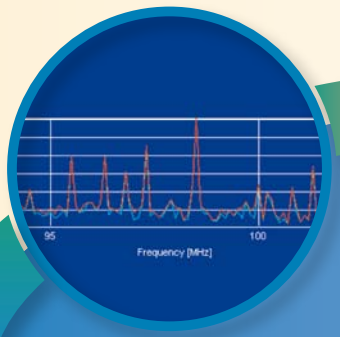
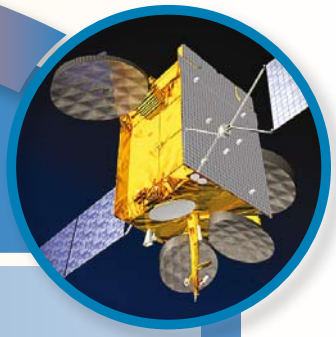




R&S® ARGUS systems

Solutions for spectrum monitoring:

- Measurements and evaluations in line with ITU regulations
- Interference analysis
- Coverage measurements
- Identification of signals
- Open interface to spectrum management databases

R&S® RAMON systems

Solutions for:

- COMINT:
  - Reconnaissance of communications networks
  - Analysis and evaluation of intercepted communications
- CESM/force protection:
  - Reconnaissance focusing on possible threats
  - Generation of initial situation picture
- Object tracing

Satmon systems

Solutions for:

- INMARSAT and Thuraya interception, plus interception of multiplex signals
- Analysis of satellite communications and multiplex signals
- Systems for stationary or semi-mobile applications as well as remote interception (remote sensor)
- Integrated analysis environment

Chapter 5

Systems for radiomonitoring and radiolocation

Scalable automatic systems – even nationwide

Rohde & Schwarz has decades of experience in the design and implementation of complex radiomonitoring, radiolocation and spectrum management systems:

- Standalone or multi-user systems
- Remote-controlled, networked, nationwide configurations using LANs/WANs
- Short-term delivery even of customized systems due to modular hardware and software design
- Full integration of spectrum management and radiomonitoring tasks based on relational databases
- Training and logistics from a single source

R&S®ARGUS – systems for spectrum monitoring applications

Rohde & Schwarz developed a very modular software for spectrum monitoring applications called R&S®ARGUS. R&S®ARGUS software provides a wide scope of functions, fulfilling even specific customer requirements due to its flexible measurement task definition tools. It enables not only the accomplishment of all measurement tasks in line with ITU regulations but provides also an open interface to spectrum management software.

R&S®RAMON – systems for COMINT/CESM applications

The R&S®RAMON systems are solutions for tactical and strategic communications intelligence. These systems feature in particular high probability of intercept, direction finding and location of short-duration signals as well as detection and tracking of radio transmitters. The radiomonitoring results provided by the R&S®RAMON systems contribute to the generation of a situation picture. Especially in regions with poor infrastructure, R&S®RAMON systems can be networked via wireless communications means for use at short notice in a limited area.

Satmon systems from Rohde & Schwarz – for monitoring satellite communications

Rohde & Schwarz has many years of experience in designing and developing mobile and general satellite communications monitoring systems. Turnkey Satmon systems allow monitoring on the radio interface from interception to analysis.

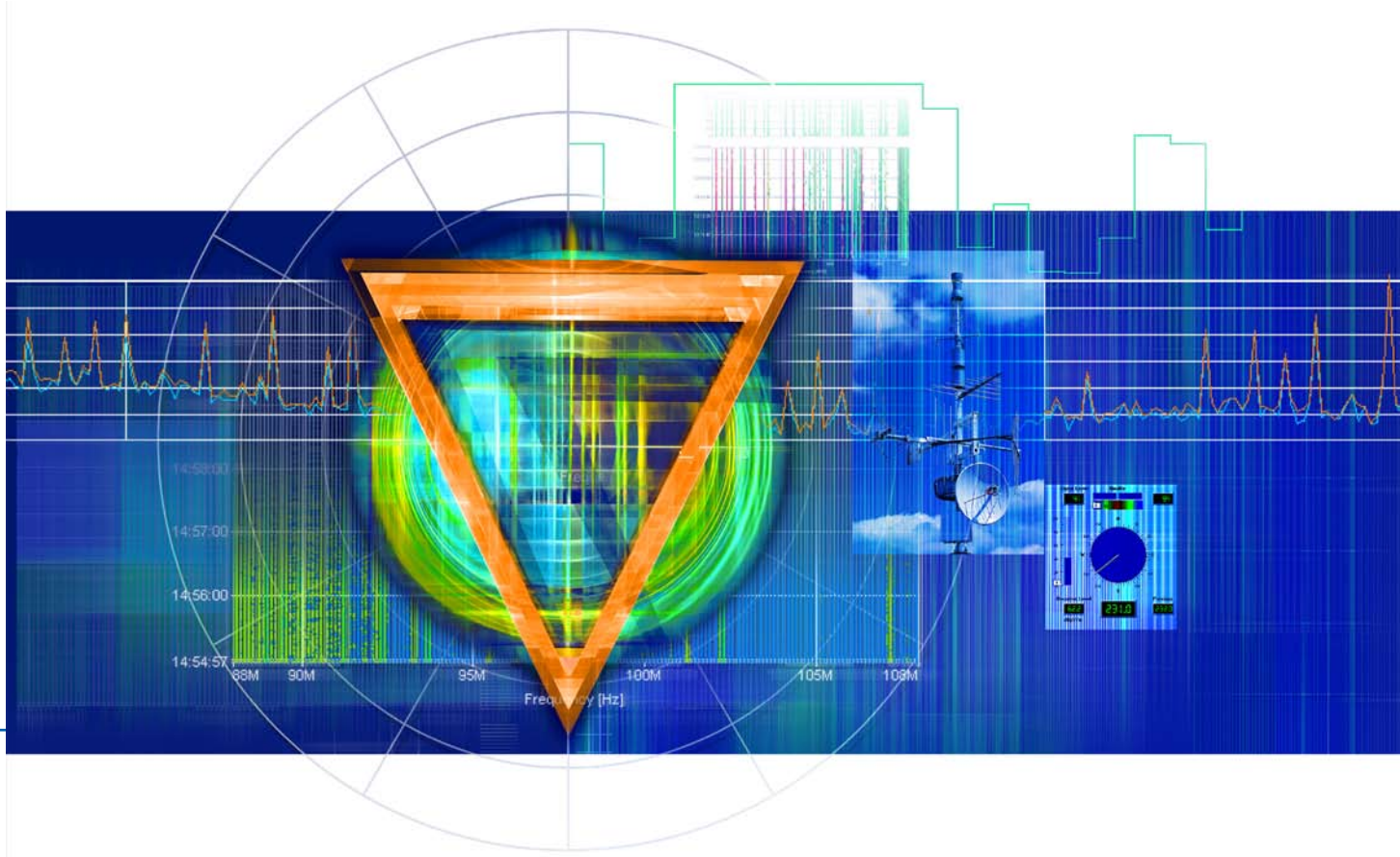
Software, Systems, and System Devices

Contents of Chapter 5

Software, Systems, and System Devices

Software, Systems, and System Devices

Software, Systems, and System Devices



Civil radiomonitoring

Wireless communications are crucial in modern society. Broadcasting, TV, and mobile phones are indispensable, as are rescue services, alarm signals, and airborne communications. However, the range of the electromagnetic spectrum available for these applications is limited and cannot be expanded as needed. Especially frequency ranges permitting easy and therefore economical technical solutions are heavily occupied. To ensure virtually ideal conditions for all users and prevent interference as far as possible, appropriate regulations must be compiled, checked, and implemented. As radio waves do not stop at national borders, this effort must be handled at an international level. The International Telecommunication Union (ITU) is in charge of this task. As a committee of the United Nations, the ITU issues recommendations, which the individual member states will then implement in national law. Usually, there are national regulating authorities in the member states, focusing on spectrum monitoring and spectrum management. Spectrum monitoring mainly includes measurements and analyses based on the applicable ITU guidelines and recommendations, as well as detecting and eliminating interference. Spectrum management primarily handles the planning and licensing of transmitters. Spectrum monitoring measurement results are very useful when it comes to verifying plans and optimizing coverage.

Rohde&Schwarz is an active sector member of the ITU and brings years of technical know-how and expertise to the various ITU study group and working party. In addition, the company develops and produces hardware, software, and systems that optimally meet the requirements of modern spectrum monitoring and are thus ideal tools for regulating authorities all over the world.

R&S®ARGUS Spectrum Monitoring and Management System

Spectrum monitoring from compact systems to nationwide networks from 20 Hz to 256 GHz

Main features

- Measurements and evaluations in line with ITU regulations
- Easy operation by intuitive graphical user interface
- Interference analysis
- Direction finding and location with up to four stations simultaneously
- Coverage measurements
- Comprehensive identification module
- Dedicated measurements and evaluations for digital signals
- Automated measurement procedures
- Processing and evaluation of measurement results
- Storage of all measurement activities including results
- Sophisticated operator guidance
- Open interface to spectrum management databases

Brief description

R&S®ARGUS is the standard software from Rohde & Schwarz for ITU-compliant measurements and evaluations. Since its first launch 20 years ago it has been continuously extended and upgraded, thus always providing an up-to-date spectrum monitoring solution.

One core requirement for a successful monitoring system is its reliability. Only a system that is permanently available can perform all the necessary tasks. And only such an efficient system can secure the revenues that are generated by a nationwide spectrum monitoring and management system. Throughout all the years, R&S®ARGUS has very impressively demonstrated this capability, worldwide.

The R&S®ARGUS software concept offers state-of-the-art monitoring and measurement in a highly modular way. Different packages cover all the needs of today and tomorrow:

- R&S®ARGUS measurement modes for all measurement and monitoring tasks
- R&S®ARGUS evaluation module for statistical evaluation and analysis of measurement results
- Order report module for use of R&S®ARGUS facilities by external applications
- R&S®MapView for display of direction finding, location and coverage results on different types of electronic maps
- Integration of standard and customer-specific spectrum management databases

Due to this flexible concept operators can set up a basic system in line with their budgets, beginning with the core set of equipment for a modest amount of money. Step by step, a nationwide system can be formed by adding additional hardware and software modules to meet new requirements.

This is one of the many reasons why more than 50 % of the world's countries have an R&S®ARGUS system.

Networking

The R&S®ARGUS system can be used as a single-station system, as a local area network system (LAN) or as large, multistation wide area network system (WAN).

The software allows full client-server operation, with or without permanent connection. The protocol used is TCP/IP, which has become the de facto standard in worldwide communications. A large variety of different communications media allows a most flexible network scenario:

- GSM communications (9.6 kbit/s with RLP)
- Radio links (up to 15 kbit/s)

- PSTN lines (dialed or leased, up to 33 kbit/s)
- ISDN (64/128 kbit/s (S_0) to 2 Mbit/s (S_{2M}))
- Microwave links (19.2 Mbit/s to 2 Mbit/s)
- Ethernet (10/100 Mbit/s)
- Dedicated digital lines, e.g. fiber-optic links (up to 2 Mbit/s)

The above figures are standard values. For each type of communications, considerably higher data rates are available on request. Due to the sophisticated client-server architecture of R&S®ARGUS, even a GSM connection is fully sufficient to remote-control a monitoring station. Optimized bandwidth management and highly efficient data compression procedures ensure that all measurement data, including audio and IF spectra, can be transferred to the control station with an absolute minimum of network resources.

Mobile applications

A core requirement for an efficient spectrum monitoring system is mobility. In many cases, e.g. remote areas of a country, urban environments or poor infrastructure, fixed monitoring stations need a mobile component to cover all necessary aspects of their duty.

Covering a frequency range from 10 kHz to 3 GHz: R&S®AU900A5

Due to the flexibility of R&S®ARGUS, mobile or transportable systems are equipped with the same software as fixed stations. Moreover, the simple addition of compass, GPS, and mobile communications (e.g. GSM or AMPS) adds significant value to a monitoring network and makes the mobile system a fully integrated monitoring station, inclusive of simultaneous transfer of audio and data.

Hardware

We have the appropriate device driver for all Rohde&Schwarz analyzers, receivers, direction finders, and accessories used in monitoring. However, with the open DCI interface it is possible to integrate other models and devices from other manufacturers as well.

Radiomonitoring vehicle

Data interfaces

The R&S®ARGUS software modules provide many ways of exchanging data between the modules themselves and other applications. These are the following:

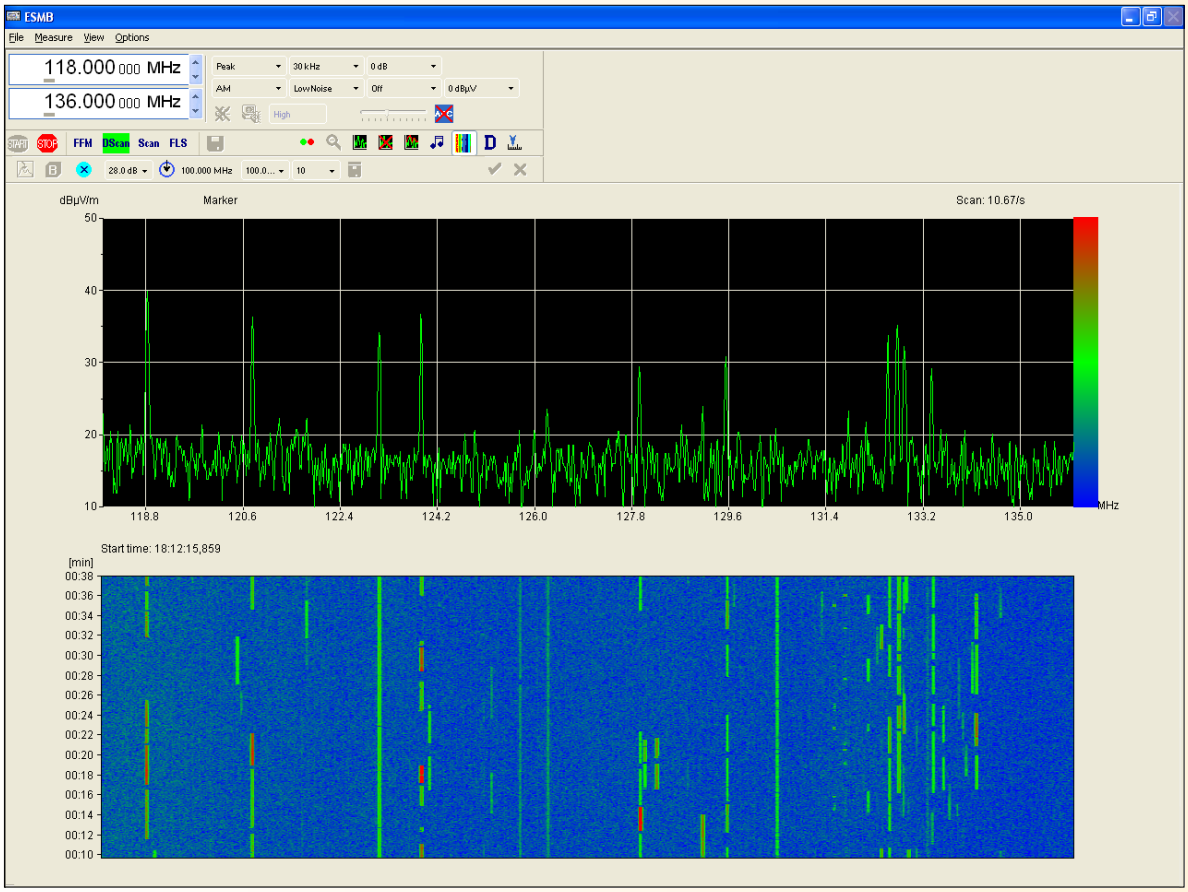
- Extensible mark-up language (XML) – transfer of measurement requests (orders) to R&S®ARGUS and of measurement results (reports) back to external applications; transfer of database requests to frequency management databases and of results back to R&S®ARGUS

- Open database connectivity (ODBC) – can be used to communicate XML requests to frequency management databases and vice versa
- Rohde&Schwarz internal formats – data exchange between all R&S®ARGUS modules

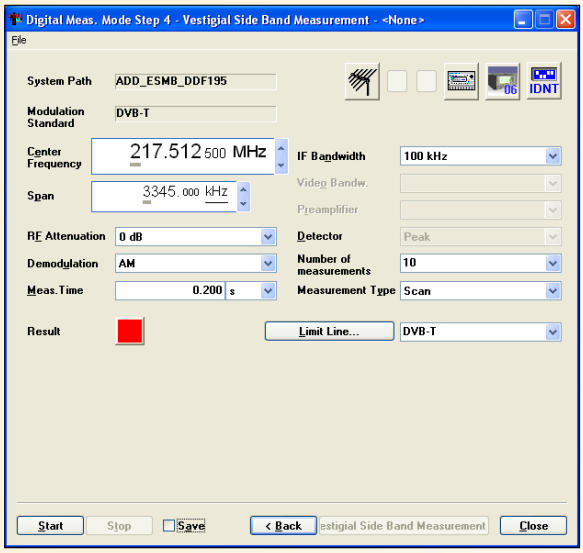
Spectrum monitoring

The following most important spectrum monitoring applications have been worked out by Rohde&Schwarz together with different national regulatory bodies on the basis of their daily work and all measurements described in the ITU Spectrum Monitoring Handbook.

- Interference due to co-channel emissions identifies an emission at a known frequency
- Interference due to adjacent channel emissions determines an emission at a known frequency and identifies an emission at an unknown frequency
- Interference due to intermodulation determines sources of intermodulation
- Monitoring of the technical parameters of transmitters provides the relevant parameters of an emission at known frequencies
- Coverage measurements using a mobile or transportable station reveal the exact field strength of transmitters at different locations
- Identification of unlicensed transmitters shows unlicensed emissions at a known frequency
- Deviation measurements of FM broadcast transmitters determine the peak deviation of one or more FM transmitters under operating conditions
- Long-term observation of transmitters involves the determination of relevant transmitter parameters over a long period of time and their statistical evaluation
- Frequency occupancy measurements determine the occupancy of one or more known channels



Example of interactive measurement mode (see following page)



Example of guided measurements of digital signals

Measurement modes

R&S®ARGUS provides various measurement modes to cover all spectrum monitoring tasks:

- The **direct measurement mode** is used to control the devices directly.
- The **interactive measurement mode** is used for obtaining an overview of a spectrum, for analyzing and identifying electromagnetic emissions, for obtaining results when an antenna is moved, for analyzing intermodulation, and for performing coverage measurements. Intermodulation with up to three source signals is taken into account.
- The **automatic measurement mode** is primarily used for the long-term surveillance and observation of bandwidth, field strength, frequency and modulation in line with a user-defined schedule.
- The **difference measurement module** is an addition to the automatic measurement mode. Two receivers of the same type simultaneously perform the same measurement at two different adjacent locations. After each scan the difference of the two spectra is calculated. The difference spectrum as well as the two originating spectra are displayed as graphics.
- The **bearing measurement mode** is used to locate transmitters. Up to four direction finders at different locations can be controlled simultaneously. It is also possible to take running fixes to locate a transmitter with only one direction finder.
- The **order report module** enables other applications to send measurement requests (orders) to R&S®ARGUS and to receive the measurement results (reports). It is also possible to define orders within R&S®ARGUS. Orders can be defined for several measurement stations and are automatically transferred by R&S®ARGUS.
- The **guided measurement modes** strongly support the operators by providing default settings for all device parameters. The user only needs to select the frequencies to be monitored. The R&S®ARGUS system then suggests default values based on the relevant ITU recommendations. These guided modes are available for measurements of analog signals as well as of digital signals.
- The **identification module** is an extremely powerful tool for online decoding of analog and digital signals. More than 120 different decoding modes have been implemented. In the VHF/UHF range, for example a large variety of decoding modules for all popular paging formats, trunk mobile radio, selective calling, dialing formats, and common mobile data text transmission systems are included.

Monitoring and analysis of digital signals

Extended functionality for the measurement and evaluation of digitally modulated signals is available. This includes broadcast standards such as DVB-T and DRM (Digital Radio Mondiale) as well as mobile phone standards such as GSM, EDGE, CDMA, DECT, UMTS, and TETRA.

Evaluation module

The R&S®ARGUS evaluation module enables a comprehensive statistical evaluation of all measurement results in line with the standards and recommendations of ITU-R. Measurement results, their definitions and statistical evaluations are documented.

Histograms and distribution can be determined and documented on the basis of the channels. These calculations can be used for providing information about the following quantities:

- Variation bandwidth of measured values
- Stability of measured values
- Ambient noise component
- Cross-modulation and intermodulation effects

IT security concept

The IT security concept of R&S®ARGUS covers three areas:

- Security through user groups as owners of the files
- User class concept with grading of access rights
- Password protection

Service throughout entire life cycle

Rohde & Schwarz provides service throughout the entire life cycle of any R&S®ARGUS system. This service includes support during the requirement analysis and system configuration as well as training, support, and maintenance of hardware and software during operation.

Device drivers

R&S®ARGUS can control the following devices:

- Receivers and analyzers: R&S®EM510, R&S®EM550, R&S®FSHx, R&S®FSQ, R&S®FSU, R&S®ESxN, R&S®ESH3, R&S®ESVP, R&S®FAM, R&S®FSx, R&S®ESxI, R&S®ESM, R&S®ESMC, R&S®VSA, R&S®ESxx, R&S®EB200, R&S®EK89x, R&S®FSEx, R&S®FSIQ, R&S®ESI, R&S®FMx, R&S®EFA, R&S®ESMB, R&S®FSPx
- Direction finders: R&S®DDF0xA, R&S®DDF0xE, R&S®PA025, R&S®PAx55, R&S®PA1555, R&S®DDF1xx, R&S®DDF0xM, R&S®DDFARC
- Decoders and recorders: DRM, RNA-930, R&S®DEF, R&S®DMC01, DataBridge, CG300, TELEVOX, SWS80, PCM-7010
- Accessories: R&S®ZS12x, R&S®RSU, R&S®RSU-T, R&S®BG016, R&S®BG030, R&S®ORBIT, rotator, compass, R&S®GPS, R&S®GX300, R&S®XL-DC; attenuator/amplifier, R&S®AllAudio

New

R&S®UMS100/120 Monitoring Systems

Compact monitoring system from 100 kHz to 6 GHz

Main features

- Compact design, easy to mount and put into operation (plug & play)
- Suitable for indoor and outdoor use as well as vehicle integration
- Designed for fully automatic and standalone operation (built-in processor and memory)
- Frequency range 20 MHz to 1.3 GHz (100 kHz to 6 GHz with options)
- Universal power supply (AC and DC)
- Low power consumption
- Remote control via LAN and mobile phone networks
- Easy integration into R&S®ARGUS radiomonitoring networks

Brief description

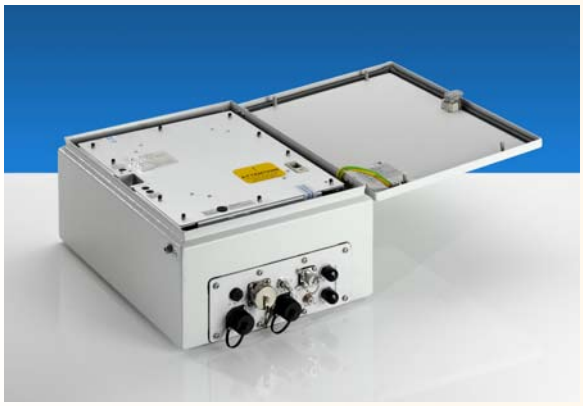
All the measurement equipment except the antennas is integrated in a closed container. To optimize outdoor use, the main container is covered by a second, external box. All connectors are protected at the bottom of the container.

The data connection to the R&S®UMS100 can be set up via a LAN cable or, in wireless operation, via a mobile phone network connection (e.g. GSM). Both capabilities are always provided by the R&S®UMS100.

Typical applications

- Automated measurement and surveillance tasks
- Monitoring of large areas with an appropriate number of R&S®UMS100 systems (e.g. national borders, coastlines, harbors, military training areas)
- Search for new (illegal) signals that may cause harm to critical communications (e.g. near airports)
- Monitoring of licensed transmitters for operating compliance
- Monitoring of rooms and buildings to detect the use of illegal transmitters (e.g. airports, hospitals, schools)
- Mobile search for new signals and monitoring of existing signals via integration of the R&S®UMS100 in conventional vehicles

Besides the automatic measurements used in unattended operation, interactive measurements can be performed to obtain more detailed information about the radio spectrum of interest.



R&S®UMS120 system unit

R&S®UMS100

Search for unknown signals
If it is necessary to check an entire frequency range for unknown signals, a scan can be initiated by defining the lower and upper frequencies. The entire frequency range from 100 kHz up to 6 GHz can be scanned within approx. 1 s.

Monitoring of fixed frequencies
In the non-scan mode, the R&S®UMS100 can measure level, frequency and offset values for defined frequencies. By using AM or FM demodulation, remote listening to audio signals can be performed.

If you need to monitor several defined frequencies, you can perform the measurements using a frequency list. After these predefined lists have been processed, the measurement results will be output on a graphic display.

Power supply

The R&S®UMS100 comes with a universal power supply concept. The system can be operated with 10 V to 30 V DC as well as with 100 V to 240 V AC or even simultaneously. For example, failure of the AC power supply will cause the R&S®UMS100/120 to switch to battery power without any interruption in operation.

Special emphasis has been placed on minimum power consumption. For typical ambient temperatures between 0 °C and +55 °C, power consumption is only approx. 25 W. Additional power is needed for heating the R&S®UMS100/120 – but only if the ambient temperature is extremely low.

Installation

The R&S®UMS100 monitoring system is supplied together with a complete set of installation material, allowing it to be placed into operation very quickly. For easy assembly, a toolset with all necessary wrenches and screwdrivers is included.

In most cases, it is sufficient to connect one monitoring antenna. A broadband discone antenna covers the frequency range 20 MHz to 1.3 GHz. To extend the frequency range, the R&S®UMS100/120 provides two antenna inputs. It is also possible to connect different antennas, e.g. a wideband antenna for the frequency range 100 kHz to 1.3 GHz and an antenna for the range 1.3 GHz to 6 GHz.

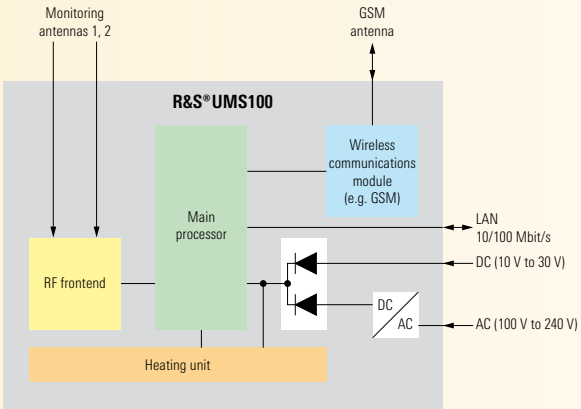
Operation

The R&S®UMS100 has no local control elements. The integrated LAN connection and the mobile phone network interface, e.g. GSM, make it possible to control the system from a remote external computer.

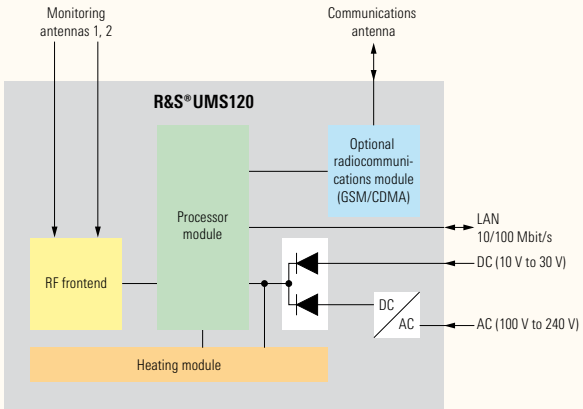
The R&S®ARGUS-UMS control software is based on the R&S®ARGUS spectrum monitoring software, which incorporates many years of experience. Owing to the intuitive, user-friendly graphical user interface of R&S®ARGUS-UMS, even complex measurement tasks can be performed extremely efficiently. R&S®ARGUS-UMS can also handle a large number of R&S®UMS100 units.

