News from Rohde & Schwarz

Combined transmission
Shortwave – satellite

Complex I/Q signals
Calculation and generation

VHF FM sound broadcasting
Solid-state transmitters for 10 kW, 5 kW and 2.5 kW

1998/III
159

ROHDE&SCHWARZ

Number 159 1998/III Volume 38

The SpaceMan system – with HF Transceiver XK2000, Message Handling Software PostMan and satellite dish as the main components – permits combined shortwave-satellite transmission which enables access to wired communication networks from any place on earth. Data are downloaded from Internet via shortwave and sent via satellite at a rate unattained so far (see article on page 4). Photo 43 180

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Regular features

Modulation Generator AMIQ and Software WinIQSIM especially developed for this generator form an ideal pair that is unique for the generation of complex I/Q signals. For details see articles on pages 10 (AMIQ) and 13 (WinIQSIM).
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Imprint

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SpaceMan DS101

With PostMan express onto Internet via satellite

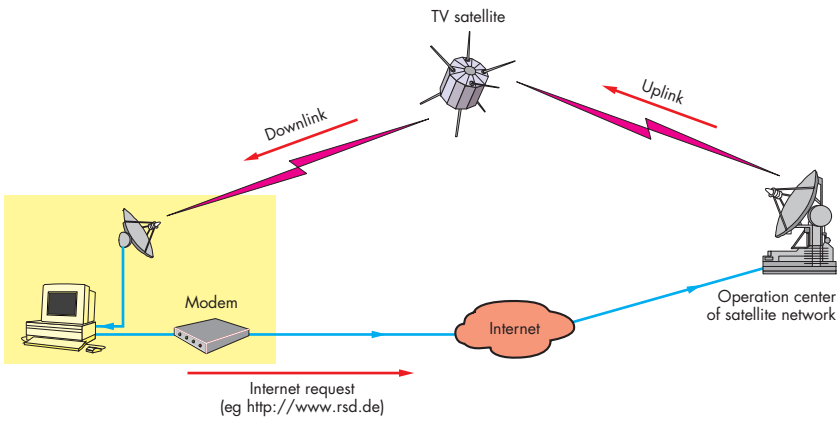
The increasing amount of information flooding data networks such as the Internet is loading wired analog and even digital networks to the limits of their capacity. The consequences are unacceptable waiting times and constraints on realtime applications. By combining shortwave and TV satellite data transmission, the SpaceMan system from Rohde & Schwarz does away with traffic jams on the information highway and in addition provides access to wired networks in areas lacking the necessary infrastructure.

Internet download via satellite

In conventional Internet access, information is exchanged via modems and the public telephone network. The information request and the reply are transmitted via the same paths. While advanced computer technology allows high data rates to be handled, the public telephone network and the required modem links considerably limit transmission capabilities. A solution to this problem is the integration of digital TV satellite technology into existing communication structures. With this approach, desired information is requested from the Internet via the known wired paths as in the case of conventional transmission. The reply data stream, however, is routed from the source (server) to the operation center of the satellite network and transmitted to the user via a fast, broadband satellite link (downlink) (FIG 1).

Routing the Internet data stream in this way becomes possible by modifying the Internet protocol (IP), which is responsible for route selection on the Internet. Using what is called IP encapsulation, the IP packets are put into an "envelope" addressed to the operation center. The operation center reads and routes on the envelope contents and, acting as a new user with respect to the addressed Web server, sends the information to the requesting party via satellite. Satellite transmission is unidirectional in this case, ie information can be received but not sent via this path. With Internet requests usually being very short (eg http://www.rsd.de) and the reply data volume comparatively large, the advantages of this technique make themselves felt all the more.

FIG 1 Conventional data transmission using TV satellites



Combined radio-satellite technique

With its SpaceMan DS101 system (FIG 2), Rohde & Schwarz is the first supplier worldwide to combine the above principle with radiocommunication. Requests to the Internet are made via radio (HF/VHF/UHF), and transmission of requested data via fast satellite links. Access to this modern information technology (IT) with radio linkup is realized by means of PostMan DS100 [1; 2], a well-known software product which allows transparent TCP/IP radio data transmission. PostMan in conjunction with shortwave transceivers of the XK2000 family [3] provides unrestricted access to wired communication networks via radio links from any point on the earth. Reception of satellite signals is implemented in SpaceMan by commercial system solutions adapted to radio technology (FIG 3). This provides wireless Internet access unimpeded by the constraints of low data rates.

Uses

Through the combined use of two transmission techniques – radio and TV satellite – SpaceMan achieves data rates far above those of terrestrial post office lines with telephone modems. A user browsing on the Internet from a ship in the North Sea for example, using shortwave and satellite links provided by SpaceMan, is at no disadvantage compared with his mainland workstation. Using satellite transmission and radio technology from Rohde & Schwarz, large volumes of data such as digital maps, databases and software upgrades can be downloaded to the PC far from any infrastructure at data rates considered so far unattainable in radiocommunication. Even realtime multimedia applications can be implemented in this way.

FIG 2 SpaceMan DS101 system for combined shortwave-satellite transmission consisting of HF Transceiver XK2000, PC with Message Handling Software PostMan, decoder and satellite dish
Photo 42 700/1

System components and technology

Apart from the radio equipment, the user requires a dish for the reception of satellite signals and a decoder, which is in the form of an extension card installed in the PC. PostMan together with control software sends user's requests via radio and handles download of data from the Internet to the PC via satellite. In most cases, a commercial elliptical 60 cm dish or similar will do for the reception of satellite signals.

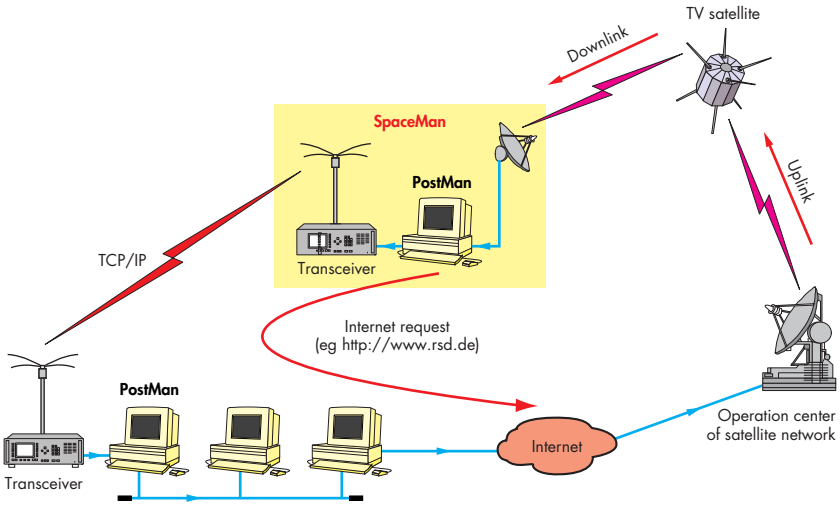
Satellite transmission is via free channels – the so-called transponders – of TV satellites such as ASTRA or EUTELSAT. Data transmission is based on DVB/MPEG2 (digital video broadcasting/MPEG2 is a method for moving picture compression). At the protocol level, a special ADBS (advanced data broadcasting system) extension is used, among other things, to provide filter functions in addition to addressing and routing. ADBS offers various protected access modes (conditional access, security, privacy). This allows individual hardware addressing of any station.

FIG 3 Combined shortwave-satellite transmission with SpaceMan

Security and data rates

The transmitted information is DES-encrypted (data encryption standard) to protect it against unauthorized interception. Security against interception can be further enhanced by adding user-specific encryption.

The broadband satellite links allow transmission of Internet data at rates up to 400 kbit/s. This is several times the data rate of conventional V.34 modems



with max. 56 kbit/s or ISDN with 64 kbit/s. The data rate of 5.4 kbit/s [4] afforded by shortwave appears modest in comparison, but is of little consequence considering that Internet requests are rather short.

Summary

Thanks to SpaceMan, users who so far could not access wired communication networks due to the lack of suitable infrastructure, now for the first time can enter the Internet from any point on the earth via radio links and at data rates unattainable for wired users up to now. SpaceMan thus opens wired communication networks also for users at sea, on islands or in other remote areas, and for land-mobile applications.

Thomas A. Kneidel

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[2] Kneidel, T.: PostMan on tour. In this issue, p 34

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[4] Wicker, G.; Greubel, G.: Fast adaptive data transmission on shortwave at up to 5400 bit/s with HF Modem GM2100. News from Rohde & Schwarz (1996) No. 152, pp 42–43

Condensed data of SpaceMan DS101

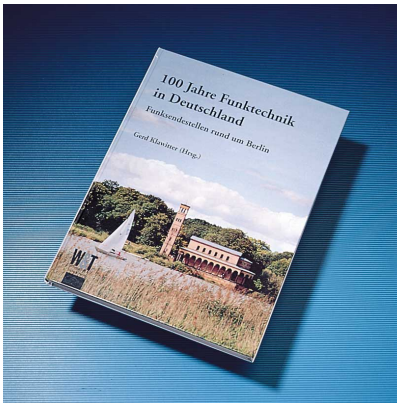
Data rate for wireless Internet/Intranet access	< 400 000 bit/s
Radio transmission to provider	transparent TCP/IP
Transmission link	HF, VHF, UHF or SatCom
HF data rate	< 5400 bit/s
Download	via digital TV satellites
Encryption	DES, optionally additional methods

Reader service card 159/01

Booktalk

100 years of radio technology in Germany

Subtitle "Radio transmitter stations around Berlin" by Gerd Klawitter (publisher). The book was published in 1997 by Wissenschaft und Technik of Berlin. ISBN 3-89685-500-X, 240 pages, 200 illustrations, 14 tables, 33 drawings. The book is available (in German only) at a price of DM 49 in bookshops or direct from the publisher (W&T Verlag, Sebastianstr. 84, D-10969 Berlin, fax: +49-30-6145117).



Apart from the beginnings of radio engineering, "100 years of radio technology in Germany" deals with all radio transmitter stations in the area of Berlin. Gerd Klawitter and his co-authors Wolfgang Behnke, Klaus Herold and Peter Manteuffel have been involved with and closely followed the development of radio engineering. However, it was not possible until the reunification of Germany to take a look at the radio broadcast stations located mostly in former East Germany. Research for this book went on for five years. Not only were hundreds of photos made but also tape recordings of talks with permanent staff evaluated, some of them already retired. Local history clubs assisted in cases where transmitter systems were already dismantled or had gone out of operation. A large number of sketches and drawings of antenna installations were prepared anew or existing documentation revised.

Of course Rohde & Schwarz receives its share in the book. Page 189 shows a VHF transmitter of the year 1957 in good condition located in Berlin-Britz. Rohde & Schwarz and its (meanwhile renamed) FTK Funktechnik Köpenick subsidiary are also mentioned in the sections dealing with the radio tower at Berlin's Alexanderplatz. The station was considerably extended and modernized after the fall of the wall. For example, two 10 kW VHF transmitters from Rohde & Schwarz were installed in 1990 and a 300 W TV transmitter in 1993.

The results of the thorough on-site research and interviews of contemporary witnesses will fascinate not only those interested in radio. The first attempts in radiocommunication under partly adventurous conditions will be of importance to anyone interested in recent history. Research as extensive as this is no longer possible today. The book "100 years of radio technology in Germany" is therefore unique in its field.

Wgr

UT Development Tool TS1232, System Simulator TS1230, Conformance Test System TS8200

New test equipment for type approval of telephones for satellite-based mobile radio system ICO

It will soon be reality – a satellite-based mobile radio system supporting terrestrial networks so that anyone can be called worldwide with a single mobile phone. The test equipment required for the development, quality control and type approval of these dual-mode phones comes from Rohde & Schwarz.

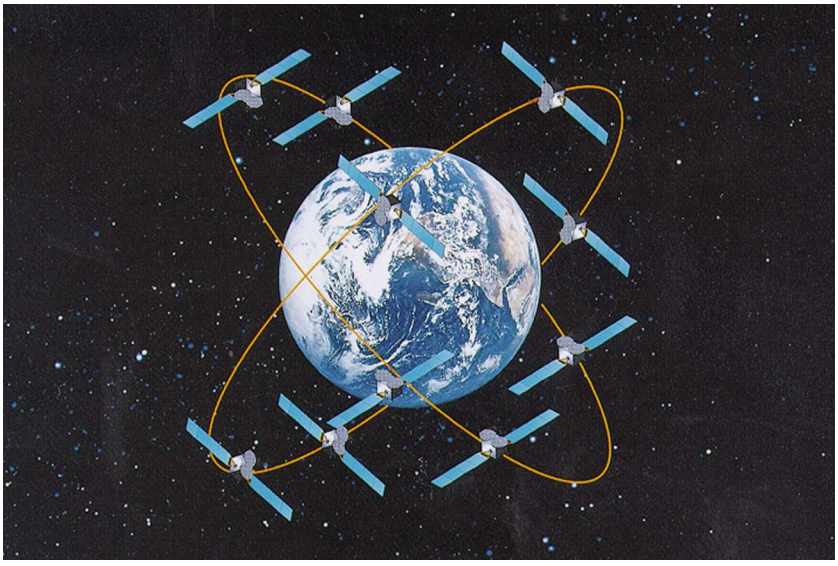


FIG 1 Distribution of ICO satellites in orbits

Dual-mode mobile phones (UTs, user terminals) allowing communication via both a satellite network and terrestrial mobile radio networks are currently at the development stage. To ensure interference-free operation of these phones, their manufacturers must use high-precision test equipment for production and quality control and for type approval. ICO Global Communications, a mobile radio service provider headquartered in London, has adopted the well-proven GSM test method as a model especially for creating a procedure for type approval of ICO mobile phones. Rohde & Schwarz was awarded a contract by ICO to design and supply test equipment for use in the development and type approval of satellite phones [1].

ICO system

ICO Global Communications is setting up a system that by the year 2000 will allow calls to be made worldwide with a single mobile phone, even if the home terrestrial network (eg GSM900) is not available as for instance in Japan or the USA. The ICO phone will be a simple mobile as known from GSM900, however with an additional module built in allowing calls to be made via a satellite too.

The ICO system will be made up of satellites, ground stations and the ICO network. The satellites are MEOs (medium earth orbit) distributed on two orthogonal orbits at an altitude of 10 355 km (FIG 1). The orbits are inclined towards the equator by 45°. Five satellites plus a sixth as a standby are deployed on each orbit. They have a transmitting and a receiving array comprising 164 antennas each that provide 4500 radio channels. The downlink frequency is 2.2 GHz and the uplink frequency 2 GHz, while the link to the ground station is established via 5 GHz and 7 GHz dish antennas.

The satellites are distributed to ensure that there will almost always be a link from a mobile phone to two and sometimes even three satellites. Radiocommunications are controlled by twelve ground stations worldwide, with the satellites operating as relay stations. This allows future expansion of the system without requiring complex and expensive work on the satellites. All ground stations are interconnected via the ICO network, which also establishes connections to local terrestrial communication networks.

Test concept

Rohde & Schwarz offers a complete family of testers for support in development through to type-approval testing of dual-mode mobile phones: UT Development Tool TS1232, System Simulator TS1230 and Conformance Test System TS8200.

UT Development Tool TS1232 is intended to support mobile phone manufacturers in initial tests at a very early stage in development. It forms the basis for the other two systems. Its main components are a digital and an analog unit. Process Controller PSM [2] with 200 MHz Pentium processor is the core of the digital unit. A DSP card generates the I/Q data that are sent to the analog unit, and also receives and analyzes demodulated I/Q data from the latter. Thanks to its high performance

and versatility, the digital unit can easily be adapted to future system expansions. The analog unit consists of RF modules that generate a modulated signal from the I/Q data or demodulate the received signal and convert it into I/Q data. Two of these RF modules are able to simulate a satellite beam consisting of two transmitters and one receiver.

LynxOS, a UNIX PC operating system, enables realtime measurement and analysis. The comfortable software allows monitoring of the individual software layers and associated interfaces in realtime, generation of user-specific test scenarios and analysis of data traffic between tester and device under test.

System Simulator TS1230 is an enhanced TS1232. This complex test system comprises six transmitters and receivers that can be configured according to user requirements. It allows simulation of call handover from satellite to satellite as well as of diversity, ie reception on several channels to improve quality. TS1230 includes a fading simulator for reproducing the characteristics of a satellite channel. In addition to level variations caused by shadowing, these are the effects due to movement of the satellite itself and the mobile phone. Various fading profiles and doppler spectra can be selected. The system simulator also provides all protocol test cases to ICO11.10 (type-approval test specifications). Together with its capability for adapting these tests to user-specific needs and generating user-specific test scenarios, this makes TS1230 an extremely versatile protocol test system.

Both UT Development Tool TS1232 and System Simulator TS1230 can be enhanced by a spectrum analyzer from the FSE family [2], enabling important RF parameters such as burst power, phase and frequency error to be tested as well as the UT transmit signal spectrum.

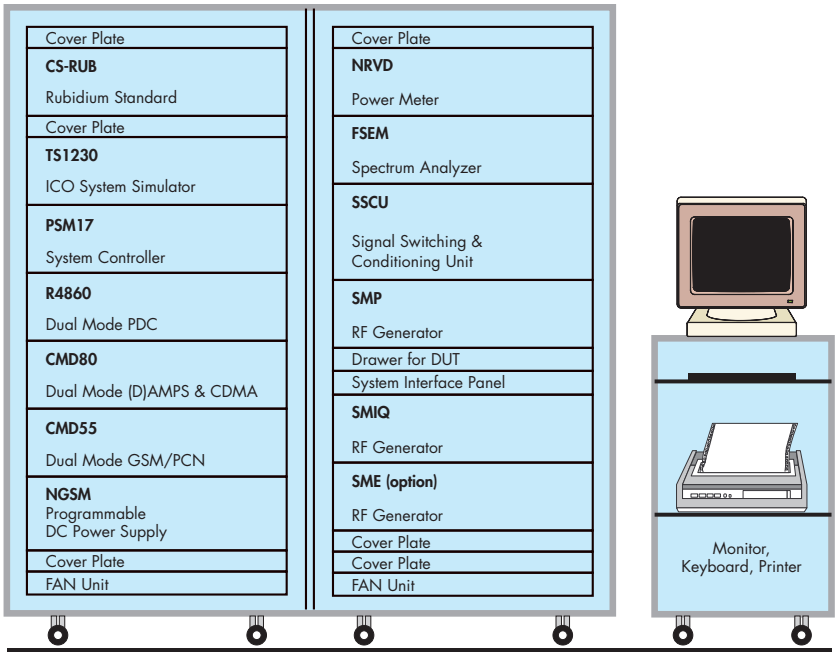


FIG 2 Layout of Conformance Test System TS8200 for dual-mode mobile phones

System Simulator TS1230 is also the core of **Conformance Test System TS8200** for type-approval testing. This is a very complex system allowing protocol tests, testing of transmitter and receiver RF parameters as well as of network compatibility. Tests are also implemented to check whether the mobile phone switches from the ICO mode to the terrestrial network and vice versa as provided by the basic module of the phone. The relevant networks are simulated by various Digital Radiocommunication Testers CMD [2]. All these tests will be implemented and carried out in line with ICO11.10 type-approval test specifications, prepared by Rohde & Schwarz in cooperation with a German test house of international reputation.

