Secure Communications
Catalog 2013/2014

R&S®SDTR
Engineered for mission success: next-generation software defined tactical radio for vehicular and semi-mobile platforms.
▷ page 8

R&S®M3AR

R&S®Series4200

R&S®M3SR

ROHDE&SCHWARZ

Secure Communications Catalog

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For more than 75 years, Rohde&Schwarz has stood for quality, precision and innovation in all fields of wireless communications.

The privately owned company group has a global presence. It develops, produces and markets a wide range of electronic capital goods for industry, infrastructure operators and government agencies.

Rohde&Schwarz is among the market leaders in all of its business fields, including wireless communications and RF test and measurement, terrestrial TV broadcasting and technologies related to the interception and analysis of radio signals.

Numerous subsidiaries and representatives not only ensure competent and customer-oriented on-site support anywhere in the world, they also safeguard customer investments with comprehensive service and support offerings.

Our business fields

Test and measurement

T&M instruments and systems for wireless communications, general-purpose electronics and aerospace and defense applications

Secure communications

Radio systems providing encrypted communications and IT security solutions for armed forces, government agencies and industry

Radiomonitoring and radiolocation

Spectrum monitoring systems and radiomonitoring equipment for homeland and external security

Broadcasting

Broadcasting, measuring and studio equipment for network operators, broadcasters, studios, the film industry and manufacturers of entertainment electronics

Test and measurement

Rohde&Schwarz is one of the world's largest manufacturers of electronic test and measurement equipment. Our products set standards in research, development, production and service. As a key partner of industry, network operators and public institutions, we offer a broad spectrum of market-leading solutions for state-of-the-art technologies, including LTE-Advanced, the wireless standard of the next generation, as well as for hyperfrequency applications up to 500 GHz. New applications in the automotive and aerospace fields, in material research and in video technology promote the trend toward ever higher frequencies in electronics. Rohde&Schwarz meets the growing demand by offering cutting-edge products for signal generation, signal analysis, network analysis and power measurement. The company is systematically expanding its oscilloscope portfolio to meet the wide-ranging needs of customers, also in the lower price segment with products from its HAMEG subsidiary that are ideal for general lab applications.

Our test and measurement portfolio

- Test and measurement solutions for all wireless technologies
  - Wireless device testers
  - Infrastructure testers
  - Protocol testers
  - Conformance/preconformance testers
  - Test systems and accessories
- Signal and spectrum analyzers
- Network analyzers
- Oscilloscopes
- Signal generators
- Coverage measurement systems
- EMC and field strength test solutions
- Power meters and voltmeters
- Audio analyzers
- Modular instruments
- Power supplies
- RF and microwave accessories
- System components
- Broadcasting and video T&M and monitoring solutions (see next page)

Test and measurement.

Broadcasting

TV viewers and radio listeners in more than 80 countries receive their programs via Rohde&Schwarz transmitters. Our innovative portfolio of broadcasting and measuring equipment drives the development of digital broadcasting worldwide.

To expand the company's leading position as a supplier of products for processing, distributing and transmitting audio/video signals, the signal processing chain from content creation to A/V consumers will be progressively closed. One step was the integration of the former DVS Digital Video Systems GmbH, now Rohde&Schwarz DVS GmbH, into the corporate group. DVS is a leading international manufacturer of hardware and software for professional film and video post production and storage. The broadcasting portfolio was recently expanded to include headends. Broadcasters and network operators can now cover all their workflow and transport stream processing and routing requirements with Rohde&Schwarz products.

Rohde&Schwarz supplies producers of consumer electronics with all necessary test equipment for the development and production of satellite receivers, TV sets and other CE equipment, also for the latest and future high definition and 3D formats. Rohde&Schwarz multistandard platforms cover the wide variety of broadcast and video technologies, providing great flexibility at all stages of the value added chain.

Secure communications

Radiocommunications systems Armed forces must be able to exchange information securely, reliably and without delay. This is crucial for the success of national and international missions. Rohde&Schwarz supplies forces with interoperable radiocommunications systems for use on the ground, at sea and in the air. Our solutions use efficient encryption methods that satisfy the highest national and international security standards. The next-generation SCA-based R&S®SDxR software defined radio systems support the network centric operations of the future.

Civil air traffic control agencies in 80 countries and at more than 200 locations – both airports and ATC centers – use Rohde&Schwarz radio systems. By adding voice communications systems to its product portfolio, the company can now offer integrated all-in-one solutions for ground-cockpit communications – from the controller working position to the antenna.

Encryption and IT security Rohde&Schwarz SIT GmbH develops highly secure products for protected voice and data transmission via radio, wireless communications and fixed line links – for private industry, government agencies, critical infrastructures and the military. Product focus is on end-to-end encryption of communications, network security and crypto modules. The company's expertise also ensures confidentiality of communications when using Rohde&Schwarz radio equipment and systems.

Our broadcasting portfolio

- Digital and analog TV transmitters for all power classes and all conventional standards worldwide, including mobile TV
- Digital and analog sound broadcast transmitters
- Audio/video headends
- Broadcasting and video T&M and monitoring solutions
- Hardware and software for professional film and video post production

Our secure communications portfolio

- Integrated communications systems for
  - Civil and military air traffic control (ATC)
  - Army
  - Navy
  - Air force
- Encryption technology for all classification levels
- IT security products

Broadcasting.

Secure communications.

Radiomonitoring and radiolocation

The need for mobile, wireless exchange of information is increasing drastically, but the usable frequency spectrum for radiocommunications is limited. Rohde&Schwarz develops and produces stationary and mobile systems for detecting, locating and analyzing radiocommunications signals. These systems allow efficient monitoring and allocation of the limited radio frequencies.

The company's receivers, direction finders, signal analyzers, antennas and customized systems have made Rohde&Schwarz a reliable partner for its customers for decades. Applications include homeland and external security, radiomonitoring by regulatory agencies and frequency management.

Services

Rohde&Schwarz operates a global service network in order to safeguard the investments of its customers.

The following on-site services are offered worldwide:

- Calibration
- Maintenance and repair
- Product updates and upgrades

Rohde&Schwarz regional service centers, plants and specialized subsidiaries provide a wide range of additional services:

- System integration
- System support
- Installation and commissioning
- Application support
- Development of customized modules, instruments and systems
- Software development
- Mechanical and electrical design
- Manufacturing to order
- Technical documentation
- Logistics concepts

Our radiomonitoring and radiolocation portfolio

- Radio intelligence systems
- Spectrum monitoring systems
- Satellite monitoring systems
- Signal analysis systems
- Receivers
- Direction finders
- Antennas
- Solutions for analyzing and controlling IP data streams

Service you can rely on

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

Radiomonitoring and radiolocation.

Services.

Chapter 1
Tactical radiocommunications

Networking across all operational levels is the first and foremost condition for efficient, modern warfare. Network centric operations (NCO) require the use of SCA-based software defined radios (SDR) in combination with high data rate waveforms. For international, combined missions, waveforms providing interoperability need to be ported to the software defined radios.

Rohde&Schwarz has taken on the challenge by developing a new generation of software defined radios. The R&S®SDxR radio family and the innovative waveforms of the R&S®HDR family provide the networking capability and interoperability required for network centric operations.

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R&S®SDTR VR5000 Vehicular Tactical Radio

The R&S®SDTR vehicular tactical radio is the first member of the R&S®SDxR software defined radio family. This next generation of software defined radios marks a revolutionary change in tactical communications – both technically and economically.

The R&S®SDTR has been designed for use in vehicles and for integration into semi-stationary and stationary applications. Its ruggedized hardware meets applicable MIL-STD environmental and EMC requirements, enabling the radio's use under extreme conditions such as in armored wheeled vehicles and tracked vehicles.

The core of the R&S®SDTR is an SCA 2.2.2 radio platform (SCA – software communications architecture). The SCA radio platform supports standardized, legacy and Rohde&Schwarz proprietary waveforms and makes it easy to port waveforms. Plus, it enables the implementation of customized waveforms.

The R&S®HDR-AJ-NB waveform supports Internet protocol (IP) based applications and can be used with a variety of network topologies. The waveform has mechanisms to make communications jam-resistant and tap-proof. These include very high frequency hopping rates as well as voice and data encryption. The waveform uses a tried-and-tested time division multiple access (TDMA) transmission structure that enables the implementation of communications networks encompassing multiple organizations and hierarchical levels, for approx. 30 users depending on the traffic load.

The R&S®SDTR features software-based encryption backed by further measures such as tamper protection.

Key facts

- SCA 2.2.2 based, expandable tactical radio platform and waveform
- Optimized for use in vehicles, meeting stringent requirements on vibration, size, weight and power consumption
- Multiband capability in VHF/UHF frequency range from 30 MHz to 512 MHz
- 50 W output power (PEP and CW) without external amplifiers
- With R&S®HDR waveform
  - Support of external, IP-based applications
  - Jam-resistant (TRANSEC) and tap-proof (COMSEC) communications
  - Simultaneous voice and data transmission

Benefits and key features

Excellent RF characteristics

- Integrated co-site filters for interference-free operation
- Integrated MELPe vocoder
- Enhanced transmitter and receiver performance

Radiocommunications using legacy and high data rate waveforms

- Standardized legacy waveforms in line with STANAGs
- R&S®HDR-AJ-NB waveform
- Other waveforms

MANET functionality

- Access to radio nodes even across networks and with topographical constraints

In line with the highest security standards

- Strict red/black separation in hardware and software
- Zeroize function

Easy to integrate

- Single-line operation for flexible integration
- Compact design with integrated amplifier and co-site filters
- Installation in inaccessible places
- Fully IP-based radio for easy system integration
- Front panel interfaces, displays and controls

Easy to operate with external control unit

- Common control unit for up to three tactical radios from the R&S®SDTR and R&S®M3TR families
- Modern, ergonomic GUI for simple, intuitive operation
- Mechanical design optimized for use in a moving vehicle

A worthwhile investment

- State-of-the-art, open platform based on advanced international standard
- Easy porting of waveforms
- Support of customized waveform developments

Excellent RF characteristics

Unlike most latest-generation radios available on the market, the R&S®SDTR was developed with a special focus on the RF parameters defining the VHF and UHF ranges. No compromises were made here. As a result, for example, the radio's output power can be kept relatively constant in adverse environments even with a VSWR as poor as 3:1.

Integrated co-site filters for interference-free operation

The R&S®SDTR comes with the amplifier and a co-site filter built in as standard. This compact solution allows the parallel operation of multiple radio lines in one vehicle (multiline configuration) even under extreme conditions. Interference is largely suppressed in both directions, i.e. transmission and reception. This makes it possible to install multiple, closely spaced antennas on small vehicles. When the antennas are spaced wider apart, multiple radio lines can be operated with very close frequency spacing.

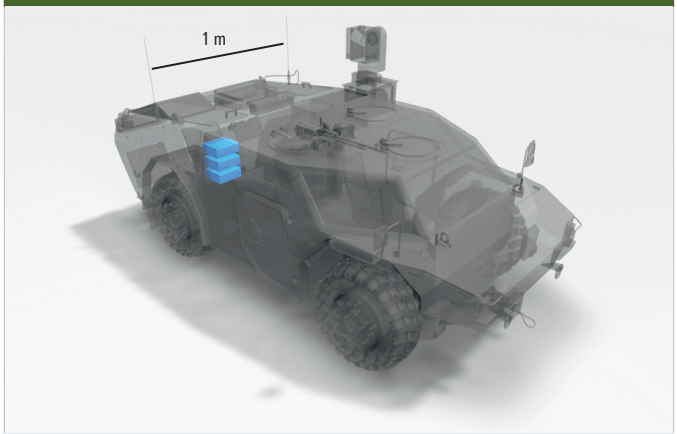
Integrated MELPe vocoder

The radio's integrated MELPe vocoder is particularly robust and provides reliable voice transmission even in noisy environments.

Enhanced transmitter and receiver performance

- Compact multiband solution for the frequency range from 30 MHz to 512 MHz
- Integrated co-site filters for interference-free operation even under difficult conditions
- Highly linear, extremely sensitive receiver
- Transmit path with extremely low phase noise
- Very high frequency hopping rates
- Operation of wideband and high data rate waveforms

Antennas can be closely spaced due to integrated co-site filters



Radiocommunications using legacy and high data rate waveforms

Standardized legacy waveforms in line with STANAGs

The R&S®SDTR can store up to ten different waveforms. The radio's basic software includes standardized waveforms such as for analog fixed frequency mode (e.g. from 30 MHz to 88 MHz in line with STANAG 4204 and from 225 MHz to 400 MHz in line with STANAG 4205). The waveforms can be activated on the radio's front panel even in an emergency. Backward compatibility with legacy waveforms makes it possible to set up communications links in joint operations (e.g. with airborne forces) and combined operations (e.g. with allied tactical units).

R&S®HDR-AJ-NB waveform

The R&S®HDR-AJ-NB (high data rate anti-jam narrowband) waveform enables simultaneous voice and data communications. Communications are monitored by a quality of service (QoS) function and can be prioritized based on predefined mechanisms as a function of propagation conditions. Orthogonal frequencies are used in the different networks, preventing mutual RF interference between radio nodes and enabling tap-proof, jam-resistant radiocommunications even if many radio nodes are involved.

The waveform supports the following functions:

- Several net entry methods like automatic net entry, late net entry, time mark based net entry, active time based net entry (synchronization methods applied as required for the current situation)
- Hailing
  Any radio operating in plain (nonencrypted) fixed frequency mode can signal call waiting to an active COMSEC/TRANSEC connection
- Break-in for voice communications
  Active COMSEC and COMSEC/TRANSEC connections can be interrupted for priority messages

Other waveforms

The R&S®SECOM-P waveform provides interoperability with the R&S®M3TR software defined tactical radios, including the lightweight handheld version. The R&S®SECOS and HAVE QUICK II ground-air waveforms are available on request. Using suitable tools and the Rohde&Schwarz development environment, users can integrate waveforms from other suppliers into the radio for interoperability with existing radios.

Modern, high data rate tactical network waveforms help to gain and maintain information superiority during missions by supporting IP-based applications such as sensors. They let military leaders securely communicate in realtime even at elevated threat levels.

MANET functionality

Access to radio nodes even across networks and with topographical constraints

In a dynamic environment with rapidly changing conditions and moving radio nodes, the required network topology can be created using pro-active mobile ad-hoc network (MANET) protocols. MANET routing protocols support radio nodes by delivering continuously updated topology information. Based on this information, radio nodes select the shortest possible multihop path to transmit data even to nodes that are not directly accessible.

In line with the highest security standards

Strict red/black separation in hardware and software

The radio's and waveforms' hardware and software architecture features strict red/black separation to satisfy customers' security requirements. Moreover, a separate module is used to encrypt payload data (voice and data). The R&S®SDTR is tamper resistant.

Zeroize function

The R&S®SDTR comes with a zeroize button on its front panel that allows quick deletion of data in case of an emergency. In addition, the radio has two separate interfaces for control data and payload data. A crypto ignition key (CIK) is available as an option.

Easy to integrate

Single-line operation for flexible integration

Military vehicles have only limited space available for communications equipment. The R&S®SDTR is a compact single-line radio and can be mounted more flexibly than large multiline radios. At the same time, the R&S®SDTR offers multiservice functionality when used with an R&S®HDR waveform.

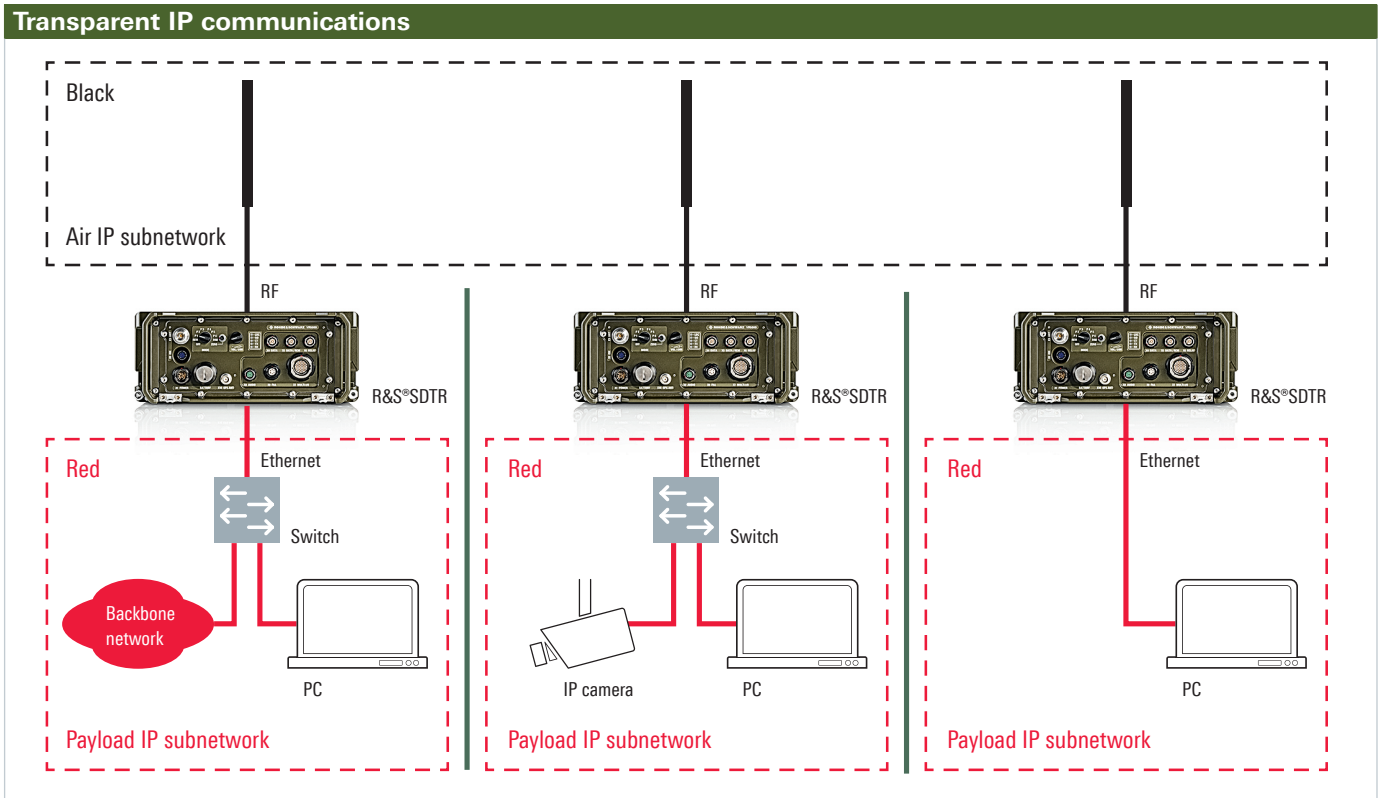
Compact design with integrated amplifier and co-site filters

The amplifier and co-site filters are built into the R&S®SDTR. No separate fan or shockmounts are required. This allows space-optimized integration of the radio.

Installation in inaccessible places

The R&S®SDTR can also be installed in inaccessible places in the vehicle, since it is remotely operated from an on-board control unit or battle management system (BMS). In case of emergency, the radio can be operated via its front panel.

Transparent IP communications



Fully IP-based radio for easy system integration

In addition to mechanical aspects, the software integration of the radio into the overall vehicle system plays a significant role. The R&S®SDTR is fully IP-based, which means that it supports radio control as well as voice and data communications based on the standardized IP protocol. This simplifies system integration, since standardized IP applications and components can be used. For example, IP-based battle management systems can be integrated via the radio's feedback message interface. Via this interface, the BMS adapts to the radio's optimized flow control mechanisms, yielding maximum data throughput.

Front panel interfaces, displays and controls

The R&S®SDTR comes with all interfaces and main control elements on the front panel, which simplifies the radio's installation and integration into existing carrier platforms.

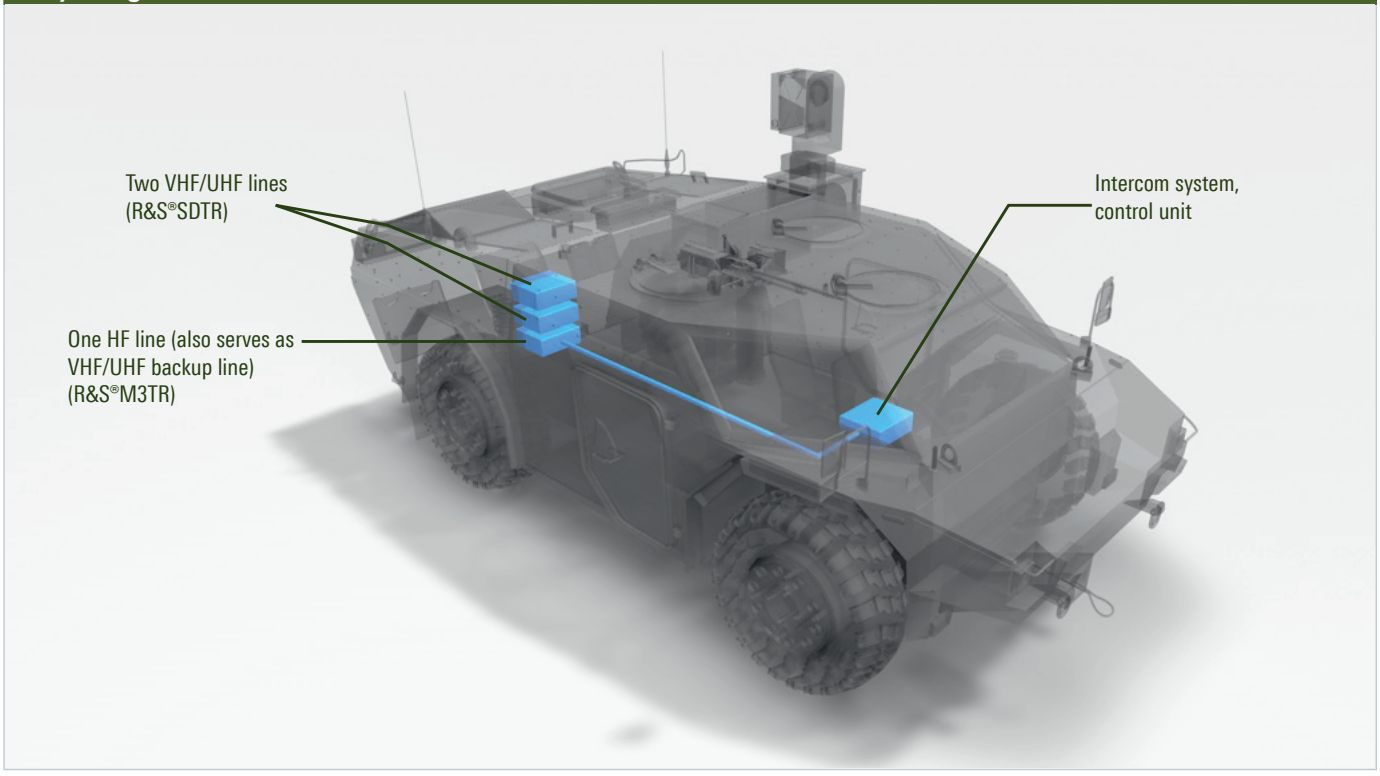
Interfaces and ports on the R&S®SDTR front panel:

- Three Ethernet LAN interfaces: two for separating payload data and control data and one for relay operation
- Multi-I/O interface providing all important interfaces such as audio lines and data interface
- Connector for loading configuration data from a fill device into the radio
- Audio interface for connecting audio accessories
- Interface for connecting a GPS antenna
- DC power supply connector
- N-type connector for VHF/UHF antenna

The front panel also contains a port for connecting the optional crypto ignition key (CIK) plus a compartment for the radio's backup battery.

The R&S®SDTR VR5000 has a rotary switch for volume and LED brightness control and another one for selecting preset modes. The ZERO button allows critical data to be deleted in case of an emergency. LEDs indicate the operating mode and status (e.g. TX, RX, encrypted, remote).

Easy integration of radiocommunications devices in a vehicle



Easy to operate with external control unit

Common control unit for up to three tactical radios from the R&S®SDTR and R&S®M3TR families

In developing the new generation of tactical radios, a major consideration was to make the radios easy to configure and operate. This led to the development of the Rohde&Schwarz control unit, which can be used to operate up to three tactical radios from the R&S®SDTR and R&S®M3TR families.

Control unit.

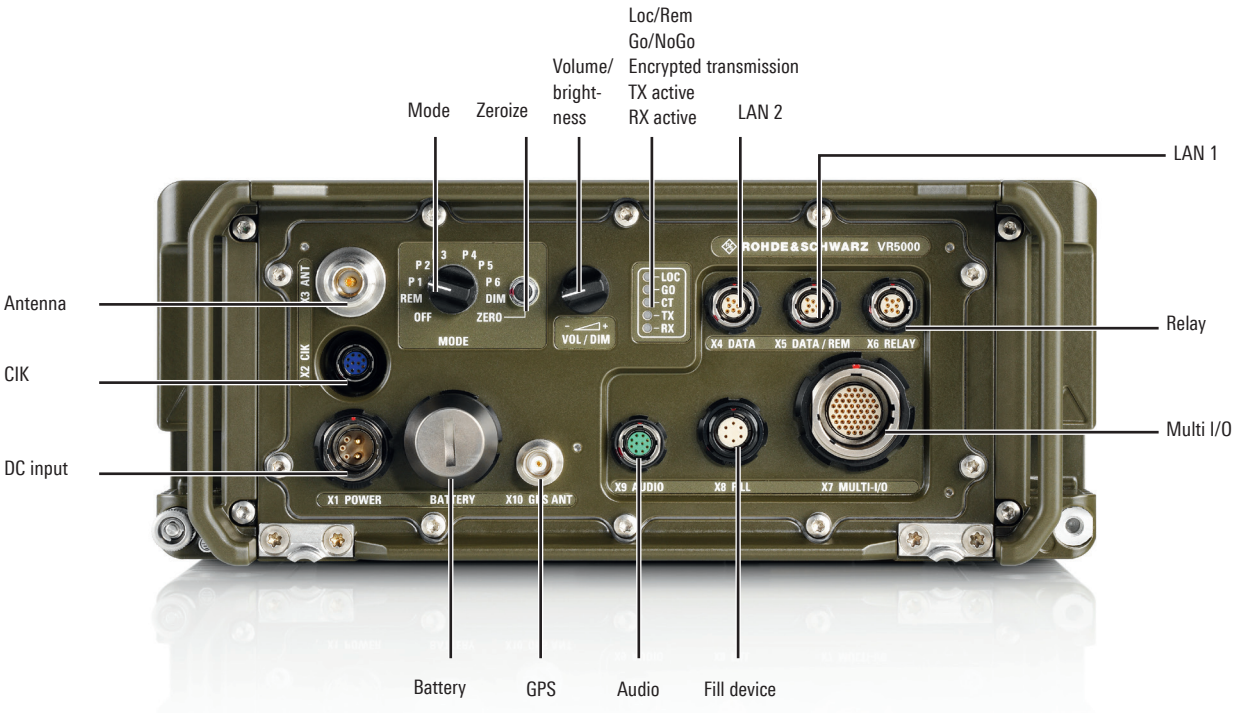
Modern, ergonomic GUI for simple, intuitive operation

The control unit has a modern, ergonomic and intuitive GUI, which makes operation very easy and significantly reduces training time.

Mechanical design optimized for use in a moving vehicle

The control unit has been designed to allow operation even under challenging conditions, for example while riding in a tracked vehicle.

Interfaces, control elements and status LEDs on R&S®SDTR VR5000 front panel



A worthwhile investment

State-of-the-art, open platform based on advanced international standard

The R&S®SDTR is a future-ready, powerful radio platform that has sufficient hardware resources to host even future waveforms with several megabits data throughput and several thousand frequency hops per second. Rohde&Schwarz selected the radio components with a view to high reliability and availability.

Conventional radios support only a single channel. The R&S®SDTR, in conjunction with the new R&S®HDR waveforms, supports simultaneous voice and data communications plus two voice channels in one radio line, which cuts the purchasing costs for multiline configurations.

Easy porting of waveforms

The R&S®SDTR has been designed as an open platform and allows the porting of waveforms based on the software communications architecture (SCA) standard. SCA defines the rules that regulate the interplay of hardware and software elements in software defined radios (SDR). SCA defines the software structure and interfaces within an SDR, specifies programmable radio elements for variable transmitters and receivers and enables waveform portability. To enable portability, a core framework must be implemented for SCA hardware.

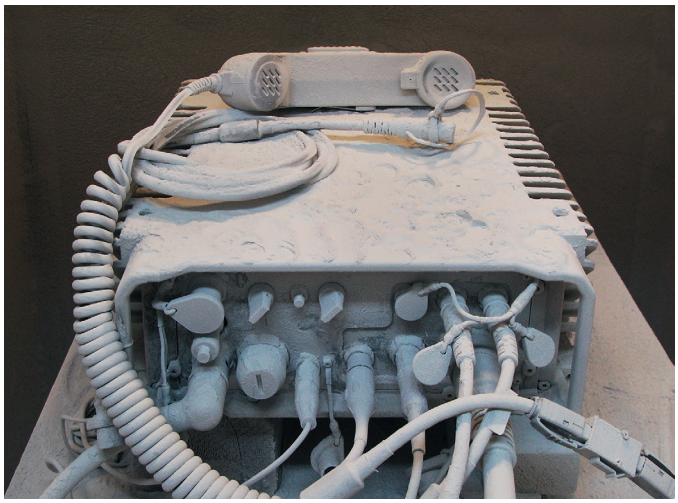
The R&S®SDxR family of software defined radios has a uniform hardware and software architecture which ensures that ported waveforms do not interfere with one another or with the radio platform. In addition, the radios' security architecture prevents waveforms being compromised by enemy attacks. The Rohde&Schwarz solution protects the copyrights of external waveform suppliers. Plus, it supports the development of customized waveforms on the red and black side.

Support of customized waveform developments

Rohde&Schwarz provides customers and partners on request with a comprehensive, harmonized tool suite, covering all aspects relevant to waveform development such as requirement analysis, waveform modeling, implementation, porting and testing.

Icing test.

Sand and dust test.



System configuration

The following options and accessories are available for an R&S®SDTR radio system.

Co-site filter

An optional co-site filter can be added to the radio's standard, integrated co-site filter. The second filter makes it possible to operate multiple radio lines in parallel, even if antennas have to be closely spaced. The second filter is often mandatory, especially for small vehicles. Like the standard filter, the optional co-site filter is built into the radio, significantly simplifying the radio's integration into the vehicle.

Control unit

The Rohde&Schwarz control unit can be used to remotely control up to two R&S®SDTR radios and one R&S®M3TR radio. The control unit's ergonomic design and modern, intuitive GUI make radio operation easy. The control unit is powered via power over Ethernet (PoE) and therefore requires no separate power supply. It has a connector for a fill device for downloading data to the radio. The control unit includes address book and messaging applications.

Mounting frame

The mounting frame comes in two versions – a quick release version for easy mounting and dismounting, and a version with an integrated fan. The second version is intended for operation in an extended temperature range (permissible temperature range), in two-line configurations and for continuous transmission.

If none of the above requirements exist and there is no need for quick dismounting, the R&S®SDTR can be built directly into the vehicle.

Crypto ignition key (CIK)

The crypto ignition key makes it easy to declassify the R&S®SDTR. When the CIK is removed from the radio, R&S®SDTR encryption mechanisms are deactivated and the radio needs no longer be treated as a crypto unit. It is also possible to operate the radio without the CIK.

Audio accessory

R&S®GA5000VR handset with push-to-talk (PTT) button with the following characteristics:

- Highly sensitive dynamic microphone element
- Highly efficient earphone element
- Whisper mode
- Rugged design
- Nonreflecting matt finish
- Electrically compatible with H-250 military handset

R&S®SDTR VR5000 radios in mounting frame.