R&S®UMS120 – modular version

With a view to maximum customer flexibility, the R&S®UMS120 was designed as a modular version; all components are separately available (unlike the R&S®UMS100 all-in-one system). The system unit with frontend, the processor module, and the connectors are identical to those of the R&S®UMS100 – as are the antennas, mast, cables, and accessories. Of course, the customer can also use other antennas from Rohde&Schwarz. Due to the optional supply voltage coupler, active antennas can be utilized without any problems; various sets of antenna cables of different lengths are available for this purpose. Using the additional GSM 850/1900 and CDMA 800/1900 options (see figures below), wireless remote control via a mobile radio network is possible.



R&S®UMS100



R&S®UMS120

Specifications of the R&S®UMS100

Antennas	
Basic antenna	20 MHz to 1.3 GHz, passive omnidirectional discone, vertical polarization
Dimensions (basic configuration)	
(W × H × D)	850 mm × 1700 mm × 850 mm (33.46 in × 66.93 in × 33.46 in)
Weight	≤1.4 kg (3.09 lb)
HF antenna	100 kHz to 1.3 GHz, passive omnidirectional monopole, vertical polarization
Dimensions (HF option, replaces basic antenna)	
(W × H × D)	300 mm × 1900 mm × 100 mm (11.81 in × 74.80 in × 3.94 in)
Weight	≤1.5 kg (3.31 lb)
SHF antenna	1.3 GHz to 6 GHz, passive omnidirectional discone, vertical polarization
Dimensions (SHF option)	
(W × H × D)	400 mm × 600 mm × 600 mm (15.75 in × 23.62 in × 23.62 in)
Weight	≤1.1 kg (2.43 lb)
System data	
Frequency range	20 MHz to 1.3 GHz (basic model)
Extendable via options (including antennas):	
HF option	100 kHz to 20 MHz
SHF option	1.3 GHz to 6 GHz
Tuning resolution	1 Hz
Tuning error	1 ppm
Input	50 Ω, nominal
VSWR	≤2.5
2nd order intercept	≥180 dBµV/m (with attenuation)
3rd order intercept	≥150 dBµV/m (with attenuation)
IF bandwidths	100/300 Hz, 1/3/10/30/100/200/300 kHz/ 1 MHz
Sensitivity	≤–10 dBµV/m (100 kHz to 20 MHz) ≤–5 dBµV/m (20 MHz to 6 GHz) (with MGC = +15 dB and 100 Hz IF bandwidth)
IF rejection	80 dB
Image rejection	80 dB
Scan speed	max. 300 channels/0.6 s
Signal level error	≤1.5 dB, typ. 0.5 dB
Signal level resolution	0.1 dB
Demodulation	AM, FM
AGC	≥130 dB

Data exchange bandwidth	
LAN	10 Mbit/s, 100 Mbit/s (physical)
GSM	up to 9600 bit/s (physical), depending on network
Audio output	line-out connector at control PC with R&S®ARGUS-UMS software
Remote control operation	Ethernet/LAN or GSM remote control PC with R&S®ARGUS-UMS software
Interfaces	
Two antenna inputs	N female, 50 Ω
GSM antenna connector	GSM 900/1800, N female
LAN connector	Ethernet, RJ-45 female
Power supply	
DC	7-terminal circular plug
AC	4-terminal circular plug
General data	
Operating temperature range	–40 °C to +55 °C +45 °C to +55 °C only with additional sun protection shield
Storage temperature range	–40 °C to +80 °C
Humidity	95 % cyclic test, +25 °C/+40 °C
Protection class	IP55
Vibration	
Sinusoidal	5 Hz to 150 Hz
Random	10 Hz to 500 Hz
Shock	40 g shock spectrum
EMC	CISPR 11, group 1, class B, in line with EU EMC guideline (89/336/EEC) and German EMC laws
MTBF	21 500 h
Power supply	
DC	100 V to 240 V AC, 50 Hz to 60 Hz
AC	10 V to 32 V DC
Power consumption	typ. 25 VA (0 °C to +55 °C ambient air temperature), max. 100 VA (incl. heating when temperature falls below 0 °C)
Dimensions (system unit)	
(W × H × D)	380 mm × 530 mm × 240 mm (14.96 in × 20.87 in × 9.45 in)
Weight (system unit (box))	15 kg (33.07 lb)

Specifications of the R&S®UMS120

Antennas	
R&S®UMS12-H11	100 kHz to 1.3 GHz, passive monopole antenna, omnidirectional characteristic, vertical polarization
Dimensions (W × H × D)	300 mm × 1900 mm × 100 mm (11.81 in × 74.80 in × 3.94 in)
Weight	≤1.5 kg (≤3.31 lb)
R&S®UMS12-H12	20 MHz to 1.3 GHz, passive discone antenna, omnidirectional characteristic, vertical polarization
Dimensions (W × H × D)	850 mm × 1700 mm × 850 mm (33.46 in × 66.93 in × 33.46 in)
Weight	≤1.4 kg (≤3.09 lb)
R&S®UMS12-H13	1.3 GHz to 6 GHz, passive discone antenna, omnidirectional characteristic, vertical polarization
Dimensions (W × H × D)	400 mm × 600 mm × 600 mm (15.75 in × 23.62 in × 23.62 in)
Weight	≤1.1 kg (≤2.43 lb)
System data	
Frequency	only adjacent or overlapping ranges can be combined
Frequency range 1	100 kHz to 30 MHz
Frequency range 2	20 MHz to 1.3 GHz
Frequency range 3	1 GHz to 3 GHz
Frequency range 4	3 GHz to 6 GHz
Tuning resolution	1 Hz
Tuning error	1 ppm per year
RF input	50 Ω, nominal
VSWR	≤2.5
2nd order intercept	≥180 dBµV (with attenuation)
3rd order intercept	≥150 dBµV (with attenuation)
IF bandwidths	100/300 Hz, 1/3/10/30/100/200/300 kHz/1 MHz
Sensitivity	≤–10 dBµV (100 kHz to 20 MHz) ≤–5 dBµV (20 MHz to 6 GHz) (with MGC = +15 dB and 100 Hz IF bandwidth)
IF rejection	80 dB
Image rejection	80 dB
Scan speed	max. 500 channels/s
Signal level error	≤1.5 dB, typ. 0.5 dB
Signal level resolution	0.1 dB
Demodulation	AM, FM
AGC	≤45 dB
Data exchange bandwidth	
LAN	10/100 Mbit/s (physical)
GSM	up to 9600 bit/s (physical), depending on network
CDMA	up to 14 400 bit/s (physical), depending on network
Audio output	line-out connector at control PC with R&S®ARGUS-UMS software

Interfaces	
Two antenna inputs	N female, 50 Ω
Communications antenna connector	GSM 900/1800, GSM 850/1900, CDMA 800/1900, N female
LAN connector	Ethernet, RJ-45 female
Power supply	
DC	7-terminal circular plug
AC	4-terminal circular plug
DC output	24 V, 0.5 A (for antenna supply via max. two R&S®ARGUS-UMS12-H6 DC feeds)
Accessories	
DC feed for antenna	100 kHz to 3 GHz, RF insertion loss 0.1 dB for DC voltage 24 V/0.5 A, 2 × N socket (including 0.4 m cable with system plug for DC output and N plug to N plug adapter)
General data	
Remote control connection	via Ethernet/LAN or mobile phone network module (option)
Operation	via control PC (with R&S®ARGUS-UMS/R&S®ARGUS software)
Operating temperature range	–30 °C to +40 °C (no exposure to direct sunlight)
With R&S®UMS12-B1 option	–40 °C to +55 °C (no exposure to direct sunlight)
Storage temperature range	–40 °C to +80 °C
Humidity	95 % cyclic test, +25 °C/+40 °C
Protection class	IP54
Vibration	
Sinusoidal	5 Hz to 150 Hz
Random	10 Hz to 500 Hz
Shock	40 g shock spectrum
EMC	ETSI EN 301 489-1, ETSI EN 301 489-22, EN 55022.class B, EN 300 339 – cabinet radiation only (in line with R & TTE 1999/5/EC Directive)
Electrical safety	EN 61010 (in line with 73/23/EC Low-Voltage Directive)
MTBF	21 500 h
Power supply, AC	100 V to 240 V AC, 50 Hz to 60 Hz
Power supply, DC	10 V to 30 V DC
Power consumption	typ. 25 VA/25 W (ambient air temp. ≥0 °C) max. 200 VA/125 W (incl. heating at ambient air temperature <0 °C)
Dimensions (W × H × D)	300 mm × 445 mm × 175 mm (11.81 in × 17.52 in × 6.89 in) (including connectors)
Weight	8 kg (17.64 lb)
With R&S®UMS12-B1 option	12.2 kg (26.90 lb)

Ordering information

Monitoring System	R&S®UMS100	3030.3013.02
Options		
Frequency Range Extension		
0.1 MHz to 20 MHz (incl. wide frequency range antenna)	R&S®UMS100HF	3030.3020.02
1.3 GHz to 6 GHz (incl. 1.3 GHz to 6 GHz antenna and boom)	R&S®UMS100SHF	3030.3036.02
Control Software (incl. hardlock)	R&S®ARGUS-UMS	3034.0090.02
Monitoring System (lockable)	R&S®UMS120	3035.1025K02
Operating Software for external PC (incl. hardlock)	R&S®ARGUS-UMS	3034.0090.02
Software options		
(only adjacent or overlapping ranges can be combined)		
Frequency Range Extension		
100 kHz to 30 MHz	R&S®UMS12-B21	3035.1102.02
20 MHz to 1.3 GHz	R&S®UMS12-B22	3035.1119.02
1 GHz to 3 GHz	R&S®UMS12-B23	3035.1125.02
3 GHz to 6 GHz	R&S®UMS12-B24	3035.1131.02
Communications modules (options)		
(only ex factory with delivery of R&S®UMS120)		
GSM 900/1800	R&S®UMS12-B11	3035.1060.02
GSM 850/1900	R&S®UMS12-B12	3035.1077.02
CDMA 800/1900	R&S®UMS12-B13	3035.1083.02
Antennas		
HF Wideband Antenna (100 kHz to 1.3 GHz)	R&S®UMS12-H11	3035.1225.02
VHF/UHF Antenna (20 MHz to 1.3 GHz)	R&S®UMS12-H12	3035.1231.02
SHF Antenna (1 GHz to 6 GHz)	R&S®UMS12-H13	3035.1248.02
For further antennas, see Rohde & Schwarz antenna catalog, PD 0758.0368.42		

Accessories		
All-Weather Cabinet for R&S®UMS120 (including mast-/wall-mounting kit) (lockable)	R&S®UMS12-B1	3035.1048.02
Base Mast with tripod (height 1.7 m (66.93 in))	R&S®UMS12-H1	3035.1154.02
Boom for supporting two antennas R&S®UMS12-H11, R&S®UMS12-H12, R&S®UMS12-H13 or two mounting brackets R&S®UMS12-H31 to -H35	R&S®UMS12-H2	3035.1160.02
Grounding Kit for R&S®UMS120	R&S®UMS12-H3	3035.1177.02
Tool Kit	R&S®UMS12-H4	3035.1183.02
Manual, printed version	R&S®UMS12-H5	3035.1190.02
DC Feed for active antennas	R&S®UMS12-H6	3035.1202.02
Type R&S®EF400 Antenna Cable, 3.5 m (137.79 in) (2 × N plug)	R&S®UMS12-H21	3035.1260.02
Type R&S®EF400 Antenna Cable, 3.5 m (137.79 in) (1 × N plug, 1 × SMA plug)	R&S®UMS12-H22	3035.1277.02
Type R&S®RG214 Antenna Cable, 5 m (196.85 in) (2 × N plug)	R&S®UMS12-H23	3035.1283.02
Type R&S®RG214 Antenna Cable, 10 m (393.70 in) (2 × N plug)	R&S®UMS12-H24	3035.1290.02
Type R&S®RG214 Antenna Cable, 15 m (590.55 in) (2 × N plug)	R&S®UMS12-H25	3035.1302.02
Type R&S®RG214 Antenna Cable, 20 m (787.40 in) (2 × N plug)	R&S®UMS12-H26	3035.1319.02
Mounting Bracket for attaching R&S®HE010 to base mast/boom	R&S®UMS12-H31	3035.1331.02
Mounting Bracket for attaching R&S®HE500 to base mast/boom	R&S®UMS12-H32	3035.1348.02
Mounting Bracket for attaching R&S®HL033 to base mast/boom	R&S®UMS12-H33	3035.1354.02
Mounting Bracket for attaching R&S®HL040 to base mast/boom	R&S®UMS12-H34	3035.1360.02
Mounting Bracket for attaching R&S®HL024A1 to base mast/boom	R&S®UMS12-H35	3035.1377.02

R&S®TMS100/110/200/210 Transportable Monitoring and Direction Finding Systems

For stationary, mobile, portable, and remote-controlled use

Main features

- Reliable solution for monitoring and direction finding between 10 kHz (500 kHz for DF) and 3 GHz
- Compact and cost-effective
- Easily carried by two persons
- Quick setup and availability
- Flexible power supply: 100 V to 240 V AC or 11 V to 32 V DC
- Manual and automatic operation round the clock
- Controlled via R&S®ARGUS monitoring software

Brief description

In some cases, the use of stationary or mobile monitoring systems is either not practical or too expensive. This is the case, for instance, if long-term measurements are to be performed outside the receive range of fixed monitoring stations, if test vehicles cannot be operated independently for a sufficient period of time, or if round-the-clock presence of operating personnel is not possible for reasons of logistics or cost.

For such applications, the transportable monitoring and DF systems of the R&S®TMS series have been developed. They are optimized for the following measurement and DF tasks in the frequency range 20 MHz to 1300 MHz (optionally extendable from 10 kHz (500 kHz for DF) to 3000 MHz):

- Investigation of interference caused by co-channel emissions, out-of-channel emissions, and intermodulation
- Short-term and long-term monitoring of transmitter parameters such as frequency offset, frequency deviation, modulation depth, and bandwidth
- Fieldstrength measurements
- Detection and identification of unlicensed stations
- Spectrum occupancy measurements

Characteristics

All measurement tasks can be performed either interactively or automatically, by local operators or by remote control.

The compact rack accommodates all measurement and control instruments required and provides weather protection in case of outdoor use. For a measurement, just set up the antennas, connect the cables, switch everything on, and the instrument is ready for use within a minimum of time.

Owing to their flexibility and versatility, the R&S®TMS systems ideally complement existing monitoring networks. For countries and organizations just starting with spectrum monitoring, the R&S®TMS systems are a cost-effective but comprehensive alternative to fixed or mobile monitoring stations.

Applications

Owing to their characteristic features, the R&S®TMS systems can be used for a wide variety of tasks.

Attended fixed monitoring station
The transportable systems have the same measurement capabilities as comparable fixed stations. And they offer great flexibility in addition. Once the allocated task at one site is completed, the systems can be moved to another site and quickly set up. Owing to the system's compact design, it can even be installed on difficult terrain or on roofs.

Unattended fixed monitoring station
The advantages are the same as with attended fixed stations. When provided with the necessary communications equipment, the transportable system can be remote-controlled from a central station. The central station may be the regional or national headquarters that also controls all other monitoring stations and thus integrates the transportable system into the nationwide network. When provided with the necessary equipment, even a transportable system can be used as a central control station.

Mobile station
With the aid of special fixtures, the systems can also be easily installed in all types of vehicle. The required antennas are installed on the vehicle roof so that (limited) operation is possible even while the vehicle is in motion. When a compass and a GPS receiver are integrated, the position and the direction of vehicle movement are always known and can be taken into account in the measurements. Mobile stations can, of course, also be remote-controlled, typically via GSM/GPRS 900/1800 links.

Portable station
The R&S®EB200 miniport receiver used in the R&S®TMS100 and R&S®TMS200 can be removed from the transportable rack and carried in a bag supplied with the system. The receiver is powered from a battery. A spare battery is integrated in the R&S®TMS and automatically charged during normal operation. The R&S®HE200 active directional antenna connected to the receiver can also be carried with one hand.

Software

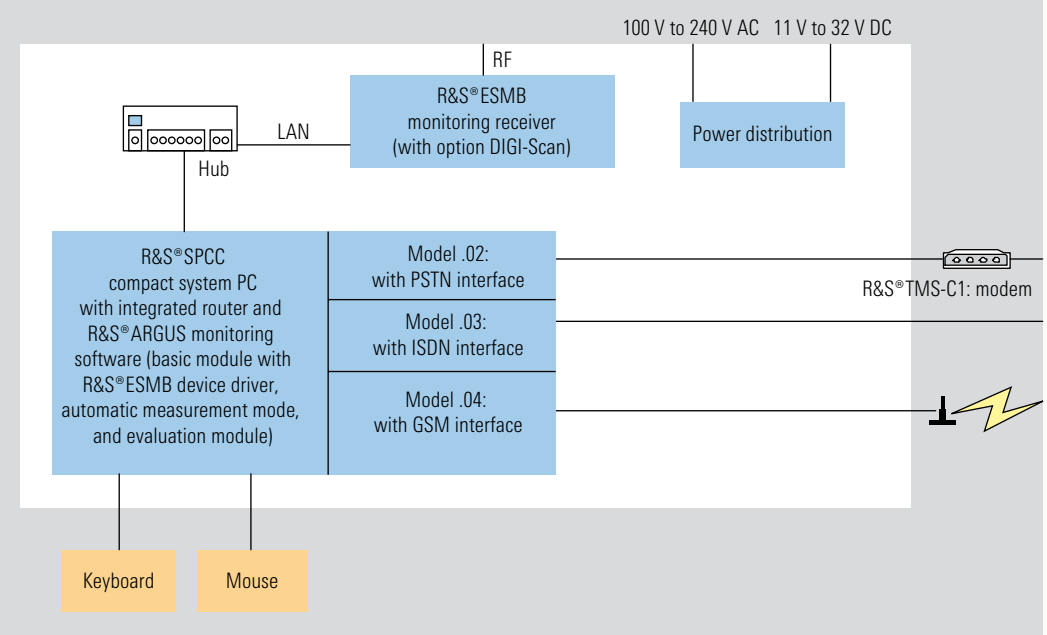
R&S®ARGUS spectrum monitoring software
When the R&S®ARGUS monitoring software supplied with the systems is used, all equipment can be controlled interactively via virtual front panels. The various measurement tasks can also be performed automatically. Measured values can be displayed in graphical representations either in realtime or at the end of the measurement in the replay mode. This applies in particular to IF and audio data. Comprehensive statistics in line with ITU-R recommendations are available for analyzing measurement results. The measurements with setups, results, and analyses are documented in reports.

Further device drivers and measurement modes are available as options.

R&S®MapView geographic information software
The optional R&S®MapView software shows the site of the direction finder and DF bearings on digital maps. With the optional R&S®ARGUS bearing measurement mode, up to four stations can take bearings and perform location

procedures simultaneously and in sync. The positions and bearings of all stations and the calculated location are then displayed in R&S®MapView.

Another R&S®ARGUS option is coverage measurements. In this case, each data set is assigned the appropriate GPS coordinates. Several level thresholds can be additionally defined and color-coded. As the values are displayed in R&S®MapView, users can see at a glance the areas with good transmitter reception and those with gaps in coverage, and thus record the information.



Block diagram of the R&S®TMS110

Overview of available models and options

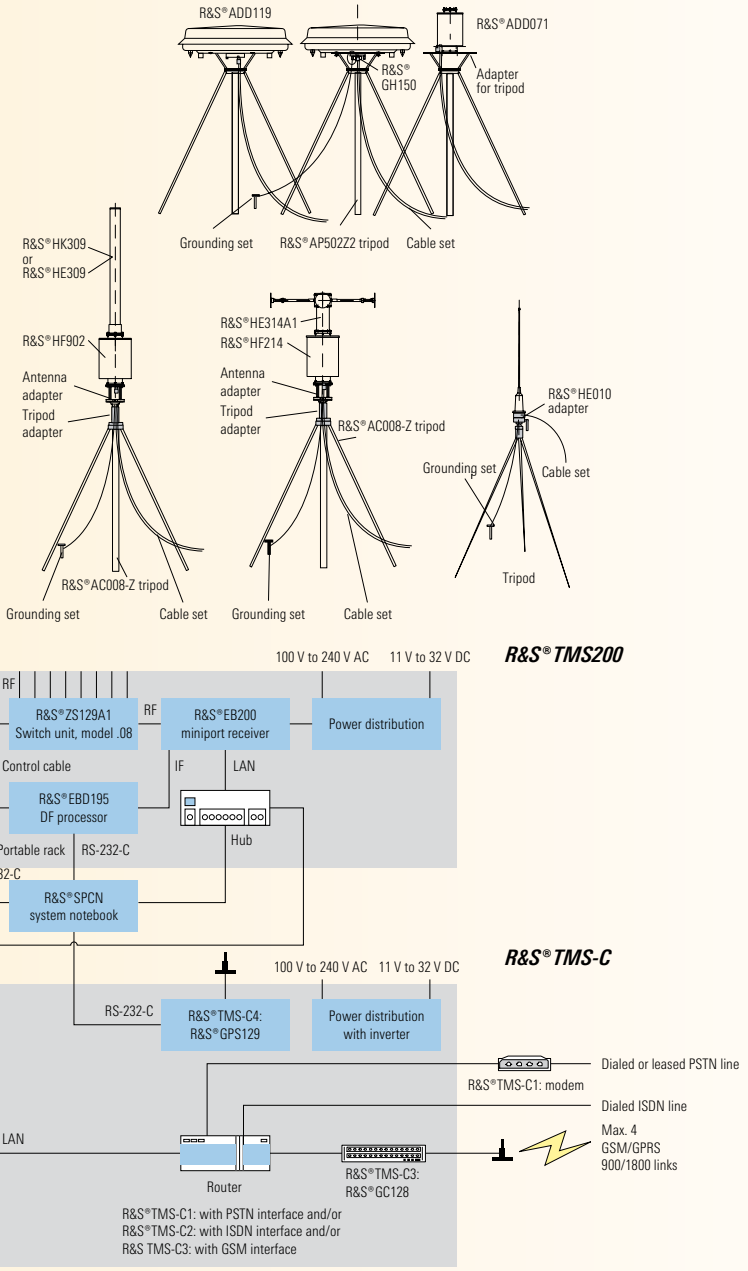
In addition to the components described below, all models include a rack with cables and power supply. The R&S®ARGUS monitoring software with basic modules, automatic measurement mode, evaluation module, and the required device drivers is installed on the controllers. The receivers are also equipped with the DIGI-Scan, IF panorama, and LAN interface options. The communications unit contains components for network connection via analog dialed or leased PSTN lines, ISDN dialed lines, or GSM/GPRS 900/1800 links.

System	Receiver	Process controller	Communications unit	Individual options
R&S®TMS100	R&S®EB200	R&S®SPCC (built-in)	•	Monitors and TFT displays for R&S®SPCC
R&S®TMS110	R&S®ESMB	R&S®SPCC (built-in)	•	Monitors and TFT displays for R&S®SPCC
R&S®TMS200	R&S®EB200	R&S®SPCN (laptop)	–	R&S®ZS129A1 switch unit incl. rackmounting kit and R&S®ARGUS device driver
R&S®TMS210	R&S®ESMB	R&S®SPCN (laptop)	–	R&S®ZS129A1 switch unit incl. rackmounting kit and R&S®ARGUS device driver

Options available for all models:

- R&S®DDF195 direction finder with R&S®ADD195, R&S®ADD071 and R&S®ADD119 DF antennas, including cable, tripod and fixture
- R&S®TMS-C transportable communication system
- Additional modules as well as interfaces for R&S®ARGUS
- R&S®MapView for the display of bearings on digital maps
- Various monitoring antennas, including cable, tripod and fixture
- Compasses, GPS receiver, DC/AC converter

R&S®TMS200 (with options) in a vehicle



Block diagram of the R&S®TMS200 with options

R&S®TMS500 Transportable Microwave Monitoring System

For stationary, mobile, portable, and remote-controlled use

Main features

- Reliable solution for monitoring tasks from 1 GHz to 26.5 GHz
- Extendable to 256 GHz
- Compact and cost-effective
- Easily carried by two persons
- Quick setup and availability
- Flexible power supply: 100 V to 240 V AC or 11 V to 32 V DC
- Manual and automatic operation round the clock
- Control via R&S®ARGUS monitoring software

Brief description

The R&S®TMS500 transportable microwave monitoring system brings all advantages of the R&S®TMS100/110/200/210 transportable monitoring and direction finding systems to the microwave range up to 256 GHz.

Optimized for flexible, mobile use in frequently changing environments, the following tasks can be performed in the range 1 GHz to 26.5 GHz (optionally extendable to 256 GHz):

- Investigation of interference caused by co-channel emissions, out-of-band emissions, and intermodulation
- Short-term and long-term monitoring of technical transmitter parameters
- Fieldstrength measurements
- Detection of unlicensed stations
- Spectrum occupancy measurements

All measurement tasks can be performed either interactively or automatically, by local operators or by remote control.

Design

The compact rack ensures easy transportation and provides weather protection in case of outdoor use. Performing a measurement merely requires that the antennas be set up, the cables connected, and everything switched on. The instrument is ready for use within a minimum of time.

To ensure maximum flexibility and easy adaptation to all operating sites and environmental conditions, the system can be powered from the normal AC supply (100 V to 240 V AC).

Owing to this flexibility and versatility, the R&S®TMS systems ideally complement existing monitoring networks. For countries and organizations just starting with spectrum monitoring, the R&S®TMS systems are a cost-effective but comprehensive alternative to fixed or mobile monitoring stations.

Applications

The special characteristics of the R&S®TMS500 make it suitable for a wide variety of tasks.

Attended fixed monitoring station

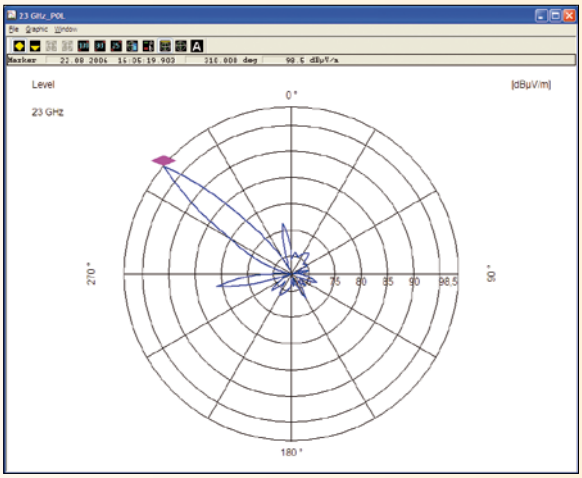
The transportable systems have the same measurement capabilities as comparable fixed stations. And they offer great flexibility in addition. Once the allocated task at one site is completed, the systems can be moved to another site and quickly set up. Owing to the system's compact design, it can even be installed on difficult terrain or on roofs.

Unattended fixed monitoring station

The advantages are the same as with attended fixed stations. When provided with the necessary communications equipment, the system can be remote-controlled from a control station. The central station may be the regional or national headquarters which also controls all other monitoring stations and thus integrates the transportable system into the nationwide network. When provided with the necessary equipment, even a transportable system can be used as a central control station.

Mobile station

With the aid of special fixtures, the systems can also be easily installed in all types of vehicle. When a compass and a GPS receiver are integrated, the position and the direction of vehicle movement are always known and taken into account in the measurements. Mobile stations can, of course, also be remote-controlled, typically via GSM/GPRS 900/1800 links.



Result of direction finding at 23 GHz with R&S®ARGUS, displayed as polar diagram

Direction finding in the microwave range

Today's standard direction finders are limited to an upper frequency of 3 GHz. However, more and more emitters occupy higher frequency ranges, creating the need for direction finding and localization far beyond the capabilities of standard equipment. This gap can be filled with the R&S®TMS500.

A simple approach is to manually turn the antenna on the tripod by 360°. While doing so, observe the level output of the R&S®FSP30. This allows you to find the antenna position that ensures maximum field strength. Finally, the direction can be determined by using a manual compass (e.g. the optional R&S®TMS-H9 handheld compass).