RF measurements are carried out by Spectrum Analyzer FSEM and Dual-Channel Power Meter NRVD, interfering signals are produced by Signal Generators SMP22 or SMIQ [2] (FIG 2). In addition to the process controller of TS1230, TS8200 also includes a system controller (likewise PSM) for organizing the control of all units and test procedures. In this way TS1230 can be fully devoted to the performance of realtime protocol tests. The individual units are controlled on an IEC/IEEE bus. The protocol tester is connected to the system controller by an Ethernet link, which allows fast and convenient control via the user interface.

TS8200 naturally also operates under a UNIX operating system and provides versatile functions such as protocol analysis, result evaluation and test result management. All functions can be called via a convenient graphical user interface. New approaches are being taken for interfacing the DUT with the system in type-approval testing. In contrast to GSM, here RF parameter measurements are carried out via an antenna and not a cable. Test results are thus far more realistic since they also allow for antenna properties. This is particularly important in the case of satellite systems because, due to the long transmission paths and resulting high signal fading, system margins are much tighter than for instance in a GSM network.

The levels used mean very challenging requirements for the test system. The mobile phone's maximum transmit power level is 40 dBm, whereas satellite signal power into the mobile's antenna is between –90 dBm and –130 dBm. The RF path must consequently handle an extremely wide dynamic range. All this places heavy demands on the quality of the RF switching matrix, which must work with very large level differences between transmit and receive signal but without affecting signal quality and measurement accuracy. These requirements are met through determination of the signal path characteristics by the switching matrix and generation of compensation data. The deviations of the system will thus be smaller than 1 dB.

It is also intended to offer an audio test option. The audio tests do not use sinewave signals but artificial voice signals instead, since voice coders in telephones are optimized for voice signals.

An antenna test system that determines the effect of the noise temperature of sky and environment on the antenna and the radiated power around it is used for measurement of antenna parameters. These results are important for the RF tests of dual-mode mobiles with Conformance Test System TS8200.

Dr Hans-Jürgen Schneider;
Karl Pfannmüller

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[2] Rohde & Schwarz Test & Measurement Products Catalog 96/97

Condensed data of Conformance Test System TS8200

Frequency range	
Transmit band	2.170 GHz to 2.200 GHz
Receive band	1.980 GHz to 2.015 GHz
Transmit level	–60 dBm to –120 dBm
Receive level	max. 40 dBm
Number of transmit channels	6, user-configurable
Number of receive channels	3
Interface with DUT	antenna or cable

Reader service card 159/02

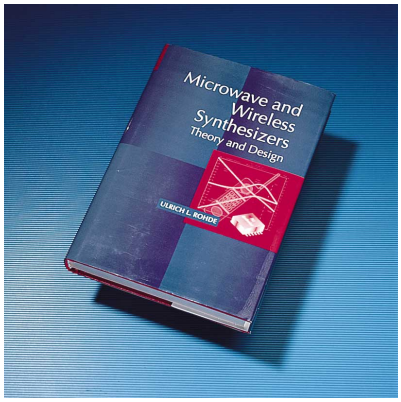
Microwave and Wireless Synthesizers

by Prof. Dr Ulrich L. Rohde, published in 1997 by Wiley, New York. ISBN 0-471-52019-5, 638 pages, price in US: $ 94, available in bookshops (in English only). Prof. Dr Rohde, honorary doctor of the universities of Grosswardein and Klausenburg in Romania, is the son of the co-founder of Rohde & Schwarz and now a partner in the company.

The book gives a comprehensive picture of synthesizer technology. It not only deals with the underlying theory but also provides numerous practical examples of circuits, many of them implemented by Rohde & Schwarz. The author explains the fundamentals of phase-locked loops, describes the linear model for calculating oscillator phase noise, looks at the design of low-noise oscillators and deals in detail with further PLL components such as crystal oscillators, mixers, phase detectors, loop filters and programmable frequency dividers. The noise characteristics of these components are treated in great detail.

Other chapters are devoted to multiloop synthesizers, direct digital synthesis, the fractional-N technique and high-performance hybrid synthesizers. With each chapter there is a comprehensive reference list including patents. The book concludes with an in-depth mathematical treatise that includes the complex nonlinear theory of noise in mixers and oscillators. Thus it covers practically every aspect of synthesizer technology. All in all the book is an excellent reference source for anyone involved in synthesizer design.

Johann Klier



I/Q Modulation Generator AMIQ

Convenient generation of complex I/Q signals

The number of systems using complex digital modulation has dramatically increased in every field of communications. Usually these elaborate signals are generated with the aid of I/Q modulators. AMIQ is a dual-channel, user-programmable waveform generator designed throughout for the generation of corresponding baseband signals.

FIG 1 Modulation Generator AMIQ – specialized in generating I/Q signals – in conjunction with Vector Signal Generator SMIQ and Software WinIQSIM makes an unbeatable team. Photo 43103/5

Modulation Generator AMIQ can be used as an I/Q source for a vector signal generator, eg SMIQ [1], as well as for direct testing of components with an I/Q or IF interface (FIG 1). All waveforms are calculated with the aid of external PC-based programs, eg with the Windows Software WinIQSIM [2] that comes with AMIQ. Via an IEC/IEEE bus or RS-232-C interface the waveform data can be loaded straight into the output memory of AMIQ or saved on the built-in hard disk. A floppy disk drive is available as a further storage and transfer medium. AMIQ has no control and display elements whatsoever. This makes for an attractive price as well as for a compact and lightweight instrument.

There are three modes available for operating AMIQ via the remote-control interface. The WinIQSIM program is the most convenient way. Via an AMIQ menu it allows the calculated signal to be downloaded into AMIQ and all its functions to be controlled. Alternatively, AMIQ can be operated from a Vector Signal Generator SMIQ. In this case, the waveform stored on floppy disk or hard disk or for instance the clock rate can be selected direct in an AMIQ menu of SMIQ, without the need for a PC. In automatic test systems

full control of all AMIQ functions is usually implemented by the system controller.

Excellent performance data

With clock rates of up to 100 MHz, AMIQ provides sufficient margin for generating even the modulation signals of very broadband radio systems. Its extremely large output memory with a capacity of 4 Mwords allows sufficiently long test sequences even at high digital modulation data rates. This is a particularly important factor for CDMA signals with chip rates in the MHz range. The waveform memory is organized in 32-bit words. 14 bits are assigned to each of the two I and Q channels of AMIQ, the remaining four bits are available for four user-programmable digital signals (marker outputs). The high amplitude resolution of 14 bits and the first-class D/A converter ensure excellent spectral purity of analog I/Q output signals (FIG 2).

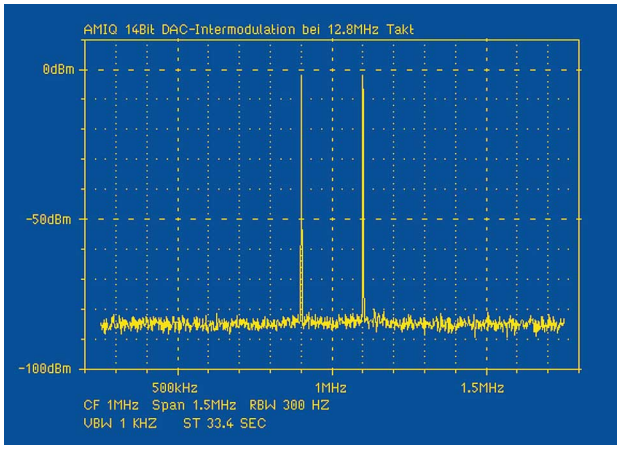


FIG 2
Intermodulation characteristic of AMIQ at 12.8 MHz clock rate

In an I/Q source it is especially important for the two channels to be identical, since any difference would inevitably cause a modulation error. AMIQ allows automatic internal alignment of the DC offset as well as of the levels of the I and Q channels. Even small amplitude or offset errors of the connected device under test at the I/Q input are no problem for AMIQ: the user correction function allows fine variation of the two values and thus overall system alignment. User correction is independent of internal automatic alignment. Skews between I and Q channels, caused for instance by slight differences in the connecting cables between AMIQ and an I/Q modulator, can be compensated by AMIQ with a resolution of about 10 ps.

Filters

AMIQ has two lowpass filters for rejecting the repetitive spurious spectra that are always present in the output signal following digital/analog conversion. The filters have passbands of 2.5 MHz and 25 MHz. They were designed for optimized group delay, frequency response and symmetry in both channels, so the digital modulation error they cause is negligible (FIG 3). I/Q signals can of course also be output unfiltered. External filters can be switched in via the rear-panel BNC connectors and will be included in the automatic alignment of AMIQ.

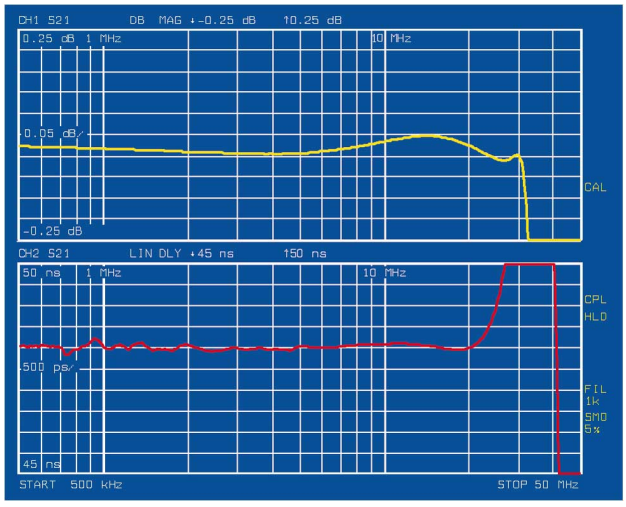


FIG 3
Frequency response and group delay of 25 MHz output filter of AMIQ

Data output

Output of the stored waveforms can be started manually through the operating menu of the PC or SMIQ, by remote control or by an external trigger signal. The I/Q or IF waveform data are output either repeatedly, one time or only when the trigger signal is applied. The four marker outputs are user-programmable, ie each marker can be synchronized at any time to a specific sample or reset. This allows generation of sync pulses at the beginning of a timeslot, level control of an RF signal generator or simply output of a clock signal.

Applications

AMIQ greatly enhances the variety of applications of a signal generator with I/Q modulation capability. It takes over where the internal modulation performance of a signal generator ends.

- Digital modulation signals with symbol rates of up to 50 MHz can be generated. Broadband multicarrier signals are no problem for AMIQ either.

- All modulation parameters can be varied as desired (eg with the aid of the WinIQSIM software). This enables the user to determine the performance limits of existing systems or to investigate possibilities for the follow-on or new development of digital communication systems.
- By deliberately adding impairments to the signals, eg offset or noise, the response of a DUT can be tested under real operating conditions.
- The output memory of AMIQ holds I/Q as well as IF data. So highly precise IF signals with minimum modulation error can be generated for calibration purposes for instance.
- Many of the modules and chips in modern communication systems feature an I/Q or IF interface. AMIQ is the ideal instrument for testing these components.

Apart from WinIQSIM, other simulation or mathematical programs can also be used to generate I/Q data. An optional conversion program changes the output formats of the most common programs into the AMIQ format.

For **use in production environments,** measuring instruments must allow fast remote control. AMIQ was therefore designed with a high-speed IEC/IEEE bus and with emphasis on fast downloading of I/Q data. These optimized times can be speeded up even more by saving predefined signals on the internal hard disk and downloading them from there straight into the output memory. Another important criterion for use in production environments is the space requirement of an instrument. AMIQ is unbeatable in this respect since it has no built-in display. And it only takes up two height units in a rack. Another benefit of AMIQ is its three years' calibration interval. That ensures high availability and makes for low maintenance costs.

But what is probably the greatest benefit of AMIQ in production is its high versatility. It is able to generate any I/Q signals, so its range of applications is practically unlimited. For measurements on receivers it can generate the desired receive signal and at the same time a modulated interference signal in the adjacent channel or CW interference. RF signals are then produced by a single vector signal generator, with no summing circuits and extra signal generators being required.

An **option** that can be retrofitted any time upgrades AMIQ for **BER measurements.** The DUT delivers the data to be tested and the associated clock, while the built-in BER tester compares them with the nominal data from AMIQ and calculates the error rate. The result is available on the remote-control interface and is displayed in the appropriate menus of WinIQSIM or SMIQ. Various standard PRBS sequences may be used as nominal data.

High reliability

The quality of AMIQ output signals is absolutely reliable. The basic AMIQ functions are automatically tested on every power-up. An extensive selftest can be called on request, checking the instrument thoroughly including the level at the I/Q outputs without any external devices being required. Erroneous measurements are thus practically excluded.

Wolfgang Kernchen;
Klaus-Dieter Tiepermann

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Condensed data of I/Q Modulation Generator AMIQ

Waveform length (data and markers)	24 to 4 000 000 samples
Amplitude resolution	14 bits
Number of marker outputs	4
Clock rate	10 Hz to 100 MHz
Output voltage (V_p into 50 Ω)	0.5 V (fixed), 0 to 1 V (variable)
Spurious-free dynamic range (sinewave 1 MHz, clock rate 10 MHz, fixed mode)	>70 dB, typ. 80 dB
DC fine variation, resolution	30 µV
Skew fine variation between I and Q channel, resolution	10 ps
Lowpass filters	2.5 MHz/25 MHz/unfiltered/external filter
Options	BER tester, rear I/Q outputs

Reader service card 159/03

I/Q Simulation Software WinIQSIM

New approaches in calculating complex I/Q signals

The number of modulation methods using I/Q in mobile communication systems has increased rapidly in the past few years. Examples are GSM, now in use worldwide, and the American mobile radio standard NADC. The generation of test signals for these systems is taking more and more time, since just familiarizing with a particular standard can be so time-consuming. With the definition of mobile radio standards of the third generation, the demand for new methods of modulation and channel access is greater than ever.

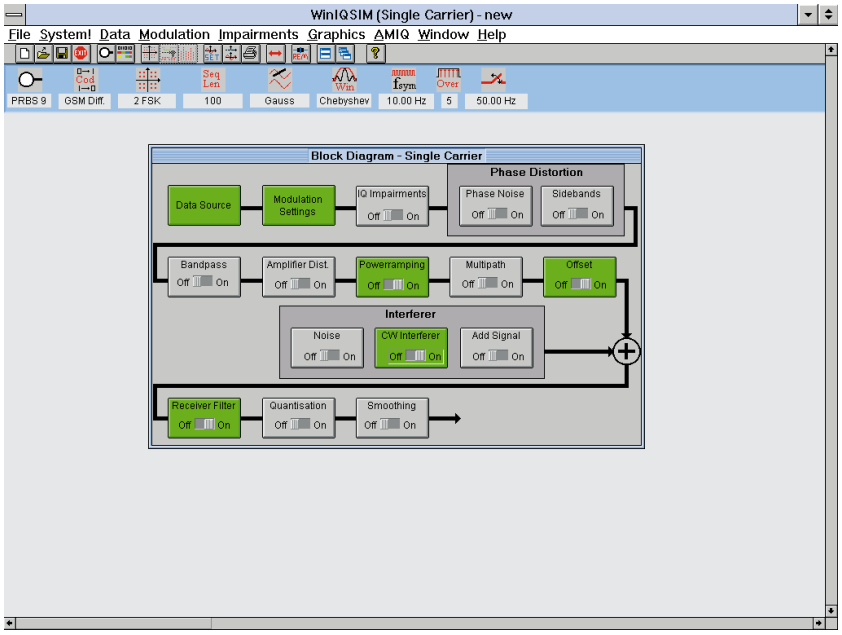

FIG 1 Block diagram providing clear overview of complete signal generation process

WinIQSIM and AMIQ – an ideal pair

Software WinIQSIM, offered in conjunction with I/Q Modulation Generator AMIQ [1], defines a new standard for generating I/Q signals. This software, successor to the well-proven IQSIM [2], is a Windows tool for calculating I/Q signals. Its capabilities range from single-carrier modulation, calculation of multicarrier, CDMA and W-CDMA signals through to configuration of TDMA frames with the aid of a convenient data editor. Impairments can also be superimposed on the signals. This software, specially developed for AMIQ, represents the user interface for the I/Q modulation generator and was designed for maximum operating convenience.

Operation has never been so easy

WinIQSIM can do much more than generate digitally modulated signals simply and fast. A central display and control element, the so-called block diagram representing the transmission model of signal generation, gives the user a clear overview of the entire signal generation process. All components contained in this block diagram, from the data source and modulation through to superimposed impairments and simulation of the transmission channel, illustrate the structure and procedure of internal signal generation (FIG 1). The whole process needed to configure a signal can be controlled through this block diagram. The current status of signal configuration and activated impairments can be seen at a glance.

A status line above the main window clearly shows current signal parameters like type of modulation, coding, symbol rate, filter and window function as well as oversampling. All parameters for virtually all modulation modes can be set independently of each other as desired, and all setting windows can be arranged by the user to configure the optimum interface for specific needs. Comprehensive graphics display modes in the time and frequency domain – eg i(t) and q(t), vector diagram, spectrum – permit simulation and analysis of characteristics as early as in the design phase of new digital communication systems (FIG 2).

Data editor for generating TDMA sequences

The data editor (FIG 3) is another, virtually indispensable tool for both examining existent TDMA systems and developing new standards. It makes the generation of data sequences to TDMA standards as easy as never before. The smallest elements of these data sequences, so-called data fields, are defined first on a building-block principle. These are

of variable length and can be filled with practically any data, eg PRBS or bit patterns.

After configuration of a comprehensive range of different data fields, the data structures of slots can easily be compiled at the next level. By combining and joining the defined slots, a complete data sequence, ie a frame, is finally obtained. In addition to the configuration of a TDMA data sequence, power time templates, ie the power ramping in a slot, can also be defined for the individual slots. In this way complex TDMA data sequences including the associated power control are produced with just a few mouse clicks. The creation of test sequences conforming to the main standards is quite straightforward with the aid of predefined configuration files of the data editor that are included in the WinIQSIM program package. Data sequences for new standards can also be implemented and edited in no time at all.

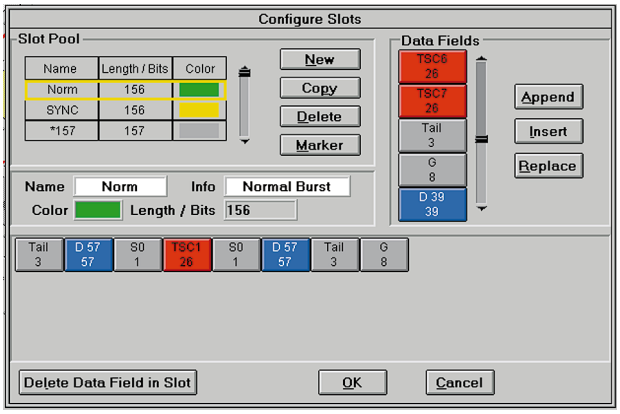

FIG 3 Data editor for creating any kind of TDMA signal

Signal variety

The WinIQSIM/AMIQ team also excels in the generation of **multicarrier signals.** Combinations of up to 512 modulated and unmodulated carriers can be configured with very little effort. In this way a composite signal consisting of signal and impairments can be generated with just one source, meaning an enormous cost benefit.