R&S®GA5000VR handset.

Antennas

The R&S®HK055L1 and R&S®HK061 antennas were designed for the VHF/UHF range. Combined with the R&S®SDTR, they are ideal for mobile or semi-stationary applications.

R&S®HK055L1 broadband mobile antenna

The R&S®HK055L1 broadband mobile antenna is a compact transmitting and receiving antenna specially designed for use on tracked vehicles. The R&S®HK055L1 covers an extremely wide frequency range from 27.5 MHz to 600 MHz. The antenna attains its outstanding characteristics without the use of any tuning equipment. It is therefore ideally suited for hopping as well as for multichannel operation. The antenna is equipped with a spring at its base. If the antenna hits an obstacle, it will bend and automatically return to its vertical position. The antenna is integrated in a weather-proof radome.

R&S®HK061 vehicular broadband communications antenna

The R&S®HK061 vehicular broadband communications antenna is a compact transmitting and receiving antenna specially designed for use on armored wheeled vehicles. The R&S®HK061 covers an extremely wide frequency range from 30 MHz to 600 MHz. The antenna attains its outstanding characteristics without the use of any tuning equipment. It is therefore ideally suited for hopping as well as for multichannel operation. The antenna is equipped with a spring at its base. If the antenna hits an obstacle, it will bend and automatically return to its vertical position. The antenna is integrated in a weather-proof radome.

A number of whip antennas are supported in addition (each antenna is available with or without a GPS antenna integrated in its base):

- R&S®HV3012 50 W VHF low-profile antenna
- R&S®HV3013 50 W UHF vehicular antenna
- R&S®HV3015 50 W VHF vehicular antenna
- R&S®HV3019 50 W VHF/UHF vehicular broadband antenna

R&S®HK055L1 broadband mobile antenna.

R&S®HK061 vehicular broadband communications antenna.

Product overview

Designation	Type
Base unit	
Vehicular tactical radio	R&S®VR5000
Waveform software (options)	
R&S®HDR-AJ-NB	R&S®GS5000AN
R&S®HDR-AJ-WB	R&S®GS5000AW
R&S®HDR-WB	R&S®GS5000WB
HAVE QUICK II	R&S®GS5000H2
R&S®SECOS	R&S®GS5000Sx
R&S®SECOM-P	R&S®GS5000SP
Hardware (option)	
Co-site Filter	R&S®VR5100-BCO
Accessories	
Control unit	R&S®GB5100
Mounting frame	R&S®KS5100VR
Handset	R&S®GA5000VR
Headset	R&S®GA5000VR
CIK	R&S®CP5000VR
Fillgun	R&S®GP3000

R&S®M3TR Software Defined Radios

Today's military missions are characterized by joint operations of multinational armed forces. Interoperability of the equipment, especially in the field of communications, is therefore the primary objective of the international partners responsible for creating one of the most important aspects for efficient cooperation. The R&S®M3TR features maximum flexibility in terms of frequency bands and waveforms for practically all services and platforms.

The R&S®M3TR software defined radio family is a generation of high-performance digital radios. The heart of the integrated communications system is the lightweight R&S®MR300xH/R&S®MR300xU manpack radio, which offers solutions for all aspects of tactical communications as well as uniform and reduced interservice logistics. A lightweight handheld version (R&S®MR3000P) complements the radio family. Like the manpack radios, the R&S®MR3000P supports both open and secure communications modes.

Base units

- R&S®MR300xH multiband tactical radio
- R&S®MR300xU multiband tactical radio
- R&S®MR3000P VHF handheld transceiver

Key features

- Multiband capability
- Multiwaveform capability
- Software-configurable and upgradeable (P³I)
- Selective links in one net
- GPS reporting and message services
- User-friendly HMI (single-knob control for basic operation)

Logistics and readiness

- Minimum volume and weight
- Built-in test down to module level
- Common logistics concept for reduced costs throughout lifecycle
- Common human-machine interface (R&S®MR300xH/R&S®MR300xU)
- Automatic firmware update of external components
- Synthesizer calibration via antenna connector
- Minimum training required
- Excellent flexibility
- High MTBF
- Low volume and weight
- Power-saving mode

R&S®MR3000P VHF handheld transceiver.

R&S®MR300xH/R&S®MR300xU manpack radio.

The three Ms

Multiband

For applications using various services and networks, different types of radio units were previously required. The R&S®M3TR covers the entire spectrum from the HF via the VHF to the UHF band, allowing interoperability as well as uniform and reduced interservice logistics. The frequency flexibility of the R&S®M3TR meets various national and international regulations, providing global operation in fast-changing missions and environments.

Multimode

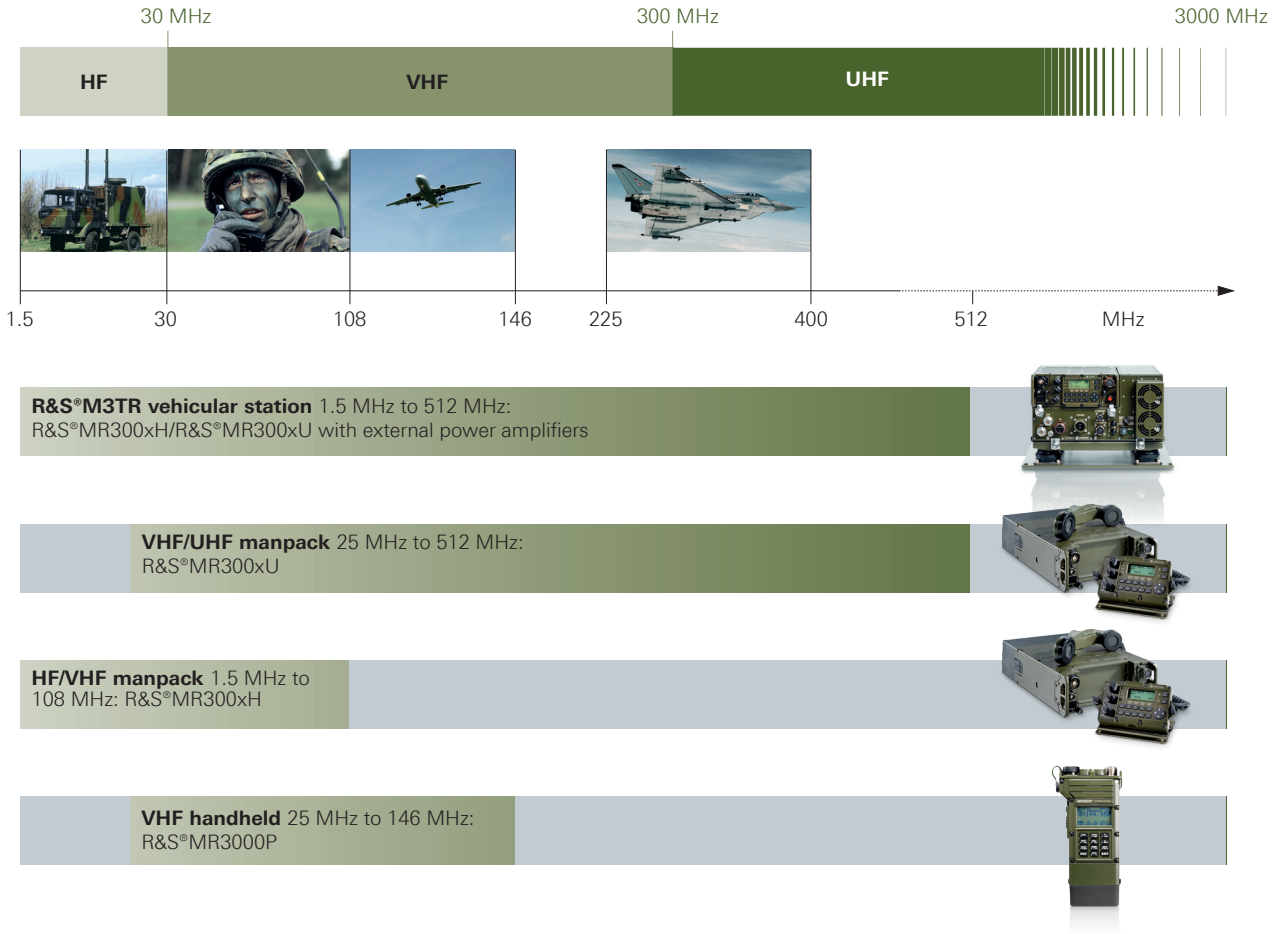
A software radio not only offers flexible network solutions, it also integrates existing national or company standards into a single unit. Due to optimized protocols and waveforms, the R&S®MR300xH/R&S®MR300xU attains maximum throughput rates for digital voice, data and position location.

Available waveforms

BLOS

- Second-generation (2G) ALE in line with FED-STD-1045/46/49
- Third-generation (3G) ALE in line with STANAG 4538
- EPM (ECCM) in line with R&S®SECOM-H, full interoperability with R&S®M3SR Series4100
- Modem waveforms in line with
  - STANAG 4285
  - STANAG 4529
  - STANAG 4539
  - STANAG 4415
- FF modulation in line with
  - AM, FM, SSB

Multiband tactical radio family



LOS
- EPM (ECCM) in line with
  - R&S®SECOM-V
  - R&S®SECOM-P, full interoperability with R&S®MR3000P
  - R&S®SECOS 5/16 TDMA, full interoperability with R&S®M3AR, R&S®M3SR Series4400
  - HAVE QUICK I/II
- Modem waveforms
  - VHF/UHF modem, up to 72 000 bit/s

Security
- Embedded COMSEC, 256-bit key
- Interface for various external COMSEC devices

Digital voice
- Vocoders adapted to mode of operation and bandwidth

Multirole

The multirole features of a software defined radio are mainly determined by its ease of integration into tactical communications networks. In addition to its use as a functional terminal in the individual subnet, e.g. CNR or PRN, it can also act as an interface between the various subnets. The R&S®M3TR can be used on diverse platforms and features interfaces to fixed networks such as WAN and LAN, as well as intelligent gateway and relay/rebroadcast functions such as routing of selective calls for subscribers inside/outside the home network.

R&S®MR300xH/R&S®MR300xU multiband tactical radio

Brief description

The R&S®MR300x radios form a family of high-performance digital radios covering the HF, VHF and UHF bands. Owing to different high-speed data modes and protocols as well as different antijam modes for HF, VHF and UHF, they perfectly integrate into tactical communications networks.

The radios are software-configurable and reprogrammable, including preplanned product improvement (P³I). Manpacks of the R&S®M3TR family are based on one mechanical platform, with a common logistics concept and one human-machine interface (HMI).

Key features

- Software-configurable and upgradeable (P³I)
- Multiband capability (1.5 MHz to 512 MHz with external devices)
- Multiwaveform capability (HF house, VHF/UHF tactical and G-A-G waveforms)
- Embedded EPM (ECCM) in line with R&S®SECOM and R&S®SECOS, HAVE QUICK I/II
- Selective links in one net
- Integrated GPS, position report
- Removable front panel for flexible use and integration
- User-friendly HMI
- High data rate of up to 72 000 bit/s
- IP over air capability (R&S®IPoA)
- SIP-based remote voice operation
- MTBF > 8000 hours

R&S®MR3000P tactical handheld transceiver

Brief description

The R&S®MR3000P is a small, lightweight, handheld transceiver that perfectly complements the R&S®M3TR family. Though compact, the R&S®MR3000P has all the features required of a tactical transceiver. It provides reliable connections, even in topographically difficult terrain, and is suitable for flexible integration into tactical networks. Since the transceiver can interoperate with the R&S®M3TR, it enables continuous radiocommunications both within and between forces. The expanded frequency range of the handheld transceiver also supports interoperability. It covers not only tactical VHF but also parts of the HF and VHF air traffic control bands.

Due to its jam-resistant digital waveform with embedded software encryption (R&S®SECOM-P), the R&S®MR3000P provides high-quality connections. Moreover, its transmit power of up to 5 W allows high ranges, even in difficult terrain. For network planning and configuration purposes, established tools such as R&S®RNMS3000 can be used. Seamless integration into tactical networks with fixed and vehicle stations as well as highly mobile forces is possible without any problem. The R&S®MR3000P features an integrated crypto module of the highest security level to provide protection for confidential messages.

Key features

- Multiband capability (25 MHz to 146 MHz)
- Embedded EPM (ECCM) in line with R&S®SECOM-P
- 5 W RF output power
- Secure transmission of voice, data and short messages
- Selective call with sender authentication
- Interoperability with the R&S®M3TR family
- GPS position report
- MTBF > 10 000 hours

Menu-oriented user interface and PC-based tools

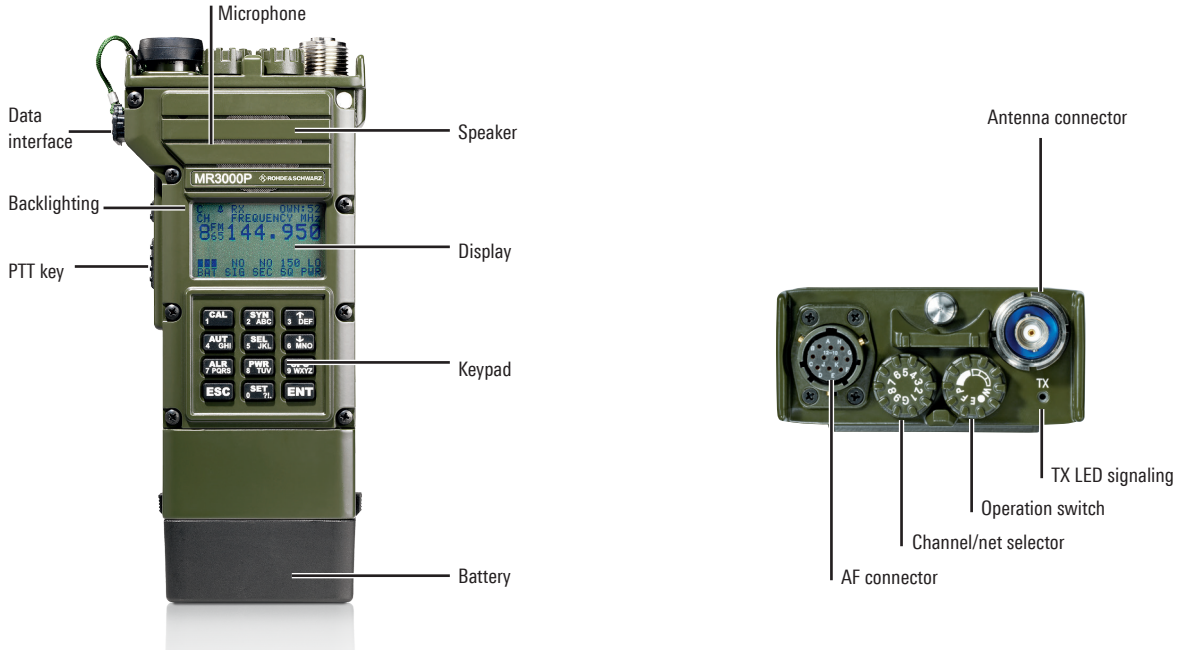
The R&S®MR300xH/R&S®MR300xU user interface is menu-oriented and easy to use. Its eleven-step rotary switch for the operating mode allows direct access to the nine most often used modes (nets) of the radio. These modes contain the complete setting of parameters such as the transmit power, the hailing frequency, the link mode, the EPM (ECCM) procedure and other net-specific adjustments. These preset pages are conveniently prepared with a PC or at a central location using the R&S®RNMS3000 radio net management software, and are loaded into the radio over the data connector before a mission starts.

Convenient and easy link establishment

Link establishment is convenient and easy. The operator chooses a mode (position 1 to 9 of the rotary switch) and activates the push-to-talk key or data transmission mode on the terminal. Everything else is done automatically. Two additional positions are available: MAN to use the radio in manual mode for fixed-frequency operation and MORE to access up to 90 additional preset pages via the radio keypad.

Operation of the R&S®MR300xH/R&S®MR300xU

Operation of the R&S®MR3000P



Software options

As a software defined radio, the R&S®M3TR is able to run a wide variety of waveforms. To provide radio systems that perfectly fit customer needs and applications, radio software can be ordered on the basis of communications requirements.

Upgrades by adding new waveforms or extending the frequency range of radio networks are also possible in this concept. Communications networks can therefore be tailored to always find the best compromise between current communications needs and budgetary setup.

EPM (ECCM) waveforms

R&S®SECOM-V and R&S®SECOM-H

The R&S®SECOM waveform (R&S®SECOM-V for the VHF and UHF bands, R&S®SECOM-H for HF) with its high hop rates and secure synchronization is setting new standards. It ensures powerful protection against detection, interception, jamming and spoofing. User data (digital voice or data) is transmitted completely digitally and in encrypted form. Within one R&S®SECOM-V net, several subnets and sublinks can be established simultaneously in the point-to-point and point-to-multipoint modes. Network synchronization and access can be planned and controlled individually for each user. Methods such as late net entry or hailing (R&S®SECOM-V) are available for this purpose.

R&S®SECOM is a combination of COMSEC and TRANSEC for encrypted voice and data communications in the frequency hopping mode.

The COMSEC part of the R&S®SECOM method is based on the R&S®RSCA crypto algorithm developed by Rohde&Schwarz. The method uses key lengths of up to 256 bit (approx. 10^{77} variants). Assuming uninterrupted transmission, the same bit sequence would be repeated after about 2×10^9 years. The keys required can be distributed by means of a key distribution device or directly from a PC. All keys are encrypted and the deciphered original is present only in the read-protected security pro-

EPM (ECCM) waveforms

Type	Designation	Runs in frequency range (in MHz)	Support of waveform by			
			R&S®MR3000H/ R&S®MR3000U	R&S®MR3001H/ R&S®MR3001U	R&S®MR3002H/ R&S®MR3002U	R&S®MR3003H/ R&S®MR3003U
R&S®GS3001S	R&S®SECOM-H	1.5 to 30	•	•	•	•
R&S®GS3030S	R&S®SECOM-V	30 to 108/ 121 to 512	•	•	•	•
R&S®GS3030S	R&S®SECOM-P	30 to 88	•	•	•	•
R&S®GS3006S	HAVE QUICK I/II	225 to 400		•		•
R&S®GS3516S	R&S®SECOS 5/16 TDMA	225 to 400		•		•
R&S®GM4121S	Secure voice/data	1.5 to 108			•	•

ALE – automatic link establishment

Type	Designation	Runs in frequency range (in MHz)	Support of waveform by			
			R&S®MR3000H/ R&S®MR3000U	R&S®MR3001H/ R&S®MR3001U	R&S®MR3002H/ R&S®MR3002U	R&S®MR3003H/ R&S®MR3003U
R&S®GS4101S	ALE-2G, FED-STD-1045/46/49	1.5 to 30			•	•
R&S®GS4155S	ALE-2G, FED-STD-1045/46/49 ALE-3G, STANAG 4538 (FLSU, LP, xDL, OD, ALM)	1.5 to 30			•	•

Modem waveforms

Type	Designation	Runs in frequency range (in MHz)	Support of waveform by			
			R&S®MR3000H/ R&S®MR3000U	R&S®MR3001H/ R&S®MR3001U	R&S®MR3002H/ R&S®MR3002U	R&S®MR3003H/ R&S®MR3003U
R&S®GM4120S	HF modem STANAG 4285, STANAG 4529, STANAG 4539, STANAG 4415	1.5 to 30			•	•
R&S®GS3030S	VHF/UHF modem 72 000 bit/s	30 to 512	•	•	•	•

cessor. Crypto units complying with NATO standards such as ELCRODAT 4-2/R&S®MMC3000 may be used as an external option.

To plan communications networks and links, a PC-based radio network management system is available. This tool allows users to generate keysets, plan frequency resources, define user channels and services and set up complete networks of radios. After the desired networks have been defined, the resulting data can be easily distributed to the radios by means of a fillgun or directly by using one of the radios' data interfaces.

R&S®SECOM-V (R&S®GS3030S)

R&S®SECOM is optimized for tactical communications and operates in the full VHF/UHF band. It is implemented as a software option running on all R&S®MR300xH/ R&S®MR300xU tactical radios.

R&S®SECOM-V was developed to meet as closely as possible the network demands of the primarily land-based mobile users of tactical radio services. R&S®SECOM-V is attuned to the requirements of land forces, where the implementation and management of complex network structures are in the foreground. The primarily hierarchical command structure of the armed forces should be mapped as closely as possible to the communications network. To this end, users can be organized in networks using the same frequency pool and the same key – one each for TRANSEC and COMSEC.

Possible address modes are point-to-point, point-to-multipoint and broadcast. Network synchronization and access can be controlled by each user. Late net entry is available for this purpose.

R&S®SECOM-V automatic net entry and time beacon:

- The radio automatically performs a net entry whenever synchronization is lost (R&S®M300xU/R&S®M300xH display message: NSYN). The time reference unit of an R&S®SECOM-V net automatically takes care of maintaining synchronization before it is lost. If the time beacon function is not active, a net entry may need to be performed from time to time

R&S®SECOM-V out-of-band hailing:

- Out-of-band hailing is an outstanding feature that considerably enhances the multiband capabilities of the R&S®M3TR radio with cross-band hailing. The latest software release makes it possible to scan FF calls over the entire frequency range from 1.5 MHz to 512 MHz. This means real multiband operation, as even HF calls can be received while operating the radio in the VHF/ UHF range. All FF modulation and squelch modes for the detection of signals are supported

R&S®SECOM-H (R&S®GS3001S)

R&S®SECOM-H is a Rohde&Schwarz proprietary frequency hopping HF radiocommunications waveform. R&S®SECOM-H is based on a multiwaveform concept and is designed to operate in environments where a certain percentage of the hop set frequencies are blocked due to either intentional disturbances (i.e. jamming) or unintentional ones, as well as environments experiencing severe Doppler spread and/or multipath delay. It is furthermore based on modem waveforms that can be adapted to the specific characteristics of the HF channel and its propagation.

R&S®SECOM-H provides digital voice (low bit rate vocoder at 600 bit/s, 1200 bit/s or 2400 bit/s, adjustable) and data services (up to 2400 bit/s). To ensure reliable links even in severely degraded channels, free hop set search (FHS) is available. FHS is an algorithm for the automatic adaptation of hop sets (ALE-like) based on channel evaluation. Radios in a point-to-point link will generate and use an advanced hop set containing only frequencies that have proven good HF performance. Channels are evaluated by measuring S/N, and results are shared between radios in the link during a three-way handshake.

For network synchronization, either the master-slave process or GPS can be used as the network time source. GPS-based network time eliminates the need for manual net entry; all stations in the network remain synchronized as long as the GPS signal is received.

Note: To have sufficient output power on an R&S®MR300xU radio in R&S®SECOM-H mode, the R&S®VK3150(C) HF power amplifier and other system components are required.

R&S®SECOM-P (R&S®GS3030S)

R&S®SECOM-P is the standard EPM (ECCM) method for the R&S®MR3000P handheld transceiver. It was especially optimized for use on small, lightweight terminal equipment. Even for this platform, R&S®SECOM-P offers maximum performance and battery operating time. Since R&S®SECOM-P can also be loaded into R&S®MR300xH/ R&S®MR300xU equipment as a software option, R&S®SECOM-P provides full interoperability between all R&S®MR300x radios in mixed networks.

R&S®SECOS 5/16 TDMA (R&S®GS3516S)

The R&S®SECOS air-ground-air waveform provides interoperability in the EPM (ECCM) mode between the R&S®M3TR and the R&S®M3AR and R&S®M3SR Series4400 radios. Besides digital voice mode, data transmission with data rates of up to 16000 bit/s is supported. Both TDMA and non-TDMA modes are implemented. For details on R&S®SECOS implementation in

the R&S®M3TR, see the related Technical Information (R&S®SECOS). Network synchronization for R&S®SECOS can be accomplished using the master-slave process via an external time source or by using GPS as the network time.

Note: To have sufficient output power on an R&S®MR3001H or R&S®MR3003H radio in R&S®SECOS mode, the R&S®VT3050 or R&S®VT3050C VHF/UHF power amplifier is required.

R&S®SECOS 5/16 TDMA guard receiver:

- The guard receiver function monitors up to two channels in background mode. This allows operators who are occupied with R&S®SECOS voice or data traffic and receive an emergency call to transmit on one of these dedicated frequencies without having to use another radio

HAVE QUICK I/II (R&S®GS3006S)

The NATO ground-air-ground waveform HAVE QUICK I/II provides interoperability in the EPM (ECCM) mode between the R&S®M3TR, R&S®M3AR, R&S®M3SR Series4400 radios and various types of legacy equipment.

Note: To have sufficient output power on an R&S®MR3101H or R&S®MR3103H radio in HAVE QUICK I/II mode, the R&S®VT3050 or R&S®VT3050C VHF/UHF power amplifier is required.

ALE – automatic link establishment

ALE-2G (R&S®GS4101S)

The common basic protocol standard for ALE is FED-STD-1045/1046/1049, known as second-generation ALE or ALE-2G. It uses nonsynchronized scanning of channels, and it takes about several seconds to half a minute to repeatedly scan through an entire list of channels looking for calls.

ALE-2G/ALE-3G (R&S®GS4155S)

The latest ALE standard uses accurate time synchronization via GPS-locked clocks or a time server to achieve faster and more dependable linking. It is generally known as third-generation ALE or ALE-3G. Synchronization may reduce the calling time to achieve a link to less than 10 seconds. Although ALE-3G is better and more reliable, the existence of a large, installed base of ALE-2G radio systems and the wide availability of equipment have made 2G the baseline standard for global interoperability.

Links are set up over fast link setup (FLSU) and kept stable using link maintenance (LM). Users can choose between open or encrypted LSU. Occupancy detection (OD) prevents collisions in the network.

xDL protocols (R&S®GS4155S)

The Rohde&Schwarz ALE-3G built-in xDL data link protocols are LDL and HDL. They offer acknowledged point-to-point delivery of datagrams over an already established HF link. Each protocol is optimized for different channel conditions and datagram sizes to enable high throughput in all communications scenarios. A good throughput can be achieved even under very challenging channel conditions below 0 dB SNR.

The low-latency data link protocol (LDL) is optimized for delivering small datagrams in all channel conditions and also longer datagrams in poor channel conditions. It supports a maximum data rate of approx. 300 bit/s.

The high-throughput data link protocol (HDL) is optimized for delivering large datagrams in medium to good channel conditions and supports a maximum data rate of approx. 3400 bit/s.

The R&S®GM4121S software can be used to additionally encrypt xDL transmitted data.

The Rohde&Schwarz IP over air (R&S®IPoA) interface provides transparent IP functionality over the xDL data link protocol. It can be used to set up communications systems that require a transparent connection of IP networks over HF radio links. IP-based applications – such as situational awareness or message handling systems – are enabled to exchange their data over such radio links. A standard IP interface allows a customer application to be easily and economically connected to the HF radiocommunications system.

Alternatively, xDL protocols can be used for serial data transfer over the RS-232 interface.

Note: To run ALE on an R&S®MR300xU radio, the R&S®VK3150 power amplifier together with a docking station or the R&S®VK3150C compact power amplifier and accessories such as an antenna coupler are required.

R&S®MR300xH/R&S®MR300xU supported services

Voice communications

Analog voice

The following signal modulations are available:
- J3E (USB, LSB)
- A3E (AM)
- H3E (AM)
- F3E (FM)

Squelch

The R&S®M3TR supports the following squelch types:
- Received signal strength indication (RSSI)
- 150 Hz tone squelch
- Signal squelch (CTCSS selective calling)
- Syllabic squelch (digital recognition of voice components in signal)

Digital voice (optional)

For communications under the EPM (ECCM) methods R&S®SECOM-V, R&S®SECOM-H, R&S®SECOM-P and R&S®SECOS 5/16 TDMA, voice is transmitted in digital form. The following vocoders are available:

R&S®SECOM-V (R&S®GS3030S):
- MELPe vocoder 2400 bit/s
- AMBE vocoder 2400/4800/9600/16000 bit/s
- CVSD vocoder 16000 bit/s

MELPe is the standard vocoder for R&S®SECOM waveforms. It offers the best voice quality and is extremely insensitive to background noise. Due to their favorable characteristics, MELPe vocoders were also a preferred choice for military radiocommunications technology when defining STANAGs.

AMBE is used for voice over data transmission under R&S®SECOM-V. It makes use of the R&S®SECOM-V 16000 bit/s channel with vocoder-specific FEC. This voice mode provides reliable good-quality and jam-proof communications. The data rate can be selected by HMI. The AMBE vocoder is ideal for the voice over data operating mode since it supports all R&S®SECOM-V data rates from 2400 bit/s to 16000 bit/s.

R&S®SECOM-H (R&S®GS3001S):
- MELPe vocoder 600 bit/s
- MMBE vocoder 1200 bit/s
- AMBE vocoder 2400 bit/s

The 1200 bit/s vocoder was specially developed for the demanding task of setting up reliable links with good quality under the poor channel conditions usually found in the HF range. As an integral component of the R&S®SECOM-H HF waveform, it is optimized for use together with this frequency hopping method. For interoperability with R&S®SECOM-V in rebroadcast applications, the 2400 bit/s vocoder can also be selected in the R&S®SECOM-H mode.

R&S®SECOM-P (R&S®GS3030S):
- CVSD vocoder 16000 bit/s

R&S®SECOS digital voice (R&S®GS3516S):
- CVSD vocoder 16000 bit/s
- AMBE vocoder 16000 bit/s

Secure voice/data (R&S®GM4121S)

Secure voice/data (SVD) enables encrypted connections in FF channels. Just like for frequency hopping R&S®SECOM waveforms, the R&S®RSCA crypto algorithm is used. SVD can be used standalone on FF channels or together with ALE-3G. MELPe vocoders are used to digitize the analog voice signals. In ALE-3G mode, SVD encryption can be applied to both voice and xDL data communications.

Key features:
- Fair to good speech quality
- Very robust realtime voice communications
- Automode capability
- Fast late entry capability

Last ditch voice (R&S®GM4121S)

Poor quality HF channels are primarily a problem for tactical radio communications. In order to ensure reliable connections in such environments despite these disadvantages, the radio must employ extremely robust transmission methods: With LDV, the digitized voice message is first stored temporarily in the transmitting radio and then transmitted at data rates between about 30 bit/s and 300 bit/s using the LDL data protocol that is part of ALE-3G. This helps ensure that the recipient receives the voice messages under almost all circumstances, though not in realtime like a conventional voice call.

Messages up to 60 s are supported. Each station can store one LDV message. The user is informed about a new received LDV message at the HMI and via an audio indication. The user can also play back the received LDV message until a new LDV message is received.

