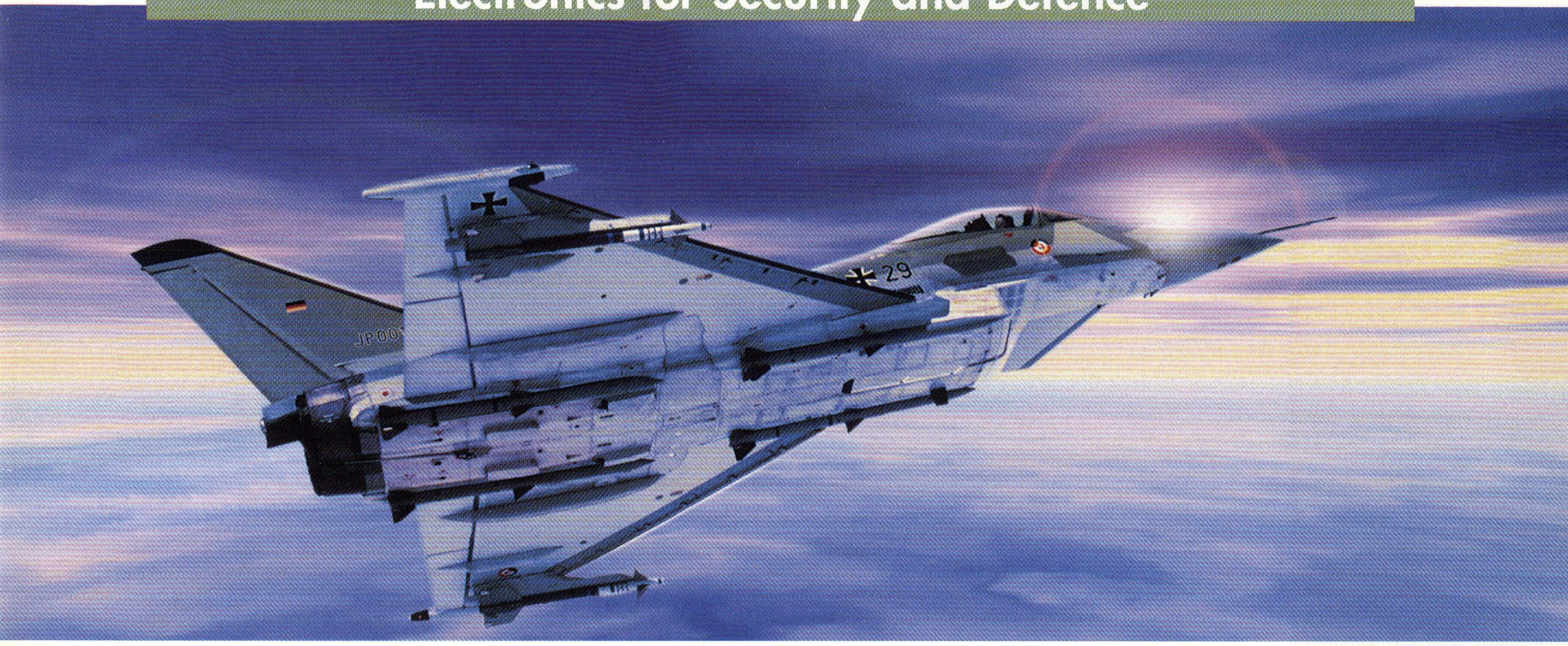
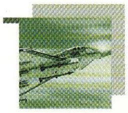
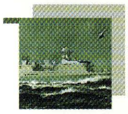
MIL NEWS

Electronics for Security and Defence

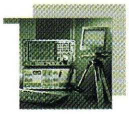




Takeoff: Eurofighter 2000 flies with SATURN



Communication: Integrated communication system for air-defence and command frigates LCF



Security: Measurement and evaluation of compromising emissions up to 22 GHz

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1998

ROHDE&SCHWARZ

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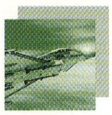
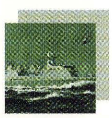
Note: The instruments, systems and solutions described may be subject to German and/or European export regulations.

TITLE STORY

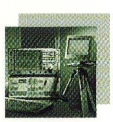


COMMUNICATION



RADIOMONITORING

FM INTELLIGENCE



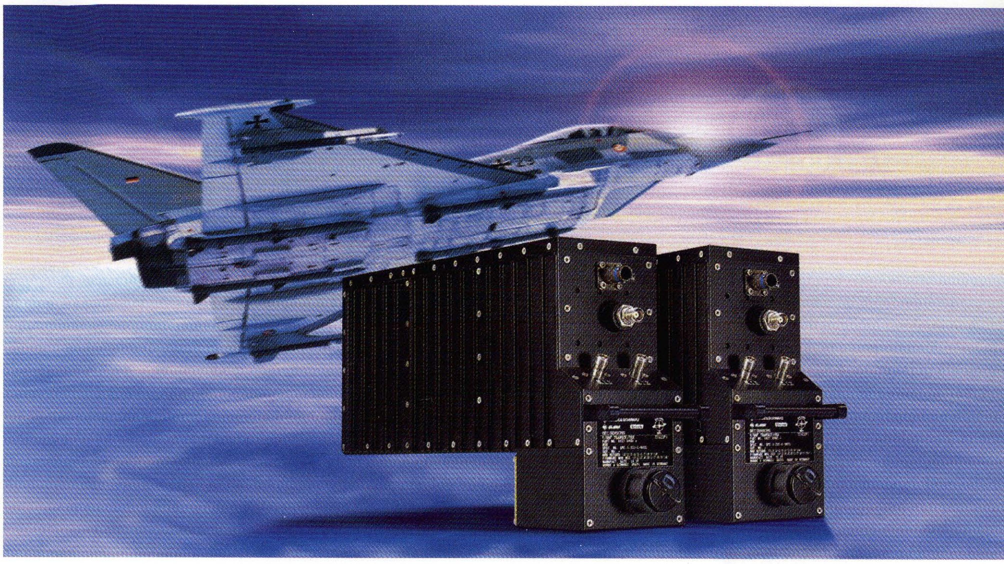
PRODUCTS

IT SECURITY

TELESTORY

VHF/UHF Transceiver SATURN for Eurofighter

By signing the relevant government contracts in December 1997 in Bonn the Defence Ministers of Germany, the United Kingdom, Italy and Spain gave the go-ahead for the production investment phase and series production of Eurofighter 2000.



This event was the long-expected signal for the four nations' collaborative program to continue from the development phase to the next phase and thus secure the future of Europe's most advanced military aircraft. The forthcoming phases provide thousands of highly qualified jobs also in the supplier industry.

Rohde & Schwarz as the leading supplier of airborne military communication equipment is involved in the Eurofighter 2000 program providing the two main VHF/UHF transceivers of the aircraft. To reflect the mandatory worksharing principle of the program, Rohde & Schwarz is heading a European consortium consisting of GEC Marconi (UK), ELMER (Italy) and ENOSA (Spain).

This consortium is under contract for the development of the VHF/UHF transceivers and expects to receive this year the contracts for the production investment phase and series production of the radio equipment.

To offer maximum protection of the communication link against hostile jamming the radio contains latest NATO technology of EPM (Electronic Protection Measures) called SATURN (Second Generation of Anti-Jam Tactical UHF Radio for NATO).

SATURN's fast frequency hopping is implemented in accordance with STANAG 4372 to guarantee interoperability of the NATO air forces. The SATURN radio covers the UHF frequency band from 225 to 400 MHz and provides clear and encrypted voice transmission/reception in the following modes:

- conventional AM mode,
- EPM HAVE QUICK and
- EPM SATURN

The VHF frequency band from 108 to 156 MHz for air traffic control is provided for non-EPM operation.

Advanced synthesizer technology, digital receiver and broadband power amplifier together with special filters are used to obtain the high spectral purity even in the EPM mode.

To digitize the speech, 16-kbit/s delta modulation is integrated for encrypted transmission and SATURN mode.

The fast hopping SATURN mode (TRANSEC) affords a remarkable anti-jam margin and ensures reliable communication links even under the expected jamming scenarios of the next century.

The fully integrated encryption function (COMSEC) in accordance with the relevant NATO standard offers maximum protection against hostile monitoring and deception. Although designed to the advanced SATURN technology, the radio is fully downward-compatible with HAVE QUICK systems and conventional AM non-EPM mode radios.

The high share of digital signal processing as well as the extensive use of data processors and software for the control of frequency hopping and ciphering makes the product look more like a computer than a radio. The pilot operates the radio from an integrated cockpit control panel, which is part of the overall cockpit design.

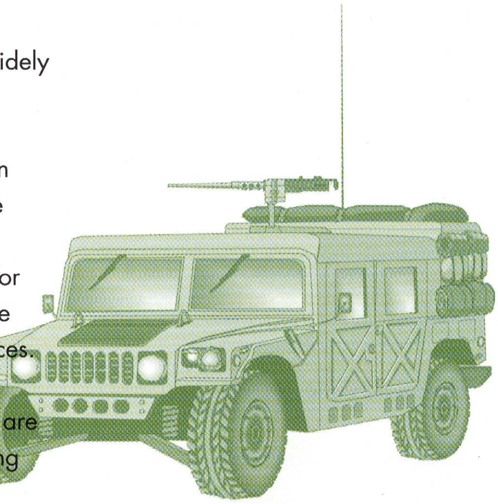
The control and data interface of the SATURN radio is implemented by a bus in accordance with STANAG 3838 (MIL-STD-1553B) and as a fibre-optic bus to STANAG 3910 (EF2000). The overall control of the radio is software-based and can thus easily be adapted to customers' requirements.