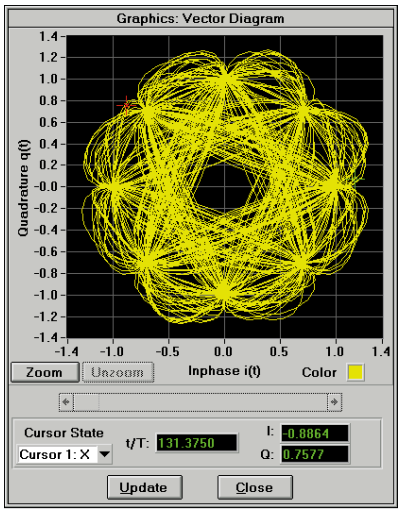

FIG 2 Graphic display of calculated signals

WinIQSIM and AMIQ allow signals to be generated **at intermediate frequencies of up to 25 MHz.** The signal modulated onto the required IF then appears at the I output of AMIQ. This signal can be used to test modulators and demodulators operating at an IF without the need for complex and expensive RF measurement equipment. So the WinIQSIM and AMIQ combination is also an excellent standalone solution for complex measurement applications.

WinIQSIM also provides the possibility of calculating **spread-spectrum and CDMA signals** with user-definable spreading codes ("code from file"). Moreover, it allows wideband CDMA (W-CDMA) signals conforming to present specifications to be generated. Irrespective of the system the user opts for, orthogonal codes, data sources and power can be varied in the individual code channels. Especially for W-CDMA, the physical channels and frame structure specified in the standard are supported. Depending on the selected symbol rate, up to 128 code channels can be set, which can be useful for testing base stations under realistic conditions. Systems currently being developed operate with 4.096 Mcps. With a maximum chip rate capability of 16.384 Mcps, WinIQSIM is already able to satisfy tomorrow's requirements.

Applications

The combined power of WinIQSIM and AMIQ opens up new applications in the field of digital mobile communications, eg verification and type-approval testing of digital mobile phones and base stations (receivers, modulators, amplifiers). Preprogrammed standard settings (GSM, DECT, NADC, PDC, PHS) in WinIQSIM provide frame structures for all common mobile radio standards. The versatile data editor makes WinIQSIM a powerful tool for developing new communication systems. Ideal signals are unfortunately very rare in real-life conditions. So WinIQSIM can be used to compute a large number of signals with defined impairments. In this way tolerance limits and potential critical spots in a system can be detected early on during development.

Another important aspect is the calculation of signals to be used by upcoming communication systems of the third generation. W-CDMA is just one of the things in store. WinIQSIM and of course AMIQ will become increasingly invaluable aids in the near future, because the demands made of digitally

modulated signals are growing all the time. To put it in a nutshell: WinIQSIM is an indispensable tool for all engaged in state-of-the-art digital modulation.

Andreas Pauly; Jens Holzhammer

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Key features of I/Q Simulation Software WinIQSIM

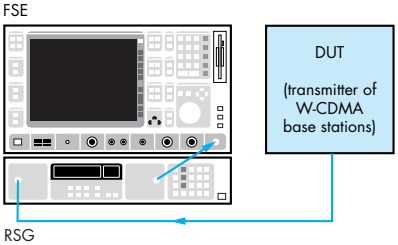
Calculation of digitally modulated I/Q and IF signals
Single-carrier, multicarrier, CDMA and W-CDMA signals
Flexible data editor
Superimposition and simulation of impairments
Versatile graphic display of calculated signal

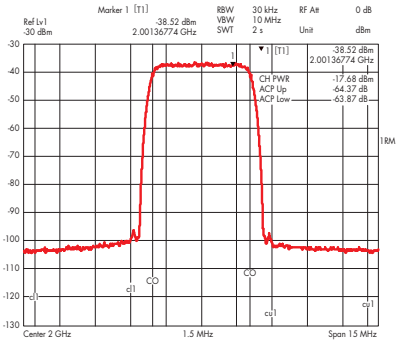
Reader service card 159/04

Precise measurement of adjacent-channel power on wideband CDMA signals

Test hint

For measuring suppression of the power radiated in adjacent channels with W-CDMA (wideband code division multiple access) signals, instruments must have sufficient margin relative to the tolerance limits laid down in specifications. This requirement becomes even more stringent for a spectrum analyzer used to measure the ACPR (adjacent-channel power ratio) on modules and components in the transmission path of W-CDMA base stations. **Spectrum Analyzer FSE** with its wide dynamic range is the ideal choice for this application. The attainable ACPR value is limited by the inherent noise floor of the spectrum analyzer and the increase of nonlinear distortion products. For this reason the level at the mixer has to be set very carefully. Use of **RF Attenuator RSG**





is recommended for optimum level setting in 1 dB steps (mixer level for FSE). The maximum dynamic range of about 72 dB ACPR is obtained with a level of about –16 dBm applied to the FSE mixer. The optimum FSE mixer level P_{Mopt} is calculated as follows:

$$P_{Mopt} = -16\ dBm = P_{RF} - attenuation_{FSE} - attenuation_{RSG}$$

Example: power of W-CDMA signal to be measured = 19 dBm, attenuation to be set on FSE = 0 dB, attenuation to be set on RSG = 35 dB.

An RMS detector is the most suitable tool for measuring power and adjacent-channel power on W-CDMA signals. It detects the power independently of the peak-to-average power ratio and delivers stable, reproducible results. The RMS value is calculated in FSE using linear detection of the video voltage. The diagram here shows as an example the result of an adjacent-channel power measurement of up to –65 dB carried out on a W-CDMA signal with 9 dBm power level. RSG setting: 25 dB attenuation; FSE settings: 15 MHz span, –30 dBm reference level, 0 dB attenuation.

ACPR values better than –65 dB are determined by measuring first the power in the transmit channel. For measuring the relative power in the adjacent channel, FSE can be set more than 20 dB higher in sensitivity (by reducing the reference level) for the same RF attenuation. Thanks to its high load capability, FSE will not be overdriven in such a measurement.

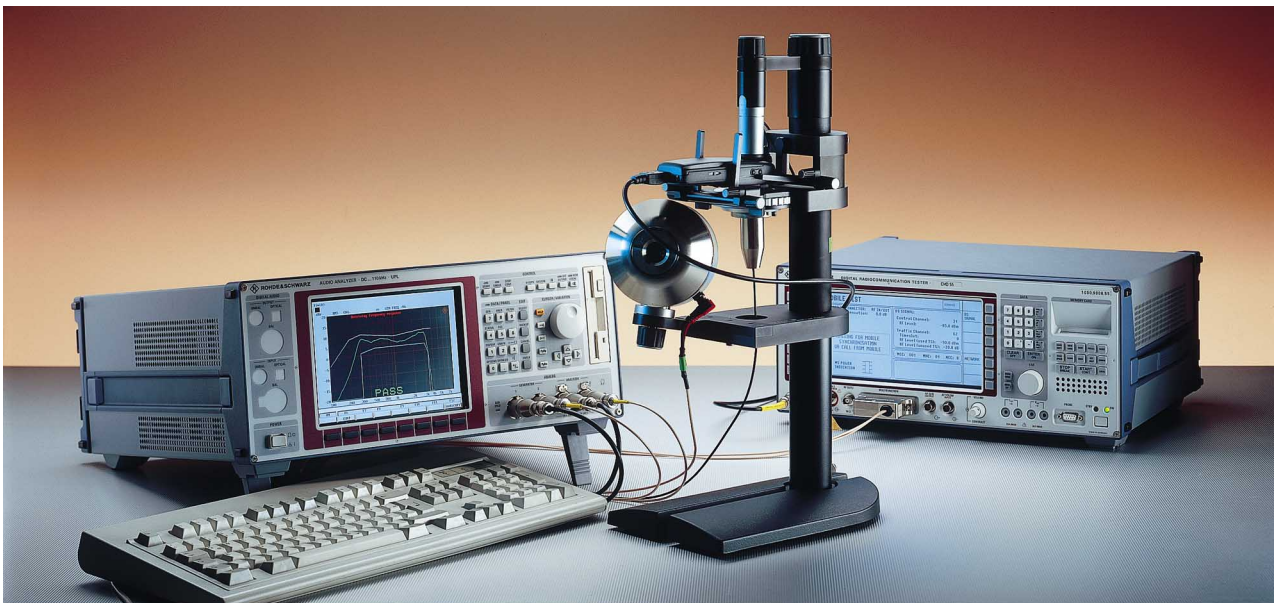
Roland Minihold

Reader service card 159/05

Audio Analyzer UPL16

Speech quality of GSM mobile phones improved by precise audio measurement

Once a yuppie status symbol, the mobile phone has now become an item of everyday use. Even fixed network subscriber lines are being replaced to an increasing extent by mobile phones. As a result, more speech quality is demanded of mobile phones. With its new model from Audio Analyzer family UPL, specially tailored to mobile phone testing in quality assurance and production, Rohde & Schwarz contributes to improving the acoustic quality of future mobile phone generations.



Acoustic measurement on GSM mobile phone using Audio Analyzer UPL16 and Radiocommunication Tester CMD55 Photo 43 158/1

Yesterday's yuppie was quite content showing off his status symbol and making calls that were just about intelligible. But the speech quality of today's mobile phone must stand comparison with that of a fixed network phone. In addition to various functional features, the acoustic quality of a mobile phone is consequently gaining in importance and has become a major sales argument on the highly competitive mobile phone market. This development shows in the standards, with GSM phase 2 not only defining improved and expanded measurement methods for the acoustic features of a mobile phone but also introducing enhanced methods of speech coding (enhanced full rate coders).

The new specifications make it necessary to extend existing and future test equipment for the type approval and production of mobile phones to include complex test procedures, for instance using artificial voice. Specially for these requirements, Rohde & Schwarz has developed a new model, UPL16, in its successful series of Audio Analyzers UPL [1]. This model includes a digital audio interface conforming to specifications GSM 11.10, section 36.4, phase 2, which allows all operating modes of the test interface to be selected for type-approval measurements. It also features enhanced analysis and generator functions enabling all audio tests to GSM 11.10-1, section 30, phase 2.

Audio Analyzer UPL16 can be integrated in **GSM System Simulator TS8915** [2] for instance, replacing all previously used acoustic measuring devices. It is controlled from the system's user interface via IEC/IEEE bus. Digital Radiocommunication Test Set CRTx establishes the link to the test mobile and provides the speech coder and decoder required for some of the tests. All other acoustic measurements are carried out by UPL16 alone and the results returned to the system. All results are also graphically output on the UPL16

display. This enhanced version of TS8951 means that all 15 test cases defined in GSM 11.10-1, section 30 (see overview in blue box) are now available instead of the previous eight.

Test cases

Sending frequency response
Sending loudness rating
Receiving frequency response
Receiving loudness rating
Side tone masking rating
Listener side tone rating
Echo loss
Stability margin
Sending distortion
Receiving distortion
Side tone distortion
Out-of-band signals sending
Out-of-band signals receiving
Idle channel noise sending
Idle channel noise receiving

UPL16 can also be used in conjunction with a Radiocommunication Test Set **CRTx** and the matching software as a **type-approval system** for testing the acoustic features of mobile phones. Here CRTx controls UPL16 via IEC/IEEE bus and establishes the link to the test mobile. Test cases are started from the CRTx user interface, and results are displayed on UPL16 and transmitted to CRTx via IEC/IEEE bus. By adding UPL16 existing CRTx systems can be upgraded for acoustic type-approval tests to GSM 11.10, section 30, phase 2.

The combination of **UPL16** and Radiocommunication Tester **CMD52, 55 or 65** is a budget-priced solution for mobile phone **quality assurance and development.** The same test cases are performed as in the type-approval system solution with CRTx, but here the tests are not validated. The test routines are identical however, so there will usually only be slight differences in those test cases using the speech coder and decoder. The radiocommunication tester is set manually to define the required RF test parameters; a convenient user interface of the application program on UPL16 allows individual test cases to be called up at a keystroke.

The combination of **CMD and UPL16** (photo) is an ideal solution for testing the acoustic features of mobile phones in **production.** This is because UPL16 not only permits standardized test cases to be carried out, but also fast functional tests specifically tailored to the needs of production which go towards efficient throughput and optimum production quality. An artificial mouth and ear are used in all applications as an acoustic interface in line with ITU-T recommendation P.57. Normally an artificial ear of type 1 is used; for special requirements ITU-T P.57 type 3.2 with defined leakage may be used. This type of ear will also be supported by future test case versions of UPL16.

The artificial mouth is controlled direct by UPL16, ie without the usual amplifier. A transformer for impedance matching of the artificial mouth is integrated for this purpose. The **arbitrary function** of UPL was enhanced for reproduction of complex signals. Arbitrary sequences of any length can now be output in the internal format as well as in the WAV format common in the PC world. Sequence length is only restricted by the RAM capacity in UPL16 (extendible to 64 Mbytes).

Third-octave analysis is integrated as an additional measurement function. This is important for many acoustic measurements and is also used in a large variety of applications other than measurements on mobile phones. The third-octave analyzer conforms to IEC 1260, class 0 and consequently satisfies the most stringent of requirements. Peak levels with selectable decay time can be recorded for each third-octave band. This function is used in all tests with artificial voice. A special, new generator function in UPL16 allows feedback of the measured analyzer signal to the generator output with selectable gain. The stability margin of a phone to acoustic feedback can thus be measured direct without any extra devices.

Tilman Betz; Adrienne Rubatos

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[2] Mellein, H.: PCS1900 System Simulator TS8915 – Exclusive type certification of PCS1900 mobile stations in the US. News from Rohde & Schwarz (1997) No. 156, pp 7–9

Condensed data of Audio Analyzer UPL16

(functions additional to Audio Analyzer UPL)

Digital audio interface	to GSM 11.10, section 36.4, phase 2
Third-octave analysis	IEC 1260, class 0
Random and analyzer loop	digital feedback of analyzer signal to generator output with selectable gain using additive noise signal
Test cases	all 15 test cases to GSM 11.10, phase 2
Control program	for performing all test cases with Radiocommunication Tester CMD52/55/65

Reader service card 159/06

Solid-state VHF FM Transmitters SR6..E1

Classic VHF sound broadcasting at its very best

Despite digital audio and video broadcasting, forecasts still anticipate an attractive market ahead for analog FM transmitter technology over the next 15 to 20 years. Rohde & Schwarz responded to these prospects and revised its highly successful, tried and tested generation of solid-state transmitters. The result is even more compact transmitters for an excellent price/performance ratio.

Solid-state VHF FM Transmitter NR410T1 [1] was thoroughly redesigned to create the new transmitters **SR610E1 for 10 kW, SR605E1 for 5 kW and SR602E1 for 2.5 kW.** Compared to their predecessors they are superior in efficiency, in their compact design with easy access to major components, higher MTBF and operation up to a VSWR of 3. They also integrate new remote control standards and feature high flexibility in terms of system integration.

FIG 1 Solid-state 10 kW VHF FM Transmitter SR610E1 Photo 43 077/3

Characteristics

These VHF transmitters for FM sound broadcasting operate in the frequency band 87.5 MHz to 108 MHz and generate a nominal output power of 10 kW, 5 kW or 2.5 kW into 50 Ω at an efficiency of over 60 %. They can transmit AF, RDS (radio data system) and SCA (subsidiary channel authorization) signals, eg DARC (data radio channel), and can work in stereo, mono and composite mode. The power is amplified by combined 2.7 kW VHF amplifiers.

Operation is menu-guided by means of control and display elements on the front panel of the exciter. Remote control is performed using an external remote control unit as standard or from a PC via the bitbus interface or an optional parallel interface. Internal communication in the VHF FM transmitter uses a rugged serial CAN bus (controller area network [2]). This bus is an open system, ie there are many suppliers of modules and software, protocol specifications are fully documented and no licencing fees are required [3]. So systems can very easily be configured or integrated, even using standard equipment, to fulfill specific customer requirements.

The VHF FM transmitters can be used as stand-alones, in passive (1+1) or (n+1) standby configurations and with exciter standby. All modules and units are accommodated in a 19-inch rack for ease of access. The main modules can be replaced without disconnecting cables. So a transmitter can be set up very quickly and, in the unlikely event of a module failing, it can be exchanged in practically no time.

Design and function

10 kW VHF FM Transmitter SR610E1 (FIG 1) is taken as an example to explain transmitter design and function. It comprises the following **main modules** (FIG 2):

- VHF FM Transmitter SU135 (exciter),
- four VHF Amplifiers VU320,
- 4-way splitter,
- 4:1 combiner,
- high-power supply unit with two transformers, rectifier block, filtering and four DC converters of 3 kW each,
- fan assembly.

The exciter generates a frequency-modulated RF signal in the range 87.5 MHz to 108 MHz at an RF output power of 20 W. AF, RDS or SCA signals are fed to the exciter as modulation signals. An additional module allows digital data according to the bit-serial AES/EBU protocol to be applied instead of AF signals.

The 4-way splitter breaks the modulated RF signal down into four identical RF signals of a power of 5 W each and then applies them to the VHF amplifiers, which boost the signal to approx. 2.7 kW. The RF output power is set and controlled by varying the operating voltage of the amplifier output stages. The harmonic filters of the amplifiers provide harmonic attenuation of typically 76 dB. The four signals

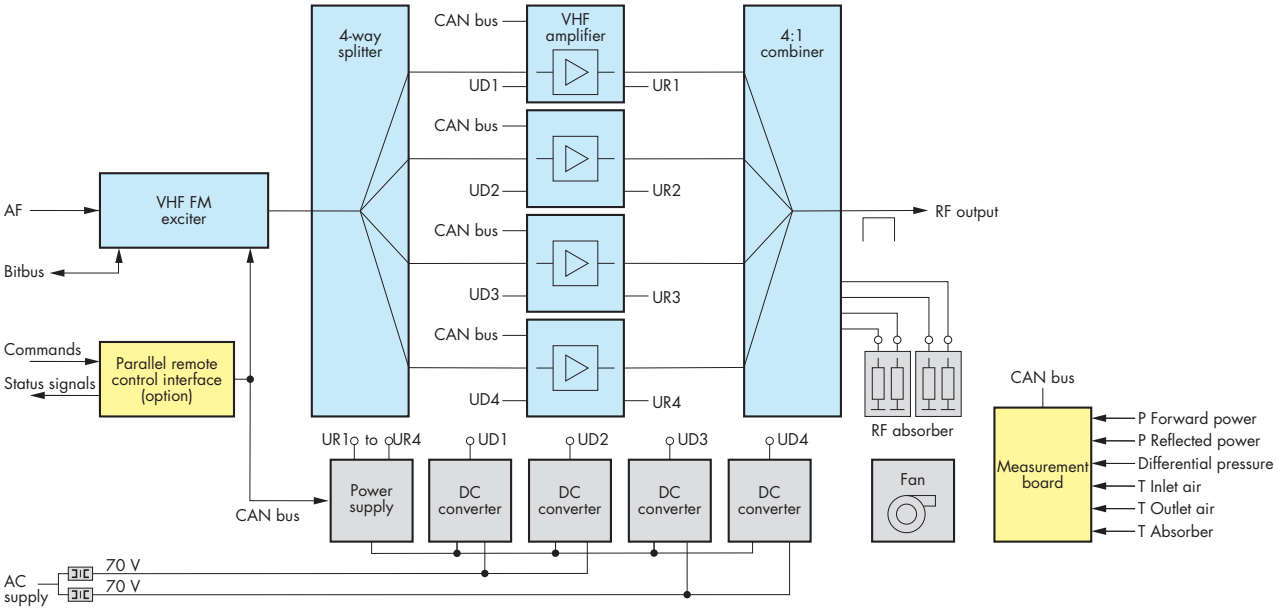

FIG 2 Configuration of 10 kW VHF FM Transmitter SR610E1

are then summed by the 4:1 combiner to produce the overall output, ie 10 kW into 50 Ω in the case of SR610E1.