Voice over IP, SIP and phone patch

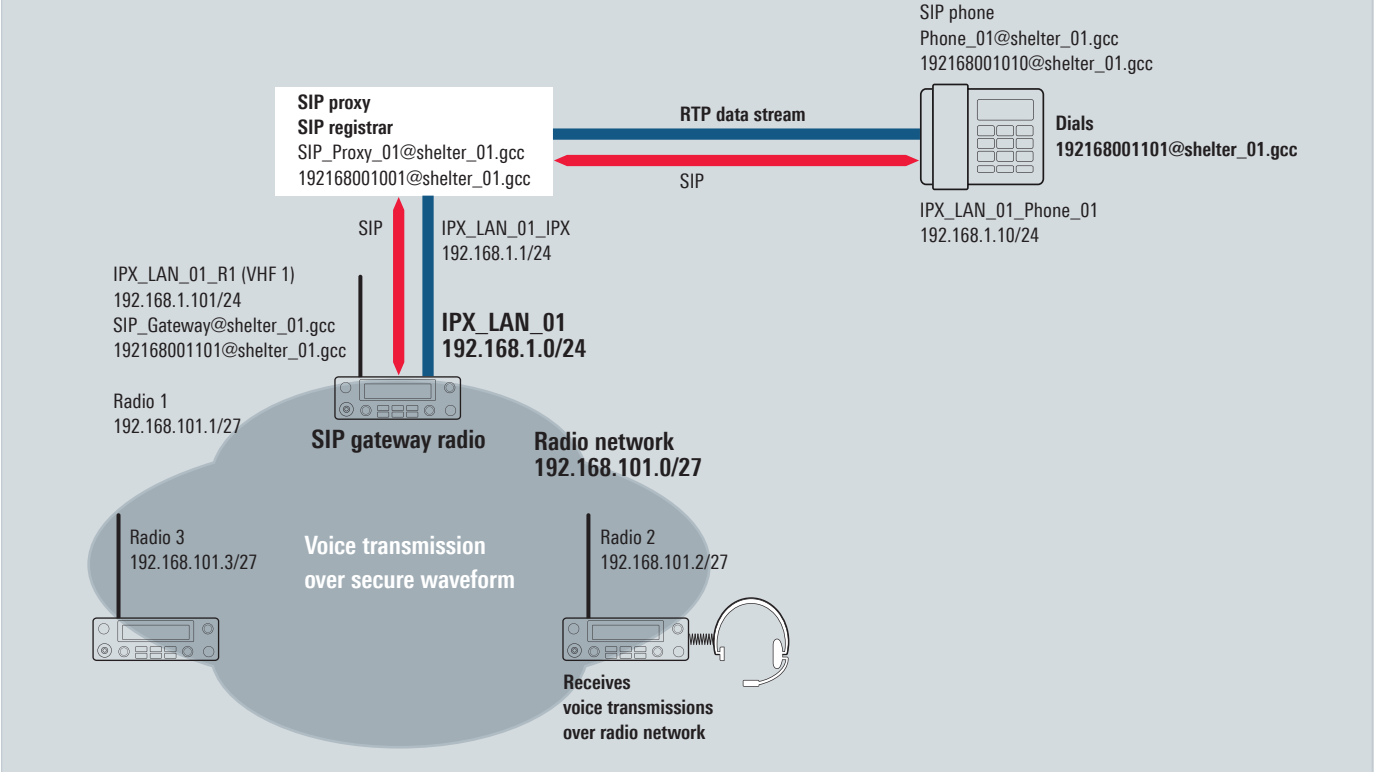
Voice over IP, especially with the SIP and RTP protocols, is standard today in many professional communications networks. The radios from the R&S®M3TR and R&S®M3SR Series4100 families have an IP interface as standard. Consequently, they can also be used to transmit digital voice to and from the radio. In addition to connecting radio networks via a local area network (LAN) or adding radio components to a LAN, the primary focus is on the following applications:

- Remote operation of tactical radios via standardized media, such as Ethernet, directional radio or satellite. One line or one channel suffices for voice traffic, data transmission and remote control
- Simple connection of the radios to telecommunications networks (phone patch) through the standardized IP interface

A phone patch is always of interest when a mobile device from a radio network is to be used to connect to a telephone network subscriber. This could be for public networks, but also for government or corporate networks. The phone patch is often part of a radio access point (RAP). The RAP acts as a gateway between radio networks and wireline networks. The R&S®M3TR and R&S®M3SR Series4100 radio families also offer state-of-the-art IP-based solutions for this application: Instead of analog telephone lines, LAN connections now establish contact to the radio world. For transmission of the voice signals on the wireline side, the system supports standard protocols for IP telephony, such as SIP and RTP. A dedicated radio in the radio network serves as a gateway between the wireless and wireline networks. To do this, the radio connects to the receiving end via an SIP proxy router, which could, for instance, be an IP-enabled telephone. In this way, any subscribers in the radio network are able to reach the subscriber in the fixed network directly via the subscriber's network address. Telephone numbers can be stored conveniently in the radio; as a result, users can look up who they want to call in their radio's address book, just as they would on a mobile phone. The gateway radio also handles protocol conversion of the incoming RTP packets. In the radio network, work continues as usual with vocoders that have been adapted to the radio channels.

In addition to the gateway between the wireless and wireline networks, it is also possible, of course, to link geographically separated radio networks via a LAN connection. This can be necessary when no direct radio contact is possible due to topographical conditions, or when LOS networks deployed at different locations are to be interconnected. Both the R&S®SECOM-H/R&S®SECOM-V waveforms and ALE-3G support this function.

Voice over IP, SIP and phone patch



Data communications

Voice priority over data (VPoD)

There is also a solution available for situations in which voice and data communications are simultaneously needed: Using VPoD, it is possible to interrupt an ongoing data link by simply pressing the push-to-talk key. Users can send emergency calls right from the ongoing data connection. After the emergency call is over, the radio returns to the original data transmission.

VPoD supported waveforms

- R&S®SECOM-H
- R&S®SECOM-V
- ALE-3G (STANAG 4538) xDL

Note: To run HF waveforms on an R&S®MR300xU radio, the R&S®VK3150 power amplifier together with a docking station or the R&S®VK3150C compact amplifier and accessories such as an antenna coupler are required.

STANAG 4285 data mode (R&S®GM4120S)

For backward interoperability, the non-self-identifying STANAG 4285 modem waveform is available. STANAG 4285 is a low and medium-rate maritime HF waveform from 75 bit/s to 3600 bit/s.

STANAG 4539 data mode (R&S®GM4120S)

The STANAG 4539 HF modem enables self-identifying (auto-baud) data communications (up to 12 800 bit/s) in a 3 kHz channel in the HF frequency range.

STANAG 4539 is based on more than one standardized modem waveform:

- STANAG 4415 (very robust traffic waveform at 75 bit/s)
- MIL-STD-188-110B (low and medium-rate serial tone waveforms from 150 bit/s to 2400 bit/s)
- MIL-STD-188-110B App. C (high data rate waveforms from 3200 bit/s to 12 800 bit/s)

R&S®SECOM-H data mode (R&S®GS3001S)

R&S®SECOM-H is designed to operate in environments where a certain percentage of hop set frequencies are blocked due to either intentional jamming or environmental interferences, e.g. atmospheric noise, thunderstorms or other electrical disturbances. For detailed information, see the related Technical Information (R&S®SECOM-H).

In R&S®SECOM-H, data rates from 75 bit/s to 2400 bit/s are possible. The data rates can be selected by HMI.

R&S®SECOS 5/16 TDMA (R&S®GS3516S)

Data transmission with data rates of up to 16 000 bit/s is supported. Both TDMA and non-TDMA modes are implemented. For details on R&S®SECOS implementation in the R&S®M3TR, see the related Technical Information (R&S®SECOS).

R&S®SECOM-V data mode (R&S®GS3030S)

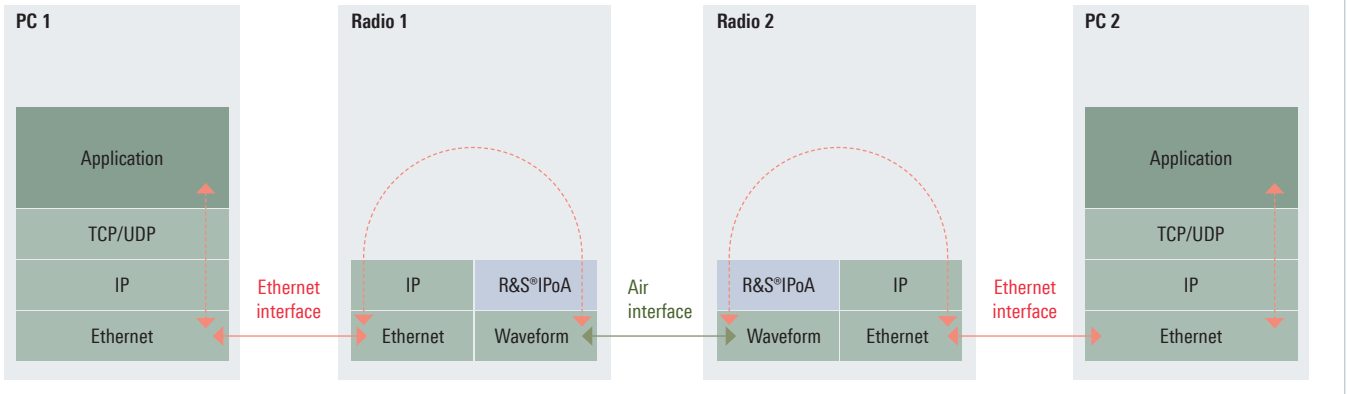
In R&S®SECOM-V, data rates up to 16 000 bit/s are possible. User data rates span from 600 bit/s to 9600 bit/s depending on FEC share and number of retransmissions. R&S®SECOM-V uses binary continuous phase FSK modulation with a shift of 6.25 kHz. For detailed information, see the related Technical Information (R&S®SECOM-V).

72 000 bit/s VHF/UHF modem (R&S®GS3030S)

For mobile radiocommunications, military users often employ terminal equipment with a narrow bandwidth and limited channel capacity. Such equipment has limited data transmission capability. The new software-based high-speed modem for the R&S®M3TR allows the transmission of radio data at high rates:

- Up to 72 000 bit/s
- Auto-baud capability

R&S®IPoA – transparent IP data transfer over air



The modem can be operated either using the integrated IP over air protocol or transparently via the serial interface. It supports ten different waveforms with different data rates. All waveforms are operable in the VHF/UHF frequency range from 30 MHz to 512 MHz.

The VHF/UHF modem user data rate ranges from 16000 bit/s to 72000 bit/s, depending on the set bandwidth.

R&S®IPoA – IP radio transmission

The R&S®IPoA embedded radio protocol provides transparent IP functionality over the air. It can be used to set up communications systems that require transparent connection of IP networks over radio links. IP-based applications – such as situational awareness or message handling systems – are enabled to exchange their data over such radio links.

An R&S®MR300xH/R&S®MR300xU radio equipped with R&S®IPoA includes static IP router functionality. The network structure can be configured very easily by entering IP subnets to be routed to different destinations over the air interface. This can be done very easily with the R&S®RNMS3000 network management system. In addition to the standard IP address of the physical Ethernet interface (which is used, for example, for remote control), a second IP address represents the radio's air interface. Using the configuration tool, the network can be configured to route e.g. wired IP subnets to different destinations over the air interface. The radio can be connected via an Ethernet connector (RJ-45) to 10BaseT and 100BaseT network equipment (such as hubs, switches and routers) provided by the R&S®KG3031/R&S®KG3032 docking station and the R&S®VT3050C compact power amplifier. If R&S®IPoA functionality is to be used with manpack radios, the R&S®MR300xH/R&S®MR300xU data connector on the front panel must be used. For this application, the Ethernet interface can be software-configured to this connector.

R&S®IPoA protocol functionality

The embedded R&S®IPoA protocol currently supports Internet protocol version 4 (IPv4). An internal address mapping function ensures that data is delivered to the correct recipient. The IP packets are transmitted transparently over the radio channel. Data link performance depends on the current channel properties and propagation conditions of the radio link. An error detection mechanism prevents the protocol from delivering erroneous data to the connected network; further error correction techniques (e.g. ARQ secured data) are implemented.

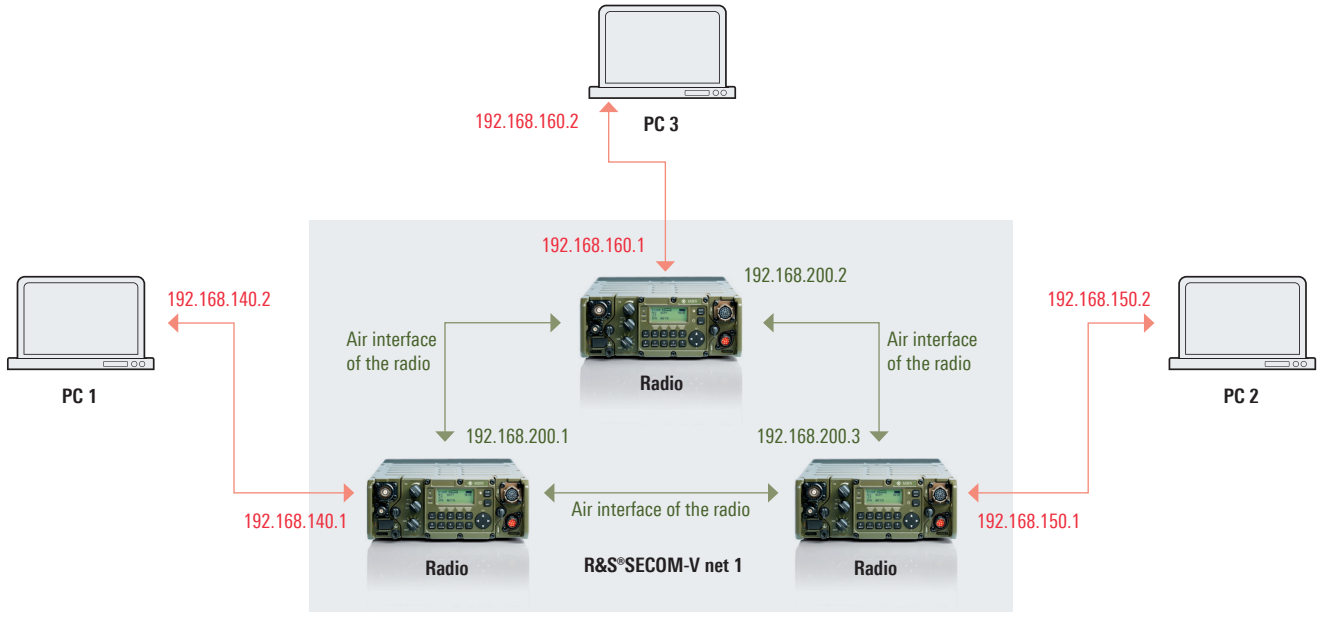
R&S®IPoA supported waveforms

- R&S®SECOM-H
- R&S®SECOM-V
- VHF/UHF modem
- ALE-3G (STANAG 4538) xDL

R&S®IPoA message service

Messages and text information can be transmitted directly from the radio HMI as well as from external sources. Each R&S®IPoA-capable waveform supports the following applications:

R&S®IPoA – example with R&S®SECOM-V waveform



Alarm messages:

- Alarm messages are messages that are preconfigured during mission planning. They can be selected on the HMI and then transmitted. Alarm messages place almost no load on the channel and are therefore always transmitted with the highest priority

Short data messages:

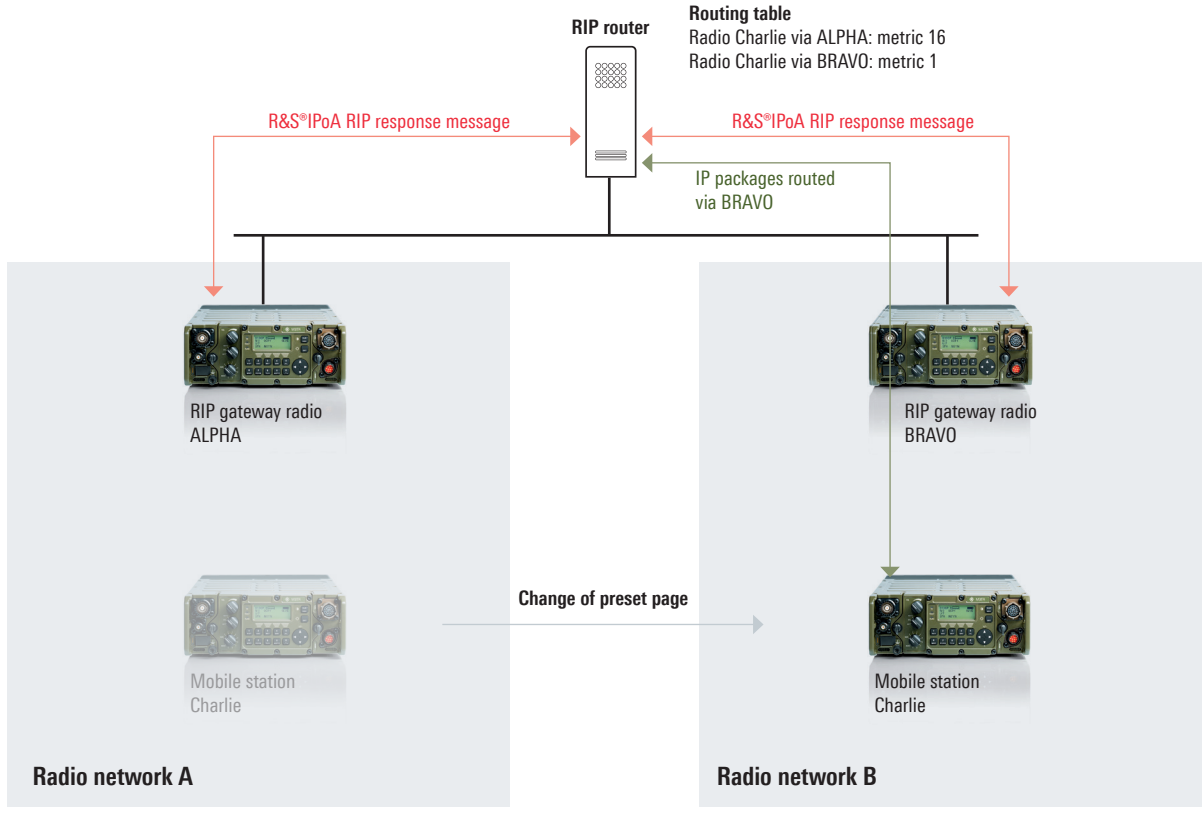
- Short data messages (SDM) can be entered directly on the HMI keyboard (similar to entering an SMS on a mobile phone). Addressing (PtP, PtM) is possible depending on the underlying waveform.

R&S®IPoA – routing information

R&S®IPoA supports automatic routing of IP packets in networks with a fixed backbone (e.g. wired, SatCom or directional radio based) and a mobile, R&S®IPoA based structure. If a mobile radio operator (station Charlie in the figure below) changes from radio network A to the neighboring radio network B, all the operator needs to do is select the preset for the new R&S®IPoA network on the radio. As soon as the radio becomes active in the new network, the RIP gateway radio assigned to that network (station BRAVO in the figure below) automatically sends an RIP message to the RIP router in the fixed network. The radio has now been registered on the new network, and all IP packets addressed to Charlie will be routed to the new network.

An RIP router forwards incoming IP packets to the neighboring router that provides the shortest path to the destination (minimum number of hops; lowest metric). For stations that no longer generate IP traffic, the metric is increased at regular intervals until it reaches the maximum value preconfigured in R&S®RNMS, i.e. 16 (= unreachable = default value in R&S®RNMS). This ensures that when the radio has changed to a new network all messages transmitted reach their destination without the operator having to make any modifications to the network configuration.

R&S®IPoA – routing information



R&S®M3TR supported services

GPS services

GPS reporting

Operators can send their own position in a waveform-specific net. A dedicated radio (GPS controller) can poll the positions of all other net members. The GPS controller can be connected to an external application (i.e. command and control software system) to make GPS information available on a digital map, for example. The external application can poll the GPS controller to get the latest GPS information of all members of the network.

Transmission of GPS information:

- The polling of GPS information is initiated by the GPS controller. After initiation of transmission, all active GPS providers send their GPS information sequentially to the GPS controller. The transmission of GPS information can be switched on/off at the GPS controller. GPS reporting can be stopped in this way. Collisions between individual transmissions of GPS information are prevented

GPS controller:

- The GPS controller is a manpack or vehicular radio (R&S®MR300xH/R&S®MR300xU). GPS controllers request the GPS information from the GPS providers either at a user's request or periodically

GPS position information:

- The GPS controller stores the latest GPS information of each radio in an internal table. This table is updated each time GPS information is received by the GPS controller. The following GPS information is provided by each GPS provider radio
  - Position (WGS84, GEO, UTM, MGRS)
  - Velocity
  - UTC time
  - Fix quality (number of satellites that are visible)

GPS reporting – supported waveforms:

- R&S®SECOM-V
- R&S®SECOM-H
- R&S®SECOM-P
- VHF/UHF modem
- ALE-3G (STANAG 4538)

R&S®HV3031 GPS receiver module for the R&S®MR3000P.

GPS receiver module on the R&S®MR300xH and R&S®MR300xU

The GPS receiver module is built into the manpack. The R&S®HV3003 GPS antenna or other embedded GPS antennas, e.g. R&S®HV3012, R&S®HV3013, R&S®HV3015, R&S®HV3019, are required to receive GPS signals.

GPS receiver module on the R&S®MR3000P (option)

A GPS receiver module is available for the R&S®MR3000P (handheld). It integrates both the GPS antenna and the receiver module and is connected to the audio connector of the handheld transceiver. External audio equipment can still be used with the GPS module installed.

BIT

Built-in test system

All components of the R&S®M3TR radio system are equipped with a BIT system that provides three modes:

- Power-on BIT (PBIT)
- Initiated BIT (IBIT)
- Continuous BIT (CBIT)

The PBIT is always performed after powering on the unit.

The IBIT is executed when manually activated by the operator. The CBIT is continuously performed during operation.

The BIT enables fault location down to the module level of functional groups. Faults are stored in a fault journal for later evaluation.

Operating hours counter:

- Display of operating time since last power-on operation
- Display of total operating time

PBIT

After power-on, the power-on built-in test (PBIT) starts automatically. The PBIT takes less than one second. It is a quick, reasonably in-depth test of the main functions such as the receive and transmit mode. The PBIT also detects installed modules and options and their versions.

IBIT

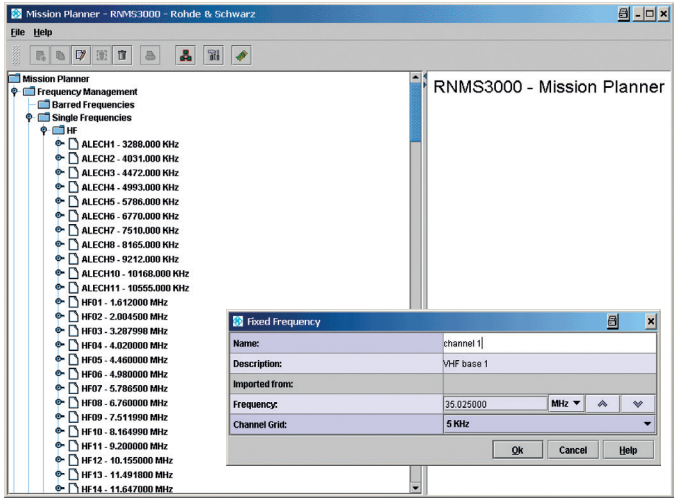
The initiated built-in test (IBIT) is the most in-depth of the built-in tests. It requires no additional equipment such as loop test cables, etc. The IBIT takes about five seconds.

CBIT

The continuous built-in test (CBIT) is the least in-depth of these tests. Unlike the PBIT and IBIT, it is a continuous test that runs in the background. The CBIT has no impact on radio operation or radio settings. The CBIT information is updated every second when the radio is switched on and in operating mode.

Test sequence as seen by the user

Mission planner – FF channel management.



Channel/net memory

A radio can store different presets containing radio link data:

Nets

A net is a set of parameters specifying a configured FF or FH network containing all relevant data for link setup and traffic. Nets are stored in preset pages accessible by the rotary switch of the radio or by the keypad, respectively. Depending on the actual configuration, up to nine (R&S®MR3000P) or up to 99 (R&S®MR300xH/ R&S®MR300xU) presets can be defined and stored in the radio.

Channels (R&S®MR300xH/R&S®MR300xU)

A channel is a set of parameters specifying an FF channel (TX and RX frequency, modulation, RF power, etc.). Channel data can be stored in both the manual preset or in one of the remaining 99 presets. In total, 450 channels are available:

First 400 channels:

- Can be generated during R&S®RNMS3000 configuration
- Can be entered directly at radio HMI
- Available on manual preset page (PP 0)

Locked channels:

- If the above channels are locked during the R&S®RNMS generation process, they cannot be changed at the radio HMI

Remaining 50 channels:

- To be generated during R&S®RNMS configuration only
- Will appear on their own preset page

Channel and band scanning:

- In the FF mode, it is possible to scan either the stored channels or a fixed frequency range. The user can define the dwell and hold time and the squelch type for the activity criterion. For band scanning, the user can set the start and stop frequency and the step width for the desired frequency range. If occupancy is detected, the scan can be stopped and the detected frequency stored in the channel memory. For channel scanning, the user can also define a priority channel.

Accessories for the R&S®MR300xH/R&S®MR300xU

Headset/handset/loudspeaker

	Designation, description	Type
	**Handset with PTT, microphone and earpiece** The R&S®GA3001 handset can be connected to the audio connector of the R&S®MR300xH and R&S®MR300xU radios, as well as to the remote control unit and other system components of the R&S®M3TR radio family	R&S®GA3001
	**Headset with PTT, microphone and earpiece** The R&S®GA3002 is a headset for single/double ear use and can be worn on both the right or left ear. A flexible cut-out polymer ear pad makes for user convenience without masking outside noise. The microphone is fitted to an adjustable flexible support	R&S®GA3002
	**Microphone/speaker** The R&S®GA3003 consists of a loudspeaker box with built-in audio amplifier and microphone	R&S®GA3003
	**Loudspeaker** For connection to the R&S®M3TR audio socket with through-connection to R&S®GA3001/R&S®GA3002; length: 2 m, 5 m or 10 m cable	R&S®GA3005

Batteries and battery chargers

	Designation, description	Type
	**Standard battery pack, lithium-ion** rechargeable, 28.8 V/5.5 Ah **Combat battery pack, Li-SO2** nonrechargeable, 28 V/7.5 Ah	R&S®IB3001 R&S®IB3002
	**Battery charger, AC, stationary** Automatic charging of up to eight R&S®IB3001 lithium-ion batteries A power supply cable is supplied with each charger	R&S®IC3000
	**Vehicle battery charger, DC, mobile** Automatic charging of one R&S®IB3001 lithium-ion battery **Power supply cable** for R&S®IC3001 vehicle battery charger, delivery without battery pack	R&S®IC3001 R&S®GK3020
	**Battery charger set** for connection to R&S®IC3001 or R&S®IV3001	R&S®ZR3001

Antenna tuning unit and auxiliary equipment

	Designation, description	Type
	**Antenna tuning unit, 150 W** Shown with recommended extra: mounting frame	R&S®FK3150 Recommended extra: R&S®KS3150F mounting frame
	**Single remote control unit** with 3.5 m, 8 m or 12 m connecting cable	R&S®GB3031R
	**Connecting cable for detachable front panel** max. length: 1.5 m	R&S®GK3005
	**Fillgun** for transmitting all relevant preset information as well as COMSEC/TRANSEC keys	R&S®GP3000, R&S®GP3100 (HAVE QUICK I/II mode) R&S®GK3021 USB cable, fillgun to PC

Docking stations

	Designation, description	Type
	**Single docking station with fan** For installation of one R&S®MR300xH or R&S®MR300xU manpack radio	R&S®KG3031
	**Dual docking station** For applications requiring the simultaneous operation of two radio stations	R&S®KG3032
	**Universal RCB converter** The R&S®GH3041 provides conversion functionalities between coaxial RCB interfaces (as used in R&S®M3TR applications) and optical RCB interfaces (as used in R&S®M3SR Series4100 applications) and vice versa, i.e. to be used in connection with the R&S®FK4115M antenna tuning unit	R&S®GH3041
	Various mounting frames for wheeled and tracked vehicles are available	

External amplifiers

Configuration overview with docking station and power amplifiers

- 50 W VHF/UHF power amplifier, standalone unit
- 50 W VHF/UHF power amplifier, compact version
- 150 W HF power amplifier, standalone unit
- 150 W HF power amplifier, compact version
- 500 W HF power amplifier

VHF/UHF antennas

- VHF
- UHF
- Multiband

HF antennas

- Whip
- Wire
- NVIS

R&S®KG3031A[1) 2)] single docking station

R&S®VT3050[1)] 50 W VHF/UHF power amplifier

R&S®VK3150[2)] 150 W HF amplifier

R&S®FK3150[3)] antenna tuning unit

Power supply

1) The R&S®KG3031A and the R&S®VT3050 can be replaced with the R&S®VT3050C.
2) The R&S®KG3031A and the R&S®VK3150 can be replaced with the R&S®VK3150C.
3) The R&S®FK3150 can be replaced with the R&S®FK4115M and the R&S®GH3041.