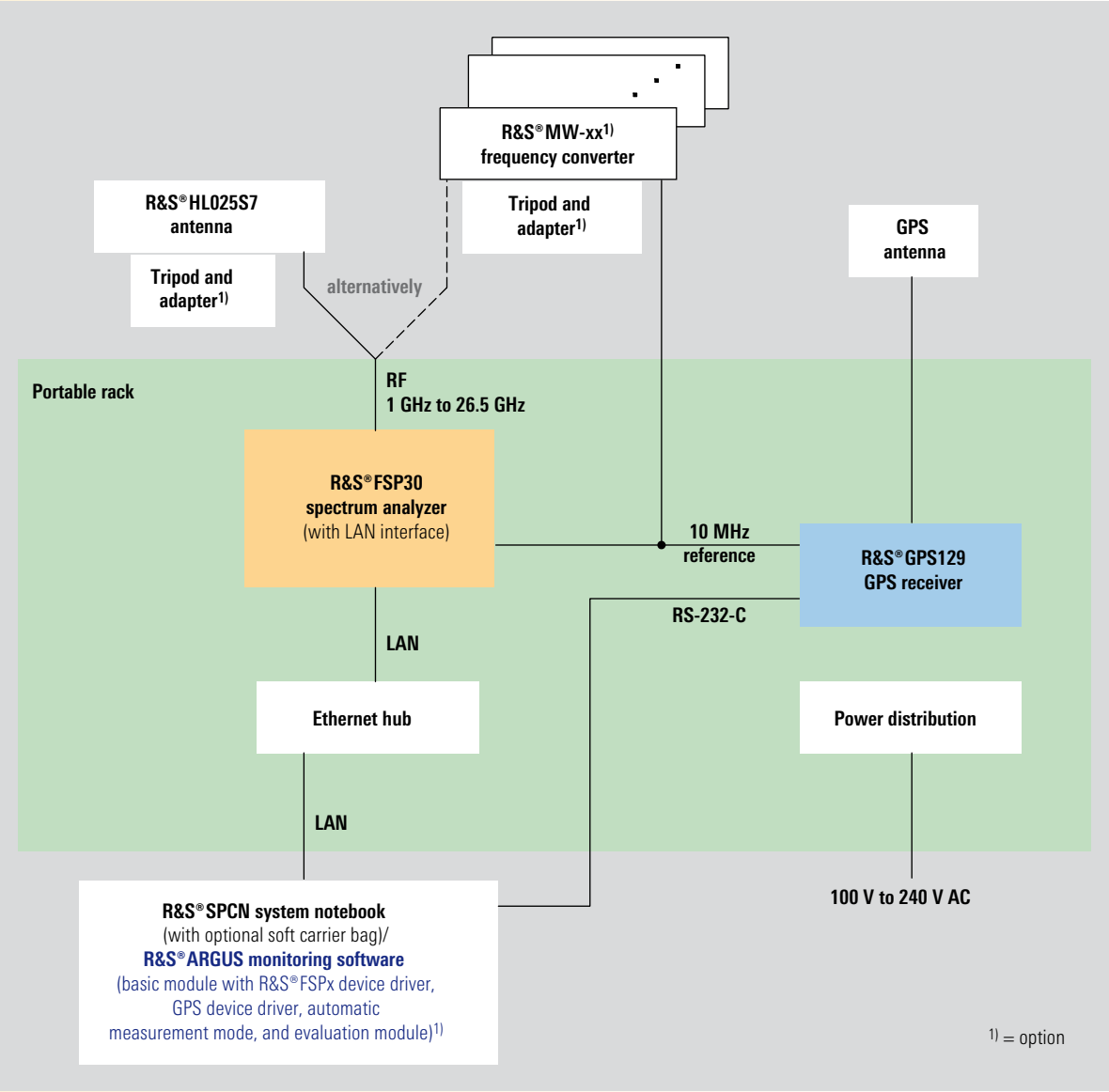
A more sophisticated and user-friendly way is to use the R&S®ARGUS spectrum monitoring software. The antenna is not turned manually but by a rotor, which in turn is controlled via the R&S®ARGUS software. The software not only moves the antenna more precisely and efficiently, but

can also display the results in graphical and tabular form. Thus, automatic direction finding in the microwave range is possible with the R&S®TMS500. Furthermore, if several R&S®TMS500 are combined in a network, even locations can be calculated.

With the appropriate options, direction finding results can automatically be displayed on a map.

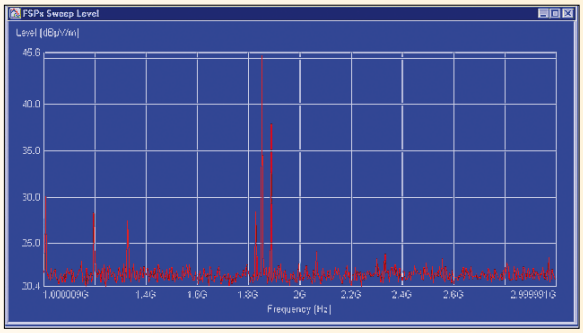
System configuration

The R&S®TMS500 consists of a R&S®FSP30 spectrum analyzer, a R&S®GPS129 GPS receiver, an Ethernet hub, and the power distribution, all integrated in a portable rack. The R&S®HL050S7 directional antenna (plus 10 m cable) is also included. The entire system is controlled from the R&S®SPCN notebook controller with R&S®ARGUS monitoring software. During the measurement, the notebook can be positioned on the rack, for instance, and then be taken to the office for result evaluation.



The R&S®TMS-C transportable communication system can be optionally integrated for remote control or system integration in an existing network.

Other options are compasses, a battery unit for the R&S®FSP30, a case for notebook and cable, and covers for the front and rear panel of the rack.



Software

R&S®ARGUS spectrum monitoring software

When the R&S®ARGUS monitoring software supplied with the systems is used, the R&S®FSP30 can be controlled interactively via virtual front panels. The various measurement tasks can also be performed automatically. Measured values can be displayed in graphical representations either in realtime or at the end of the measurement in the replay mode. Comprehensive statistics in line with ITU-R recommendations are available for analyzing measurement results. The measurements with setups, results, and analyses are documented in reports.

Other device drivers and measurement modes are available as options.

R&S®MapView geographic information software

The optional R&S®MapView software shows the position of the measurement station and the bearings on digital maps.

With the optional R&S®ARGUS bearing measurement mode, up to four stations can take bearings and perform location procedures simultaneously and in sync. The positions and bearings of all stations and the calculated location are then displayed in R&S®MapView.

Another R&S®ARGUS option is coverage measurements. The results can also be displayed with R&S®MapView.

R&S®TMS-C Transportable Communication System

For stationary and mobile communications and remote control of R&S®TMS and R&S®TMSR systems

Main features

- Integrated network equipment accommodated in a portable rack
- Communications via analog PSTN and/or ISDN lines and/or GSM/GPRS 900/1800 links
- Integration of additional GPS receiver
- Compact and cost-effective
- Flexible power supply: 100 V to 240 V AC or 11 V to 32 V DC (optional)
- Can be used together with R&S®ARGUS or R&S®RAMON monitoring software

Brief description

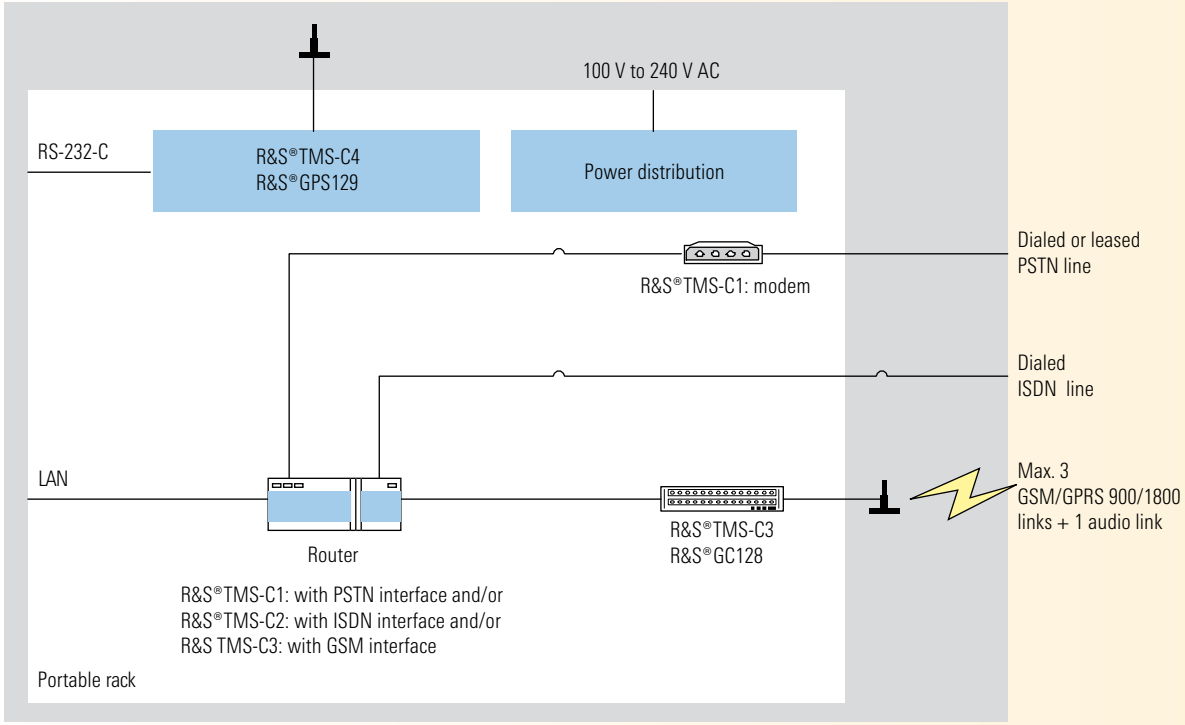
The universal R&S®TMS-C transportable communication system was developed for communications and remote control in the transportable monitoring and direction finding systems of the R&S®TSM100/110/200/210/500 and R&S®TMSR100/200 families. It can be used wherever flexible, easily transportable but sturdy network equipment is required.

All R&S®TMS-C systems consist of a portable rack, a router, and the power distribution. To ensure maximum flexibility and easy adaptation to all operating sites and environmental conditions, the system can be powered from the normal AC supply (100 V to 240 V AC) or from batteries (11 V to 32 V DC).

Options

All options can be used simultaneously.

- R&S®GPS129 GPS receiver for automatic position location, time synchronization, and use as a reference frequency source
- Modem and router interface for analog dialed and leased lines
- Router interface for dialed ISDN lines
- R&S®GC128 communication unit and router interface for GSM/GPRS 900/1800 links (optional with up to three additional GSM modules for channel banding and use as a telephone)
- Power supply from 11 V to 32 V DC



Modular COMINT/CESM Systems

R&S®RAMON systems for communications intelligence were designed for the armed forces and government authorities with security tasks; they support the following:

- Military missions as part of UN peacemaking and peacekeeping missions (e.g. reconnaissance via fact-finding teams or protection of one's own forces)
- Acquisition of information as a basis for political decisions
- Prevention of contraband trade and illegal border crossing
- Protection of objects and persons

Main features

R&S®RAMON systems are characterized by the following:

- High probability of intercept (POI), also of low probability of intercept (LPI) signals
- High degree of automation to support the intercept operator
  - Automatic segmentation and preclassification by the radiolocation system
  - Automatic classification and demodulation/decoding
  - Automatic comparison of the intercepted data with profiles in the emitter database
- Control of the task/report workflows
- Analysis and evaluation of interception results
- Customized system design based on commercial-off-the-shelf (COTS) components
- Scalability

- Remote-control capability via any type of wireline or wireless communications
- Delivery of complete, turnkey systems

Brief description

R&S®RAMON systems consist of several instruments from the Rohde & Schwarz portfolio of radiomonitoring and radiolocation products, plus the R&S®RAMON system software as an operator interface. The software ensures the following:

- Direct control of the radiomonitoring equipment via the workstation computer
- Storage and evaluation of the obtained data
- Control and monitoring of the information flow in a networked system with several workstations or different system locations
- Simplified routine procedures due to automatic workflow control

Basically, there are two different types of communications intelligence (COMINT) systems – systems for strategic and tactical intelligence. The following paragraphs will take a closer look at these systems.

Strategic COMINT systems

Strategic COMINT systems are used to acquire reconnaissance information to assess the (military) situation of other countries and to gain information about one's own security situation. This information covers the need for relevant information of the political and military leadership and promotes decision-making processes. Crises can thus be recognized at an early stage, for example.

The systems are operated continuously, i.e. during times of peace and crisis. Another key function of strategic intelligence includes the provision of basic reference data, which forms the basis for the efficient operation of strategic and tactical COMINT systems.

Strategic systems are usually stationary, but they can also be designed as semi-mobile or transportable systems in shelters. They typically monitor a large geographic area; they may even be operated as nationwide systems. As a result, a large number of workstations and personnel is required to operate such a system. Strategic systems are usually equipped with special analysis components, allowing the systems to technically analyze the intercepted signals. Although this in-depth technical analysis is relatively time-consuming, it does not present a problem, as the intelligence process carried out by such a system is usually not time-critical. This time factor is the decisive difference between strategic and tactical systems.

R&S®RAMON offers solutions to the strategic requirements detailed above. Strategic R&S®RAMON COMINT systems are deployed at customer sites all over the world. The range of applications includes systems set up at one location (i.e. command and control station with operator workstations and sensors at the same location) as well as nationwide systems with a network of remote-controlled sensor stations and a central command and control station.

Tactical CESM systems

Tactical communications electronic support measures (CESM) systems are used to acquire information on-site. A military leader is usually directly in charge of these systems. Application examples are missions outside one's own country (e.g. UN peacekeeping or peacemaking missions), as well as conflicts at home or defense emergencies. Thus, information acquisition by means of communications intelligence contributes directly to providing immediate protection and combat support. There is no clear-cut dividing line between CESM systems and strategic intelligence systems; both depend on and complement each other. CESM systems are always part of an overall reconnaissance operation.

Tactical CESM systems are usually mobile, i.e. they are installed in vehicles or on board ships. Due to low mast heights on vehicles or shelters, the geographic interception area is often limited. As a result, maximum mobility and armor protection are often requested, as the systems have to be used directly in the focus of action.

The work in CESM systems is supported by the basic reference data obtained via strategic intelligence. As the results are to be directly included in the planning and execution of operations, including warning one's own forces against threats, work in a CESM system is carried out under enormous time pressure. As a consequence, unknown signals are usually not technically analyzed in more detail by the mobile systems. Moreover, due to the high requirements placed on mobility, the deployable number of staff is very small. Thus, focusing on the signals/frequency ranges transmitted by the enemy forces (that are seen as threat) is indispensable in interception.

System workflow

The following example of a semi-mobile CESM system is to illustrate the tasks, functions, and workflow in a communications intelligence system. The system in this example can be used as a standalone system, or as a system complementing a strategic system. The tasks and thus also the hardware/software used will, of course, vary from operator to operator; however, the main basic functions will remain the same.

The example describes a virtual scenario, in which a semi-mobile CESM system is used to support troops for self-protection during a UN peacekeeping mission.

The CESM system

The semi-mobile CESM system consists of one command and control (CC) station and two VHF/UHF monitoring and direction finding (MDF) stations. All three stations consist of shelters, which are mounted on trucks.

The VHF/UHF MDF stations are unattended and consist of the following elements:

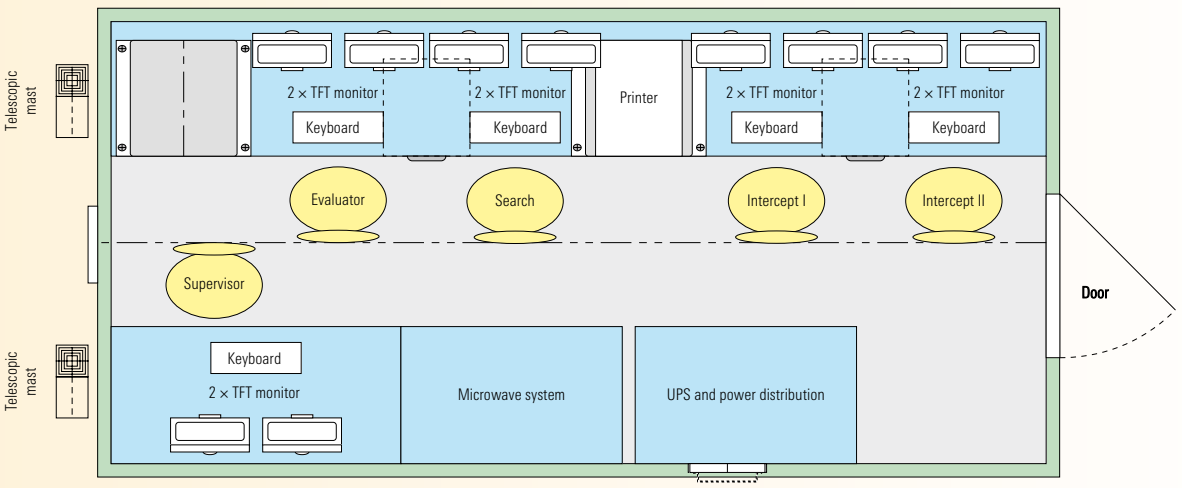
- R&S®DDF05A digital direction finder from 20 MHz to 3 GHz
- R&S®AMMOS sensor group with five R&S®EM050 VXI VHF/UHF digital wideband receivers incl. antennas for the frequency range from 20 MHz to 3 GHz
- R&S®AMREC recording system for recording narrowband IF signals

The R&S®AMMOS system is configured with interception processing channels (IPC) for narrowband interception.

The command and control station is equipped with five operator workstations (see Fig. 1)

- One supervisor
- One search operator

Fig. 1: Top view of command and control station



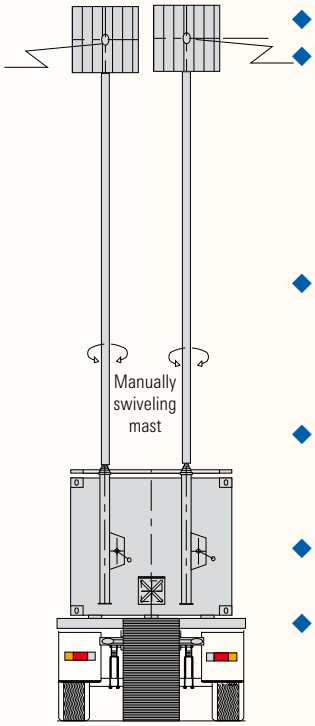


Fig. 2: Command and control shelter in operation with microwave dish antennas

- Two intercept operators
- One evaluator

The operator workstations are equipped with the following software tools:

- Emitter data manager providing access to the emitter and interception database
- ReportEdit application providing access to the report database
- Mission-planning tool for the supervisor
- R&S®ScanLoc enhanced software for the search operator
- R&S®AMMOS-IT software with graphical user interfaces for voice, data, and classification – IPCs for the intercept operators
- Analysis and evaluation tools for the evaluator (e.g. ActivityAnalyzer, Replay)

Two point-to-point tactical microwave links are used (Fig. 2) in order to link the CC with the MDF stations. They provide a data rate of 8 Mbit/s for full remote control of the R&S®DDF05A digital direction finders and the R&S®AMMOS sensors in the MDF stations.

The situation

The description of a typical workflow is based on the following situation:

- The system, consisting of the command and control station plus the two VHF/UHF MDF stations, is deployed out of area as part of a UN peacekeeping mission. This mission takes place in Midland, a virtual country somewhere in the world (see Fig. 3).

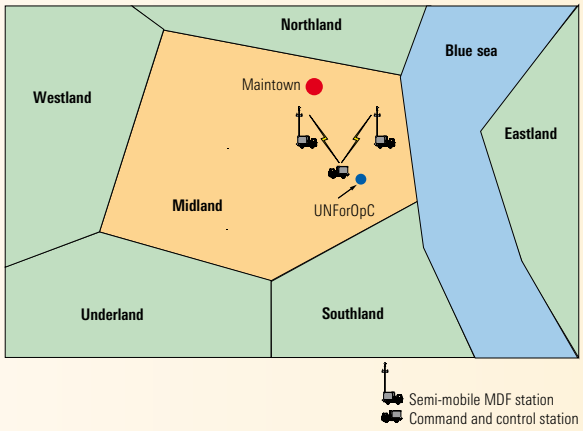


Fig. 3: Setup configuration of tactical CESM system at UN Forces Operation Center close to Maintown, Midland

- Surveillance has previously been performed at various locations in Midland. Therefore, the emitter database contains signal descriptions together with appropriate profile data about operators, networks, etc.
- A tactical VHF radio link is provided, which is used as a communications link between the CC station and a military command unit in order to task the CESM system.

System operation

The flow chart in Fig. 4 provides a graphical overview of the general operational steps.

The mission

A tactical commander of the UN Peacekeeping Forces Operation Center (UNForOpC) close to Maintown issues a request for surveillance of the surrounding area in order to protect the local troop contingent. The request, forwarded in unformatted, textual form – in this context regarded as the mission for the CESM system – defines the following:

- The geographic target area to be surveyed
- A request for a continuous, regular situation report at 8 hour intervals
- A request for spot reports upon detection of targets of special interest (threat emitters)

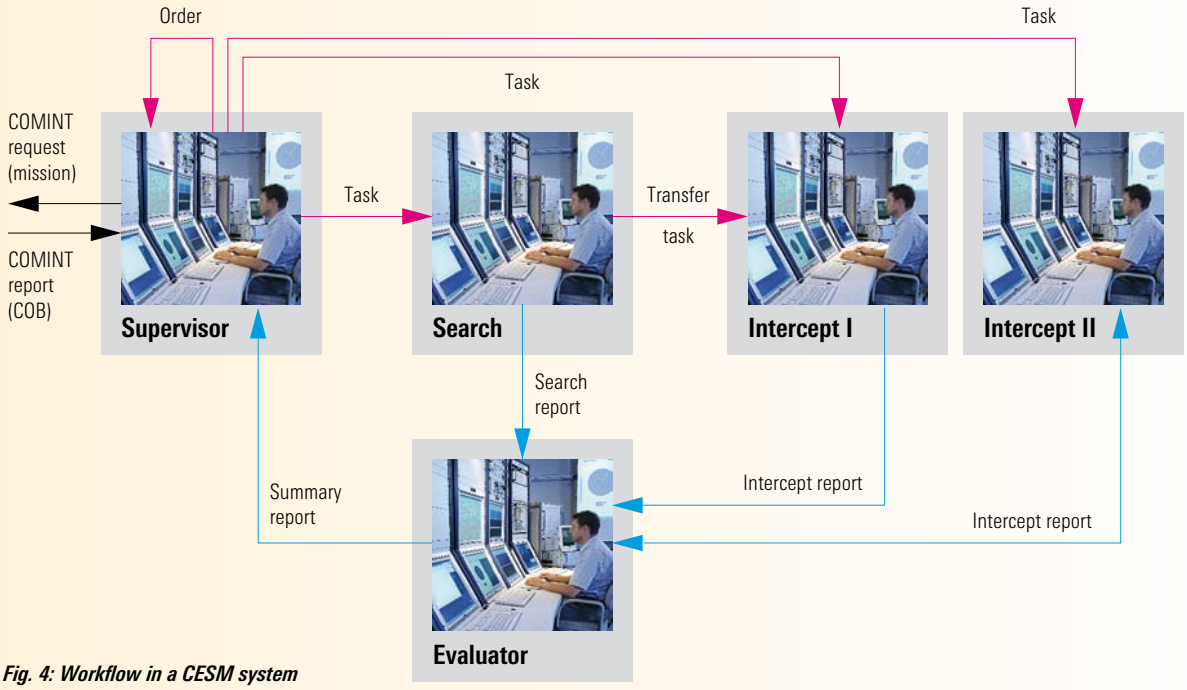


Fig. 4: Workflow in a CESM system

Supervision

The supervisor – the officer in charge of the CESM system – receives the mission as well as information about the current situation in the Maintown area from the Midland EW field center. This information includes data about specific target emitters that are regarded as a threat.

The supervisor plans the mission using the mission-planning tool and R&S®MapView. The supervisor checks the RF coverage area of the sensors and also possible microwave link setups from the operation center (where the CC is supposed to be situated) to different elevated areas in the vicinity. Using the circular error probability (CEP) tool with R&S®MapView, the supervisor simultaneously checks the expected location error based on the geometry of the setup locations of both VHF/UHF MDF stations. After selecting the sites for the stations, the supervisor issues a deployment order for the two semi-mobile VHF/UHF MDF stations.

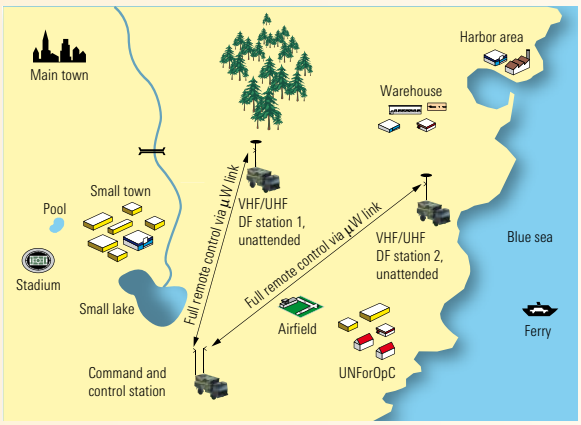


Fig. 5: Possible setup configuration of the system in the target area

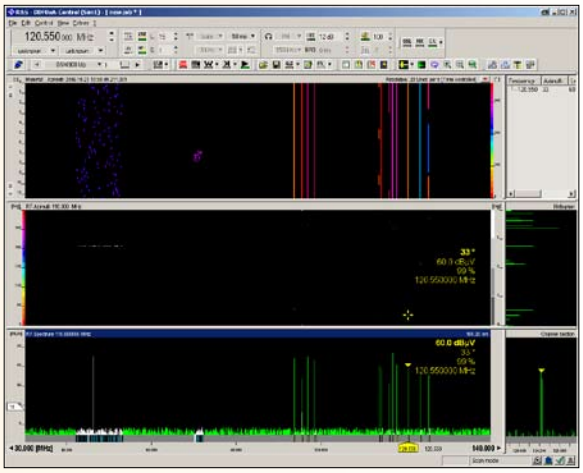


Fig. 6: Graphical user interface (GUI) of one of the digital direction finders; differently colored icons above the frequency axis indicate the preclassification results for the active emitters

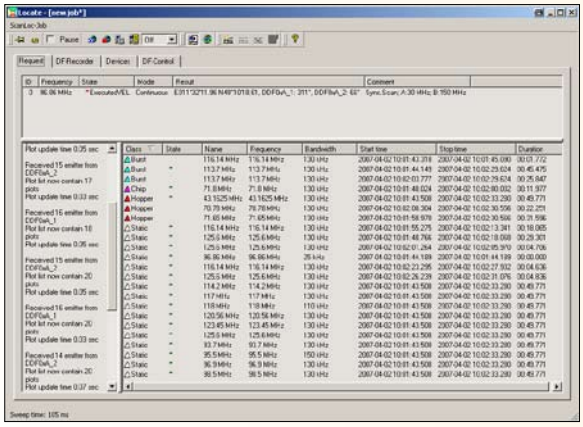


Fig. 7: Location results as displayed in the locate module. The different, preclassified categories of signals are marked by different symbols. Results for frequency hoppers contain a list of all single frequencies of the hopper which were intercepted

The supervisor creates a general COMINT order for this mission, which serves as a reference for the specific tasks to be issued. ReportEdit is used for this purpose.

The supervisor then creates the following tasks:

- A search task, which ensures continuous scanning and surveillance of the frequency range of interest
- A surveillance task to continuously search for specific known threat emitters that must be reported if they become active

Search

Search of emissions will be performed using the R&S®ScanLoc scanning location system.

After being informed about the successful setup of the two DF shelter stations, the search operator starts to work on the search task by defining a search job to be executed on the two DF sensors, using the locate application. For this purpose, the following has to be defined:

- The RF frequency range and other parameters required by the job editor
- The target area by drawing a rectangle on the digital map in R&S®MapView; this is calculated by the locate application into azimuth sectors for every connected MDF station

With execution of the R&S®ScanLoc job, the two DF systems start scanning the frequency range in synchronous mode.

The search operator has a direct overview of all active signals in the selected frequency range in the RF spectrum, waterfall, and azimuth display of the direction finders. A fully automatic process divides the RF spectrum into segments and assigns the intercepted signals to different signal categories. The operator can define a specific time interval of several seconds for this process. After the defined interval of time has elapsed, each DF system forwards the results to the command and control station.

The locate application on the search operator's workstation automatically matches the incoming preclassified bearings and calculates the locations. The locations are displayed on the digital map in the R&S®MapView application, where the different categories of emissions are shown with different symbols. The search operator thus gets an automatic display of all currently active signals in the selected target area. The signals are also listed in numeric form in the locate application window.