Operation and monitoring

Transmit frequency, RF output power, operating and modulation mode, RF thresholds, module parameters, interfaces, system control, etc can be set on the exciter under menu guidance. To monitor and control the VHF FM transmitter, various operating states are collected, evaluated by the exciter and can be displayed, eg differential air pressure, inlet and outlet temperatures as well as excessive absorber temperature. Measured values of the exciter, exciter status (eg operating hours, system events), modulation values (eg frequency deviation, AF level), RF output power, reflected power and operating voltage of the individual VHF amplifiers are also evaluated and displayed. Monitoring functions are supported by an error table. If transmitter control breaks down, the transmitter switches to a defined, failsafe state.

Power supply

A three-phase line voltage of 230 V or 400 V (50 Hz or 60 Hz) is required to supply the transmitter. The high-power supply unit consists of two identical modules for voltage conditioning. If one of these modules fails, the other will continue to operate. The four DC converters connected to the high-power supply unit generate the operating voltages required for the VHF amplifiers. The principle of controlling the output power via the operating voltage of the power transistors yields an efficiency of at least 60% even in faulty operation or operation at less than the nominal power.

Andreas Buschke

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[2] Lawrenz, W.: CAN Controller Area Network. Hüthig, Heidelberg

[3] Böttcher, J.: Kriterien der Offenheit. Elektronik 25/1997

Condensed data of solid-state VHF FM Transmitter SR610E1

Frequency range	87.5 MHz to 108 MHz
Output power	10 kW
Power supply	230/400 V (50/60 Hz)
Power consumption with integrated fan	16.6 kW
Power factor to DIN 40110	>95
Cooling air	15.5 m^3/min
Operating temperature range	–10 °C to 50 °C
Dimensions (W x H x D)	580 mm x 2026 mm x 1000 mm
Weight	700 kg

Reader service card 159/07

Freely programmable RF parameter measurements on GSM mobile phones

Sooner or later every manufacturer of mobiles has to test prototypes for compliance using an internationally recognized type-approval test procedure that comprises both extensive signalling tests and dedicated RF tests. These **RF tests** include the following:

- EMI measurement,
- I/Q signal analysis for testing the power ramp and the frequency/phase characteristic,
- spectral analysis of the transmitter,
- receiver sensitivity,
- receiver selectivity.

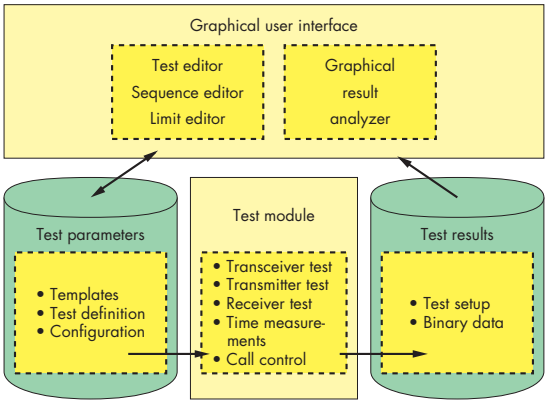


FIG 1 Block diagram of CS-RFD application software

Each is covered by using predefined type-approval scenarios. The tests are randomly sampled however and only check individual parameters for compliance with limit values stipulated in the GSM standard. The type-approval test systems of the Rohde & Schwarz TS89XX* family provide the stipulated test cases and manufacturers can make relevant preparations for the type-approval test. Other types of measurements might be of interest, eg for testing a receiver's sensitivity as a function of carrier frequency. The type-approval test only tells the manufacturer whether a receiver maintains the reference sensitivity at a given frequency. So for the RF test cases he would like freely definable scenarios based on the methods specified in GSM type-approval testing. **Software Package CS-RFD** now makes these freely programmable test cases available to all TS89XX users.

The main components of this intuitive user interface are a test editor, sequence editor, limit editor plus a graphical result analyzer (FIG 1). They allow the user to define, perform and evaluate individual test cases. Bit error rate measurements, for example, can be stored as a function of the frequency channel, the receive level or the fading profile. Results are viewed and evaluated by means of the graphical result analyzer (FIG 2). All conditioned data can be exported for further processing with commercial word processing programs.

In the definition of an individual test case, a distinction is made between general test parameters and specific parameters defined by the user. General parameters may include selection of the method of call setup, channel parameters such as time slot, frequency channel or the required logic channel combination for subsequent RF measurement. Specific parameters refer to the concrete test method. It is possible to define the fading profile and the position of an interferer for measuring selectivity, or the frequency range and bandwidth for spectral analysis of the transmit signal. The following **freely definable test parameter blocks** are offered:

- general test parameters,
- parameters for measuring electromagnetic interference,
- parameters for spectral analysis,
- parameters for I/Q signal analysis,
- parameters for receiver measurements.

The parameters are managed dynamically by the test editor, ie only those parameters are offered that the test system can implement. So low-end systems are also supported by this application package. There is also an online plausibility check to prevent invalid parameter combinations. Test scenarios can be saved and loaded individually, enabling every system user to create a custom test environment.

Heinz Mellein; Detlef Wiese

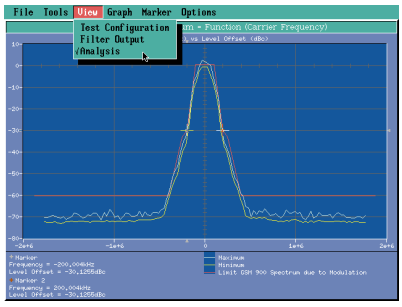


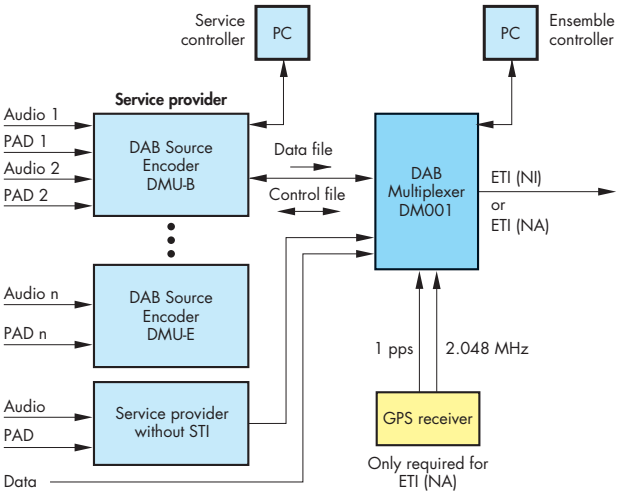
FIG 2 Graphical analysis with CS-RFD software (here: display of modulation spectrum with limit line)

* Rohde & Schwarz: Type-Approval Systems for Mobile Radio TS8915A/B (Info 4/96)

Reader service card 159/08

STI makes DAB more user-friendly

Together with other renowned companies, Rohde & Schwarz has implemented a preliminary version of the service transport interface (STI to standard ETS 300 797) as a bidirectional connection in the DAB transmission link between source encoders and ensemble multiplexer. DAB Source Encoders of the new DMU family are optionally equipped with STI, and it can be retrofitted in all existing DAB Ensemble Multiplexers DM001.



Typical system application of DAB Source Encoder DMU and DAB Multiplexer DM001 (PAD = program associated data)

In the case of a **reconfiguration in the DAB studio,** eg change of the data rate of the audio signal, the data source and multiplexer have to be reconfigured with the correct timing. With the introduction of STI consisting of a data file and control file, this procedure becomes much simpler because modification is only necessary at the data source. Subchannel data are transmitted in the unidirectional data file. The control file, normally bidirectional, forms the communication path between the DAB source encoders (service providers) and the DAB ensemble multiplexer (ensemble provider), which is used for configuration changes and status signalling (FIG). Reconfigurations thus become possible without program interruption. Furthermore, the service information for a given configuration, which is transmitted on the fast information channel (FIC), can be applied and dynamically adapted via the data file.

A service provider should be autonomous in flexible utilization of the assigned capacity and not be disturbed by any other service provider. This is ensured by defining the general conditions for the ensemble in the multiplexer configuration in a service provider profile (SPP) for each provider. These conditions include for instance capacity limits for the FIC and the subchannel data as well as the maximum number of service components and services. Also defined are numerical ranges for the assignment of identification codes, which must be unique in an ensemble. The SPP is entered with the aid of the ensemble controller software. The profiles of several service providers are integrated into an ensemble configuration, which is loaded into the multiplexer. In **DAB Multiplexer DM001** a FIG (fast information group) database is generated for each service provider for the service information applied to the STI in the form of FIG data streams. From this database the FIC to be transmitted is generated. All audio-relevant definitions such as data rate, protection level or service label are made upon configuration of **DAB Source Encoders DMU.** The STI configuration software under MS-Windows consisting of main manager, control file manager and FIG encoder is available for this purpose.

Timed activation is also possible by defining a **scheduling table.** Entry or modification of the DAB configuration (MCI or multiplex configuration information, ie subchannel and service organization) is made in the control file manager. The FIG encoder allows the service provider autonomous, decentralized entry and updating of selected FIG primary data and their automatic coding in FIGs. The FIGs are transferred via the STI into the database of the ensemble provider and from there they are periodically inserted into the DAB signal.

DAB Multiplexer DM001 ensures continued operation with existing **source encoders that produce no STI signals** or with encoders from the DMU family without the STI option. For these service providers an SPP is also entered via the control software on the ensemble multiplexer, plus the subchannel and service organization as before. Statistical information for the defined services can be generated with the aid of the FIG encoder.

Cornelius Heinemann; Peter H. Frank

Reader service card 159/09

Application of DF antennas for Direction Finders DDF0xS and DDF0xM

The wide selection of DF antennas available in the ADD family allows tailor-made adaptation of Digital Scanning Direction Finders DDF0xS [1] and Digital Monitoring Direction Finders DDF0xM [2] to any task [3]. These antennas cover the frequency range 0.3 to 3000 MHz and, depending on the type chosen, enable operation as a correlative interferometer or by the Watson-Watt principle (FIG 1).

Which of the two DF methods is used depends on different aspects. The **Watson-Watt method** is always preferable if the three-channel, digital scanning or monitoring direction finder is to achieve maximum scanning speed. Watson-Watt is also the better choice for direction finding in the shortwave range when limited space is available, for instance onboard ships. In this case only compact DF antennas (eg crossed-loop antennas) can be used, their voltages being evaluated by the Watson-Watt method.

The **correlative interferometer** method is suitable when maximum accuracy and sensitivity are required and the reduced scanning speed due to sequential measurement of antennas arrays can be accepted. If, in direction finding of sky waves in the shortwave range, elevation as well as azimuth is to be determined and possibly SSL (single-station location) is to be performed [4], the correlative interferometer method should again be used. Another advantage of the method is that DF antennas implemented in the form of a single circular array can cover extremely wide ranges (eg 0.3 to 30 MHz or 20 to 1300 MHz). This means that no stacked antennas are required for the different frequency subranges and so the weight and wind load of the antenna system are not increased.

HF antennas

The compact **DF Antenna ADD115,** accommodated in a radome of 1.1 m in diameter and covering the frequency range 1 to 30 MHz, consists of two orthogonally arranged loop elements and an omnidirectional receiving antenna. The signals of these three elements are evaluated by the Watson-Watt method. **HF Adcock Antenna ADD012** with monopulse capability offers higher sensitivity and accuracy. It was designed for semimobile and stationary use and can be configured as one circular array (eight active vertical elements and one element in the center) or as two circular arrays (switchover frequency 8 MHz).

Maximum DF accuracy is offered by **DF Antennas ADD010 and ADD011,** which implement the correlative interferometer method. ADD011 consists of nine circularly polarized crossed-loop antenna elements and thus allows also bearings of steep sky waves. ADD010 comprises vertical elements of 2 m in height and is consequently very suitable for semimobile applications. Antennas ADD010/011 and ADD012 can be set up together without any additional connecting cables, combining maximum probability of interception with the accuracy of a wide-aperture interferometer (FIG 2).

VHF/UHF antennas

DF Antenna ADD150, which operates by the correlation method, was designed for across-the-board applications. It covers the frequency range 20 to 1300 MHz and is housed in a radome of 1.1 m in diameter and about 0.2 m in height. **DF Antenna ADD050** offers enhanced accuracy and sensitivity in the frequency range 20 to 200 MHz. It is a circular array of 3 m in diameter and can be adapted to extremely active signal scenarios by switchover to passive mode. **DF Antenna ADD051** (FIG 3) is a combination of ADD050 and ADD150. It operates from 20 through 1300 MHz with optimum accuracy and sensitivity.

Compact DF Antenna ADD155 offers maximum scanning speed in the VHF/UHF range. It is designed for 20 to 650 MHz and consists of two concentric eight-element Adcocks. Only 1.1 m in diameter and about 0.2 m in height, it is especially suitable for mobile applications.

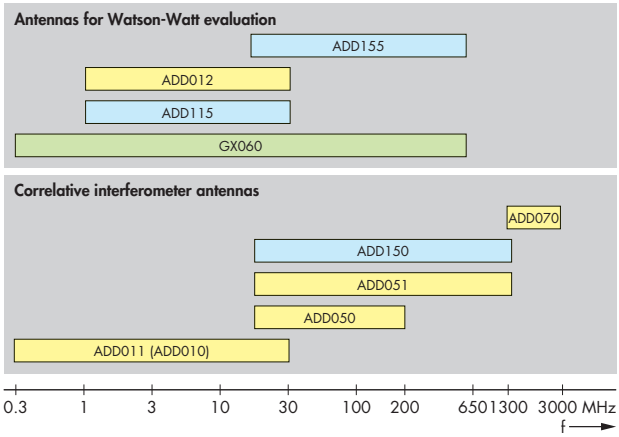


FIG 1
Rohde & Schwarz antennas for Digital Direction Finders DDF0xS (scanning) and DDF0xM (monitoring) (blue: for mobile and stationary applications; yellow: for stationary and semimobile applications). Antennas of other manufacturers can be connected via Antenna Interface GX060.

FIG 2 Combination of correlative interferometer ADD011 and Adcock antenna ADD012 Photo 43 178/3

UHF antennas

DF Antenna ADD070 is available for the frequency range 1300 to 3000 MHz. It is configured as a circular array with a central reflector. This design allows any combination with VHF/UHF antennas since all cables of the antennas on the upper part of the mast can be run through the center of ADD070.

Franz Demmel; Ulrich Unselt

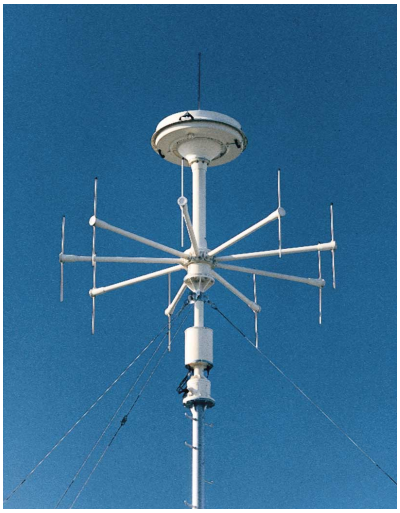


FIG 3 DF Antennas ADD051 and ADD070 for frequency range 20 to 3000 MHz
Photo 43 073

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[1] Demmel, F.; Genal, W.; Unselt, U.: Digital Scanning Direction Finders DDFxS – Fast direction finding of broadband and short-term signals. News from Rohde & Schwarz (1998) No. 158, pp 21–23

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

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Reader service card 159/10

MPEG2 transport stream analysis in networked DVB monitoring system using Stream Explorer software

MPEG2 Measurement Decoder DVMD [1] and the optional Stream Explorer® [2] software form a test system for comprehensive monitoring and detailed analysis of MPEG2 transport streams. A whole variety of extended functions make the market leader fit for new tasks. The increased networking of DVB transmission equipment calls for network-compatible test systems into which the new Stream Explorer (version 2.00) with all its complex analysis functions can be integrated. In addition, extended measurement functions in both DVMD and Stream Explorer allow insight into the increasingly complex and flexible structures of MPEG2 transport streams.

Compact MPEG2 Measurement Decoder DVMD ensures interruption-free and automatic monitoring of transport stream syntax in real time. The interactive Stream Explorer PC software enhances these functions so that now even the most concealed details can be explored. As a 32-bit application for standard operating systems Windows 95 and Windows NT, the software combines and expands many of DVMD's individual functions and uses all modern means of structuring and graphically visualizing transport stream data. This combination of decoder and software is a convenient tool for any user as its capabilities exceed by far those of the decoder alone.

With the new version of Stream Explorer Rohde & Schwarz makes all these enhanced functions also available for automatic operation thanks to implementation of the software interface for the Microsoft component object model (COM). The COM interface is the standard interface on which Windows programs of any kind can exchange data and commands. Stream Explorer operates as an OLE automation server for other Windows programs. Monitoring software can thus access all functions and use them as required (FIG 1a).

Stream Explorer also supports DCOM (distributed COM), so networked monitoring systems located at separate sites can be implemented. If two sites are interconnected via a network link, a central monitoring computer can use it to access the detached test stations (FIG 1b).

For applications not requiring an automatic monitoring system (eg remote maintenance), Stream Explorer can also be remotely controlled direct via the network. The standard pcANYWHERE software provides a convenient solution for every application (FIG 1c).

