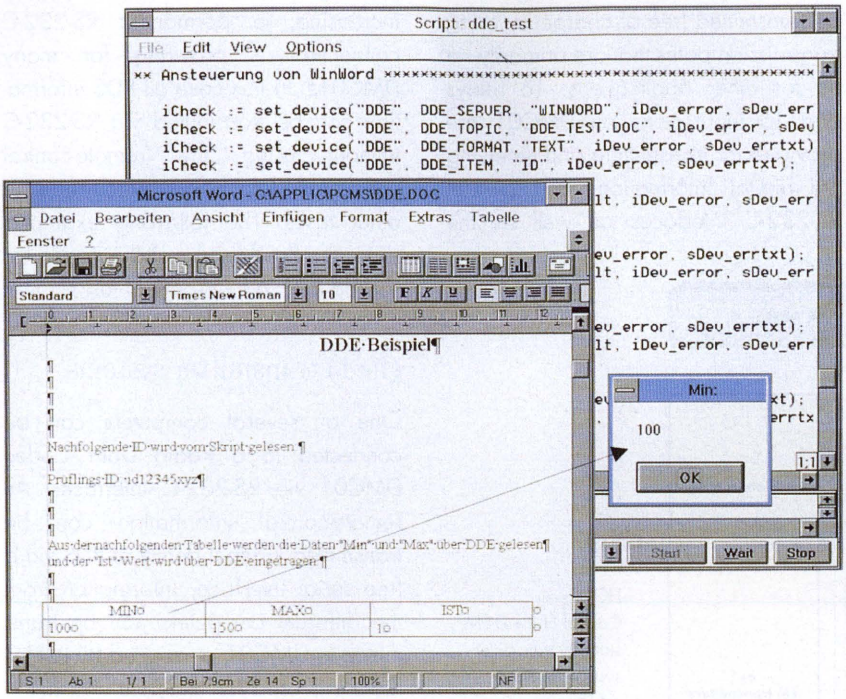


FIG 3 Example of DDE client function with MS-Windows as server

So script programs can be generated and tested even if there are no devices available at the workstation.

Depending on the application, different **protective mechanisms** are required such as for access rights to specific data, eg test data, but also for authorization to carry out certain functions like system configuration. Thanks to a log-in mechanism, the user checks in by entering his password. Each user belongs to a user group having access to common data. Moreover, each user belongs to a user class which gives authorization to perform certain functions. Thus, there are users who can start test routines using script programs but who are not authorized to modify scripts.

There is practically no other system-software component that needs to be as flexible as **report generation** with regard to type of system and special customer

server and DDE client function in this respect has already been mentioned. Individual graphics and tables can be printed out direct. Adoption of graphics and tables into the clipboard for integration into a word-processing program is also possible.

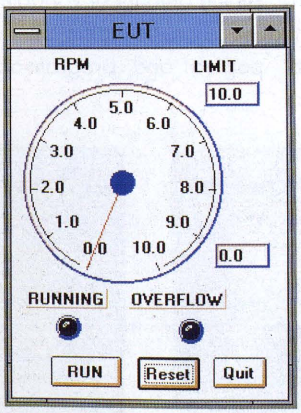


FIG 4 Application generated with LabWindows simulates RPM meter

Follow-up costs for extensions are reduced to a minimum thanks to the **flexible extendibility** concept of the system software. Thus, the cost-conscious customer can first start up with a smaller system and, at a later time, integrate additional units by loading the corresponding device drivers into his system. This also applies to fully automatic test routines in the form of scripts. The user can also reconfigure the system software any time according to his requirements.

Manfred Gruber

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Reader service card 149/10 for further information on software products

Radio Data Codec DMC01 – cost-effective remote-control solution for FM transmitter sites

For performing complex remote-control tasks at FM transmitter sites, a large number of special systems is available with a virtually boundless variety of functions and features which increase elaboration and thus expenditure. But how does the user who only has to send a few commands and messages and thus does not want to install and keep up his own remote-control system solve the task? For this type of user Rohde & Schwarz provides the ideal solution: Radio Data Codec DMC01 [1; 2] with its free remote-control connectors for installation at transmitter sites. With this codec commands and messages can be transmitted free of charge by using transmission paths that are primarily set up for other applications. 16 relays and 16 input ports on DMC01 are provided for transmitting and receiving the digital information, and several RS-232-C interfaces as well as the transmitted and received RDS signals are available for the data transport of remote-control information.

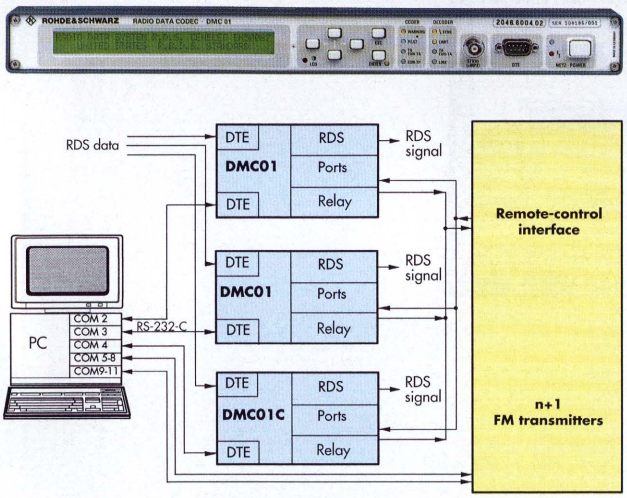
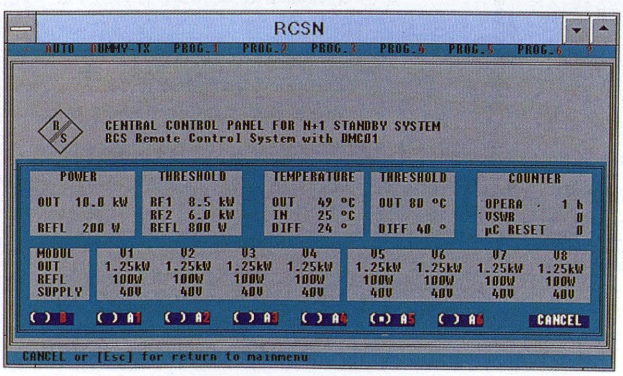


FIG 1
Control of (n+1) FM standby transmitter system via PC in addition to main function of DMC01 as RDS codec

DMC01 can independently perform both remote-control and RDS tasks in a unit provided that the relays or inputs are not used for RDS-specific remote control. As the amount of variable RDS information such as traffic announcements, paging and program-accompanying information is constantly increasing, a permanent RS-232-C connection is provided for many DMC01s. In this case all RDS information can be transmitted via RS-232-C without using the remote-control connectors, which thus remain free for other tasks. The following examples show the flexible use of the codec for solving such remote-control tasks.

(n+1) transmitter systems

One or several computers can be connected to a Radio Data Codec DMC01 via RS-232-C interfaces. As remote-control information can be transmitted independently of RDS via a free serial interface, information from the different computers can be transmitted to DMC01 or queried by it. This feature is used for example with (n+1) FM standby transmitter systems to make a connection between the remote-control interface of the central transmitter control unit to a PC at the transmitter site. In this case the parallel commands and messages of the control unit are adapted by three DMC01s via the remote-control interfaces and connected each to a PC via an RS-232-C interface (FIG 1). This data transfer is performed by the software program RCSN (Remote Control System for n+1 FM transmitters). Moreover, RCSN supports the direct query of measured values and messages of the individual



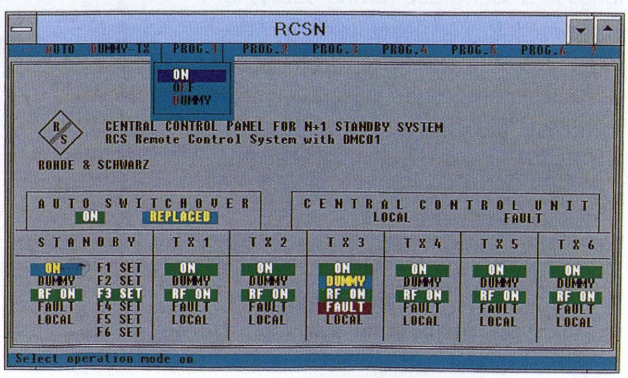


FIG 2 Message and command interface of software program RCSN (left) as well as measured values of FM transmitters (right)

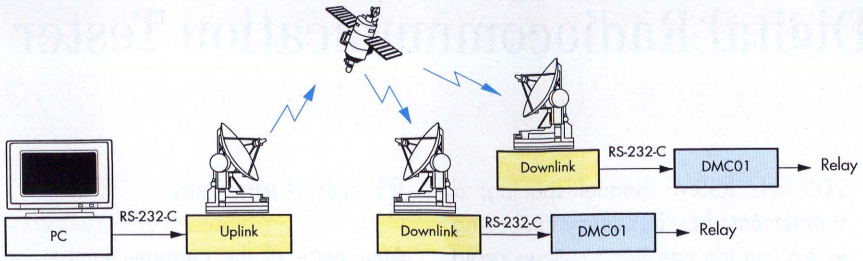


FIG 3 Data feed to Radio Data Codec DMC01 via satellite

transmitters of the system via additional serial interfaces of the PC. FIG 2 shows the command and message interface of RCSN.

It goes without saying that each DMC01 can also be addressed by a computer via a modem link and can thus control relays or query contacts. This modem link can be used exclusively for remote control or, combined with the transmission of RDS data, be permanently or only briefly selected.

RDS and remote control via satellite

A further application of DMC01 is in the supply of commands that are given from a central station to individual transmitter sites via a satellite link (FIG 3). Specific relays on individual DMC01s can be switched irrespective of the RDS data. The use of relays can be determined by the user. PROFI (Professional RDS Loading Function Interface), a program developed by Rohde & Schwarz, facilitates relay control. Thanks to the special menu window of the program, an application-specific name can be allocated to each relay (FIG 4).

Remote control via RDS channel

The Radio Data System provides the inhouse channels as well as the transparent channel for the distribution of remote-control data in the RDS data channel of FM broadcasting. Commands can thus be distributed to wherever the FM program is received. At their destination the commands must be decoded from the FM stereo MPX signal and converted into relay states. Also messages can be transmitted via the VHF network. The messages are read by DMC01 at its input ports, packed in the RDS data channel and transmitted by means of the program signal. These status messages can thus be received and evaluated at some other place (FIG 5). Such a concept can for example be used for monitoring unattended transposers. Like the program signal, remote-control information can also be passed on using relay receivers. In this case the FM signal is received at one site and retransmitted at a different frequency. This can also be done several times within a transmitter network.

These are just some of the typical remote-control applications of Radio Data Codec DMC01; it is possible to implement them in practically any variation and combination. This remote-control system is future-proof as DMC01 will be retrofitted with further relays and ports.

Hans Mieslinger

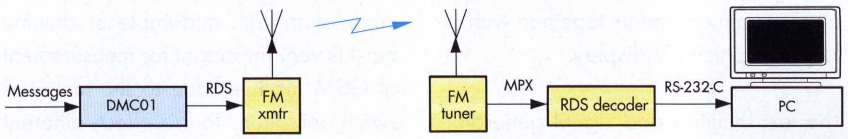


FIG 5 Evaluating messages on monitoring receiver using RDS decoder

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[2] Mieslinger, H.: RDS transmission and FM transmitter control with Radio Data Codec DMC01. News from Rohde & Schwarz (1994) No. 146, pp 35–36

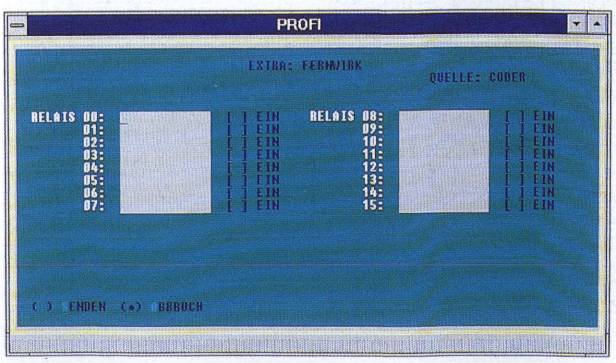

FIG 4
Remote-control menu of PROFI program

Reader service card 149/11

Module test with Digital Radiocommunication Tester CMD52/55

Digital Radiocommunication Testers CMD52 and CMD55 are compact units for the complete testing of GSM or GSM/PCN/PCS mobiles in service and production environments [1 – 4] whereby the test set simulates the corresponding base station. A call is established with the mobile by means of signalling. In this state all important parameters can be measured at the transmitter and receiver end. Many mobiles allow measurements in the socalled service mode for checks and adjustments as well as for troubleshooting. There is also a need to test the individual modules of a phone, components or function units in the conventional way. For this purpose CMD offers the module test mode. The measurement functions of this mode can easily and rapidly be operated via a clear and convenient menu together with a large graphic LCD display.

The test facilities and signal generator of CMD can be operated simultaneously and thus also allow filters, amplifiers, converting modules and units to be checked. In contrast to conventional evaluating units and signal generators, CMD can also solve special GSM measurement tasks – eg whether an amplifier component falsifies GSM burst timing.

RF synthesizer

The RF synthesizer of CMD not only operates in the GSM, PCN and PCS bands but also covers the extended frequency range from 800 to 1000 MHz and 1700 to 2000 MHz. Thus measurements outside band limits are also possible and limit values such as frequency response of single function units can be analyzed more easily. The frequency is entered using the GSM channel number or in MHz; a conversion between the two entries is possible. The frequency resolution of 200 kHz (GSM channel spacing) is supplemented by frequency fine tuning which, on the one hand, allows rapid and easy measurements on the GSM channels and, on the other, also measurements with the GSM bit frequency (67.7 kHz) as offset. The very wide level range of –120 to +13 dBm is available at the two outputs, which are offset in level to one another. The level can be generated with or without a burst (577 µs with a duty cycle of 12.5%). An external source is not required since the level is generated internally.

The following types of modulation are available: unmodulated, pseudo-random bit sequences and dummy-burst modulation with midamble (GSM training sequence). Especially the modulation with midamble or dummy burst is very important for measurement of GSM modules due to the temporal synchronization. To this effect, different training sequences can be activated at the touch of a key (FIG 1). Thus, the user does not have to cope with a lengthy, bit-by-bit entry or has to feed in the bit sequence via an external data generator. In addition to these functions of the module test mode, the synthesizer of CMD also provides a GSM control channel (BCCH) in the start menu of the signalling test.