If signals that were previously intercepted and are already stored in the R&S®ScanLoc emitter database become active, they will be displayed on the map with their name. For this purpose, the R&S®ScanLoc emitter database is queried online for comparison of intercepted data with stored profiles.

Fig. 8 shows an example of an R&S®MapView result display.

The search operator decides which signals need to be processed by selecting the signal with the marker in the RF spectrum/waterfall, listening in to the signal with an R&S®AMMOS voice IPC dedicated to the respective direction finder, and – with one mouse-click – handing this signal over to one of the intercept operators. This results in a task that automatically appears in the report application of one of the intercept operators.

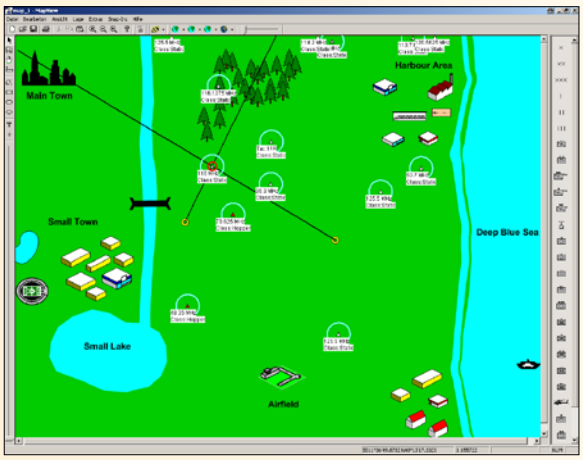


Fig. 8: Example of display of emitters on R&S®MapView during search operation with R&S®ScanLoc. Different types of emitters are shown with differently colored symbols. Known emitters (match with emitter data) appear with their names (here: Tac 1FR in the center). VHF/UHF DF stations are indicated by yellow circles

At this stage, the search operator may also issue reports:

- Spot reports upon detection of a threat emitter, which corresponds to a target described as threat in the mission and/or search task; such a spot report will be forwarded directly to the tactical commander for immediate action
- Search reports at regular time intervals

Intercept

The intercept operators perform two tasks:

- Intercept tasks on signals that where handed over from the search operator (visible in ReportEdit)
- Surveillance tasks that were received from the supervisor

Intercept triggered by the search operator

The intercept operators work on transfer tasks from the search operator. These tasks may refer to "normal" signals to be processed, or to threat signals that require further processing. Processing of threat signals transferred by the search operator is similar, except that a spot report is sent back after the work is finished (instead of a normal intercept report – as in the former case).

One of the intercept operators starts working on the signal by opening the task with the ReportEdit application. The operator uses R&S®MapView and the locate application, and can thus keep track of the geographic location of this specific target emission throughout signal processing. If a radio network is active on this frequency, the locations of all participating radio stations are displayed as they become active. Thus, the communications network will be displayed on the digital map with all stations that were active during the observation time interval.

The operator decides whether to use an R&S®AMMOS voice IPC – in case of a voice transmission that can be demodulated – or a classification IPC – in case of an unknown data signal. ReportEdit assigns the frequency to the respective IPC running on the R&S®AMMOS sensor group (depending on the currently available resources). In case of a classification IPC, the signal will – after successful classification – be automatically routed to an IPC for decoding digital transmission for further processing, which may include the recording of decoded content.

The operator may decide to record the signal if the signal is of one of the following types:

- Voice in a language unknown to the operator
- Data that can be neither decoded nor classified

Demodulated voice signals will be recorded using the R&S®AllAudio application. The intercept operator may issue a request for content analysis, which is passed on to the evaluation operator. Data signals can be recorded using the R&S®AMREC recorder, which records the IF frequency of the signal for further processing.

An intercept report will be created by the operator for every intercept task, which will then be sent to the evaluation operator.

Intercept triggered by the supervisor (surveillance)

The surveillance task in this example also focuses on threat signals. The signals are described in the emitter database with their technical parameters. The data sets can be viewed using the emitter data manager, which is

an intranet web application. The intercept operator creates a surveillance job for execution on the R&S®AMMOS sensors. The job consists of individual data sets for every single emitter under surveillance. A date set contains the RF frequency, type of modulation, and other parameters as necessary.

The job is then executed, and the selected R&S®AMMOS IPC (e.g. of the data type) starts to consecutively tune to every defined frequency and checks it for emitter activity. When it detects a signal above the RF threshold, the IPC compares the parameters of the detected signal with the signal description. If the result is a match, an alarm is issued and added to an alarm list, which the operator can see in a window on one of the workstation displays.

A location request is issued automatically. R&S®ScanLoc not only processes the frequency ranges as defined by the search operator but additionally handles a single frequency list, which is processed by the DF systems in the back-ground. This single frequency list is then applied together with the request from the intercept operator, who will receive the location of the target emitter immediately. The location is displayed in numeric form and shown on the digital map of the R&S®MapView application. As long as this request is enabled, location data of the emitter is continuously updated on the digital map.

The intercept operator now issues a spot report and forwards it to the supervisor, who will decide how to proceed.

Evaluation

The evaluation operator receives all intercept reports in the in-box of the ReportEdit application, and decides about further processing. The operator has the following tasks:

- To evaluate the intercept/search reports and check them for completeness as well as for compliance with the specified order(s)/tasks.
- To perform traffic and content analyses, including dissemination of the data within the intercept reports/audio recordings/text recordings. The result will provide basic information for building the VHF/UHF communications order of battle (VHF/UHF COB).
- To merge and summarize the intercept reports, including the analysis results, in order to create a mission report, which contains the salient information of the current VHF/UHF communications scenario. This is a textual description of the current communications order of battle, possibly supplemented by a map display (a screenshot from R&S®MapView, where current locations of emitters may have been marked by using tactical symbols and text objects).

Should the evaluation operator be overloaded with the work to be performed, the supervisor will provide support. Evaluation work includes the following tasks:

- Requesting additional actions by the intercept operators in case data is missing or incomplete
- Requesting technical analyses by one of the intercept operators

In this example, technical analysis may refer to the replay of recorded IF signals with R&S®AMREC and analysis of the recorded signals using the R&S®AMMOS sensor in the VHF/UHF DF station.

This technical analysis only involves tools that are available during online operation. Nevertheless, it is still possible to conveniently process signals that were not successfully handled during hectic online operation. In offline operation, signals can be handled/processed much more carefully.

Thus, signal classification results not achieved during online operation can be obtained. The database already contains basic reference data that will be used to analyze the intercepted emissions/targets and will help find differences in the communications behavior with a view to previous, similar situations.

Supervision

Finally, the process ends with the supervisor.

The reports forwarded to the supervisor by the evaluator may lead to a modification of the initial COMINT tasks assigned to the intercept operators. Spot reports in particular

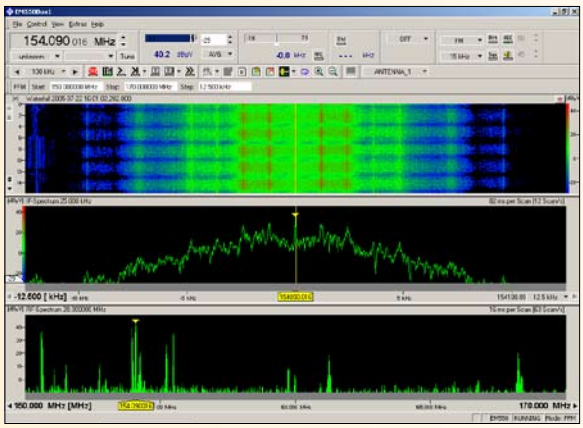


Fig. 9: Graphical user interface (GUI) of the R&S®EM550

may require action such as additional tasks to be assigned to the intercept operators (e.g. a surveillance task for an intercept operator asking for continuous surveillance of a specific target emitter).

The supervisor acknowledges the COB, modifies it as required, and then forwards it to the tactical commander as requested in the initial mission. The COB no longer provides technical details but the finished results of the COMINT process. The supervisor is of course in close contact with the commander during tactical operation.

Product descriptions

R&S®RAMON user interfaces

R&S®RAMON is a control software for all instruments used in radiomonitoring and radiolocation, enhancing the instruments' scope of functions. In local operation, the graphical user interfaces (GUI) of the control software (Control) are the interface between the instrument and the operator. They also allow the instruments to be remote-controlled. As part of the R&S®RAMON software family, they permit individual instruments to be integrated in complex radiomonitoring and radiolocation systems. Fig. 9 shows an example of a receiver user interface.

Important Control features:

- Optimized for fast operation: All major functions can be accessed via keyboard shortcuts; the display windows can be scaled directly using the mouse.
- Short-term storage of scan data: Data obtained during the frequency scan is buffered in a loop memory. By clicking the mouse, overwriting of this memory is stopped, and a window opens, allowing the currently stored data to be replayed. This function helps the operator when handling short-duration signals.
- Dynamic adjustment of bandwidth: If instruments are remote-controlled via a WAN connection, the software automatically adjusts the data throughput to the bandwidth available on the communications link. For this purpose, data is averaged prior to being transmitted; thus, the high probability of intercept will not be reduced.
- Frequency lists for marking signals: By pressing a key/clicking the mouse, occupied frequencies can be stored in a list and, at the same time, are graphically highlighted in the spectrum display. The frequency list thus obtained can be processed and stored. This function is also used by the automatic detection and preclassification algorithms for visualization purposes.

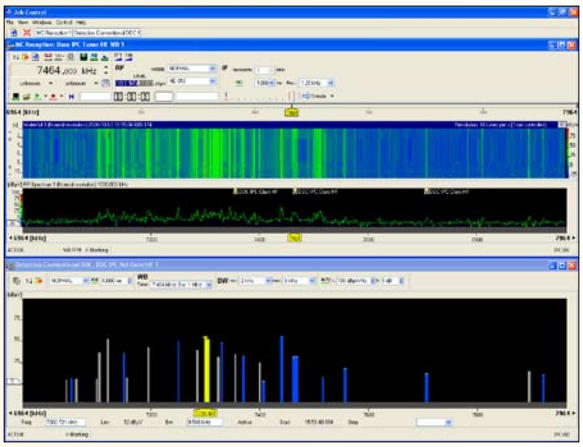


Fig. 10: Graphical user interface of an intercept operator workstation – Monitor 1. The display shows a 1 MHz window of the R&S®AMMOS HF IPC wideband tuner and the detection conventional IPC (bottom). The different colors in the bottom window indicate the signal history

- Concurrent operation: Instruments equipped with control elements can be operated via the user interface on the PC as well as directly via the front panel (control elements of the instrument are not disabled). This is beneficial in situations where operation via the front panel is more convenient (e.g. while riding in a vehicle), but a high-resolution display in large format of the RF or IF spectrum data is still required, for example.

Various marker, zoom, and display functions complement the functions detailed above, allowing the operator to focus on the key information – the intercepted radio signal.

R&S®RAMON user interfaces are available for the following instruments:

- R&S®EB200, R&S®ESMB, R&S®EK893, R&S®EK895, R&S®EK896, R&S®EM510, R&S®EM550 receivers
- R&S®DDF195, R&S®DDF0xM, R&S®DDF0xE, R&S®DDF0xA direction finders
- R&S®AMMOS sensor groups with R&S®EM010, and R&S®EM050 receivers, and R&S®GX401EM, R&S®GX401BP, and R&S®GX405BP DSP boards
- R&S®GX420 (R&S®AMREC) IF signal recording/replay system
- Others on request

The control software for R&S®AMMOS-based monitoring systems is also referred to as R&S®AMMOS-IT.

Fig. 10 and Fig. 11 show the GUI of a typical intercept operator workstation. The workstation is equipped with two TFT monitors; one of them shows the user interface for the R&S®AMMOS IPCs. A 1 MHz section of the HF spectrum of an HF broadband receiver and the detection conventional IPC are displayed.

Recording and replay of measurement data

Measurement and result data of the instruments can be stored on the hard disk of the control PC for subsequent analysis (offline). In addition to the measurement data, AF signals (demodulated audio signals) and IF signals can be recorded. The various methods are described further below. The following data can be recorded:

- Receiver and DF measurement data of a single frequency (logging)
- Receiver and DF measurement data of several frequencies in the scan mode (recording)
- Decoded text

The Logger application records the data of a single frequency, such as RF frequency, level, bandwidth, modulation, DF value, and DF quality. If the receiver or direction finder is in scan mode, data is recorded of the frequency

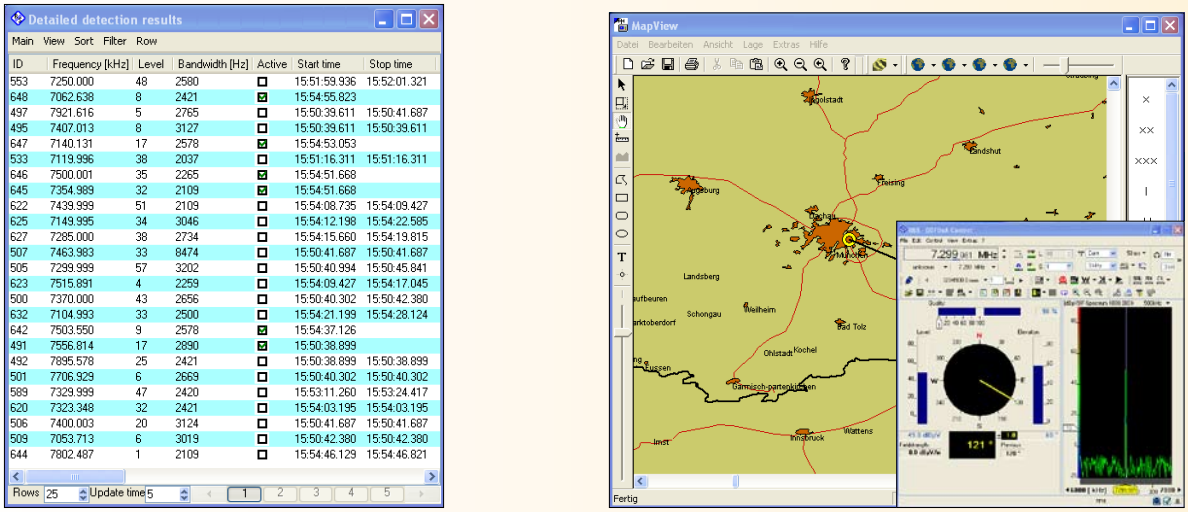


Fig. 11: Graphical user interface of an intercept operator workstation – Monitor 2. The list shows the detected conventional signals that are displayed on the first monitor in the spectrum. A bearing is automatically taken of each detected signal

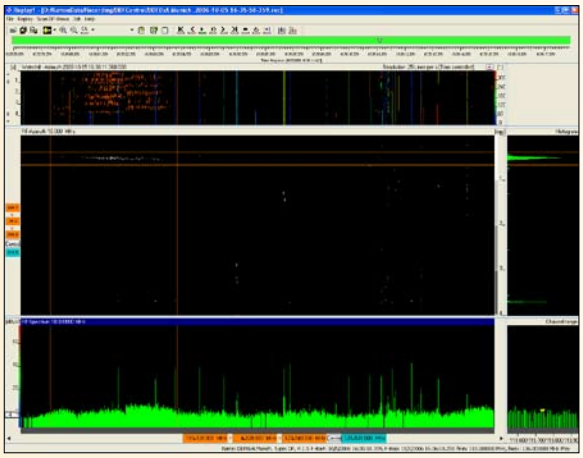


Fig. 12: User interface of the REPLAY application. The figure shows the signal of a frequency-hopping transmitter between 119.8 MHz and 123.7 MHz. The bearing is 317°

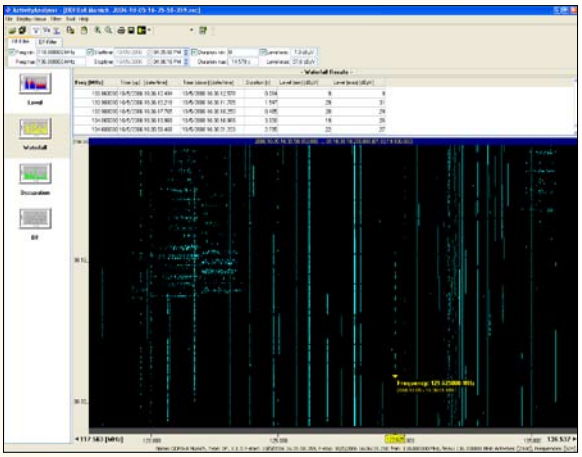


Fig. 13: Waterfall diagram of the user interface of the ActivityAnalyzer application

that has been marked by the frequency marker in the RF spectrum. Data is continuously recorded in a log file with a definable maximum size; this data can be accessed at any time. This process is supported by filter functions, especially if data sets need to be retrieved after some time has elapsed. Selected data sets can also be transferred from this application to a report.

Data collected in one of the scan modes is recorded by a recording function on the appropriate user interface. This data includes the FFT measurement data displayed online in spectrum and waterfall diagrams, and if needed also in the azimuth diagram. The recorded binary file can be replayed and analyzed using the REPLAY (R&S®RA-RPLY) and ActivityAnalyzer (R&S®RA-ACT) software modules.

REPLAY displays the recorded data in realtime on an interface similar to one of the instrument's user interfaces. All tools in the user interfaces are available in REPLAY; data can also be replayed at higher speed.

Data can be displayed not only in the REPLAY application. Recorded DF data that is replayed can be made available to the LOCATE location software. Thus, if there are recordings by different direction finders, a triangulation can be performed when data is replayed with several REPLAY instances in the location software. The location data can then be displayed on a geographic background in the R&S®MapView geographic information software.

The DF-Eval application also allows DF data to be recorded. See section "R&S®MapView geographic information software" for more information about this application.

The ActivityAnalyzer is used to statistically evaluate the recorded data, which can be visualized for this purpose in different diagrams:

- Waterfall display (time versus frequency)
- Spectrum display (minimum/maximum level versus frequency)
- Channel occupancy display (occupation duration of all channels during the recording period)
- DF display versus frequency (if a DF scan is recorded)

Using filter functions for the recording period, signal dwell time, level, or frequency, it is possible to limit the visualized data to a specific area of interest. An export function allows data to be stored in ASCII format; thus, this data can be further processed in customer-specific applications.

Radiolocation software

Efficiently detecting communications signals is primarily a result of the transmitter's direction finding and position fix. To perform radiolocation, two or more DF systems are combined to form a radiolocation network system. All directions finders from Rohde&Schwarz can be remote-controlled and networked: R&S®DDF195, R&S®DDF0xM, R&S®DDF0xE, and R&S®DDF0xA.

The backbone of each R&S®RAMON radiolocation system is the LOCATE module. Depending on the configuration and options, it forms a one-channel radiolocation system for locating discrete radio signals (→ monitoring location = R&S®MonLoc; type designation: R&S®RA-LOC), or a multichannel radiolocation system for simultaneously locating several radio signals (→ scanning location = R&S®ScanLoc; type designation: R&S®RA-SLOC). As part of the R&S®RAMON software family, a radiolocation system can be easily integrated in existing radiomonitoring systems from Rohde&Schwarz.

In addition to the radiolocation software, the following factors are decisive when it comes to the functions provided by a radiolocation system:

- Type of communications between the individual DF locations (see also "Networking of systems/components")
- Type of operation of remote DF systems: locally, i.e. attended, or completely remote-controlled

R&S®MonLoc system concept

R&S®MonLoc allows all main parameters of the local and remote direction finders to be displayed on a central PC. The remote direction finders are connected to the central PC via data links using the TCP/IP protocol. Connection may be established via analog or digital PSTNs (dialed or leased lines), a GSM network, or a microwave link, for example. The bandwidth of the data link is optimally utilized so that system capabilities can be fully exploited and high probability of intercept is ensured even at low data rates (down to 9.6 kbps). The audio signal from a remote direction finder can also be simultaneously transmitted on the same communications channel.

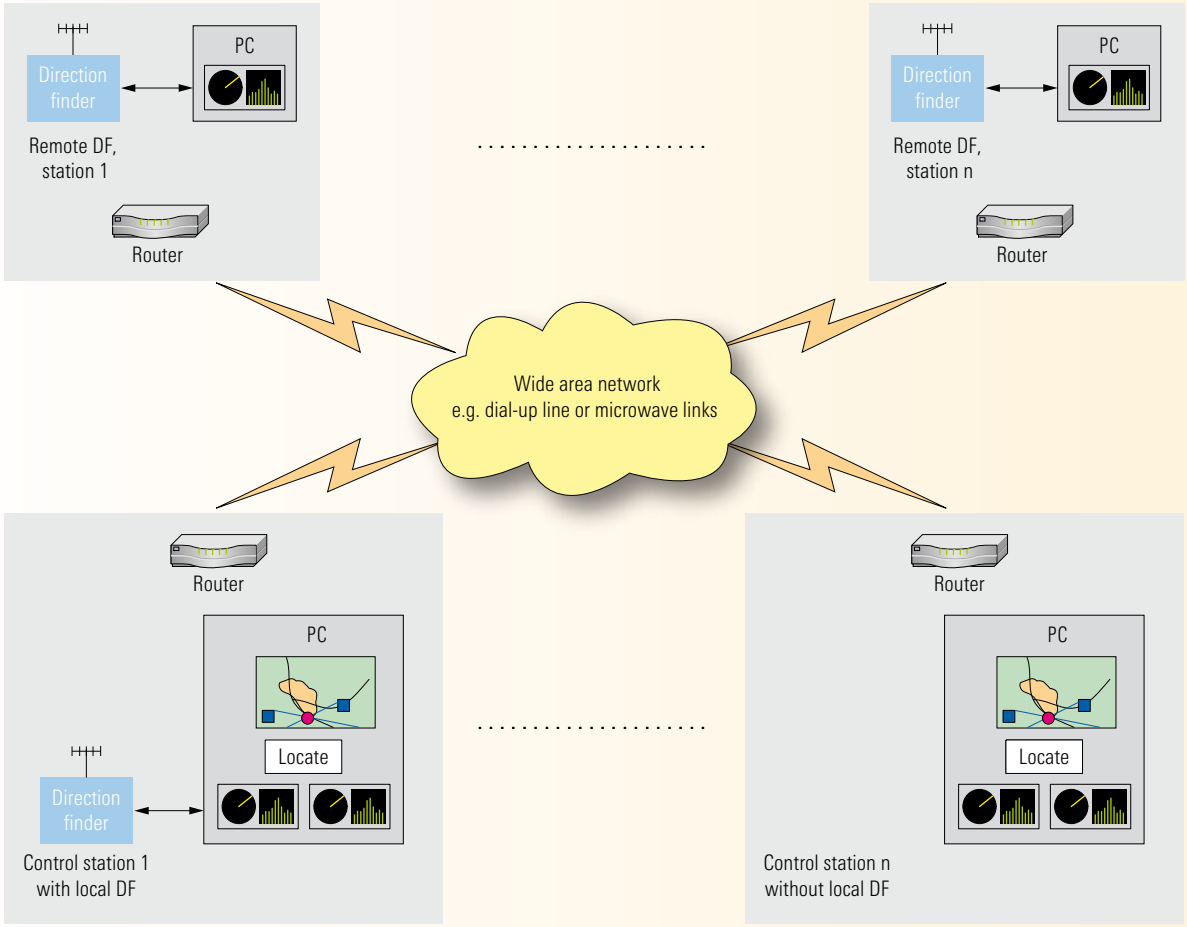


Fig. 14: R&S®MonLoc system overview

The flexible system concept allows an unlimited number of control stations to be combined with an unlimited number of DF stations (see Fig. 14). Any kind of radiolocation system from small mobile stations to nationwide radiolocation systems can thus be set up and operated with a minimum of personnel.

In systems with several networked operator positions, R&S®MonLoc also supports automatic processing of position finding requests from several operators. The radiolocation workstation may be unattended in this case.

R&S®MonLoc central control
The operator in an operator-selectable control station chooses the DF stations best suited for the task at hand by means of a mouse-click in a list. The links to the selected direction finders are automatically established. If sufficient bandwidth is available for link setup, the graphical user interfaces of the selected DF devices can be simultaneously displayed on the screen of the central control PC. However, at least parameters such as bearing quality and level of remote direction finders are displayed.

All networked direction finders can be controlled from the user interface of the local direction finder. The position of the DF stations and the bearings are marked on a digital map. The use of two screens is recommended so that user interfaces and the map can be separately displayed.

The following operating modes are supported:

- Fixed frequency mode (FFM)
- Search mode
- Scan mode

In addition to FFM permitting direction finding and radiolocation on single frequencies, the search mode is used for detecting unknown and new radio signals or for monitoring signals stored in a frequency list. Any setting made on the local direction finder is automatically transferred to the remote DF stations so that correct location results are always obtained.

The scan mode is supported by the R&S®DDF0x digital monitoring direction finders. It is used to detect unknown conventional radio signals but especially to detect and take bearings of short-duration and broadband emissions. In R&S®MonLoc location systems, bearings of such emissions are obtained manually by the operator with the aid of measurement rulers in the azimuth or histogram window of the direction finder, i.e. the graphical user interfaces of all direction finders need to be displayed on the operator's workstation. This is performed manually for all currently networked direction finders. All bearings on the measurement line are automatically displayed on a digital map, and the location is calculated. For this function, a higher transmission rate is required on the data link (e.g. 64 kbit/s).

If the remote DF stations are attended, the operator of the central station may notify the operators of the remote stations about the frequency band to be detected by sending a DF request. After manual evaluation, the operators of the remote stations can transfer the results to the central station, where the bearings are displayed and triangulation is performed, merely by clicking a mouse. For fully automatic location of short-duration and broadband signals, the R&S®ScanLoc system can be used.

R&S®ScanLoc brief description
R&S®ScanLoc is an HF/VHF/UHF radiolocation system. It can be used for the following:

- Short-duration radio emissions (bursts)
- Frequency-agile radio emissions (e.g. frequency hoppers)
- Conventional radio emissions

R&S®ScanLoc uses direction finders in synchronized scan mode. The heart of the system is the R&S®DDF0xA digital scanning direction finder with its high scanning speed of up to 20 GHz/s, or the R&S®DDF0xE digital monitoring direction finder. Up to four direction finders of the same type can be integrated in one R&S®ScanLoc system.

R&S®ScanLoc main features

- Automatic position fix of short-duration and conventional emissions
- Instantaneous signal interception, direction finding, and radiolocation
- Automatic preclassification of emissions:
  - Continuous
  - Burst
  - Frequency hopping with list of frequencies
  - Chirp
- Automatic comparison of detected emitters with reference emitter library
- Automatic tracking of mobile radio emitters
- View of averaged results on a digital map (including situation layers)
- Storage and evaluation of location results
- Various possibilities for system extension with R&S®RAMON system software

R&S®ScanLoc system concept

Up to four direction finders can be controlled by one R&S®ScanLoc system from one central control station. All direction finders are time-synchronized via GPS and scan the same frequency range(s). Bearings together with the associated frequency and time tags are buffered on the local subsystems for preclassification and data reduction. The results of the remote DF stations are then transferred to the location center via communications links with data transmission rates down to 19.2 kbit/s.

R&S®ScanLoc system operation

The entire R&S®ScanLoc system is controlled from the central control station, where the preclassified DF results of all direction finders are collected. The geographic positions of the detected emissions are calculated and presented together with the emission type (continuous/burst/FH/chirp/unknown) on a digital map.

To identify emitters, the preclassified location results are further averaged in terms of time and frequency and in accordance with the individual emission type. These emitters are then presented as circles on the map, which is an alternative to presenting all detected emissions. This provides further data reduction for the operator. Detected emitters are stored in a database either automatically or after individual selection. If automatic recognition is activated, the emitters are automatically compared with a reference emitter library. If the parameters and type of a detected emitter match an entry in the list, its name is also shown on the map.

Two main operating modes are available:

- Continuous surveillance of a scenario:
  This automatic operating mode provides an overview of all signal activities (emissions) or emitters (averaged emissions) in the selected scan range together with their locations. The system scans the frequency ranges of interest and continuously produces location results.
- Focused snapshot of a scenario:
  This semi-automatic operating mode interrupts the continuous surveillance mode. It enables the operator to concentrate on a single event, which may not even be active anymore. The operator can focus on a special section of the frequency range, azimuth range, and time range. This mode is especially designed for a quick analysis of specific emissions in highly dense signal scenarios as well as for systems using communications links with low data transmission rates.