Tactical communication with ManPack Transceiver XV3088

ManPack Transceiver XV3088 for tactical VHF communication is used by armies throughout the world for stationary, vehicle and also portable use. It is characterized by ease of operation, long operating times, reliable link setup, minimum liability to breakdown and modular design, which means logistic and cost benefits.

Up to 20 km (ground to ground) can be covered by VHF Transceiver XV3088

COMMUNICATION



The VHF range is still the most widely used band for tactical ground-to-ground communication, and equipment working exclusively on VHF will continue to make up the bulk of tactical radio equipment. Tactical VHF links are the basis for combat management, artillery fire control and various logistic services. Communication distances to be covered by Transceiver XV3088 are between 1 and 20 km, depending on the tactical situation and the terrain. The frequency range is 30 to 87.975 MHz. At a channel spacing of 25 kHz this means that 2320 channels are available, nine of which can be permanently stored (even without supply voltage). Besides frequency information, additional data can be stored under the channel numbers. In each individual unit, selective call addresses and other presettings which are not accessible to the operator can be programmed by means of a fill gun, a PC-programmable buffer memory. The fill gun also allows updating under field conditions. It is connected to the transceiver via one of the data or audio interfaces.

Upon channel selection, the channel characteristics are indicated on the transceiver display; these include: simplex/half duplex, selective/multi-address call, link with/without encryption, transmitting power 0.2 W or 5 W as well as subaudio squelch.

Thanks to its modular design, Transceiver XV3088 can be adapted to any operator requirements.
The following components are available:

- 25 and 50 W amplifier,
- a variety of antennas such as 0.5 or 1.5 m rod antennas as well as long-wire antennas,
- accessories (data modem, intercom, backpack, mounting frames),
- various handsets/headsets with/without integrated control pad,
- battery charger (standard or fast),
- rechargeable batteries.

This comprehensive range of features makes XV3088 suitable for a variety of applications, such as for use as a portable unit, but also mobile and stationary use, data transmission at 2400 bit/s as well as selective code transmission (three-digit, numerical). Remote control of the transceiver is also possible.

COMMUNICATION

Multirole Radio – a quantum leap in radio technology

From the user's point of view streamlining the variety of products available in the field of tactical and strategic transceivers would be highly desirable. Technological advances in the field of processors resulted in the implementation of an increasing number of functions and the generation of waveforms by means of software. Consequently the demand for standardized architecture at high level is becoming stronger. Acceptable solutions can undoubtedly be obtained by adapting to user requirements, bearing in mind technical and economic aspects.

The present situation

Communication services place different demands on the communication media regarding data rates, real-time behaviour, transmission methods and coverage. Up to now specialized transceivers with fixed waveforms were used because of the limited number of frequency ranges and bandwidths which were moreover adapted to national requirements. Modular configuration was only possible to a limited extent by adding hardware and software modules.

Since most of the platforms have to handle several services, a great variety of these special transceivers with different functions, design, operation and serviceability is used, sometimes more than once for reasons of redundancy. This entails a multitude of problems and so national and multinational programs and organizations like Speak Easy, FM3TR, Nexcom, DMR or MMITS have been trying to find a solution – sometimes at the same time without knowing it. In the USA, a supervisory authority, the PMCS-IP (Programmable Modular Communications System Integrated Product Team), was established by the government for coordinating and streamlining the variety of civil and military requirements.

What is needed and desired by the user? In the ideal case a communication system with the following characteristics:

- **Flexible use**
  Bottlenecks, for example, are avoided by spontaneous configuration of several functional links to the waveform of the critical service.
- **Interoperability of different partners**
  For example, loading the respective waveform parameters for different missions.
- **Multifunctionality**
  Use of the same radio platform for different tasks in the network, eg terminal, relay unit, base station channel, etc.
- **High availability**
  For example, redundancy by using all installed functional links for several services handling different waveforms.
- **Upward compatibility**
  Through open architecture permitting upgrades at the pace of the technical progress.
- **Low space and power requirements, low costs**
  Less transceivers needed, the number being mainly determined by the number of simultaneously performed services.
- **Uniform logistics**
  Identical hierarchical levels for users, configuration, servicing and functional extensions.

Chances of implementation

Communication systems featuring these characteristics are not yet available but studies and demonstrations of individual functions indicate that an implementation will be possible in the foreseeable future. Due to the rapid progress in semiconductor technology manufacturers now have the processor modules required for an open architecture and for implementing waveform parameters by means of software. The use of COTS (commercial off-the-shelf) techniques and standards (eg bus structures) from the field of computers helps to minimize the implementation risks.

The illustrations demonstrate operational and cost advantages of multifunctional transceivers over conventional transceivers. FIG 1 shows a platform for four different services, at least two of which are performed simultaneously. FIG 2 reviews the costs.

Part of Rohde & Schwarz

Multiband units like VHF/UHF transceivers handling different waveforms were already used in the past for different services such as civil and military air-traffic control or air defence. However, the waveform parameters of these units were "permanently wired" and in most cases could only be modified by modifying the transceiver or by adding a hardware module.

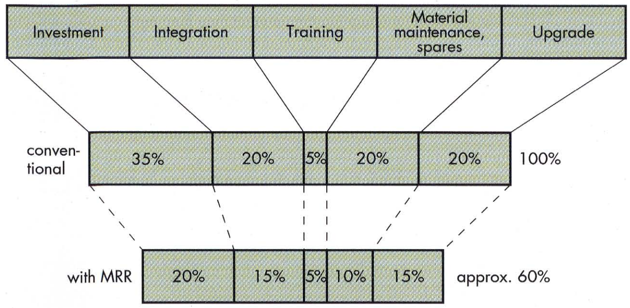


FIG 2
Life cycle costs in a comparison of conventional and multifunction transceivers

The product range of Rohde & Schwarz includes transceivers for tactical and strategic services from the HF to the UHF range for stationary, land-mobile, seaborne or airborne platforms. To be fit for the future, Rohde & Schwarz performed a systematic analysis, structurization and evaluation of all required waveform parameters. As a result, a multitude of parameters and value ranges can be defined together with users and thus a basis created for a programmable multifunctional transceiver. Rohde & Schwarz has also acquired valuable experience in industry initiatives like MMITS (Modular Multifunction Information Transfer System) in the USA. The aim is an industry standard that permits functions of different manufacturers to be implemented via architecture interfaces.

Next steps

Standardizations at a high level are indispensable but detrimental to the implementation of functions as the technical progress will always be far ahead of any accord that can be reached for a standard. So, in addition to future instruments or subsystems, new tools and methods will have to be developed in cooperation with manufacturers, operators and service providers to allow optimum and safe use of all new capabilities. The latter include software configuration, loading of software updates or new software functions via the air interface as well as protection against undesired manipulation.

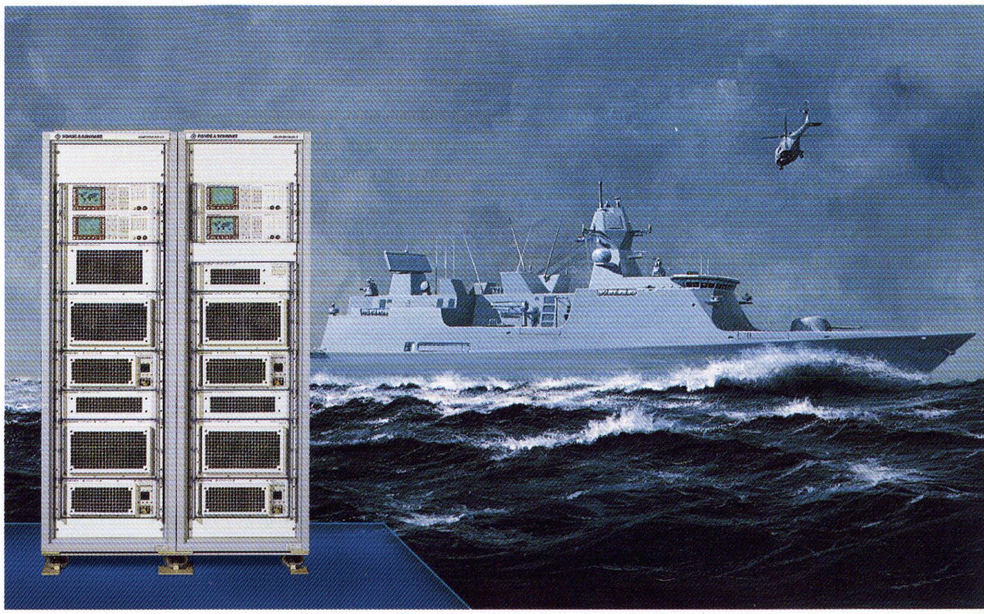
FIG 1 Conventional equipment for reliable operation, two of eight units active (left). Use of MRRs, eg M3TR: multimode, multirole radio with two of four units active

Service	1	2	3	4
Band/ waveform	tact. VHF	tact. UHF	DWF/SCRA	HF long-range communication
Operational unit	VHF1	UHF1	SCRA1	HF1
Standby unit	VHF2	UHF2	SCRA2	HF2

Service	1	2	3	4
Band/ waveform	tact. VHF	tact. UHF	DWF/SCRA	HF long-range communication
Operational unit, programmed, configured	VHF1 MRR	no activity at present	no activity at present	HF1 MRR
Instrument pool MRR Standby unit	VHF2	MRR	MRR	MRR

Integrated communication system for the air-defence and command frigates of the Royal Netherlands Navy

The requirements for naval communication systems have changed rapidly over the last few years. It has thus become necessary to develop a new approach for communications on shore and on board naval ships. This development has been implemented by Rohde & Schwarz and its partners. The Royal Netherlands Navy therefore chose Rohde & Schwarz as the integrator of an integrated communication system for their air-defence and command frigates. Together with the sensors and weapons systems, the communication system is an integral part of the frigate's combat system.