RF signal analyzer

After entry of the channel number or frequency and the approximately expected power, CMD can synchronize to GSM signals. For pulsed signals triggering is to the incoming power; for continuous signals to one of eight possible training sequences. CMD then performs measurements of peak power, average power, power ramping as a function of time (power time template, burst) as well as measurement of phase and frequency error.

The measured values are displayed numerically together with go/nogo information and predefined tolerances (FIG 2). This go/nogo analysis provides information about possible malfunctions at a glance. Being able to change the preset tolerances, the user can include DUT-specific features or tighter tolerances, for example to take temperature effects into account.

The power-ramping measurement is performed with a very wide dynamic range of more than 72 dB. This allows a check of correct power switch-off in the inactive time slot in line with the GSM specification. The graphic display of the measurement curve is combined with range indicators showing whether the curve is within or

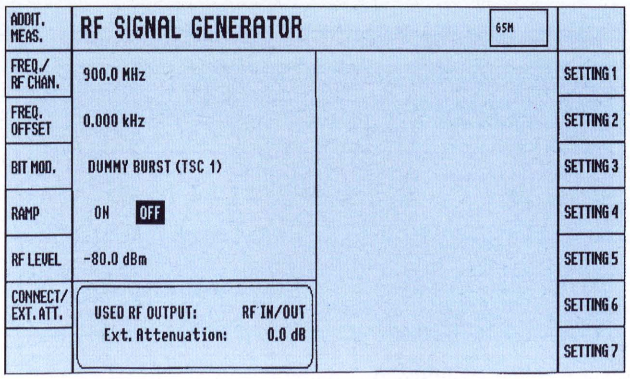

FIG 1
RF signal generator menu of CMD: in addition to rapid and easy entry of all parameters, seven freely configurable, complete setups can be called up.

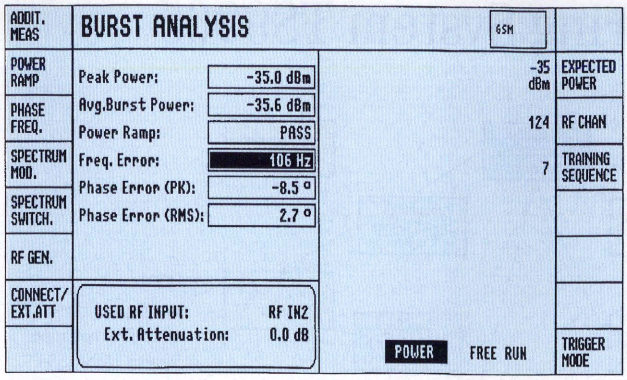

FIG 2 During GSM burst analysis, CMD displays all test parameters in one menu. For graphic display, it is possible to call up different submenus.

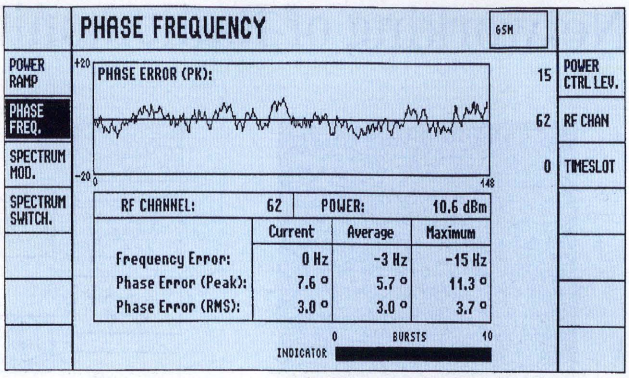

FIG 3 Oscilloscope display of phase error provides information about type and possible source of malfunction.

outside the given limit values and contains a marker function for accurate measurements. The phase and frequency error measurement provides a current, an average and a maximum value. Tolerance values and averaging factors can be set. The phase error is displayed graphically as a function of time (FIG 3). If the error is too high, the oscilloscope display provides information about the type of error and the possible source of the malfunction. It is also possible to indicate the averaged phase or frequency error on an analog bar which can facilitate adjustments.

Three measuring modes are available for GSM measurements with graphic displays. The first one is the continuous mode, which is ideal for periodic checks and adjustments. The single-shot mode allows a specific measurement start. The continuous mode with an automatic stop-on-error function in case of tolerance violation is especially suitable for the detection of rarely occurring errors.

DC and AF measurements

Ammeters and voltmeters of CMD are floating and can be remotely controlled like any other unit of CMD. Moreover, they allow **simultaneous measurement of current and voltage** without any recabling being required. The ammeter of CMD offers another important benefit: in addition to the average current, the maximum current (during transmission in the active time slot) and minimum current (quiescent current in inactive time slots) are also displayed. With these measured values, the user can check whether the voltage supply and filtering are correct. The display of the **transmitter power** of the mobile in the same menu clearly shows the ratio of the transmitter power to the current drain as well as any malfunctions. When the average current is measured, CMD operates with the GSM-specific time constant so that a steady average-value display is guaranteed even for pulsed currents.

The **audio components** of the mobile or additional audio equipment can be checked using the AF generator (50 Hz to 10 kHz) and AF evaluator. The AF voltmeter, AF counter and distortion meter (with settable center frequency) operate independently of the AF generator. Thanks to a high-impedance input, a low-impedance output as well as wide level ranges, the DUT can very easily be adapted. When the call is established, other applications are available with the aid of the echo test or by using the speech coder/decoder provided in CMD.

The carrier frequency of mobiles or modules can be adjusted by measuring the IF. To this effect, CMD contains an IF counter which is synchronized to the CMD reference frequency (TCXO, OCXO or external).

Spectrum measurements

The GSM specification defines special measurements for checking emissions in adjacent channels. These measurements – **spectrum due to switching and modulation** – can be carried out with the aid of a high-grade spectrum analyzer coupled with suitably set averaging and a control program. CMD performs these elaborate measurements automatically and in a very short time. All parameters including the frequencies to be measured are preset. The tolerance values for the go/nogo analysis can be changed. These spectrum measurements in CMD can be performed with the call established and in the module test mode.

Werner Mittermaier

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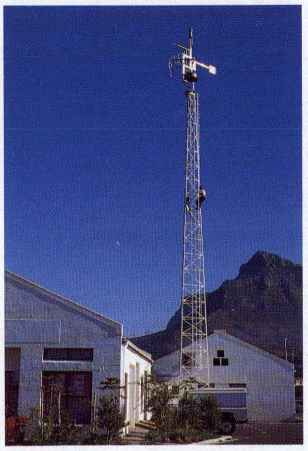
Reader service card 149/12

Networking of Radiomonitoring System TS9965



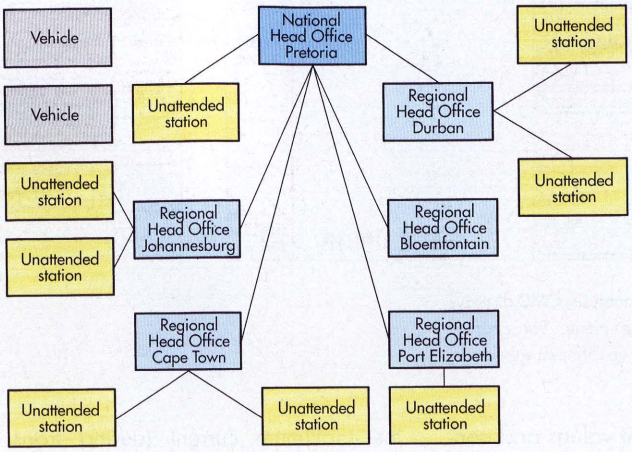


FIG 1
Station configuration of Radiomonitoring System TS9965 in South Africa and associated antenna system installed with Department of Post and Telecommunication in Cape Town
Photo: Hesse

Radiomonitoring System TS9965* is a powerful and versatile system for handling radiomonitoring tasks. Networking of the components allows the system to be used not only as a single station but also as a multi-station system. The measurement stations may be distributed countrywide, with data collected and evaluated centrally.

Network concept

For handling communication, TCP/IP (Transmission Control Protocol/Internet Protocol) is used so that all common transmission media (see blue box) are suitable for this system. Access via WANs and LANs (wide area and local area networks) becomes transparent with the aid of this protocol. TCP/IP is already integrated in Windows NT™, the operating system for the radiomonitoring software. Client/server applications have also been implemented to ensure optimal ease of operation combined with low network loading.

A client/server application in Radiomonitoring System TS9965 is **Measurement Software TS9965/Win,** which has been split up into operating and measurement software. As a true 32-bit application under Windows NT™ operating system, this software is setting new standards and is best equipped for the future. Thanks to **Communication Software TS9965/Net** it is irrelevant whether there is a wide area network or a local area network between the operating software and the measurement software or if both are run on the same workstation. The user does not see any difference in the operation.

The **operating software of TS9965/Win** runs on an operator station (PC) ensuring access to the software via a user-friendly interface. This is where the measurement tasks are defined. After selection of the measurement station's name, software TS9965/Win is automatically connected to the right station via Communication Software TS9965/Net, and the desired data are transferred without any action from the operator being required. Remote control of the measuring instruments in all stations connected is thus ensured. The operating software collects the test results from the measurement stations, stores them and displays them in graphic form. The test results are also passed on to evaluation software such as TS9965/Eval for statistical analysis or TS9965/Map for displaying DF results and calculating the triangulation results.

The **measurement software of TS9965/Win** runs on a measurement station (PC and measuring equipment). Here, the measurement requests from all stations connected are received, coordinated and executed. Measuring instruments are controlled, results and alarm conditions determined and transferred to the operator consoles.

Another client/server application is the **frequency-management database.** The database is usually on the server in the central station and handled from the operator consoles. Exchange of data sets between TS9965/Eval and a large number of databases available on the market is possible via a standardized interface.

Transmission medium	Speed
GSM networks	4.8 to 9.6 kbit/s
Terrestrial radio networks	0.3 to 9.6 kbit/s
Dialling lines	1.2 to 28.8 kbit/s
Packet transfer networks	1.2 to 64 kbit/s
Mobile satellite links	2.4 kbit/s to 2 Mbit/s
Leased lines	1.2 kbit/s to 2 Mbit/s
ISDN	64 kbit/s to 2 Mbit/s
Microwave links	19.2 kbit/s to 8 Mbit/s
Ethernet	10 to 100 Mbit/s

Transmission media

* Pfitzner, J.: Radiomonitoring System TS9965 – Complete coverage up to 18 GHz. News from Rohde & Schwarz (1994) No. 146, pp 22–25

Nationwide radiomonitoring in South Africa

The requirements placed by a nationwide radiomonitoring system on the network and its integration into existing international networks call for a radiomonitoring system configuration tailored to the needs of the specific application. Radiomonitoring System TS9965 installed by Rohde & Schwarz in South Africa (FIG 1) serves as an example. It consists of one National Head Office (NHO), five Regional Head Offices (RHOs), eight unattended remote-control stations and two vehicles. The NHO has access to all stations, whereas the RHOs only have access to the remote-control stations within their region.

Connection to the stations is made via wide area network. In this particular case different transfer media are used. Networked leased lines of a public national network operator are used between the NHO and the RHOs and leased lines or microwave links between the RHOs and remote-control stations. The vehicles can be connected to the other stations via satellite or GSM.

Within the stations, the individual workstations are in contact with each other via a local area network. Each workstation can access the network via the network server with the speed of its computer being minimally affected. The server controls the data flow and access to the network as well as to the connected printers and plotters.

The **National Head Office** (FIG 2) performs the following tasks:

- management of the entire nationwide radiomonitoring system,
- coordination of all nationwide radiomonitoring and frequency-management activities,
- linkup to an international network (eg for data exchange with ITU),
- linkup to other national organizations, eg ministries,
- management of local area networks within the NHO (LAN network server),
- measurement of data within the station (RM/DF section/audio logger) as well as in other stations (operator console),
- management of all nationwide measurement results in a frequency-management database (FM database server),
- evaluation of measurement results and generation of reports (operator console/audio analyzer),
- generation of maps for all stations and display of DF results (GIS console).

The **Regional Head Offices,** which are similarly equipped as the National Head Office, perform the following tasks:

- management of the unattended stations connected to the RHO,
- coordination of all regional radiomonitoring and frequency-management activities,
- management of the local area network within the RHO (LAN network server),
- measurement of data within the station (RM/DF section/audio logger) as well as in the remote stations connected to the RHO (operator console),
- management of all regional measurement results in a frequency-management database (FM database server) and transfer of these results to the NHO,
- evaluation of measurement results and generation of reports (operator console/audio analyzer),
- display of DF results (GIS console).

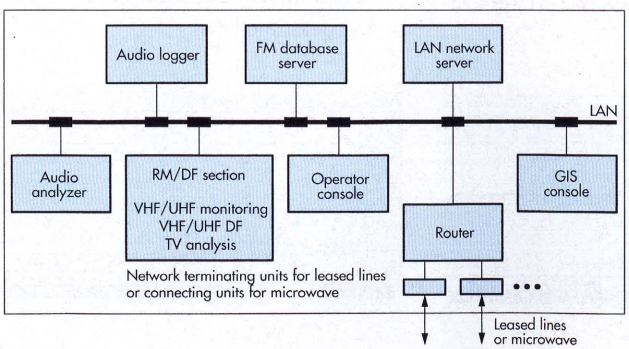


FIG 2
Configuration used at National Head Office and Regional Head Offices

The **vehicles** are configured like an RHO and perform the following tasks:

- management of the local area network within the mobile measurement station (LAN network server),
- measurement of data within the station (RM/DF section/audio logger),
- management of all measurement results in a frequency-management database (FM database server),
- evaluation of measurement results and generation of reports (operator console/audio analyzer),
- display of DF results (GIS console).

The unattended **remote-control stations** accept measurement requests and transfer the results to the responsible RHO or NHO.

Rohde & Schwarz provides worldwide expert advice to ensure optimal network design for the use of Radiomonitoring System TS9965. Comprehensive function tests, proficient commissioning and specalized training make for fast system availability.