R&S®ScanLoc database

The operator can store all detected emitters of interest in a report database. The following parameters can be stored:

- Frequency/list of frequencies for FH
- Signal ID
- Emitter name
- Type of signal
- Bandwidth
- Comments
- Start/stop time
- Position

Other tools

MasterSlave

The MasterSlave tool is used to exchange data between different applications, such as graphical user interfaces (GUI) of the instruments, tools for evaluating measurement data, or the graphical user interface of the report database (ReportEdit).

A central software instance of MasterSlave on one of the PCs acts as the server in a system. The GUI of the instance allows links to be set between the different R&S®RAMON applications. Client applications of MasterSlave are visible as a toolbar, for example in the graphical user interfaces of the instruments.

MasterSlave handover permits parameters to be transmitted from one application to another by clicking the mouse. Fig. 15 shows the toolbar of a broadband search receiver. Using the buttons of the toolbar, handoff receivers can be set to the frequency of a radio signal that was selected in the RF spectrum of the search receiver.

The MasterSlave Control option allows automatic operation. For this purpose, a search receiver scans a single-frequency list of known radio networks, for example. If radio activity is detected on one of these frequencies, one of the handoff receivers is automatically set to this frequency. With the second active signal, the second handoff receiver is set, and so forth. The handoff receiver remains on the frequency as long as the radio network is active. If activity can no longer be detected on the frequency during a settable hold time, the handoff receiver is released again and can be assigned a new frequency by the search receiver.

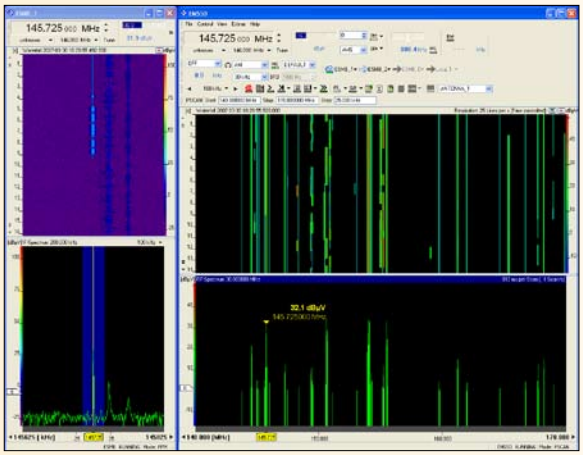


Fig. 15: Signal handoff to handoff receiver via Master/Slave handover

User Manager

The User Manager (see Fig. 16) is an application for managing the access rights of the system operators. By means of this application, an administrator (operator with administrator rights) defines, processes, and deletes operators and operator roles in the system. The operators can thus be granted access to the applications they require in their specific roles, but they cannot start any other applications. Operators can also be granted or denied access to functions within an application (e.g. ReportEdit the graphical user interface to the report database).

The User Manager thus provides a very finely graduated rights administration in a COMINT/CESM system.

Database systems

Based on an Oracle database, two database applications are used to control the workflows in R&S®RAMON systems; they also store and process signal-related data (see Fig. 17). The Report database supports the control of workflows in a COMINT/CESM system. For this purpose, the ReportEdit application is the GUI. The signal-related database application is referred to as the Emitter database. The Emitter Data Manager (EDM) is the interface to the operator. EDM is an intranet application based on Microsoft Internet Explorer (see Fig. 18 and Fig. 19).

Report database and ReportEdit

Communications intelligence is a step-by-step process in which radiocommunications signals are intercepted, analyzed, stored, and evaluated. These processes are controlled by means of orders, tasks, and reports. In larger systems with several workstations (see system example in Fig. 18) a supervisor usually organizes these processes. The supervisor plans the interception tasks based on a customer order. Using the ReportEdit software module, the supervisor assigns specific orders and tasks to the individual operators.

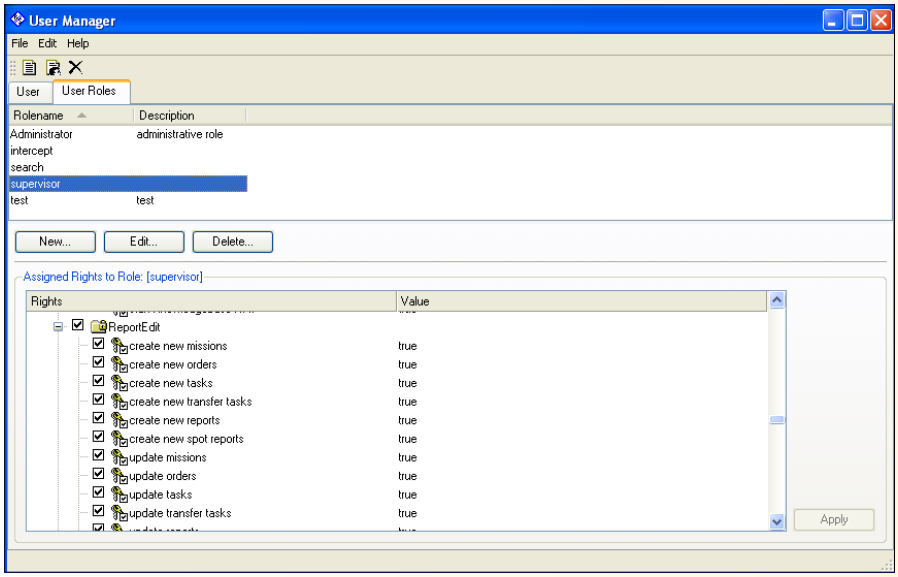


Fig. 16: User Manager graphical user interface: The screenshot shows different access rights to the Report database

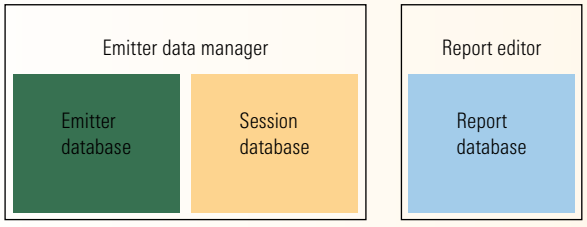


Fig. 17: R&S® RAMON database applications

The operator transfers the interception results via mouse-click to the reports and sends them to an evaluation workstation.

The following data can be stored in a report and transferred to the subsequent operator:

- Measurement data of the receivers, direction finders, and analyzers
- Screenshots of the graphical user interfaces of the instruments, of tools such as ActivityAnalyzer and REPLAY, and the R&S®MapView map application
- Hyperlinks to stored audio signals
- Hyperlinks to stored IF signals

The evaluator in turn stores the results of the tactical and operational evaluation in a summary report, which in turn is stored in the Oracle-based database. The supervisor then accesses this data and compiles reports for the customer as well as new orders which include the information just obtained.

Depending on the size and structure of the radiomonitoring system, there may be several hierarchical layers that can be easily displayed by adapting the database structure. Large systems are equipped with a master control layer below which other subsystems are arranged (e.g. grouped according to frequency ranges).

Fig. 18 and Fig. 19 show content examples of orders and reports. These documents are compiled from templates, which the operator fills in and complements. ReportEdit provides a set of templates. The links and interactions between the individual workstations are specifically configured for each system.

In a radiomonitoring system with workstations in a local area network (LAN), all operators access a central database server. The order/report documents are stored in the LAN's Oracle database. However, if data is to be exchanged with external systems, e.g. with remote fixed stations or mobile units, an export function ensures that the orders or report documents (including file attachments) can be exchanged (in this case, a file attachment is data linked via hyperlinks, such as screenshots or audio recordings).

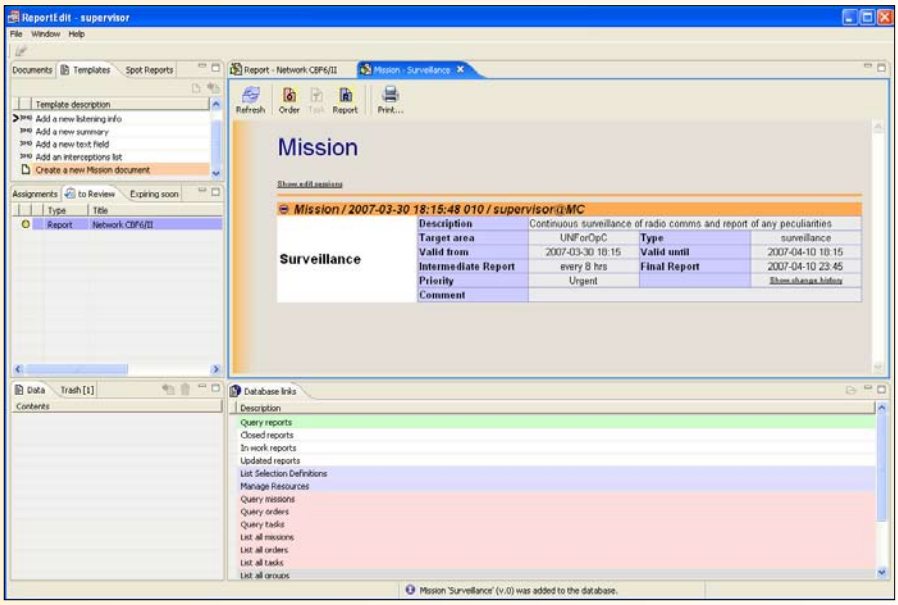


Fig. 18: Creating a mission (reference order) for the system

Emitter database and EDM

The Emitter database is used to store interception data and forms the backbone of the work of the system operators. It includes raw data from the interception process, also referred to as session data, as well as basic reference data, which forms the basis for a comparison with the current interception data. Fig. 20 shows the basic structure of this database.

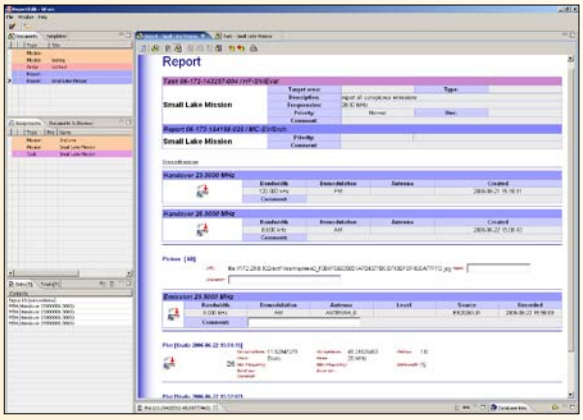


Fig. 19: Search Report, generated by the search operator

Objects are the heart of the databases. They define the users of communications facilities, who are of major interest (to the intercept operators). An object may be an individual person or a group of persons; the term can refer to a military unit as well as part of this unit. Objects in turn are combined to form groups. Within a group, several objects in a radio network communicate with each other, using a specific transmission method.

The signal center is directly linked to the object. All radio signals intercepted from a geographic location are summarized in a signal center. An example of such a signal center

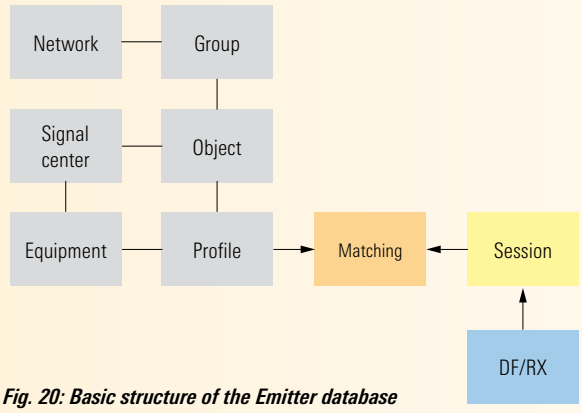


Fig. 20: Basic structure of the Emitter database

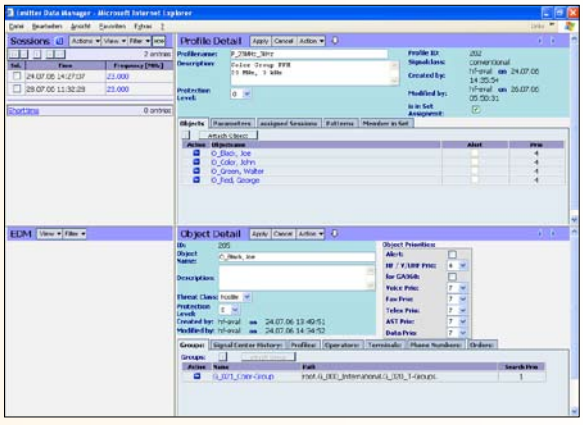


Fig. 21: Emitter Data Manager with profile data set (profile detail). The lower part of the window shows the data of one of the objects assigned to this profile (object detail)

is a ship, which uses different means of communications to contact other ships (e.g. HF or VHF/UHF communications, and INMARSAT). If these links have been detected, the ship (object) can be described by these radio characteristics. Intercepting all known means of communications at the same location can thus provide information about the ship's location.

The equipment data is also part of the basic reference data.

Profiles are created from the measurement data (technical parameters) of an intercepted signal; these profiles can be linked to the above data sets (objects, etc). This is a typical evaluator task. In a continuous process, these profiles are now fully automatically compared with the interception data (session data) provided by the sensors. Fig. 22 shows a classification result (session data set) with a list of objects (users) that are possible points of transmission. As profiles are linked to objects in the database, object data about an intercepted signal can be directly displayed. The basic algorithm (matching) can be parameterized by the database administrator.

Fig. 22: Display of the classification result of a radio signal at 23 MHz (session detail). It automatically contains a link to possible objects that use the detected radio transmission method on this RF frequency for communications

The intercept operator notices an alarm at the workstation's EDM user interface if a signal is partially or completely recognized by the matching algorithm. If the intercept operator uses a receiver with a classifier (see description of R&S®AMMOS sensor), for example, the result data set is automatically, after classification has been performed, compared with the profile data sets in the database that were selected by the database administrator (supervisor) for raising the alarm. If the comparison yields a positive result (specific percentage based on number of evaluation points), the intercept operator is immediately informed.

The data sets of the basic reference database are usually compiled and maintained by the evaluator in a radiomonitoring system. The evaluator analyzes and evaluates the interception data, draws conclusions from this analysis, and creates object and profile data sets, which are used as basic reference data to support the interception process.

Especially after a radiomonitoring system has been initially put into operation, the compilation of basic reference data is a key task of the operators. When a system is supplied to the customer, the Emitter database does not contain any data sets or parameters and is only filled by the customer.

R&S®MapView geographic information software

R&S®MapView software is used to display DF and radiolocation results on a map. This type of display is an indispensable key function for the intercept operator when processing a radio signal, as well as for the evaluator (operational and tactical evaluation).

A wide variety of different map formats can be displayed directly in R&S®MapView, or imported for display. Thus, the customers' digital maps can usually also be utilized in Rohde&Schwarz systems. R&S®MapView is described on page 206.

Recording systems

AF recording

R&S®AllAudio software is used to distribute and record audio signals in COMINT and CESM systems. The software processes the audio signals of local receivers and direction finders on the specific workstation computer and allows all audio sources of remote system sections to be accessed. By means of integrated compression algorithms, audio signals can also be transferred via data lines with very low data rates. The signals can then be recorded in the remote system and/or locally on the workstation computer.

An integrated intercom system permits voice communications between the operators of a COMINT/CESM system. The operators can be connected with each other either in a local Ethernet network or via a wide area network (WAN).

The functions of R&S®AllAudio are described on page 202.

IF recording
The digital R&S®AMREC IF recording/replay system (see Chapter 4, page 126) is available to record IF signals. The key control elements for R&S®AMREC are directly integrated in the appropriate graphical user interfaces of the R&S®AMMOS IPCs.

Networking of systems/components

One of the key characteristics of the components of a COMINT/CESM system is their remote-control capability. Each radiolocation system is based on the remote-control functions because two or more direction finders communicate with each other via radio or wireline means of communications.

Communications between modules of the R&S®RAMON software family is principally based on the TCP/IP protocol. To transmit data via a wide area network (WAN), a full-duplex communications link is required that provides modem links via dialed or leased lines of wireline communications networks, mobile radio connections (GSM), as well as radio relay links, and satellite communications (INMARSAT, VSAT).

Radios – whether for military, tactical, or civil/commercial applications – usually provide only a simplex communications link, however. For this reason, special software must convert the TCP/IP-based data telegrams to another protocol on both computers involved in the connection in order to enable remote control.

Another important factor in remote control is the available data rate. Radio relay systems or leased lines usually provide extremely broadband connections, which allows the transmission of realtime information, for example of an IF signal spectrum or RF spectrum of a scanning receiver/direction finder. Connections with lower bandwidth (which usually include simplex radio links) do not permit this type of data transmission.

The operational requirements placed on a COMINT/CESM system must therefore be made to match the available means of communications. For example, an existing communications system should be replaced by a more powerful system if specific, indispensable operational requirements have to be met.

Example
A radiolocation system consists of two direction finder stations which can be connected alternatively via a radio relay system (full-duplex) with 256 kbit/s, or a tactical radio system (simplex) with 9.6 kbit/s. When the data link is set up via the radio relay system, the entire content of the direction finder user interface of the remote DF can be transmitted in realtime. This includes the IF panorama display as well as the demodulated audio signal of the radio signal whose bearings were taken. At the same time, the setting commands of the operator are transmitted via the local PC.

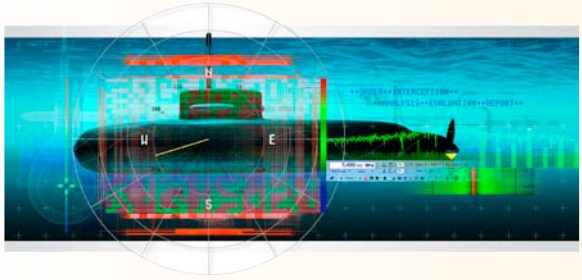
If the connection is set up via the tactical radio system, either the DF commands are transmitted from the local DF system to the remote DF system, or DF data is received from the remote direction finder. This data includes the current geographic position of the remote direction finder, the DF value, and data such as RF receive level and DF quality. The audio signal and spectrum data are not transmitted. Thus, analyzing and evaluating the DF and radiolocation result is much more difficult than in the first case. While evaluation is still possible when the system is used in the VHF/UHF range, it will be very difficult to perform in the shortwave range, where propagation conditions vary strongly and are extremely problematic.

The specialists at Rohde&Schwarz advise customers when designing their remote-controlled COMINT/CESM system to come up with a tailor-made solution.

Platform integration

R&S®RAMON systems have already been successfully integrated in a wide variety of platforms, including armored and non-armored land vehicles, shelters, aircraft, ships, and submarines. Customers benefit from the many years of expertise and know-how Rohde & Schwarz has in system integration, as well as from the modular design and networking capability of the hardware and software components.

An example of a system integration in a customer-specific platform is the highly complex and sophisticated integration in a submarine, which is briefly described below. Submarines are highly mobile and extremely difficult to detect even when they remain in the area of operation for long periods of time.



By providing covert reconnaissance, they are an important means of gathering intelligence about targets on land, at sea, and in the air.

They are also increasingly being used in coastal waters against criminal and terrorist targets. Their features and scope of capabilities thus make them the perfect carrier for radio reconnaissance systems. Rohde & Schwarz has therefore developed a solution specially for submarines that detects and locates sources of RF emissions.

This COMINT/CESM system consists of the following:

- R&S®ADD215 DF and monitoring antenna specially designed for submarines
- R&S®DDF05A digital VHF/UHF scanning direction finder
- R&S®AMMOS automatic modular monitoring system
- R&S®AMREC subsystem for IF signal recording and offline signal analysis
- R&S®RAMON software and the required workstation computer for largely automatic operation

The system searches for RF signals from 50 kHz to 3.6 GHz (direction finding from 300 kHz to 3 GHz) and detects them by using state-of-the-art DSP receiver technology and a powerful wideband direction finder. The system demodulates and decodes both civil and military analog and digital modulation types and transmission methods (voice, fax, data communications). It detects LPI signals such as burst, hopper, and GSM emissions.

The COMINT/CESM system categorizes and identifies the emitters by using technical parameters based on an efficient database concept and tracks emitters automatically – thus preventing the loss of hostile signal sources.

Meets demanding environmental requirements

The COMINT/CESM system for use in submarines is modular in design: On the one hand, it consists of military customized products. On the other hand, it contains the R&S®ADD215 DF and monitoring antenna, which was developed specifically for use in submarines, and special system cabinets designed for the application and platform at hand (see photo on next page). The conditions on board a submarine place exceptionally demanding requirements on the integrated devices.

The COMINT/CESM system for submarines has passed the tests and certifications specified by the EN and MIL standards with flying colors. This is true both for shock and vibration as well as for EMC, magnetic stability, reduced operating noise, watertightness (for the cabling and the R&S®ADD215 DF and monitoring antenna), and pressure resistance.

The submarine's crew operates the COMINT/CESM system from the multifunction consoles (MFCC) which are normally located in the vessel's operations center. The system software is based on R&S®RAMON, which is designed to allow those on duty to focus solely on their task. The software optimally allocates both the sensor resources as well as the search and monitoring tasks to each console.

Perfect for submarine use

The following three potential operation profiles show how well the COMINT/CESM system from Rohde&Schwarz, which consists of customized military products, is designed for military use in submarines:

- During the search for, direction finding and interception of signals, all subsystems in the submarine and the R&S®ADD215 DF and monitoring antenna on the extended mast are active.
- When the submarine is submerged, the direction finder and antenna are not active. All remaining subsystems ensure loss-free signal processing and postprocessing
- Finally, to reduce power consumption and acoustic emission, or when only the system's administrative services are required, the COMINT/CESM system can be operated in reduced mode.

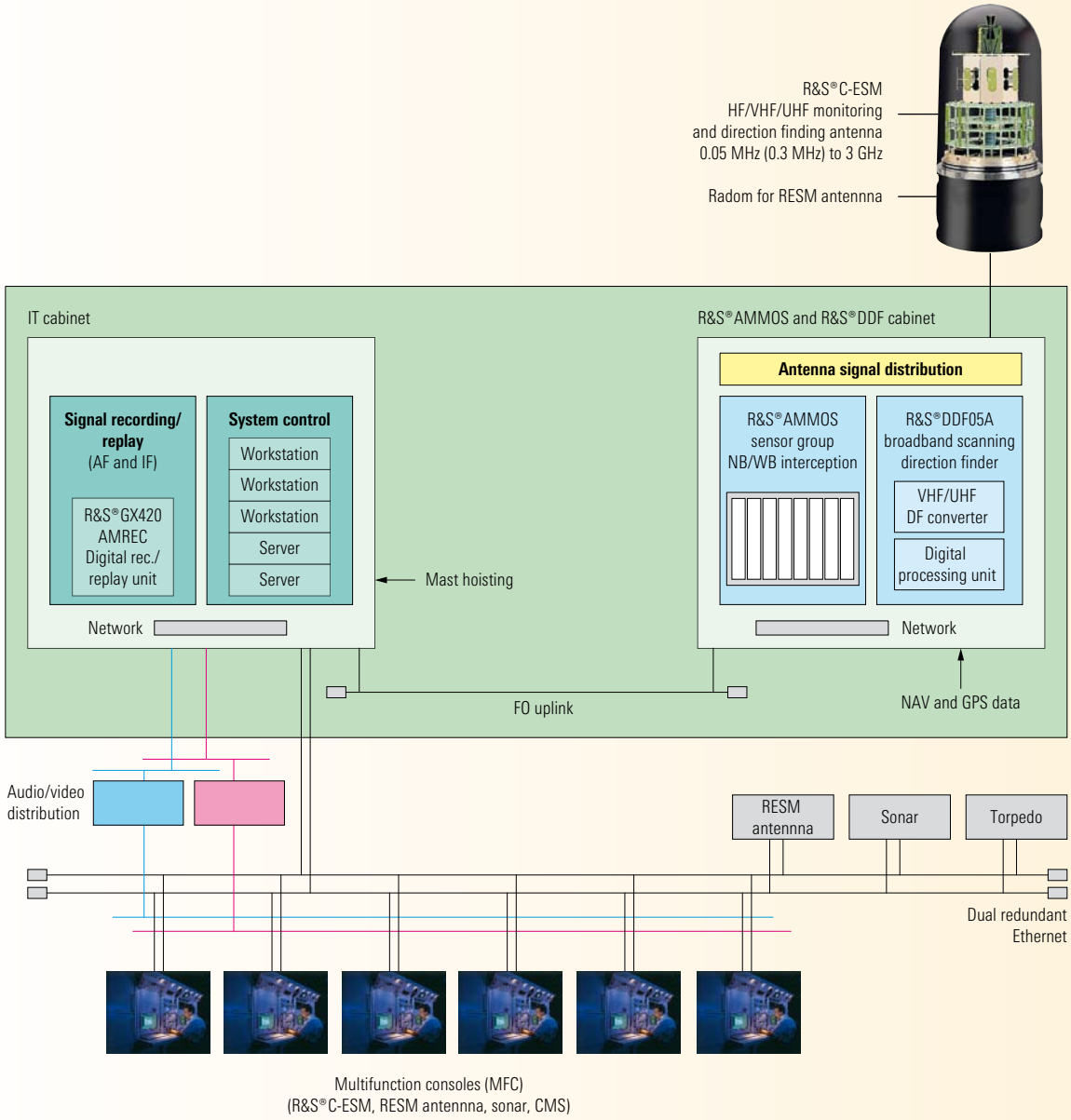


Fig. 23: The block diagram shows the system configuration

R&S®TMSR
Lightweight CESM System

Highly mobile communications intelligence and direction finding equipment

Main features

- Compact multipurpose interception and DF system for security organizations, border/coast guards, special task forces, etc
- Detection, identification, and recording of radio signals from 10 kHz to 3 GHz, direction finding from 0.5 MHz to 3 GHz
- Listening in to demodulated AM, FM, SSB, and CW signals
- Recording, replay, and evaluation of audio signals
- Easy means of obtaining results
- Immediate detection of electronic emissions beyond line of sight
- Identification and pre-evaluation of detected emitters
- Display of results plus situation display on digital maps
- High mobility and quick deployment

Brief description

An increasing number of low-intensity conflicts throughout the world have led to a growing demand for portable, highly mobile communications intelligence and direction finding equipment. Special task forces from security organizations require modular and easily scalable reconnaissance equipment, while national defense organizations need electronic support measures (ESM) equipment that enables situational awareness in out-of-area deployments.

Lightweight equipment of this type is offered by Rohde&Schwarz in the form of the R&S®TMSR, which has primarily been designed for the following applications:

- Generation of an (initial) image of the radio scenario in the frequency range (10 kHz) 0.5 MHz to 3 GHz
- Situational awareness beyond line of sight
- Detection concentration in shadowed areas
- Detection of deployable transmitters
- Overt or covert reconnaissance before and during missions
- Protection of your own forces

Depending on the mission, the R&S®TMSR can be used under a wide variety of operating conditions:

- When deployment on short notice is required
- With very low outlay in personnel and material
- For uncertain or unknown positions
- As a manpack version that can be carried by one person
- Adaptable to various means of transportation

Basic components

Each R&S®TMSR system consists of the following basic components:

- Transit case with integrated power distribution
- R&S®EB200 miniport receiver
- R&S®DDF195 digital direction finder
- Laptop or rack-integrated computer
- R&S®RAMON software for convenient device control, result display, and evaluation

The R&S®EB200 miniport receiver is a very small and compact manpack unit with a very wide frequency coverage. Owing to its high scanning speed of up to 1.2 GHz/s (in DIGI-Scan mode), it is ideal for use as a search or scan receiver. To support monitoring operations, the receiver includes an IF panorama display with a realtime bandwidth of up to 1 MHz.

The R&S®DDF195 digital direction finder, consisting of the R&S®EBD195 DF processor and the R&S®ADD195 DF antenna, is connected to the IF of the R&S®EB200 miniport receiver. The R&S®DDF195 with its advanced correlative interferometer method provides reliable DF results even in mobile operation. It processes conventional as well as short-duration signals with dwell times down to 10 ms.

The transit case with an integrated shockmount frame protects the instruments even under tough environmental conditions. It allows quick and easy changing of carriers and setups.

Modes of operation

Manpack operation

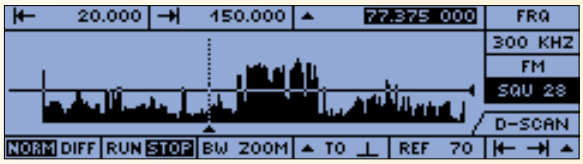
After the R&S®EB200 miniport receiver has been taken out of the transit case, the receiver is stowed in a carrying bag as shown in the photo below. The receiver is thus weather-protected, easy to carry and convenient to operate.