The concept of this integrated communication system is based on modular subsystems with the benefit that it can be tailored exactly to the customer's requirements. This concept envisages that some of the equipment would be made available by the Royal Netherlands Navy. Other parts such as internal communication and public address equipment will be delivered by other proven and reliable suppliers. The task of Rohde & Schwarz is therefore not only the delivery of main parts of the equipment, but also the integration of the equipment into the complete communication system.

The integrated communication system handles the exchange of information between users and systems on the frigates and users and systems on other ships, aircraft or coastal stations for military and civilian purposes. To this end the system supports all the links necessary for coordination within and between national or international operational task groups. The system can be divided into the external and the internal communication system, data handling systems, and some other systems. The external and internal communication system will be described in the following.

The external communication system

The main functions of the external communication system are transmission, reception, reradiation, rekey, relay and gateway for RATT as well as voice and data traffic in the VLF/LF/HF/VHF/UHF/SHF radio bands for terrestrial and satellite communications. The system is designed for plain and cipher voice, data, telex and Morse traffic and satisfies the requirements of GMDSS systems in accordance with SOLAS regulations.

The external communication system consists in general of the following subsystems:

- VHF/UHF transmit/receive system,
- VLF/HF transmit/receive system,
- ESM receiving system and
- Satcom system (SHF, UHF, INMARSAT)

VHF/UHF transmit/receive system

The UHF part of the system is intended exclusively for military tasks and equipped with the latest state-of-the-art UHF transceivers from Rohde & Schwarz. These transceivers operate with the advanced transmission technique for Link-11 and Link-22 data links, Have Quick II and SATURN-EPM. Moreover the system contains filter-combiners to reduce the number of antennas and to improve the minimum usable frequency separation for simultaneous transmission and reception.

Applications of the VHF/UHF transmit/receive system are to be found particularly in:

- the military UHF band for data and voice communications in the line-of-sight range,
- the VHF aeronautical radio band for half-duplex radiotelephone communications with civil aircraft including a monitoring receiver for the 121.5 MHz and 243 MHz emergency frequencies, and
- the VHF international maritime mobile (IMM) band, for duplex and half-duplex radiotelephony communications in accordance with the requirements of GMDSS, inclusive dual-watch and digital selective call (DSC) facilities.

VLF/HF transmit/receive system

The VLF/HF communication system designed for the military sector is based on the HF Broadband Radio Equipment XB2900 from Rohde & Schwarz. It serves as a link to other ships, aircraft or coastal stations in the VLF/HF band. The design is based on a minimum of antennas for the complete VLF/HF system. The system connects a large number of HF transceivers to an antenna system and allows several transmitters to be combined to achieve a higher output power. To avoid conflicts arising in the frequency allocation, the system protects and manages the transmit and receive frequencies and supports the user with a frequency management system. The system complies with the requirements of SOLAS/GMDSS units and contains a meteorological receiver system, a NAVTEX installation and a digital selective call (DSC) facility.

The internal communication system

The internal communication system provides flexible interconnection capability for the relevant communication equipment on board the frigates. It ensures optimal efficiency in allocating the various resources, such as the external communication equipment, to internal users with the aid of intercom circuits and to external users by means of radio relay facilities.

The internal communication system consists in general of the following subsystems:

- internal distribution system,
- public address system,
- conference extension lines system,
- automatic telephone system,
- audio logging system as well as
- telebrief system (for helicopters).

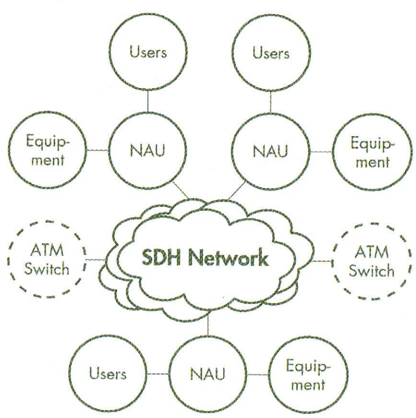
In addition to the internal and external communication system, the following subsystems are part of the integrated communication system:

- tactical data link,
- crypto modem,
- message handling,
- communication control,
- video and entertainment facilities.

Internal distribution system

The internal distribution system ICCS-5 is an SDH (synchronous digital hierarchy) fibre-optic network with access and switching units as well as voice terminals. The SDH ring provides the infrastructure for the integrated communication system. The high-bandwidth transmission backbone (622 Mbit/s) can also be used by other systems via standard interfaces and thus, for example, ATM switches can be integrated in the future.

The SDH fibre-optic network provides the infrastructure for the integrated communication system.



In addition, the system offers real-time video, LAN emulation, high-speed data switching and client-server applications. All in all a solution which enables the transmission of digital information among all system elements via a single, highly reliable network.

Rohde & Schwarz will take charge of and perform the installation and commissioning of the systems on the first two ships, whereas the Royal Netherlands Navy will carry out the complete installation and commissioning on the last two ships. The acceptance tests will be carried out by Rohde & Schwarz. The first frigate will be named „HNLMS De Zeven Provincien" and undergo sea trials in the year 2001. The other three frigates will follow at intervals of one year.

Radiomonitoring at sea – example of a ship-based system

RADIOMONITORING

A ship-based radiomonitoring system is described in this article for the search, detection, analysis and direction finding of signals of short duration in the HF band. Particular attention is paid to the handling of advanced digital signals.

Because operations of this ship-based system are largely fully automatic, it is possible to detect emitters by means of a scanning direction finder as well as to set receivers and analyzers for the identification and classification of defined methods and patterns.

The system is extremely compact and can easily be integrated into the user's concept with the given flexible interfaces. It comprises the following components:

- a fast digital Scanning Direction Finder DDF 01S,
- an antenna system for shipboard use,

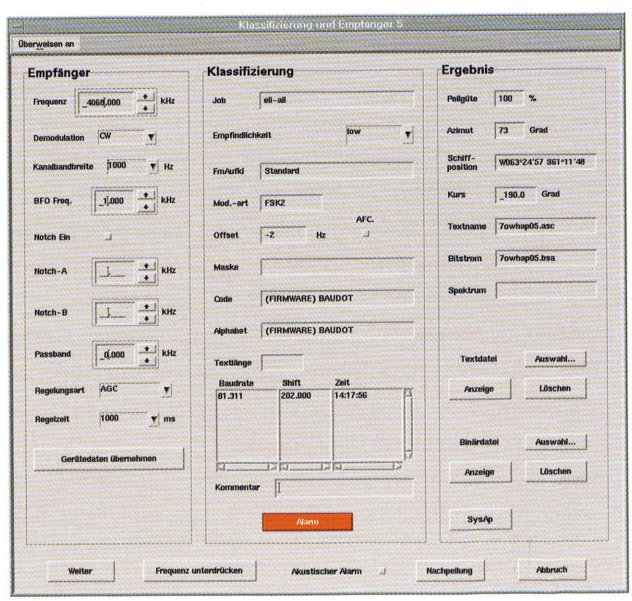


FIG 1
Example of a result window for classification results, signal parameters and receiver settings (status)

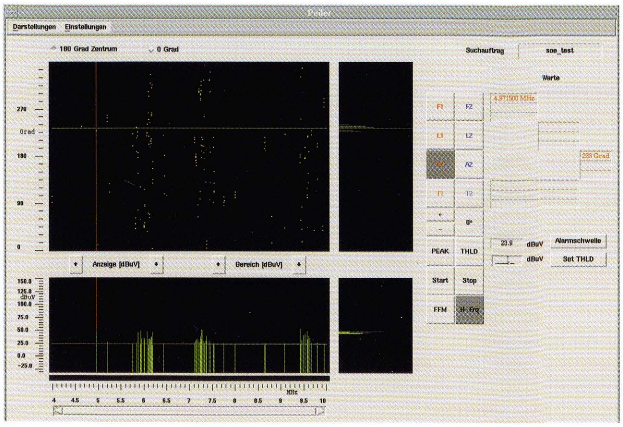


FIG 2 Superimposed histogram window for the evaluation of azimuth and frequencies

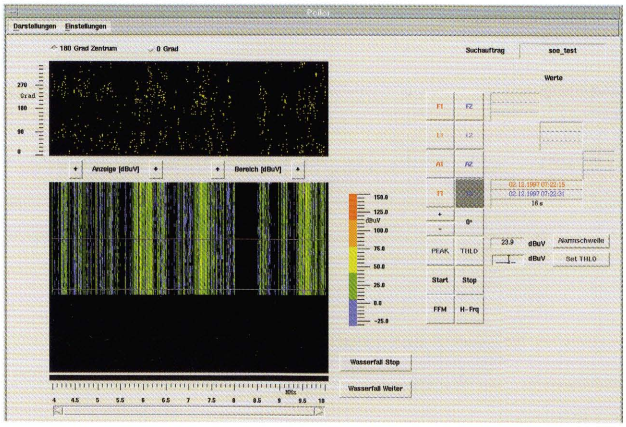


FIG 3 Waterfall display reveals the time sequence of signal activities

- a computer-controlled matrix for the distribution of the incoming antenna signals to the receive and classification paths,
- a maximum of eight separate receive and classification paths,
- a Unix workstation with large screen as system software and database platform,
- one or several PCs fitted with screen which can be enhanced with decoder modules and associated software either in the form of commercial units or user's own equipment as required, and
- interfaces to the onboard systems (position computer, compass, intercom, LAN).