In addition to network capability, the current versions of DVMD and Stream Explorer feature a number of valuable innovations: Statistical multiplex will be used increasingly in future to transmit the programs contained in a transport stream, so monitoring of program data rates becomes all the more important. In statistical multiplex the data are no longer transmitted at a fixed rate but at a variable rate that may fluctuate considerably depending on the redundancy of picture contents. The user can now set two limits for monitored data rates. The lower limit defines minimum quality, while the upper limit allows excessive utilization of transport stream

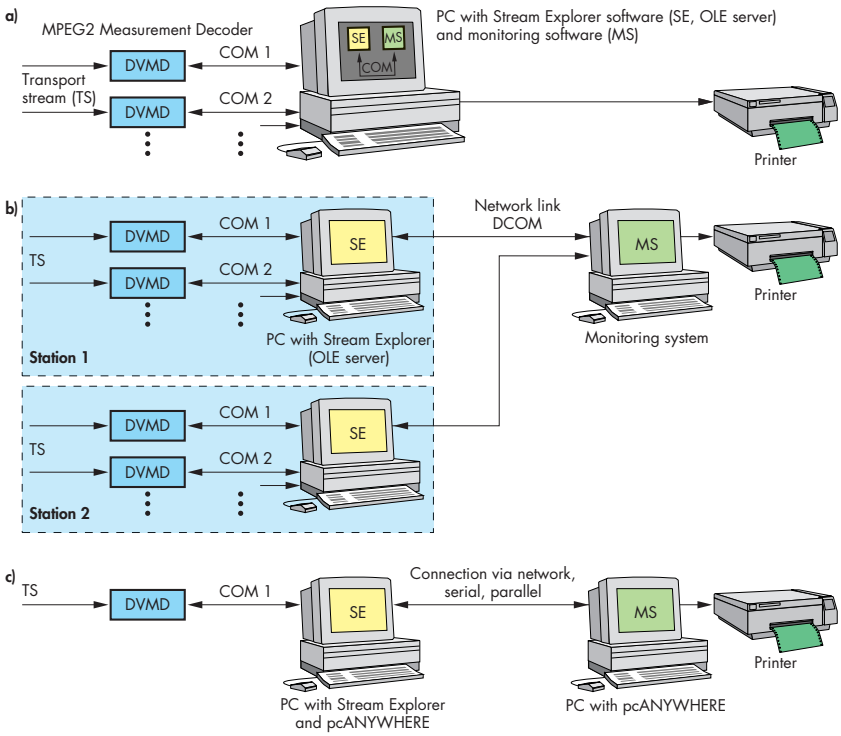

FIG 1 Connection of MPEG2 transport stream test points to DVB monitoring system via network; a) automatic monitoring system, remote control of Stream Explorer via COM, b) automatic monitoring system with separate sites, c) remote control of Stream Explorer via pcANYWHERE software

bandwidth to be detected. Limit violations are entered in an error report and stored in a log file. They can be signalled via relay contacts by means of the DVMD-B5 hardware option (alarm lines and parallel printer interface).

In addition to the service information (SI) defined for MPEG2 and DVB, broadcasters and network operators will to an increasing extent transmit data with user-specific syntax, such as measurement and control information for transmission systems or encryption codes for conditional access systems. A syntax editor allows Stream Explorer to learn user-specific structures and interpret them (FIG 2). For syntax definition Stream Explorer provides all basic elements of the MPEG2-defined structures for service information, for example loops and descriptors. So it is also adapted to non-DVB-compatible multiplex streams such as ATSC (Advanced Television Systems Committee) as used in North America.

An important note for all those already in possession of DVMD and Stream Explorer: the new firmware and software versions are downward-compatible and do not require any extra hardware, so upgrading is possible without any problems.

Richard Finkenzeller;
Michael Fischbacher

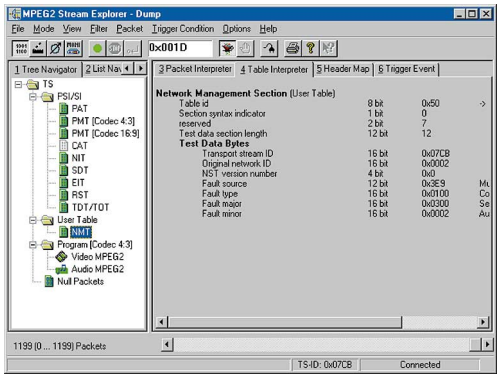

FIG 2 Stream Explorer interprets user-specific structures.

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[2] Fischbacher, M.; Rohde, W.: PC software for MPEG2 dream team DVG/DVMD. News from Rohde & Schwarz (1997) No. 154, p 29

Reader service card 159/11

Focus on service – Mitsubishi Electric Europe B.V. opens new EMC competence center

Mitsubishi Electric Europe B.V., whose German subsidiary opened its new EMC competence center in Ratingen in April 1998, intends to offer economical and extremely fast EMC certifications also for customers other than Mitsubishi. The new center consists of a test lab that is accredited for all areas of electronics and as its main task checks compliance with RFI limits for CE label award, as well as of a unit that assesses the environmental electromagnetic compatibility of equipment and systems. The new EMC competence center not only works for the Mitsubishi group, it is also available to all other manufacturers of electrical and electronic goods and offers a wide range of services such as preconformance consultation during design and EMC planning.

Many years of experience in testing electromagnetic compatibility and assessing the conformity of consumer electronics, industrial automation products and semiconductor components automatically result in a long partnership with the EMC specialist Rohde & Schwarz. To ensure that its ambitious objectives are achieved, Mitsubishi equipped its new competence center with the latest in EMC measuring instruments and systems from Rohde & Schwarz, as illustrated by the photos in a Mitsubishi brochure. Sö

Correct usage of quantities, units and equations (III)

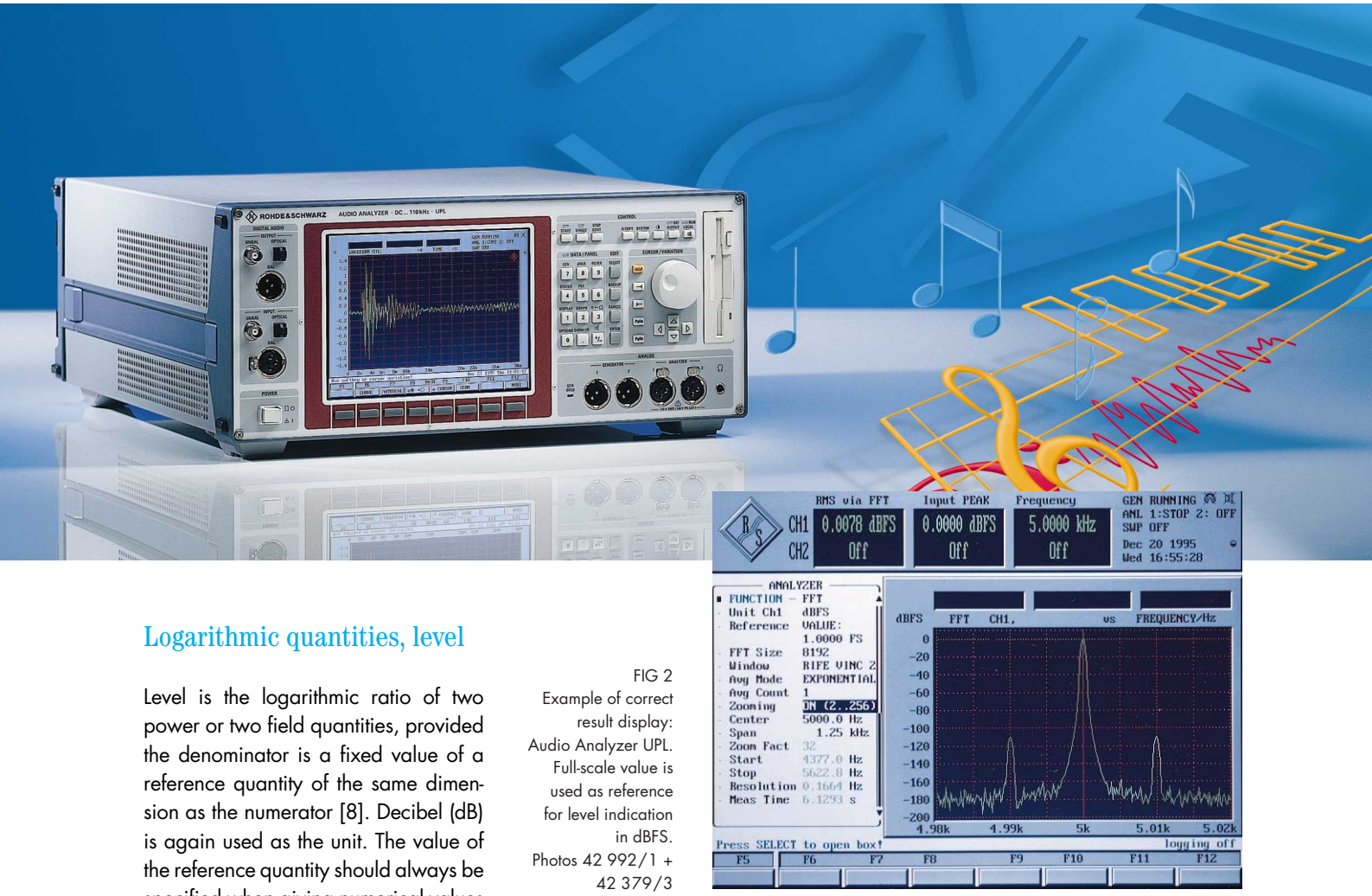

FIG 2
Example of correct result display: Audio Analyzer UPL. Full-scale value is used as reference for level indication in dBFS. Photos 42 992/1 + 42 379/3

Logarithmic quantities, level

Level is the logarithmic ratio of two power or two field quantities, provided the denominator is a fixed value of a reference quantity of the same dimension as the numerator [8]. Decibel (dB) is again used as the unit. The value of the reference quantity should always be specified when giving numerical values of levels. According to IEC 27-3 [9] the reference quantity in parentheses can follow the dB symbol to obtain an abbreviated form. If the numerical value of the reference quantity equals 1, this value can be omitted in the parentheses. Some abbreviations introduced by ITU (International Telecommunications Union) are given below [10]. Here dB is directly followed by a letter or a group of characters to identify the reference value. These abbreviations are not recommended by IEC and DIN but only listed for information.

Quantity Reference value	Notation		Level Definition	Unit, short form	
	Full	Short		IEC	ITU
Electric power Reference value 1 W	L_P (re 1 W)	$L_{P/W}$	$10 \lg \frac{P}{1\,W}$ dB	dB(W)	dBW
Electric power Reference value 1 mW	L_P (re 1 mW)	$L_{P/mW}$	$10 \lg \frac{P}{1\,mW}$ dB	dB(mW)	dBm
Electric voltage Reference value 1 V	L_V (re 1 V)	$L_{V/V}$	$20 \lg \frac{\lvert V\rvert}{1\,V}$ dB	dB(V)	dBV
Electric voltage Reference value 1 µV	L_V (re 1 µV)	$L_{V/\mu V}$	$20 \lg \frac{\lvert V\rvert}{1\,\mu V}$ dB	dB(µV)	dBµV
Electric field strength Reference value 1 µV/m	L_E (re 1 µV/m)	$L_{E/(\mu V/m)}$	$20 \lg \frac{\lvert E\rvert}{1\,\mu V/m}$ dB	dB(µV/m)	**not** ☹ dBµV/m

TABLE 6 Example of level definitions with different reference values (to [10])

Example [7]: power quantity level, written in full notation

$$L_P \text{ (re 1 mW)} = 10 \lg \frac{P}{1\,mW} \text{ dB}$$

or identified by an indexed quantity symbol

$$L_{P/mW} = 10 \lg \frac{P}{1\,mW} \text{ dB}$$

☹ wrong	☹ wrong	☹ wrong	☺ correct	☺ correct	☺ correct	☺ correct	☺ correct
V[V]	*V* [V]	*V* in [V]	*V*	*V*/V	*V* in V	*E*/(V/m)	*E* in V/m
0.1	0.1	0.1	0.1 V	0.1	0.1	0.1	0.1
0.2	0.2	0.2	0.2 V	0.2	0.2	0.2	0.2
...	...	...	...	...	...	...	...

TABLE 7 Labelling of table headers and coordinate systems

or abbreviated

$$L_P = 10 \lg \frac{P}{1\ \mathrm{mW}}\ \mathrm{dB\ (mW)}$$

Short form according to ITU:

$$L_P = 10 \lg \frac{P}{1\ \mathrm{mW}}\ \mathrm{dBm}$$

TABLE 6 lists various level definitions and the short forms specified by IEC and ITU. DIN 40146-2 and [11] contain further definitions of level for the field of telecommunications.

The difference of the levels of a signal at two different points of a transmission system is a quantity, the difference of the levels of two different signals at the same point of a transmission system is a level spacing [8].

Note on use of parentheses
According to DIN 5493-2 [8] parentheses are used as follows.

$$10 \left(\lg \frac{P}{1\ \mathrm{mW}}\right)\ \mathrm{dB}$$

In IEC 27-3 [9] however:

$$10 \lg \left(\frac{P}{1\ \mathrm{mW}}\right)\ \mathrm{dB}$$

DIN 1338 prescribes the use of parentheses solely to avoid ambiguities. Therefore no parentheses have been used in these formulas.

☹ wrong	☺ correct	☺ correct	☺ correct
P/W	*P*/W	*P*/W	*P*
1	1	1	1 W
1m	$1 \cdot 10^{-3}$	10^{-3}	1 mW
1µ	$1 \cdot 10^{-6}$	10^{-6}	1 µW
1n	$1 \cdot 10^{-9}$	10^{-9}	1 nW

TABLE 8 Labelling of table headers and coordinate systems for large ranges (prefixes may not be used separately)

FIG 3 Power Reflection Meter NRT with clear-cut display provides a wealth of information.
Photo 43 055/1

Notation

According to DIN 1313 and DIN 1338 quantities and units are written as follows:
In ***italics:***

- physical quantities, eg *m* (mass); *V* (electric potential difference),
- variables, eg *x; n,*
- function and operator symbols whose meaning can be chosen as required, eg *f*(x).

In **roman type:**

- units and their prefixes, eg kg; pF; V; dB; also DM,
- numerals, eg 4.5; 67; 8fold; $^1/_2$,
- function and operator symbols with fixed meaning, eg sin; lg; π,
- chemical elements and compounds, eg Cu; H_2O.

Values of quantities in tables and diagrams

DIN 461 includes recommendations for labelling diagram coordinates. These recommendations can be applied analogously to the labelling of table headers. TABLES 7 and 8 illustrate incorrect and standard-conforming labelling of table headers and coordinate systems. The labelling of test and measurement equipment is especially difficult since there is limitation on the space and usable characters available. FIG 2 shows the front panel and display of Audio Analyzer UPL from Rohde & Schwarz as an example of correct and comprehensive result display. Power Reflection Meter NRT (FIG 3), which simultaneously displays forward and reverse power, is also a good example.

Dr Klaus H. Blankenburg

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[10] CCIR Recommendation 574-3 (1990): Use of the decibel and the neper in telecommunications

[11] DIN 5493-2 B1: Logarithmische Größen und Einheiten, Logarithmierte Größenverhältnisse, Pegel, Hinweiszeichen auf Bezugsgrößen und Meßbedingungen (09/94)

Antenna System AK610 for HF radiomonitoring

FIG 1 Model of HF Antenna System AK610; full-scale dimensions approx. 350 m x 350 m

All the components required in a radio receiving system have to be optimized to produce the best possible design. And a very important part of this process is selection of the right antenna. In the HF range in particular, a lot of importance attaches to matching the antenna – especially its vertical radiation patterns – to the reception task. Signals with high-angle radiation as well as those with a low angle of incidence need to be received, and both short and global distances have to be covered without a gap.

HF Antenna System AK610 (FIG 1) can be matched optimally to all transmission requirements, making it suitable for any task in the field of radiomonitoring from 1.5 MHz to 30 MHz. The system consists of a number of broadband log-periodic directional antennas for horizontal and vertical polarization (AK410A3 horizontal, AK210A3 vertical).

In **horizontal polarization** the whole azimuth range is covered with only six Directional Antennas AK410A3 due to their relatively wide half-power beamwidth of approx. 70°. This produces an almost omnidirectional pattern with an uncircularity of only about –2.5 dB (FIG 2). The vertical radiation patterns are adapted to the required task by adjusting the distance of the antenna from the ground, ie by using masts of different height.

Most of the waves transmitted via the ionosphere can be received by antennas for horizontal polarization. But the sky waves to be received are subject not only to level variations but also to changing position of the field vectors as a function of time (resulting in a change of polarization). So antennas for **vertical polarization** are additionally required to increase probability of intercept for incoming signals of horizontal origin and also for vertically emitted waves. Due to their half-power beamwidth of approx. 120°, only three Directional Antennas AK210A3 are needed for vertically polarized signals to cover the whole azimuth range of 360° with maximum uncircularity of –2 dB (FIG 3).

The antennas of the AK610 system are configured in a regular star arrangement, with the vertical antennas instal-

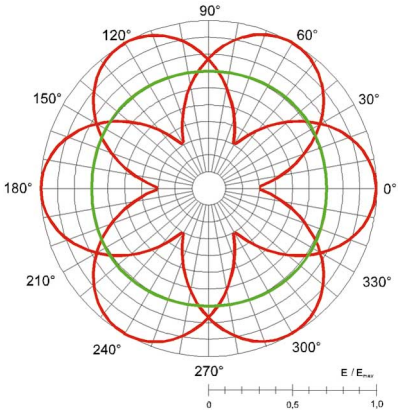


FIG 2 Azimuth patterns of Antenna System AK610 for horizontal polarization

led in the gaps between two horizontal ones. This ensures maximum decoupling, so the characteristics of the individual antennas are not affected by adjacent radiators. This antenna design has also proved to be very cost-efficient because fewer masts and less space are required compared to arrangements with similar decoupling from adjacent antennas.

The log-periodic antenna principle ensures optimum electrical data such as matching and almost frequency-independent azimuth patterns over the whole frequency range from 1.5 MHz to 30 MHz. The antennas operate in the halfwave mode throughout the range, yielding high directivity of about 10 dB to 12 dB even at low frequencies. Thanks to the optimized design, antenna efficiency is greater than 90%, which in turn means higher gain. An automatic test and dynamic matching system is available for continuous testing and adapting the antenna system to the receiver installation and receiving conditions.

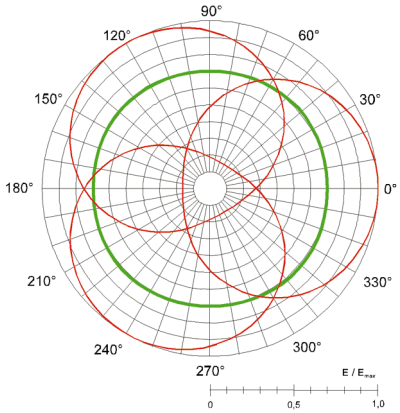


FIG 3 Azimuth patterns of Antenna System AK610 for vertical polarization

Klaus Friede

Reader service card 159/12

ACCESSNET® Trunked Radio System for Oman Aviation Services

At the beginning of the 70s, Muscat, capital of the Sultanate of Oman, had only a simple airstrip lying in a plain in a rough and rocky mountainous area. Flight operations were handled in the simplest possible way from a small terminal building. In the past 25 years this airstrip has undergone continuous modernization and expansion to become today's Seeb International Airport (FIG 1), which with about three million passengers per year is now among the most efficient and advanced

FIG 1
Seeb International Airport in Muscat, capital of Sultanate of Oman
Photo: author

airports in the region and one of the most important bases of Gulf Air. This airline – owned by Bahrain, Oman and Qatar – operates a large network of regional and international routes. Besides Gulf Air, another 21 airline companies operate at this airport. Oman Aviation Services (OAS) is the local service provider for these companies and responsible for complete passenger handling as well as all ground services including catering and transport of goods. To master these tasks, OAS awarded R&S BICK Mobilfunk GmbH, a subsidiary of Rohde & Schwarz, a contract for replacing its aging radiocommunication equipment by a powerful and reliable ACCESSNET® Trunked Radio System to ensure longterm trouble-free radiocommunications. It is easy to imagine how flight operations would be affected if the trunked radio system, which handles virtually the entire communications, failed for only a few minutes.