Manpack operation

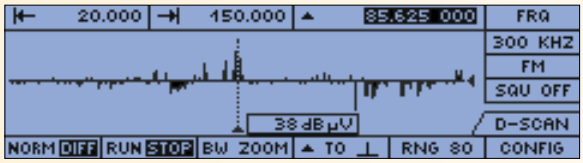
The handheld R&S®HE200 active directional antenna is used in this implementation. It consists of four antenna modules covering the entire frequency range from 10 kHz to 3 GHz.

The receiver is powered from a battery that can be quickly exchanged. Operation time can thus be adapted to the mission by means of additional batteries, which can also be stored in the carrying bag. Two battery packs are included in the R&S®TMSR system.

Working with the manpack system, the operator can use the fast DIGI-Scan mode of the receiver to obtain an overview of the spectrum occupancy. Even volatile and short signal bursts are clearly indicated and are accessible in this mode. The receiver can be changed to listen mode with a single keystroke.



DIGI-Scan: spectrum display



DIGI-Scan: differential mode

The DIGI-Scan differential supports immediate recognition of changes in the radio scenario, e.g. occurrence or disappearance of radio signals. Upon activation of this mode, the displayed spectrum (i.e. a snapshot of the current radio scenario) is stored as a reference. Only new signals and variations in signal strength are clearly discernible as peaks. Measuring the angle of incidence of a detected signal is possible with the directional antenna by means of the signal level. This is supported by activation of a tone (audible in the loudspeaker or earphone) whose pitch reflects the signal level.

Important frequencies can be stored in one of the 1000 memory locations of the R&S®EB200 miniport receiver. These parameters can later be used for further processing by the R&S®RAMON software.

Mobile operation

The R&S®TMSR system can also be operated in vehicles or ships.

The entire system can quickly be set up in a vehicle with the DF antenna fixed to the rooftop by means of a car adapter from Rohde&Schwarz. This setup is shown in the photo at the bottom left. In this case, the R&S®EB200 miniport receiver is stowed in the transit case and operated in conjunction with the R&S®DDF195 digital direction finder.

Stationary operation

When used in a stationary environment (e.g. in a building), the system can be operated from the AC mains supply (110 V or 240 V).

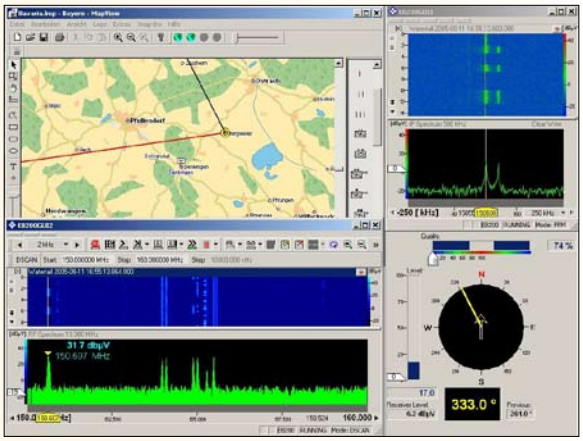
Changing from one setup to another is a matter of minutes.

Added value

The R&S®RAMON software adds substantially more functionality to the system. The following commercial-off-the-shelf (COTS) software modules are included:

- R&S®RAMON Basic
- R&S®EB200-Control
- R&S®DDF195-Control
- R&S®RA-REC, R&S®RA-RPLY, and R&S®RA-ACT
- R&S®MapView
- R&S®DF-Eval
- R&S®AllAudio (AFBASIC and AF-REC)

Vehicle setup – R&S®ADD195 DF antenna fixed to rooftop



Display on the laptop of a R&S®TMSR200 with additional R&S®EB200 search receiver: RF and IF spectrum, DF data as well as map display at a glance

These software modules provide the following functionality:

- Display of high-resolution and high-speed RF and IF spectrum and 2D waterfall for recognition of signals
- Direction finding with standard polar view and azimuth histogram/waterfall view for observation of radio networks
- Instant replay of RF spectrum display for evaluation of short-duration signals via an integrated RF spectrum data buffer
- Recording, replay, and statistical evaluation of frequency spectrum data
- Display of COMINT results plus additional (e.g. tactical) information on digital maps
- Recording of digital audio signals
- Import and export of RF frequency parameter sets from the R&S®EB200 miniport receiver to and from the R&S®RAMON control software

The software supports the following modes of operation:

- Fixed frequency mode (FFM): display, analysis, and direction finding of a fixed frequency signal
- Search: searching a single frequency list or a frequency range, including display of bearings
- Scan: display of current RF spectrum

The screenshot provides an example of the graphical user interface of the device control software.

The operator can enter any setting for the receiver or direction finder directly on the PC or via the front panels of the devices. The receiver or direction finder settings and results are displayed in different graphical views on the screen of the control PC. Direct front-panel control of the instruments is shown on the respective displays of the graphical user interface. This is very convenient in situations where controlling the instruments via their front panels is easier (e.g. in a vehicle in motion) but the operator still wants to have large scalable displays of the results.

R&S®MapView is used to display and evaluate DF and location results, the site of the direction finder and the current DF bearings being displayed on a digital map.

Frequently used functions such as zooming map sections, shifting map sections, distance measurement, selection of map objects, and single results can be accessed quickly via a special toolbar. The current situation can be displayed with the aid of graphic symbols, text elements, and lines that can be positioned on the map as required. Thus, detected radio networks as well as a tactical situation can be displayed.

With DF evaluation, bearing results can be collected and evaluated. DF evaluation allows continuous or triggered recordings, replay, and post-evaluation of DF missions, i.e. car or DF locations and DF results. A single mobile R&S®TMSR system can be used to fix a position by conducting multiple DF measurements from different car or DF locations (running fix).

R&S®AllAudio enables listening in, recording, and replay of the receiver's audio signal. The recordings are stored on the computer hard disk in an audio database. The operator can set bookmarks during recording in order to later quickly find the bookmarked section or recording. Comments can also be added.

For more information about the R&S®RAMON software modules, please refer to the relevant Technical Information publications from Rohde&Schwarz.

System configurations

R&S®TMSR100

This system consists of the R&S®EB200 miniport receiver, the R&S®EBD195 DF processor, the R&S®SPCC system process controller, and the R&S®RAMON software. All the units are integrated into the transit case (see photo on next page).

R&S®TMSR100

This system is designed for use with one R&S®ADD195 DF antenna and covers the frequency range from 20 MHz to 1300 MHz. The R&S®SPCC system process controller is a highly compact PC with integrated router. Thus, it is readily prepared for communications in a wide area network (WAN) as it can be directly connected to various types of communications equipment. Three different interface configurations are provided for connection to analog PSTN lines, digital ISDN lines, or an integrated GSM modem.

R&S®TMSR200

This system contains the R&S®ZS129A1 switch unit (antenna selector) and the R&S®SPCN laptop computer instead of the integrated R&S®SPCC system process controller. All units except the laptop are integrated into the transit case.

The laptop can optionally be integrated into a suitcase. In the suitcase, the laptop is cushioned on shockmounts, and the interface connectors are accessible via a multipoint connector on the left side of the suitcase. With the R&S®ZS129A1 RF switch matrix the system can be used with several DF and monitoring antennas. This way the system can be equipped with antennas covering the frequency range from 10 kHz to 3 GHz for monitoring and 0.5 MHz to 3 GHz for direction finding.

Both systems include an AC/DC power distribution that enables direct connection of various DC and AC supplies. Internally, all instruments are DC-powered. Moreover, a network hub is integrated to enable the connection of additional external network devices and additional R&S®EB200 miniport receivers.

Extending the system

Because the R&S®TMSR uses R&S®RAMON software modules, it offers virtually unlimited capabilities for updates, upgrades, and extensions to meet future requirements. Enhanced functionality can be achieved by using the following optional components, for example:

- Second R&S®EB200 miniport receiver
- Second R&S®EB2-CTL control software for R&S®EB200
- R&S®RA-MSH master/slave handover software

The second R&S®EB200 miniport receiver can be connected to one of the ports of the integrated network hub. With the additional R&S®RAMON R&S®EB200 control software, the receiver can now be operated with the same full functionality as the one already integrated into the rack. The second receiver can be used for continuous observation of the RF spectrum while the integrated receiver is used for monitoring, audio recording, and – in conjunction with the R&S®DDF195 – for direction finding.

The master-slave handover function is used to control at least two receivers. It permits the operator to hand over settings from one receiver to another. Therefore, one receiver can be used in scan mode (as a master) while tasking one or more additional receivers for monitoring operation in fixed frequency mode (as slaves – in this case the rack-integrated R&S®EB200). By using the cursor to select a frequency in the master's RF spectrum display, the operator automatically tunes the slave receiver to this frequency (including master receiver settings such as bandwidth and type of modulation). The operator can now listen in to the detected signal on the slave receiver and observe the signal with the corresponding IF spectrum data. Also, the bearing will concurrently be processed by the direction finder.

Specifications

Operating temperature range	–10 °C to +45 °C
Storage temperature range	–40 °C to +70 °C
Humidity	80 % cyclic, +25 °C/+40 °C
Sinusoidal vibration	5 Hz to 150 Hz
Random vibration	10 Hz to 500 Hz
Shock	40 g shock spectrum
EMC	in line with EMC directive of EU (89/336/EEC) and German EMC law
Safety	in line with EN 60950/VDE 0805
Quality standard	developed and manufactured in line with ISO 9000
Power supply	100 V to 240 V AC, 47 Hz to 63 Hz, 235 VA, 11 V to 32 V DC/200 W
Dimensions (W × H × D) (box)	555 mm × 358 mm × 720 mm (21.85 in × 14.09 in × 28.35 in)
Weight	approx. 45 kg (approx. 99.21 lb)

Ordering information

Lightweight CESM System[1]		
With integrated PC, including: R&S®EB200 with DIGI-Scan, IF panorama, LAN interface, two battery packs and carrying bag, R&S®HE200, R&S®EBD195, R&S®ADD195 DF antenna, R&S®SPCC with keyboard and mouse, R&S®RAMON software, hub, power distribution and transit case (color: green)		
Communication unit for network connection		
Via analog dialed or leased line	R&S®TMSR100	3028.3510.02
Via dialed ISDN line	R&S®TMSR100	3028.3510.03
GSM900 or GSM1800	R&S®TMSR100	3028.3510.04
Lightweight CESM System[2]		
With integrated antenna switch unit and external notebook, including: R&S®EB200 with DIGI-Scan, IF panorama, LAN interface, two battery packs and carrying bag, R&S®HE200, R&S®EBD195, R&S®ADD195 DF antenna, R&S®ZS129A1 (1-out-of-6) switch unit, R&S®SPCN with mouse, PCMCIA 2 × serial port extension card and soft carrying bag, R&S®RAMON software, hub, power distribution and transit case (color: green)	R&S®TMSR200	3028.3561.02
Options		
Front and rear cover for transit case with opening for cables and fan	R&S®TMS-B4	3026.7660.02
Adapter for R&S®HE309/R&S®HF902 Antenna to be mounted on R&S®AC008-Z tripod	R&S®TMS-H1	3026.7260.02
RF Cable for monitoring antennas		
Length 5 m	R&S®TMS-H2	3026.7360.05
Length 10 m	R&S®TMS-H2	3026.7360.10
Length 20 m	R&S®TMS-H2	3026.7360.20
Grounding Set for antennas	R&S®TMS-H3	3026.7418.02
Adapter for R&S®ADD071 DF antenna to be mounted on R&S®AP502Z2 tripod	R&S®TMS-H4	3026.7460.02
Roof Rack Adapter for R&S®ADD195 DF antenna	R&S®TMS-H5	3026.8766.02
Battery Pack with 24 V/26 Ah	R&S®TMS-H6	3026.8014.02
Protective Case for DELL notebook with integrated power supply for AC mains/DC power (11 V to 32 V DC)[3]	R&S®TMSR-H7	3028.3961.02
Transit Case for antenna cables	R&S®TMS-H8	3026.8114.02
Photo Tripod for use with R&S®HE200 antenna	R&S®TMS-H10	3026.8189.02
Adapter for mounting on R&S®TMS-H10 photo tripod		
For R&S®HE200	R&S®TMS-H11	3026.8214.02
For R&S®HE500	R&S®TMS-H12	3026.8266.02
Complete option "Second Receiver" for R&S®TMSR (master/slave) Including one R&S®EB200 model .22, R&S®EB200ZK transit case (color: bronze-green), R&S®RAMON EB2-CTL software, and R&S®RA-MSH, and cable set	R&S®TMSR-MSH	3028.3710.02

[1] An antenna cable set and a monitor/TFT display for local operation are required.

[2] An antenna cable set is required.

[3] Notebook is supported by shockmounts.

R&S®TMSLoc Mobile Interception and Location System

Main features

- Complete location system consisting of:
  - Central R&S®TMSR system (master)
  - Up to three remote R&S®TMSR systems (slave)
- Mobile use
- Compact size and low weight, therefore easily transportable
- DF and monitoring range 20 MHz to 1300 MHz – optional: 0.5 MHz to 30 MHz and 1300 MHz to 3000 MHz
- Complete with radio systems for the tactical VHF band or the UHF band 430 MHz to 470 MHz, or for wireline or GSM communications with corresponding modems
- Systems can be operated from DC sources (e.g. power supply in vehicles)
- Ideal for short-term missions and when sites are frequently changed
- Easy integration into vehicles
- Using the communications infrastructure in the mission area
  - Analog or digital connections via dialed or leased PSTN lines
  - GSM mobile radio links
- Using the system-internal wireless communications equipment
  - Military transceivers (tactical VHF band)
  - Commercial transceivers (UHF band)

Brief description

Locating the source of an emitted signal is one of the key functions of a monitoring system. Compact mobile location systems using wireline or wireless communications are required for tactical missions in a limited area to ensure precisely this function and to prepare reports of the actual scenario. R&S®TMSLoc is such a system.

R&S®TMSLoc is based on the R&S®TMSR tactical interception and direction finding system (see page 186). R&S®TMSLoc networks up to four R&S®TMSR systems to form a radiolocation system. Networking is possible in two different ways:

In each case, data links are established between the individual stations. Via these links, an R&S®TMSR (master) can remote-control up to three other R&S®TMSR (slaves).

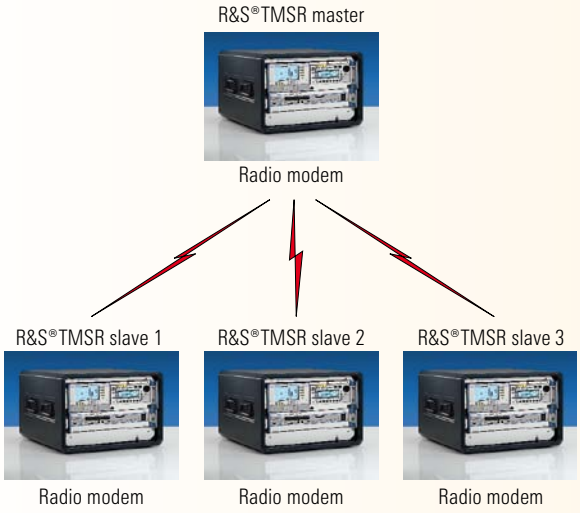
The system is operated with a location module of the R&S®RAMON product family. Bearings taken by the individual R&S®TMSR systems and location results are displayed on digital maps with the aid of R&S®MapView.

System description

All DF stations are identical R&S®TMSR systems. Each R&S®TMSR can therefore be used independently as a tactical interception and DF system. For radiolocation, the systems are networked using the R&S®RA-LOC location software.

The location software ensures communication between the R&S®TMSR systems. One R&S®TMSR operates as the master, and remote-controls the other systems (slaves) during radiolocation. The slaves are set by DF commands from the master, and bearing results are returned to the master. DF and location results are displayed on the controller of the master system. Results can be recorded continuously, at the user's request or with the aid of preset filter functions. The results are also available for subsequent evaluation and display on a digital map of R&S®MapView (offline

display of results). The networked R&S®TMSR systems may also be used locally without remote control by one master system. In this case, each system may issue a DF request which is sent to and served by the other systems. The requesting station thus receives the bearing results and calculates the position fix while the other systems continue their local intercept and DF operation.



Wireline or GSM communications

A router and, depending on the model, a modem for communicating with the R&S®SPCC controller are integrated in the R&S®TMSR100 systems. If R&S®TMSR200 systems (with external laptop) are used, router and modem may be accomodated in a separate case. This second case is then available as the R&S®TMS-C transportable communication system. Depending on the model, the integrated modem provides interfaces for the following:

- Analog dialed and leased lines (public or private telephone networks)
- Digital dialed lines in accordance with Euro ISDN standard (public or private telephone networks)
- The third system type includes a complete GSM modem (with RF section). A GSM antenna can be directly connected for operation in a GSM mobile radio network

Wireless communications using transceivers

If interception and radiolocation are to be carried out within a limited mission area independently of the local infrastructure, the use of system-integrated wireless communications equipment is indispensable.

Networking using radio modems

Radio modems operating in the frequency band 430 MHz to 470 MHz are used in this case. The modems form an addressed network where data telegrams are routed between the individual R&S®TMSR stations. The advantages of this type of equipment are its low weight, the extremely compact size, and the low power consumption of the modems. In addition, one of the modems can be used as a relay transmitter so that even R&S®TMSR slave stations in the silent zone of the master can be reached.

The picture shows an R&S®TMSLoc system with four R&S®TMSR stations linked by radio modems.

Networking using tactical radios

R&S®XV3088 transceivers operating in the tactical frequency band 30 MHz to 88 MHz are used in this case. When VHF radios are used, the distance between the master and slave stations is normally greater than in the case of UHF radio modems (= longer DF base line). Radio modems, however, offer greater flexibility for networking (routing) than tactical radios.

Software, Systems, and System Devices

New

Introduction to Satellite Monitoring

Satcom applications

People can communicate via telephone or data channels virtually everywhere around the world. Communications is based on various bearer services, depending on the topology, the political situation or the level of industrialization and infrastructure in large areas. Local and domestic calls are usually handled via the public switched telephone network (PSTN). International calls are routed around half the globe via deep-sea cables. However, terrestrial networks cannot be installed everywhere nor is this economically feasible. In scarcely populated hilly or vast landscapes (e.g. the Himalayas, deserts, the polar regions) with only sporadic or little telephone and data traffic, communications via satellite-based radio links is a highly cost-effective and flexible alternative to terrestrial networks. In war zones with destroyed terrestrial infrastructures, satellite-based communications systems often provide the only means of communicating over long distances. In regions with a destroyed infrastructure, communications is mainly restricted to densely populated areas and border areas [1].

Services and organizations entrusted with safeguarding the internal and external security of their country require suitable systems to detect satellite-based voice and data channels. A demand for such systems exists not only in regions with high satellite communications density. A communications satellite in a geostationary orbit is capable of illuminating more than one third of the earth's surface, and its signals can be accessed everywhere within the illuminated area (footprint) by means of suitable systems.

Modern satellite telephones are highly flexible, as they rely on the use of GPS information, spotbeam technology and satellites with onboard processing (OBP) capability.

Historical development, trends

As early as October 1945, Arthur C. Clarke mentioned, in an article published in Wireless World, the possibility of using extra-terrestrial relays. However, the idea was not put into practice until almost two decades later when in July 1963 SYNCOM-2, the first geostationary communications satellite, was successfully put into orbit, enabling the professional use of satellite communications (Satcom) [2]. During the 1980s, many Satcom satellites were launched and put into operation, allowing a large number of terrestrial radio relay links or relay systems to be assigned to geostationary satellites. Communications intelligence organizations at that time began to intercept satellite communications using large parabolic antennas.

Since the 1980s, great progress has been made in the field of mobile Satcom via geostationary satellites. Analog transmission was replaced by digital transmission after a few years. The use of increasingly sophisticated signaling protocols, voice codecs, and forward error correction (FEC) has led to a steady improvement in voice quality, reliability, and volume in mobile Satcom. This development has also been significantly promoted by the steadily increasing satellite performance in terms of transmitted power and radio spot beaming in conjunction with frequency reuse and onboard processing (OBP). The International Maritime Satellite (INMARSAT) organization, for example, has been a Satcom operator for many years. In a few years, its global satellite network will have fully changed to the fourth generation. Thuraya, another satellite operator, was founded at the turn of the millennium and has since experienced high growth rates.

With the rise of powerful fiber-optic networks, growth rates have slightly decreased as regards multichannel links between the switching centers of telecommunications

companies as well as major companies and organizations. Notwithstanding this, the demand for satellite communications based on very small aperture terminals (VSATs) linked up to major switching centers is increasing (see above). In addition to tried-and-tested standards such as Intelsat Business Service (IBS) or Satellite Multiservice (SMS), which are continuously being improved, new standards, codecs, and FEC methods (e.g. MPEG, various voice codecs, turbo codes) are increasing the capacity and performance of satellite-based transmission links.

Given the highly flexible communications capacities offered, users rely on satellite communications even in regions with an excellent terrestrial infrastructure. One possible reason for using a Satcom link is to avoid national switching centers that may be monitored, an approach that is referred to as bypassing. Detecting bypass communications of interest may be part of the activities of services and organizations (see Satcom applications).

There is a growing demand for communications, in view of technologies continuously improving and communications costs decreasing. At the same time, user requirements, e.g. the need for wider transmission bandwidths, are increasing. The globalization of markets is another factor that boosts communications volume.

Hand in hand with the technological progress, the monitoring of IP-based communications, especially voice over IP (VoIP), has developed into a promising field of activities for services and organizations. Broadband IP-based satellite data links are highly flexible and can handle a large number of subscribers, protocols, and services (voice, fax, data).

Because of the high data volume, intercept systems must be able – using suitable filters and tools – to deliver to analysts of services and organizations only the contents relevant to a specific mission. Scaling and designing an intercept and analysis system to furnish the desired contents constitutes a major challenge.

Terrestrial and satellite-based technologies are in the process of merging. Digital signaling procedures tend to operate more and more independently of the transmission channel, and tried-and-tested communications systems serve as models for new systems in mobile Satcom. For example, the GMR standard used by Thuraya corresponds to a large extent to the widely used and successful GSM standard.

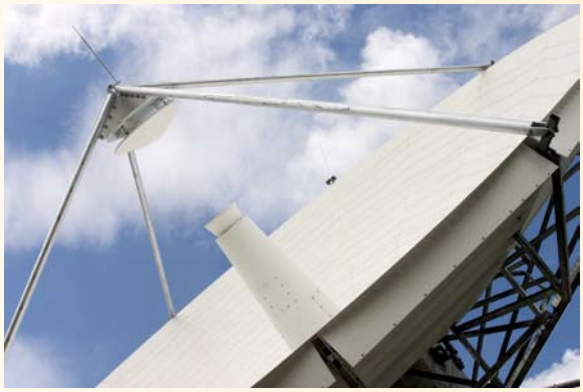


Fig. 1: 9.5 m C-band antenna installed at Munich site

Satellite orbit

Most Satcom satellites move in a geostationary orbit. A satellite in geostationary orbit rotates in the plane of the earth's equator synchronously with the earth, i.e. with the same period as the earth's rotation (24 hours), at a height of approx. 36 000 kilometers above the earth. Geostationary satellites appear to be stationary to observers on the earth. Satellites moving in an inclined geosynchronous orbit rotate in a plane that is inclined relative to the equatorial plane. During a 24-hour period, inclined geosynchronous satellites perform an elevation movement that, viewed from the earth, describes an elongated figure of eight with a smaller or larger angle of inclination, depending on the observer's location. To receive signals from inclined geosynchronous satellites, e.g. in the C or Ku band, by means of antennas with large diameters, tracking dish antennas are required. The antenna must be capable of tracking the satellite through its figure of eight, or the satellite will move outside the antenna's optimum capture range. The larger the antenna diameter, the higher the antenna directivity at a given frequency. With small dishes and at relatively low frequencies, e.g. in the L band, the 3 dB beamwidth is larger than the satellite's angle of inclination, eliminating the need for tracking. Another characteristic feature of geosynchronous satellites is the constant

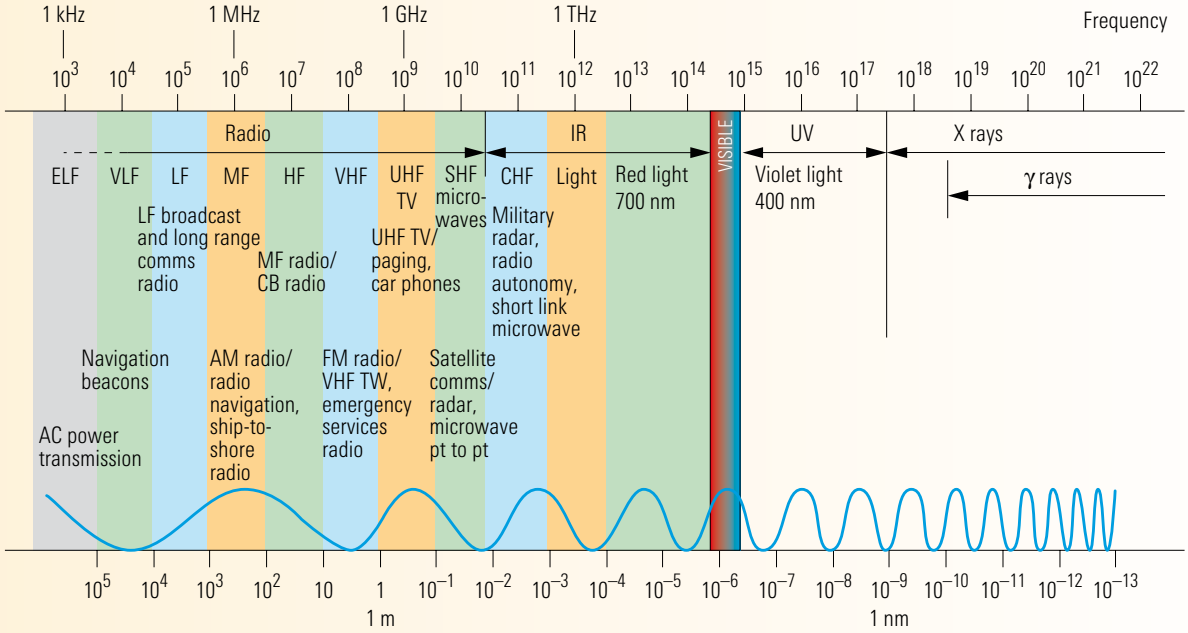


Fig. 2: Electromagnetic spectrum

signal level they provide to earth stations, which is due to their fixed position above their footprints. Geosynchronous satellites are further characterized by a high free-space loss of approx. 180 dB. Through the use of high-performance satellites and transmission methods as well as flexible spotbeaming, it has become possible to steadily decrease the size of user equipment, in particular in mobile Satcom. Satcom systems relying on a large number of low-earth-orbit (LEO) satellites have not proven successful economically due to their high operating costs.

Frequency bands

The L, C and Ku bands are currently the most widely used Satcom frequency bands. The table below as well as Fig. 2 include uplink and downlink frequency values for a number of bands. Technical literature specifies slightly varying values for the band limits, cf. [1] and [2].

Frequency band	Downlink	Uplink	User group
VHF/UHF	<1 GHz	<1 GHz	Military
L band	1.53 GHz to 2.7 GHz		Mobile
C band	3.7 GHz to 4.2 GHz	5.925 GHz to 6.425 GHz	TV, telecommunications
X band	7.25 GHz to 7.75 GHz	7.9 GHz to 8.4 GHz	Military
Ku band (Europe)			TV, telecommunications
FSS service	10.7 GHz to 11.7 GHz	12.75 GHz to 13.25 GHz, 13.75 GHz to 14.5 GHz	
BSS service	11.7 GHz to 12.5 GHz	17.3 GHz to 18.1 GHz	
SMS service	12.5 GHz to 12.75 GHz	12.75 GHz to 13.25 GHz, 13.25 GHz to 14.5 GHz	
Ka band	17.7 GHz to 21.2 GHz, 22.5 GHz to 23 GHz	27 GHz to 31 GHz	Telecommunications

Table: Typical frequencies

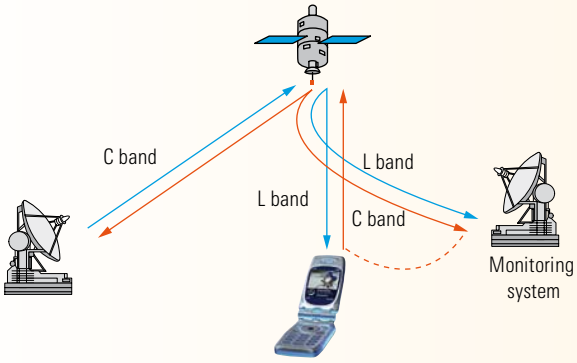


Fig. 3: Strategic interception principle (dashed line: direct interception)

Interception principle

During telephone calls via satellite in full-duplex mode, voice information is transmitted in both directions simultaneously. To capture duplex traffic at the radio interface, it would appear appropriate to pick up the uplink and downlink signals of a mobile earth station (MES) by means of suitable antenna systems. However, this type of interception is difficult especially with passive radiomonitoring of MES (e.g. Thuraya or INMARSAT telephones). Geographic conditions, low MES transmit powers, and possibly the use of directional transmit antennas, allow reliable reception of uplink traffic only within close range of the MES (several hundred meters to several kilometers).