Each receive and classification path is equipped with the proven HF Receiver EK 895/896 from Rohde & Schwarz and the fast Signal Analyzer GA 101 with integrated digital signal classificator and stepped decoders. The AF and IF signals are available at an interface to enable further processing with external analyzers. Signal Analyzer GA 101 is a key component of the receive and classification paths. Classification algorithms and demodulators for complex and fast FSK and PSK signals are available; various decoders suited for digital transmission methods are also supplied. A system software package allows the entry of signal descriptions in simple easy-to-follow paradigms stored in databases. In addition, a special facility is made available for generating and testing method descriptions using the same software that is also utilized during operations.

The system is order-controlled. An order defines the frequencies and azimuth ranges to be monitored by the direction finder and can allocate one or several receive and classification paths depending on the task on hand. The direction finder detects the signal activity and informs the software about it; the software in turn routes the signals automatically to the receive and classification paths. After detection and classification of the emissions the relevant parameters are saved in the Oracle database with a time stamp and thus are available for comparison, polling and postprocessing.

Overview displays marked in colour inform the user at all times on the current state of the system. A result window for each receive path is displayed at a keystroke. This window clearly shows the results of classification, signal parameters and receiver setup in the status and result boxes (FIG 1). Supplementing the automatic operation, a convenient Windows MMI (Man Machine Interface) helps the user in the manual control of all system functions. The user interface of the fast Scanning Direction Finder DDF 01S makes the signals available in various displays, thus allowing optimum presentation of the results to suit the different tasks (see FIGs 2 to 5):

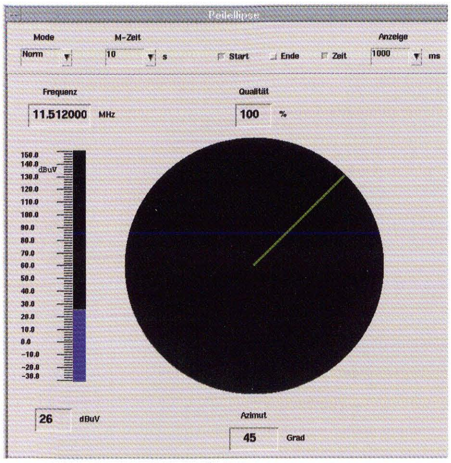


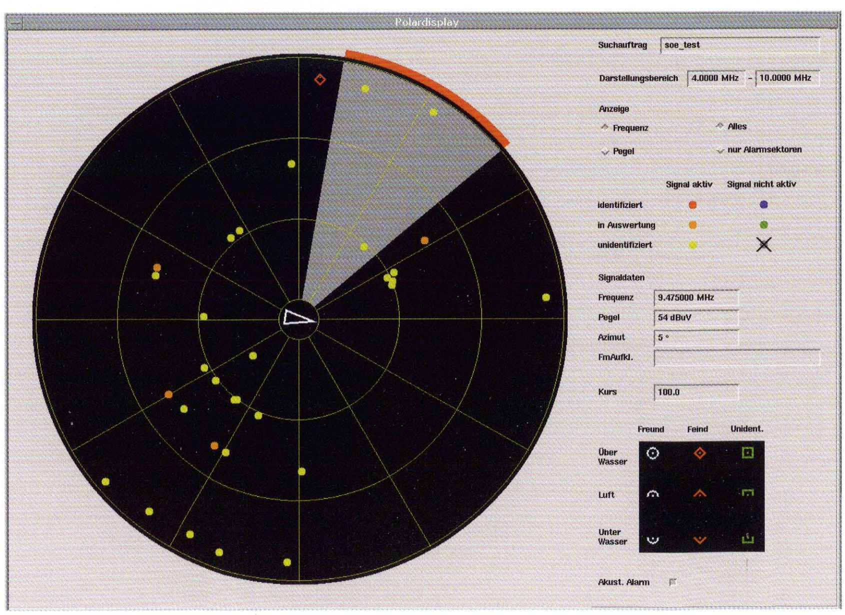
FIG 4 DF ellipse for the assessment of DF quality

- The overview display presents the bearing and signal level as a function of the frequency. A histogram window which can be optionally superimposed permits the evaluation of specific azimuth or frequency ranges for the detection of networks. The facilities are rounded off by the zoom feature, a convenient cursor control and the waterfall display which exhibits the temporal behaviour of signal activities (FIGs 2 and 3).
- The fixed frequency mode (FFM) represents the traditional DF display. The direction finder is set to a fixed frequency. The DF quality is assessed by means of the DF ellipse (FIG 4).
- The polar display is suitable both for North- and ship-referenced representation of scenarios and offers the user a fast overview (FIG 5).

The system has a comprehensive user management with password-protected log-on procedure, various loadable user profiles with different privileges, protection against unauthorized use during pauses and interruption-free operation on change of users.

The use of commercial off-the-shelf products for the fast scanning direction finder, digital signal analyzers and software modules matched to the COM-ESM task makes for an efficient and productive utilization of the system. Integration of the system into large reconnaissance units, frequency extension or customization are just as simple to implement as fitting the system in a shelter or incorporating it into a fixed station. Installation, training and logistic support are effected in the well-tried Rohde & Schwarz way – and all this for customized delivery too.

FIG 5 Polar display for North- and ship-referenced representation of scenarios



New antenna system for the communications intelligence regiment 940 of the German Armed Forces

The political change that has taken place in Europe has brought about extended and additional tasks for communications intelligence as a whole. A consequence of this development is that for example the communications intelligence regiment 940 of the German Armed Forces based at Daun has been furnished by Rohde & Schwarz with a completely newly configured antenna array in accordance with standard specifications. The former antenna system installed in 1973 was optimized for signals that were of interest before the Wall came down and the receiving direction of the rhombi was aligned to certain geographic locations. This describes exactly the limitations of many existing antenna installations with respect to today's spectrum of tasks. FIG 1 illustrates schematically that only a narrow region can be covered because of the radiation pattern, which is strongly directional in azimuth and elevation, ie merely an "island" coverage is possible.

The two key reasons for installating of the new antenna array were:

- reception over 360° in the azimuth became necessary,
- target areas could be in any part of the world.

It can be concluded from FIG 2 that a task of this nature cannot be solved by adding further "islands", in other words additional similar antennas. For blanket coverage new concepts are needed.

Horizontal log periodic antennas prove to be highly suitable for complete coverage as shown in FIG 3:

- The large half-power beamwidth of the horizontal pattern makes for complete azimuth coverage through to 360°; the latter with six antennas only. Provided the terrain is suitable, the star-shaped arrangement with the multiple use of the masts represents a very cost-effective solution.
- The capability to shape the vertical pattern allows either a complete coverage of all ranges or to concentrate on a specific target area to suit the task on hand. Special features of wave propagation can be fully taken into account with this type of antenna.

Horizontal log periodic antennas receive waves of horizontal polarization and thus cover the most important part of the signals transmitted via the ionosphere. As the wave travels through the ionosphere, its polarization changes depending on the conditions of the layers. This change in polarization is time-dependent and very pronounced, so generally no inference can be made on the transmitting antenna from the polarization of the wave at the location of the receiving antenna.
It is to be expected that at times only vertically polarized waves arrive at the receiving site, especially in the reception of distant transmitters. As dictated by physical law vertically polarized waves can only be picked up sparsely by horizontal log periodic antennas, which otherwise operate optimally.

To avert a drastic sensitivity loss of the receiving equipment during the periodically recurring times of vertical waves, it is necessary to extend the installation by antennas for vertically polarized waves. Vertical log periodic antennas offer the same broadband characteristic of impedance and radiation pattern as horizontal LP antennas. "Tailoring" the vertical radiation pattern is not possible to the same perfection as for horizontal LP antennas, which is a limitation of all vertically polarized antennas because of the physical principle involved.