Antenna selection chart – HF band

Type, description	Frequency range	Power	Mast	Application
R&S®HV3007 Whip antenna 	1.5 MHz to 30 MHz	25 W	–	For manpack applications
R&S®AK3001 Wire antenna 	1.5 MHz to 30 MHz	150 W	–	For manpack applications, long wire adapter, R&S®GK3019, model .04 required
R&S®AK3031 Wire dipole antenna 	2 MHz to 90 MHz	25 W	R&S®KM3032	For manpack applications, BNC adapter, R&S®GK3019, model .02 required
R&S®HA104 Whip antenna 	1.5 MHz to 30 MHz	150 W	–	For vehicle applications, suitable for ground waves and vertically polarized low-angle sky waves, R&S®FK3150 antenna tuning unit required
R&S®AK503 HF antenna system for mobile use 	1.5 MHz to 30 MHz	150 W	R&S®KM011	For vehicle applications, R&S®FK3150 antenna tuning unit required

Antenna selection chart – VHF band

Type, description	Frequency range	Power	Mast	Application
R&S®HV3004 Whip antenna 	25 MHz to 108 MHz	25 W	–	For manpack applications
R&S®HV3020 Whip antenna 	25 MHz to 108 MHz	25 W	–	For manpack applications, long radiator
R&S®HD3088 Hang-up antenna 	30 MHz to 88 MHz	12.6 W	–	For manpack applications BNC adapter, R&S®GK3019, model .02 required
R&S®HD3001 Long wire antenna 	30 MHz to 88 MHz	25 W	–	For manpack applications, high-gain directional antenna
R&S®HV3021 Long tape antenna 	25 MHz to 146 MHz	5 W	–	For handheld applications, long radiator
R&S®HV3022 Short tape antenna 	25 MHz to 146 MHz	5 W	–	For handheld applications
R&S®HV3012 Whip antenna 	30 MHz to 108 MHz	50 W	–	For vehicle applications, low-profile antenna
R&S®HV3015 Whip antenna 	30 MHz to 108 MHz	50 W	R&S®KM3031	For vehicle and stationary applications
R&S®HV3088L Long tape antenna, foldable 	30 MHz to 88 MHz	5 W	–	For handheld transceivers

Antenna selection chart – VHF/UHF band

Type, description	Frequency range	Power	Mast	Application
R&S®HV3009 Whip antenna 	118 MHz to 400 MHz	15 W	–	For manpack applications
R&S®HV3013 Whip antenna 	225 MHz to 450 MHz	50 W	R&S®KM3031	For vehicle and stationary applications
R&S®HV3019 Whip antenna 	100 MHz to 512 MHz	50 W	R&S®KM3031	For vehicle and stationary applications
R&S®HK055L1 Broadband mobile antenna 	27.5 MHz to 600 MHz	50 W < 30 MHz, 100 W > 30 MHz	R&S®KM055	For vehicle applications
R&S®HK061 Broadband vehicle communications antenna	30 MHz to 600 MHz	100 W	–	For vehicle and stationary applications

Accessories for the R&S®MR3000P tactical handheld transceiver

	Designation, description	Type
	**Handheld microphone/speaker**	R&S®GA3023
	**Headset with PTT or VOX**	R&S®GA3022
	**Battery pack, lithium-ion** For handheld transceiver	R&S®IB3022
	**Universal battery charger, AC, stationary** For handheld transceiver; automatic charging of up to eight R&S®IB3022 lithium-ion batteries	R&S®IC3022
	**Vehicle support** Vehicle mount with charger	R&S®IV3021
	**Fillgun** For transmitting all relevant preset information as well as COMSEC/TRANSEC keys	R&S®GP3021
	**Vehicle battery charger, DC** Automatic charging of two R&S®IB3022 lithium-ion batteries	R&S®IC3023
	**Battery charger, AC, mobile** Charger, AC, mobile for handheld transceiver; automatic charging of one R&S®IB3022 lithium-ion battery	R&S®IC3024
	**GPS receiver** TAIP interface	R&S®HV3031

Product overview

Designation	Type
R&S®M3TR radio family	
HF/VHF tactical radio, 0.5 W to 10 W (HF up to 20 W)	
Int. GPS receiver, ATU, RS-232 and IP interface	R&S®MR3000H
Int. GPS receiver, ATU, RS-232 and IP interface; prepared for HAVE QUICK I/II and/or R&S®SECOS 5/16 TDMA	R&S®MR3001H
Int. GPS receiver, ATU, RS-232 and IP interface; prepared for HF waveforms	R&S®MR3002H
Int. GPS receiver, ATU, RS-232 and IP interface; prepared for HAVE QUICK I/II, R&S®SECOS 5/16 TDMA and HF waveforms	R&S®MR3003H
VHF/UHF tactical radio, 0.5 W to 10 W	
Int. GPS receiver, RS-232 and IP interface	R&S®MR3000U
Int. GPS receiver, RS-232 and IP interface; prepared for HAVE QUICK I/II and/or R&S®SECOS 5/16 TDMA	R&S®MR3001U
Int. GPS receiver, RS-232 and IP interface; prepared for HF waveforms	R&S®MR3002U
Int. GPS receiver, RS-232 and IP interface; prepared for HAVE QUICK I/II, R&S®SECOS 5/16 TDMA and HF waveforms	R&S®MR3003U
Tactical handheld transceiver, 0.2 W and 5 W	
Handheld transceiver	R&S®MR3000P
Mating connector set (R&S®MR300xH/R&S®MR300xU)	
Mating connector set	R&S®GK3004
EPM (ECCM) support equipment (R&S®MR300xH/R&S®MR300xU)	
Key generation equipment for R&S®SECOM incl. R&S®KGE3000 key generation module	R&S®CP3000
Fillgun for transmitting all relevant preset information as well as COMSEC/TRANSEC keys	R&S®GP3000
Fillgun HAVE QUICK I/II for transmitting all relevant preset information	R&S®GP3100
Key distribution device for R&S®SECOS 5/16 TDMA	R&S®KDD3750
Power amplifiers (R&S®MR300xH/R&S®MR300xU)	
500 W HF power amplifier for R&S®MR300xH/R&S®MR300xU radios; 1.5 MHz to 30 MHz; standalone	R&S®MG3500
150 W HF power amplifier for R&S®MR300xH/R&S®MR300xU radios; 1.5 MHz to 30 MHz	R&S®VK3150
150 W HF compact power amplifier for R&S®MR300xH/R&S®MR300xU radios	R&S®VK3150C
1.5 MHz to 30 MHz	
1.5 MHz to 30 MHz; with field telephone and audio/data interface	
50 W VHF/UHF power amplifier for R&S®MR300xH/R&S®MR300xU radios; 30 MHz to 512 MHz; with/without co-site filter	R&S®VT3050
50 W VHF/UHF compact power amplifier for R&S®MR300xH/R&S®MR300xU radios	R&S®VT3050C
30 MHz to 512 MHz	
30 MHz to 512 MHz; with co-site filter	
30 MHz to 512 MHz; with field telephone and audio/data interface	
30 MHz to 512 MHz; with co-site filter, field telephone, audio/data interface and MIL-STD-188-220C modem	
Batteries and chargers (R&S®MR300xH/R&S®MR300xU)	
Standard battery pack, lithium-ion, rechargeable; 28.8 V/5.5 Ah	R&S®IB3001
Combat battery pack, Li-S02, nonrechargeable; 28 V/7.5 Ah	R&S®IB3002
Battery charger, AC, stationary; automatic charging of up to eight R&S®IB3001 lithium-ion batteries	R&S®IC3000
Battery charger, DC, mobile; automatic charging of one R&S®IB3001 lithium-ion battery	R&S®IC3001
Battery charger set; for connection to R&S®IC3001 or R&S®IV3001	R&S®ZR3001
Power supply cables for chargers must be ordered separately	

Designation	Type
Docking stations and accessories (R&S®MR300xH/R&S®MR300xU)	
Single docking station with fan; frame only; not operational without additional components	R&S®KG3031
Dual docking station with fan; frame only; not operational without additional components	R&S®KG3032
Ground plate without shockmounts; standard/with slides; for R&S®KG3031/KG3032	R&S®KG3030G
Ground plate with shockmounts; standard/with slides; for wheeled and tracked vehicles; for R&S®KG3031/KG3032	R&S®KG3032G
Auxiliary box; standard/field telephone; incl. audio line, Ethernet, audio wideband and multipurpose I/O interface; for R&S®KG3031/KG3032	R&S®GB3130A
Single remote control unit with 3.5/8/12 m connecting cable	R&S®GB3031R
Different RF interfaces and power filter options available on request	
Power supply unit/mounting frame (different models available)	R&S®IV3001
Mounting frame with shockmounts	
For R&S®VT3050 or R&S®VK3150 power amplifier	R&S®KS3000V
For R&S®VT3050C or R&S®VK3150C power amplifier	R&S®KS3001V
For R&S®FK3150 antenna tuning unit	R&S®KS3150F
Blower unit for R&S®VK3150 or R&S®VT3050 power amplifiers	R&S®KL3000V
Audio accessories (R&S®MR300xH/R&S®MR300xU)	
Handset with PTT microphone and earpiece	R&S®GA3001
Headset with PPT microphone and one/two earpiece(s)	R&S®GA3002
Loudspeaker/microphone	R&S®GA3003
Loudspeaker for connection to R&S®MR300xH/R&S®MR300xU audio socket with through-connection to R&S®GA3001/GA3002; cable length: 2/5/10 m	R&S®GA3005
Control cables, data cables, RF cables, power supply cables (R&S®MR300xH/R&S®MR300xU)	
Various cables available on request; must be ordered separately	
Manpack antennas (R&S®MR300xH/R&S®MR300xU)	
Wire antenna for manpack or stationary use; 1.5 MHz to 30 MHz; 150 W	R&S®AK3001
Wire dipole antenna for manpack use; 2 MHz to 90 MHz; 25 W; broadband antenna; with/without mast	R&S®AK3031
Long wire antenna; 30 MHz to 88 (108) MHz; 30 W high-gain directional antenna	R&S®HD3001
Hang-up antenna; terminated with BNC connector; 30 MHz to 88 MHz; power rating 12.5 W into 50 Ω	R&S®HD3088
GPS antenna for manpack and vehicle applications; active; magnetic holder; L1 band	R&S®HV3003
Whip antenna for manpack; 25 MHz to 88 (108) MHz; 20 W	R&S®HV3004
Long whip antenna for manpack; 1.5 MHz to 30 MHz; 25 W	R&S®HV3007
Whip antenna for manpack; 118 MHz to 400 MHz (88 MHz to 450 MHz); 15 W	R&S®HV3009
Vehicular antennas (R&S®MR300xH/R&S®MR300xU)	
HF antenna system for mobile use; 1.5 MHz to 30 MHz; 150 W	R&S®AK503
Whip antenna for vehicle use; 1.5 MHz to 30 MHz; 150 W	R&S®HA104
Whip antenna for vehicle use; 30 MHz to 108 MHz; 75 W; low profile; with/without GPS base	R&S®HV3012
Whip antenna for vehicle or stationary use; 225 MHz to 512 MHz; 50 W; center-fed; with/without GPS base	R&S®HV3013
Whip antenna for vehicle or stationary use; 30 MHz to 108 MHz; 50 W; center-fed; with/without GPS base	R&S®HV3015
Whip antenna for vehicle or stationary use; 100 MHz to 400 (512) MHz; 50 W; center-fed; with/without GPS base	R&S®HV3019
Broadband vehicle communications antenna 30 MHz to 600 MHz; color: CARC383 (green)	R&S®HK061
Stationary antennas (R&S®MR300xH/R&S®MR300xU)	
Broadband mobile antenna; 27.5 MHz to 600 MHz; color: green or sand yellow	R&S®HK055L1
Mast for antennas; height: 8.5 m	R&S®KM3031
Mast for antennas; height: 7 m	R&S®KM3032
Whip antenna for stationary use; 225 MHz to 512 MHz; 50 W; center-fed; with mast	R&S®HV3013
Whip antenna for stationary use; 30 MHz to 108 MHz; 50 W; center-fed; with mast	R&S®HV3015
Whip antenna for stationary use; 100 MHz to 400 (512) MHz; 50 W; center-fed; with mast	R&S®HV3019
GPS antenna supplement for R&S®HK055L1	R&S®KM055
For other antennas, see the "Antennas HF-VHF/UHF-SHF" catalog, PD 0758.0368.42 (printed edition) or PD 0758.0368.52 (CD-ROM)	

Designation	Type
Antenna adapters (R&S®MR300xH/R&S®MR300xU)	
Different antenna adapters available on request	
Antenna tuning unit (R&S®MR300xH/R&S®MR300xU)	
Antenna tuning unit; 1.5 MHz to 30 MHz; 150 W	R&S®FK3150
Antenna tuning unit; 1.5 MHz to 30 MHz; 150 W; with RCB interface; FH capability; color: RAL 7001	R&S®FK4115M
Universal RCB converter	R&S®GH3041
Rucksacks and manpack bags (R&S®MR300xH/R&S®MR300xU)	
Transport bag for R&S®KM011 mast; color: olive drab	R&S®MZ3011
Rucksack for R&S®AK3031 antenna; color: camouflage or olive drab	R&S®MZ3031
Rucksack for R&S®MR300xH/R&S®MR300xU and accessories; color: camouflage or olive drab	R&S®MZ3060
Rucksack for R&S®MR300xH/R&S®MR300xU, R&S®XV3088 and accessories; color: camouflage	R&S®MZ3088
Transport bag for R&S®AK503 antenna, antenna head, radiators and ropes; color: olive drab	R&S®MZ3503
Handheld transceiver and accessories (R&S®MR3000P)	
Tactical handheld transceiver, 25 MHz to 146 MHz; 0.2/5 W; including R&S®SECOM-P	R&S®MR3000P
Central update tool for R&S®MR3000P radio	R&S®CS3021
Handheld microphone/speaker	R&S®GA3023
Serial data cable	R&S®GK3028
Power supply cable for R&S®IV3021	R&S®GK3029
Fillgun; for transmitting all relevant preset information as well as COMSEC/TRANSEC keys	R&S®GP3021
GPS receiver	R&S®HV3031
Battery pack, lithium-ion, for R&S®MR3000P radio	R&S®IB3022
Battery charger, AC, stationary, for R&S®MR3000P radio; automatic charging of up to eight R&S®IB3022 lithium-ion batteries	R&S®IC3022
Vehicle charger, DC, for R&S®MR3000P radio	R&S®IC3023
Charger, AC, mobile for R&S®MR3000P radio; automatic charging of one R&S®IB3022 lithium-ion battery	R&S®IC3024
Vehicle support; vehicle mount with charger for R&S®MR3000P radio	R&S®IV3021
Long tape antenna for R&S®MR3000P radio; length: 1.1 m	R&S®HV3021
Short tape antenna for R&S®MR3000P radio; length: 0.5 m	R&S®HV3022
Long tape antenna, foldable; power rating 5 W at 50 Ω; length: 1.5 m	R&S®HV3088L
Bag for R&S®MR3000P radio	R&S®MZ3021
Set bag for R&S®MR3000P radio and accessories	R&S®MZ3022
Battery pack bag for R&S®MR3000P radio	R&S®MZ3023
R&S®RNMS3000 radio network management system	
Mission planner	R&S®DS3100M
Remote device loader	R&S®DS3300D
Remote distributor	R&S®DS3321D
Test system for radio equipment of the R&S®M3xR family	
Base system; mobile rack version; complete set of radio test equipment including system racks and base software suite	R&S®UCS226XB
R&S®M3TR BASE, system interface base; radio adaptation box and cabling set; including specific radio test software package	R&S®UCS-B20

R&S®MMRS Modular Multirole Radio System

The R&S®MMRS is a modularly designed, flexible radiocommunications system based on the R&S®M3TR. Owing to its modularity, it can be adapted to various mission requirements.

In today's deployment scenarios, armed forces are confronted with rapidly changing situations and constantly changing requirements on personnel and equipment in difficult terrain. To meet this challenge, a mobile, flexible and powerful radiocommunications system is indispensable.

The R&S®MMRS is an easy-to-transport, space-saving and adaptable radiocommunications system that satisfies a wide range of requirements. Its multirole capability to operate in VHF/UHF and HF underscores its flexibility.

The R&S®MMRS meets the essential requirements for a military field ATC system, a relay station, a radio station with up to two radio circuits simultaneously, or for company or battalion field headquarters.

All on the basis of the R&S®M3TR in rugged 19" boxes that are easy to transport.

Key facts

- Independent of existing infrastructure
- Scalable
- Modular
- Multirole-capable
- Operator-friendly
- Simple and fast to set up
- Easy to deploy
- Ruggedized for field use under harsh conditions

Benefits and key features

System overview

- Different solutions for different needs
- Flexible system for various situations
- Fast setup for semi-mobile deployment

Deployment scenarios for the R&S®MMRS

- Field headquarters
- Field ATC
- Radio station
- Relay

Modular system concept

- Radio rackbox
- Intercom box
- Operator console
- Laptop/tablet

System and accessories tailored to requirements

- Versatile power supply
- Specially ruggedized multicables
- Suitable antennas for all possible frequency ranges
- Headsets with active noise reduction

Transport and operation

- Remote operation
- Operation in vehicles and buildings
- Transportability
- Ruggedized to face harsh conditions

System overview

The R&S®MMRS is a radio system based on the radio rackbox and the intercom box. These units can be combined and expanded with other modules to suit the individual application or mission.

Different solutions for different needs

Weight plays a major role in today's deployment planning. The modular design of the R&S®MMRS makes it possible to adapt the system to each mission and thus save logistical resources.

Flexible system for various situations

The R&S®MMRS is flexible due to its low weight, easy transportability, and the fact that neither infrastructure nor a vehicle is needed for operation.

Fast setup for semi-mobile use

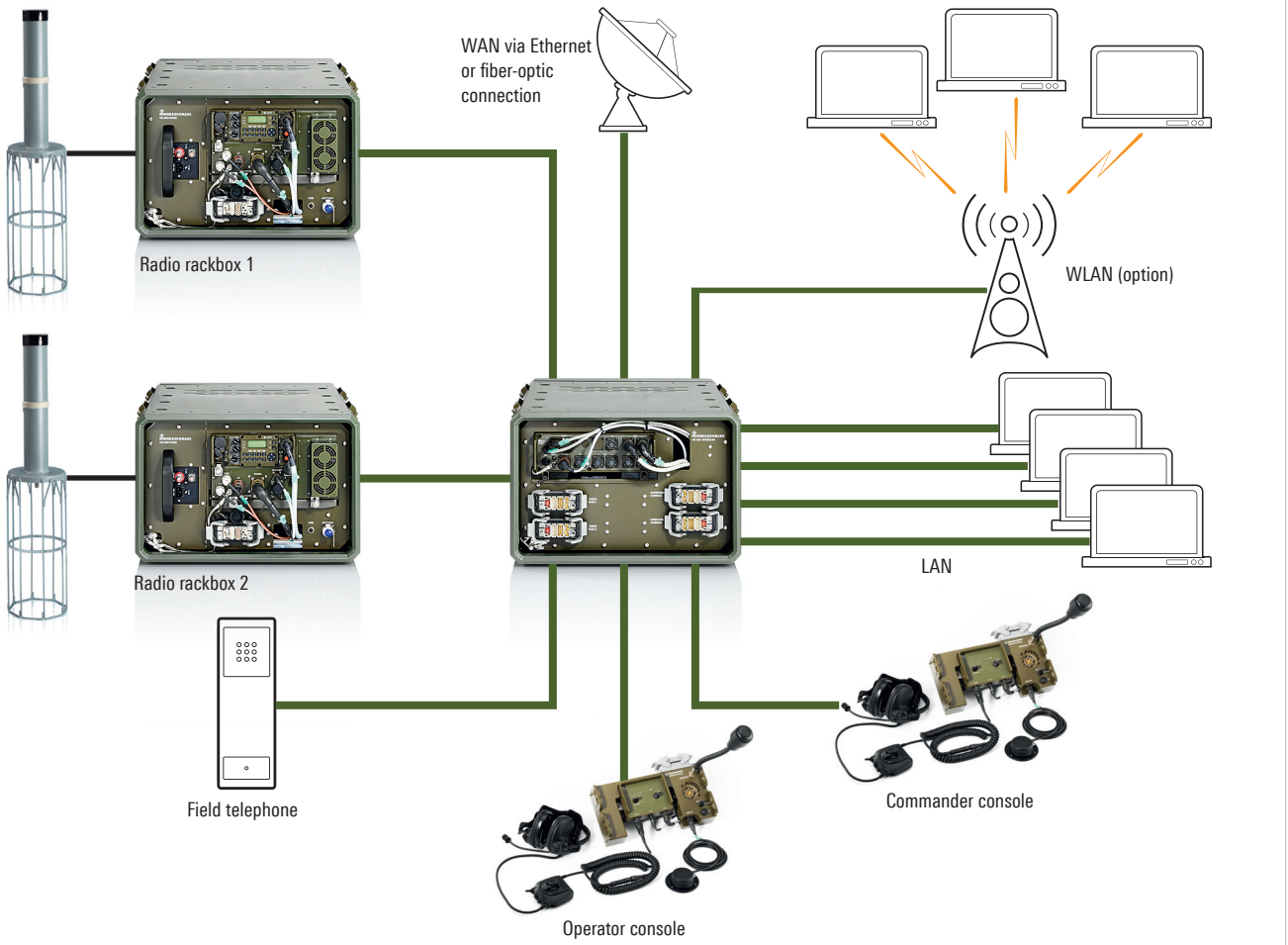
Due to its specially designed multicable, the R&S®MMRS core system can be set up and dismantled in just a few quick steps.

Setup scenarios

	Intercom box	Radio rackbox 1	Radio rackbox 2
Field HQ	●	●	●
Field ATC	o	●	o
Relay	o	●	●
Gateway	●	●	●
Onboard communications	–	●	–
Checkpoint	o	●	o

● = required; O = optional; – = not required

Overview



Deployment scenarios for the R&S®MMRS

Today's armies must be able to handle a wide variety of tasks. The R&S®MMRS is a flexible radiocommunications system that meets this requirement.

The R&S®MMRS can be used in many ways:

- Field headquarters:
  The R&S®MMRS makes it possible to set up field headquarters at the company or battalion level with alternatives for IP-based LAN, WLAN (purchase option) and WAN connections; see intercom box for details
- Field ATC:
  The R&S®MMRS system is a mobile air traffic control (ATC) system that allows military forces to establish mobile airstrips in a very short period of time to obtain a logistical or combat advantage wherever needed
- Radio station:
  In its basic version, the R&S®MMRS is a radio station that is independent, quick to set up, and designed for land-, sea- or air-based operations
- Relay:
  Through simple configuration, the R&S®MMRS can fulfill the function of a highly mobile relay station and thus increase the radius of operation in the areas of deployment
- On board communications:
  Since the human machine interface (HMI) can be operated remotely, the radio rackbox can be stowed in the storage space of a vehicle, and the radio can be operated from the driver's cabin by using the remote HMI. The R&S®MMRS can also be used on board ships with the required power supply
- Checkpoint
  When a checkpoint is set up and operated, the radio rackbox can be deployed on the vehicle or in remote operation for radiocommunications

Modular system concept

The R&S®MMRS is based on several modules, which allows application-specific system configuration to meet different needs using optimized equipment.

Radio rackbox

The R&S®MMRS is based on the multiband, multimode and multirole R&S®MR3001U VHF/UHF tactical radio. To increase the transmission output power up to 50 W, the R&S®M3TR is installed in the compact R&S®VT3050C amplifier. Together with a power supply unit supporting AC and/or DC input and a rugged 19" box, the R&S®KG3050 radio rackbox is set up for VHF/UHF frequencies.

For HF frequencies, a similar system with the R&S®VT3150C (150 W, option) is available.

Intercom box

To provide the operator with easy and flexible remote operation and control of the radio rackboxes, an intercom system is available. The central unit of the intercom system is installed in a separate, rugged 19" box and forms the intercom box.

The intercom box provides the following:

- Interface for two (optionally up to four) radio rackboxes
- Router for up to four computers in LAN
- Option for WLAN
- WAN via Ethernet or fiber-optic connection for backbone
- One connection for a field telephone
- Connection for fill gun device to upload missions centrally to all radios

R&S®KG3050 radio rackbox.

R&S®KG3051 intercom box.

Operator console

When operating and controlling the radio system, the operator works with easy-to-use consoles. There are two different types of consoles. The operator console for a normal operator, and the supervisor console for the commander.

Both consoles have an intercom group selector to change between different preconfigured audio channels.

In addition to the operator console features, the supervisor console has a mode selector to change between different preconfigured intercom and radio modes. By selecting a specific mode, the commander can, for example, disable the operator console for security reasons and take exclusive control of all connected radio rackboxes. For remote control purposes, the supervisor console offers two slots for the dismounted front panels of the radios.

Laptop/tablet

For the transmission of files, a data application such as R&S®Postman III is needed with which e-mails containing attachments can be sent. For this purpose, a tablet PC or a laptop can be connected to the intercom or to the radio.

Supervisor console with dismounted radio front panels.

Operator console.

System and accessories tailored to requirements

Power supply

For flexibility during a mission, the R&S®MMRS can be supplied with power in various ways. The requirements are 100 V to 240 V AC or 24 V DC.

Power generators, vehicular power supplies or electricity from public sources may be used. For each radio rackbox, a separate power source is needed. The intercom box power is supplied by one of the radio rackboxes.

Specially developed multicables

To allow the system to be put into operation quickly and easily, Rohde&Schwarz has developed special ruggedized multicables (length: 2 m or 10 m) that integrate all the necessary connections between the radio rackbox, the intercom box and the user terminals into one cable connection.

The core system can thus be set up in just three steps:

- Connect radio rackboxes to the intercom box
- Connect antennas to the radio rackboxes
- Connect the system to the power supply

Suitable antennas

Rohde&Schwarz provides matching antennas for all possible frequency ranges to fulfill customer-specific requirements. In addition to the antennas, suitable accessories are also available, e.g. antenna masts and bags.

Headsets

For the mission-proven use of the R&S®MMRS, Rohde&Schwarz provides a headset with active noise reduction (ANR), which enables reliable communications even under noisy environmental conditions.

Transport and operation

Remote operation

In many system solutions for such radio stations, vehicles are bound to the radio station. Since the R&S®MMRS in remote operation with an external power supply is not tied to any vehicle, the vehicle can be used for other purposes.

Operation in vehicles and buildings

Of course, the system can also be used inside vehicles or buildings in order to utilize the existing infrastructure.

Transportability

For transport by land, air or sea, the 19" boxes are easy to load and save space. The low weight of the radio rackbox (44 kg) and the intercom box (30 kg) makes it easy to manually transport the system over a short distance.

Outer dimensions	
Rackbox	351 mm × 534 mm × 710 mm (13.82 in × 21 in × 27.95 in)
Operator console	335 mm × 170 mm × 50 mm (78 mm with handle) (13.19 in × 6.7 in × 1.97 in) (3.07 in with handle)
Supervisor console	445 mm × 170 mm × 50 mm (78 mm with handle) (17.52 in × 6.7 in × 1.97 in) (3.07 in with handle)

Ruggedized to face harsh conditions

Today's deployment scenarios and their environmental conditions place high demands on personnel and material. The R&S®MMRS is designed for use in harsh conditions.

Product overview

Designation	Type
Radio rackbox [1)]	R&S®KG3050
Intercom box	R&S®KG3051
Supervisor console	R&S®KK3052
Operator console	R&S®KK3052
Rackbox multicable, type 1, length: 2 m	R&S®KG3050-Z1
Rackbox multicable, type 2, length: 10 m	R&S®KG3050-Z2

[1)] Lowpass filter and bandpass filter to be ordered separately according to customer requirements.

Chapter 2
Airborne radiocommunications

Rohde&Schwarz has been developing airborne transceivers for demanding radiocommunications applications since 1968. Many of these analog transceivers are still being deployed today by armed forces worldwide. After decades of use, they continue to provide reliable radiocommunications, proving the quality, reliability and robustness of Rohde&Schwarz products. The R&S®M3AR family has been deployed around the world since 2000 and has proven its value.

Type	Designation	Description	Page
R&S®M3AR	**Software defined radios**	VHF/UHF transceiver family for airborne communications	50
Product overview			63
R&S®XK516D	**Civil HF airborne voice/data radio**		65

R&S®M3AR Software Defined Radios

The software defined, multiband-capable airborne transceivers of the R&S®M3AR family feature a modular design and state-of-the-art technology. This leads to high MTBF values and a long life. The compact and lightweight transceivers offer high performance, making them suitable for operation in all types of aircraft, including unmanned aerial vehicles. Different waveforms are available, which can be installed at any time to provide interoperability in a variety of operational scenarios.
The challenge

The R&S®M3AR family is the product of decades of experience, especially in the design and development of airborne radio equipment and software defined radio technology. The R&S®M3AR multiband, multimode, multirole radio is the solution of choice for the reliable transmission of mission-critical information, whether for jet or propeller aircraft, helicopters or unmanned aerial vehicles.

Rohde&Schwarz satisfies the most demanding requirements of a multitude of airborne platforms. The R&S®M3AR transceivers are in operation around the world and feature high reliability even under extreme environmental conditions. The outstanding MTBF values ensure low maintenance effort and high availability.

A variety of optional EPM (ECCM) methods are available. For instance, the R&S®SECOS frequency hopping method with integrated encryption can be installed in parallel with HAVE QUICK I/II.

The R&S®M3AR family consists of the R&S®MR6000A in an ARINC 600 housing and the R&S®MR6000R/ R&S®MR6000L, both of which are ARC-164 form and fit compatible. The R&S®MR6000L is equipped with a local control panel while the R&S®MR6000R is remotely controlled. All R&S®M3AR radios can be remotely controlled via the MIL-STD-1553B data bus, as well as by the R&S®GB6500 control unit. The R&S®MR6000R or R&S®MR6000L can serve as a form, fit and function (F3) replacement for legacy AN/ARC-164 radios.

R&S®M3AR software defined radios

R&S®GB6500

R&S®MR6000R

R&S®MR6000L

R&S®MR6000A

Key facts

- Frequency range from 30 MHz to 400 MHz
- Compact and lightweight with high transmit power (up to 20 W in AM mode and up to 30 W in FM mode)
- EPM (ECCM): HAVE QUICK I/II, SATURN, R&S®SECOS
- Approved for jet and propeller aircraft as well as helicopters and unmanned aerial vehicles
- Embedded NATO or R&S®SECOS encryption
- Suitable for communications with military and civil air traffic control (e.g. 8.33 kHz channel spacing or offset carrier receive operation)
- Suitable for fixed-wing or rotary-wing aircraft operated by the air force, army and navy
- Flexible integration through different interfaces (MIL-STD-1553B data bus, RS-485) or front panel control
- Safety aspects in line with civil specifications (R&S®MR6000A)
- Very compact and lightweight (R&S®MR6000L/R)

Benefits and key features

Outstanding radio characteristics

- Excellent RF parameters
- Frequency bands from 30 MHz to 400 MHz
- Outstanding RF characteristics on a single platform with the R&S®MR6000A

Secure communications

- EPM (ECCM) methods for anti-jam communications
- Tap- and spoof-proof communications through integrated encryption
- Wideband interface for external encryption devices (e.g. ELCRODAT 4-2, KY58, KY100)

Flexible range of applications

- High power for secure communications even during very low level flights and higher altitude instrument flying
- Preset concept permits flexible participation in various networks through simple change of the preset

Low maintenance effort

- Powerful built-in tests (BIT) for error detection and diagnostics
- High reliability due to robust design and high-quality components

Future-ready investment

- Highly accelerated life testing (HALT)
- State-of-the-art technology ensures long product life

Outstanding radio characteristics

Excellent RF parameters

Despite its compact design, the R&S®M3AR radio family offers excellent RF characteristics, even under harsh environmental conditions. The R&S®M3AR transceivers are compatible with common military and civil communications standards.

The receiver features excellent sensitivity, high crossmodulation immunity, selectivity and suppression of strong interference signals. The transmitter is optimized for low spurious emissions and the suppression of wideband noise.

Rohde&Schwarz radios for the army, air force and navy.

Frequency bands from 30 MHz to 400 MHz

The aviation sector has special applications that must be supported by radiocommunications systems. Civil aviation requires the following frequency ranges:

- 108 MHz to 117.975 MHz, AM (receive only)
- 118 MHz to 136.975 MHz, AM, with additional 8.33 kHz channel spacing

In military aviation, the following frequency ranges are important:

- 30 MHz to 87.975 MHz, FM
- 225 MHz to 399.973 MHz, AM and FM

Civil maritime communications require the FM frequency range from 156 MHz to 173.975 MHz.

The range from 137 MHz to 155.975 MHz is used, for example, for a variety of mobile radio services in both AM and FM.

The R&S®M3AR family of transceivers covers all of these frequency ranges in AM and/or FM, depending on the application. Without multiband capability, a separate transceiver would be needed for each frequency band, which would create not only additional costs but also significantly more integration effort.

Outstanding RF characteristics on a single platform with the R&S®MR6000A

If several transceivers are used simultaneously in an aircraft (co-site operation), there is a risk of mutual interference. For example, this is true especially on large airborne platforms used for air surveillance. More than 20 radio systems can be installed on such a platform. Jets or helicopters featuring a relatively small fuselage also need to be equipped with a large number of antennas. Antennas are not only required for VHF/UHF and HF radios, but also for air navigation and sensors. Transceiver emissions, for example, must not disturb localizer and glideslope reception during an instrument landing approach.

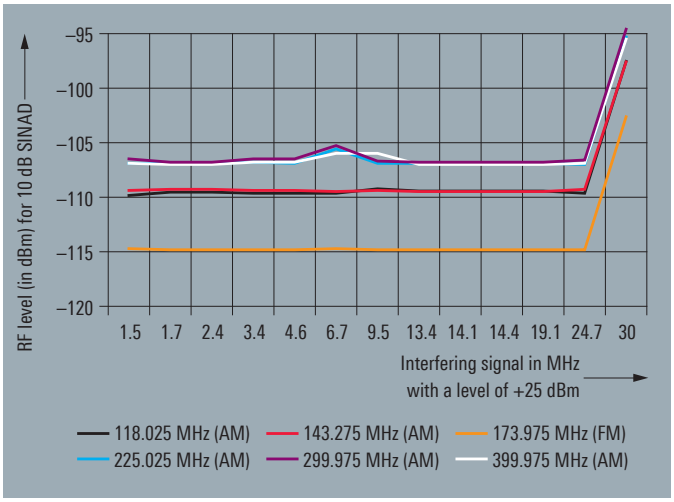
The RF parameters of airborne transceivers must meet extremely demanding requirements to ensure reliable transmission and reception. Besides high sensitivity and selectivity, the receiver's large-signal immunity is also crucial. This applies especially under challenging conditions such as parallel radio operation on the same platform or in the vicinity of powerful broadcast transmitters. The interfering signals that occur in such a scenario should have a relatively low influence on the effective usable sensitivity.