Reliable coverage of larger areas can be achieved by monitoring two downlink paths (e.g. in the L and the C band or the C and the Ku band) using appropriate antenna systems and frequency downconversion and distribution (see Fig. 3). Under certain conditions, small (semi)mobile systems for the direct interception of uplink and downlink traffic in the vicinity of the MES may be a viable alternative (see Fig. 3, dashed line). Strategic, wide-area intercept systems retrieve MES uplink contents from the downlinks of the respective gateway stations, considerably increasing their performance and efficiency compared with (semi)mobile systems. The advantages offered by strategic intercept systems include interception from a safe distance (up to a few thousand kilometers), a developed infrastructure, a sufficient staff force, and reliable communications links to other organizations. (Semi)mobile systems, however, have the advantage of gathering source information as well as unique identification characteristics of subscribers. Based on such characteristics, a strategic system can perform large-area monitoring of subscribers.

Specific, mission-relevant information is extracted by means of Satmon **production systems** from Rohde & Schwarz. If the technical parameters of a satellite communications link are not known, they are first determined by means of an **analysis system**.

Analysis system

Analysis systems (see Fig. 4) can detect and record completely unknown satellite carriers, take snapshots of such carriers and evaluate their contents. Recording includes the determination of technical parameters such as frequency, bandwidth, symbol rate, modulation or FEC (forward error correction). Analysis is completed with carrier identification based on the carrier contents. Technical analysis covers all transmission parameters a subscriber would have to set on a satellite modem in order to correctly receive a desired carrier, including the technical parameters of the satellite. Based on this information, a production process can be started. While an analysis system should be capable of continuously recording contents, this is not its actual task. Based on the information gathered in a satellite and carrier database, the operator decides whether a carrier is relevant to a specific mission. If a carrier is mission-relevant, it is advisable to record it continuously by means of a production system and evaluate its contents; if a carrier is not mission-relevant, it should nevertheless be monitored.

Production system

To extract information from INMARSAT or Thuraya links or carriers using time division multiplex, production systems are required. The underlying technical standards are known. Production is aimed at recording a maximum of transmitted messages in order to extract mission-relevant information. Only configuration is done manually; otherwise data processing is fully automatic – from the receiving antenna to the recording of contents in a database. Operators can thus concentrate on evaluating mission-relevant information. Not only audible and legible Satcom contents are of interest; the technical parameters

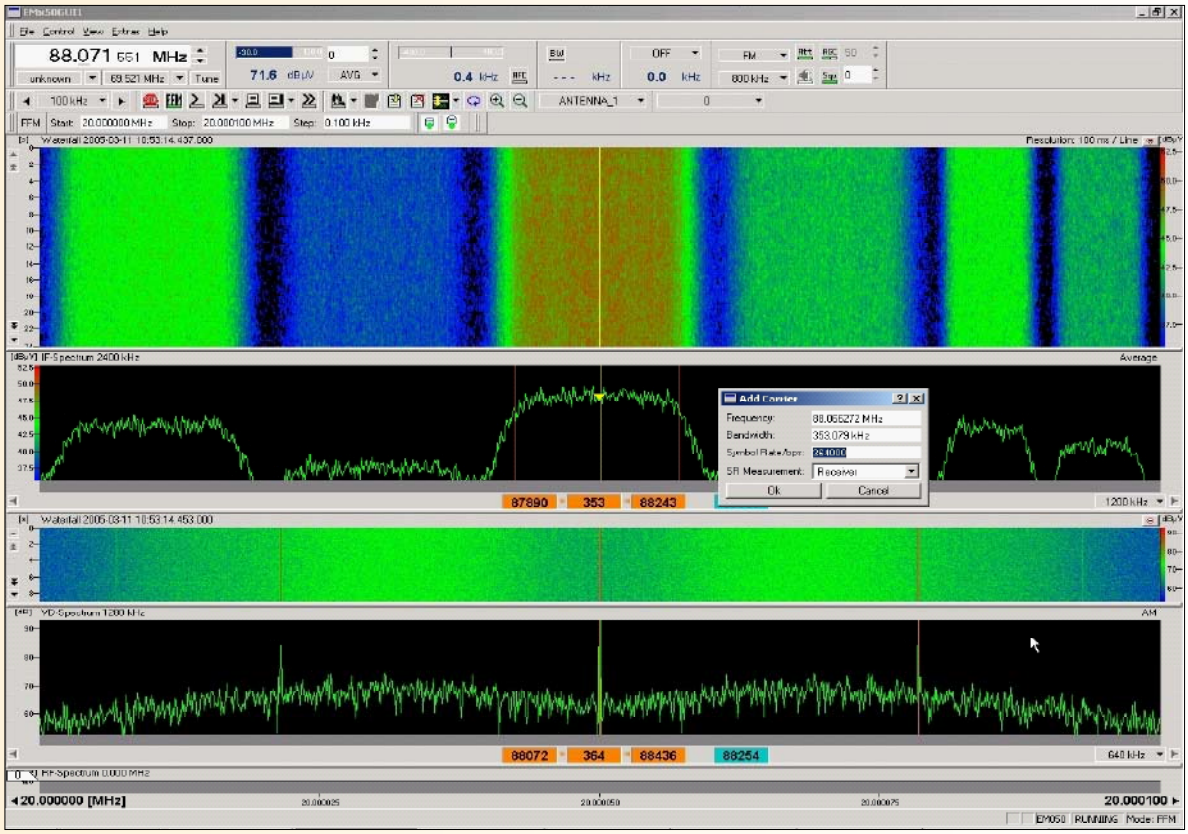


Fig. 4: Analysis system from Rohde & Schwarz, semiautomatic interception of satellite carriers

of a transmission link may also provide useful information. Technical information that may first appear insignificant often reveals interesting correlations.

There are four stages to evaluate the contents of one or several Satcom systems by means of production systems (see Fig. 5):

- Tasking
- Processing
- Analysis
- Reporting

Tasking

In view of the large number of communications channels that may be active at any time, suitably devised search and selection criteria are needed to cover mission-relevant information based on limited material and human resources. In addition to general intercept tasks, there are usually long-term and short-term intercept missions. This means that requirements continuously change with respect to the target regions to be covered, the subscribers to be monitored during defined periods of time, and the reporting procedures. Reporting will not function properly

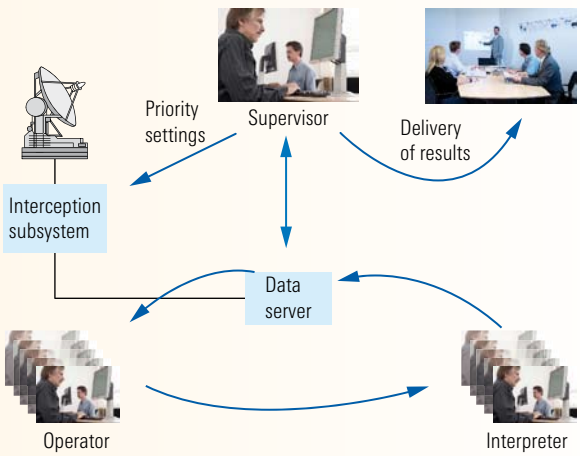


Fig. 5: Multioperator systems involving several hierarchical levels

unless customers deliver a correct definition of the tasks to be handled by the intercept systems and consistently redefine their tasks as information requirements change. The challenge is then to translate task definitions (delivered by customer) into priority-controlled search or carrier lists (for the intercept system) in order to gain the desired information.

Processing

A single recorded communications event – e.g. a telephone call – is referred to as a session. Intercepted and recorded sessions, including audible or legible contents and technical parameters (session-related information, SRI), will in most cases have to be preprocessed before being routed on to the next higher stage (contents analysis). For example, contents may have to be translated into another language. Processing also includes the conditioning, masking, summarizing, and categorizing of contents. An issue of special importance is the contents-based detection and identification of unknown subscribers and correlations. The analysis environment therefore contains suitable tools for (semi)automatic detection and identification.

Analysis

Processed sessions derived directly from the intercept system usually require interpretation. Analysts compile a sequence of sessions, for example, in order to form an overall picture. Analysis is a multistage process implemented in different ways by different organizations. During analysis, sessions from different sources (services and organizations or intercept systems) are compiled. The activities of a specific subscriber via different communications systems are combined. The Rohde&Schwarz evaluation environment comprises tools for contents processing as well as tools for the first stage of contents analysis. Contents captured and recorded by INMARSAT, Thuraya and other (satellite) monitoring systems as well as communications intelligence (COMINT) are collected in a database.

Reporting

Reporting includes the fast transport of recorded and processed contents. Recorded sessions undergo processing and the first stage of contents analysis, and are then routed as a message to the customer. Reports may be redirected to subsequent customer systems via specific interfaces that are continuously expanded. Before a message is passed on to a subsequent customer system, it is

SRI

Session-related information (SRI) includes all information that belongs to recorded voice, fax and data contents. An SRI data record is usually generated for each session (data, telephone or fax communications). From the contents of these records, filters and selection tools can extract specific information (e.g. activities that took place at specific times, with specific identifications – IDs, call numbers, addresses – using specific protocols, standards or services). SRI data records may further include information and setting parameters relevant to the test system, such as modem modes, IDs of known exchanges, and bit error ratios. SRI provides recorded session contents with an identity, which allows them to be efficiently processed in databases (see Fig. 6).

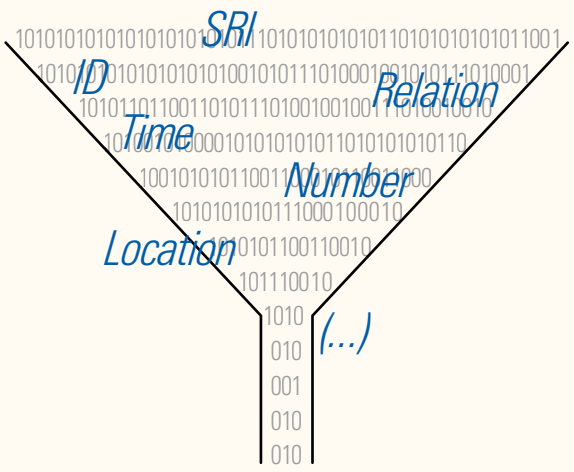


Fig. 6: Filtering and selection mechanisms

normally checked by the supervisor as to its relevance for a specific mission. A message may be rejected or returned to its author for revision, including an appropriate comment.

Satmon production systems with an integrated evaluation environment from Rohde & Schwarz are efficient tools for implementing the above four stages for the interception of INMARSAT, Thuraya and/or TDM signals. The database-supported evaluation environment from Rohde & Schwarz helps operators perform their missions by means of individually assigned user rights.

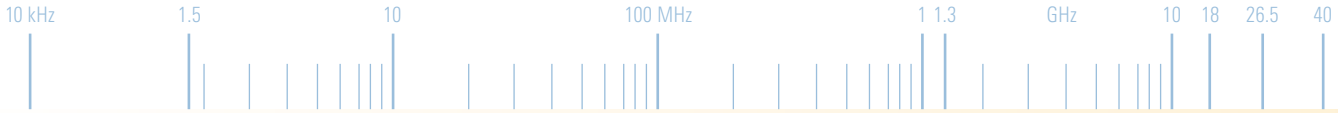
Satmon systems from Rohde & Schwarz

Rohde & Schwarz focuses on satellite communications systems with satellites traveling in a geostationary or inclined geosynchronous orbit. Systems from Rohde & Schwarz cover mobile satellite communications, parts of VSAT communications and time division multiplex (TDM) transmissions. The R&S®GSA system family is divided into three functional areas: general satellite monitoring (R&S®GSA3xx), Thuraya monitoring (R&S®GSA6xx), and INMARSAT monitoring (R&S®GSA9xx). The contents recorded with R&S®GSA systems can be conveniently analyzed by means of the R&S®IntAs interception analysis software. Should you require any further details, just call our Sales Department. On request, you will also be given a live demonstration of our satellite monitoring systems at our Munich site.

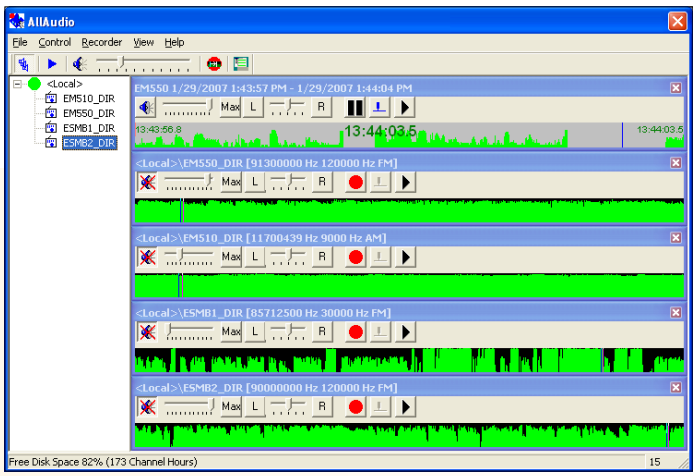
References

[1] Dodel, H: Satellitenkommunikation, Anwendungen Verfahren Wirtschaftlichkeit. Hüthig Verlag Heidelberg 1999.

[2] International Telecommunication Union: Handbook on Satellite Communication. Third Edition, ITU 2002.


10 kHz
1.5
10
100 MHz
1
1.3
GHz
10
18
26.5
40

R&S®AllAudio Integrated Digital Audio Software



Software package for digital recording, playback, mixing, and distribution of audio signals

Brief description

R&S®AllAudio is a software package for digital recording, playback, mixing, and distribution of audio signals. A complete intercom system is also provided. The range of applications includes the following:

- Digital recording of audio signals and low IF signals
- Audio recording database
- Digitizing of analog audio signals with selectable quality
- Integration of digital audio signals from Rohde & Schwarz monitoring receivers/direction finders
- Distribution of audio signals via LAN or WAN
- Instant replay of audio signals
- Search and replay while recording
- Remote control of other R&S®AllAudio software

On the workstation of a monitoring system, R&S®AllAudio handles the acquisition of the analog and digital audio signals from connected receivers, direction finders, etc, and from the workstation's microphone.

These signals may be recorded to hard disk, switched to analog output channels (e.g. for analysis) and also distributed to all workstations connected to the local area network (LAN) or to other workstations or LANs connected via wide area networks (WANs).

To ensure optimum audio quality even with low network bandwidths, several powerful audio compression codecs such as Speex and OggVorbis have been implemented.

Characteristics

R&S®AllAudio control panel

Distributed audio signals from connected workstations are selectable for live listening in or offline playback. To enable communication between stations, an intercom subsystem is also integrated into R&S®AllAudio, which makes use of the operator headset and/or speaker.

Operation

R&S®AllAudio is mainly controlled via the R&S®AllAudio control panel. All available local or remote workstations with their audio sources are listed in a tree dialog at the left side, ordered by workstation names.

On the right side, individual source control panels are displayed for each selected audio source. The source control panels are used to control listening in, recording, playback, mixing, and switching of audio sources. Volume and balance (left/right) of the output to either speakers or headset can be controlled as well. In replay mode, the time of day of the recording is displayed. Up to eight audio sources can be selected simultaneously for direct access by the user.

The main toolbar contains the main volume control and the main mute function and allows direct access to the audio database and intercom control panel.

For most efficient use of R&S®AllAudio it is possible to define systemwide shortcuts and hotkeys.

Audio distribution and listening in

Highly efficient distribution of digital audio signals in a LAN is achieved via UDP/IP multicast technology which requires only a minimal amount of network bandwidth. Connection of workstations via a WAN is implemented by means of R&S®AllAudio gateways which convert the protocol used to TCP/IP and, if necessary, compress the audio signals. Special bandwidth management is integrated in R&S®AllAudio in order to use the available communications bandwidth of the WAN in an optimized way.

All connected sources feature an instant replay buffer of 60 s. An operator may replay parts of a signal of the last 60 s by simply clicking at the desired play position in the replay buffer display in the source control panel. Local audio sources or replayed audio sessions can be switched to analog output channels which may be connected to the input of an analysis device. This may be performed while the current radio signal content is recorded. The R&S®AFBASIC basic module includes two audio input channels. The R&S®AF-D8 option adds eight digital audio input channels. The R&S®AF-A8 option adds eight analog or digital audio input channels plus three output channels. Up to 26 input channels and three output channels are supported by one basic module, i.e. operated from one workstation.

Recording and playback

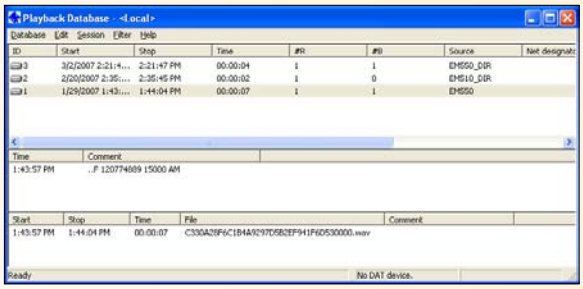
R&S®AllAudio allows recording of local audio sources to hard disk with the R&S®AF-REC option. Recording is manually or automatically controlled by the audio signal level, the monitoring receiver itself (with R&S®AF-COR option) or via the R&S®ARGUS/RAMON system interface. Recordings (wave files) are grouped into sessions. If recordings are longer than one hour, they are automatically split into several wave files. R&S®AllAudio sessions, including one or more recordings and corresponding management information, are stored in a local audio database.

Audio database dialog window

Bookmarks can be entered during recording or playback in order to mark an important signal sequence. Bookmarks can later be used as search criteria during post-evaluation. A comment for a complete session may also be entered.

The upper window of the audio database window contains an overview of recorded sessions. The center window shows the bookmarks entered; the lower window displays the recordings of the selected session. The user selects files for playback by querying the database by date, time or workstation/source to retrieve a list of available signals.

R&S®AllAudio is also designed to run on unattended stations where the recordings are made automatically and evaluated at a central station equipped with an audio server running R&S®AllAudio software for playback only (with R&S®AF-RREC option).



Audio database dialog window

Backup and export

R&S®AllAudio offers two different strategies for backup:

- DAT streamer: The wave files are backed up to the streamer along with the database information. Optionally, the wave files on the hard disk can be deleted after successful backup. However, the management information (recording time, etc) is still kept in the database to allow easy access to audio information stored on external streamer tapes

- Export of audio sessions: Selected audio sessions (wave files including management information) may be exported to disk. These files can be saved to CD-ROM, etc

The backup can be initiated either automatically or interactively when the operator simply selects the data to be saved. In this case, all relevant data is saved depending on user-defined criteria such as date or disk usage.

If the user wants to listen in to a current audio source, an instantaneous playback can easily be started via the playback button of the source control panel.

Intercom

R&S®AllAudio allows voice communication (with R&S®AF-ICM option) between two or more operators in a LAN or WAN. The main features are as follows:

- Output of calls to operator headset and additional speaker (if available)
- Single button/function key for accessing participants (point to point) or groups (LAN: multipoint to multipoint; WAN: point to multipoint)
- Call tone at the called workstation
- Automatic attenuation of online and playback audio signals during intercom operation

Operation in a system

In a monitoring system, the workflow concerning audio operation may be as follows: Each monitoring workstation records audio signals which are stored as audio sessions (recordings) on the local hard disk. After a working period, e.g. one day, selected sessions can be exported to a central server. At a dedicated R&S®AllAudio workstation, an operator imports the audio sessions from each workstation into a central audio database for post-evaluation. R&S®AllAudio may also synchronize the workstation time with a selected R&S®AllAudio workstation via LAN. The time of the selected workstation is updated regularly by a GPS receiver via the R&S®ARGUS or R&S®RAMON software. Stations not connected to the LAN must be synchronized separately.

Specifications

R&S®AFBASIC Basic Module	
Signal quality	telephone quality (8 kHz, 8 bit) radio quality (22 kHz, 8 bit) high audio quality or low IF quality (44 kHz, 16 bit)
Frequency range	
20 Hz to 3.5 kHz	telephone quality
20 Hz to 10 kHz	radio quality
20 Hz to 20 kHz	high audio quality
Compression rates	2-fold (ADPCM), 4-fold (GSM), 8-fold (CELP)
Audio input channels	2 audio input channels for: analog audio (via sound card), digital audio from Rohde&Schwarz devices (e.g. R&S®DDF0xM, R&S®EB200, R&S®ESMB), digital audio from other R&S®AFBASIC modules (TCP/IP point-to-point connection via LAN/WAN) with selectable audio compression, digital audio from other R&S®AFBASIC modules (UDP/IP point-to-multipoint connection via WAN)
Analog audio output channels	2 analog output channels for listening-in to headset (L and/or R) or speakers (L and/or R) audio delay typ. 200 ms
Audio matrix and mixer	audio input channels can be mixed or switched to the 2 listening-in output channels or can be switched to other optional output channels
Audio distribution	output and distribution of configured audio channels to other R&S®AFBASIC modules
Time for instant replay	60 s audio buffer
Interface	R&S®ARGUS/R&S®RAMON system interface
Note:	
This module is needed for each R&S®AllAudio workstation. Functionality can be expanded by adding R&S®AllAudio options. R&S®AllAudio supports up to 32 users and 64 audio sources in one system.	

Note (cont.):
For installation of R&S®AllAudio, a multimedia PC with Windows NT/2000 or XP, loudspeakers and a headset are required. R&S®AllAudio occupies the sound card of the PC. Due to sound card driver restrictions, no other applications may therefore directly use the sound card.

R&S®AF-D8 Digital Channel Extension

Function	8 additional digital audio input channels
Audio input channels	see R&S®AFBASIC

Note:
Up to 26 input channels are supported by one R&S®AFBASIC module. Up to 8 input channels can be selected simultaneously for direct access by the user.

R&S®AF-A8 Analog/Digital Channel Extension

Function	8 additional analog/digital audio input channels and 3 additional analog audio output channels
Audio input channels	see R&S®AFBASIC
Audio output channels	3 additional analog audio output channels (on multichannel sound card) for connection to decoders or analyzers, etc
Sound card	multichannel sound card for PCI slot

Note:
Up to 26 input channels and 5 output channels, including the analog output channels for listening-in, are supported by one R&S®AFBASIC module. Up to 8 input channels can be selected simultaneously for direct access by the user.

R&S®AF-REC Recording and Database

Function	recording and local audio database
Recording	digital recording of local audio sources on hard disk starting from the insert mark or from the play mark of the instant replay buffer, search and playback while recording, bookmarks and/or comment via microphone can be entered during recording or playback
Control	recording controlled by audio level, recording controlled by external system (e.g. R&S®ARGUS®, R&S®RAMON), timer-controlled recording, manually controlled recording
Database	integrated local audio database with backup and export functions, management of audio sessions which contain one or more recorded wave files; storage of time stamps, comments, time-related bookmarks, receiver and workstation name
Audio server	server for remote access by other R&S®AllAudio workstations (see also R&S®AF-RREC)

Note:
For backup and restore functions a DAT streamer (e.g. Sony SDT 9000, capacity 12 Gbyte) or another hard disk is recommended. For recording 240 channel-hours, 8 Gbyte HDD capacity is needed (8 kHz/8 bit).
A microphone is not included. The microphone occupies one audio input channel in R&S®AllAudio. Both analog input channels on the sound card are occupied.

R&S®AF-COR COR Control

Function	COR-controlled recording via the COR output of a receiver (TTL level or 24 V optocoupler), an I/O board (for PCI slot) for up to 16 COR inputs is included

R&S®AF-RREC Remote Recording and Database

Function	access to remote audio database, remote-controlled recording, local audio database

R&S®AF-ICM Intercom

Function	voice communication between operators in a LAN or WAN: between two users (point to point) or within groups (LAN: multipoint to multipoint; WAN: point to multipoint), automatic attenuation of other audio signals during voice communication
Note:	A microphone or headset is not included.

R&S®MapView Geographic Information Software

Digital map display for direction finding and radiolocation systems

Main features

- Fast online display of results on digitized maps
- Offline display of results in combination with external databases
- Use in direction finding and radiolocation systems as well as in coverage measurement systems
- Graphical situation display
- Special functions for use in mobile systems
- Import of digital maps in various formats
- Generation and digitizing of new maps
- Editing and adaptation of digital maps

Brief description

The R&S®MapView software is used to display geographic data on digital vector and raster maps. It was primarily designed for radiomonitoring and radiolocation applications, and this is why the online result display is fast and has features optimized for this task.

The digital maps are easy to work with by virtue of the range of functions that are available, for example:

- Fast map zooming
- Measurement of distances and directions
- Direct selection of map objects as well as direction finding and radiolocation results
- Rapid finding of map objects by means of the tree next to the window
- Quick change of maps using the buttons in the toolbar
- Dimming the map section to highlight the result layer (radiomonitoring/radiolocation results, symbols, graphics, etc)

Facilities for displaying direction finding and radiolocation results on maps are essential for DF evaluations in civil and military radiomonitoring systems. In military applications, this display is used to support operational and tactical analysis (R&S®RAMON systems). In the case of civil applications, the transmitter-site display supports the DF evaluation (R&S®ARGUS systems). Another application is displaying results obtained by coverage measurement systems (R&S®ARGUS systems).

The current position of the cursor, and also of objects and location results can be displayed in a variety of formats, i.e. degrees longitude/latitude (dezimal or °, min, s), UTM, NATO-UTM, RT90 or SWERREF99.

Mobile use

R&S®MapView has functions that make it ideal for use in conjunction with mobile systems (e.g. in homing DF vehicles):

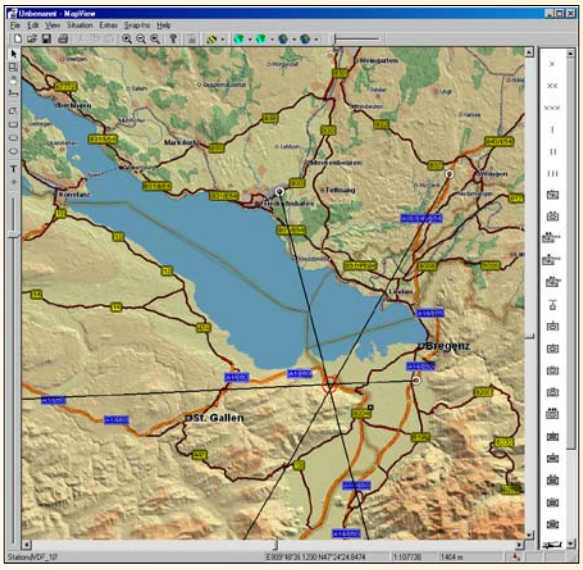
- Optimized for use with small TFT displays (e.g. in vehicles, see picture below)
- Automatic map navigation on the basis of the current vehicle heading and position (rotatable vector maps)
- Length of DF beam proportional to the current RF receive level of the DF signal – evaluation of the DF results possible by monitoring level variations
- RF receive level display right next to the DF symbol on the map
- Routing function in conjunction with the map & guide option (route display)
- Scaling as a function of vehicle speed
- Indication of heading (in conjunction with an electronic compass or GPS)

Situation display

With the aid of graphical elements, R&S®MapView makes it possible to display the results obtained from the analysis of the full range of information provided by a radiomonitoring system. The situation display is the basis for the assessment of the situation. It is generated by using several map layers and can be stored.

Besides standard functions such as text entry and drawing various line figures, the users can select symbols with the mouse and position them on the map. They can generate the symbols themselves and save them to various libraries. The picture below shows the toolbar with a selection of tactical symbols.

Display in a tracking DF system. Operation has been optimized for use without keyboard. The map is displayed in full-screen mode; by pressing a key, the displayed menu is shown with its main functions. The length of the DF beam depends of the level – short DF beam for high receive level



Three-dimensional map with radiolocation results

System applications

In radiomonitoring systems such as R&S®ARGUS or R&S®RAMON, R&S®MapView communicates with other software applications from Rohde&Schwarz via a TCP/IP interface. These applications can be the control software for the direction finders, the location software, and database applications.