Jörg Pfitzner; Wolf Seidl

Reader service card 149/13

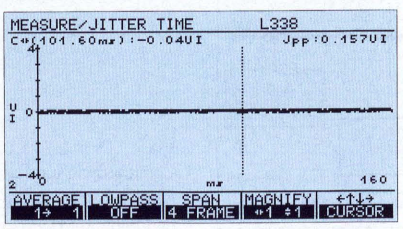
Analysis of digital transport layer with Video Analyzer VCA

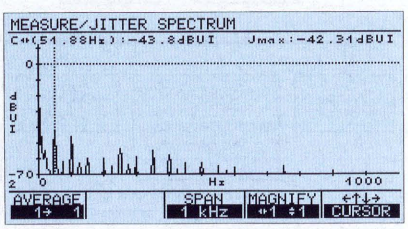
FIG 1 Digital Video Component Analyzer VCA, specialist for in-depth analysis of digital video signals Photo 42 246/1

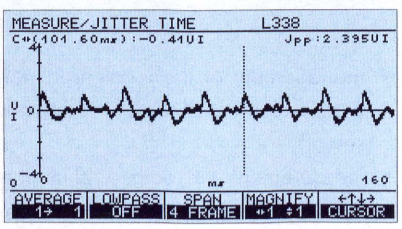
Today digital interfaces are standard equipment for the transmission of TV signals in modern studios. Troublefree operation can be expected as long as all signal transmitters and receivers comply with the interface specifications and the maximum permissible cable lengths are adhered to. If problems occur, however, permanent errors can be rapidly located. Troubleshooting gets more difficult with intermittent errors or errors occurring with specific equipment combinations. In such cases the test engineer not only needs a good nose but must also make use of special measuring equipment to avoid time-consuming checks, queries or unnecessary service work.

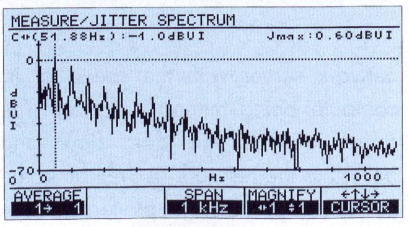
Digital Video Component Analyzer VCA [1] enables the engineer in the TV studio to carry out an in-depth analysis of data and to check the data frame for correct syntax (FIG 1). The option **Analysis of the Digital Transport Layer (VCA-B11)** extends VCA, permitting the physical quality of the data signal to be analyzed. Up to now a great variety of measuring instruments was required and parameters like data jitter and signal delay could only be estimated or determined in an elaborate way. The new option helps to considerably reduce the instrument pool and permits reproducible results to be obtained in a simple measurement.

FIG 2 Jitter measurement with VCA. Top: high jitter quality of crystal-controlled SDI generator (here R&S CCVS + Component Generator SAF). Bottom: jitter of A/D converter caused by external synchronization









With option VCA-B11 the following **parameters** can be determined:

- data jitter,
- amplitude spectrum,
- return loss,
- signal headroom (decoding margin),
- signal delay.

These parameters yield reliable information on the quality of the digital data stream.

The greatest uncertainties are encountered with data jitter, which may be caused by instrument faults, cascading or even external synchronization. A particular problem is that jitter can propagate at certain frequencies. This means that the point where the error is detected may not be the error source. The following features of the **jitter measurement** carried out with VCA permit faults to be exactly localized and eliminated:

- numeric readout of peak-to-peak jitter using two selectable filters,
- display of jitter characteristic synchronously with the video signal,
- jitter spectrum in three selectable frequency ranges
- cursor for evaluating measurement results,
- signal outputs for supporting jitter measurement according to the clock extractor method.

The numeric value of peak-to-peak jitter is required for determining jitter amplitude but no conclusions can be drawn from these values on the jitter source or

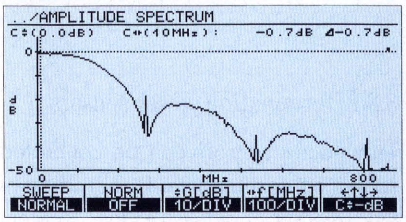


FIG 3 Undisturbed amplitude spectrum of digital-serial signal

the resulting effect. With VCA the jitter can be determined in the time and frequency domain. In the time domain triggering is possible to four frames, one frame or a user-selectable line. Thus any tie-up between jitter and data signal becomes evident. The spectral jitter distribution can be measured with VCA in three selectable frequency ranges from 10 Hz to 8 MHz permitting jitter components in frequency and amplitude to be determined exactly. FIG 2 shows the difference in quality of two digital-serial signal sources, a high-grade serial digital interface generator and a commercial A/D converter, measured with VCA.

Measuring the **amplitude spectrum** of the digital-serial signal is important for testing signal sources and cables. An undisturbed amplitude spectrum (FIG 3) is a precondition for correct functioning of cable equalizers. A disturbed or deformed amplitude spectrum does not necessarily cause data errors but it uses up the decoding margin. Compared to an eye diagram displayed on an oscilloscope, the spectrum display has a decisive advantage. Since the data signal is considerably attenuated in long cables, errors are more clearly seen in the amplitude spectrum than in the eye diagram.

The **return loss** (FIG 4) determined for checks and acceptance tests is measured without an expensive spectrum analyzer. What is required for this measurement is simply a 75-Ω SWR bridge with BNC connectors offered by Rohde & Schwarz as accessory VCA-Z1. With this equipment combination the return loss can be measured even outside the frequency range of 270 MHz specified by the standard.

The **signal headroom** in studio environments is the safety margin between a distorted data signal and the onset of decoding errors. Option VCA-B11 comprises a measurement unit for this margin so that a fast overview of signal quality can be obtained. An internal noise generator corrupts the data signal until data errors occur. The noise level tolerated by a digital-serial video signal is a measure for the aperture of the data eye at the most critical point. VCA also evaluates errors by means of CRC or TRS error measurements, the facilities for which are part of the basic equipment. Another advantage is that the operating point of the cable equalizer in the receiver module remains unchanged during the measurement so that misinterpretations of results are excluded.

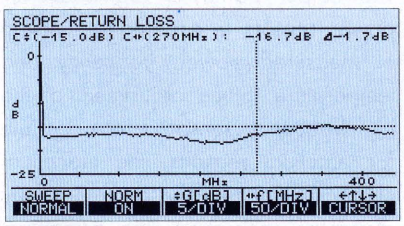


FIG 4 Measurement of return loss at signal output. DUT meets required return loss of >15 dB from 5 to 270 MHz.

Because of the increasing use of line and frame stores in practically all kinds of studio equipment, the magnitude of the **signal delay** encountered in digital studios becomes more and more uncertain. The VCA option permits the delay between two signals to be measured (FIG 5). With this measurement genlock generators in the studio can be set to give favourable delay times at all coupling points. In addition, the absolute signal delay of a path can be

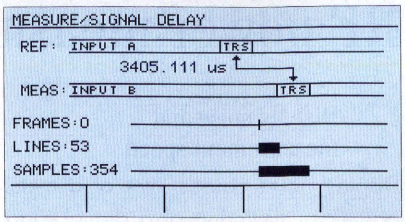


FIG 5 Display of delay measurement in samples, lines and frames

measured with the signal applied to VCA directly as well as via the path to be measured. When a frame-16 identification pulse, eg from CCVS + Component Generator SAF [2], is used, the measurement range covers ±8 frames, which is sufficient for even the most complex of processing procedures.

Gernot Osterloh

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Reader service card 149/14

RF power measured the right way (VIII)

3.2.2 Display noise and measurement speed

Display noise causes jitter of a meter pointer or flickering of a digital readout. Like the zero error, display noise is an additive error independent of the measured power. By reducing the measurement bandwidth, display noise can be traded off for measurement speed (FIG 45). Usually the measurement results are numerically averaged, partly using analog prefiltering. Depending on the measuring instrument, filtering can either be selected by the user or set automatically. The smaller the power, the more effective filtering must be.

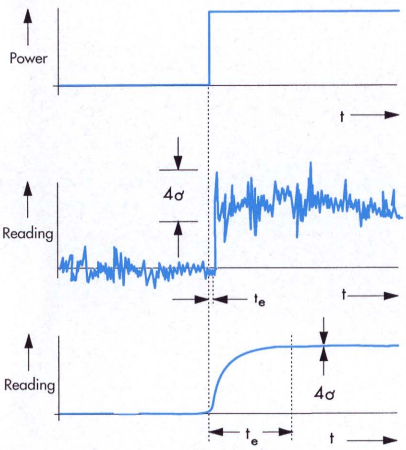


FIG 45 Display noise and dynamic behaviour of power meter without (top) and with display filter (bottom)

A meaningful indication of the minimum power specified for a sensor is as a rule only possible with high noise filtering, settling times from 10 to 30 s not being unusual (FIG 46). Short measuring times of about 0.1 s can only be achieved at higher power levels, with thermoelectric sensors in the relatively narrow range from 1 to 100 mW. Diode detectors, which can be operated beyond the rectifier square-law region, have the advantage that they allow a power range of 40 dB to be measured at maximum speed. They are therefore ideal for use in automatic test systems. Since the display noise causes random measurement errors, it has to be described as a statistical error. It is usually specified as twice the standard deviation (2σ) corresponding to a confidence level of 95%.

3.2.3 Envelope analyzers

The basic units are similar in design to digital oscilloscopes. Broadband amplification of the sensor signal is followed by digitization with a fast A/D converter. Periodical signals can be displayed with high time resolution by random sampling. As with average-weighting power meters, the display noise can be reduced by limiting the bandwidth, which may cause smoothing of the pulse edges. For correcting sensor-specific characteristics, the same methods are used as with average-weighting power meters.

3.3 Calibration

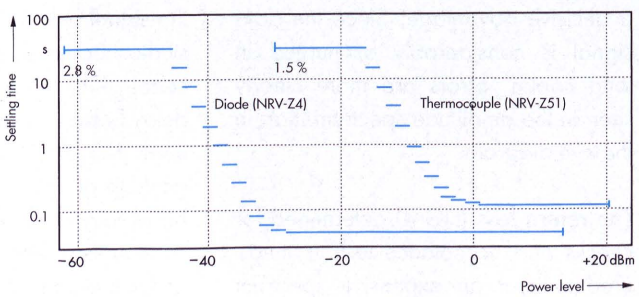
The output signal of high-frequency power sensors is a complex function of measured power, frequency and temperature. Since adjustment of the high-frequency sensor is not possible for practical reasons, the individual characteristics must be determined by means of calibration. The determination of a single, frequency-dependent proportionality factor is sufficient in few cases only. With modern sensors, the calibration data are stored in a digital memory connected with the sensor and numerically processed in the basic unit.

3.3.1 Terminating power sensors

Terminating sensors can be calibrated so that either the power P_d absorbed at the reference plane or the incident power P_i is indicated (FIG 47). Usually, indication of the incident power is calibrated. The power P_{GZ_0} of the source delivered to Z_0 load can then be measured. With older power meters, the calibration parameter is referred to as the calibration factor. For ease of understanding, one should assume that the power delivered to Z_0 load is to be measured in the special case of a matched source (FIG 48). After connection of the sensor, the incident power will be of the value P_{GZ_0} whereas the power absorbed at the reference plane will be smaller by the mismatch loss of the sensor. To ensure that the power indication is independent of the reflection coefficient of the sensor, the sensor must be calibrated for the incident power.

Despite correct calibration, measurement errors may occur if both ends, that is source and sensor, are mismatched. In this case the incident power is dependent on the magnitude and phase of the two reflection coefficients and usually differs from the power

FIG 46 Settling time as function of measured power. Display filter is set so that relative noise component (2σ) remains within 0.1%. Only with filter set to maximum does noise component rise to specified value with measured power further decreasing.



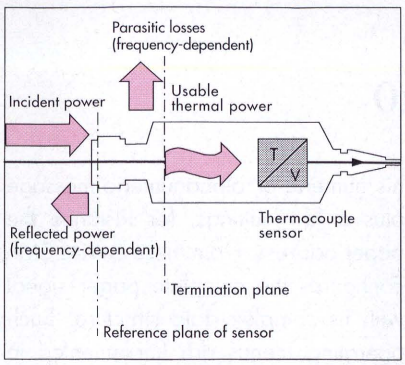


FIG 47 Power distribution in thermocouple sensor. Absorbed power is equal to sum of usable thermal power and parasitic losses.

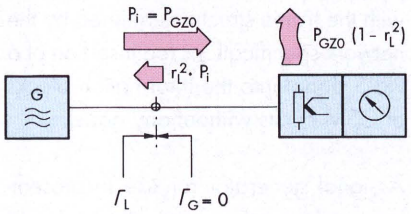


FIG 48 Power measurement on matched source

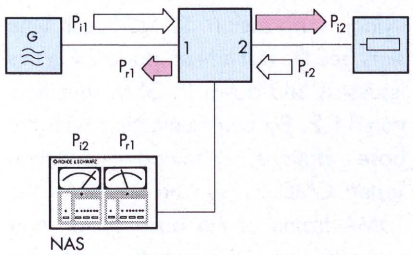


FIG 49 Calibration of directional power meters

delivered to Z_0 load. The error cannot be corrected and is in the measurement result as a mismatch uncertainty (see FIG 10). Since the source is given, the mismatch uncertainty can only be influenced by the sensor. The better the sensor matching, the lower is the measurement uncertainty.

Considerably higher accuracy can be obtained when measuring the maximum available power P_{Gmax} of the source instead of the power delivered to Z_0 load. For this purpose the sensor must be conjugate matched to the source via a tuner and calibrated for indication of the power absorbed at the reference plane (see FIG 7). This method of calibration is used for high-precision standards with thermistors. The calibration parameter is the ratio of the thermal power P_{therm} converted in the termination to the absorbed power P_d at the reference plane. It is referred to as the effective efficiency η_e and always smaller than 1 due to the parasitic losses between RF connector and termination.

$$\eta_e = P_{therm} / P_d. \quad (28)$$

It may at times be necessary to measure the absorbed power with a power meter calibrated for incident power. If the reflection coefficient r_L of the sensor is known, the equation

$$P_d = P_i(1 - r_L^2) \quad (29)$$

can be used for conversion.