The ACCESSNET® system comes with an operation and maintenance computer, trunked radio exchange with software and an eight-channel radio base station with antenna system (FIG 2). In the event of a power failure, operation of the trunked radio system is safeguarded long enough by an emergency power supply system. ACCESSNET® uses the quasi signalling standard MPT1327, so various kinds of radio equipment (handheld, vehicle-based and desktop models) from different manufacturers can be used, which is a major advantage over proprietary trunked radio systems. OAS fully utilizes all ACCESSNET® capabilities to handle its own operations, and as the local service provider rents access to all trunked radio services to airlines, service utilities, security forces, emergency and support services. These have the possibility of communicating internally within the individual closed user groups or at overhead level with all other groups.

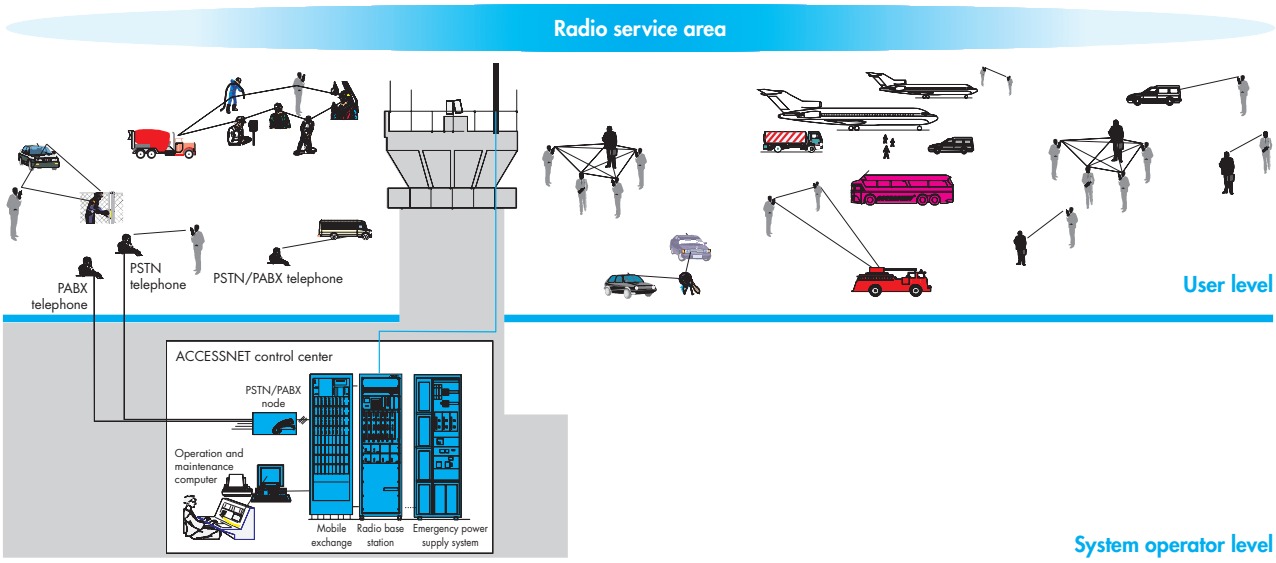


FIG 2 Use of ACCESSNET® Trunked Radio System in airport area

The main **performance features of the ACCESSNET® Trunked Radio System** include:

- individual calls,
- group calls (groups with fixed or variable definition),
- broadcast calls,
- conference calls,
- PSTN/PABX calls,
- priority calls,
- emergency calls,
- data transmission.

With the commissioning of ACCESSNET® Oman Aviation Services has created the basis for offering upmarket trunked radio services at the airport and ensuring longterm service quality for an increasing number of very different radio operation requirements. OAS is thus making an essential contribution towards maintaining in the long run its own and the international competitiveness of Seeb International Airport for the benefit of all air passengers in the Middle East.

Karl-Heinz Wagner

Reader service card 159/13 for further information on ACCESSNET®

VOR-ILS analyzer for air traffic control

Rohde & Schwarz Cologne Plant developed VOR-ILS Analyzer EVS200 for the inspection and maintenance of modern air traffic control systems especially for DFS (German air traffic control) in Offenbach and has already supplied 36 units. Among other things DFS is responsible for the proper functioning of instrument landing systems (ILS) at 17 German civil airports and of VHF omnidirectional radio beacons (VOR).

The compact and lightweight VOR-ILS Analyzer EVS200 (photo) is the result of two years of close cooperation with departments at DFS. It is used for inspecting terrestrial radionavigation equipment at airports and field stations. The analyzer is able to test the following components of ILS and VOR systems: ILS localizers (108 MHz to 118 MHz), glidepath transmitters (320 MHz to 340 MHz), outer marker (75 MHz) and VOR beacon (108 MHz to 118 MHz).

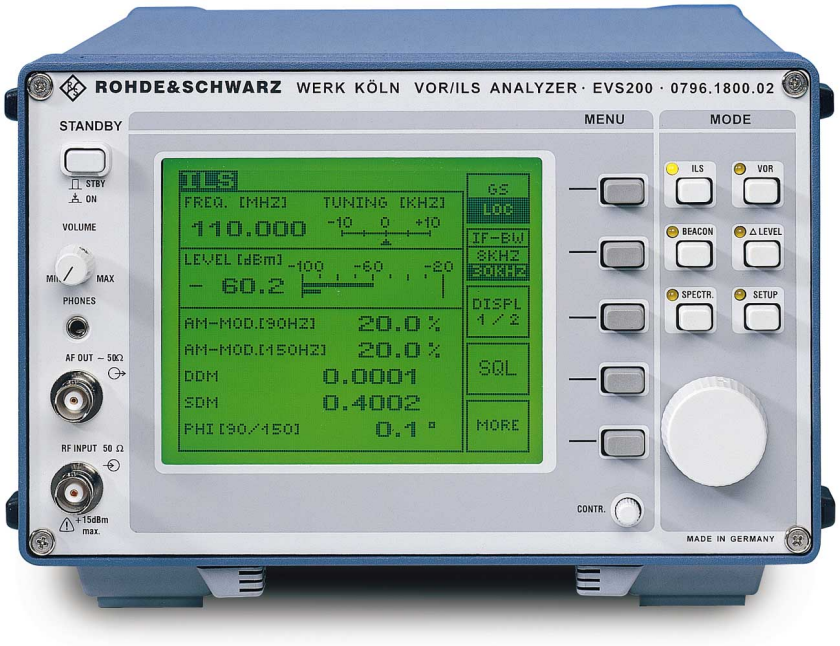
The following individual parameters are measured: DDM, SDM, modulation depth, absolute level, delta level, VOR parameters, ILS parameters (see display) and 75 MHz marker parameters.

Measurement applications include: dynamic runway measurements at a rate of up to 90 measurements/s, measurement of DDM and SDM on antenna array (120 memory locations), point-by-point far-field measurements and functional monitoring of transmitter systems in the field with remote data transmission. Transmitting antenna characteristics can be measured in delta level mode and, for clearance and glidepath, parameters can jointly be analyzed without shutting down the transmitter system. The parameters can be measured and analyzed even in the presence of high interfering field strength.

The modern DSP technology of the VOR-ILS analyzer produces high measurement accuracy accompanied by excellent longterm stability. The analyzer has an integrated selftest, and the high immunity to interference and optimum shielding of the modules allow measurements at levels up to +15 dBm. For portable use EVS200 is equipped with a built-in battery and charger, while for operation in vehicles the onboard power supply can be used. The analyzer can be remotely controlled on an RS-232-C interface and all data collected as well as memory contents can be called up. Parameters of the DSP can be derived at the multifunctional output for in-depth analysis. Production conforming to ISO 9001 as well as high mechanical resistance to MIL-STD-810D and IEC 68 optimally support portable use of the analyzer. A marker beacon mode and spectrum monitoring round off the instrument's versatility.

In addition to regular ground inspection of navigation aids, international recommendations of ICAO (International Civil Aviation Organization) call for measurements to be carried out from a system installed onboard an aircraft, eg Flight Inspection System COMPIS from Rohde & Schwarz. EVS200 has been integrated into COMPIS and is optimally suited for this application too. High measurement speed and digital processing of results open up new dimensions in measurement accuracy. The method has already been patented internationally.

Helmar Scherpe



VOR-ILS Analyzer EVS200, here with ILS mode menu, for use in air traffic control Photo 43 151

Reader service card 159/14

Spectrum Analyzer R3131, an allrounder for the small budget

Model R3131 from Advantest is a spectrum analyzer representing a new generation. This instrument, marketed by Rohde & Schwarz, offers versatile applications in manual operation as well as in system use and all that for unbeatable price/performance. With its clear-cut user interface, compact size, weight of only 12 kg and attractive price, R3131 is an obvious choice as a personal analyzer for every workplace in **design** and **service,** besides being an ideal, budget-priced tool for **training purposes.**

Its frequency range from 9 kHz to 3 GHz covers all main mobile radio standards and paging systems and makes R3131 the perfect match for a radiocommunication tester (photo) since it allows precise analysis of purely RF parameters. As a stand-alone and full-featured spectrum analyzer it easily fits into other applications of course.

IEC/IEEE bus and RS-232-C are standard interfaces in R3131; a disk drive allows instrument settings and traces to be stored for integration into Windows applications. Measurement results can be documented via a standard parallel printer interface.

Thanks to the high-speed IEC/IEEE-bus interface, which, in conjunction with interface cards, ensures minimum data transmission times (reading a trace of 500 points takes just 1.2 s), R3131 is also suitable for use in **production** environments. Its performance data guarantee minimum throughput time of DUTs in automatic test systems, thus contributing to a considerable reduction of costs and time to amortize.

Operation of Spectrum Analyzer R3131 is extremely simple. Bandwidth, power or amplitude modulation depth, for instance, can be selected by a simple keystroke in the softkey menus. Further features include a built-in counter with 1 Hz resolution, eliminating the need for a separate frequency counter, a pass/fail comparator function for checking compliance with defined limit values, as well as an autotune function for centering the strongest signal on the screen at a keystroke and displaying it with spread frequency band. Noise measurements for determining oscillator signal purity or noise levels normalized to system bandwidth are further functions that can be activated with a single button.

Various **power measurement functions** are standard nowadays in every spectrum analyzer, for instance measurement of channel and adjacent-channel power, occupied bandwidth, average or total power in the selected frequency window. R3131 comprises in addition an AM/FM demodulator with headphones output and four selectable rectifiers with an extra quasi-peak detector for precompliance EMC diagnosis.

Peter Wollmann

An ideal match: Spectrum Analyzer R3131 adds versatile measurement functions to Radiocommunication Tester CMD. Photo 43 118

Reader service card 159/15

HF Transceivers XK2000 – new functions and features

HF Transceiver Family XK2000 [1; 2] is now offering a large variety of new features. For operators of systems already supplied the good news is that in most cases only a software update or minor hardware modifications are necessary. In addition to an attractive, improved man-machine interface the user will especially appreciate the new applications in naval communications.

Separate arrangement of transmitters and receivers requires the use of additional receivers in the system, which must be compatible with the exciter in terms of logistics, man-machine interface and remote-control interface. So now all relevant **transmitter functions** of Receiver/Exciter GX2900 (photo) can be **deactivated** simply at a keystroke, making the exciter a full-featured, user-friendly receiver. A **power supply unit** offering a **wide input voltage range** from 97 V to 246 V AC or 19 V to 31 V DC can be integrated into this equipment configuration.

The functions of the receiver have been enhanced by a **fast frequency and channel search mode** with selectable dwell and hold time.

Data Link Interface GV2120 for link-11 mode conforming to STANAG 5511 is available in a new version allowing transmission and reception in the single sideband in line with LinkY MkII and SLEW (single-tone link eleven waveform).

In naval communications there is increasing demand for **direct control** of **HF Data Modem GM2100** as stipulated by MIL-STD-188-110A and STANAG 4285, ie without built-in ALE/ALIS Processor GS2200. This is now fully possible with the built-in options Modem Data Interface GV2130 and Modem Control Interface GS2120; all settings relevant for the data mode can be made in a convenient menu.

Due to the parallel operation of numerous RF communication lines onboard ships, there is always a need for **high selectivity** – both when transmitting and receiving. The transmit or receive path can be optimized with the aid of Motor Selection FK2850, a motor-tuned filter integrated into the system via the optional External Control Interface GV2110. In receive mode this produces extra selectivity of typically 45 dB at 10% frequency offset, and in transmit mode improved signal/noise ratio of typically 170 dBc/Hz.

The **man-machine interface** of all XK2000 units has been enhanced, setting of passband tuning and notch filter is now uniform and convenient. Frequency bands can be blocked prior to equipment delivery if the customer wishes, and instead of the previous eleven there are now 17 receiver bandwidths available. All main settings can be accessed in the configuration menu and now also in the particular manual menu for extremely fast access. All built-in options and the software versions used are clearly shown in a menu. User-defined settings can be saved and the factory-set configuration can be recalled any time at a keystroke. To avoid loss of customer-specific settings, these can be stored on floppy disk using the software supplied.

If Transceivers XK2100, XK2500 and XK2900 are to be operated with **antenna tuning units,** new ways of configuration are now available to the user. The tuning unit can be bypassed for reception in the VLF band for instance, or configured so that no retuning is required if a new frequency differs from the one previously set by less than 10%. There are no restrictions to operating Antenna Tuning Unit FK855C3 with Transceiver XK2500 at a transmitter power of 500 W. With antenna lengths of 12 m and more and transmit frequencies above 2.2 MHz, Antenna Tuning Unit FK855C3 is even able to handle power up to 1 kW (XK2900). Below 2.2 MHz transmitter power is automatically reduced to 700 W.

Receiver/Exciter GX2900 for frequency range 10 kHz to 30 MHz Photo 41 829

Robert Träger; Ulrich Otto

REFERENCES

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

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

Reader service card 159/16

PostMan on tour

In its PostMan software package [1] Rohde & Schwarz has created a unique, so far unmatched product that opens up new avenues in message handling. PostMan has been introduced to a wide public at many presentations and live demonstrations all over the world. Featuring international standard interfaces and TCP/IP protocol transmission, PostMan can be integrated into any existing communication systems and applications.

PostMan amazed its audience at one demonstration by **surfing the Internet via shortwave** over a distance of 700 km. At the presentation, commercial software products such as the Netscape Navigator were used together with a 150 W Shortwave Transceiver XK2100 [2] and the PostMan software. The station called over the air was an unmanned system in Munich, which set up the link to the wired public switched telephone network and from there to the Internet (FIG 1). During the presentation a number of web pages were called and their contents downloaded. It was thus shown that Internet access is possible on shortwave from anywhere in the world using commercial Internet browsers, PostMan and the appropriate radio equipment. The astonishment at this demonstration was so great that some of the audience suspected the web pages had been stored before. Any traces of doubt were removed, however, when further web addresses named at random by the guests were called. And what is possible for the browser, is equally possible for other Internet services.

Another highlight of PostMan is its **E-mail features.** It is difficult to imagine the exchange of information in today's world of communication without E-mail. But communication by E-mail necessitates cable connection to the PSTN. This is something available to just about everyone in Europe for instance, but not in other parts of the world such as Africa or on the world's oceans. PostMan fills these gaps, providing full access from and to the worldwide wired Internet or X.400 E-mail networks via radio. So, PostMan allows E-mails to be sent from any place in the world to any addressee and vice versa. The clue to this is an address gateway in the base station (FIG 2). It converts the Rohde & Schwarz RSPeer radio address format to SMTP and X.400 formats. Of course faxes, digital photos or any other data can be attached to the E-mails. An integrated encryption technique developed by Rohde & Schwarz is available to prevent the increasingly rampant tapping of E-mails.

Another feature that received a great deal of attention during the presentations was **resource mapping of remote workstations** by radio. In this application the PostMan driver in conjunction with the connected radio equipment basically acts like a network card. This allows the linkup of computers to existing PC networks via radio, thus opening up the whole range of operations available in a wired network environment. Via radio a system administrator can access the resources of a computer thousands of kilometers away, for example to edit files on its hard disk.

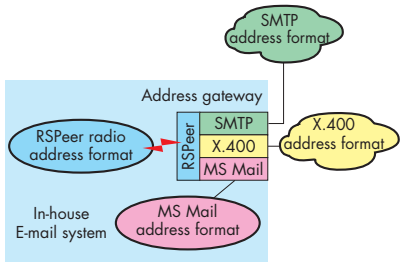


FIG 2 Address gateway to E-mail networks with very different address formats

PostMan sets new standards for radio-based communication networks and enables applications thought quite impossible not so long ago.

Thomas A. Kneidel

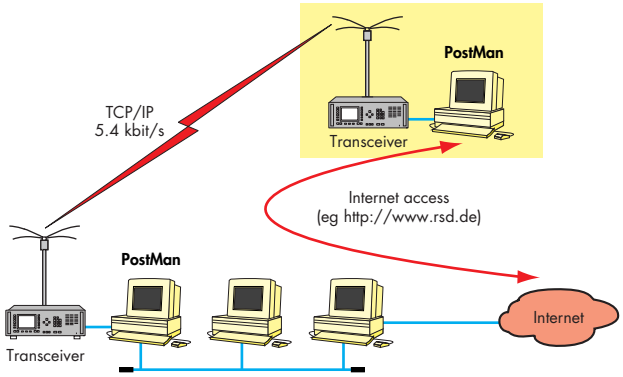


FIG 1
Surfing the Internet via shortwave with PostMan software

REFERENCES

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

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

Reader service card 159/17

Another step to becoming a global player – Rohde & Schwarz Support Centre Asia

Business in Asia has been very good in recent years, and Rohde & Schwarz has now taken an important step towards emphasizing its presence on one of the fastest growing telecommunications markets by establishing the Rohde & Schwarz Support Centre Asia (SCA) as a private limited company.

To begin with SCA will concentrate on the following **focal activities:**

- As a regional system house it will be responsible for setting up and installing standard test systems and their technical support.
- As a regional service center it will support the local service offered by Rohde & Schwarz representatives.
- As a regional calibration center it will calibrate Rohde & Schwarz equipment.

In its role as a **system house** SCA handles all the technical aspects of standard test systems ordered by customers from the Asia-Pacific region. The tasks range from assembly of the racks through on-site installation to final acceptance. SCA also conducts training, offers follow-on support and service and performs any modifications required. The major system design activities remain with Rohde & Schwarz Munich.