Interworking with these software modules, the current locations of the direction finders are automatically displayed on the map; they are continuously updated while the direction finders are moving. In this case, the current heading of the vehicle is also indicated on the map by the DF symbol. DF results are displayed on the map as DF beams, location results as circles. The signal parameters can also be displayed as a legend of the location symbol, depending on the software module which provides the data (e.g. signal category and HF frequency in the R&S®ScanLoc system).

The R&S®ARGUS bearing measurement mode or the R&S®RAMON's location software can be used to record the DF results for more detailed analysis at a later date. This also makes it possible to take running fixes and so locate radio signals with just one direction finder (direction finding from different locations).

It is, of course, also possible to use the offline result-display mode in conjunction with the system software packages mentioned above. DF and location results, backed up on a database, can be displayed on the map.

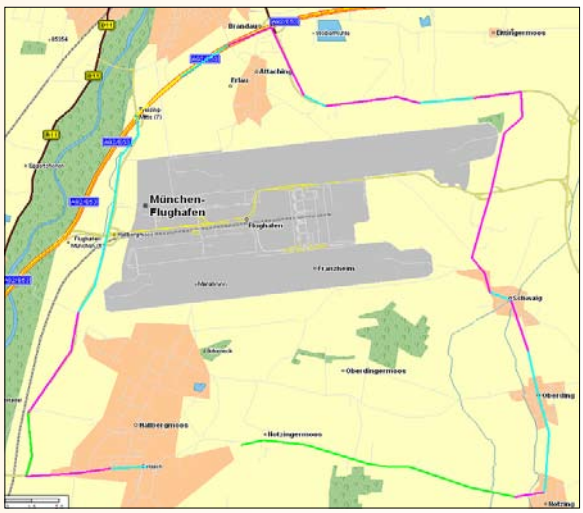
In conjunction with the R&S®ARGUS software package, the transmitter sites and the coverage measurement results can also be displayed (see picture on right).

R&S®MapView can also be linked to other customer-specific applications via an open TCP/IP interface.

Maps

The usefulness of geographic display software depends on the quality of the available maps. R&S®MapView uses a special data format to ensure optimal compliance with the requirements of radiomonitoring systems. There are various ways of obtaining maps:

- The R&S®MapEdit option is for generating, converting, and maintaining (and so subsequently modifying) user-specific maps
- As an option, maps from other manufacturers can be directly opened in R&S®MapView and used without being converted:
  - Vector maps in map&guide format (road maps with routing information) with the map&guide server option
  - Raster maps of the German Bundeswehr Geographic Office (AMilGeo) with the CMRG (compressed milgeo raster graphics) server option
  - Raster maps in LS telcom format with the LS telcom server option
  - Vector maps in MapInfo format with the MapInfo server option
  - Vector and raster maps in the following formats: ESRI Shape, ESRI Grid, and ESRI Coverage tables, ArcInfo WorldFile, ADRG ImageLayers, ERDAS ImageLayer with ESRI server option



Display of coverage measurement results. The receive field strength recorded during the test trip is displayed in color

R&S®MapEdit option: generating maps

The R&S®MapEdit option is for generating and editing user-specific digital maps. Many projection modes are supported for map generation. There are several ways of generating maps:

- Paper maps can be scanned with the R&S®MEBASIC basic module, imported into R&S®MapEdit in the form of a raster map and georeferenced.
- Using a digitizer with the R&S®ME-DIGI option, paper maps can also be manually digitized and georeferenced. In this case, a vector map for R&S®MapView is generated.
- Vector or raster maps from an existing GIS (geographic information system) can be imported using the R&S®ME-VECT option. These maps should be in DXF format (with georeference) or in VPF (VMAP/DCW) format.

Maps used in R&S®MapView via a map server cannot be edited with R&S®MapEdit.

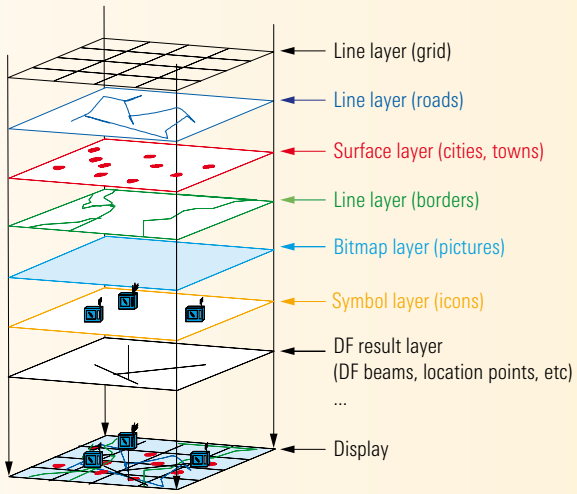
Digitizing or scanning?

R&S®MapEdit distinguishes between digitized vector maps and scanned raster maps. The use of vector maps comes into its own if information has to be displayed to scale (i.e. reduction of information density at higher zoom levels, maximum information density for displaying smaller map sections).

The advantage of using raster maps is the user-friendliness of map generation and the low cost of maps.

The vector maps used by R&S®MapView have several layers. The picture shows the basic structure of the maps. The layers may contain text, points, lines/surfaces, scanned maps, or symbols. The layer technique means that the information the user wants can be displayed with a high degree of flexibility because layers can be displayed or hidden depending on the magnification of the map section being zoomed.

The information density can therefore be adapted to the current scale.



Layered map structure

R&S®MapView and R&S®MapEdit were designed for use on PCs with 32-bit operating systems (Windows XP).

Ordering information

Basic module		
Geographic Information Software		
(contains a license for R&S®MapView, display of raster or vector maps, situation display editor, system interface, special features for mobile DF systems, and optimized display for DF and location results (maps not included))	R&S®MapView	4046.1205.02
Options		
R&S®MapView Map & Guide Server (displays map & guide road maps with routing support)		
With basic world map	R&S®MV-MWLD	4046.1457.11
With road map of Europe (contains the Europe City map (Germany, Austria, Switzerland, Benelux, France, Italy, Great Britain, Iberian peninsula, Scandinavia))	R&S®MV-MEU	4046.1457.12
With road map of Central Europe (contains the Central Europe City map (Germany, Austria, Switzerland, Liechtenstein, Alsace, Northern Italy))	R&S®MV-MCEU	4046.1457.02
With road map of Benelux countries (contains the Benelux City map (Belgium, Netherlands, Luxembourg))	R&S®MV-MBNL	4046.1457.03
With road map of Germany (contains the Germany City map)	R&S®MV-MGER	4046.1457.04
With road map of France (contains the France City map)	R&S®MV-MFRA	4046.1457.05
With road map of Great Britain (contains the Great Britain City map)	R&S®MV-MGBR	4046.1457.06
With road map of Iberian peninsula (contains the Iberia City map)	R&S®MV-MIBE	4046.1457.07
With road map of Italy (contains the Italy City map)	R&S®MV-MITA	4046.1457.08
With road map of Scandinavia (contains the Scandinavia City map)	R&S®MV-MSCA	4046.1457.09
R&S®MapView CMRG Server (displays raster maps of the German Bundeswehr Geographic Office (AMilGeo))	R&S®MV-CMRG	4046.1470.02
R&S®MapView LS telcom Server (displays raster maps in LS telcom format)	R&S®MV-LSTE	4046.1492.02
R&S®MapView MapInfo Server (displays vector maps in MapInfo format)	R&S®MV-MINF	4046.1434.02
R&S®MapView ESRI Server (displays vector and raster maps in the following formats: ESRI Shape, ESRI Grid, and ESRI Coverage tables, ArcInfo WorldFile, ADRG ImageLayers, ERDAS ImageLayer, DTED)	R&S®MV-ESRI	3029.8273.02
Digital Map Editor (contains a license for R&S®MapEdit, the import of raster maps, the import of vector maps in DXF and VPF format, the generation of vector maps by digitizing paper maps (requires the Digitizer Summagrid V), editing the vector maps, inserting other map elements, and Rohde & Schwarz support for generating the first map)	R&S®MapEdit	4046.1170.02
Alternative to R&S®MapEdit		
Basic module of R&S®MapEdit digital map editor (contains a license for R&S®MapEdit, the import of raster maps, and the insertion of additional map elements)	R&S®MEBASIC	4046.1270.02
Options for R&S®MEBASIC		
R&S®MapEdit Import of vector maps Import of vector maps in DXF and VPF (VMAP/DCW) format, editing of imported maps	R&S®ME-VECT	4046.1286.02
R&S®MapEdit map digitizing Generation of vector maps by digitizing paper maps (requires the Digitizer Summagrid V), editing of generated maps	R&S®ME-DIGI	4046.1292.02

R&S®ZS129x Switch Units

Intelligent RF and IF signal distribution

Main features

- Suitable for stationary, portable, and mobile applications
- Compact design
- Cost-effective implementation of customer-specific solutions due to modular design and wide variety of units and modules
- Manual operation and remote control for optimum hardware and software interworking
- Additional outputs for controlling additional switch units via the same control interface
- Tried and tested in various systems

Brief description

The R&S®ZS129x switch unit family is a cost-effective and reliable approach to RF and IF signal distribution. Its flexible concept allows adaptation to system requirements by adding optional extensions.

The family includes the models R&S®ZS129A1/A2/A5.

The R&S®ZS129A1 has been designed as an indoor RF and IF switch unit for stationary, transportable, and mobile systems. The standard models are available with a 1-out-of-6 , 1-out-of-8, 1-out-of-12, 2-out-of-2 RF switch each covering the frequency range from DC to 3 GHz. They can be operated with a 10 V to 35 V DC or 115/230 V AC power supply.

One DC feed for active antennas is standard; optionally, up to five further DC power feeds can be retrofitted. The relays can be replaced by GaAs switches offering switching about 1000 times faster. The R&S®ZS129A1 is controlled manually from the front panel or via the RS-232-C, USB, or TTL interface. It can also be controlled by the R&S®ARGUS spectrum monitoring software or the R&S®RAMON modular COMINT/CESM system.

The R&S®ZS129A2 switch unit has been designed as an outdoor unit for mounting on top of masts close to receiving antennas. Thus, the length of the RF cables between the antennas and the switch unit can be minimized, and only one RF cable and one control cable need to be routed to the equipment inside the station.

The R&S®ZS129A2 is controlled from the R&S®ZS129A1 switch unit or from the R&S®GB127S or R&S®GB127M antenna control unit. The cables between the control unit and the R&S®ZS129A2 have been tested for lengths up to 100 m.

The configurable R&S®ZS129A5 is ideal for a wide variety of indoor RF and IF switching applications. Its flexible concept allows adaptation to system requirements by adding optional modules. The unit is of modular design. Various switches, power splitters, and DC feeds can be integrated into an empty prefabricated enclosure to meet specific requirements.

R&S®ZS129A1

R&S®ZS129A2

R&S®ZS129A5

Specifications

Interfaces	
R&S®ZS129A1	RF INPUTS, RF OUTPUT, COM1, USB, TTL IN, EXP1, I²C REM CTRL, POWER IN
R&S®ZS129A2	X1 to X8, OUTPUT, CTRL IN, CTRL OUT, EXT/AUX
R&S®ZS129A5	SIGNAL1 to SIGNAL18, CTRL IN, CTRL OUT, POWER, SER CTRL
RF data (all models)	
Frequency range	DC to 3 GHz
Impedance	50 Ω
Switching time	≤15 ms
General data	
Operating temperature range	
R&S®ZS129A1	–10 °C to +55 °C
R&S®ZS129A2/A5	–35 °C to +55 °C
Storage temperature range	
R&S®ZS129A1/A2/A5	–40 °C to +70 °C
Humidity	
R&S®ZS129A1	95 % relative humidity at +40 °C
R&S®ZS129A2/A5	95 % relative humidity at +55 °C

Power supply	
R&S®ZS129A1	+10 V to +35 V DC/max. 8 A/60 W
R&S®ZS129A2	+28 V DC (via control input)
R&S®ZS129A5	+28 V DC (via control input) or +5 V to +35 V DC (from ext. power supply)
Dimensions (W × H × D)	
R&S®ZS129A1	484 mm × 89 mm × 495 mm (19.06 in × 3.50 in × 19.49 in) (overall) 19" rackmount, 2 height units
R&S®ZS129A2	404 mm × 335 mm × 183 mm (15.91 in × 13.19 in × 7.20 in) (overall)
R&S®ZS129A5	450 mm × 85 mm × 460 mm (17.72 in × 3.45 in × 18.11 in) (overall) 19" rackmount, 2 height units
Weight	
R&S®ZS129A1	approx. 6 kg (13.23 lb), depending on installed options
R&S®ZS129A2	approx. 11.2 kg (24.69 lb), depending on installed options
R&S®ZS129A5	approx. 3.6 kg (7.94 lb)

Ordering information

Switch Unit	R&S®ZS129A1	
1-out-of-12		3026.3012.02
1-out-of-6		3026.3012.06
1-out-of-8		3026.3012.08
2-out-of-2		3026.3012.22
Unused inputs terminated into 50 Ω		
1-out-of-6		3026.3012.16
1-out-of-8		3026.3012.18
1-out-of-12		3026.3012.12
Switch Unit	R&S®ZS129A2	
1-out-of-8		3023.2015.02
Switch Unit	R&S®ZS129A5	3023.2515.05

Options		
DC Feed, 100 kHz to 3 GHz	R&S®ZS129F1	3024.6614.02
DC Feed, 100 kHz to 3 GHz	R&S®ZS129F1	3024.6614.03
Switch		
1-out-of-2	R&S®ZS129S1	3024.6514.02
1-out-of-6	R&S®ZS129S2	3024.6520.02
1-out-of-8	R&S®ZS129S3	3024.6537.02
2-out-of-2	R&S®ZS129S5	3024.6550.02
I²C Bus Control Board	R&S®ZS129C1	3024.6714.02
Power Splitter	R&S®ZS129M1	3025.4515.02

Additional options are available on request.

R&S®GB127x
Antenna Control Units

Rotator control plus

RF and IF signal distribution

Main features

- Suitable for stationary and mobile applications
- Compact design
- Split concept for stationary applications with remote R&S®RD127 rotator control unit mounted close to the antennas, thus minimizing cabling
- Manual operation and remote control
- Additional outputs for controlling additional switch units via the same control interface
- Antenna controllable in all three degrees of freedom (azimuth, polarization, and height)

Brief description

The family of R&S®GB127x antenna control units is a cost-effective and reliable solution for controlling antenna rotators and distributing RF and IF signals. The family includes the models R&S®GB127S/M/MU and R&S®RD127. The R&S®GB127S antenna control unit has been designed as a universal antenna control unit for stationary systems. Normally, it is used in combination with the R&S®RD127 rotator control unit, which contains the RF switching section and the control unit for the antenna rotators. The R&S®GB127M antenna control unit has been designed for mobile systems and contains the control unit for the antenna rotators. The R&S®GB127MU mast control unit is the interface between a telescopic mast and the R&S®GB127M antenna control unit.

Specifications

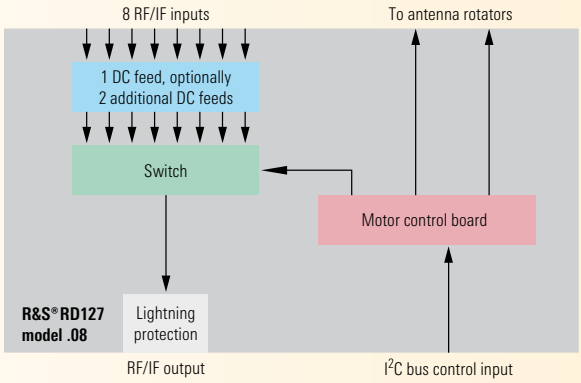
Interfaces	
R&S®GB127S	COM1 to 4, LPT, EXP1 to 2, I²C REM CTRL, POWER, loudspeaker, display, keypad, chipcard reader
R&S®GB127M	COM1 to 4, LPT, EXP1 to 2, I²C REM CTRL, POWER, ELV/POL, AZIMUTH, loudspeaker, display, keypad, chipcard reader
R&S®GB127MU	DC IN, ENCODER, MAST CONTROL, MAST ALARM, MAN/AUTO, MAN MAST CONTROL, COM1, REM CTRL
R&S®RD127	RF IN, RF OUT, ELV/POL, AZIMUTH, ROTATOR CONTROL
General data	
Operating temperature range	
R&S®GB127S/M	0 °C to +50 °C
R&S®GB127MU	–20 °C to +55 °C
R&S®RD127	–35 °C to +55 °C
Storage temperature range	
R&S®GB127S/M/MU/ R&S®RD127	–40 °C to +70 °C
Humidity	
R&S®GB127S/M/MU	95 % relative humidity at +40 °C
R&S®RD127	95 % relative humidity at +55 °C
Power supply	
R&S®GB127S	100 V to 240 V AC/50 Hz to 60 Hz, 180 VA
R&S®GB127M/MU	10 V to 33 V DC
R&S®RD127	+28 V DC (via control input)
Dimensions (W × H × D)	
R&S®GB127S/M	484 mm × 89 mm × 495 mm (19.06 in × 3.50 in × 19.49 in) (overall) 19" rackmount, 2 height units
R&S®GB127MU	220 mm × 83 mm × 150 mm (8.66 in × 3.27 in × 5.91 in) (overall)
R&S®RD127	404 mm × 356 mm × 183 mm (15.91 in × 14.02 in × 7.20 in) (overall)
Weight	
R&S® R&S®GB127S	7.6 kg (16.76 lb)
R&S®GB127M	8.8 kg (19.4 lb)
R&S®GB127MU	2 kg (4.41 lb)
R&S®RD127	11.4 kg (25.13 lb)
RF data of the R&S®RD127	
Frequency range	DC to 3 GHz
Impedance	50 Ω
Switching time	≤15 ms

Ordering information

Antenna Control Unit		
(for indoor use, control via RS-232-C interface and manual operation)		
With external rotator control	R&S®GB127S	3022.2011.02
With integrated rotator control	R&S®GB127M	3022.2511.02
Mast Control Unit		
(for outdoor use, control via R&S®GB127M)	R&S®GB127MU	3027.4512.02

Options		
Rotator Control Unit (for outdoor use, control via R&S®GB127S)		
With 1-out-of-4 switch	R&S®RD127	3021.9012.05
With 1-out-of-8 switch	R&S®RD127	3021.9012.08
DC Feed, 100 kHz to 3 GHz	R&S®ZS129F1	3024.6614.02
Equipment that is typically used: Yaesu G2800 and Winter AR/AE1049 azimuth rotators as well as Yaesu G550 polarization/elevation rotator. Further models on request.		

R&S®RD127 rotator control unit



Block diagram of the R&S®RD127

R&S®GC128
GSM Communication Unit

GSM-based data and voice communications

Main features

- Data rate of 9.6 kbit/s per GSM channel
- Up to two additional GSM modules available for multilink
- Further optional GSM module for use as a telephone
- Operable with GSM 900 and GSM 1800
- Minimum interference with RF measurement equipment in vehicles, permitting simultaneous RF measurement and GSM transmission
- Ideal for transportable or mobile RF measurement and radiomonitoring systems
- Wide power supply range from 9 V to 30 V DC

Brief description

The R&S®GC128 GSM communication unit is the ideal solution for wireless TCP/IP-based communications links between monitoring or RF measurement systems.

The R&S®GC128 supports the GSM 900 and GSM 1800 bands. GPRS may be used for faster data exchange (if supported by the local network operator). Depending on the required bandwidth, up to three GSM channels can be banded, which ensures a considerably higher data rate. A fourth GSM module with headset can optionally be supplied for use as a telephone.

The device provides various interfaces to GSM antennas, network equipment such as routers, and RS-232-C and USB interfaces for remote control via a process controller. Built as a 19-inch, one-height-unit rackmount model, it can be easily integrated into standard racks for indoor use. When integrated into the R&S®TMS-C transportable communication system, where it is protected by the transit case, it can also be used outdoors.

Specifications

Interfaces	ANTENNA, COM1, USB, DATA CHANNEL 1 to 4, CONSOLE, HEADSET, POWER

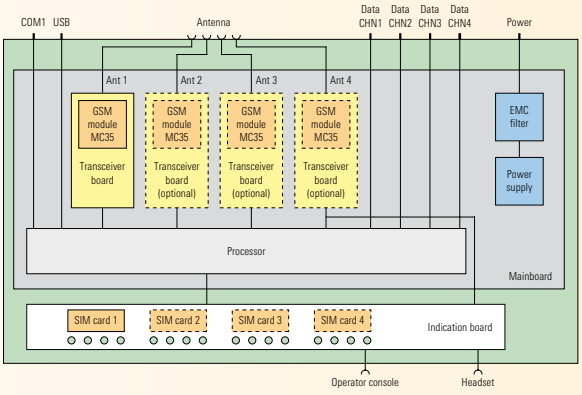
General data	
Operating temperature range	–10 °C to +55 °C
Storage temperature range	–40 °C to +70 °C
Humidity	95 % relative humidity at +55 °C
Power supply	9 V to 30 V DC 100 V to 240 V AC at 50 Hz to 60 Hz (via bench power supply)
Dimensions (W × H × D)	483 mm × 43 mm × 296 mm (19.02 in × 1.69 in × 11.65 in) (overall) 19" rackmount, 1 height unit
Weight (basic version)	approx. 2.5 kg (5.51 lb)

Ordering information

GSM Communication Unit	
(for data transfer via one GSM/GPRS 900/1800 link) R&S®GC128	3027.8518.02

Options		
Additional Module (with headset for audio transfer via one GSM 900/1800 link)	R&S®GC128A	3028.1517.02
Additional Module (for data transfer via one GSM 900/1800 link)	R&S®GC128D	3028.1769.02

R&S®GC128 with optional headset



Block diagram

R&S®GPS129
GPS Receiver

GPS receiver with reference frequency generator

Main features

- GPS receiver and reference frequency generator combined in a single unit
- High precision due to GPS-based operation
- Compact design: 19" rackmount with just one height unit for integration into system racks
- Suitable for stationary, transportable, and mobile applications
- Available with AC or DC power supply

Brief description

The R&S®GPS129 consists of a GPS receiver and a satellite-controlled clock, plus a power supply unit, all installed in a metal 19" rackmount and ready to operate.

It provides the user with extremely precise time and position data.

In addition, the R&S®GPS129 offers high-accuracy 2.048 MHz and 10 MHz frequency outputs to increase the frequency accuracy of receivers if the receiver is provided with a frequency reference input.

Specifications

Interfaces	ANTENNA, COM0 to 1, TIME CAPTURE/ PULSE OUTPUT, 2.048 MHz, 2.048 MHz switched, 10 MHz, 10 MHz switched, POWER

General data	
Operating temperature range	0 °C to +50 °C
Humidity	85 % relative humidity
Power supply	100 V to 240 V AC, 50 Hz to 60 Hz, 20 VA 19 V to 35 V DC, max. 2 A/20 VA
Dimensions (W × H × D)	483 mm × 44 mm × 345 mm (19.02 in × 1.73 in × 13.58 in) 19" rackmount, 1 height unit
Weight	3 kg (6.61 lb)

Ordering information

GPS Receiver		
(with reference frequency generator, including GPS antenna)	R&S®GPS129	
100 V to 240 V AC operation		3026.1010.02
19 V to 35 V DC operation		3026.1010.04

R&S®GPS129 and R&S®GC128 integrated in the R&S®TMS-C transportable communication system

R&S®SA129x
Station Monitoring Units

Monitoring remote stations

Main features

- Monitoring of various sensors in remote (measurement) stations
- Automatic alarm message forwarding to control station if a sensor exceeds user-defined threshold
- Connections via PSTN or LAN
- Re-initialization of remote stations

Brief description

The R&S®SA129 station monitoring unit provides extensive capabilities for the supervision of remote stations.

Various sensors are available for monitoring the opening of windows or doors, temperature, relative humidity, smoke detection, and power supply. If the status changes or a user-defined threshold is exceeded, a connection to the central control station is automatically established. In the control station, the sensor messages are output to an LC display of the central R&S®SA129 or a printer, or displayed by an optical or acoustic signal. Additionally, the status of the remote stations can also be retrieved via an Internet browser. The connection between the monitoring units in the remote station and the central station is possible via telephone lines or a local area network (LAN). One R&S®SA129 in the central station can control up to eight R&S®SA129 in the remote stations. Power supply is 115/230 V AC. The integrated batteries ensure operation for up to 24 h in case of power failure. Another application of the R&S®SA129 involves reinitializing a remote-controlled system by interrupting the power supply, the system process controller being shut down beforehand to prevent data loss. The optional telephone filter can counteract interferences in the telephone lines caused by electrostatic discharges or spurious signals due to strong electromagnetic signals.

Specifications

Interfaces	COM1 to 2, LINE, Ethernet, LPT, AF, I/O 1A, I/O 1B, I²C REM CTRL, POWER, loudspeaker, display, keypad, chipcard reader

General data	
Operating temperature range	0 °C to +50 °C
Storage temperature range	–20 °C to +70 °C
Humidity	95 % relative humidity at +40 °C
Power supply	115/230 V AC selectable, 50 Hz to 60 Hz, 55 VA, internal battery 12 V DC, 7 Ah
Dimensions (W × H × D)	484 mm × 89 mm × 395 mm (overall) (19.06 in × 3.50 in × 15.55 in) 19" rackmount, 2 height units
Weight	2.6 kg (5.73 lb) (connection box)

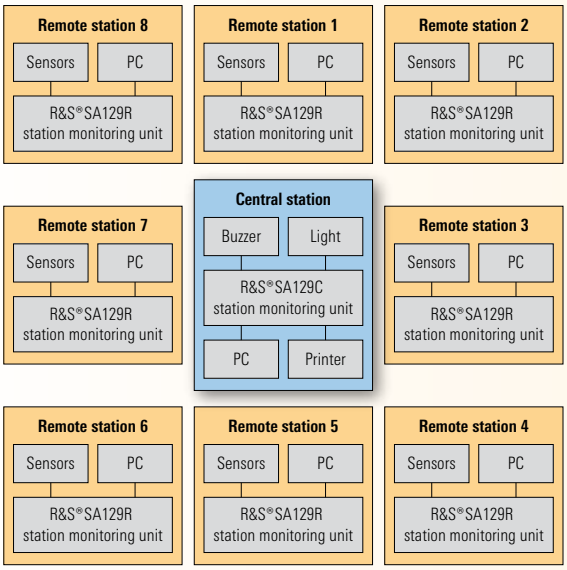
Ordering information

Station Monitoring Unit		
PSTN	R&S®SA129	3024.4011.02
LAN, for control station	R&S®SA129C	3029.9511.02
LAN, for remote station	R&S®SA129R	3030.0266.02

Options		
Sensor Kit for R&S®SA129	R&S®SA129-S	3024.4263.02

Further sensors on request.

Recommended extras		
Telephone Filter	R&S®SA129Z2	3023.1519.02



One central R&S®SA129 controls eight remote stations

R&S®SPCx
System Process Controllers

Main features

- High-end, state-of-the-art controllers
- High immunity to EMI
- Low spurious emissions

Brief description

The R&S®SPCx system process controllers are high-end, state-of-the-art controllers with special characteristics for use in measurement systems. Their high immunity to EMI makes them suitable for use in interference-polluted environments. Low spurious emissions ensure that measurements are not impaired by fields produced by the controller.

Four models are available for different applications

Bearing in mind the rapid changes on the computer market, parameters such as memory and computing speed are not specified.

- R&S®SPCR: The 19" rackmount is notable for its sturdy design which makes it particularly suitable for use in vehicles
- R&S®SPCT: The tower model is typically used in stationary systems where power consumption and space requirements are of minor importance
- R&S®SPCN: The notebook is the ideal solution where space is at a premium or for applications with frequently changing sites
- R&S®SPCC: This compact controller can also be rackmounted but, in contrast to the R&S®SPCR, it requires little space and takes up only two height units. It is therefore the first choice for mobile and transportable systems. The R&S®SPCC is provided with two unused ISA or PCI slots, as desired by the user, and equipped with a router either for analog dialed/leased lines, dialed ISDN lines, or GPRS/GSM 900/1800 links

A great variety of monitors, mouses, keyboards, printers, drives, memory extensions, and cards is optionally available for all models.