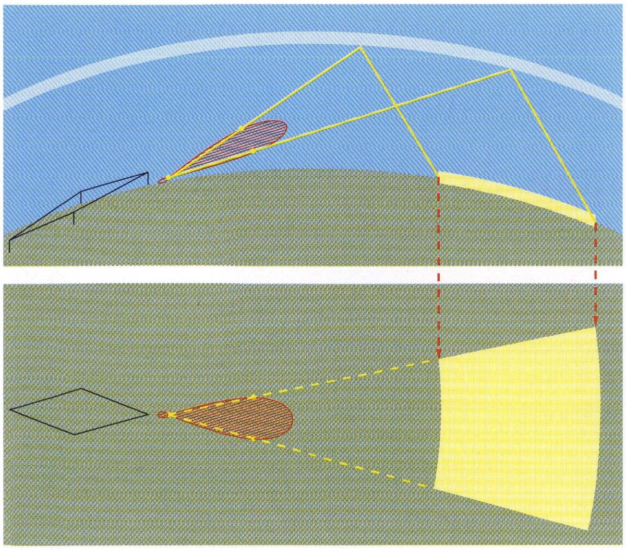


FIG 1 Highly directional patterns in azimuth and elevation cover only an area of limited size

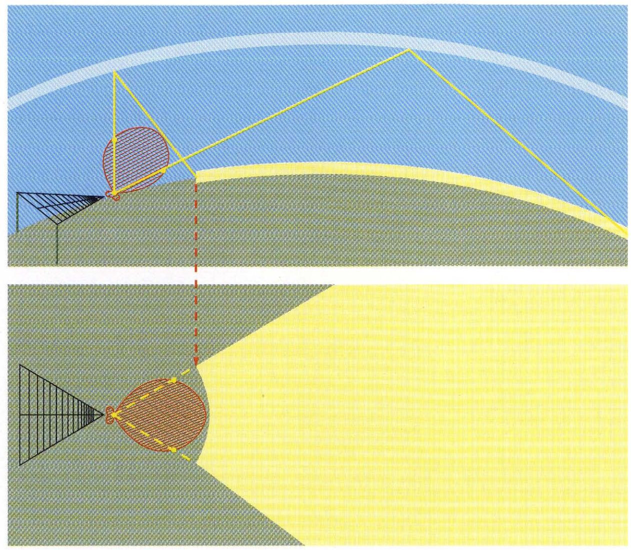
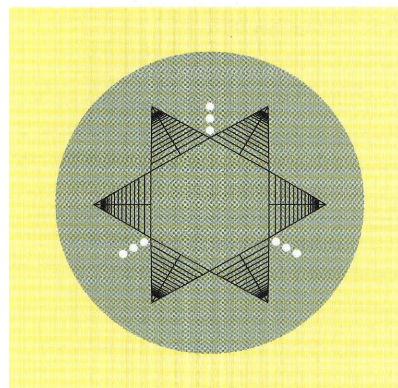


FIG 3 Complete coverage using horizontal LP antennas

By contrast to previous installations the newly developed vertical LP antennas used at Daun have a far higher gain and consequently lead to greatly improved reception sensitivity for vertically polarized waves. This improvement is obtained through the use of dipoles. The greater expenditure for the higher mast is traded off against the ground network that is no longer required.



To summarize, it seems apt to quote part of the speech made at the official commissioning of the antenna system on 10 September 1996 at Daun: "Open to all sides, the new antenna installation at Daun makes surveillance of potential targets from all corners of the world possible and lives up to the requirements of today's international scenario."

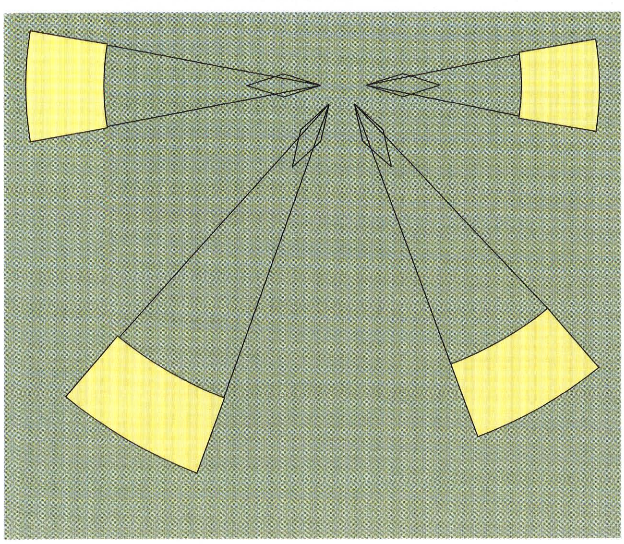


FIG 2 Concentrated ("island") monitoring with strongly directional antennas

RADIOMONITORING

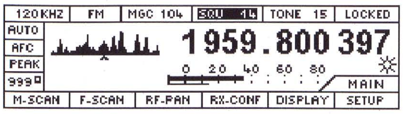
Radiolocation from 10 kHz to 3 GHz now also portable

Miniport Receiver EB200 and Active Handheld Directional Antenna HE200 form a portable unit for radiomonitoring in the wide frequency range from 10 kHz to 3 GHz. Whether used for monitoring emissions, detecting interference or locating miniature transmitters at any location, EB200 offers features unrivalled in its class up to now. The favourably priced, compact receiver with LAN interface may also be used as a detached rackmount unit.

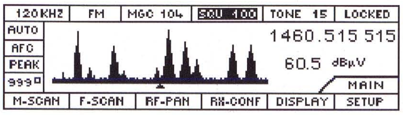
Designed for portable use

The ergonomic front-panel layout of Miniport Receiver EB200 guarantees convenient operation in portable use. Antenna and headphones connectors are located on the left of the front panel, so the user has a full view of receiver settings. The receiver can be operated with one hand only without blocking out the graphics display which shows alphanumeric characters, symbols and spectra. Various display modes allow for zoomed representation of parameters that happen to be important for the application on hand (FIG 1). When a recorder is connected, emissions can be logged in digital form for subsequent evaluation.

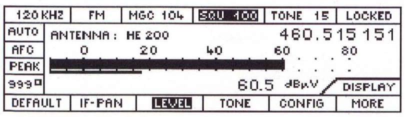
EB200 is powered from a plugged-on battery pack (option). The battery can easily and quickly be replaced when flat. While the receiver is operated from a second battery pack, the flat battery is charged from the AC power supply via the integrated battery charger. The power-saving receiver concept permits battery operation for about four hours, which is sufficient for most applications. In addition, a commercial battery belt may be plugged to a special connector of EB200 for 24-hour operation.



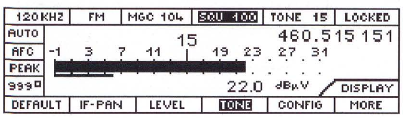
Frequency



IF panorama



Level



Level, zoomed

FIG 1 EB200 with optimum display to suit every application

The sturdy aluminium housing protects the receiver even against heavy shocks and is small enough to be accommodated in the glove compartment of a vehicle. When powered from the vehicle battery (10 to 30 V), the receiver can be operated for several days due to its low power consumption of less than 22 W. A cooling fan is not required, so operation is completely silent when the loudspeaker is switched off.

System-compatible for stationary use

EB200 is a compact, favourably priced, high-quality receiver that can be used in stationary systems. Thanks to its small size, a receiver block consisting of six EB200 comes up to about the size of a PC (FIG 2) so that a compact radiomonitoring system with analyzers, direction finders and recorders can be set up. Networking via LAN simplifies cabling and optimizes the command transfer speed. Since EB200 is controlled to SCPI standard, any existing control software for Compact Receiver ESMC can be used without problems. Due to the tracking preselection in the range 20 to 1800 MHz, which is standard in EB200, weak signals can be clearly detected even in the vicinity of powerful transmitters. EB200 can be retrofitted with an external preselection for the RF range 10 kHz to 30 MHz.

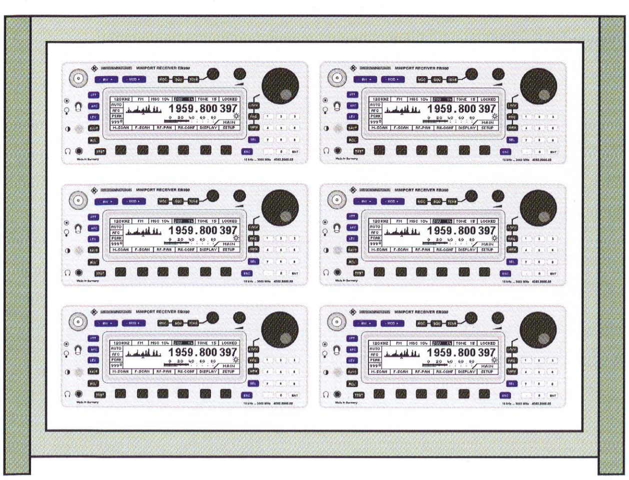
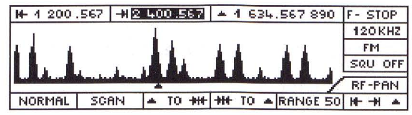
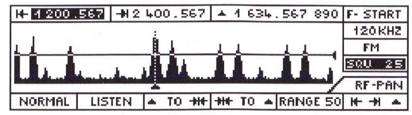


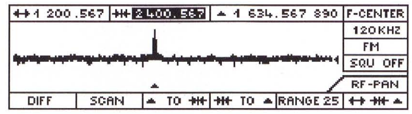
FIG 2 Block of six Miniport Receivers EB200



Scan mode



Listen mode



Differential mode

FIG 3 DIGI-Scan option for displaying, monitoring and detecting signals

Optimally equipped for any operating mode

Using the frequency spectrum (DIGI-Scan) option, EB200 scans the desired frequency range with digital control. The received spectrum is displayed (FIG 3) and emissions can be directly identified. Each detected signal can be aurally monitored at the push of a button: the frequency marker is positioned on the signal of interest with the stored spectrum in the background.