As a regional **service center** SCA supports the service teams of the local representatives and carries out repairs that cannot be done in the various countries and used to be referred to Munich. The objective is further expansion of the Rohde & Schwarz service network in the Asia-Pacific region. In future more service training for Asia-Pacific representatives will be staged in Singapore. In addition, SCA service engineers will help out the local service organizations (on-the-job training).

As a **calibration center** SCA meets the demands of all customers who need to perform annual calibration of their test and measurement equipment. Supported by an Automatic Calibration System ACS100, SCA is able to offer fast service for the major categories of equipment in use in the region. A second calibration system will soon be added but as a mobile to travel the region. This is a particularly valuable service because a number of countries do not allow imported equipment to be reexported.

In terms of systems as well as service and calibration, SCA closely cooperates with those departments responsible at Munich headquarters. This also applies to the planned extension of activities to other business sectors of Rohde & Schwarz. The system and service engineers of the Rohde & Schwarz Support Centre Asia all received excellent training in Munich and Singapore and are competent technical representatives of Rohde & Schwarz in the Asia-Pacific region. Boon-Huat Lim (4th from left in photo) from Singapore is SCA's general manager; he studied in Germany and speaks not only Chinese but also fluent English and German. This makes for optimum communication between headquarters and SCA. Jean-Louis Vincent (3rd from left), who was formerly head of the R&S France service and system departments, is responsible for the technical administration of the system, service and calibration center.

Team of Rohde & Schwarz Support Centre Asia in Singapore Photo: author

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Dr Erich Freund

R&S France demonstrates automatic production test line

Great interest was shown in the production test line demonstrated live by Rohde & Schwarz France. Photo: Laurent

In March this year Rohde & Schwarz France organized in Meudon-la-Forêt a project day on the subject of "automated measurements in production" to demonstrate its know-how in this field. Invited guests were able to experience an automatic test line in action (photo). At the same time videos of various systems already in operation at key customers were shown in an adjacent hall. The test line presented was to be just an example. Rohde & Schwarz France's specialty is being able to offer global solutions while at the same time taking into account a customer's specific testing needs. As to the type of products tested, it is obvious that the demodulator of a TV set needs a different approach than a component for a radiotelephone or a consumer electronics product. Although the goal is always the same, ie the best possible quality, the means of achieving it are different. Rohde & Schwarz has a large variety of instruments and systems allowing measurements to be performed in areas as different as in-circuit and functional tests, optical inspection, audio/video, radiocommunication or EMC tests.

When it comes to the degree of automation, the manufacturer can decide whether all test systems are integrated into the line or some tests are carried out offline. In the latter case the products have to be handled by an operator and connected to the system, which then performs the necessary tests automatically. If the manufacturer decides in favour of maximum automation to improve quality and productivity, the line transports the products from station to station. Automating a production line not only means testing automatically, it is also an assurance that products will definitely be handled by each section of the test line.

The compact test line presented in France loads ready populated circuit boards. Each PCB is routed via a handler, which positions it on the interface connected to Test Workstation TSAS for performing an in-circuit and functional test. The conveyor belt then takes the PCB on to Optical Inspection System LaserVision2. In a production environment, fault-free PCBs stay on the conveyor belt and are then temporarily put into storage or transported to another point of the manufacturing process. Faulty PCBs are taken from the belt by an operator, repaired and manually placed back on the conveyor belt ahead of the handler.

The modular concept of the production line leaves all options open for the user. Before it reaches the first test station for instance, the PCB may pass through a labelling station. After each test the PCB can be sent to a station that marks it as being fault-free. A reversing system is also possible, where the PCB is turned over to test the other side. Practically any instruments, test assemblies or measurement systems can be integrated into the line for checking the quality and functions of the final product and to ensure compliance with specifications. No matter how big the customer's requirements are, Rohde & Schwarz is able to offer turnkey systems by cooperating closely with a whole network of specialized suppliers, and also undertakes project planning so that the customer has only one partner plus a single warranty covering each and every element of the system.

The event organized by Rohde & Schwarz France was a tremendous success. More than 60 representatives from France's electronics industry took advantage of this opportunity for an in-depth look at automated test and measurement in modern production.

Guy Prevert; Danièle Laurent

Modulation Generator AMIQ with 14 bits resolution, 4 000 000 samples memory, 100 MHz sample rate and **Simulation Software WinIQSIM AMIQ-K1** for digitally modulated I/Q and IF signals, single-carrier, multicarrier and CDMA signals are ideal for generating highly accurate I/Q signals; BER measurement as option.

Data sheet PD 757.3970.21 enter 159/03

Digital Radio Tester CTS Besides CTS55 (GSM), the new models CTS60 (DECT) and CTS65 (GSM and DECT) as well as the modification kits for upgrading CTS55 and CTS60 to CTS65 and options for remote control and module testing in GSM are contained in the updated data sheet.

Data sheet PD 757.2509.22 enter 159/18

Spectrum Analyzers FSE A 24 cm (9") LC TFT colour display for all models, the new FFT filter option (standard in .30 models) with bandwidths in steps from 1 Hz to 1 kHz, an additional total level error (RBW 5 kHz) <1 dB and modifications in the TV demodulator option were the main reasons for issuing a new data sheet.

Data sheet PD 757.1519.25 enter 159/19

Industrial Controller PSM An improved processor (233 MHz; 32 Mbytes RAM, expandable to 256 Mbytes), a larger colour LCD (10.4") in model PSM17 and the consequent new order designations made the revision of the data sheet necessary.

Data sheet PD 757.1048.24 enter 159/20

Shielded TEM Cell S-LINE (150 kHz to 1 GHz) New S-LINE P model for use in production; a thoroughly revised data sheet focusing on application.

Data sheet PD 757.2338.22 enter 159/21

DAB Transmitter Series NA6... (175 MHz to 240 MHz) **and NL6...** (1452 MHz to 1492 MHz) Newly developed transmitters with high power efficiency for terrestrial digital audio broadcasting; output power in band III 50 W to 2 kW, and in L band 50 W to 750 W; COFDM modulator and GPS receiver installed, passive exciter standby as option.

Data sheet PD 757.3811.22 enter 159/22

Our contribution to safe aviation is the DGPS-based, automatic Continuously Monitored Precision Inspection System COMPIS.

Poster PD 757.3734.21 enter 159/23

QPSK Demodulator CT050PD (950 to 2150 MHz) generates MPEG2-coded signals from received DVB-S TV programs; it includes an RS-232-C interface and optical signal output.

Data sheet PD 757.3792.21 enter 159/24

DAB Multiplexer DM001 is now fully compatible with STI thanks to the optional STI expansion DM001-S (DY001 no longer covered by data sheet).

Data sheet PD 757.2580.22 enter 159/25

VHF Solid-State TV Transmitter NM500 The updated data sheet only contains the new continuously tunable models, with output power between 5 kW and 20 kW and smaller size.

Data sheet PD 757.1277.22 enter 159/26

DF and Location Software MapView and Map Editor MapEdit The updated DF/location software is now available under a new designation and order number; the post-evaluation option allows searching for particular location results.

Data sheet PD 757.1483.22 enter 159/27

New application notes

Multiport Measurements using Vector Network Analyzer ZVR
Appl. 1EZ37_0E enter 159/28

Internal Data Transfer between Windows 3.1/ Excel and Vector Network Analyzer ZVR
Appl. 1EZ39_0E enter 159/29

Measurement of Adjacent Channel Power on Wideband CDMA Signals
Appl. 1EF40_0E enter 159/05

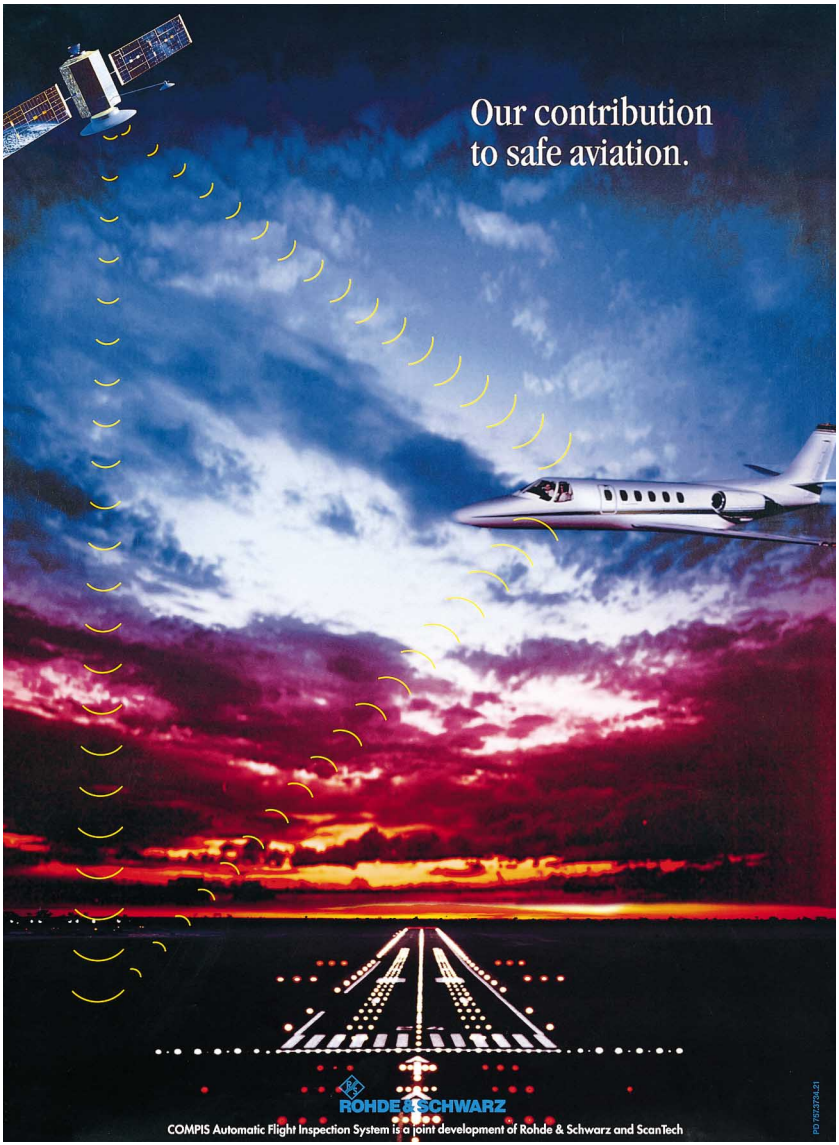
Power Calibration of Vector Network Analyzer ZVR
Appl. 1EZ41_1E enter 159/31

FER Measurements on CDMA Mobile Radios under Conditions of Fading
Appl. 1MA05_0E enter 159/32

Reduced Measurement Time for Testing GSM Base Stations through Parallel Use of CMD and FSE/ FSE-K11
Appl. 1MA06_0E enter 159/33

SMIQ as Fading Simulator for External Signals
Appl. 1MA07_0E enter 159/34

Schz



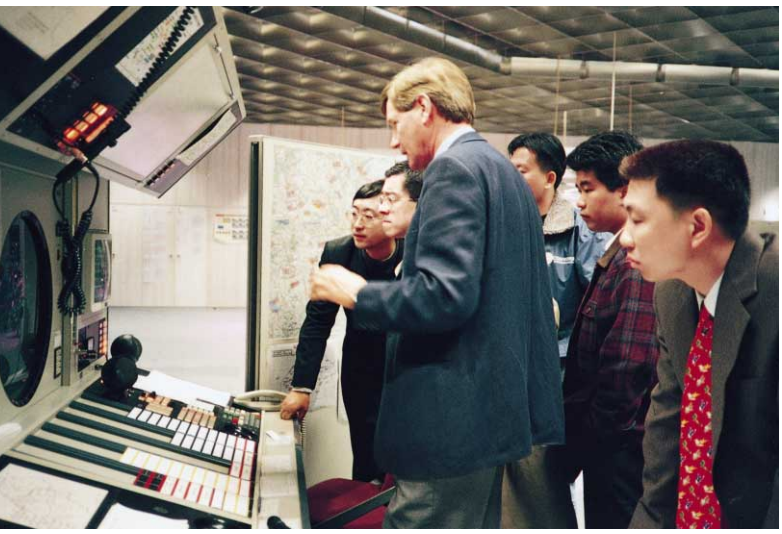


Photo: Beckmann

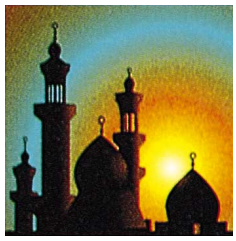
△

HF transceivers for China Southern Airlines

Guangzhou airport in the south of China, near Hong Kong, is the base of China Southern Airlines, the country's third biggest carrier after Air China in Peking and China Eastern in Shanghai. Its modern fleet counts 75 aircraft, mainly Boeings and a few from Airbus. CSA operates national routes and also flies to a number of international destinations like Amsterdam, Washington and Tokyo. CSA recently equipped ten of its planes with HF Transceivers XK516D1 from Rohde & Schwarz, and more are due to follow soon. To obtain first-hand information on the company's product range, a delegation of specialists from CSA visited Rohde & Schwarz headquarters in Munich and the production plant in Memmingen at the beginning of the year. The visitors naturally looked in at Munich's airport too, where they were able to see ATC systems from Rohde & Schwarz and a brand-new, realtime 8.33 kHz receiver (photo).

The customers were extremely satisfied with the many practical demonstrations and the results of their talks. Rebuilding of Guangzhou airport is planned for early in 2000 and new ATC systems are to be installed. The visit reinforced the customers' confidence in the performance and quality of Rohde & Schwarz products, and it is intended to expand business ties in the long term.

J. Beckmann



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Rohde & Schwarz at Tridex 98

At the Tridex 98 show, focusing on electronic warfare, communications and simulation, which was staged in Abu Dhabi in March, many high-ranking representatives of civil and military authorities visited the Rohde & Schwarz stand in the German pavilion. Among them was Gmelich Meijling, Secretary of State of the Dutch Ministry of Defence in The Hague. To show his appreciation of all the information offered him, he invited the Rohde & Schwarz team to a reception onboard the Dutch frigate Abraham van der Hulst in the port of Abu Dhabi. Rohde & Schwarz is currently working on a number of large projects – internal and external communication systems – for the Dutch Navy. The Portuguese company EID, which is responsible for internal communication, is co-operating in this, while Rohde & Schwarz is supplying the external communication component and bears system responsibility.

At Tridex Rohde & Schwarz presented products including its Message Handling Software PostMan, Series 400 and 600 radio equipment and Radiomonitoring Receiver EB200. Another highlight was the LCF program of the Dutch Navy, which was contracted at the end of 1997 (see News from R&S No. 156).

W. J. de Vries

World's first terrestrial, digital TV broadcast network to cover Britain

Rohde & Schwarz UK, the company's British subsidiary, was awarded a contract by Castle Transmission Ltd, the major British network operator, to install the world's first terrestrial, digital TV broadcast network. Rohde & Schwarz will supply all solid-state high-power transmitters (about 60) plus equipment for realtime analysis of the digital data stream (several hundred units). The order also includes more than 100 COFDM modulators, needed for terrestrial transmission of digital TV. The network will enable Castle Transmission to transmit the new digital services shortly to be provided by British Digital Broadcast and BBC.

The contract was won thanks to Rohde & Schwarz's lead in digital broadcasting technology and excellent price/performance ratio. The new TV transmitter network will go into operation in autumn this year and provide the whole of Britain with program coverage. The hardware will include DVB-T Transmitters NV500 with rms power up to 4 kW, CODFM Modulators SDB-M, which are fully compatible with ETS300744, and MPEG2 Measurement Decoders DVMD for realtime analysis. Rohde & Schwarz UK will install the TV transmitters and all cooling systems turnkey, besides providing 24-hour hotline support and service.

PI

Mobifinder detects forbidden cellphone use

The mobifinder® from Rohde & Schwarz is able to detect GSM900 and GSM1800 cellphones activated in critical environments like hospitals, airplanes and chemical plants where they could disturb sensitive electronic systems. Confidential conversations are safeguarded against eavesdropping, forbidden use is signalled.

The unit can measure and store the receive level, date and time of up to 200 alarms and issues acoustic, optical or – through an integrated vibrator – "silent" signals. Selective input filters and detection of the GSM coding exclude the possibility of false alarms. The small and handy mobifinder® (photo) weighs only 80 g and can work on its battery power for up to 150 hours. There is no risk of losing data when batteries are replaced. A PC kit allows simple transmission of all collected data to a personal computer. Data can be saved in tabular form for security or flight reports for instance, or transferred to other programs.

PI

▽

6th international EMC show and conference in Düsseldorf

EMV 98, already Europe's biggest platform for electromagnetic compatibility according to the organizers, was staged in Düsseldorf's exhibition grounds for the first time in February this year. The move from the previous location in Karlsruhe was made necessary by the constant increase in the number of exhibitors and visitors in recent years and the organizers, are now planning to repeat the show annually in Düsseldorf, earmarking 23 through 25 March for the 1999 event.

K.-H. Weidner

Photo: Weidner

the bigger conference program. All 160 exhibitors, 40 from abroad, had ample space in one hall to present their products and services to a public of more than 5300 attending the three days of the show.

100 papers, ten tutorials plus numerous seminars and workshops provided the some 1400 conference participants an excellent opportunity of hearing about and discussing every aspect of electromagnetic compatibility. In addition to the large variety of EMC themes, the program included special subjects like power and transport engineering and PCB design. Workshops were conducted in English, evidence of the international significance the event has gained.

On an attractive stand promising "Solutions from the World Market Leader" (photo), Rohde & Schwarz presented various focal EMC themes and consulted visitors on solutions to their EMC applications. Following the success of EMV 98, MESAGO,

TV Monitoring System TS6120 ensures worldwide reception of Voice of Germany

To further improve the availability and quality of its satellite transmissions, Deutsche Welle (Voice of Germany) is now using a TS6120 system from Rohde & Schwarz to monitor worldwide coverage of its analog and digital sound and TV broadcasts. Video Analyzers VSA and VPC1000 are used to measure the analog television signal, while QPSK Demodulator CT050PD and MPEG2 Measurement Decoder DVMD keep a watch on digital broadcasts. An Audio Monitoring System AMON checks for channel crossovers, frequency response and signal/noise ratio.

The stations of the monitoring network are located all over the world and can pick up any satellite transmitting the programs of Deutsche Welle. Measured data and alarms are sent to the German center. The software for the purpose, with its extremely user-friendly interface, enables statistical evaluation as well as monitoring. The constant acquisition of various parameters shows their trends, so service personnel can intervene before things go wrong, avoiding costly downtime in nearly all cases.

C. Christiansen

Active shortwave antennas now improved

The Active Shortwave Antennas HE010 (vertical polarization) and HE015 (vertical and horizontal polarization) have been successful all over the world for many years. The time had come for a redesign, because the radial components in them are no longer obtainable. Rohde & Schwarz used this opportunity for further improvement of the products. Both antennas now integrate future-proof surface-mounted devices. The second RF output was done away with in HE010 because the majority of users only work the antenna with one receiver. The antenna is now especially notable for its enhanced sensitivity. HE010 is unchanged externally. HE016 (photo), successor to HE015, is smaller and lighter than the forerunner model and, for the same technical specifications (except the built-in HE010), is being offered with a big cut in price.