3.3.2 Directional power sensors

Directional sensors are usually calibrated for indication of the outgoing power (FIG 49). This means that the power incident to the load is indicated, as desired, but unfortunately also the reflected power referred to the source connector of the power sensor. For SWR measurements, the resulting error is negligible even if the sensor exhibits a somewhat higher insertion loss. Considerable measurement errors may however occur if the power absorbed by the load is to be measured with incident and reflected power being approximately equal. In this case the indicated reflected power must be increased by the amount of the insertion loss of the directional power sensor.

3.3.3 Coaxial voltage probes

Coaxial voltage probes are calibrated for indication of the incoming or outgoing power. Details can be taken from the manufacturer's documentation.

Thomas Reichel

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Our new refresher topic "Digital modulation in mobile radio" will start in the next issue.

New signal-generator characteristics to satisfy needs of digital mobile radio

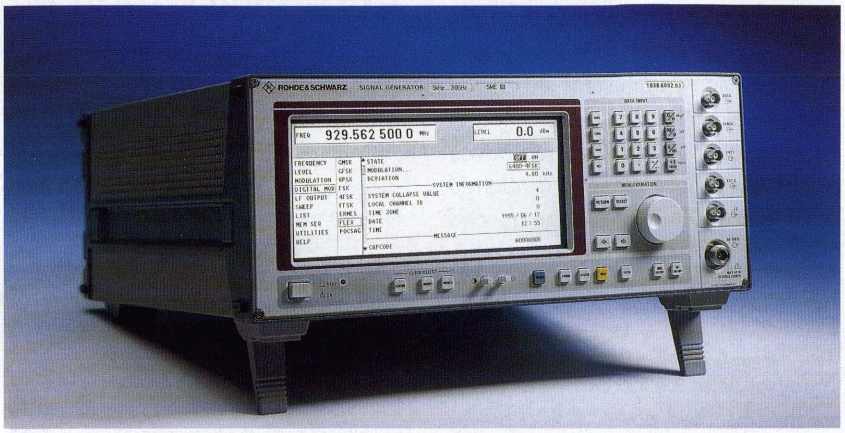

FIG 1 Signal Generator SME supplying all imaginable test signals for digital mobile radio
Photo 42 214

Digital mobile radio has created new measurement tasks for signal generators, so the performance of such generators will go far beyond the classic profile. Among the well-known features of signal generators are precise frequency and level setting as well as amplitude, frequency/phase and pulse modulation. Internal modulation sources furnish sinewave signals for AM and FM/φM or squarewave signals for pulse modulation. Signal Generators SME (FIG 1) and SMHU58 are used to illustrate the enhanced characteristics that are now required of signal generators to match the complex scenario of digital mobile radio.

The enhanced performance of the signal generators begins with their **modulation characteristics.** In addition to the above analog modulation modes and pulse modulation, digital modulation modes are available. SME features practically all modulation modes used in present-day digital mobile radio: GMSK, GFSK, FSK, FFSK, 4FSK, BPSK, QPSK, O-QPSK and π/4DQPSK. Each of these modulation modes provides a choice of setting combinations for the variable parameters such as bit rate, filtering and frequency deviation. In GMSK mode for instance, setting combinations are offered in line with the network standards of GSM/DCS1800, Mobitex, DSRR, CDPD, ETS300.112, ETS300.113 and many more with variable filter bandwidths and bit rates.

For testing in the field of digital mobile radio, signal generators must be able to generate the data contents of the modulation signal. SME offers various possibilities of **selecting or programming data signals.** Firstly there is a choice of preprogrammed, standardized PRBS signals of different length, and secondly the possibility of programming data signals in tabular form with the aid of an editor. It is also possible to store externally generated data signals up to a length of 8 Mbits in the data memory of SME. Such long data streams are used as a test sequence for propagation measurements in the GSM system for instance, the BCCH signal being contained in time slot 0 and the TCH signal in time slot 3 of a TDMA frame. Another very convenient way of data-signal generation is offered by SME for testing radiopagers. Via a special operating menu, the user enters his numeric or alphanumeric message plus a few settings, for instance the pager address. From these entries SME configures the complete pager signal with its complex data structure. Such operating menus are implemented in SME for the pager systems FLEX, POCSAG and ERMES [1]. Finally, Software SME-K1 is a tool for data-signal generation that can be run on a PC. This software allows convenient programming of data sequences in line with the frame structures defined by the network specifications (eg insertion of a PRBS signal into the information blocks of GSM bursts without any gaps).

A signal generator for use in present-day mobile-radio applications should be able to establish **synchronism** between the given frame clock, data signal and level burst. An application in this context is the measurement of signal suppression in adjacent time slots (see the test hint on page 24 in this issue) as laid down in GSM specification 11.2. By communicating with the base stations, Radiocommunication Tester CMD is synchronized to the TDMA frame of the base station and occupies one of the eight time slots with a traffic channel. SME is then synchronized to the frame clock generated by CMD and occupies the two adjacent time slots. The two bursts generated by SME exactly agree in their timing; level rise and fall times follow a given profile and the bit sequence of the burst corresponds to the structure of a standard burst.

One of the new requirements is the **generation of level bursts to standard,** ie controlling RF power during a TDMA time slot. Two facilities for envelope shaping are standard in signal generators: the amplitude modulator and the pulse modulator. Each by itself is not entirely suitable for generating level bursts to standard. Common amplitude

modulators do not have the required dynamic range, while the switching slopes of pulse modulators are so steep that intolerable spectral components outside the useful band are obtained. Power ramping to standard (rise and fall times of level burst in line with prescribed profile) is ensured with SME by connecting pulse and AM modulator in parallel with a certain time shift. The control signal for the AM modulator is shaped in the desired way (GSM) by a filter.

A **new operating concept** is also required because of the increasing complexity of signal-generator applications. The multitude of functions provided by modern signal generators can only be handled by using a menu concept with all possible settings being clearly shown on a large display [2]. Two operating menus will illustrate the concept adopted for SME. The menu for setting GMSK modulation allows direct access to the standards implemented (FIG 2). GSM is selected, and the submenu called up with "Select Standard" offers the user's options. A wealth of possible variations is due to the fact that parameters such as "Filter BxT" can also be varied departing from the standard. FIG 3 shows the menu for configuring data signals generated for testing radio pagers in line with the FLEX standard. The menu options followed by ... open up submenus.

Extensive research and development work in the field of digital mobile radio is bringing out new modulation and coding methods. So there is a need for signal generators which are not only able to generate signals in line with fixed standards, but which are free of any restrictions regarding their modulation capabilities. Rohde & Schwarz offers Signal Generator SMHU58 for this field of application. With its network-specific modulation coders, SMHU58 is able to process data signals and convert them into **modulation signals for GSM/DCS1800, DECT, PDC, PHS, NADC, TETRA and IS-95 CDMA networks in line with the relevant standards.**

In addition to these "preprogrammed" modulation signals, SMHU58 is able to generate any kind of **vector modulation signals.** Software Package IQSIM is offered by Rohde & Schwarz to make it easier for the user to generate I/Q modulation signals. This software guides the user in the development of the main parameters of the desired modulation interactively and generates the I/Q modulation signals which are loaded into Dual Arbitrary Waveform Generator ADS used as the I/Q source of SMHU58. SMHU58, ADS and IQSIM represent an extremely versatile platform allowing both simulation on a PC and the actual generation of any waveforms and modulation signals. An example of the high performance of this combination is generation of a multicarrier signal for simulating multichannel access of a mobile-radio system [3].

Franz Lüttich

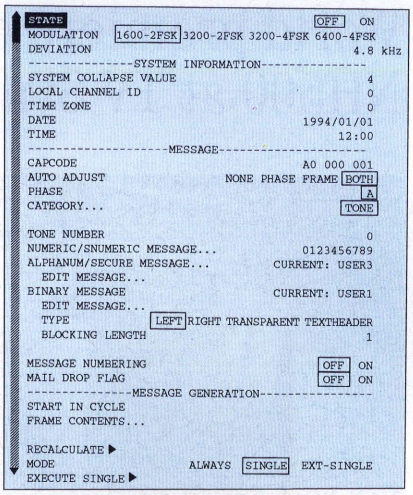

FIG 3 Menu for setting FLEX radiopaging standard

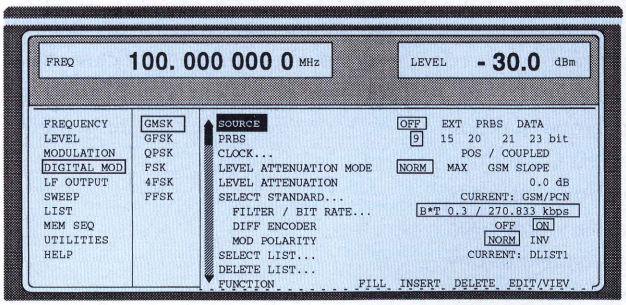

FIG 2
SME menu for setting GMSK modulation

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Reader service card 149/15 (SME) and 149/16 (SMHU58)

World première of solid-state UHF TV Transmitter NH500 at TV Symposium in Montreux

Solid-state UHF TV Transmitter NH500 was a center of attention at the TV Symposium 1995 in Montreux. Photos: Mahnken

Rohde & Schwarz created quite a stir at this year's TV Symposium in Montreux (FIGs) with its new solid-state TV transmitters of the NH500 series. International specialists are of the same opinion that Rohde & Schwarz has again set standards for terrestrial TV transmitters. The development of a fully-transistorized transmitter for the UHF range and output power of 5 to 30 kW was a natural follow-on to the existing product range of Rohde & Schwarz.

Seeing as adherence to prescribed technical parameters is matter-of-course in TV transmitters from Rohde & Schwarz, innovation focussed on meeting the latest market requirements. Reliable and economic operation of the transmitters had top priority during their development and a new concept was born that gave the NH500 transmitter family the nickname ecoTv. The transmitters are up to 30% smaller and consume 10% less power than comparable products on the market. This means savings in infrastructure (better utilization of space) and also in operating costs.

Of course no compromises were made on reliability. The transistors are operated with an average junction temperature of max. 120°C. And the bottleneck in the redundancy of many semiconductor transmitters has been eliminated: NH500 no longer has any preamplifiers between the exciter and the power amplifiers. Thanks to the high gain of the power output stages (>50 dB) it is possible to directly control all output power modules by an exciter. And as a result of a new cooling concept, better heat dissipation at reduced air flow rate and pressure could be achieved as compared to conventional technology.

It goes without saying that the ecoTV comprises all the well-proven features of solid-state technology such as built-in amplifier redundancy, no maintenance and interrupt-free operation when amplifiers or power supplies have to be exchanged.

Rohde & Schwarz's innovation has already been rewarded by an order. The first 10-kW transmitter of series NH500 was successfully accepted and approved by German Telekom and put into operation at Schwerin all to schedule.

Jürgen Nies

Reader service card 149/17

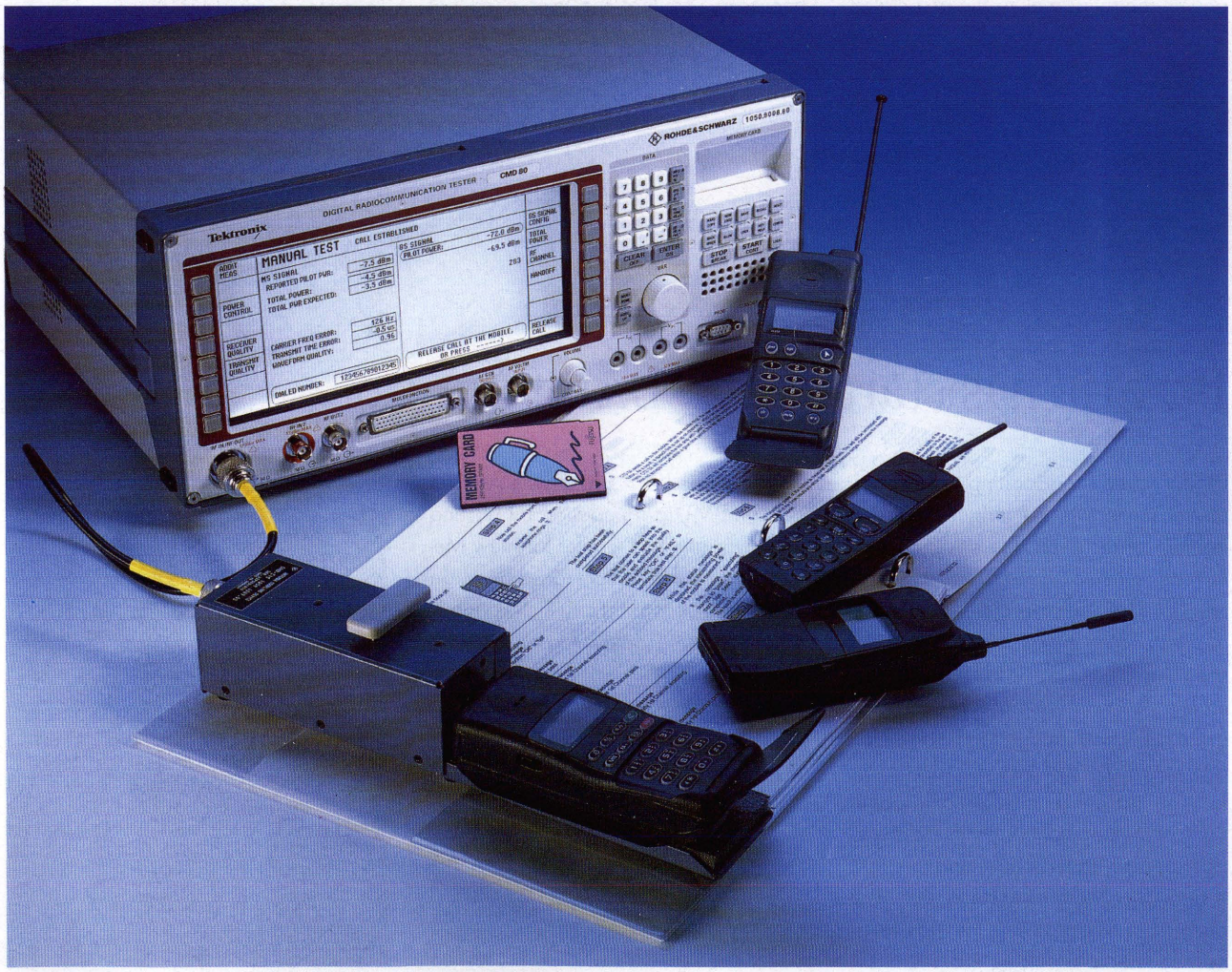
Digital Radiocommunication Tester CMD80 – compact tester for CDMA mobile stations

The allocation of new frequencies in the 1900-MHz band for PCS services in the United States has triggered off a new competition between the different mobile-radio systems. In addition to GSM, the CDMA system IS95 is given the best chance. While GSM has the more mature, tried and tested technology, CDMA promises better utilization of the available frequencies. Commercial use of the first CDMA mobile stations started in mid-1995 – in the beginning dual-mode CDMA/AMPS mobiles in the 800-MHz band only. Many operators in the US plan to take up CDMA network operation in the 1900-MHz band in 1996. As a leading manufacturer of mobile-radio test gear, Rohde & Schwarz naturally also supports CDMA IS95 with its equipment. To satisfy the requirements of manufacturers and network operators for a compact mobile tester, Rohde & Schwarz in cooperation with its US marketing partner Tektronix has developed CMD80 (FIG 1), which is based on Mobile Station Testers CMD52 and CMD55 [1; 2].