Miniature transmitters at close range are detected with the DIGI-Scan option in the differential mode. In this mode the displayed spectrum is stored as a reference. Current spectra are displayed relative to the reference spectrum and new signals or signals of different level are indicated in the form of peaks. If a measurement is made with the distance, the field strength of transmitters at close range varies more than that of transmitters at a greater distance. Thanks to this differential display, miniature transmitters can easily and reliably be detected even in the case of spread-spectrum emissions.

EB200 and Handheld Directional Antenna HE200 are an ideal combination for the location of a signal source. In difficult terrain, which cannot even be accessed by DF vehicles with four-wheel drive, the handheld antenna finds the direction of the transmitter. The supplied adapter permitting the antenna to be fixed to any commercial tripod should be used for long-term monitoring. The highly sensitive amplifier in the antenna handle is able to detect even the weakest of signals. Direction finding is simplified by a tone, the pitch of which corresponds to the signal level. When the tone is added to the signal contents, aural monitoring and direction finding can be performed at the same time. Even the level variation of keyed transmitters can be detected by means of the change in pitch.

Signal evaluation is based on the signal contents and the signal spectrum. Particularly in the case of digital transmissions, the spectrum may be the sole means of identifying a signal without resorting to more sophisticated analysis equipment. Since signals have different bandwidths, a fixed IF spectrum can only be a compromise. For this reason the resolution of the IF spectrum option of EB200 can be varied. Thus the signal spectrum is always optimally displayed and the user is provided with the correct information for evaluating the received signal.

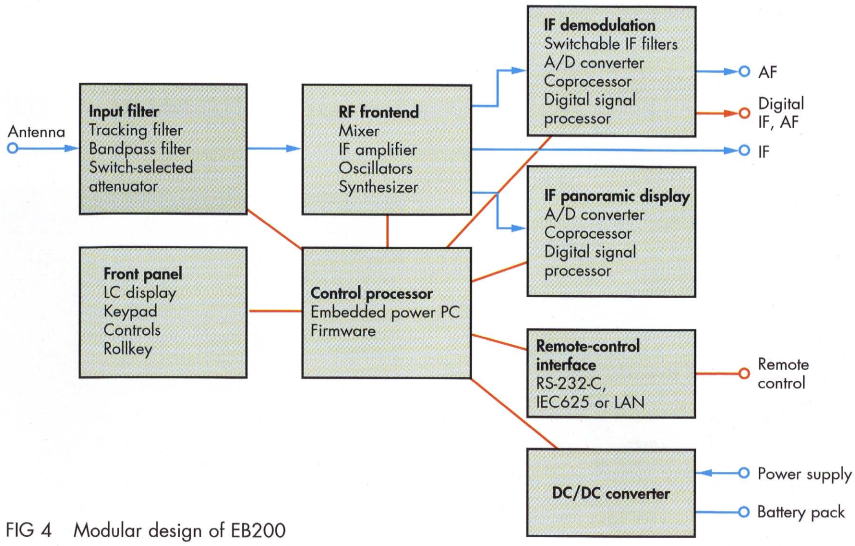


FIG 4 Modular design of EB200

With its 10 bandwidths between 150 Hz and 120 kHz EB200 has the right one for each signal to be investigated. Not only AM and FM but also LSB, USB and CW signals are demodulated as standard. Since the AF filter automatically tracks the bandwidth, a telephone filter is not required. In the case of broadband signals (up to 1 MHz) the IF spectrum option comes into its own: with this option EB200 covers five additional bandwidths and displays spectrum, level and offset of all signals. Broadband signals are however not demodulated. With the aid of the IF spectrum option practically any kind of emission can be identified.

Future-proof concept through digital signal processing

The successful combination of modular design (FIG 4) and functionality of a large instrument is obtained in EB200 through the use of large-scale integration ICs and digital signal processing in the IF filters, demodulators and synthesizer modules. At the same time a great number of selectable bandwidths and demodulators is available as well as a future-proof solution because additional functions or special methods of analysis can be downloaded from a PC at any time. Thus new features and enhancements find their way from the floppy to the receiver ensuring that EB200 will always reflect the latest state of the art.

Measurement and evaluation of compromising emissions up to 22 GHz

With the Test Receiver FSET, Rohde & Schwarz is adding another member to the spectrum analyzer family FSE. FSET covers a frequency range from 100 Hz to 22 GHz with very high sensitivity and a wide range of resolution bandwidths from 10 Hz to 500 MHz. The test receiver was designed particularly for measuring and evaluating compromising emissions and developed in close cooperation with the German Information Security Agency. The test receiver comprises two units, the receiver and the preselector/ preamplifier, each coming in two models: FSET22 with FSET-Z22 covers the frequency range from 100 Hz to 22 GHz, FSET7 with FSET-Z2 with a reduced upper limit of 2 GHz for preselection and 7 GHz for the receiver.

FIG 1 Test Receiver FSET22 and RF Preselector FSET-Z22

The transmission of information and data in digital form, eg in computer networks, is widely used and is often an important information medium within organizations – for internal communication or communication between different locations or partners. The exchanged data are normally confidential and not intended for third persons. However, any kind of electronic information processing and transmission causes electromagnetic emissions either at the information-processing devices themselves (eg display, computer, printer) or at the transport media (eg lines and cables). Even if the information is encrypted so that third parties have no access, the unprotected information may be modulated onto the encrypted data stream through parasitic effects, thus allowing unauthorized persons to reconstruct data with the aid of suitable means. Direct emissions are also possible, for instance via the display. To avoid such compromising emissions, suitable measures, eg screening, are used which have to be checked with suitable measuring instruments.

Receivers with special characteristics reaching the limits of the technically feasible are needed to detect such compromising emissions. A basic condition is high sensitivity ensuring that even the weakest signals can be detected and are not masked by the inherent noise. At the same time the receiver must not be overdriven by large signals, which may not even contain any information. Overdrive would lead to compression of the receiver input with the result that small signals would be masked. The basic disadvantage of spectrum analyzers with a view to the above characteristics is more than compensated for in the FSET by a powerful preselection and a design based on common receiver principles. FSET with Preselector FSET-Z22 therefore meets both requirements.

The 1 dB compression point of the RF input of more than +10 dBm makes the receiver highly immune to large signals. Up to 2 GHz, Preselector FSET-Z22 uses switchable 0, 10, 20 and 30 dB preamplifiers. The fixed 20 dB preamplifiers used above 2 GHz offer the best noise figures that can be achieved at present to obtain the required sensitivity. 31 highpass, lowpass or bandpass filters prevent preamplifiers and receiver being overdriven by strong out-of-band signals. Up to 40 MHz, 11 highpass and seven lowpass filters may be combined as required, from 40 to 250 MHz either octave or suboctave bandpass filters are used, and above 250 MHz bandpass filters are provided for RF selection. In spite of the many RF filters with switches and an attenuator, switchable in 1 dB steps, connected ahead of the preamplifiers, the noise figure of FSET is very low (FIG 2).

At low frequencies, the sensitivity of the test system is not only limited by the inherent noise of the receiver but also by mains hum and its harmonics. FSET avoids internal hum loops by a careful design of the RF input. Since hum can also be introduced by the test system itself and via the couplers, a balanced input is provided in the frequency range up to 50 kHz. Hum voltages are eliminated by a high common-mode suppression so that only signals from the DUT proper are received. The preselector with filters and amplifiers is controlled from the receiver. Settings for measurements in the entire frequency range can be predefined and are then automatically used by the receiver. Thus operator errors are practically excluded.

The edges of unintentionally emitted data signals in particular generate a wideband pulse spectrum that may be modulated with information. Sufficiently wide bandwidths are therefore required for detecting the pulse spectrum with high sensitivity. FSET offers IF bandwidths from 10 Hz to 500 MHz in steps of 1, 2 and 5.

The filters are Bessel filters with optimized group delay. They minimize overshoots of pulse signals so that even very close pulses of different amplitudes can be detected. The steepness of the IF filters (60/6 dB <4.5) ensures high selectivity for weak signals in the vicinity of strong signals.

Signal evaluation is of particular importance in the detection of compromising signals. FSET comprises evaluation aids and outputs a linear or logarithmic AM video signal of high spectral purity and wide dynamic range to external instruments, eg for correlation. The video bandwidth is independent of the IF bandwidth between 1 Hz and 500 MHz. External video filters may also be connected into the signal path and are calibrated by the internal calibration routines. If a signal is modulated with mains hum, the hum may be suppressed at video frequencies by means of an internal narrow comb notch filter (4.5 Hz at -3 dB). Thus only the carrier signal and the wanted modulation on the carrier remain. The carrier may be suppressed by a switchable AC/DC coupling of the video signal so that only the wanted AM modulation is obtained.