Dr C. Rohner

Digital audio broadcasting success

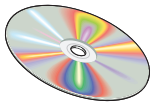
Rohde & Schwarz recently received two orders for a total of 108 of its new DAB transmitters for band III (NA6… series) and L band (NL6… series). Deutsche Telekom is taking more than 90 transmitters for both frequency bands. 18 band III transmitters will go to the Walloon Ministry of Power and Transport in Belgium, and RTBF, the broadcaster for the French community, will take care of implementation.

P. H. Frank

Ultramodern UHF TV transmitters for private broadcaster in Malaysia

From Natseven, a new private TV station in Malaysia, Rohde & Schwarz received an order to supply eight UHF TV transmitters (four NH510V of 10 kW and four NH520V for 20 kW, each with exciter standby) for phase I in nationwide broadcasting of its program. The contract, won in the face of tough international competition, can be put down to Rohde & Schwarz's leading-edge TV transmission technology plus excellent price/performance ratio. Phase I of the new network is for prime coverage and has been on air since April this year. When phases II and III will have been completed, mainly requiring gap-filler transmitters for shadow regions, 95% of Malaysia's population will be able to receive the new broadcaster.

PI



NEWS on CD-ROM

"News from Rohde & Schwarz" is now being brought out on CD-ROM – starting with issues 150 through 156 from 1996/97 – in all three languages (English, French and German). The silver disk also contains a brief company portrait in English. The viewer for the pdf data (Acrobat Reader) is also included. The contents can be downloaded and printed out on A4 or US letter paper. Copies are obtainable from your nearest Rohde & Schwarz office.

wgr

Press comments


PALMARÈS TECHNOLOGIQUE

CATÉGORIE "INSTRUMENTATION ELECTRONIQUE"

Lauréat : Rohde & Schwarz

Produit : SMIQ, générateur de signaux intégrant un simulateur de fading

Remarqués par le Jury

MESURES 689 - NOVEMBRE 1997

Rohde & Schwarz test & measurement technology is obviously among the very best of its kind. Two instruments from the company's large, modern selection have won international awards in their categories:

The French magazine "Mesures" (issue 11/97) named Signal Generator SMIQ the laureate for its prize "Palmarès Technologique" in the category for electronic test instruments. The jury was composed of specialists and equipment users from France's electronics industry. At the awards ceremony Philippe Catherine, managing director of R&S France, was presented with the certificate and a trophy. This is the second time that Rohde & Schwarz has won the award since 1995, when it went to Spectrum Analyzer FSE.

The SMIQ family of vector signal generators offers high-grade digital modulation, fast measurements through high-speed synthesis and big reserves in measuring capability thanks to its spectral purity. Newly added is an optional fading simulator for generating faded signals. Reason enough for the editors of "HF-Praxis" (edition 11/97) to feature SMIQ as their cover spread.

Every year the distinguished US magazine "Test & Measurement World", which circulates worldwide, publishes lists of the best products in various categories. Rohde & Schwarz's Audio Analyzer UPL received an honourable award from the magazine in the measuring instrument category – and that in the home of Audio Precision, the toughest competitor of R&S in this sector. The efforts being made on the US market, together with Tektronix, are obviously having an effect, the name Rohde & Schwarz is spreading.

Optical inspection + electrical test = universal test line

Hilmar Beine, senior editor of "productronic", a magazine focusing on electronics manufacture, interviewed Klaus Kundinger, business field manager/production test at Rohde & Schwarz, on the subject of optical inspection in the 1-2/98 issue:

... This is exactly where we have to move things forward – adherence to interface specifications and a flexible, inline standard system that allows you to integrate the electrical test in an inexpensive, elegant way. Our idea, which we're currently examining for feasibility and above all its attractiveness for the market, is the creation of a platform that combines our Universal Test System TSU and the LaserVision optical inspection system in a single system.

Custom-made

Dan Strassberg, senior technical editor of the US electronics magazine "EDN", looked at the subject "Custom-made signal sources conquer design of products for wireless communication" in a highlight article in edition 2/98, presenting Vector Signal Generator SMIQ as one example of the modern generation of instruments.

Denmark's army plans new mobile DF system

"Jane's International Defense Review" (issue 4/98) looked at a new, mobile DF system that the Danish army is setting up with direction finders from Rohde & Schwarz:

The Danish army is planning a new version of its mobile, automated intercept and direction finding system (DAISY), based on the digital Direction Finders DDF06M from Rohde & Schwarz. The new DAISY offers mobile, manual and automatic DF operation in the frequency range 0.3 to 1300 MHz, scanning with the possibility of suppressing selected frequencies and of both working on fixed frequencies as well as searching certain frequencies, AM, FM, SSB and CW demodulation, high bearing accuracy, access by up to three users and protection against voltage surge.

Rohde & Schwarz France was the hub of the world of testing for a day. The French electronics magazine "Electronique International" devoted two pages of its 2/98 issue to this project day on the subject of automation in production tests. For the numerous visitors RSF presented a complete conveyor belt with an integrated optical inspection station and a system for in-circuit and functional tests (see report on page 36 of this issue).

Top performance priced low

This was the headline chosen by the Swiss electronics magazine "Polyscope" when it presented EMI Test Receiver ESCS30 in edition 9/97:

ESCS30, the logical follow-on in the ESHS/ESVS/ESS family, comes as a full-compliance test receiver to CISPR and VDE. It can perform standard EMI measurements that make exacting demands for accuracy, overdrive capability, dynamic range and selectivity. At the push of a button ESCS30 will start complete tests of interference voltage, interference power and interference field strength.

Prof. Dr Geoffrey F. Gott of the University of Manchester Institute of Science and Technology (UMIST) in Great Britain is managing an international program for the measurement and analysis of the occupancy of the shortwave spectrum by the various radio services. In this short report he gives the objectives and initial results of the research project, in which Rohde & Schwarz is also involved.

International measurement program – Spectral occupancy at high frequency in Europe

The HF spectrum (3 MHz to 30 MHz) is capable of long-range communication with modest transmitter powers by the ionospheric reflection of low-angle sky waves. It is also used for short-range communication by ground wave or by the ionospheric reflection of high-angle sky waves, the latter technique being important in mountainous or forest terrain. Examples of HF users are international broadcasters, land-based fixed and mobile, maritime mobile and aeromobile operators. To enable organized use of the spectrum, the International Telecommunication Union defines a number of frequency allocations across the spectrum for each type of user.

The main problems of the HF channel arise from time-varying multipath propagation, atmospheric and galactic noise and interference from other HF users. Propagation and noise have been extensively studied and documented. But interference from other users, although often very severe due to the typically high congestion of the spectrum, has received little attention.

The **aim of the international measurement program** is to provide occupancy data for the entire HF spectrum. This may be used in conjunction with frequency predictions to advise operators on the typical occupancy they may encounter and show how this occupancy depends on relevant parameters. Such information may also be useful to communication system designers, to HF ground wave users (who may then choose operating frequencies to avoid severe sky wave interference), and to study groups who are concerned with the determination of international frequency assignments.

Several **automatic occupancy measurement systems** are currently in operation in Europe (FIG 1). The **sites** range from Kiruna in northern Sweden (inside the Arctic circle) to Munich in southern Germany. The systems use Test Receivers ESH3, Active Rod Antennas HE010 and Active Turnstile Antennas HE004, all from Rohde & Schwarz (FIGs 2 and 3). These antennas give occupancy measurements for signals received at low and high angles of elevation. Each system is connected to the telephone network to enable control and retrieval of measured data.

Occupancy is measured across each ITU-defined HF frequency allocation at each measurement site [1]. The test receiver is stepped in frequency through each allocation, typically spending 1 s at each increment. The fraction of the increments for which the receiver IF output signal exceeds a defined threshold level defines the congestion value for that allocation. This procedure is shown in FIG 4, which indicates the measurement of congestion for the fixed and ground mobile frequency allocation 10.15 MHz to 10.60 MHz. Congestion values are measured for threshold

FIG 1
Sites of HF occupancy measurement systems

FIG 2 HF occupancy measurement system of UMIST; at the core of the system is Rohde & Schwarz Test Receiver ESH3

levels corresponding to an incident field strength of 1 µV/m to 100 µV/m, and for IF bandwidths ranging from 200 Hz to 10 kHz.

Mathematical models are currently being fitted to the experimental congestion values [2] and examples of such models have been published [1,3,4]. The modelled value of congestion Q_k, for ITU frequency allocation k is given by

$$Q_k = \frac{e^{y_k}}{1 + e^{y_k}}$$

where y_k is the model index function incorporating parameters on which occupancy depends. Measured congestion values are probabilities ranging from 0 to 1, and the above logit transformation ensures that the modelled values do not fall outside this range.

Measurements in the UK have been made since 1982. As a simple example, the earliest model for the entire HF spectrum was for UK summer solstice, for which the index function has the following form [1]:

$$y_k = A_k + (B_0 + B_1 f_k + B_2 f_k^2)\ 20\ \lg\psi + (C_0 + C_1 f_k + C_2 f_k^2)\ sunspots$$

A_k has 95 values corresponding to the 95 ITU frequency allocations, f_k is the allocation center frequency, ψ is the field-strength threshold, and *sunspots* are the 12-month running mean of the monthly mean international sunspot number. For this example the measurement bandwidth was fixed at 1 kHz, and only the rod antenna was used. The model was initially based on 5500 values of congestion measured over the period 1982 to 1995. When measured and fitted values were compared, 54 % of the measured values were given by the model to an inaccuracy of ±0.01, 87 % to an inaccuracy of ±0.05 and 96 % to an inaccuracy of ±0.1, where congestion values are in the range 0 to 1.

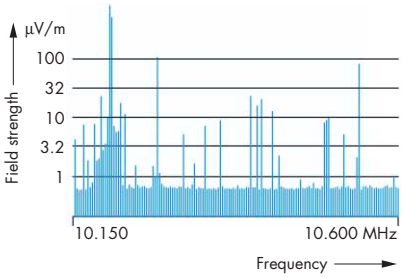


FIG 4 Results of occupancy measurement

To demonstrate the ability to **predict future values of congestion,** the project team used a model developed from summer solstice data obtained from 1982 to 1992 to predict occupancy at the summer solstice for the years 1993, 1994 and 1995. The predicted values were then compared with measured ones. For example, for the 1995 predictions 79 % of the predicted values were within ±0.05 of the measured values. When the model was subsequently fitted using measured values up to 1995, the model gave 83 % of fitted values within ±0.05 of the measured values. Thus the predicted values were nearly as accurate as the modelled ones. This indicates that the model specification had not altered significantly by the inclusion of the 1993 to 1995 data, which shows that the utilization of the HF spectrum had not altered significantly in a systematic way over these years. It may be noted

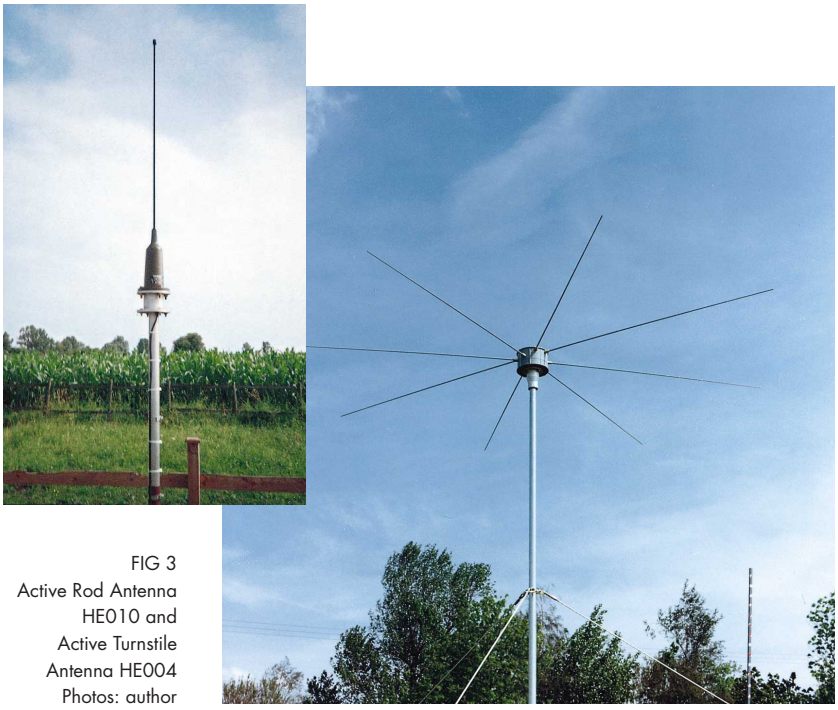


FIG 3
Active Rod Antenna HE010 and Active Turnstile Antenna HE004
Photos: author

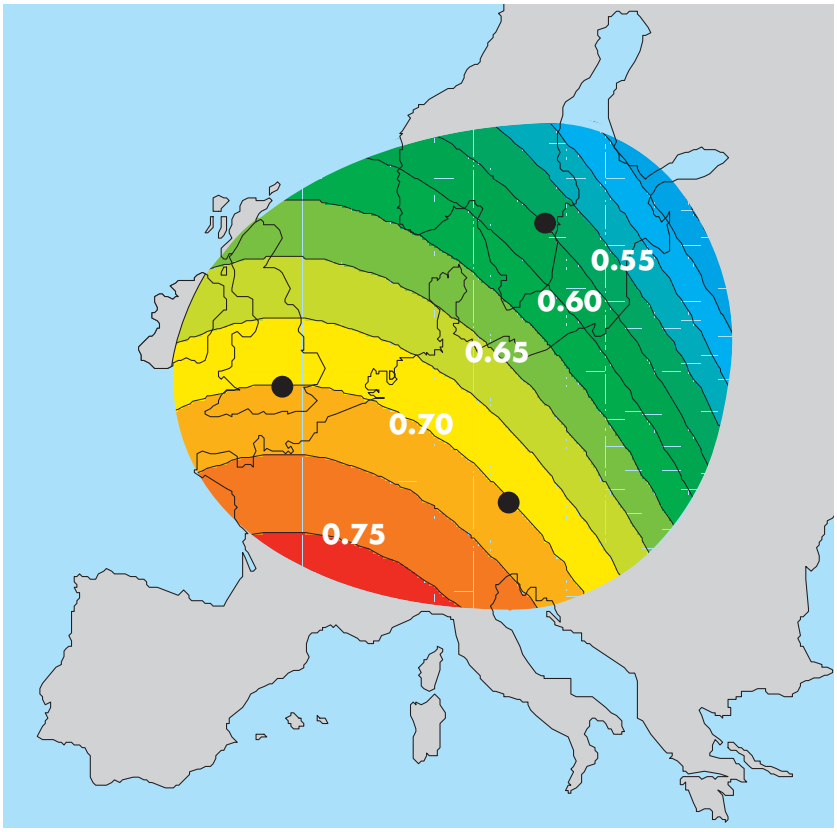


FIG 5 Example of modelled HF occupancy over northern Europe

that the predicted values of congestion are based on predicted sunspot numbers.

Since 1993, frequent measurements have been undertaken at Baldock, Linköping and Munich, and **comprehensive models for low-angle and high-angle HF occupancy** are being developed for northern Europe. These recent model index functions include the parameters field-strength threshold, frequency, time of day, week of year, bandwidth, sunspot number and geographical location [3]. Up to 300,000 measured congestion values are currently being fitted in the modelling procedures, and an example of modelled occupancy contours is shown in FIG 5. These contours are for the fixed and ground mobile frequency allocation 7.3 MHz to 7.8 MHz, midnight, summer 1995, for a threshold level of 1 µV/m and a bandwidth of 1 kHz.

A measurement system at Cobbett Hill near Farnborough in the UK has been operational since 1995 to determine the variation of HF occupancy with azimuth. Twenty travelling-wave Vee antennas are used to systematically monitor occupancy for twenty different azimuths, and these results are also being modelled [4]. The measurement system at Kiruna became operational in 1997 and no modelling has yet been attempted for this site. It will be of interest to see if the high latitude of Kiruna gives rise to very different occupancy characteristics when compared to results from the other European sites.

It is hoped that the project may continue until high sunspot numbers are encountered, so that a wide range of sunspot numbers may be included in the models currently being developed.

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Prof. Dr Geoffrey F. Gott

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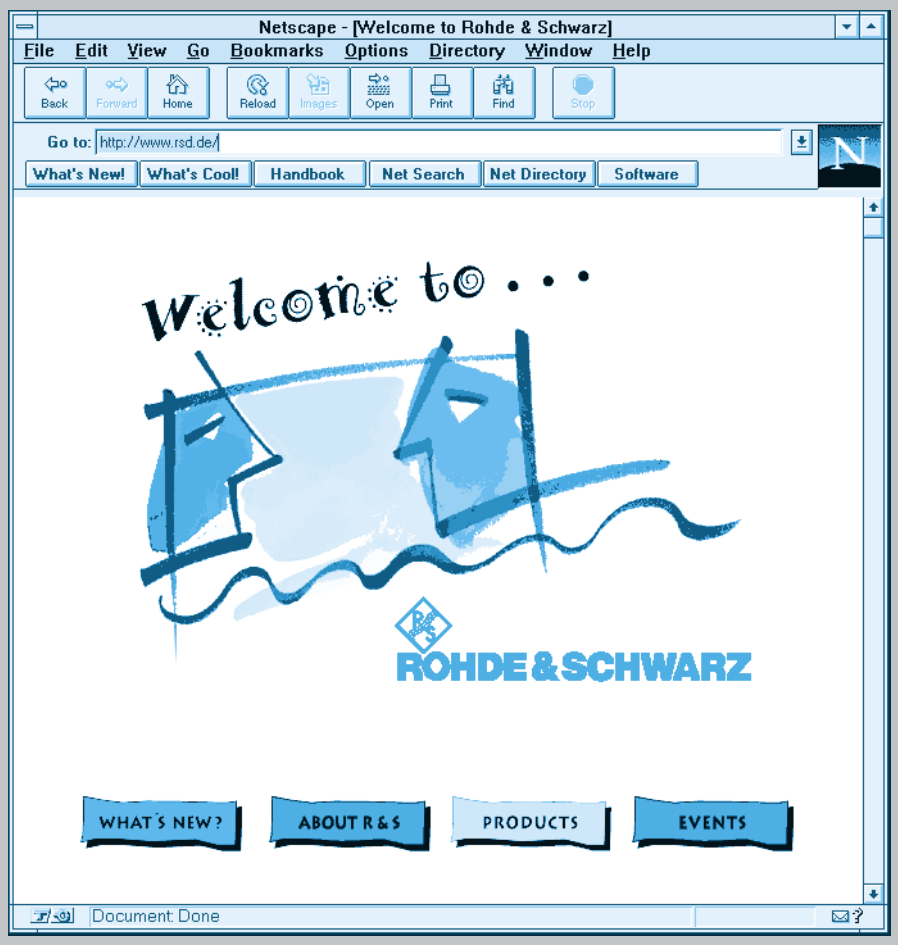

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