FIG 1 Digital Radiocommunication Tester CMD80 checking CMDA mobile phones in line with test specification IS98 Photo 42 161

CMD80 simulates a CDMA base station and provides the signalling functions required for the call to the mobile; these include:
synchronization of the mobile,
registration,
call setup by mobile/base station,
call clearing by mobile/base station.

During the call CMD80 verifies the RF performance of the mobile station and checks the basic signalling functions (FIG 2). Unlike previous testers, CMD80 does not rely on any special test modes integrated in the mobile stations, but performs the measurements under very much the same conditions as those in a real network.



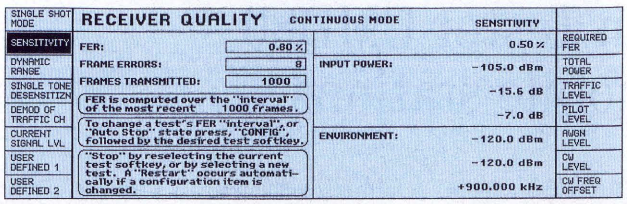


FIG 2
Sensitivity test by measuring frame erasure rate

CMD80 executes all measurements required to check a CDMA mobile station for correct functioning in the way prescribed by test specification IS98:
sensitivity (service option 2 according to IS126),
modulation quality,
vector error,
phase error,
carrier suppression,
frequency accuracy,
RF power.

CMD80 also checks the operation of functions which, in case of failure, might disturb network operation. These are mainly open-loop and closed-loop power control as well as the associated timing conditions to be adhered to. In echo mode the AF or voice picked up by the microphone of the mobile station is looped back to the loudspeaker of the mobile station with a short delay so that voice quality can also be assessed as it is perceived by the listener.

CMD80 requires no detailed CDMA knowledge on the part of the user. Its extremely user-friendly operation is particularly appreciated by service personnel. Softkeys both along the right and left side of the large, high-contrast LCD guide the user through the clearly arranged menus. Brief help texts explain the measurement function where necessary, so that the user need not familiarize himself with the various functions beforehand. All CMD80 functions can be remotely controlled via IEC/IEEE bus. The use of ultramodern microprocessors and digital signal processors makes for particularly fast measurement speed, satisfying the special needs of production environments.

Roland Steffen

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Reader service card 149/18

Bavaria has started into DAB future

Digital audio broadcasting via terrestrial transmitters is no longer simply a domain of research and development. As of summer 1995, the world's biggest DAB pilot project to date is ready to go on the air. Six stereo sound programs in CD quality plus supplementary services with user-friendly program selection and at the same frequency will be radiated all over Bavaria. The transmitters will reach about 43% of the population within the coverage area of Bayerischer Rundfunk (BR) – and once again Rohde & Schwarz belongs to those paving the way for a new sound-broadcasting era.

In December 1994 Bayerische Medien Technik BMT (a foundation by BR and the Bavarian State Center for New Media) and Rohde & Schwarz signed an agreement according to which Rohde & Schwarz is the general contractor for

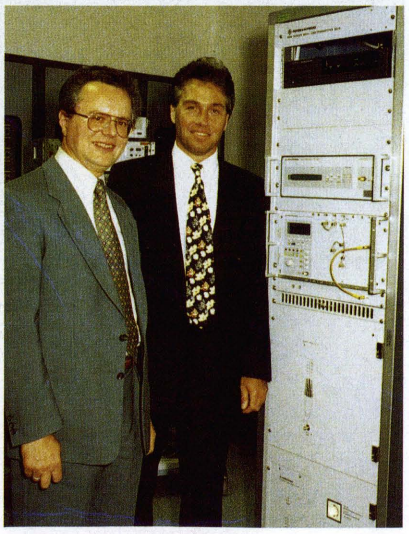

FIG 1 Hans-Joachim Götz (left), technical advisory board of Bavarian State Center for New Media, and Franz Dosch, head of the sound and TV broadcasting division at Rohde & Schwarz, celebrating technical acceptance of the world's largest DAB network on the Wendelstein
Photo 42 208/II-35

the ultramodern transmitter station equipment – from the modulation feed and multicarrier COFDM modulators specially developed for DAB through high-power DAB transmitters and transmitting antennas to installation and commissioning of the entire system (FIG 1). The equipment supplied also includes the frequency and time synchronizing devices required in this single-frequency network. The parties to the Bavarian pilot project decided in favour of a linkup to GPS (Global Positioning System), which enables extremely accurate time synchronization between the individual DAB transmitters, a must in single-frequency networks.

Rohde & Schwarz bears overall responsibility for project implementation and of course the main DAB products are of its own make. At the program feed end, six MUSICAM Codecs MUSIC [1] convert the analog or digital stereo audio signals into data streams with reduced bit rate (data compression) which, via a data multiplexer, are brought into the standardized DAB data format ETI (Ensemble Transport Interface) (FIG 2). This data stream is taken to a satellite, which feeds the modulation signals to the individual transmitter stations. After demodulation in the transmitter station the ETI signal is available at the COFDM Modulator MCM01 [2] for terrestrial broadcasting via antenna. All MCM01 parameters are in line with ETSI Specification ETS 300 401. The specifications were worked out within the EUREKA project EU 147, in which Rohde & Schwarz is also a member [3].

In the DAB transmitter – for instance SM225D1 for band III [4] – the complete COFDM signal with 1536 carriers and 1.5-MHz bandwidth is converted to IF and subsequently equalized to compensate for the nonlinearities in the output amplifiers (FIG 3). A second mixer upconverts the DAB signal to the output frequency. The control logic of this mixer unit with microprocessor, LCD and menu guidance controls the total transmitter system and also provides the remote-control interface.

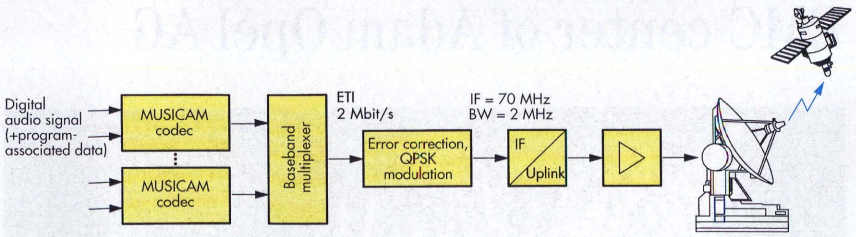

FIG 2 Transmission of digital audio signal from studio to satellite for distribution of modulation signal to individual transmitter sites

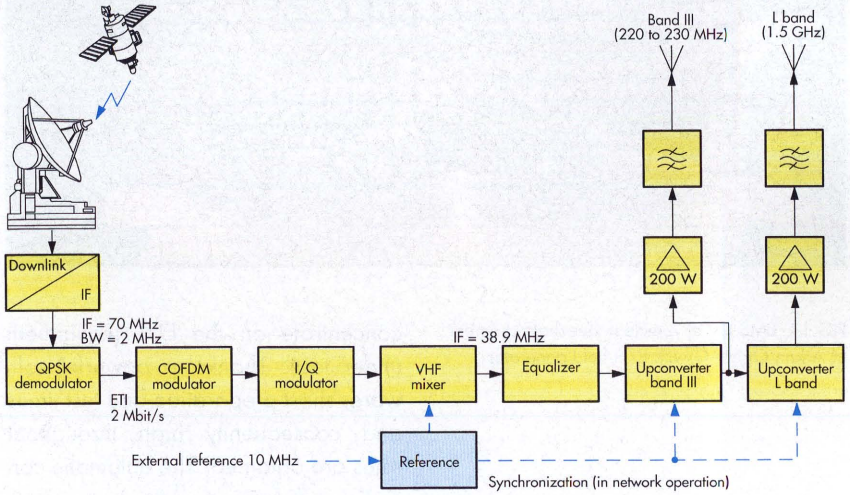

FIG 3 DAB signal processing in solid-state DAB transmitter for band III or L band

Modern, air-cooled transistorized amplifiers boost the DAB signal to nominal power: 250 W and 500 W are required for the DAB project. Multisection RF filters ensure that adjacent channels are not disturbed by interference. The DAB signals are terrestrially broadcast via omnidirectional or directional antennas and can be received by DAB radio sets with a simple rod antenna.

The DAB pilot project in Bavaria covers the broadcasting stations Munich/BR, Nuremberg/Studio Franken, Regensburg/Hohe Linie, Dillberg, Landshut, Gelbelsee, Wendelstein and Pfaffenhofen/Ilm; if the trials show frequency compatibility to be acceptable, the Traunstein/Hochberg station will be added. Under another agreement with German Telekom, Rohde & Schwarz will supply for the DAB pilot project Bavaria a complete 200-W DAB transmitter system in the L band for installation on the Munich Olympic tower.

Wilfried Kalthoff

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[1] Stark, A.; Krawinkel, C.: MUSICAM Codec MUSIC – compression of audio data without any loss in quality. News from Rohde & Schwarz (1994) No.144, pp 20–23

[2] Heinemann, C.: COFDM Modulator MCM01 – channel coding and modulation for digital audio broadcasting. News from Rohde & Schwarz (1995) No. 148, pp 26–28

[3] Mayr, J.: DSR and DAB – digital sound broadcasting today and tomorrow. News from Rohde & Schwarz (1994), No. 145, pp 44–45

[4] Steen, R.: 250-W Solid-State DAB Transmitter SM225D1 – terrestrial sound transmitter for digital audio broadcasting. News from Rohde & Schwarz (1995), No. 148, pp 29–31

Reader service card 149/19 for further information on DAB products

EMC center of Adam Opel AG

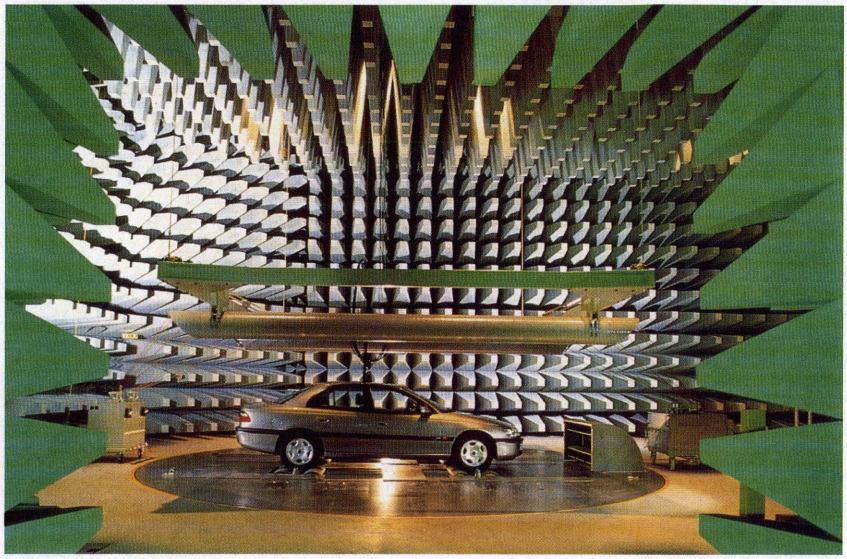


FIG 1 EMS test of vehicle in anechoic chamber of Adam Opel AG with E/H field generator

About a year ago Adam Opel AG put its new EMC center in Rüsselsheim into service. It comprises three anechoic chambers and several shielded and unshielded working areas with state-of-the-art test equipment. Opel is now in possession of all facilities required to measure the electromagnetic compatibility (EMC) of its vehicles and to thoroughly test supplier parts.

Rohde & Schwarz delivered altogether ten **EMC test systems** of different configuration, some of them computer-controlled, mainly for carrying out tests in line with ISO 11451, ISO 11452, ISO 7637, DIN/VDE 40839, CISPR12 standards and in-house regulations. The test systems are used for **development-accompanying investigations** and **acceptance tests.** High-grade instruments and system components ensure reproducible measurement results. Industrial controllers provide reliable system control so that the person carrying out the test can fully concentrate on the EUT (equipment under test). Thanks to powerful software, short preparation and test times and consequently high throughput rates are obtained. The automatic correction of frequency-response errors ensures a maximum of accuracy. The characteristics of an EUT are monitored fully automatically and documented in informative test reports.

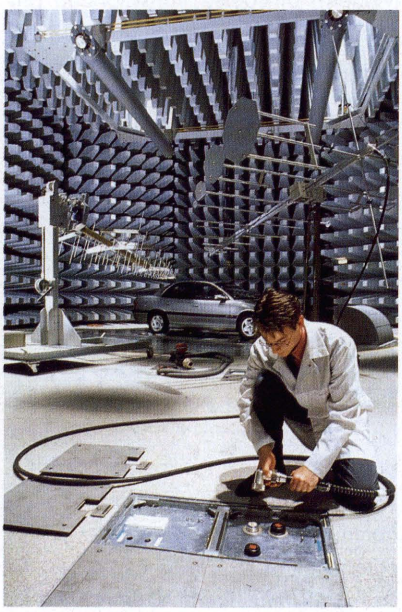


FIG 2 Preparation for EMS test with log-periodic antenna

One of the systems is used for testing the **electromagnetic susceptibility (EMS) of fully assembled vehicles.** Although a high degree of safety is attained through development-accompanying investigations, the final test of the completed vehicle is indispensable. The tests are carried out in an anechoic chamber (24 m x 17 m x 9 m) under conditions as close as possible to reality (FIGs 1 and 2). On a rotatable roller bench the vehicle can be run just like on the road, however, without changing its position. In the chamber the test system reproduces electromagnetic fields in the frequency range 1.5 MHz to 1 GHz as generated in real life by various sources. Field strengths of about 200 V/m are generated.