If very wide bandwidths are used for the measurements, pulse signals are reduced to extremely narrow video pulses. For instance, with an IF bandwidth of 500 MHz the pulse width is

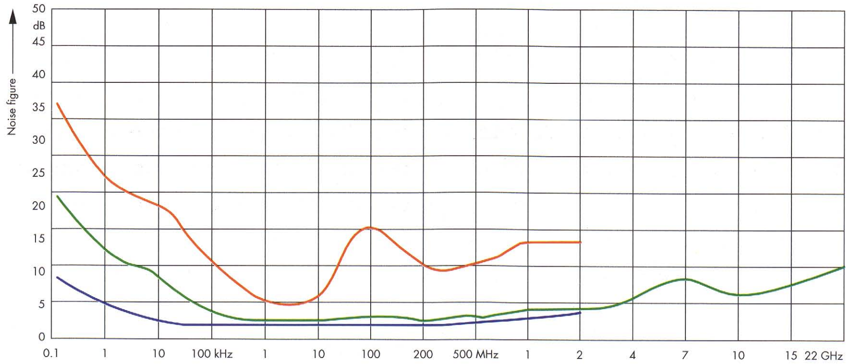


FIG 2 Noise figure of FSET22 with FSET-Z22 versus frequency and as a function of preamplification

only about 2 ns. These narrow pulses are hard to detect particularly when they occur very rarely. FSET comprises a pulse stretcher for the correct measurement of pulse amplitudes. The pulse stretcher detects even the shortest pulses at the correct amplitude and extends them to 50 ns (1 dB drop). Thus the pulses can be more easily displayed on an oscilloscope at the video output, for instance, and they are long enough to be digitized by the internal 20 MHz A/D converter and displayed on the FSET with the correct amplitude (FIG 3).

Internal hardware and firmware evaluation aids simplify signal analysis. The video dynamic range is of great importance when signals of considerably differing levels are to be displayed. The dynamic range of the AM video detector is shown in the TABLE. The wide dynamic range particularly for the linear level display is achieved by a new digital design. This is also for the benefit of the

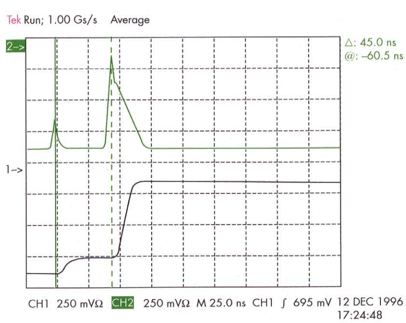


FIG 3 Two pulses spaced 45 ns apart with different amplitudes are correctly detected with the aid of the pulse stretcher

peak detector following the video detector. The peak detector consists of digital comparators that are reset between two samples of the A/D converter. This ensures that signals are not lost during the reset of the detector. Since the resolution of the display is finite, data must be compressed for displaying spectra. This

IF bandwidth	Log video	Lin video
10 Hz to 1 kHz	120 dB	90 dB
2 kHz to 10 MHz	110 dB	90 dB
10 MHz to 500 MHz	70 dB	30 dB

causes signal details to be lost particularly at frequency ranges that are large compared to the resolution bandwidth. This is not the case in the FSET: all measured samples are stored in the 1 Mbyte memory (= 500 000 samples), and signal sections of interest can subsequently be displayed with a high resolution – a time-saving feature particularly if long measurements are performed (FIG 4).

The memory may also be used for point-by-point averaging of traces. Up to 1024 full-resolution traces can be averaged linearly or logarithmically. Since the complete signal information is available and the synthesizer is synchronized to the reference in all frequency display ranges, stable signals are not lost and only the noise is eliminated. Further analyses may be performed in the time domain using horizontal sweep down to 100 ns/div and the AF demodulators. An AM, an FM and a phase detector are available for analog modulation and demodulators are provided for all common types of digital modulation (FSK, PSK, QPSK and MSK). The demodulated signal can be displayed and – in the case of analog modulation – output at the rear panel of the receiver. Up to a resolution bandwidth of 100 kHz, all digital demodulators are realized by means of signal processors. This results in an optimum noise characteristic and high accuracy even if the modulation depth and the frequency or phase deviation are very low. An analog FM demodulator is provided in addition for bandwidths of up to 10 MHz. It is designed for the demodulation of low deviations at high modulation frequencies. FIG 5 shows the demodulated signal represented as a spectrum in FIG 4. The signal is frequency-modulated with a deviation of 100 Hz.

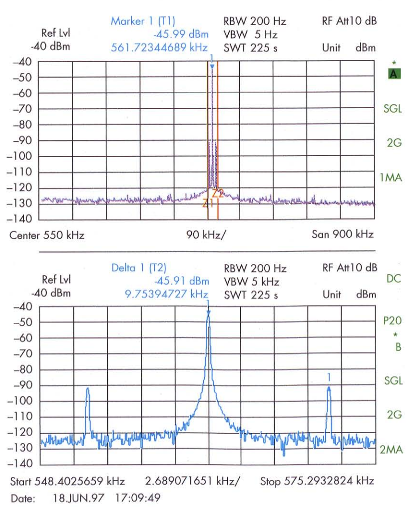


FIG 4 Spectrum in split-screen mode (100 k to 1 M, RBW 100 kHz, original and zoom)

A powerful computer network consisting of a 586 PC, five transputers and five DSPs ensures sufficiently high computing power. For instance, FSET may be operated with a minimum sweep time of 5 ms in a 7 GHz range with the sweep fully synchronized to the reference frequency and 25 traces displayed per second. Transducer factors of, for instance, clamp-on current probes or antennas with associated cables are considered in the measurement results so that results are displayed as field strength or current with the correct physical unit. Limits can be entered by the user as required. They are stored on the integrated hard disk

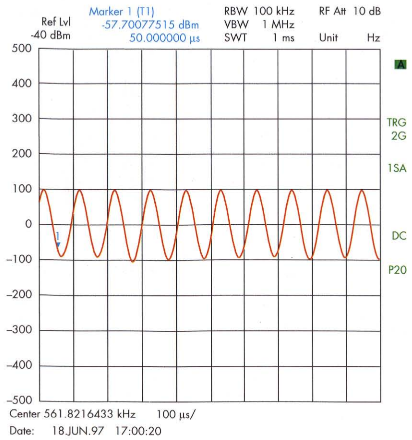
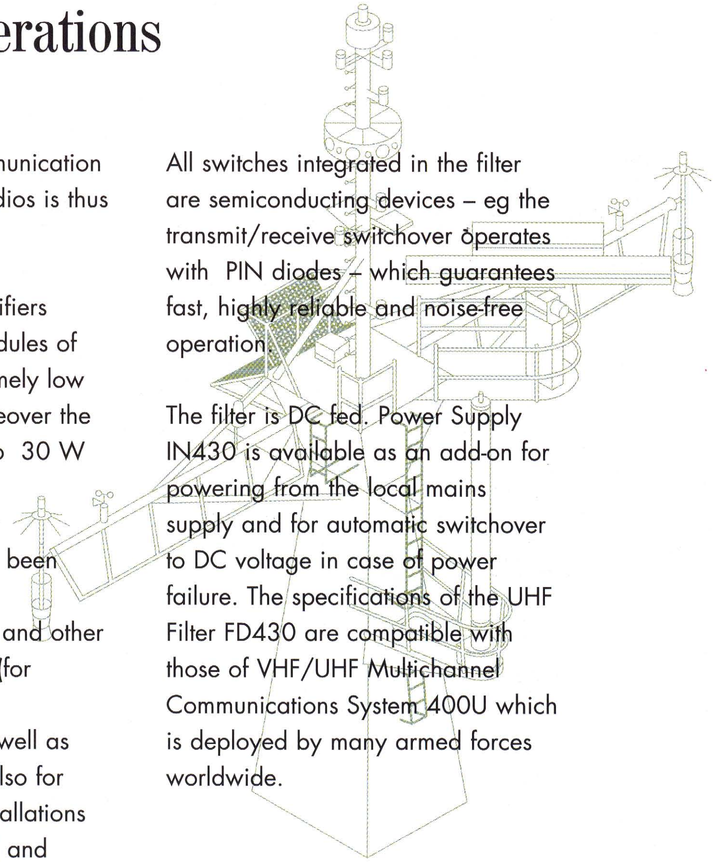


FIG 5 Signal from FIG 4, FM-demodulated

and may be linked to a margin in a pass/fail monitoring procedure. If, for reasons of security, the data should not be stored in the unit, a replaceable hard disk may be used which can be exchanged from the front panel. The frequency axis may be displayed as a straight line above the logarithmic frequency axis on a logarithmic scale. The powerful computer is also of advantage for system operation. FSET can be controlled extremely fast via the IEC/IEEE bus. Control of other instruments is also possible via a second IEC/IEEE-bus interface and application programs can be run internally in DOS or the Windows standard mode. The parallel operation of the internal computer and the receiver does not reduce the measurement speed.