Some important radio characteristics will now be described in detail:

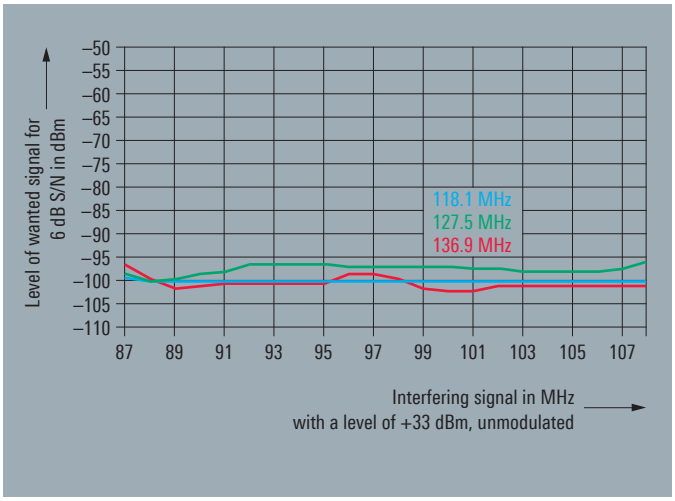
Robust protection against strong external signals

At low altitudes, airborne transceivers are commonly exposed via their antennas to high field strengths produced by broadcast transmitters or radar equipment. The radios must not be damaged even in the presence of an interference level amounting to a few watts at the antenna. Moreover, they must still provide adequate sensitivity under the influence of interfering signals exhibiting a few hundred milliwatts of power at the receiver input. Of course, immunity to high frequency (HF) and VHF FM audio broadcasting is also very important.

Immunity to interference: Even with an interference level of 25 dBm in the HF range (1.5 MHz to 24 MHz), the sensitivity of the R&S®MR6000A transceiver in the VHF/UHF frequency range is barely affected.



FM immunity: With its integrated FM immunity filter, the R&S®MR6000A ensures effective usable sensitivity in line with the EUROCAE ED-23C civil standard even in the presence of very strong VHF FM audio broadcast transmitter signals (2 W) and enables a range of approx. 370 km (approx. 200 NM).



The R&S®MR6000A transceiver has demonstrated its immunity to all of these interference types. The immunity to interference figure shows the effective usable sensitivity of the transceiver under the influence of an HF interfering signal with a level of +25 dBm during reception in the VHF/UHF range from 118 MHz to 399.975 MHz. Thanks to the integrated highpass filter that suppresses HF interfering signals, a sensitivity of about 1 µV (–107 dBm) is achieved.

The FM immunity figure illustrates the effect of the FM immunity filter used in the R&S®MR6000A to suppress radiated signals from VHF FM audio broadcast transmitters. Even with an interference level of 2 W (+33 dBm), the 5 µV (–93 dBm) receiver sensitivity specified in the ICAO and EUROCAE standards is still met with a large margin. The sensitivity is an important factor that affects the audio quality and achievable range.

In practice, however, high sensitivity is available without limitations only if the radio exhibits both appropriate large-signal suppression capability and selectivity. In addition to the above-mentioned integrated filters that protect against HF and VHF FM signals, the R&S®MR6000A also has built-in frequency-agile co-site filters that are capable of effectively suppressing interfering signals in the same frequency band

Crossmodulation immunity against strong AM interfering signals

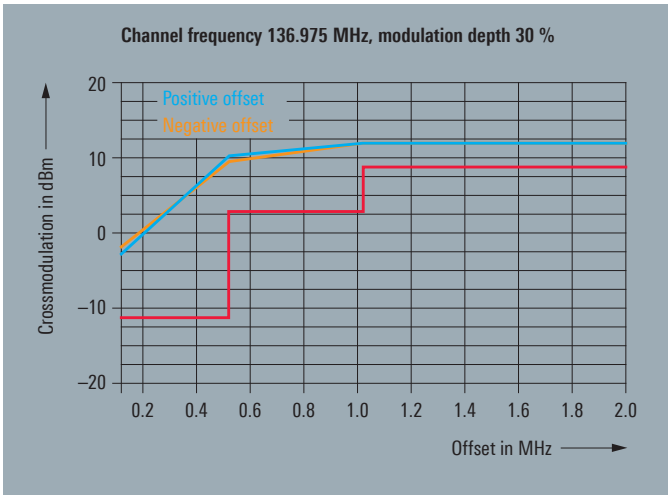
Crossmodulation occurs whenever a strong interfering signal with amplitude modulation (AM) overdrives the receiver's input amplifiers or first mixer. Problematic crosstalk effects of this type are largely independent of the strength of the wanted signal. Such effects also occur when the aircraft is close to the called ATC station. The R&S®MR6000A easily manages such challenges since it was developed based on the ARINC 716 US standard which specifies high crossmodulation immunity for VHF airborne transceivers. Accordingly, the transceiver tolerates interfering signals at a level of +10 dBm, for example, with an offset of 500 kHz from the receive frequency, exceeding the standard´s requirements by far (crossmodulation immunity figure).

High transmit power under real-world conditions

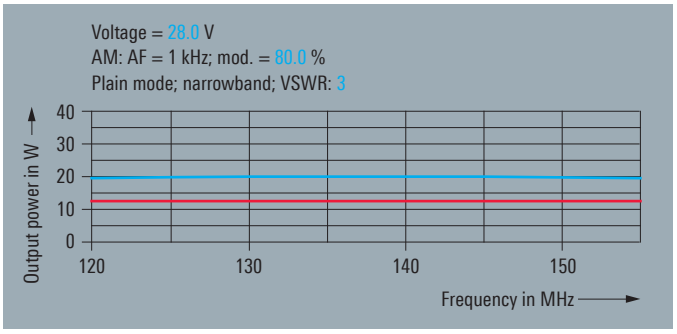
Antennas usually exhibit some degree of mismatch to the 50 Ω impedance used in aircraft installations. This depends on the antenna bandwidth, for example. As a result, the voltage standing wave ratio (VSWR) of aircraft antennas is typically in the range from 1.5 to 2.5, which means that the airborne transceiver's output stage is terminated by an unmatched load impedance. Depending on the phase angle (cable length), the transmitter's efficiency will be degraded, the current drain will increase and the output power will decrease.

The R&S®MR6000A has a specified transmit power of 20 W AM (carrier) and 30 W FM. The power output stage has a large margin and was designed to be highly insensitive to the load impedance. The transmit power figure below shows the results of a measurement in the VHF range. It can be seen that the radio outputs approx. 20 W RF power over the entire frequency range even with a VSWR of 3.

Crossmodulation immunity: The red curve shows the requirements specified in the VHF ARINC 716 standard while the two other curves represent the behavior of the R&S®MR6000A transceiver.



Transmit power: Even at a VSWR of 3, the transmit power of the R&S®MR6000A remains at approx. 20 W (blue line), which is well over the specified limit (red).



Secure communications

EPM (ECCM) methods for anti-jam communications

Electronic protective measures (EPM) protect radio links from electronic countermeasures (ECM) such as jamming. Frequency hopping is an EPM (ECCM) method that is available as an option in all R&S®M3AR radios. The NATO frequency hopping method HAVE QUICK I/II and the state-of-the-art SATURN method are integrated in the R&S®M3AR family in line with STANAG 4246 and STANAG 4372. These methods ensure a jam-free radio link.

Rohde&Schwarz also developed the R&S®SECOS frequency hopping method, which provides reliable protection against active jamming even at high air speeds. It can also encrypt voice and data transmissions up to 16 kbit/s. R&S®SECOS has been tried and tested around the world for many years. This method can be integrated in Rohde&Schwarz transceivers in parallel with HAVE QUICK I/II, providing the flexibility to participate in national and international missions. When using the R&S®SECOS or SATURN frequency hopping method, voice communications are compressed by means of a CVSD vocoder and then transmitted digitally.

Tap- and spoof-proof communications through integrated encryption

To protect radio links from tapping and spoofing, the information being transmitted can be encrypted. With the R&S®MR6000A from the R&S®M3AR family, Rohde&Schwarz was the first manufacturer to offer embedded NATO encryption. This eliminates the need for an additional external encryption device. The R&S®MR6000A therefore saves space, reduces weight and is easy to install in the aircraft. The R&S®MR6000A is interoperable with external crypto devices such as the KY57, KY58, KY99, KY100 and ELCRODAT 4-2.

The powerful R&S®SECOS encryption method developed by Rohde&Schwarz is available for all transceivers in the R&S®M3AR family. When using the R&S®SECOS method, the encryption keys can be encrypted and transmitted over nonsecure lines (black key loading). For NATO encryption keys, the R&S®MR6000A with integrated crypto module uses the DS-101 interface for black key loading.

Wideband interface for external encryption devices (e.g. ELCRODAT 4-2, KY58, KY100)

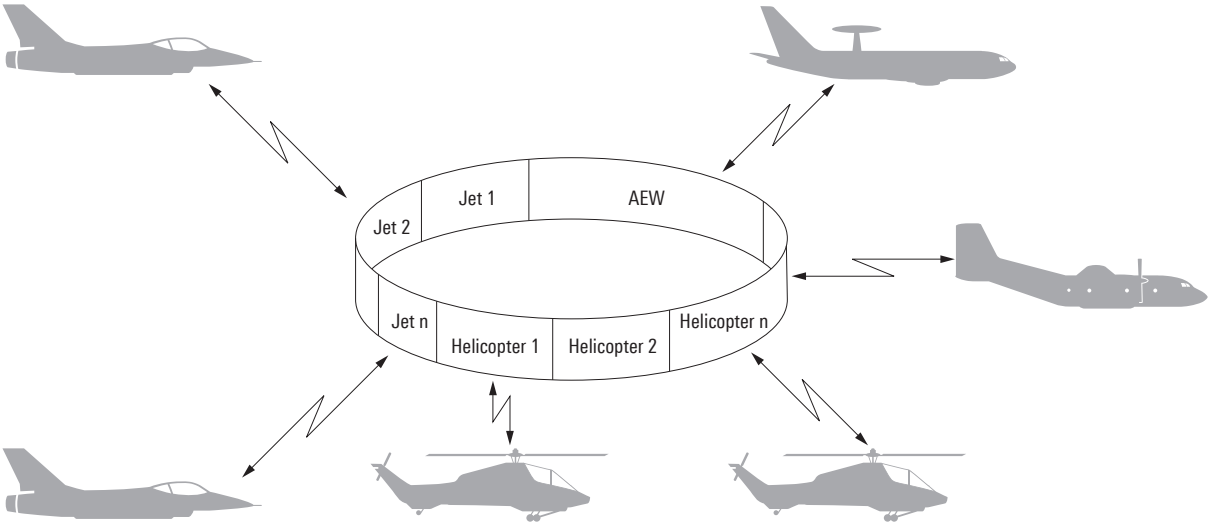
All R&S®M3AR radios conform to STANAG 4204 and STANAG 4205 and can be connected to external encryption devices. This permits the use of state-of-the-art frequency hopping methods with legacy encryption devices, so that systems such as the KY58, which is widely used by NATO, can be combined with HAVE QUICK I/II for instance. Besides world-class airborne transceivers, Rohde&Schwarz also offers encryption devices that are certified for the highest German and NATO classification levels. The ELCRODAT 4-2 and the R&S®MMC3000 are external encryption devices that can be used with all R&S®M3AR radios for establishing secure radio links.

Flexible range of applications

High power for secure communications even during very low level flights and higher altitude instrument flying

Especially with helicopters, high transmit power is important because of the need for effective communications between two-aircraft formations and flights during tactical flying missions near the ground.

Reliable and secure communications in TDMA data mode using R&S®SECOS



When flying under instrument flight rules, long distances occur between the aircraft and the air traffic control stations. In this case, the receiver must be able to detect and process even weak radio signals and output them with good audio quality.

Although lightweight and compact, R&S®M3AR transceivers deliver outstanding transmit power of up to 20 W in AM mode and up to 30 W in FM mode. This ensures quality communications links for aircraft operating near the ground, as well as between transmitters and receivers that are located far apart. During formation flying and for on-ground radio checks however, the transmit power can be stepped down in order to reduce self-generated electromagnetic radiation and as a result minimize susceptibility to reconnaissance.

Preset concept permits flexible participation in various networks through simple change of the preset

Presets are used to save the operational parameters (e.g. frequencies and encryption keys) that are required to participate in an encrypted network such as R&S®SECOS. Prior to a mission, the required presets can be set up using the R&S®RNMS3000 network management software. This PC-based, centralized planning and preparation of operational parameters ensures consistent presets among individual radio network participants and well-organized frequency management.

The operational parameters are loaded via a fill interface. The desired preset is selected via the MIL-STD-1553B data bus, for example.

The R&S®M3AR radios contain two separate memory areas, each of which can hold 100 presets, so that a sufficient number of presets is available even for longer missions.

Due to the preset concept, simply changing the preset number provides error-free switching between radio networks during flight, even in critical situations.

Depending on how the transceiver is integrated in the aircraft (e.g. operation through a central unit via the MIL-STD-1553B data bus), the presets can be identified by intuitive, recognizable names such as “EDDM TWR” or “Squad A” that are shown on the display of the radio and remote control unit.

Suitable for fixed-wing or rotary-wing aircraft operated by the air force, army and navy

Military aircraft place a variety of demands on the radio with respect to environmental impacts such as g-force, vibration and temperature range. Furthermore, army, air force and navy airborne platforms must sometimes support special applications in the various frequency ranges. The R&S®M3AR offers a wide bandwidth to support a variety of applications.

R&S®MR6000L – intuitive, simple operation

For the navy for example, a LINK 11 interface in line with STANAG 5511 was integrated in the R&S®MR6000A, as well as sonobuoy functionality and a guard receiver for monitoring channel 70 of the Global Maritime Distress Safety System (GMDSS), so that digital selective call (DSC) signals can be received.

The tactical VHF range, including a 40.5 MHz guard receiver, was integrated in the entire R&S®M3AR product family for communications with ground troops. The high transmit power of up to 30 W in FM mode and the excellent receiver characteristics ensure reliable communications links even during very low level flights.

Flexible integration through different interfaces (MIL-STD-1553B data bus, RS-485) or front panel control

The R&S®M3AR radio family can be flexibly integrated in an aircraft. The R&S®MR6000L with local control panel is easily installed directly in the cockpit.

Alternatively, the R&S®MR6000L offers remote control capability via the MIL-STD-1553B data bus, through the R&S®GB6500 control unit or using an RS-485 serial interface in conjunction with the applicable Rohde&Schwarz protocol.

The R&S®MR6000A and R&S®MR6000R series are designed for installation in the avionic bay. They can be remotely controlled via the MIL-STD-1553B data bus or by using the R&S®GB6500 control unit via the RS-485 interface. A maximum of three R&S®GB6500 units can control up to five R&S®M3AR transceivers over a system bus. This provides the flexibility to implement a variety of operational concepts that are optimized for the aircraft, which improves crew resource management (CRM).

The R&S®MR6000L and R&S®GB6500 displays are suitable for conventional night flights as well as flying with night vision goggles (NVG).

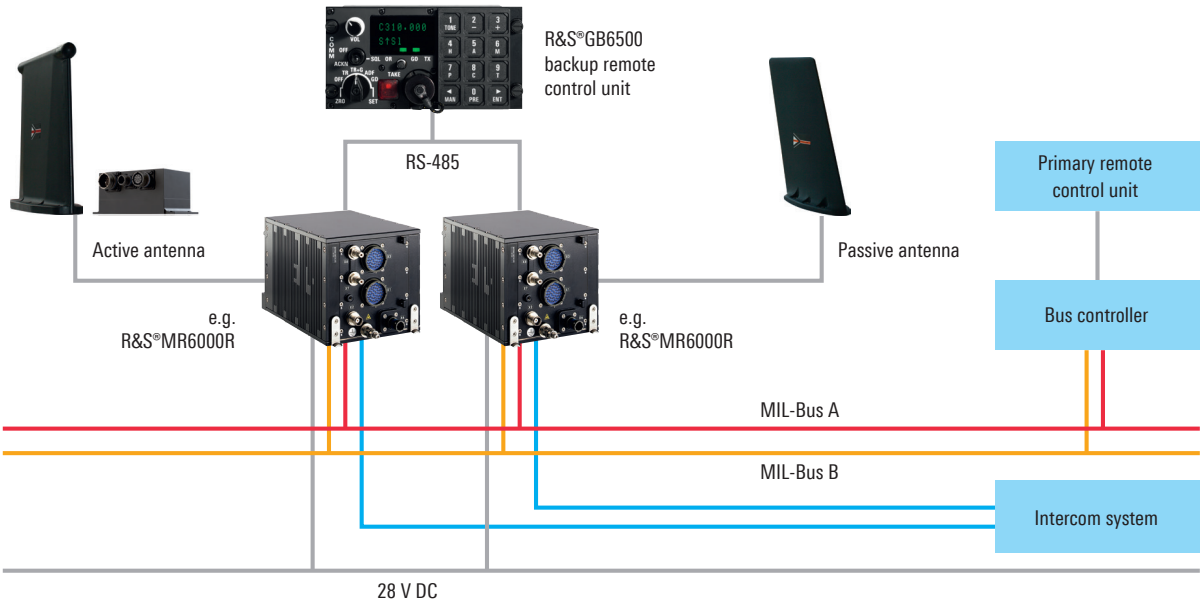
Safety aspects in line with civil specifications (R&S®MR6000A)

Approval by civil aviation safety authorities requires the use of development processes in line with the civil avionics standards for software (RTCA/DO-178B, level C) and for hardware (RTCA/DO-254, design assurance level C). This is a great challenge, especially for airborne transceivers where waveforms and a large number of functions are mapped by software. As part of these processes, the specific requirements to be met by the software and hardware components are derived, starting from the equipment level, and then validated and verified. All process steps are subject to permanent quality control in line with DO-178B/DO-254. This procedure minimizes the risk of malfunctions described in the specifications for level C failure classification and ensures top functional safety.

Besides the civil standards for software (RTCA/DO-178B) and hardware (RTCA/DO-254), immunity to cosmic radiation is equally important:

High-energy ionizing neutrons can cause disruptions in electronic components that lead to software errors, thereby potentially endangering the operation of a transceiver. Cosmic radiation increases with altitude and reach-

Flexible alternatives for operating the radios



es its maximum at an altitude of approx. 18000 m. The R&S®MR6000A is highly immune to such radiation, making it a good choice for safe, reliable operation in transport aircraft and jets.

Very compact and lightweight (R&S®MR6000L/R)
Airborne platforms have very limited weight and space resources. Especially when retrofitting, new equipment usually must not be larger and heavier than the equipment it replaces. The purpose of retrofits is to meet civil specifications (e.g. 8.33 kHz channel spacing) or tactical military requirements (e.g. encrypted communications). The R&S®MR6000L/R airborne transceivers come in the very compact ARC-164 housing and offer integrated frequency hopping methods (e.g. with SATURN) and encryption for secure tactical radiocommunications (e.g. with R&S®SECOS) in addition to 8.33 kHz channel spacing. The radios of the R&S®MR6000L/R series offer excellent performance although they are lightweight (less than 4 kg) and require little space.

Automatic and reliable testing of airborne transceivers with the R&S®UCS226XB test system.

Low maintenance effort

Powerful built-in tests (BIT) for error detection and diagnostics
The three types of built-in tests (PBIT, CBIT and IBIT) aid the user in checking the functionality of the device and determining if, and where appropriate, what type of errors exist. BIT results can be viewed on the display or polled via the MIL-STD-1553B data bus.

The power-on BIT (PBIT) is a short self-test that is executed each time the device is powered on.

The continuous BIT (CBIT) checks the functionality and performance of the radio during operation. This test continuously polls the status messages of the individual modules.

The initiated BIT (IBIT) is activated by the user and runs a complete transmit and receive test loop. Because this test interrupts operation of the radio, it is usually carried out only during maintenance activities.

Two types of status messages are provided to guide the user as to what action to take. If a warning is generated, the radio can still be operated, but should be checked as soon as possible. Error messages indicate that the radio can no longer be operated and must be serviced.

If one of the built-in tests identifies a defective module, the device should be sent to an authorized service center for maintenance or repair. As a final step, the device is tested in accordance with the applicable specifications to make sure it functions properly. The R&S®UCS226XB is a system for carrying out corrective maintenance and automatic test runs (I-level support and test equipment). It therefore provides a fast and cost-effective way to keep the R&S®M3AR family of transceivers up and running. Because Rohde&Schwarz can incorporate its worldwide leading know-how from the field of test and measurement into the area of airborne transceivers, customers have a first-class solution from a single source.

High reliability due to robust design and high-quality components
The R&S®M3AR family of transceivers features a robust design and high-quality components. The result is high MTBF. The R&S®M3AR transceivers are tested in accordance with various military and civil standards such as MIL-STD-461, MIL-STD-810 and RTCA/DO-160. For instance, Rohde&Schwarz airborne transceivers can be operated in temperatures ranging from –40 °C to +71 °C. To prevent damage, the devices automatically continue to operate at reduced power if overheating occurs. When the temperature normalizes, the device automatically returns to the original power level without manual intervention.

The military aviation sector demands a high level of device reliability, particularly in extreme environmental conditions. Whether they are exposed to high g-forces in jet aircraft or to heavy vibrations in helicopters and transport aircraft, R&S®M3AR transceivers were designed for such operating environments. This is a key reason why the R&S®M3AR is deployed by air force, army and navy airborne units around the world.

Future-ready investment

Highly accelerated life testing (HALT)

This procedure involves gradually increasing mechanical and thermal stressing of the device under test (i.e. R&S®M3AR transceiver). The stress applied will exceed the ambient conditions normally to be expected during the life of the device under test. As a consequence, weaknesses in the electrical and mechanical design are detected, which would otherwise only result in failures attributable to wear after a long period of operation. HALT will identify weaknesses in the design in an accelerated manner, which allows redesign to improve reliability where shown to be economically feasible.

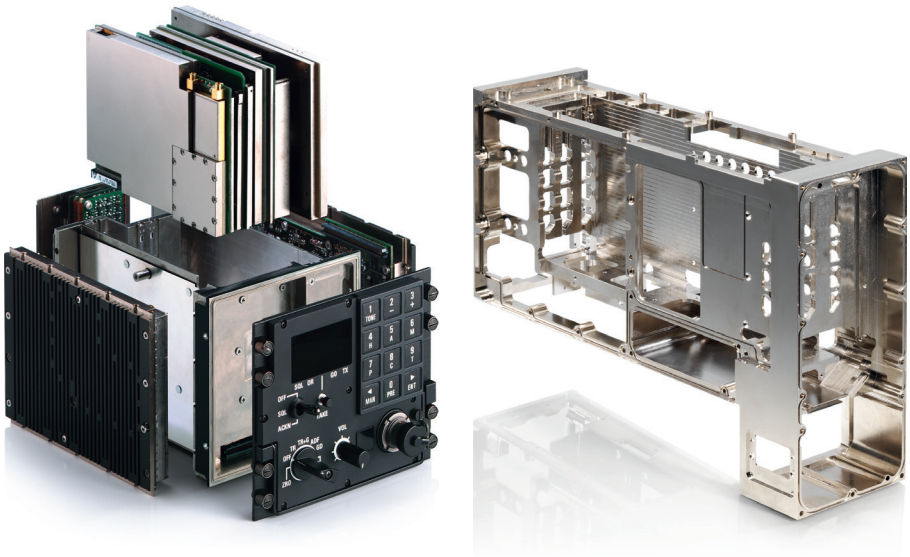
HALT did not identify any improvements that should be made to the transceiver. The test system reached its limits and did not damage the transceiver. Temperature limits were +120 °C/–100 °C and vibration limits 50 g RMS.

State-of-the-art technology ensures long product life

The R&S®M3AR family of transceivers features a modular design and is manufactured with SMD technology. The high quality and workmanship of the components that are used ensure a high MTBF and in general a long product life cycle. This minimizes the impact of discontinued components, reduces stockkeeping and streamlines logistics.

The multiband, multimode and multirole capabilities of the R&S®M3AR provide the flexibility to deploy the device in various frequency ranges with different waveforms, as well as in a multitude of scenarios and missions. Instead of multiple radios to support different applications, only one device is required. Logistics and training effort is significantly reduced as a result.

Modular design and high-grade components ensure outstanding quality and long product life.



Series of the R&S®M3AR family

The R&S®MR6000A, which comes in a standard housing in line with ARINC 600, is the most powerful radio in the R&S®M3AR family.

The R&S®MR6000R, one of the world's most compact and lightweight airborne transceivers, is designed for installation in the avionic bay and can be remotely controlled.

The R&S®MR6000L, extremely powerful despite its compact dimensions, can be installed in the cockpit as a replacement for legacy AN/ARC-164 radios with local control panel, for example.

The R&S®MR6000E is an L-shape radio developed especially for the Eurofighter Typhoon. It is remotely controlled and has an optical interface.

The Airbus A400M is equipped with the R&S®MR6000A transceiver.

R&S®MR6000A.

R&S®MR6000A ARINC 600 housing

The R&S®MR6000A, the most powerful radio in the R&S®M3AR family, features RF power of up to 20 W in AM mode or 30 W in FM mode. It is a radio with an integrated crypto module and embedded NATO encryption algorithms. The elimination of the external encryption device and cabling saves valuable space and weight in the aircraft.

The integrated pre/postselector minimizes susceptibility to interference and improves co-site behavior. This is particularly important since there is limited space for antennas on aircraft fuselages. In addition, the antennas are usually very difficult to decouple. The solution integrated in the R&S®MR6000A saves the cost of additional approvals and integration of external filters.

The radio software was developed in line with RTCA/DO-178B, level C, and the radio hardware in line with RTCA/DO-254, DAL C. This made it possible to certify that the aircraft in which the radio is integrated meets civil aviation requirements. The certification was carried out by the European Aviation Safety Agency (EASA).

In addition, the R&S®MR6000A is marked by numerous integrated features designed to support a multitude of applications:

- Choice of frequency hopping methods: HAVE QUICK I/II, SATURN or HAVE QUICK I/II and R&S®SECOS in a single device
- In addition to the mandatory functions defined in STANAG 4372 (SATURN), the following are also available: ATEC, PTEC, TOD beacon (TX, RX), system messages, data modes, hailing, relay (clear and cipher voice and data), transmitter break-in, time delay compensation, split synchronization, data message, etc.
- Embedded NATO or R&S®SECOS encryption
- LINK 11 interface in line with STANAG 5511 and MIL-STD-188-203-1A
- Additional guard receiver for the 40.5 MHz, 121.5 MHz, 243.0 MHz distress frequencies; dedicated guard receiver for the digital 156.525 MHz or analog 156.8 MHz distress frequency (depending on radio configuration)
- Integrated pre/postselector
- Tactical VHF frequency range for communications with ground troops (i.e. expanded frequency range from 30 MHz to 399.975 MHz)
- Sonobuoy command
- Direction finding and homing support for locating transmitters in the VHF and UHF ranges
- Option of loading encrypted NATO encryption keys via the DS-101 interface (black key loading)
- Option of loading encrypted R&S®SECOS encryption keys (black key loading)

- Immunity to VHF broadcast transmitter interference in line with ICAO and ED-23B
- Low noise figure for excellent receiver sensitivity in AM and FM mode
- High transmit power of at least 20 W (AM) and 30 W (FM)
- High dynamic range and crossmodulation immunity in line with ARINC 716
- Ideal selectivity and spurious response immunity
- Remote control via MIL-STD-1553B data bus, RS-485 interface and applicable Rohde&Schwarz protocol (used by the R&S®GB6500 for example) or a combination of both
- Development processes in line with RTCA/DO-178B, level C, for software and RTCA/DO-254, DAL C, for hardware

R&S®MR6000R and R&S®MR6000L ARC-164 housing

These two radios, which come in ARC-164 housings, differ in that the R&S®MR6000R is designed for installation in the avionic bay and is remotely controlled, while the R&S®MR6000L is installed in the cockpit and is controlled via a local control panel. Despite weighing less than 4 kg, the R&S®MR6000R and R&S®MR6000L series offer outstanding reception and transmission performance.

The R&S®MR6000L display comes with a choice of white, red or NVG-compatible illumination.

The R&S®MR6000R/L series have the following features:

- Choice of frequency hopping methods: HAVE QUICK I/II, SATURN or HAVE QUICK I/II and R&S®SECOS in a single device
- Embedded R&S®SECOS encryption
- Additional guard receiver for the 40.5 MHz, 121.5 MHz and 243.0 MHz distress frequencies
- Tactical VHF frequency range for communications with ground troops (i.e. expanded frequency range from 30 MHz to 399.975 MHz)
- Direction finding and homing support for locating transmitters in the VHF and UHF ranges
- Option of loading encrypted R&S®SECOS encryption keys (black key loading)
- Immunity to VHF broadcast transmitter interference
- High transmit power of at least 10 W (AM) and at least 15 W (FM)
- Remote control via MIL-STD-1553B data bus, RS-485 interface and applicable Rohde&Schwarz protocol (used by the R&S®GB6500 for example) or a combination of both

R&S®MR6000E L-shape radio

The Eurofighter Typhoon, the result of multinational cooperation at the European level, will take on the future tasks of the air force. It goes without saying that in the area of secure radiocommunications, know-how from Rohde&Schwarz will be deployed.

The R&S®MR6000E, developed especially for this aircraft, establishes the encrypted air-to-air voice radio link and is also used for voice communications with air traffic control. It supports the SATURN and HAVE QUICK I/II

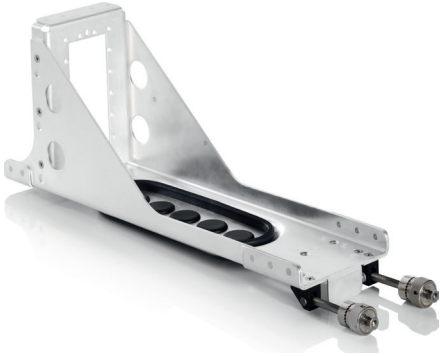
Developed for the Eurofighter Typhoon in cooperation with INDRA (Spain) and SELEX Communications (Italy): the R&S®MR6000E.

R&S®MR6000R (left) and R&S®MR6000L (right).

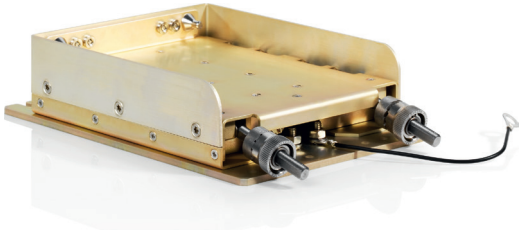
frequency hopping methods in line with STANAG 4372 and STANAG 4246. SATURN uses a 16 kbit/s voice encoder for high-quality voice communications. The R&S®MR6000E has a distinctive L-form and, in addition to a MIL-STD-1553B data bus, also features an optical interface in line with STANAG 3910 for the Eurofighter Typhoon.

R&S®GB6500.

R&S®KR6000A mounting tray for the R&S®MR6000A.



R&S®KR6010 mounting tray for the R&S®MR6000R.



R&S®KR6010 cooling tray for the R&S®MR6000R.

Accessories

R&S®GB6500 remote control unit

The R&S®GB6500 can operate all series of the R&S®M3AR family and connects to the radio via the RS-485 interface. In a typical installation, e.g. for a tandem cockpit, two radios are operated by two R&S®GB6500 remote control units. The radios can also be controlled via the MIL-STD-1553B data bus. The R&S®GB6500 can serve as a backup in this case and can therefore be connected in addition to the MIL-STD-1553B data bus.

The remote control unit is suitable for installation in cockpits in line with MS 25212. Like the R&S®M3AR transceivers, the R&S®GB6500 remote control unit was qualified in line with military environmental and EMC standards such as MIL-STD-461 and is therefore suitable for use in aircraft.

The R&S®GB6500 display is suitable for conventional night flights as well as flying with night vision goggles (NVG).

The R&S®GB6500 user interface is identical to that of the R&S®MR6000L, which simplifies crew training.