A Signal Generator SMT02 is used at the beginning of the **signal chain.** It outputs an RF signal the level of which can be varied and modulated. The signal is routed to the power amplifiers in the amplifier room via a remote-controlled relay matrix. The amplifiers have an output power of up to 10 kW, which is applied to the transmitting antenna via coaxial switches. The antennas used for vehicle testing are designed for high field strengths and large EUT throughput. The range between 1.5 and 20 MHz is covered by a remote-controlled E/H field generator of adjustable geometry and switchable polarization. The polarization of the log-periodic antennas (20 MHz to 1 GHz) is adjusted by means of a motor either remotely or directly at the antenna. Coaxial switches and power amplifiers are monitored and controlled from the control room. All main functions may be computer-controlled via appropriate interfaces. A Millivoltmeter URV5 with two Insertion Units URV5-Z2 is used for measuring the forward and reflected power. Up to four isotropic field sensors inform via fiber-optic cables on the field strength at the EUT location.

System Software EMS-K1 (see News from Rohde & Schwarz No. 148, pp 12–15) supports all commonly used methods of field-strength generation:
1) field regulation by means of closed control loop (field sensor in the vicinity of the EUT),
2) substitution method (mostly used at present: the EMS test is preceded by a reference measurement in the empty anechoic chamber), and
3) theoretical method (the required power is determined by means of a formula or derived from the antenna gain available in the form of tables).

As it is not advisable for test personnel to stay within the anechoic chamber because of the high field strengths, the EUT is stimulated and monitored by means of an **EUT monitoring system** via fiber-optic cables.

The whole project was completed in only 17 months in close cooperation with the user. The time span was even shorter for the test equipment: only nine months between the receipt of the order and the final acceptance tests. With such a tight schedule nothing could be left to chance. Adam Opel AG fully relied on the experience Rohde & Schwarz has acquired over the years in the implementation of EMC systems. In addition to supplying the test equipment, Rohde & Schwarz was in charge of planning and installation of the complete laboratory fittings and fixtures. These installations in the rooms take into account the flow of work and guarantee easy access to measuring instruments when servicing is called for. The operator positions were designed to enable the operator to control the tests easily and at the same time afford a clear overview of measurement procedures and EUT conditions.

Reinhard Göster

FIG 3 RFI measurement on vehicle components
Photos: Adam Opel AG

Reader service card 149/20

Rohde & Schwarz hands over HF Radioteletype Unit A

At a ceremony attended by numerous guests of honour from the world of politics and industry, Friedrich Schwarz handed over the key for the first completed HF Radioteletype Unit A to the vice-president of the Federal German Office for Defence Technology and Procurement (BWB), Dr Martin Guddat (FIG 1). The guests were welcomed by a brass band playing Bavarian music before they were accompanied to the marquee for refreshments.

FIG 1
Symbolic handover of key for first HF Radioteletype Unit A (from right: Jürgen Dangel, Dasa, Friedrich Schwarz, Dr Martin Guddat, BWB)
Photo 42 166 V/14A

FIG 2 HF Radioteletype Unit A, shelterized
Photo 40 493/1

For 40 years Rohde & Schwarz has been supplying HF radioteletype units, and they have a long tradition in the German armed forces. The new radioteletype generation, which marks the beginning of the modernization of the teletype system in the army and the introduction of digital technology, brings the "period of the steam radio" to a close, as was formulated in one of the speeches. The new equipment generation is the result of ten years of intensive cooperation between government agencies and industry and has an order volume of more than DM 100 million. In his speech about the "biggest radio unit ever batch-produced by Rohde & Schwarz" Friedrich Schwarz praised the excellent cooperation in this first large project realized together with the subcontractor Daimler-Benz Aerospace (Dasa). With its automatic, jam-resistant radiocommunication between terminals, this innovative HF radioteletype unit is unrivalled throughout Nato.

In his address, Jürgen Dangel of Daimler-Benz Aerospace presented the teletype unit A as a solid reference for German industry. Orders and services of this kind could be handled on a national basis, there was no need to look for partners abroad. In spite of expanding satellite communications, the responsible government agencies had shown farsightedness by relying on shortwave transmission which, thanks to automatic, jam-resistant techniques, guaranteed reliable communications and offered numerous advantages. The excellent cooperation with Rohde & Schwarz – even in difficult times – should be continued for further projects.

Dr Martin Guddat expressed his pleasure at receiving the HF Radioteletype Unit A from Rohde & Schwarz. He reviewed the time between the placement of the order and the handing over of the key. He acknowledged the considerable economic risks for the companies involved during the development work, which finally led to cooperation between Dasa and Rohde & Schwarz. With the teletype unit A a state-of-the-art equipment was now available that was an ideal complement to all other army facilities.

After a short, cheerful speech by Brigadier General Hans-Herrmann Schwede of Army Support Command, the symbolic handover of the key took place. Friedrich Schwarz and Jürgen Dangel first handed the "unlosable" key to Dr Martin Guddat, who passed it on to General Schwede, who in turn handed it to Lieutenant Colonel Frank Exner, commander of Mountain Signal Training Battalion 8.

A few words on the technical side. The units are designed for teletype, data, fax, voice and morse communications. Radio systems with 150-W output power and frequency hopping are used in mobile shelters (FIGs 2 and 3), in armoured vehicles and in stationary applications; 1000-W systems are used for high command levels. HF transceivers for mobile and stationary use come from the Rohde & Schwarz equipment family HF850, whereas the avionics systems are from the R&S equipment family XK510. The adaptive components are supplied by Daimler-Benz Aerospace.

Christian Rockrohr

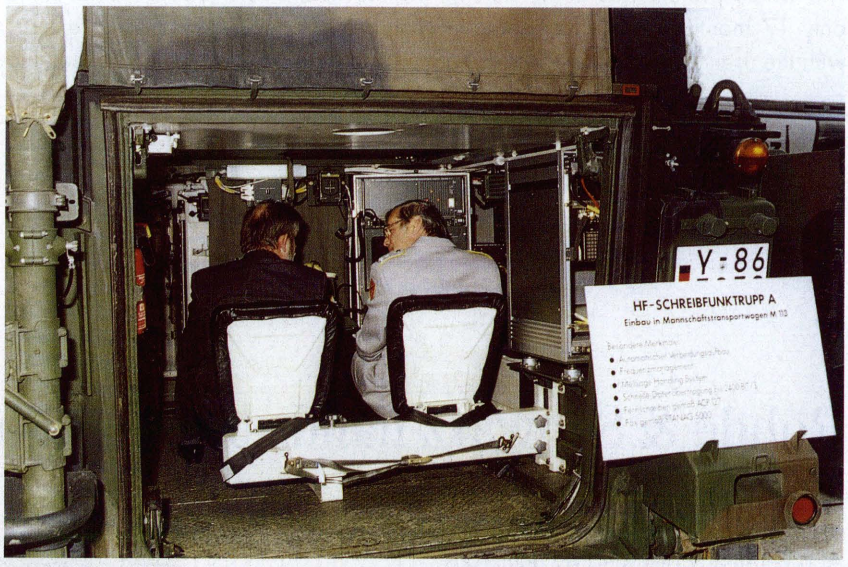


FIG 3 Interior of armoured personnel carrier

Reader service card 149/21

TV Test Transmitter SFM (5 to 1000 MHz) for standards B/G, D/K, L/L', I, M, N, K1 (when fully equipped) with stereo/dual sound, NICAM, RF up-converter (with a max. of three separately settable converters, eg for adjacent-channel measurement) and IF modulator for multichannel and multistandard systems; IF 32 to 46 MHz, output level up to +10 dBm, upgradable for digital standards, optional 75 Ω output.

Data sheet PD 757.1702.21 enter 149/22

Test Receiver ESVB (20 to 1000 (2050) MHz) for coverage measurements in digital audio and video broadcast networks, as programmable test receiver as well as for field-strength and RFI measurements; upgradable for digital mobile radio measurements; rms indication, powering from AC supply or internal/external battery.

Data sheet PD 757.1777.21 enter 149/23

EMS Test System TS9981 (80 MHz to 1 GHz) automatically measures susceptibility to electromagnetic fields to IEC1000-4-3 (IEC801-3); test field strength ≥10 V/m, four power classes; basic desktop model and expandable rack.

Data sheet PD 757.1531.21 enter 149/24

EMS Test System TS9986 (150 kHz to 230 MHz) automatically measures susceptibility to conducted interference to IEC1000-4-6 (IEC801-6); severity level up to 10 V; models for two power classes (expandable) and for automatic EUT monitoring.

Data sheet PD 757.1548.21 enter 149/25

EMS Software EMS-K1 for Windows™ supports Rohde & Schwarz EMS Test Systems TS998. to perform automatic measurements of electromagnetic immunity to all common standards.

Data sheet PD 757.1654.21 enter 149/26

Digital Radiocommunication Testers CMD54 and CMD57 (now also for DCS1900 and E-GSM) – the specifications including the options have been thoroughly revised.

Data sheet PD 757.1231.21 enter 149/27

Attenuators and Matching Pads, Terminations – the new Attenuators RBU50 (50 W) and RBU100 (100 W) for DC to 2 GHz with an attenuation of 3, 6, 10, 20 and 30 dB (error < ±0.5 dB) have been included in the data sheet; the remaining product range has been adapted.

Data sheet PD 756.3860.25 enter 149/28

Modulation Analyzer FMAV (50 kHz to 1360 MHz) – AF Analyzer/DSP Unit FMA-B8 is incorporated in the basic unit (FMA-B2 has become superfluous); FMA-B6 is no longer available.

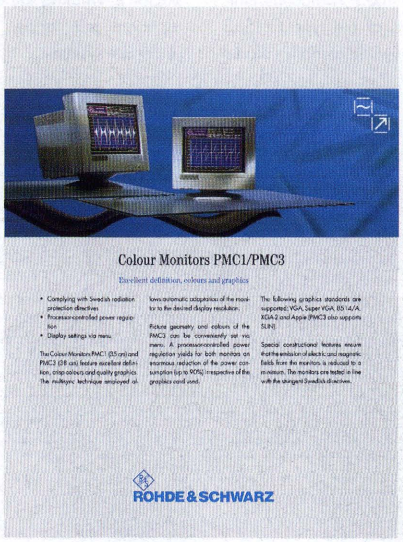
Data sheet PD 757.9839.22 enter 149/29

Solid-State UHF TV Transmitter NH500 (5/10/15/20/30 kW) for PAL, PALplus, NTSC and SECAM and sound transmission to NICAM (with external coder), IRT and BTSC is of modular design, future-proof and can easily be integrated into systems; high efficiency, broadband; the basic 10-kW model can be accommodated in two racks.

Data sheet PD 757.1690.21 enter 149/17

Colour Monitors PMC1 and PMC3 – the new models for VGA, Super VGA, 8514/A, XGA-2 and Apple (PMC3 also supports SUN) are now presented in one data sheet.

Data sheet PD 757.0070.22 enter 149/30



Multicarrier Modulator MCM01 (2 Mbit/s) provides an I/Q multiplex signal in the baseband for DAB transmissions; modes I, II or III (with TII symbols), network delay compensation up to 0.5 s, control via ETI, LCD (2 x 40 characters), several interfaces.

Data sheet PD 757.1683.21 enter 149/31

VHF-UHF Direction Finder PA1555 (20 to 1000 MHz) – the new data sheet lists five DF antennas that are available for PA1555 (including a compact antenna for use in vehicles).

Data sheet PD 757.1560.21 enter 149/32

Voltage and Power Measurements – the brochure on fundamentals, definitions and products has been revised and expanded.

Info PD 757.0835.22 enter 149/33

TACAN Receiver ETS200 (962 to 1213 MHz) is a high-precision and compact digital monitoring and test receiver from **R&S Cologne Plant**; azimuth and level indication, resolution 0.1°, RS-232-C interface, 12-V power supply.

Data sheet PD 757.1754.21 enter 149/34

VOR Signal Analyzer FVS100 is a high-precision and compact digital AF and IF analyzer from **R&S Cologne Plant** for direction finding (0.01°), modulation depth (0.1%) and frequency deviation (0.1 Hz).

Data sheet PD 757.1748.21 enter 149/35

Center of Competence for mobile radio systems is the title of a brochure by which **R&S Bick Mobilfunk GmbH** presents itself and its custom-tailored system solutions, eg ACCESSNET®.

Info PD 757.1677.21 enter 149/36

Schz

30 years of Rohde & Schwarz in France

On 22 June 1995 Rohde & Schwarz's French representative celebrated its 30th birthday (photo above). The entire staff turned out to welcome the 250 customers who had come to Meudon from all over France. Hostesses handed out the day's program to the guests together with a questionnaire plus tombola card. Following coffee and croissants in the open, the visitors had an opportunity of getting to know all about Rohde & Schwarz's activities through a small exhibition, of seeing equipment in action and discussing matters of interest with the specialists of RSF. A mobile test unit for digital communication networks was also on show, while two screens were set up for a presentation of the new corporate film and the "factory of the future" in Memmingen.

Some 160 customers participated in two conferences staged parallel to the exhibition. The first talk, on the subject of electromagnetic compatibility, was given by the technical director of EMITECH, one of the three EMC laboratories in France. The second focussed on digital radiocommunication and was presented by a professor from SUPELEC, the college of electrical engineering.

Friedrich Schwarz, Reinhard Bruckner and Herbert Spiegel attended from Rohde & Schwarz headquarters in Munich. Friedrich Schwarz's address was listened to with great interest by the customers, journalists and RSF team, who all expressed their appreciation of the fact that he had come in person to help celebrate the event.

The atmosphere created for the day was that of a leisurely Bavarian beer garden. So between the talks and looking round the show, the guests were able to refresh themselves with beer and weisswurst and relax to the accompaniment of a jazz band.