Frequency-agile UHF Transmitting/Receiving Filter FD430 optimizes radio operations

PRODUCTS



UHF Filter FD430 is used in multiple, simultaneously operating radio systems where interference is caused by the system's nearby antennas and by frequency hopping. The selectivity of the filter improves the transmission and reception qualities in the frequency range 225 to 400 MHz since the main filter and amplifier section of FD430 is put to use twice. The following attributes are improved through the use of the filter:

- spectral purity and broadband noise of transmitters,
- crossmodulation, intermodulation and blocking of receivers.

The interference-free communication range of neighbouring radios is thus significantly extended.

The use of low-noise amplifiers between the four filter modules of FD430 results in an extremely low noise figure of 8 dB. Moreover the drive signal is amplified to 30 W (AM)/ 100 W (FM).

The UHF Filter FD430 has been developed for

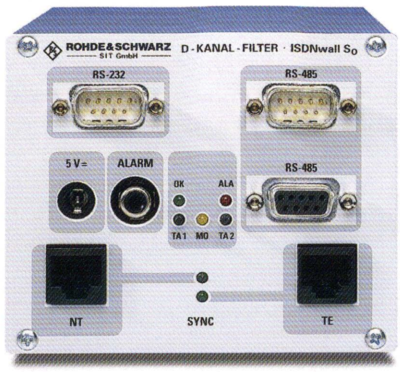
- HAVE QUICK, SECOS and other EPM (ECCM) methods (for SATURN on request),
- fixed radio stations as well as with shock absorbers also for
- transportable radio installations (cabins, mobile towers) and
- use on ships.

All switches integrated in the filter are semiconducting devices – eg the transmit/receive switchover operates with PIN diodes – which guarantees fast, highly reliable and noise-free operation.

The filter is DC fed. Power Supply IN430 is available as an add-on for powering from the local mains supply and for automatic switchover to DC voltage in case of power failure. The specifications of the UHF Filter FD430 are compatible with those of VHF/UHF Multichannel Communications System 400U which is deployed by many armed forces worldwide.

D-channel filter ISDNwall – essential contribution to increased security of ISDN telecommunications systems

What harm can be done when the telephone's handsfree microphone is activated by an outsider just at the moment when strategic decisions are being made in the very room? It is hardly a secret that intelligence services both in the East and West resort to every possible means and utilize large personnel resources to reach their objectives. The emergence of digital technologies has brought new threats to IT security against which protective measures have to be found.



Based on an order of the German Information Security Agency (BSI), the Rohde & Schwarz subsidiary SIT, Gesellschaft für Systeme der Informationstechnik mbH, Berlin, has developed ISDNwall to increase the security of ISDN (integrated services digital network) telecommunication systems. This device performs filtering of the D channel, which is used for ISDN control. Basically, the D-channel filter is an ISDN firewall. A survey of the market has shown that there is no comparable product worldwide.

The primary protection afforded by ISDNwall is the prevention of unauthorized access to services and performance features, the aversion of concealed information transfer in the D channel and the possibility of detecting and preventing intrusions within the network and from the outside. In spite of the filter function the high transmission capacity of the ISDN channels is maintained, ie the D-channel capacity of 16 kbit/s for the S_0 bus and 64 kbit/s for S_{2M}. B channels are not affected either. ISDNwall is able to protect telecommunication systems with more than 10 000 subscribers.

FIG 1 Principle of D-channel filter

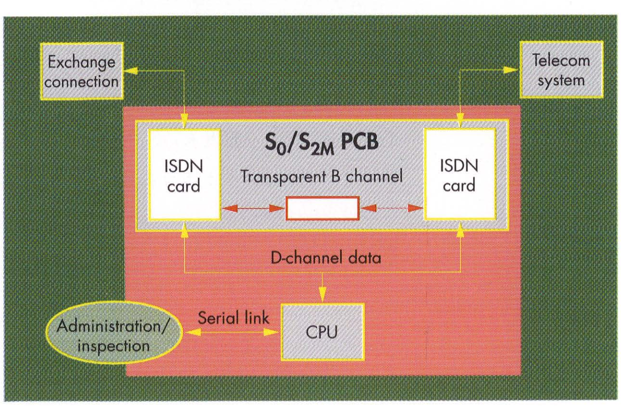
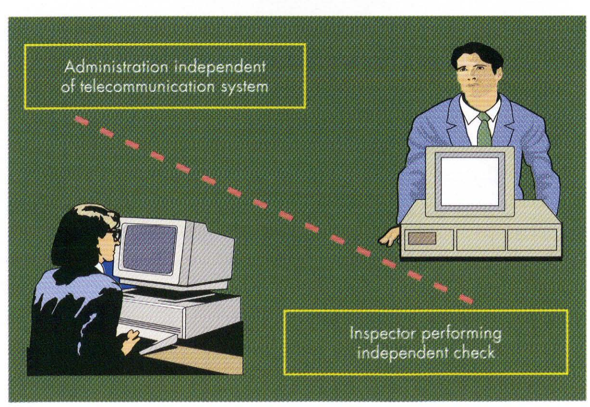


FIG 2 Separation of administrator and inspector



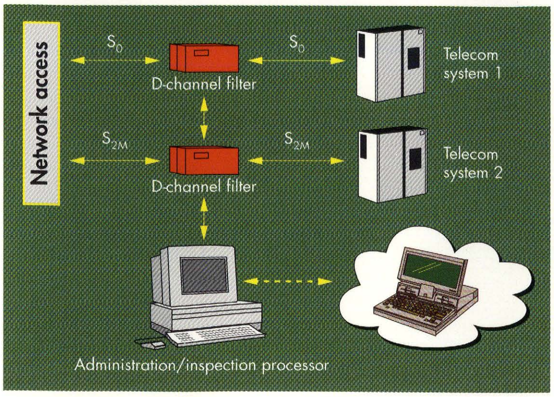


FIG 3 Configuration of individual systems

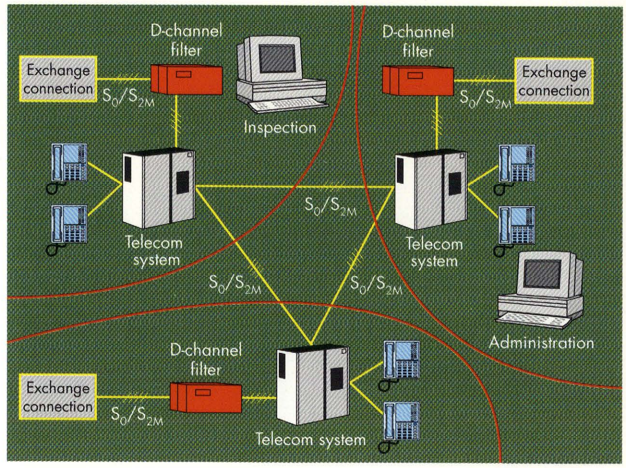


FIG 4 Configuration of networked systems

Design of the filter

All incoming and outgoing information on the D channel is separated from the user data in the B channels by means of two ISDN interface cards (1 or 3 x S_0 or 1 x S_{2M}), which are accommodated on one PCB, and then forwarded to a processor board (FIG 1). The filter software bars all services and performance features that are not explicitly activated for a specific subscriber/extension number or group of subscribers. Any unauthorized attempt to use barred services and features is met by the filter with a link cleardown. Furthermore the device can protocol such events and generate alarms.

An administrator is responsible for configuring and adapting the filter to the telecommunication system to be protected. Furthermore an inspector can carry out checks (FIG 2). Both can access the filter via a commercial PC. Complex functions are available to the administrator; they can be handled via a familiar graphical user interface (Windows 95, Windows NT). Internal filter conditions can be set via easy-to-understand menus. A difference is made between protocol-specific and subscriber-specific filter conditions. Protocol-specific conditions ensure transmission in the D channel. They thus prevent or detect unauthorized access attempts via protocol elements. The subscriber-specific filter conditions assign authorized services and performance features to the extension numbers.

Another essential function of the D-channel filter is the recording of any violation of filter conditions and of all security-relevant events in a report which is stored in a nonvolatile memory. Only the inspector is authorized to view, copy and clear the report data. Access of the administrator/inspector to the filter is protected by a strict authentication using cryptographic algorithms. Any attempt to violate this mechanism is recorded and prevented after a selectable number of unsuccessful attempts. Highly security-relevant events are signalled by an optical and acoustic alarm. Further cryptographic functions guarantee the integrity of programs and filter conditions.

To protect telecommunication systems against manipulations via PSTN or private networks, the D-channel filter can be connected to any S_0 or S_{2M} interface of a single or networked telecommunication system (FIGs 3 and 4) with point-to-point connections to the PSTN. The different versions of ISDNwall can serve one or three S_0 interfaces simultaneously, for S_{2M} one filter is provided per interface.

No modifications have to be made to the telecommunication system when the filter is installed. Since ISDNwall is completely system-independent, the make of the system is of no importance. The special design of the filter reliably prevents any attempt to manipulate the system electrically from the network via the ISDN system connector. ISDNwall is noteworthy for its great flexibility. This, in conjunction with the protocol functions, allows quick reaction regarding adaptation to new, presently unknown attacks. The cryptographic techniques and algorithms used for authenticating and safeguarding the program integrity can be tailored to customer requirements.

Printed in Germany 0598 (P ro/ho)

PD 757.4260.21

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