Mounting trays and mating connector sets

The mounting trays for the R&S®MR6000A and R&S®MR6000R series optimize the mechanical integration of the radios in the aircraft and make it easy to install and remove the radios. There are two versions of the R&S®KR6010 for the R&S®MR6000R: mounting tray (standard) and cooling tray. The cooling tray improves the heat dissipation of the radio, which is important at higher operating temperatures and longer transmit cycles.

Since the R&S®MR6000L is installed directly in the cockpit, a mounting tray is not required.

To connect the radios to the cable harness in the aircraft, Rohde&Schwarz offers the appropriate mating connector set for each series of the R&S®M3AR family.

Service and maintenance tools

R&S®BA6000 base station adapter

The base station adapter comes in two versions: the R&S®BA6000L for the R&S®MR6000L radio with local control panel, and the R&S®BA6000R for the remotely controlled R&S®MR6000R radio. The base station adapter is used for demonstration and training purposes, as well as for test and verification applications in the lab. It features the following interfaces:

- Low-temperature connector for 100 V to 240 V AC power supply
- Connector for 28 V DC power supply
- Two MIL-STD-1553B data bus connectors
- One RS-232 interface
- One 37-pin X1 and one 37-pin X3 interface
- Antenna connector
- NF 7 connector for a microphone or headset on the front side of the adapter
- Integrated loudspeaker

The base station adapter also has a fan for cooling the radio.

R&S®BA6000 base station adapter.

Rear panels of the R&S®ZK6000 maintenance connection boxes.

Identical front panel of the R&S®ZK6000 maintenance connection boxes.

R&S®ZK6000 maintenance connection box

The R&S®ZK6000 maintenance connection box enables operation of the R&S®M3AR transceivers outside the aircraft for performing tests and maintenance. The maintenance connection box provides access to the radio functions via standard interfaces. This allows easy and flexible configuration of the radio without requiring special mating connectors and additional cabling. Basic functions such as switching the radio on/off, assigning radio addresses as well as PTT/tone transmit are already integrated in the R&S®ZK6000. The maintenance connection box is available in two versions: the R&S®ZK6000A with connectors for the R&S®MR6000A, and the R&S®ZK6000L/R for the R&S®MR6000L and R&S®MR6000R series.

R&S®CP6000 radio commander

The R&S®CP6000 radio commander is PC software that serves as a tool for integrating airborne transceivers into aircraft. This program can be used to control the radio via the MIL-STD-1553B data bus or the RS-485 interface. For control via the MIL-STD-1553B data bus interface, a suitable PCMCIA card is necessary. Rohde&Schwarz can recommend a specific model upon request.

R&S®ZS6001 PC maintenance tool software

The R&S®ZS6001 PC maintenance tool software allows the synthesizer to be calibrated during maintenance. The calibration interval depends on different factors and is described in the transceiver operating manual. In addition, the IBIT can be activated and the result displayed. The software communicates with the radio via an RS-232 interface that can be accessed using the R&S®ZK6000, for example.

Product overview

R&S®MR6000A (examples of available equipment)

ARINC 600 housing – remote control

Designation	Type
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; fixed frequency; interfaces: RS-485, MIL-STD-1553B trafo coupling; audio output: 150 Ω or 600 Ω	R&S®XM6023
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; audio output: 150 Ω or 600 Ω	R&S®XM6123
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): R&S®SECOS 5/16 voice and data, HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; audio output: 150 Ω or 600 Ω	R&S®XM6423D
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): R&S®SECOS 5/16 voice and data; interfaces: RS-485, MIL-STD-1553B trafo coupling; audio output: 150 Ω or 600 Ω	R&S®XM6523D
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): SATURN, HAVE QUICK I/II; COMSEC: embedded NATO; interfaces: RS-485, MIL-STD-1553B trafo coupling; audio output: 150 Ω or 600 Ω	R&S®XM6923L

R&S®MR6000L (examples of available equipment)

ARC-164 housing – local control

Designation	Type
Frequency bands: 30 MHz to 88 MHz , 108 MHz to 174 MHz, 225 MHz to 400 MHz; fixed frequency; interfaces: RS-485, MIL-STD-1553B trafo coupling; illumination: NVG (green A); display: green; audio output: 150 Ω or 600 Ω	R&S®XM6012
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; illumination: NVG (green A); display: green; audio output: 150 Ω or 600 Ω	R&S®XM6112
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): R&S®SECOS 5/16 voice and data, HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; illumination: NVG (green A); display: green; audio output: 150 Ω or 600 Ω	R&S®XM6412D
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): R&S®SECOS 5/16 voice and data; interfaces: RS-485, MIL-STD-1553B trafo coupling; illumination: NVG (green A); display: green; audio output: 150 Ω or 600 Ω	R&S®XM6512D
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): SATURN, HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; illumination: NVG (green A); display: green; audio output: 150 Ω or 600 Ω	R&S®XM6912

The following control panel illumination is available for the R&S®MR6000L:

- NVG (green A); display: green
- White; display: red
- Red; display: red

R&S®MR6000R (examples of available equipment)

ARC-164 housing – remote control

Designation	Type
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; fixed frequency; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output:150 Ω or 600 Ω	R&S®XM6013
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 150 Ω or 600 Ω	R&S®XM6113
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): R&S®SECOS 5/16 voice and data, HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 150 Ω or 600 Ω	R&S®XM6413D
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): R&S®SECOS 5/16 voice and data; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 150 Ω or 600 Ω	R&S®XM6513D
Frequency bands: 30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; EPM (ECCM): SATURN, HAVE QUICK I/II; interfaces: RS-485, MIL-STD-1553B trafo coupling; fill interface; audio output: 150 Ω or 600 Ω	R&S®XM6913

Accessories

Designation	Type
Mating connector for R&S®MR6000R	R&S®ZR6000
Mating connector set for R&S®MR6000A	R&S®ZR6000A
Mating connector set for R&S®GB6500	R&S®ZR6500
Remote control units (R&S®M3AR)	
Remote control unit; control interface: RS-485; illumination: white; display: yellow	R&S®GB6500
Remote control unit; control interface: RS-485; illumination: white; display: red	
Remote control unit; control interface: RS-485; illumination: NVG (green A); display: green	
Remote control unit; control interface: RS-485; illumination: red, display: red	
Remote control unit; control interface: RS-485; illumination: NVG (green B); display: green	
Trays (R&S®M3AR)	
Mounting tray for R&S®MR6000A	R&S®KR6000A
Mounting tray for R&S®MR6000R	R&S®KR6010
Cooling tray for R&S®MR6000R	R&S®KR6010
Service and maintenance tools (R&S®M3AR)	
Base station adapter for R&S®MR6000L (local control)	R&S®BA6000L
Base station adapter for R&S®MR6000R (remote control)	R&S®BA6000R
Maintenance connection box for R&S®MR6000A	R&S®ZK6000A
Maintenance connection box for R&S®MR6000L/R	R&S®ZK6000L/R
Radio commander	R&S®CP6000
PC maintenance tool software	R&S®ZS6001
Radio network management system (R&S®RNMS)	
Mission planner	R&S®DS3100M
Remote device loader	R&S®DS3300D
Remote distributor	R&S®DS3321D
Test system for radio equipment of the R&S®M3xR family	
Base system; mobile rack version; complete set of radio test equipment including system racks and base software suite	R&S®UCS226XB
R&S®M3AR BASE; system interface base; radio adaptation box and cabling set; including specific radio test software package	R&S®UCS-B31

The radio systems described are hardware- and software-configurable. The system delivered has the configuration as confirmed in the order.

R&S®XK516D Civil HF Airborne Voice/Data Radio

HF transceiver for airborne communications

The R&S®XK516 airborne voice/data radio is designed for use in commercial aircraft. The system provides conventional voice air-to-ground, ground-to-air, and air-to-air data communications over long distances. It is suitable for aircraft operational communications (AOC), airline administrative communications (AAC) as well as air traffic communications (ATC).

The data communications modules are fully integrated in the transceiver. The voice/data radio therefore fits into the space of the conventional HF voice radio. Additional space for the data communications capability is not needed. The functioning of the equipment is controlled by the integrated test system that continuously monitors a number of functions. After the test routine has been triggered, the faulty module will be located and indicated. BITE results are reported to the onboard CFDS/CMC system via two ARINC 429 busses.

Interfaces to the central maintenance systems of Airbus and Boeing are implemented in the radio, which results in one order number for nearly all aircraft types. The R&S®XK516D HF airborne voice/data radio is designed to meet the requirements of the following standards:

- ARINC 719 (voice function)
- ARINC 753 and 635 (data function)

The integrated data communications capability meets the specifications of ARINC 753 and 635 and provides data communications at a data rate of 1800 bit/s.

Global HF data

Communications are possible by using strategically located data link ground stations, which provide access to ARINC and SITA airline networks as well as to Honeywell's global data center. For full compatibility between existing and new equipment as well as aircraft wiring, three interfaces between transceiver and antenna coupler are simultaneously available:

- Multiwire serial interface in line with ARINC 753
- Conventional ARINC 719 control lines
- Single-wire coaxial interface

This ensures the interchangeability of the LRUs with existing voice transceivers and couplers. The single-wire coaxial interface needs only the coaxial cable to transfer control and BITE information between transceiver and coupler. Therefore, it has a high potential for reducing weight. The retrofitting of older aircraft is simple because it does not depend on the existing aircraft wiring.

The R&S®XK516D is a joint development of Rohde&Schwarz and Honeywell Aerospace Electronic Systems.

Chapter 3
Stationary and shipborne radiocommunications

The Radiocommunications Systems Division of Rohde&Schwarz is one of the leading global suppliers of professional radio equipment and systems for use in fixed and mobile ground stations, on board ships and in aircraft. Embassies, government authorities and armed forces around the world use these radiocommunications solutions. Turnkey communications are our business. From ground-to-air VHF and UHF equipment for clear ATC communications en route, during approach, landing and take-off to shortwave radio for intercontinental routes.

The HF/VHF/UHF communications systems from Rohde&Schwarz represent a revolutionary change, both technically and economically. They include a wide range of equipment: base radio systems (receivers, transmitters and transceivers) and useful options, accessories and auxiliary equipment. Excellent specifications, careful system engineering, proven quality and convincing logistics and serviceability as part of our philosophy characterize the following products.

Type	Designation	Description	Page
R&S®M3SR	**Software defined radios**		68
R&S®M3SR Series4100	Software defined radios	HF radio family for stationary and shipborne communications	68
Product overview			89
R&S®M3SR Series4100	HF broadband system	Flexible and modular multiline radio system	91
Product overview			103
R&S®M3SR Series4400	Software defined radios	VHF/UHF radio family for stationary and shipborne communications	104
Product overview			113

R&S®M3SR Series4100 Software Defined Radios

Rohde&Schwarz has developed a state-of-the-art generation of communications systems designed to take HF radio to the next level. Shortwave communications are a resource that can be set up easily, offer extreme reliability and are highly valued by security authorities and organizations as well as military users all over the world.

The R&S®M3SR Series4100 HF radios are innovative, versatile software defined radios (SDR) that belong to the popular R&S®M3SR radio family. They support frequency hopping and provide interoperability with the R&S®M3TR family of tactical radios in all of the HF operating modes. Possible applications include typical navy applications on board ships and on shore, civil air traffic control, embassy radio systems and tactical applications.

Software defined radios save on logistics effort and reduce operating costs. In particular, the costs of warehousing spare parts and of maintenance are reduced tremendously. Having fewer internal hardware components also helps to significantly boost the reliability compared to conventional radios.

The R&S®M3SR Series4100 is a powerful radio platform that can be extended at any time. This helps to provide a safe, future-ready investment.

Besides the existing HF House waveforms, the R&S®M3SR Series4100 will also support future waveforms that attain a suitable level of market acceptance and lead to international standards. A software update is all that is required.

Key facts

- Frequency range: 1.5 MHz to 30 MHz (transmission), 10 kHz to 30 MHz (reception)
- Power classes of 150 W, 500 W, 1000 W and standalone receiver
- LINK 11, LINK 22, LINK Y support
- Embedded secure voice and data capability
- IP over air capability
- SIP-based remote voice operation

Benefits and key features

IP for easy integration

- R&S®IPoA radio transmission
- R&S®IPoA protocol functionality
- R&S®IPoA embedded services
  - Alarm messages
  - Short data messages
  - GPS reporting
- IPoA with STANAG 4538
- Voice over IP, SIP and phone patch
- Audio and remote control via IP
- Phone patch
- Domain connect

Interoperable waveforms for multinational cooperation
- ALE-2G, R&S®GS4101S
- ALE-3G, STANAG 4538, R&S®GS4155S
- HF modem, R&S®GM4120S
- HF modem, R&S®GM4122S

Secure and reliable communications
- Secure digital voice (SDV), R&S®GM4121S
  - Last ditch voice
- R&S®SECOM-H EPM (ECCM), R&S®GS3001S
- Management of black keys for additional security

Unrivaled radio parameters
- Collocation capability due to excellent receiver specifications
- Selective level control for optimum transmit power (software option)
- Digitally tuned RF selection (hardware option)
- Digital IF and audio signal processing

Suitable for a wide range of situations
- Three power classes and suitable line of accessories
- HF broadband system

Easy operation
- Clear status display
- Preconfigured menus
- Radio configuration only by authorized personnel

Low maintenance effort
- Rugged design, suitable even for difficult environmental conditions
- Powerful built-in test (BIT)
- Excellent reliability
- Easy module exchange

IP for easy integration

IP is becoming generally accepted in all areas. The R&S®M3SR Series4100 offers IP support at both the air interface and the radio for receiving payload, control and audio data.

R&S®IPoA IP over air radio transmission

The R&S®IPoA embedded radio protocol provides transparent IP functionality over the air. It can be used to set up communications systems that require transparent connection of IP networks over radio links. IP-based applications – such as situational awareness or message handling systems – are able to exchange their data over such radio links.

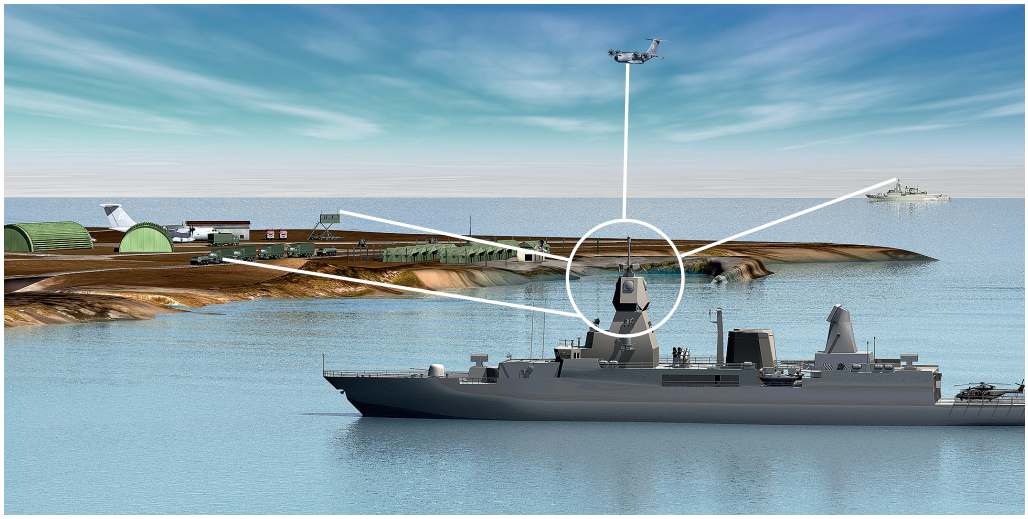
The R&S®RNMS3000 network management system provides a wizard that creates an IPoA network structure automatically.

R&S®IPoA protocol functionality

The embedded R&S®IPoA protocol currently supports Internet protocol version 4 (IPv4). An internal address mapping function ensures that data is delivered to the correct recipient. An error detection mechanism prevents the protocol from delivering erroneous data to the connected network; additional error correction techniques (e.g. ARQ secured data) are implemented. IPoA is supported by R&S®SECOM-H and ALE-3G (STANAG 4538)

R&S®IPoA embedded services

Messages and text information can be transmitted directly from the radio HMI as well as from external sources.



State-of-the-art secure radiocommunications.

Alarm messages

Alarm messages are preconfigured. They can be selected on the HMI and then transmitted with the highest priority (R&S®SECOM-H only).

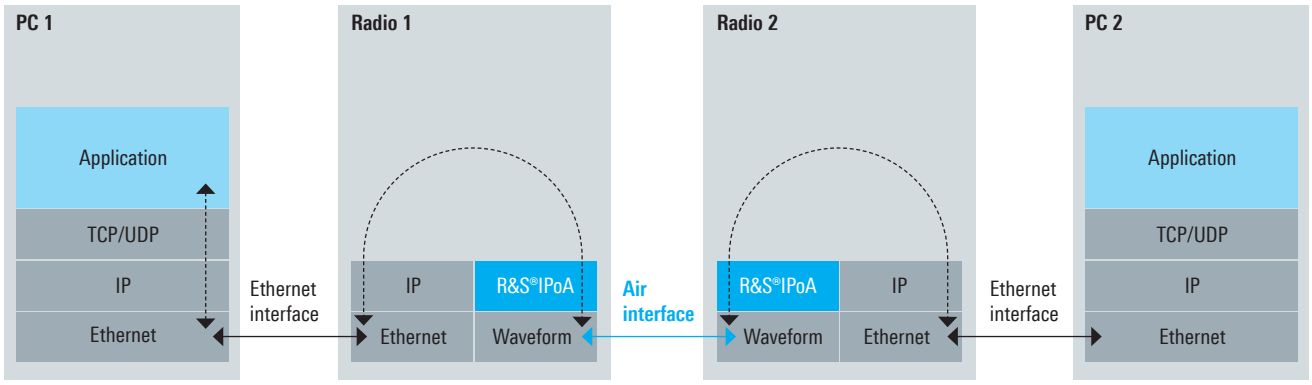
Short data messages

Short data messages (SDM) can be entered directly on the HMI keyboard.

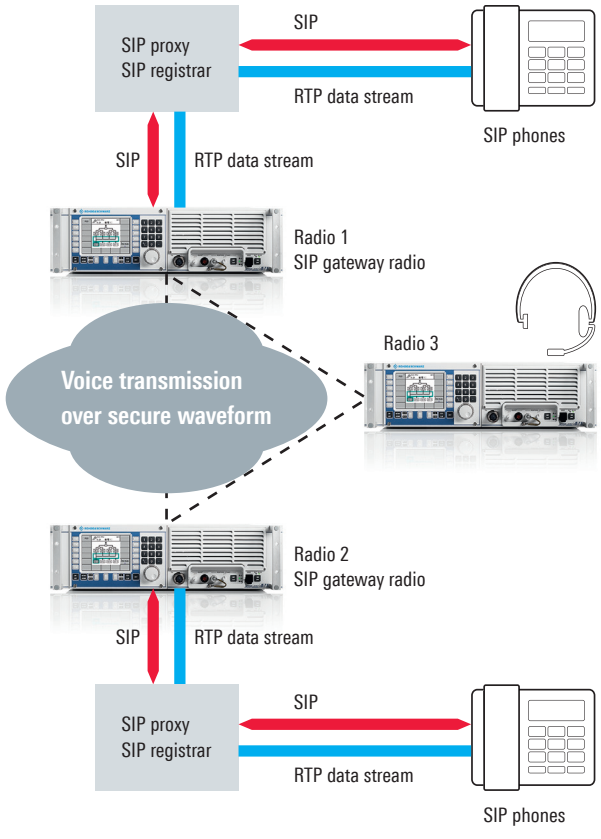
GPS reporting

GPS reporting allows the position of the own radio to be transmitted. The position of other radios can be shown on the HMI or transmitted to other applications. For example, the R&S®M3SR Series4100 radio in ALE-3G or R&S®SECOM-H can receive the position from R&S®M3TR radios in the field (blue force tracking).

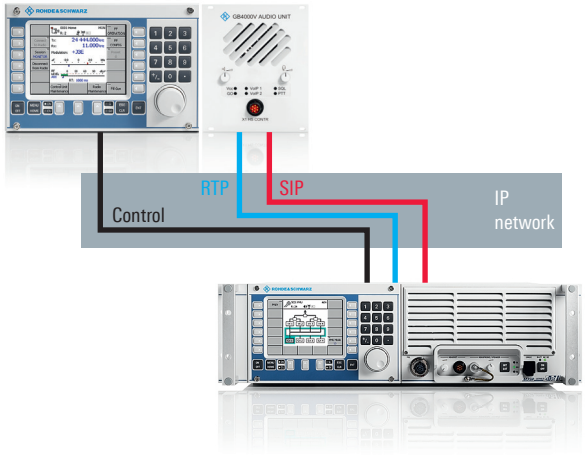
R&S®IPoA – transparent IP data transfer over air



Easy integration into a VoIP network (phone patch)



EUROCAE ED-137 support



IPoA with STANAG 4538

Depending on the destination IP address, an advanced, highly robust link setup with ALE-3G is used to establish a link to the appropriate radio. Once the link has been set up, the actual payload is transmitted with the xDL data link protocols from STANAG 4538 using error protection based on an integrated automatic repeat request (ARQ) procedure.

In the implementation developed by Rohde & Schwarz, the different LDL and HDL protocols are selected automatically. An intelligent choice is made based on the data size and current channel quality, due to a mechanism that ensures that the optimum waveform is always selected for maximum data throughput under a very wide range of channel conditions. Data transmission is still possible in very poor channels with a signal-to-noise ratio (SNR) as low as –7 dB.

Voice over IP, SIP and phone patch

The R&S®M3SR Series4100 radio family has an IP interface as standard, which can be used for remote control, configuration and also transmission of digital voice from and to the radio. Thanks to this interface the radio can be easily integrated into systems using one cable. Although other interfaces such as audio line interface or serial RS-232 are no longer required, they are still available.

Audio and remote control via IP

Since all relevant information is transmitted via Ethernet, the operator does not have to be at the same location as the R&S®M3SR Series4100 radio, provided an IP connection is available. The audio interface complies with the EUROCAE ED-137 standard, which allows the radio to be connected to an R&S®VCS 4G IP-based voice communications system, for example.

Phone patch

The phone patch is used to integrate the R&S®M3SR Series4100 radio into an SIP phone system. With ALE-3G, participants in the radio network can also be directly reached from a standard SIP phone. In addition, the radio network participants can directly communicate with other participants via the SIP phone system. If the secure digital voice (SDV) option is used, the connection is encrypted.

Domain connect

Local VoIP domains can be interconnected. For example, VoIP networks on board ships can be connected with a shore station. It is also possible to connect remote sites to the public switched telephone network.

Interoperable waveforms for multinational cooperation

Interoperable waveforms are required to enable cooperation among different nations. The most important waveforms for multinational cooperation are covered by the NATO HF House. The R&S®M3SR Series4100 family supports these waveforms.

NATO has defined several standards to ensure interoperability between modern HF transceivers. The HF House is a structured overview of different HF standards ratified by the NATO countries. The R&S®M3SR Series4100 family supports most of the waveforms mentioned in the HF House. These waveforms can easily be activated by an option key.

The network layer, link layer and physical layer are embedded into the radio. This ensures high reliability and low maintenance costs since no additional hardware such as external modems is necessary. STANAG 4538 allows the radio to be directly used as a static IP router. Rohde & Schwarz products also support STANAG 5066 as an external application.

ALE-2G, R&S®GS4101S

R&S®GS4101S is the ALE software for second-generation automatic link establishment systems. This software option provides support for the FED-STD-1045/1046/1049 and MIL-STD-188-141B App. A+B standards.

ALE-3G, STANAG 4538, R&S®GS4155S, R&S®GS4165S

ALE-3G (third-generation automatic link establishment) offers significant benefits compared to ALE-2G, including considerably faster and more robust link setup, improved automatic channel selection algorithms and embedded data link protocols. In addition, the automatic link maintenance (ALM) functionality is supported, allowing channels to be switched during a transmission without interrupting the link. The layer 2 protocols known as LDL (low-latency data link) and HDL (high-throughput data link) have the benefit of improved robustness at low S/N values compared to conventional protocols.

The ALE-3G xDL protocols permit ARQ-secured, channel-adaptive data transmission that has been optimized for the special characteristics associated with shortwave channels. Mechanisms such as code combining and packet aggregation optimize the data throughput. Due to its robustness, the LDL protocol can even transmit reliably in channels with a negative signal-to-noise ratio.

HF modem, R&S®GM4120S

The STANAG 4539 HF modem provides transmission data rates from 75 bit/s to 12 800 bit/s. It is the recommended modem for new NATO projects. It automatically adapts the receiving data rate and is used preferably with the R&S®STANAG5066 data protocol. STANAG 4539 complies with MIL-STD-188-110B section 5.3 + App. C. The STANAG 4539 implementation in the R&S®M3SR Series4100 performs significantly better than that of the competition and is robust in case of multipath propagation. STANAG 4539 includes the STANAG 4415 modem standard.

The STANAG 4285 HF modem is used primarily for broadcasting operation and for ARQ-secured data transmission, typically in conjunction with an external STANAG 5066 application.

The MIL-STD-188-110B App. F waveform uses independent sidebands for high-speed data transmission with up to 19200 bit/s. It consists of two identical MIL-STD-188-110B App. C modems to double the available data rate.

STANAG 4529 is used in naval applications; it requires only 1240 Hz bandwidth to achieve data rates from 75 bit/s to 1200 bit/s.

STANAG 4481 is a conventional FSK and PSK waveform for navy applications and data rates from 50 bit/s to 600 bit/s. STANAG 5065 allows shore-to-ship broadcast reception using the low frequency band, in particular from 60 kHz to 160 kHz.

HF modem, R&S®GM4122S

This option activates the STANAG 4539 and STANAG 4285 modems as described above.

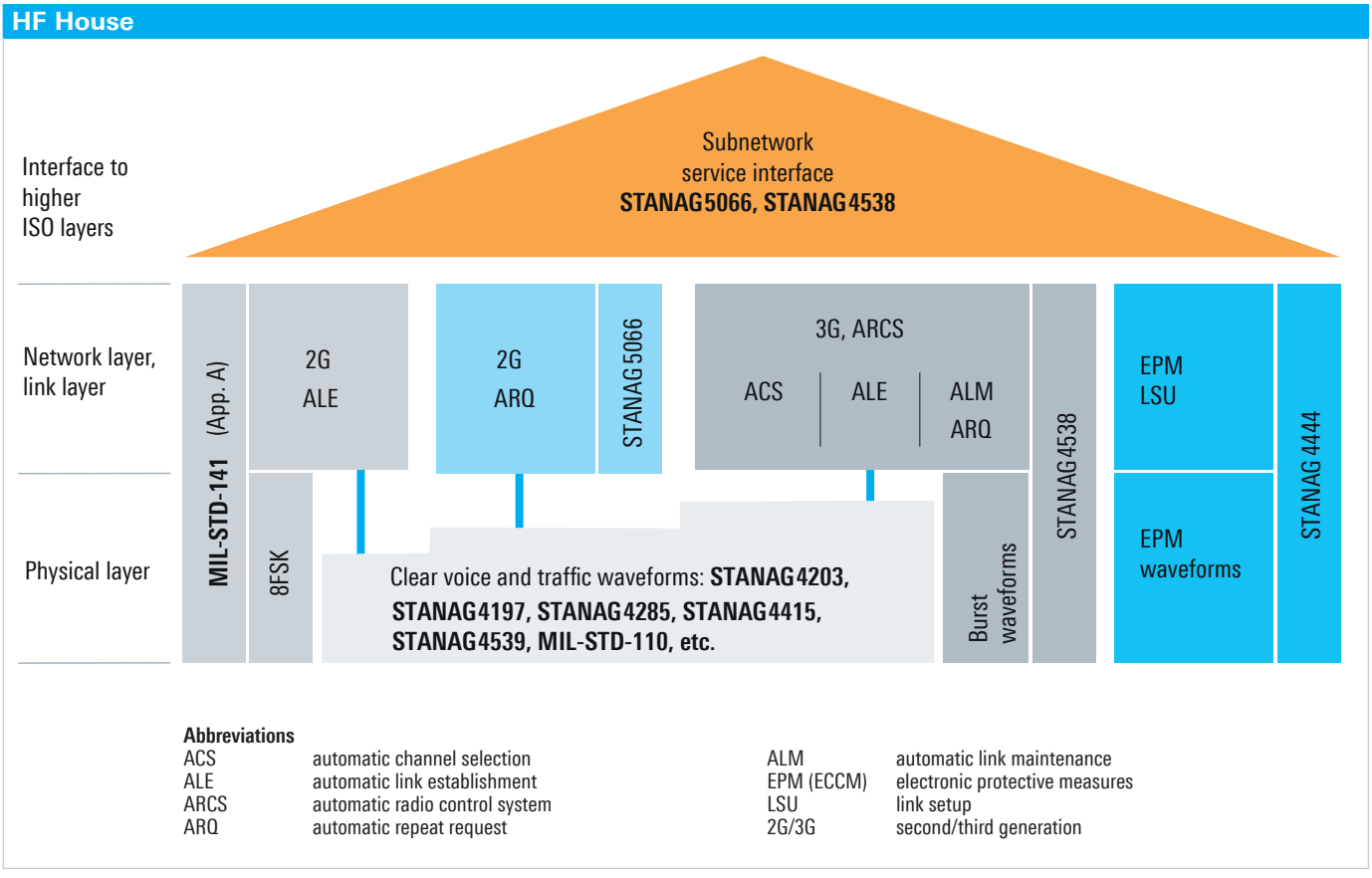
Secure and reliable communications

Due to the potentially worldwide propagation of an HF signal, it would be possible to eavesdrop on communications all over the world. In order to protect confidential transmissions effectively, the information must be encrypted.

Secure digital voice/data (SDV), R&S®GM4121S

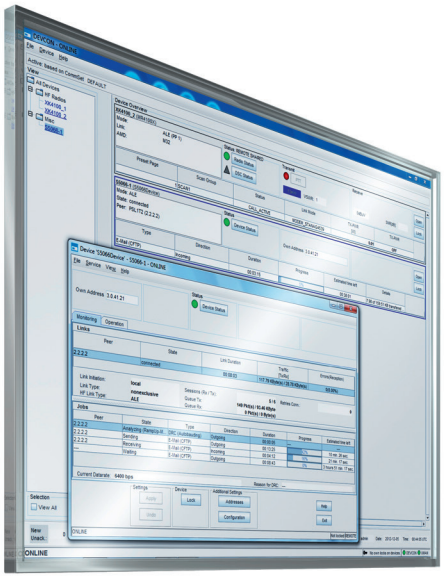
SDV provides easy-to-use, versatile embedded encryption for fixed frequency connections as well as for connections established with ALE-3G.

When using ALE-3G's synchronous link establishment process, users profit from the combination of information security (SDV) and ALE-3G's inherent mechanisms for improving transmission security (linking security). In ALE-3G mode, the replay protection protects against spoofing attacks.



Abbreviations

ACS	automatic channel selection
ALE	automatic link establishment
ARCS	automatic radio control system
ARQ	automatic repeat request
ALM	automatic link maintenance
EPM (ECCM)	electronic protective measures
LSU	link setup
2G/3G	second/third generation



R&S®STANAG5066 is a communications solution for the robust and highly secure exchange of data using HF radio networks in line with STANAG5066. R&S®STANAG5066 uses the internal modems of R&S®M3SR Series4100 radio.

Keys are generated using the R&S®CP3000 key management system.

The Rohde&Schwarz RSCA crypto algorithm with a key length of up to 256 bits can be used for both voice and data connections. Either the voice information that has been digitized or the data, which is transmitted using LDL and HDL, is encrypted.