RSF

Royal Air Force purchases 405 radiocommunication test sets CMS

Britain's Royal Air Force (RAF) recently awarded Rohde & Schwarz an order for 405 radiocommunication test sets of the type CMS33 (the photo shows lieutenant colonel I. Sinkinson receiving one of the first sets from Keith Randall, sales manager of Rohde & Schwarz UK Ltd). The superior features of the successful CMS family convinced the RAF – known for its extremely tough requirements when it comes to test equipment for avionics maintenance – in the intensive field trials that were conducted.

CMS33 is based on CMS57, which has been on the market longer, was the first combined test set for radiotelephony and navigational radio to be recommended by Airbus Industrie and was codified by a number of military bodies. CMS33 more than satisfies the requirements of the RAF for tests on VOR/ILS/MB (VHF omnidirectional radio range/instrument landing system/marker beacon) installations as well as HF, VHF and UHF radio sets. Another major factor in winning the order was the optional test facility for onboard autopilot systems.

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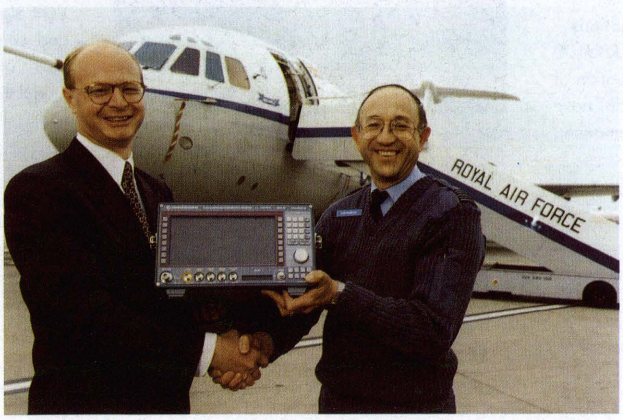
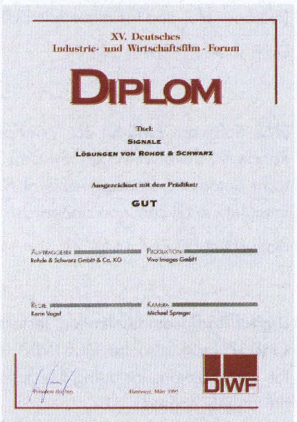


Hotline service

Rohde & Schwarz is now offering hotline assistance to all users. This express service by the Support Center is now available as an extra to the aid provided by sales offices. Specialists will answer questions relating to test equipment from Rohde & Schwarz and Advantest. Solutions to problems can be devised during the call. IEEE bus instructions can be tested direct, for example, and other operating assistance can be given. The service can also be used to request application notes, program examples and other information about test equipment from Rohde & Schwarz and Advantest, all produced using the latest communication aids. The hotline of the Support Center can be reached from 08:00 through 17:00 on

- phone +49180-5124242
- fax +4989-4129-3777
- Email address 73400.1310@compuserve.com.

H. Semmerow



New R&S corporate film judged good

Every year the German trade & industry forum in Hanover awards prizes for commercial films. For 1994 the jury certified the corporate film "Signals – Solutions from Rohde & Schwarz" as good (photo). The awards ceremony, staged by the federal commerce bureau (Eschborn), was held in Hanover in March. The prizes were presented by Dr Heinrich L. Kolb, parliamentary undersecretary to the department of commerce.

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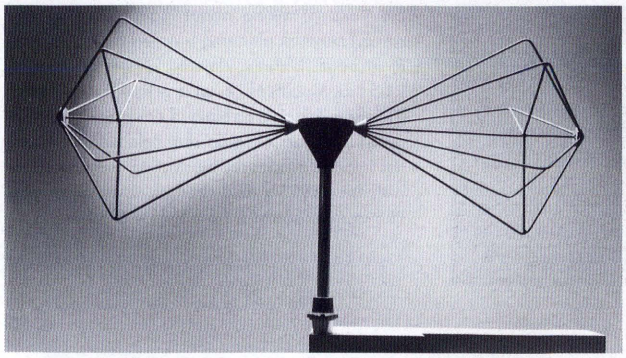

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NPL tests antennas: clear lead for Rohde & Schwarz

In its magazine "RF & Microwave News" (no. 3, winter 1993/94) Britain's National Physical Laboratory (NPL) reported on the excellent performance of its new 60-meter antenna range. At frequencies up to 300 MHz the measured and computed attenuation of the test range agrees down to 0.1 dB. The precision range perfects the testing and calibration of antennas. The NPL has used it to take a particularly close look at the balance characteristics of biconical antennas from different producers. Here the field strength of an antenna with vertical polarization and 2 meters above ground, for example, is recorded and compared to that of the same antenna after inversion (rotation through 180°). No difference should be discernible. A test of this kind is important for the reproducibility of EMC measurements. On the subject of reproducibility of antenna performance the NPL writes: "In the worst case this variation amounted to ±15 dB, and can commonly be ± 5 dB. For the best designs the variation is less than ± 0.2 dB". The case in point, ie ± 0.2 dB, is Biconical Antenna HK116 from Rohde & Schwarz (photo).

In the same context the NPL reported on tests of logarithmic-periodic antennas. With many products the contacts between radiators and uprights are uncertain, which can mean dips in gain of several dB. Here the NPL writes: "The best designs have welded elements or superior mechanical contacts". Here too Rohde & Schwarz is firmly in the lead thanks to the welded elements of its HL223. M. Stecher

China's vice-minister for broadcasting visits Rohde & Schwarz

On their tour of Europe, the vice-minister for film, radio and television of the People's Republic of China, He Dong Cai, and the accompanying delegation paid a short call in Munich specially to visit Rohde & Schwarz and find out something about digital audio broadcasting. The minister studied in Germany in the 80s and underwent practical training at various broadcasting corporations. His friendly ties with Rohde & Schwarz go back to this time, especially with Dr Mangold, who invited him to Munich for informative visits. He Dong Cai was then vice-president of the office for radio and television of the province Guangdong. Both were very pleased at meeting again and talking about business relations between Rohde & Schwarz and the ministry in China, which have endured for many years now.

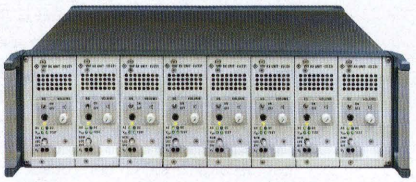
On their arrival at Rohde & Schwarz the Chinese delegation were welcomed by president and COO Hans Wagner and Franz Dosch, head of the sound and TV broadcasting division. During their brief visit the guests were shown modern FM transmitters as well as a DAB transmitter (top photo). The latter was of special interest, seeing as a pilot DAB/DVB project is due to start soon in China. This was followed by technical discussions, and at lunch both parties toasted to further expansion of their cooperation (bottom photo). Possible steps for implementing a DAB network in China were discussed during the concluding talks in the afternoon.

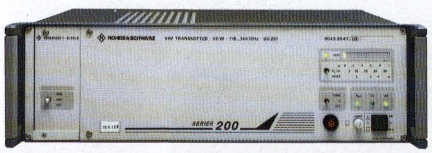
J. Beckmann

ATC communication for Polish airports

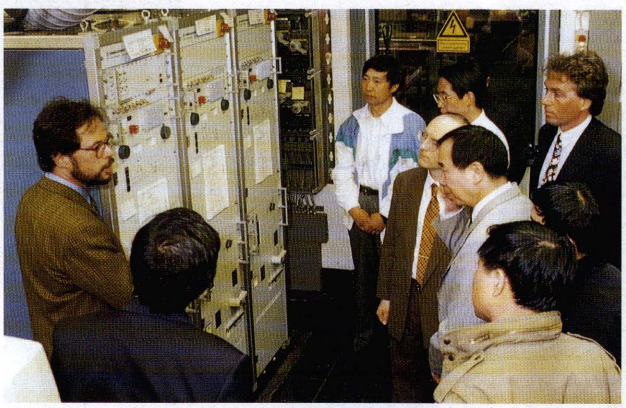
Rohde & Schwarz is outfitting the regional airports Danzig and Cracow with the latest in communication systems under contract to Poland's air-traffic-control administration. Rohde & Schwarz will be responsible for the overall project at both airports, and the Swiss company Schmid Telecom AG is contributing an all-digital voice exchange system.

The software-controlled VHF communication installations offer remote control and monitor operation, and each consists of a primary and a standby system. The systems for the airports Danzig (8 radio channels, 7 transmit and 8 receive channels) and Cracow (11 radio channels, 9 transmit and 11 receive channels) are fitted with single-channel VHF radio sets from the 200 series (photos). In this series, which has been successful worldwide, Rohde & Schwarz implements highly innovative technology for ATC communication: a complete range of single-channel VHF radio sets with receivers, transmitters and transceivers, including accessories and options, individual power supplies for receivers, and DC or AC/DC power supplies with automatic switchover. Further outstanding features of this entirely new generation of equipment are its modular design and three different remote-control modes





for optimum matching to the special-to-system requirements of any project. Sö



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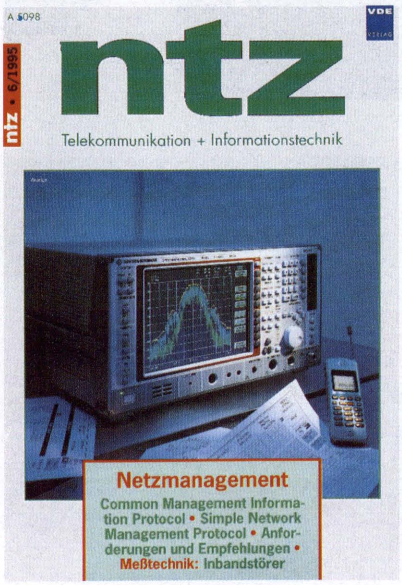
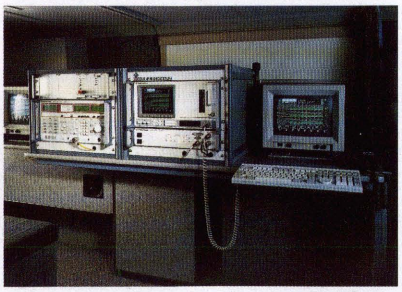
Testing speed – a triple record

Like many other national and international publications in recent months, issue 2/95 of Switzerland's monthly magazine for industrial electronics "Neue Technik" focussed on the new family of spectrum analyzers from Rohde & Schwarz:

FSE sets records for speed in three different sectors. The fastest full-span sweep time is 5 ms in a fully synchronous sweep. This gain in speed means no sacrifice in frequency accuracy, quite the contrary, it is even enhanced. The fastest sweep time in zero span is – at 2 µs – ideal for high-resolution measurements on pulse edges. More than 20 sweeps per second are the best basis for simple and fast adjustments, use in production or analysis of quickly changing signals.

Edition 6/95 of "ntz", one of Germany's leading radiocoms magazines, front-spread the FSE spectrum analyzer, which is especially suitable for tests on modern, digital mobile-radio systems and also as a general-purpose spectrum analyzer in the frequency ranges 20 Hz to 3.5 GHz and 9 kHz to 7 GHz. But not only "ntz" took a liking to the new spectrum analyzer for its title, the instrument also featured big in publications round the world, like Electronique International, L'Onde Electrique, Electronique, Radio Communications Magazine, Microwave Engineering Europe, Electronic Times, Land Mobile, Electronics Weekly, Mobile and Cellular.





"armada international" number 2/95 presented the GB609 control unit (left next to the pilot), which is integrated into the instrument panel in the cockpit of the Franco-German Tiger combat helicopter.

Self-help is the best help

This was the caption chosen by issue 4/95 of "Elektrotechnik" for its article about an EMC installation for internal tests of immunity to radiated fields (IEC1000-4-3):

In their "compact diagnostic chamber" Siemens Matsushita Components and Rohde & Schwarz have jointly devised an installation that is suitable as an internal test lab for small and medium-sized businesses. Time to design can be speeded up, and inhouse EMC know-how improved... The diagnostic chamber is modular, so it can be expanded. Incorporating another directional coupler, a second amplifier and an E/H field generator will give coverage of the frequency range 10 kHz to 100 MHz. And extension for measurements to IEC1000-4-6 is also possible.

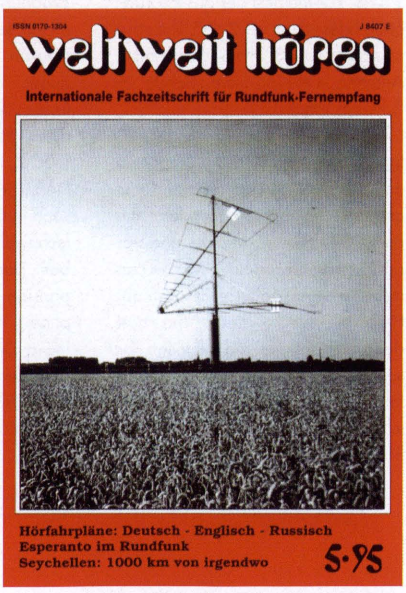
Everyone is talking about digital phoning. But careful network planning is called for if everyone is to hear it. Peter Hatzold, system trainer at R&S Bick Mobilfunk, in an article in issue 4/95 of "Telekom-Praxis", explained coverage measurements and tests of radio channels with the channel impulse response, illustrating the procedure with the TS9955 field-strength test system plus PCS channel sounder from Rohde & Schwarz.

Measuring the smallest signals with high sensitivity

The May edition of the "Journal of Electronic Defence" reported on the latest developments from Rohde & Schwarz in active antennas, making measurements of signal radiation more sensitive and better reproducible:

Active antenna system AM524 as well as H-field test antenna HM525 now enable the operator to measure radiated signals with exceptionally high sensitivity and excellent convenience... For the first time we have here an antenna system thoroughly optimized for sensitive measurements of radiation, setting new standards in dynamic range and with its remotely controllable extra functions.

Specially for sound broadcasting over medium and worldwide ranges – the high-power logarithmic-periodic antenna AK226/4471 from Rohde & Schwarz, featured on the cover of issue 5/95 of "weltweit hören".



Shortwave radio or satellite communication?

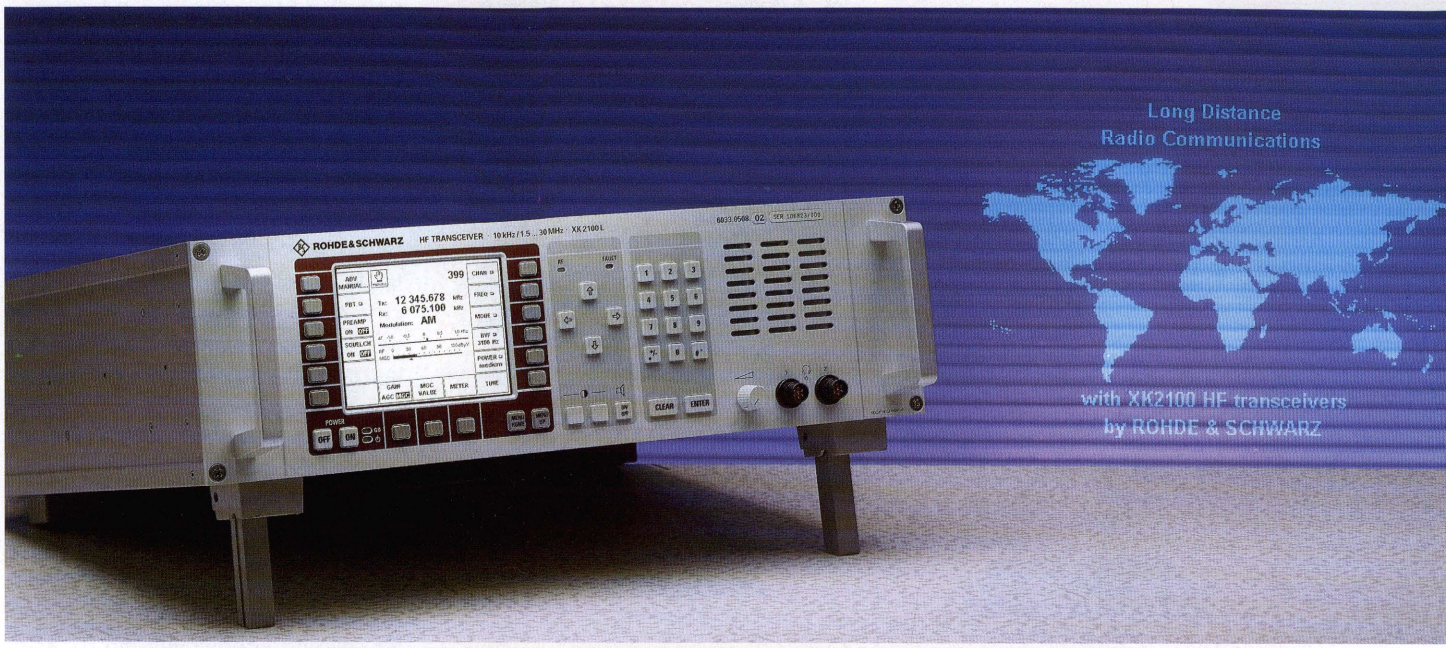


FIG 1 Modern HF transceiver of XK2000 family from Rohde & Schwarz with integrated radio processor for automatic link setup as well as integrated 2700-bit/s modem and built-in radiophone/network interface unit Photo 41 251

Satellite communication – SATCOM in brief – is a catchword. Terms such as worldwide communication, global communication and long-haul links are its offshoots. Cannot these terms also be applied to the well-known field of shortwave communication? One speaks of secure radio links in this case, because reliable communication via a cable network encircling the globe has been possible for a long time. As an alternative to the cable network, there were only shortwaves as a worldwide medium until a few years ago, and they are regarded as rather "moody".

Anyone listening in to shortwaves will be able to ascertain that many radio stations share the same frequency. Fading and atmospheric disturbances are additional factors in making transmissions difficult. The physical aspects of shortwave propagation will not be dealt with here however. Today communication processors with intelligent procedures simplify radio operations considerably and enable errorfree transmissions. If there is no suitable frequency available to implement a shortwave transmission, even the best communication processor is powerless in the face of solar wind, northern lights and other disturbances which make a radio link physically impossible. Operators therefore apply for a large number of frequencies to be equipped for all eventualities.

The last paragraph should not be seen as putting one off shortwaves but rather as a tribute to the achievements of modern technology. The generally held opinion that shortwave communication is obsolete can be refuted through the existence of modern radio equipment with an integrated communication processor like ALIS or ALE for automatic link setup and with fast modems handling up to 2700 bit/s (FIG 1). Error-correction schemes FEC (forward error correction) and ARQ (automatic repeat request) ensure errorfree communication even under difficult conditions.

Modern shortwave stations can be upgraded with universal add-on components (FIG 2) and yet shortwaves in the longterm are the most cost-effective transmission medium. Fees for the use/allocation of frequencies are hardly significant; FIG 3 shows a comparison of costs between shortwaves and satellite links. Proponents of one or the other type of communication would probably represent these figures somewhat differently. Using some other figures for the initial outlay on shortwave equipment and fees incurred with satellite networks does not radically change the argument. The curves may well shift depending on purchase price and degree of utilization. But the trend is clear: **shortwave communication is unbeatable for price.**

The decision to buy shortwave or satellite equipment will largely be determined by the type of application. Many users resort to both types of communication and employ one or the other governed by the situation on hand. It should be pointed out that

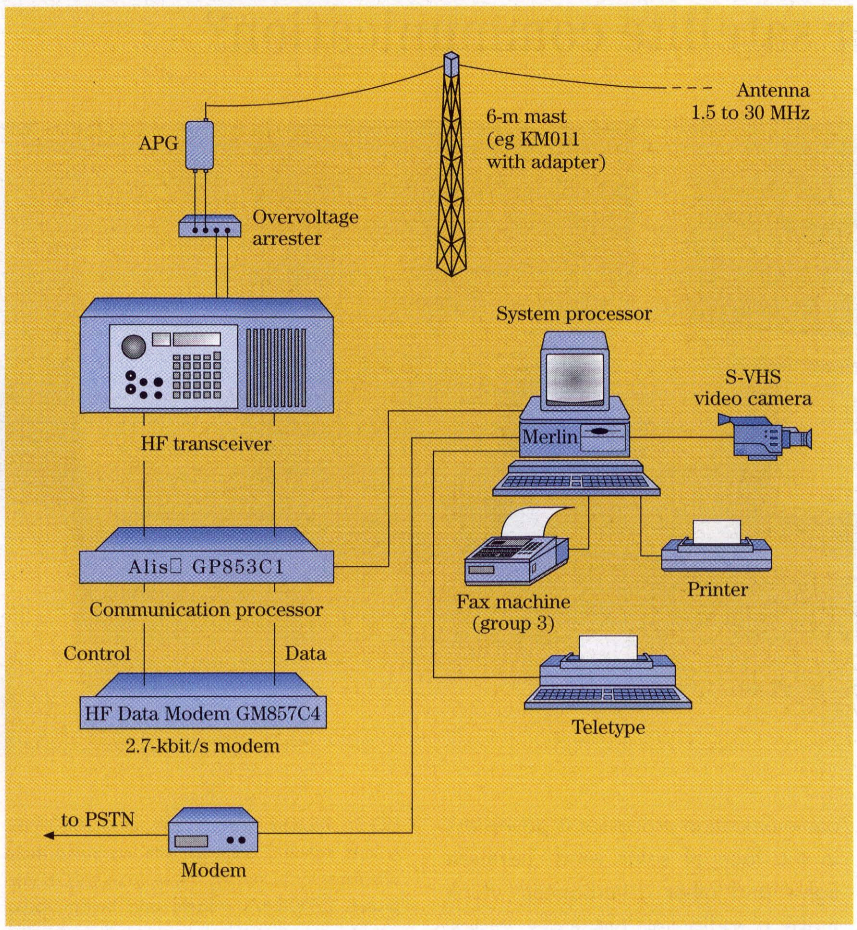


FIG 2 Block diagram of modern shortwave station

shortwave equipment too is becoming smaller, more compact and more convenient to operate (see FIG 1).

So much for portraying the "old lady" (shortwaves) after her rejuvenation. But what about satellite communication?

We will look at satellite phone for the frequency range 1.5 to 1.6 GHz as an alternative to shortwaves. Without a great deal of hardware and involving low initial outlay – a briefcase houses all the equipment including antenna – a link can be established via satellite with any phone subscriber. However use of satellites is chargeable and the phone lines have to be paid for too. Beside the telecommunication satellites V-SAT, which have been in operation for some time, there are now systems that are directly accessible to anyone.

Known as versions A, B, C and M, such services are offered by Inmarsat, the International Maritime Satellite Organization. In the case of version P, which is still in the planning phase the same as the Iridium project of Motorola, it should even be possible to communicate by means of a handy. Using Satphone SP1600 shown in FIG 4, one is able to communicate today already from practically any point on the earth with any other phone subscriber. Similar to the well-known radiophone networks (GSM nets), link-up to telephone networks but in this case all round the globe can be set up via a ground station. Data and fax messages are transmitted error-protected in the same communication channel at the rate of 2400 bit/s. Depending on requirements. the phone case can be equipped with a fax machine or a portable PC (laptop) and, if necessary, also with a compact modem. A separate fax machine is ideal for sending handwritten messages or documentation. For transmitting mainly files and data the use of a notebook PC can be recommended. Fax transmission is also possible with the aid of a modem and associated program. In a nutshell, complete office communication together with a phone connection is provided in a briefcase and, if required, even a cordless phone can be hooked up to SP1600.

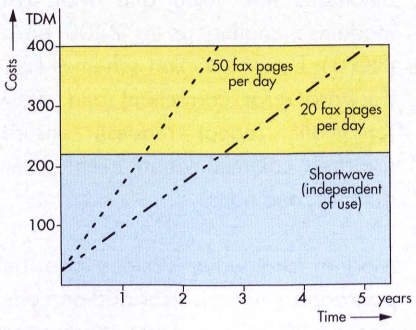


FIG 3 Cost comparison between satcom (Inmarsat) and shortwave in terms of investment and fees

How does satellite communication work? There are four geostationary satellites at an altitude of 36000 km that enable global communication irrespective of whether the subscriber happens to be in a jungle, desert or even in the middle of an ocean. As can be seen from the map (FIG 5), communication only becomes problematical or even impossible in the polar region (from about the 85° parallel) because of the flat angle of incidence. From the footprint in the north-south direction it can be seen that worldwide coverage would be feasible using two satellites only. Through strong overlapping of the coverage areas the four satellites in use guarantee a reliable link, even in regions with high volumes of traffic such as the Atlantic. As for Europe, it can be serviced by

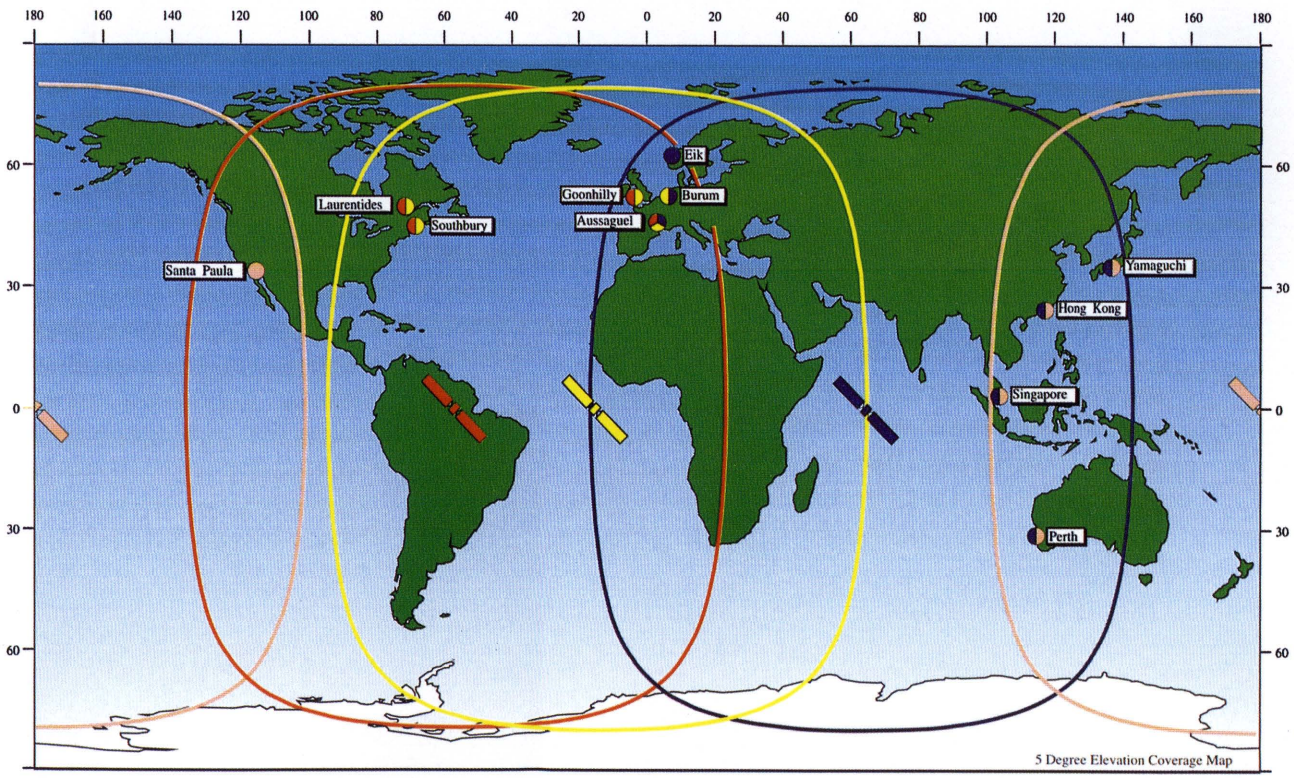
FIG 4 Unlimited freedom of communication through Satphone SP1600 from Rohde & Schwarz
Photo 41 471

means of three satellites. The system operates in line with open and worldwide harmonized standards. The connection to/from the public telephone network is made from the satphone via a direct link to the satellite and its transponder. The satellite phone SP1600 from Rohde & Schwarz is also obtainable as a rackmount for ship, land-vehicle and container applications. A self-tracking 60-cm antenna with gimbal-mounting is available for shipboard use.

Udo Böhler

Reader service card 149/37 for further information on HF Radio Equipment Family XK2000 and 149/38 on Satphone SP1600

FIG 5 Positions and coverage of communication satellites as well as main ground stations



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