Last ditch voice

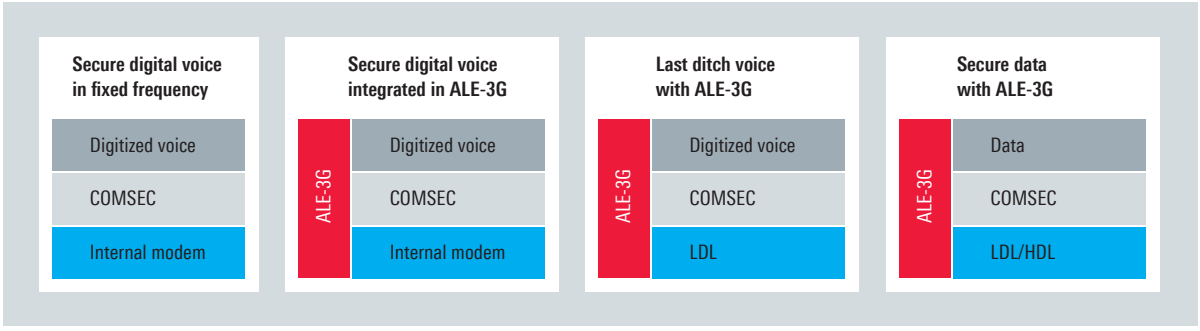
In order to ensure reliable connections in heavily disturbed channels, the radio must employ extremely robust transmission methods: A very good choice is the last ditch voice (LDV) technique from Rohde&Schwarz available for the R&S®M3SR Series4100 radio family.

With LDV, the digitized voice message is first stored temporarily in the transmitting radio. Then, the stored LDV message is sent. Messages are transmitted as a type of voice mail, and not in realtime. Instead, they are passed on to the receiver without error through the LDL protocol's ARQ. This takes place fully automatically after the transmitter has triggered the process. The receiver reports the arrival of a new message and stores it. The message can be called up as often as desired. Transmission of LDV messages is always encrypted.

R&S®SECOM-H EPM (ECCM), R&S®GS3001S

R&S®SECOM-H is a Rohde&Schwarz proprietary HF frequency hopping radiocommunications waveform similar to STANAG 4444. It is designed to operate in environments where a certain percentage of the hop set frequencies are blocked due to either intentional (i.e. jamming) or unintentional disturbances, as well as in environments with severe Doppler spread and/or multipath delay. In addition, it is based on modem waveforms that can be adapted to the specific characteristics of the HF channel and its propagation.

Structure of the stack



Structure of the stack for secure digital voice with and without ALE-3G link establishment and for last ditch voice.

R&S®SECOM-H provides digital voice (low bit rate vocoder at 600 bit/s, 1200 bit/s or 2400 bit/s, adjustable) and data services (up to 2400 bit/s). To ensure reliable links even in severely degraded channels, free hop set search (FHS) is available. FHS is an algorithm for the automatic adaptation of hop sets based on channel evaluation. Radios in a point-to-point link will generate and use an advanced hop set containing only frequencies with proven good RF performance.

For network synchronization, GPS can be used as the network time source. GPS-based network time eliminates the need for manual net entry; all stations in the network remain synchronized as long as the GPS signal is received. Alternatively, the time can be exchanged over the air.

Management of black keys for additional security
The COMSEC/TRANSEC crypto algorithm was developed by Rohde&Schwarz. It supports key lengths up to 256 bits. Keys are generated using the R&S®CP3000 key management system. Keyset files are transmitted by the R&S®CP3000 to the R&S®RNMS3000 network management system using an additional asymmetric key protection key. This means that exclusively black keys are transported. Using the mission planner module, it is possible to set up secure R&S®SECOM-H radio networks consisting of the R&S®M3SR Series4100 and the R&S®M3TR. The R&S®SECOM-H radio configuration from the mission planner can be loaded into the radio via Ethernet or a fill device.

For SDV applications, the keys can also be generated using other solutions. In this case, the key can be entered directly into the radio.

Rohde&Schwarz radios are used on board the ADCF frigate of the Royal Netherlands Navy.

Unrivaled radio parameters

A high frequency (HF) radio channel is a transmission medium that is characterized by time variance, low signal-to-noise (S/N) ratios, Doppler effects and multipath propagation. However, HF allows worldwide communications due to its unique propagation characteristics. To obtain usable signals, the operating frequencies and antennas as well as the radio parameters such as sensitivity, selectivity and noise suppression are essential.

Collocation capability due to excellent receiver specifications
Simultaneous operation of multiple radio lines on board ships is extremely challenging for the collocation capability of the radios due to the spatial proximity of the radios that results in low antenna decoupling values. However, due to the outstanding specifications of the radios of the R&S®M3SR Series4100, such challenges are easily surmounted. For HF parameters such as second and third-order intercept, desensitization and crossmodulation immunity, the R&S®M3SR Series4100 sets new standards. For example, even without preselection the receiver provides third-order intercept (IP3) of > 40 dBm (typ.). This parameter is particularly important in cases where very low amplitude signals must be reliably detected in the simultaneous presence of high-power interference from nearby transmitter systems.

Selective level control for optimum transmit power (software option)
Mutual influences between adjacent transmitter lines would cause a traditional transmitter to reduce its output power since the external power is taken into account as reflected power during VSWR calculation. The optional selective directional coupler available in the power amplifiers makes it possible to perform narrowband weighting of the transmit signal and the reflected antenna power. This means that the transmitter power control of the transmitter lines is not influenced during normal operation.

Digitally tuned RF selection (hardware option)

The optional HF pre/postselectors are steep-edged bandpass filters with a relative bandwidth of a few percent. They work at the transmitter and receiver ends and can be precisely set to the relevant operating frequencies. The HF pre/postselectors influence the performance of the radios in two ways. First, they reduce the TX phase noise to values better than –165 dBc (1 Hz) (typ.). Second, they significantly increase the large-signal characteristics of the receive section, i.e. crossmodulation immunity, desensitization and second and third-order intercept points. The HF pre/postselector in the R&S®M3SR Series4100 supports frequency hopping.

Digital IF and audio signal processing

The R&S®M3SR Series4100 combines the unmatched dynamic range of radios with analog mixers with the latest in digital IF and audio signal processing. The second IF frequency of 48 kHz is sampled, digitized and processed using digital signal processors. This means that a wide range of IF bandwidths are available in all modes with high selectivity and optimized for voice and data communications. Digital signal processing also provides functions for noise suppression.

Suitable for a wide range of situations

The R&S®M3SR Series4100 is extremely flexible and can be optimally adapted to a wide range of diverse deployment conditions. The logistics effort is low because the modular concept allows the use of many identical system components.

Three power classes and suitable line of accessories

The output power that is required of HF transceivers is highly dependent on the particular application scenario. The radios of the R&S®M3SR Series4100 are available in power classes of 150 W, 500 W and 1000 W. The R&S®M3SR Series4100 also includes a separate, standalone receiver. Without additional hardware, the R&S®M3SR Series4100 components can also be used to set up IP-based split-site systems. The product portfolio is rounded out by system components such as antenna tuning units (ATU) and dipole antennas from Rohde&Schwarz. For radio applications on ship and shore, broadband radio systems are also available. All components are designed to operate 24/7 within the rated temperature ranges at full output power.

HF broadband system

The HF broadband system [1] is a flexible and modular multiline radio system for the HF frequency range. The applications range from navy ships to shore radio stations with up to 32 radio lines. The system offers the full range of R&S®M3SR Series4100 modulation modes and waveforms, from simple SSB operation and ALE to EPM (ECCM) radio line. Intelligent radio line management provides flexible and dynamic allocation of transmit power, from a few watts to several kilowatts, to support a variety of military missions.

[1] See separate product brochure: R&S®M3SR Series4100 HF broadband system (PD 5214.1243.12).

R&S®M3SR Series4100 software defined radios.

Easy operation

Rohde&Schwarz has extensive experience in stationary radio systems, which is reflected in the operating concept of the R&S®M3SR Series4100 radios. The displays and control elements are arranged in a user-friendly manner and are easy to understand.

Clear status display

All required settings on the radio can be made using the R&S®GB4000C control unit. The R&S®GB4000C can be integrated into the radio or it can control the radio remotely. It can also be used to operate several R&S®M3SR Series4100 radio systems (only one at a time) in an IP network.

Preconfigured menus

The user interface for the R&S®M3SR radio family has clearly structured menus that are organized by function. Each operating mode is set using preconfigured menus (preset pages). The R&S®M3SR Series4100 can manage up to 100 preconfigured menus. The configuration is generated using the R&S®RNMS3000 network management system. The preset pages can then be loaded into the radio via LAN, RS-232 or a fill device.

Radio configuration only by authorized personnel

The areas that contain the settings for maintenance and configuration of the radio are password-protected. This ensures that only authorized personnel can carry out maintenance or in-depth configuration of the radio. The password can be set in the R&S®RNMS3000 network management system.

Low maintenance effort

The R&S®M3SR Series4100 radios were developed with low maintenance effort in mind. A variety of control and monitoring functions are available that provide the user with detailed status information about the radios. In addition, built-in test functions permit service and maintenance tasks to be carried out in a targeted manner. The radio systems can be remotely analyzed, eliminating the need for on-site service. Resistance to vibrations and a wide operating temperature range allow the systems to be used in diverse applications.

Rugged design, suitable even for difficult environmental conditions

The radios fulfill the requirements stipulated in the MIL-STD-810F military standard for operating temperature and mechanical influences such as vibration and shock. The corresponding standard for electromagnetic compatibility is MIL-STD-461E.

Powerful built-in test (BIT)

Multiple test procedures support users in checking that the radio functions properly and in identifying any malfunction down to module level. BIT results can be displayed locally and also queried from a remote site.

The following built-in tests are supported:

- Power-on BIT (PBIT)
- Continuous BIT (CBIT)
- Initiated BIT (IBIT)

The PBIT is a short self-test that is automatically performed each time the radio is powered on. The CBIT continuously polls the status messages from all radio modules during regular operation.

The R&S®GB4000C control unit has a user-oriented GUI for intuitive radio operation.

View of the radio's interior.

The IBIT allows a functional check of the complete system. Besides the base unit, it also checks external system components such as power amplifiers, power supplies and any antenna tuning units that are connected. Failures and warnings are reported as plain text. The radio also shows the total operating time.

Excellent reliability

The R&S®M3SR Series4100 radios can operate in continuous-wave mode over a wide ambient temperature range from –20 °C to +55 °C. If the temperature exceeds the permissible range, the transmitter will automatically and gradually decrease its output power in order to maintain operation. If ambient conditions return to normal, the transmitter will revert to normal operation without requiring any manual intervention.

Easy module exchange

All RF modules are equipped with LEDs showing the module status. Modules can easily be exchanged without recalibrating the radio.

System overview

Logistical structure

The logistical structure of the R&S®M3SR Series4100 is based on radio models that are available for the R&S®EK4100 receiver, the R&S®GX4100 receiver/exciter and the R&S®XK4115 150 W transceiver.

Each radio model consists of:

- Hardware base unit
- Radio software
- Software and hardware options

The base units, known as R&S®MR4100x, are all ruggedized with a splashproof IP32 front panel. The radio software for these base units can be ordered in the form of "A" software (with no export restrictions) or "D" software (requiring an export license).

Depending on customer requirements, individual hardware and software options can be added to the system (see product overview).

The final type designation and the order number for a custom-configured R&S®EK4100A/R&S®EK4100D or R&S®XK4115A/R&S®XK4115D are order-specific. This makes it possible to clearly identify any customized unit with all of its options using a unique order number.

R&S®M3SR Series4100 power classes

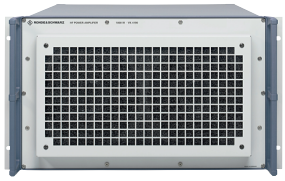
R&S®EK4100A/D receiver

R&S®XK4115A/D 150 W transceiver

R&S®IN4000A power supply

500 W transceiver systems

R&S®GX4100A/D
HF receiver/exciter

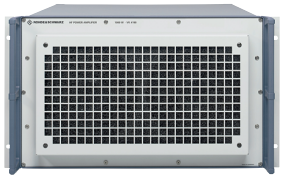


R&S®VK4150
500 W HF power amplifier

R&S®IN4150 power supply

1000 W transceiver systems

R&S®GX4100A/D
HF receiver/exciter



R&S®VK4190
1000 W HF power amplifier

R&S®IN4190 power supply

R&S®EK4100A/R&S®EK4100D VLF-HF receiver

The R&S®EK4100A/R&S®EK4100D VLF-HF receiver provides an internal AC power supply for operation on 110 V to 230 V AC voltage. Alternatively, it can be operated on 28 V DC voltage.

Key features

- Frequency and channel scanning
- IP3 > 40 dBm
- Latest DSP technology
- 10 kHz to 30 kHz reception
- High sensitivity
- Full remote control via IP or RS-322
- Audio via IP or analog
- Modular concept

R&S®EK4100A/D

R&S®DS4100A/D
radio software

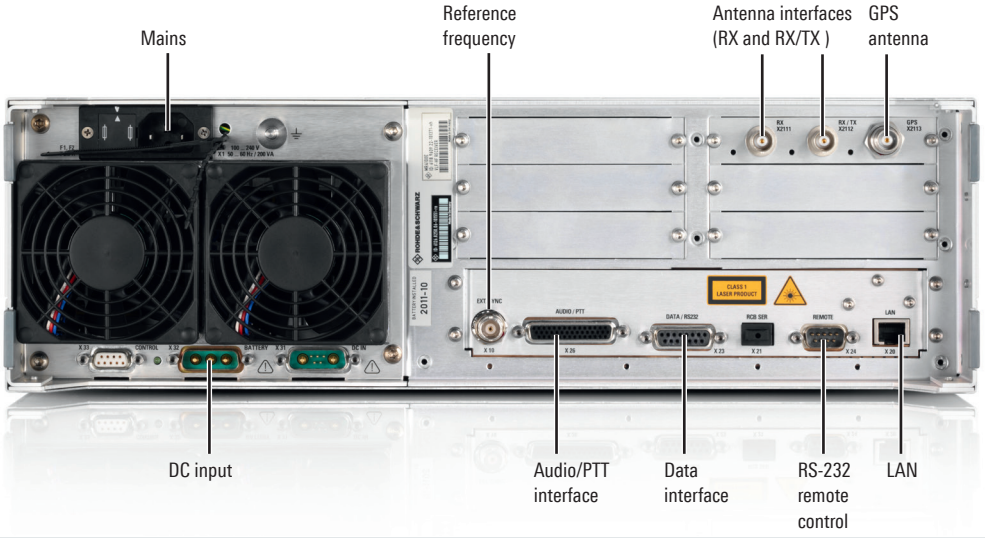
Software options

Hardware options

R&S®MR4100E
VLF-HF receiver
(base unit)

R&S®EK4100A/D VLF-HF receiver: front view

R&S®EK4100A/D VLF-HF receiver: rear view



R&S®XK4115A/R&S®XK4115D 150 W transceiver

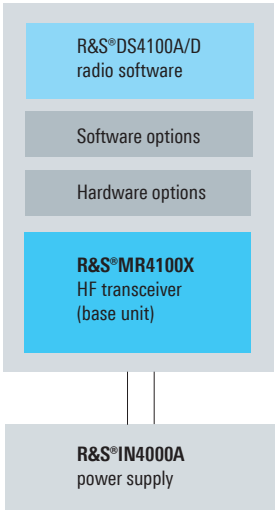
The R&S®XK4115 has a built-in 150 W power amplifier. The transceiver can be operated on 28 V DC voltage or, with an external R&S®IN4000A power supply, on 230 V AC voltage. In addition to the receive characteristics it shares with the R&S®EK4100A/R&S®EK4100D, the transceiver offers the following noteworthy features:

- 24/7 operation (TX at +55 °C)
- Link operation ready
- Frequency hopping capability

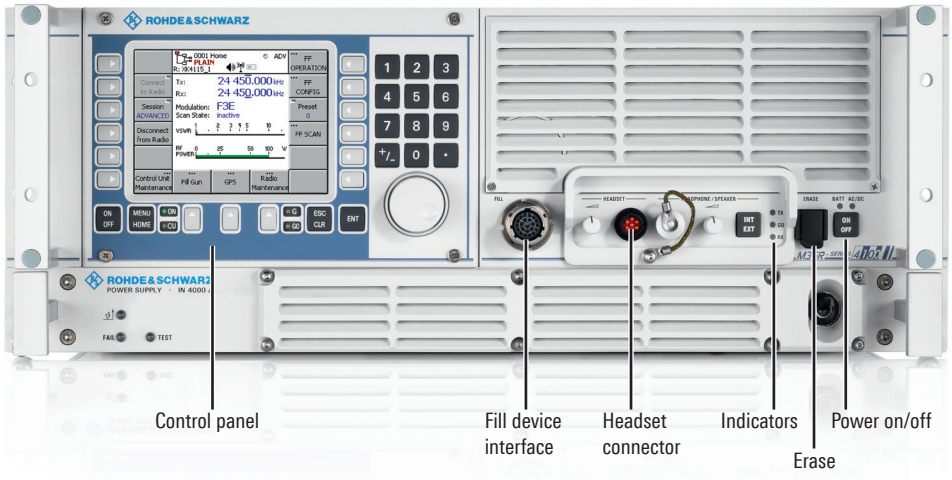
R&S®IN4000A external power supply

The R&S®IN4000A features a wide AC input range that provides robust protection against AC voltage fluctuations. A sophisticated voltage regulation concept ensures highly stable DC output voltage regardless of load fluctuations and ambient temperature variations.

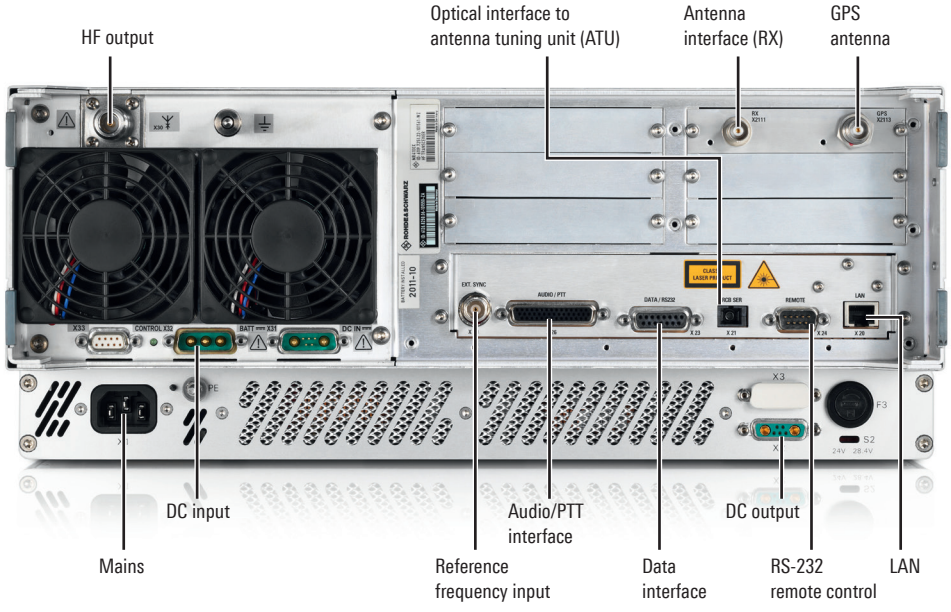
R&S®XK4115A/D



R&S®XK4115A/D transceiver with R&S®IN4000A external power supply (front)



R&S®XK4115A/D transceiver with R&S®IN4000A external power supply (rear)



500 W/1000 W transceiver systems

To cover large distances, transceiver systems with an output power of 500 W and 1000 W are available. These solutions provide exceptionally high radio link availability – even under moderate propagation conditions.

They provide higher signal-to-noise ratios as required when transmitting at high data rates, for applications in worldwide embassy radio systems, in civil ATC systems or in the military. It also goes without saying that these systems offer frequency hopping capability.

A 500 W or 1000 W transceiver system consists of the following components:

- R&S®GX4100A/R&S®GX4100D receiver/exciter
- R&S®VK4150/R&S®VK4190 power amplifier
- R&S®IN4150/R&S®IN4190 power supply

R&S®GX4100A/R&S®GX4100D receiver/exciter

The R&S®GX4100A/R&S®GX4100D controls the R&S®VK4150/R&S®VK4190.

R&S®GX4100A/D

R&S®DS4100A/D radio software

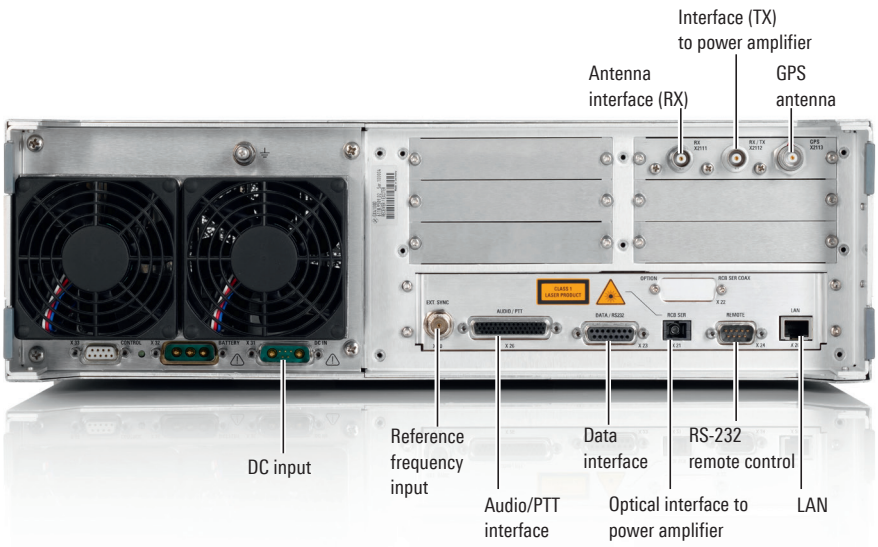
Software options

Hardware options

R&S®MR4100G
HF receiver/exciter (base unit)

R&S®GX4100A/R&S®GX4100D receiver/exciter: front view

R&S®GX4100A/R&S®GX4100D receiver/exciter: rear view



R&S®VK4150/R&S®VK4190 power amplifier

The digitally controlled R&S®VK4150/R&S®VK4190 power amplifier is available as a standard model and a special model with built-in receiver input protection. The receiver input protection protects the receiver input from destruction through HF interference on the antenna The built-in receiver input protection should be selected whenever undisturbed reception of wanted signals is required under extreme conditions.

- 24/7 operation at full output power (100 % duty cycle) even at +55 °C
- Rugged design, high MTBF
- Software option for selective level control available

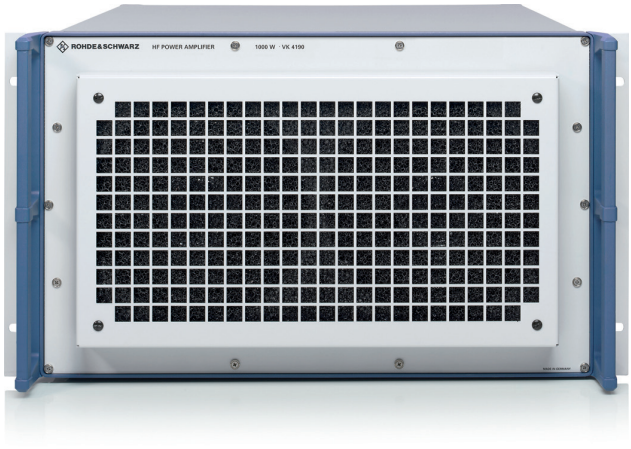
R&S®IN4150/R&S®IN4190 standard power supply

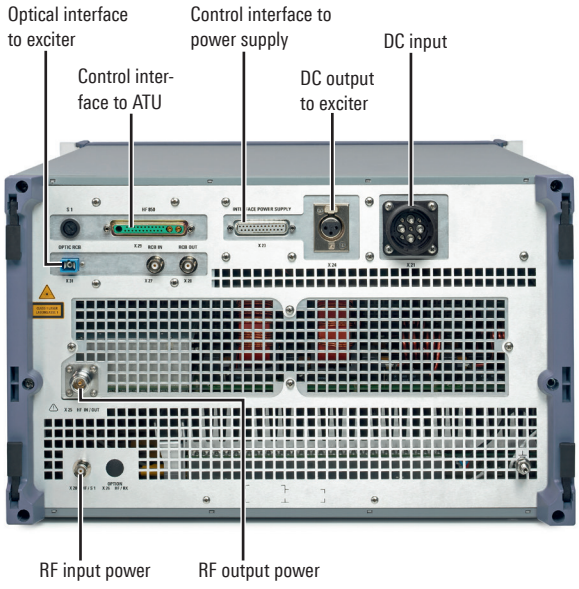
The R&S®IN4150/R&S®IN4190 standard power supply is controlled by the R&S®VK4150/R&S®VK4190 power amplifier. The control connection ensures that the power amplifier and the power supply always operate in the most efficient mode possible.

Different models available for all conventional electrical networks

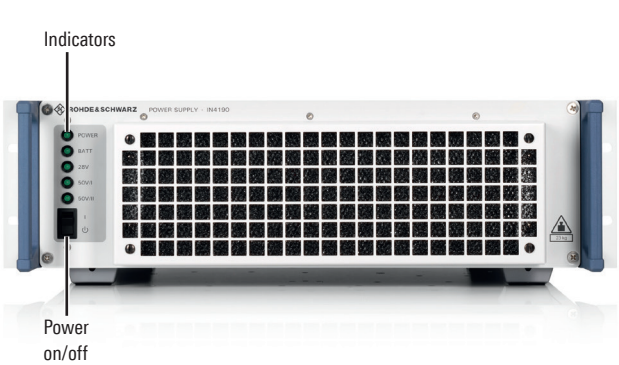
- High efficiency (up to 90 %)
- State-of-the-art power factor correction (> 95 %)
- Automatic switchover between AC and battery supply in case of power failure

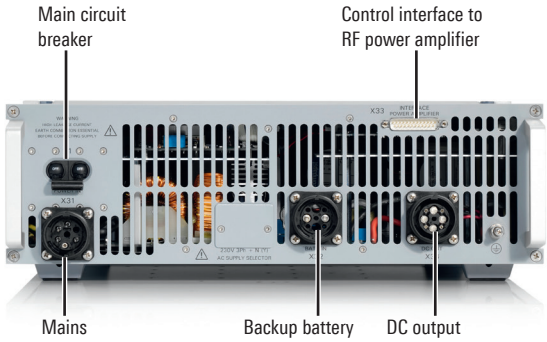
R&S®VK4150/R&S®VK4190 power amplifier: front and rear view





R&S®IN4150/R&S®IN4190 power supply: front and rear view

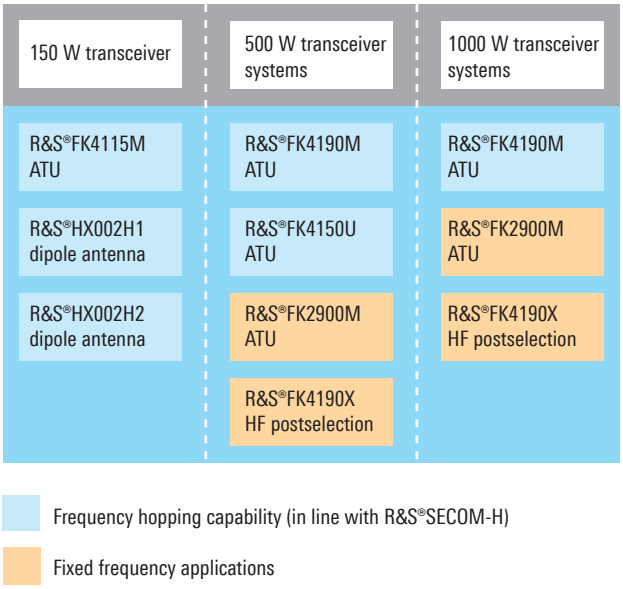




Antenna tuning units

All Rohde&Schwarz antenna tuning units (ATU) operate in the frequency range from 1.5 MHz to 30 MHz, where an antenna impedance transformation into 50 Ω in both the receive and transmit modes is performed. Additionally, Rohde&Schwarz ATUs provide preselection in the receive mode.

R&S®M3SR Series4100 overview



Key features

Silent tuning functionality

The Rohde&Schwarz antenna tuning units (ATU) offer a silent tuning feature over the entire frequency range from 1.5 MHz to 30 MHz. The advantage for the user is low probability of intercept (LPI), since Rohde&Schwarz ATU frequency setting is performed very quickly and without any emission of RF power.

Before this feature can be used, the Rohde&Schwarz ATUs must be connected to the antenna to "learn" its characteristic. Learning takes place in a user-defined frequency range within the HF band (1.5 MHz to 30 MHz).

Maintenance-free, rugged design

The rugged design of the Rohde&Schwarz ATUs allows them to be operated 24 hours a day.

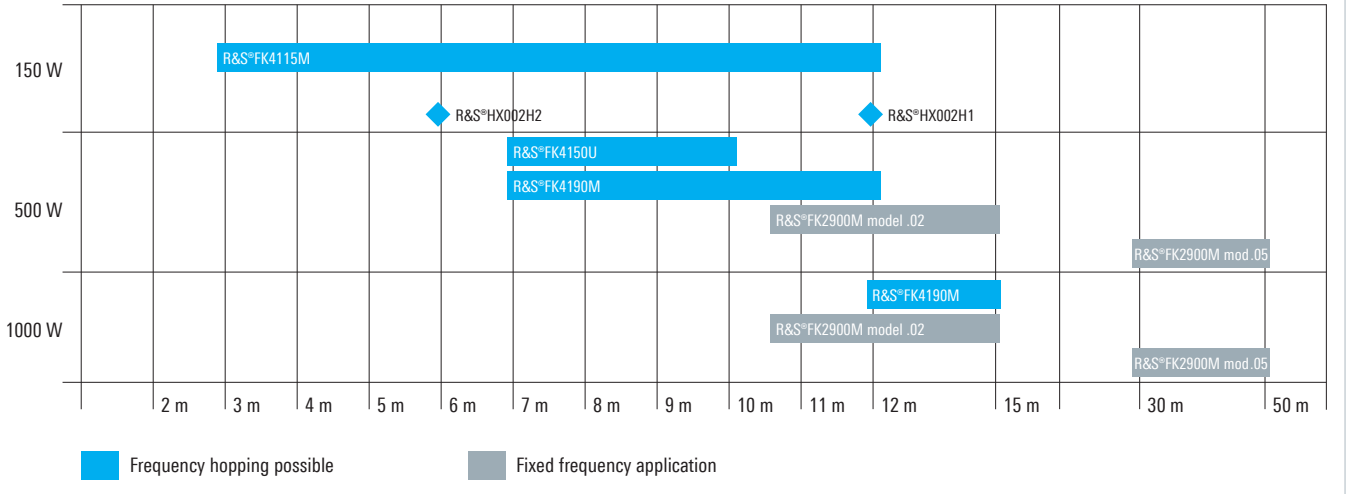
BITE

The Rohde&Schwarz ATUs are included in the continuous monitoring of the entire system so that deviations from the normal operating status are displayed on the control unit.

EMC and overvoltage protection

All circuit boards are equipped with EMC filters. For protection against overvoltage as produced by lightning strikes to the antenna, the Rohde&Schwarz ATU's output is provided with lightning protection. All antenna tuning units are tested to withstand arcs of 10 kV/10 kA.

ATU selection guide



R&S®FK4115M HF antenna tuning unit

The R&S®FK4115M matches rod, whip and wire antennas (as used in naval and stationary applications) to the RF output of the 150 W transceiver of the R&S®M3SR Series4100. The antenna tuning unit (ATU) can handle up to 150 W PEP or 100 W CW at a 100 % duty cycle.

The R&S®FK4115M has an extremely fast setting time for silent channels and allows frequency hopping operation in line with R&S®SECOM-H.

- Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz
- Tuning of rod, whip and wire antennas
- 150 W PEP, 100 W CW at 100 % duty cycle
- Frequency hopping capability (R&S®SECOM-H)
- Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is < 5 ms
- If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (nonsilent mode) in < 100 ms (typ.)

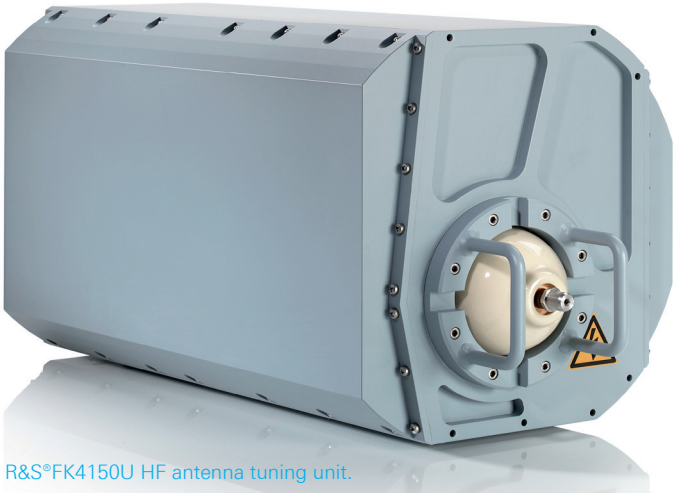
R&S®FK4150U HF antenna tuning unit

The R&S®FK4150U matches rod, whip and wire antennas (as used in submarine applications) to the RF output of the 500 W transceiver systems of the R&S®M3SR Series4100. The antenna tuning unit (ATU) can handle up to 500 W PEP and CW with rod/whip antennas of 7 m to 10 m length.

The R&S®FK4150U has an extremely fast setting time for silent channels and allows frequency hopping operation in line with R&S®SECOM-H.

- Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz
- Tuning of rod, whip and wire antennas
- 500 W CW and PEP with 7 m to 10 m rod/whip antennas
- Frequency hopping capability (R&S®SECOM-H)
- Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is < 5 ms
- If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (nonsilent mode) in < 100 ms (typ.)

R&S®FK4115M HF antenna tuning unit.



R&S®FK4150U HF antenna tuning unit.

R&S®FK4190M HF antenna tuning unit

The R&S®FK4190M matches rod/whip and wire antennas (as used in naval applications) to the RF output of the 500 W and 1000 W transceiver systems of the R&S®M3SR Series4100.

The antenna tuning unit (ATU) can handle up to 500 W CW and PEP with rod/whip antennas of 7 m to 11 m length and up to 1000 W with 12 m rod antennas. Additionally, it provides preselection in the receive mode. The R&S®FK4190M has an extremely fast setting time for silent channels and allows frequency hopping operation in line with R&S®SECOM-H.

- Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz
- Tuning of rod/whip antennas of 7 m to 11 m length
- 500 W CW and PEP at 100 % duty cycle
- 1000 W CW and PEP (12 m rod antennas only)
- Frequency hopping capability (R&S®SECOM-H)
- Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is < 5 ms
- If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (nonsilent mode) in < 100 ms (typ.)

R&S®FK4190M HF antenna tuning unit.

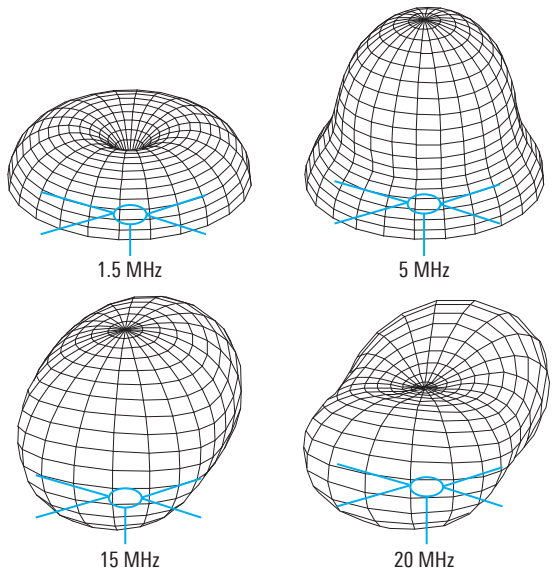
R&S®FK2900M 1 kW HF antenna tuning unit

The R&S®FK2900M matches the amplifier outputs of the transceivers to rod and wire antennas. It is designed for stationary or shipboard applications.

- Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz
- Tuning of all rod antennas from 10.5 m to 12 m
- Tuning of long-wire antennas
- 1000 W CW and PEP at 100 % duty cycle
- Once the tuning data for these frequencies is known and stored, the ATU setting time is < 40 ms
- If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned in < 200 ms

R&S®FK2900M 1 kW HF antenna tuning unit.

Typical three-dimensional radiation patterns



Typical three-dimensional radiation patterns above perfectly conducting ground.

Dipoles and postselector

R&S®HX002H1/R&S®HX002H2 150 W HF dipoles

The R&S®HX002H1 and R&S®HX002H2 150 W HF dipoles are suitable for setting up radio links over any distance. In particular, the optimized omnidirectional coverage ensures high transmission reliability over short and medium distances.

- Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz
- Integrated tuning unit for dipole
  - 12 m dipole version (H1) optimized for base station use
  - 6 m dipole version (H2) optimized for naval applications
- 150 W CW and PEP
- Frequency hopping capability (R&S®SECOM-H)
- Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is < 5 ms

R&S®FK4190X 1 kW HF postselector

This filter with a power rating of 1000 W is used together with the 500 W and 1000 W transceiver systems for suppressing mutual interference that may occur with co-sited transmit and receive antennas. It is mainly used for shipborne applications in order to meet collocation requirements if space for antennas is limited.

When connected between the transceiver and the ATU, the filter effectively suppresses spurious emissions due to its high selectivity of 30 dB (20 dB for f > 15 MHz) at f ± 10%. Tuning is digital by means of RF relays.

- Covers the entire frequency range from 1.5 MHz to 30 MHz
- 1000 W CW and PEP at 100% duty cycle
- Reduces transmitter noise
- Reduces harmonics

R&S®HX002H1 150 W HF dipole.

R&S®FK4190X 1 kW HF postselector.

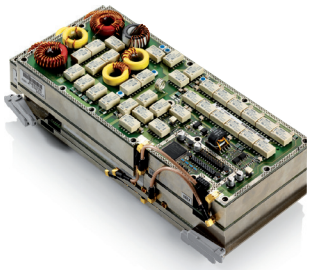
Software and hardware options

Description of software options

Type	Designation, description	Available for software	
		R&S® DS4100D [1]	R&S® DS4100A [2]
R&S®GM4120S	**HF modem** Single-tone modems in line with STANAG 4285, STANAG 4539, MIL-STD-188-110B section 5.3 + App. C, STANAG 4529, STANAG 4481, STANAG 5065, MIL-STD-188-110B App. F.	•	
R&S®GM4121S	**Secure digital voice/data** SDV enables encrypted connections in fixed frequency channels. In combination with ALE-3G/STANAG 4538 (in this case the R&S®GS4155S or R&S®GS4165S option is additionally required), both secure voice transmission and secure data transmission are supported.	•	•
R&S®GM4122S	**HF modem** Single-tone modems in line with STANAG 4285, STANAG 4539, MIL-STD-188-110B section 5.3 + App. C.		•
R&S®GM4158S	**Multitone** Support of external multitone HF modems such as DRM modems.		•
R&S®GS3001S	**R&S®SECOM-H EPM (ECCM) waveform** This option activates the R&S®SECOM-H frequency hopping waveform.	•	
R&S®GS4101S	**ALE-2G** This option activates the support for second-generation automatic link establishment (ALE) systems. This software option provides support for the FED-STD-1045/1046/1049 and MIL-STD-188-141B App. A+B standards.	•	•
R&S®GS4114S	**LINK software** This option makes the radio parameters comply with the STANAG 5511, STANAG 5522 and MIL-STD-188-203-1A standards. External LINK 11 as well as LINK Y or LINK 22 modems (fixed frequency) can be connected directly to the radio.	•	
R&S®GS4115S	**Selective level control** The selective level control option for the 500 W and 1000 W power amplifier makes it possible to perform narrowband weighting of the transmit signal and the reflected antenna power. This ensures that transmitter power control is not influenced by extraneous signals during normal operation.	•	•
R&S®GS4117S	**CE conformity mark** HF system CE conformity (in line with EN 300373-1/-2/-3) means that the TX bandwidth must be limited and the output power reduced to 400 W for frequencies up to 4 MHz.	•	•
R&S®GS4155S	**ALE-3G** This option activates the STANAG 4538 waveform which includes: ▮ ALE-3G (including ALE-2G) and ALM (for ALE-3G) ▮ IP-optimized ARQ xDL protocols In order to use ALE-3G with embedded encryption for data and voice, the SDV (R&S®GS4121S) option key has to be installed.	•	
R&S®GS4156S	**Split site** Software for IP-based split-site operation.	•	•
R&S®GS4157S	**RSS-181 conformity** This option activates the SSB transmission bandwidth to comply with the Canadian RSS-181 standard.	•	•
R&S®GS4165S	**ALE-3G** This option activates the STANAG 4538 waveform which includes: ▮ ALE-3G (including ALE-2G) and ALM (for ALE-3G) ▮ IP-optimized ARQ xDL protocols In order to use ALE-3G with embedded encryption for data and voice, the SDV (R&S®GS4121S) option key has to be installed.		•

[1] D version of radio software: export license required.
[2] A version of radio software: without export restrictions.

Description of hardware options

Type	Designation, description	Available for		
		R&S® MR4100E	R&S® MR4115X	R&S® MR4100G
R&S®GB4000C 	**Control unit** The R&S®GB4000C control unit is used for controlling, configuring and monitoring R&S®M3SR radios via Ethernet. The R&S®GB4000C is available as a standalone remote control unit and as an embedded local control panel. The control panel comes as a ruggedized model for demanding environmental conditions. A separate data sheet is available.	•	•	•
R&S®FK4120, R&S®FK4140 	**RF selection, 20 dB** Digitally tuned tracking bandpass filter (1.5 MHz to 30 MHz) with 20 dB edge steepness at 10% frequency offset. The R&S®FK4120 digitally tuned RF selection increases the selectivity of the transmit and receive paths. Receiver parameters such as second and third-order intercept, IF rejection, image frequency rejection and crossmodulation immunity are significantly improved. In the transmit direction, the TX phase noise is suppressed to produce typical values as low as –165 dBc (1 Hz). The digitally tuned RF selection is recommended for receiving low-amplitude signals in the simultaneous presence of strong HF carrier signals. This is the case when multiple HF radio lines operate simultaneously and independently of one another and reception should be possible even if adjacent lines are transmitting.	•	•	•
	RF selection, 40 dB Digitally tuned tracking bandpass filter (1.5 MHz to 30 MHz) with 40 dB edge steepness at 10% frequency offset. The R&S®FK4140 digitally tuned RF selection increases the selectivity of the transmit and receive paths. Receiver parameters such as second and third-order intercept, IF rejection, image frequency rejection and crossmodulation immunity are significantly improved. In the transmit direction, the TX phase noise is suppressed to produce typical values as low as –165 dBc (1 Hz). The digitally tuned RF selection is recommended for receiving low-amplitude signals in the simultaneous presence of strong HF carrier signals. This is the case when multiple HF radio lines operate simultaneously and independently of one another and reception should be possible even if adjacent lines are transmitting.	•	•	•
R&S®GS4102 	**NMEA interface** The NMEA (DSC) interface is necessary when the R&S®M3SR Series4100 transceiver systems are used to forward distress calls located by an external GMDSS monitoring and communications system.		•	•
R&S®GP4100A 	**Fill device** The fill device is used to transfer configuration data to one or more R&S®M3SR Series4100 radios.	•	•	•

Overview of hardware and software options

Type	Available for					
	Receiver		150 W transceiver		500 W/1000 W system	
Radio	**R&S®EK4100A**	**R&S®EK4100D**	**R&S®XK4115A**	**R&S®XK4115D**	**R&S®GX4100A**	**R&S®GX4100D**
Base unit	**R&S®MR4100E**		**R&S®MR4115X**		**R&S®MR4100G**	
Radio software	**R&S®DS4100A**	**R&S®DS4100D**	**R&S®DS4100A**	**R&S®DS4100D**	**R&S®DS4100A**	**R&S®DS4100D**
Hardware option						
R&S®GB4000C local control unit	•	•	•	•	•	•
R&S®FK4120 digitally tuned RF selection, 20 dB	•	•	•	•	•	•
R&S®FK4140 digitally tuned RF selection, 40 dB	•	•	•	•	•	•
R&S®GS4102 NMEA (DSC) interface			•	•	•	•
Software option						
R&S®GM4120S HF modem		•		•		•
R&S®GM4121S secure digital voice/data		•		•		•
R&S®GM4122S HF modem	•		•		•	
R&S®GS3001S SECOM-H		•		•		•
R&S®GS4101S ALE-2G	•	•	•	•	•	•
R&S®GS4114S LINK software		•		•		•
R&S®GS4115S selective level control (PA)					•	•
R&S®GS4117S CE conformity mark			•	•	•	•
R&S®GS4155S ALE-3G/ STANAG 4538 including ALE-2G		•		•		•
R&S®GS4156S split site	•	•	•	•	•	•
R&S®GS4157S RSS-181 conformity			•	•	•	•
R&S®GS4158S multitone support	•		•		•	
R&S®GS4165S ALE-3G	•		•		•	

Product overview

Designation	Type
R&S®EK4100A/R&S®EK4100D receiver	
Base unit	
VLF-HF receiver, AC/DC, without local control panel and radio software	R&S®MR4100E
R&S®XK4115A/R&S®XK4115D transceiver	
Base unit	
HF transceiver, 150 W, DC, without local control panel and radio software	R&S®MR4100X
Power supply units	
External power supply, AC/DC, ruggedized model	R&S®IN4000A
500 W and 1000 W transceiver systems	
Base unit	
HF receiver/exciter, DC, without local control panel and radio software	R&S®MR4100G
Power amplifiers	
500 W HF power amplifier	R&S®VK4150
500 W HF power amplifier, with receiver input protection	R&S®VK4150
1000 W HF power amplifier	R&S®VK4190
1000 W HF power amplifier, with receiver input protection	R&S®VK4190
Power supply units for 500 W and 1000 W transceiver system	
Power supply, 230 V AC, 1 or 3 phases + N/208 V AC, 3-phase Δ	R&S®IN4150
Power supply, 440 V AC, 3 phases (used together with an R&S®BV4190 transformer)	R&S®IN4150
Power supply, 220 V DC	R&S®IN4150
Power supply, 115 V AC, 1 phase + N or 230 V AC, 1 or 3 phases + N/208 V AC, 3-phase Δ	R&S®IN4190
Power supply, 440 V AC, 3 phases (used together with an R&S®BV4190 transformer)	R&S®IN4190
Transformer, 440 V AC, 3-phase Δ	R&S®BV4190
Auxiliary equipment	
Remote control units	
Remote control unit	R&S®GB4000C
Remote audio operation	
Audio unit for R&S®M3SR Series4100 and R&S®M3SR Series4400	R&S®GB4000V
External power supply, 24 V/45 W	R&S®NGRA24-GB
Audio units	
Headset, incl. microphone (ruggedized version) with cable and NF-7 connector	R&S®GA012
Handset, incl. microphone (ruggedized version) with cable and NF-7 connector	R&S®GA013
Headset, dynamic with cable and NF-7 connector, with active guard	R&S®GA015
Headset, dynamic with cable and NF-7 connector, without active guard	R&S®GA015A
Handheld microphone, with cable and NF-7 connector	R&S®GA016H1
Support equipment	
Morse key with cable and connector	R&S®GA2180
Fill device	R&S®GP4100A
USB cable, between fill device and PC	R&S®GK3021

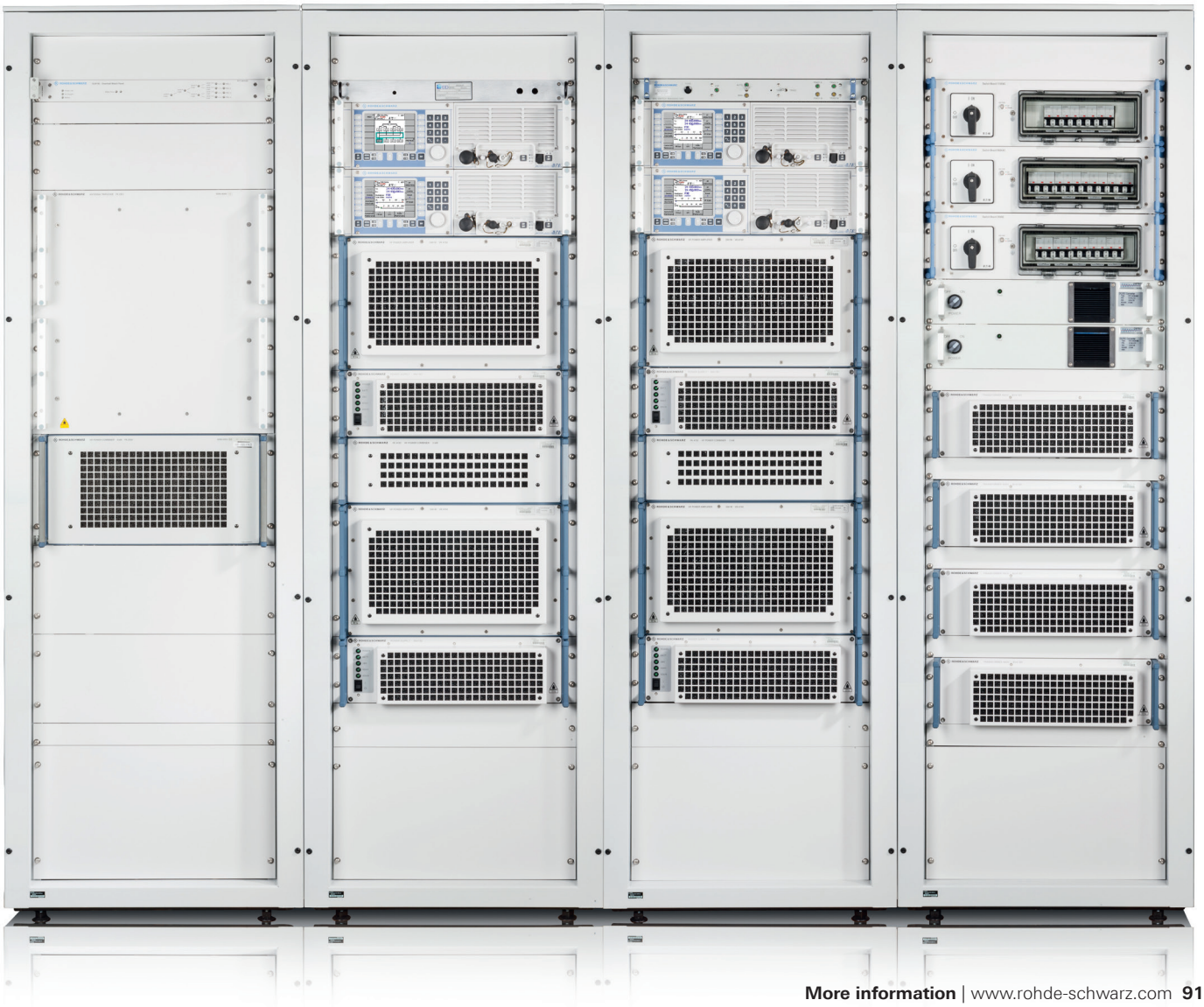
Designation	Type
HF antenna tuning units and postselectors	
HF antenna tuning units (150 W transceiver)	
HF antenna tuning unit, for land-based and shipborne applications	R&S®FK4115M
HF dipole antenna, for land-based applications	R&S®HX002H1
HF dipole antenna, for shipborne applications	R&S®HX002H2
HF antenna tuning units (500 W/1000 W transceiver systems)	
HF antenna tuning unit, for land-based and shipborne applications, 10.5 m to 12 m rod antennas (model .02)	R&S®FK2900M
HF antenna tuning unit, for land-based and shipborne applications, 30 m to 50 m mast antennas (model .05)	R&S®FK2900M
HF antenna tuning unit, for land-based and shipborne applications, frequency hopping capability	R&S®FK4190M
HF antenna tuning unit, for submarine applications, frequency hopping capability	R&S®FK4150U
1000 W HF postselection	R&S®FK4190X
R&S®RNMS3000 radio network management system	
Mission planner	R&S®DS3100M
Remote device loader	R&S®DS3300D
Remote distributor	R&S®DS3321D
Radio test equipment	
Test system for radio equipment	R&S®UCS226x

R&S®M3SR Series4100 HF Broadband System

The HF broadband system is a flexible and modular multiline radio system for the HF frequency range. The applications range from navy ships to shore radio stations with up to 32 radio lines. The system's excellent scalability makes it suitable for use on board a wide range of ships, from Corvette-class vessels to aircraft carriers as well as for shore stations.

The system offers the full range of R&S®M3SR Series4100 modulation modes and waveforms, from simple SSB operation and ALE to EPM (ECCM) radio line. Intelligent radio line management provides flexible and dynamic allocation of transmit power, from a few watts to several kilowatts, to support a variety of missions.

Example: HF broadband system with one four-line block.



HF broadband system – a future-ready investment

The system is based on the principle of combining shipboard HF radio lines with the help of highly linear, passive line couplers and then transmitting the combined signal using a broadband antenna system. The system covers the entire HF frequency band from 2 MHz to 30 MHz and consists of separate broadband antennas, each covering a subband. A diplexer or triplexer selects each antenna segment.

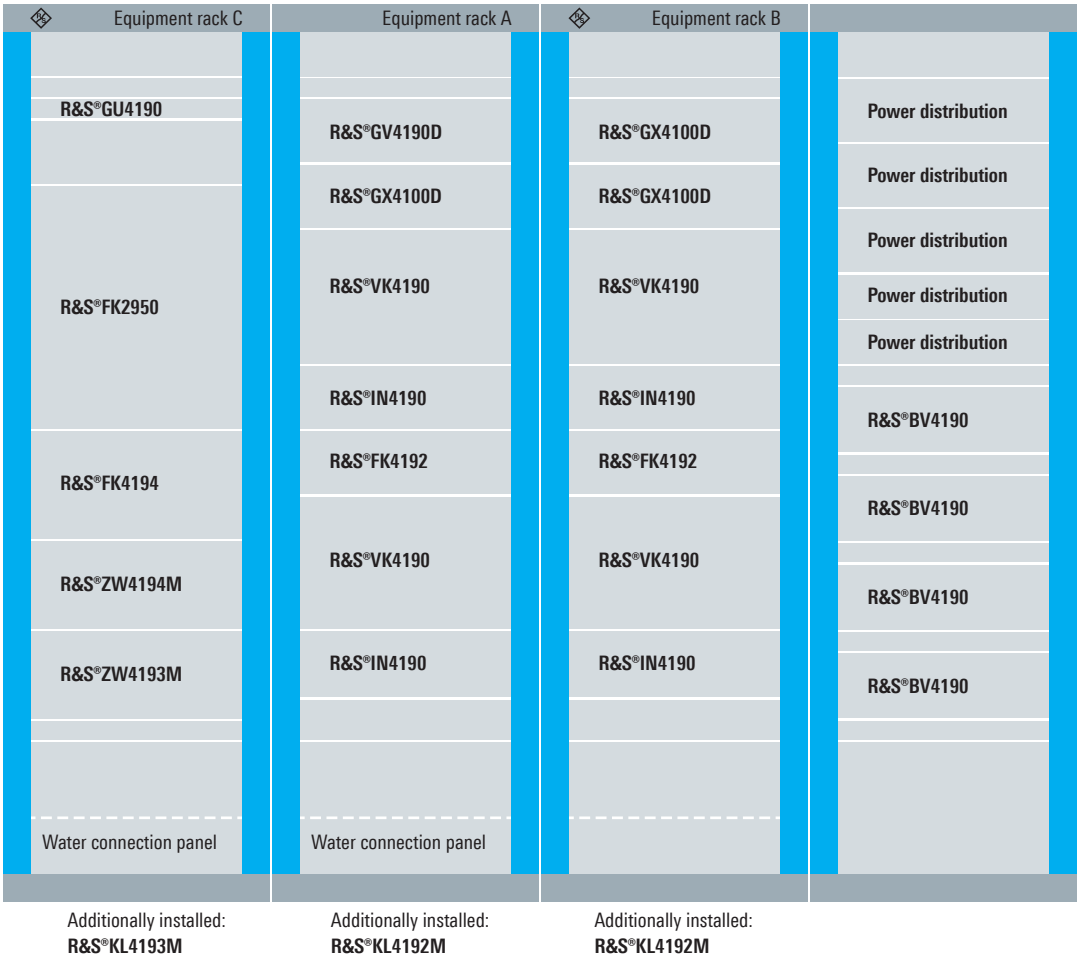
The antenna system contains no switched elements. The broadband capability of the antennas eliminates the need for antenna tuning units. Since only passive components such as couplers and filters are used, the result is a low-maintenance system with superior reliability.

System configuration of the HF broadband system

A broadband system can consist of up to 32 radio lines which are connected to a broadband antenna system. The channel spacing between adjacent radio lines can be adjusted to a minimum of one percent. The individual radio lines can be occupied by any of the waveforms supported by the R&S®M3SR Series4100 including:

- Voice (SSB, AM, FM)
- Radio teletype (RATT)
- Modem (e.g. STANAG 4285, STANAG 4539)
- Automatic link establishment (ALE-2G/3G)
- Tactical data links (e.g. LINK 11, LINK 22)
- EPM (ECCM) paths

Example rack layout



Broadband block

The broadband block is a modular component of the HF broadband system. It consists of four 1000 W transceiver systems, the appropriate passive, highly linear power combiner and the R&S®GV4190D power management unit (PMU). The PMU allocates the radio signals of each of the connected receivers/exciters to one, two or four power amplifiers at the small signal level. It also permanently monitors status reports from system components such as amplifiers, power supplies, power combiners and filters. In the case of coherent power addition, the PMU also ensures that the signals to be added are in phase.

R&S®FK2950 antenna triplexer, R&S®FK2960 antenna diplexer

The HF broadband antenna system may consist of an R&S®FK2950 antenna triplexer and a three-section broadband antenna.

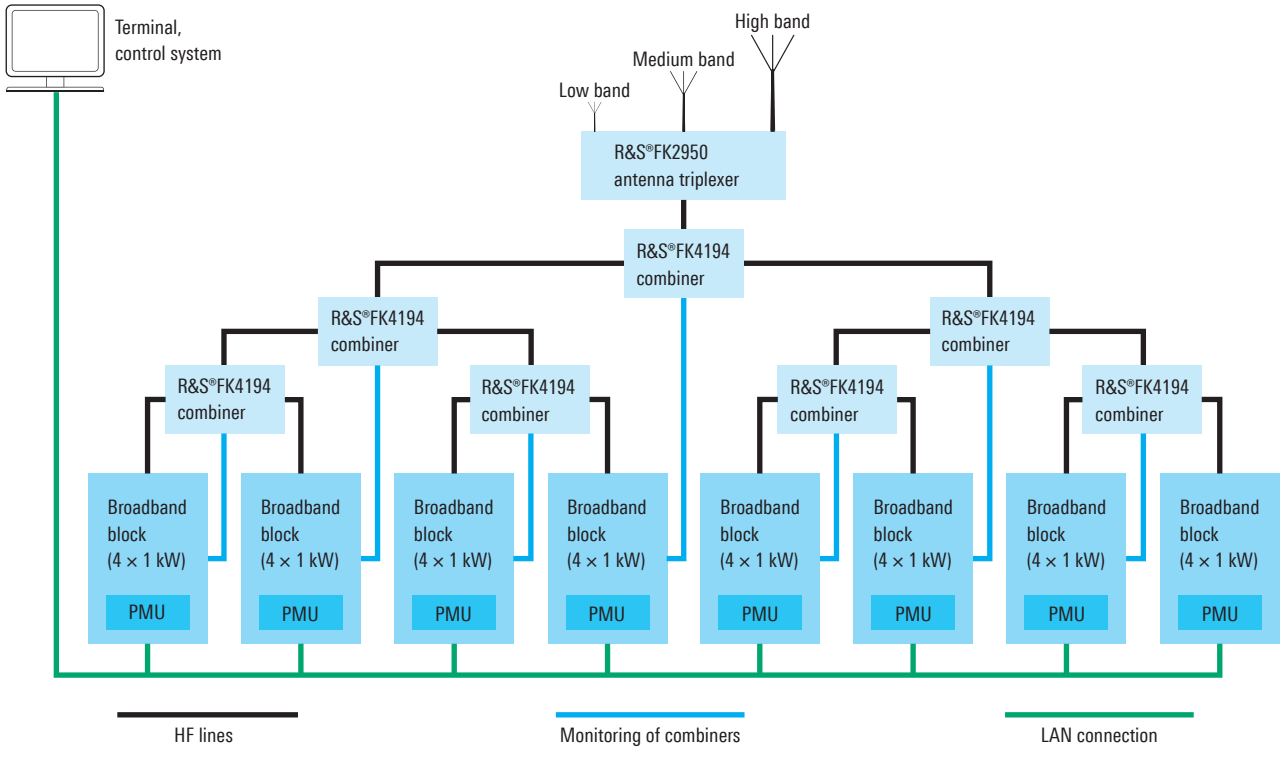
A two-section antenna (e.g. twin fan) and an R&S®FK2960 antenna diplexer may be used for smaller systems or ships.

An antenna mismatch of up to VSWR 3:1 can be tolerated without loss of power. For land-based installations, single broadband antennas (e.g. log-periodic antennas) from 2 MHz to 30 MHz can be used.

Local control

Broadband blocks can be locally configured and controlled with the R&S®GB4000C local control panel. The PMU offers a selection of operational modes to ensure a defined logical allocation between the receivers/exciters and the power amplifiers. These modes are especially suitable for locally controlling 4 kW transmitter/receiver systems such as those deployed at shore stations.

The HF broadband system can be expanded to support up to 32 radio lines



Flexible, logical allocation of connected receivers/ exciters and power amplifiers

Through the right combination of coherent and noncoherent signal paths, the number of radio lines in operation and their output power can be varied over a wide range.

Coherent mode means that the output power of two radio lines can be arithmetically added (without taking into account coupler loss). This requires that both line coupler input signals have identical frequencies and phase angles.

If the input signal frequencies or phase angles are not identical, this is referred to as noncoherent mode and results in attenuation of the input power by 3 dB (= factor of 2).

R&S®FK4192/R&S®FK4194 passive HF power combiners

- R&S®FK4192: 2 kW
- R&S®FK4194: 4 kW

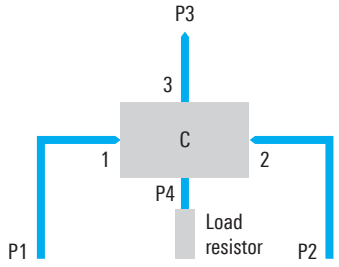
The power combiner section consists of three individual couplers, arranged at two levels so as to maximize the power management possibilities. The individual couplers are zero-degree couplers. This ensures perfect power combination if the two inputs are in phase (coherent combining). The coupling device is designed as a four-port system, which provides two inputs, one RF signal output, and one output to the balance load. The following simple example clarifies this function:

Two exciter signals (P1 and P2) are applied to the inputs of the coupler, which behaves differently according to whether the two signals are:

- A: identical, coherent
- B: not identical, not coherent

Coherent means that the signals originate from the same source (modulator) and are in phase:

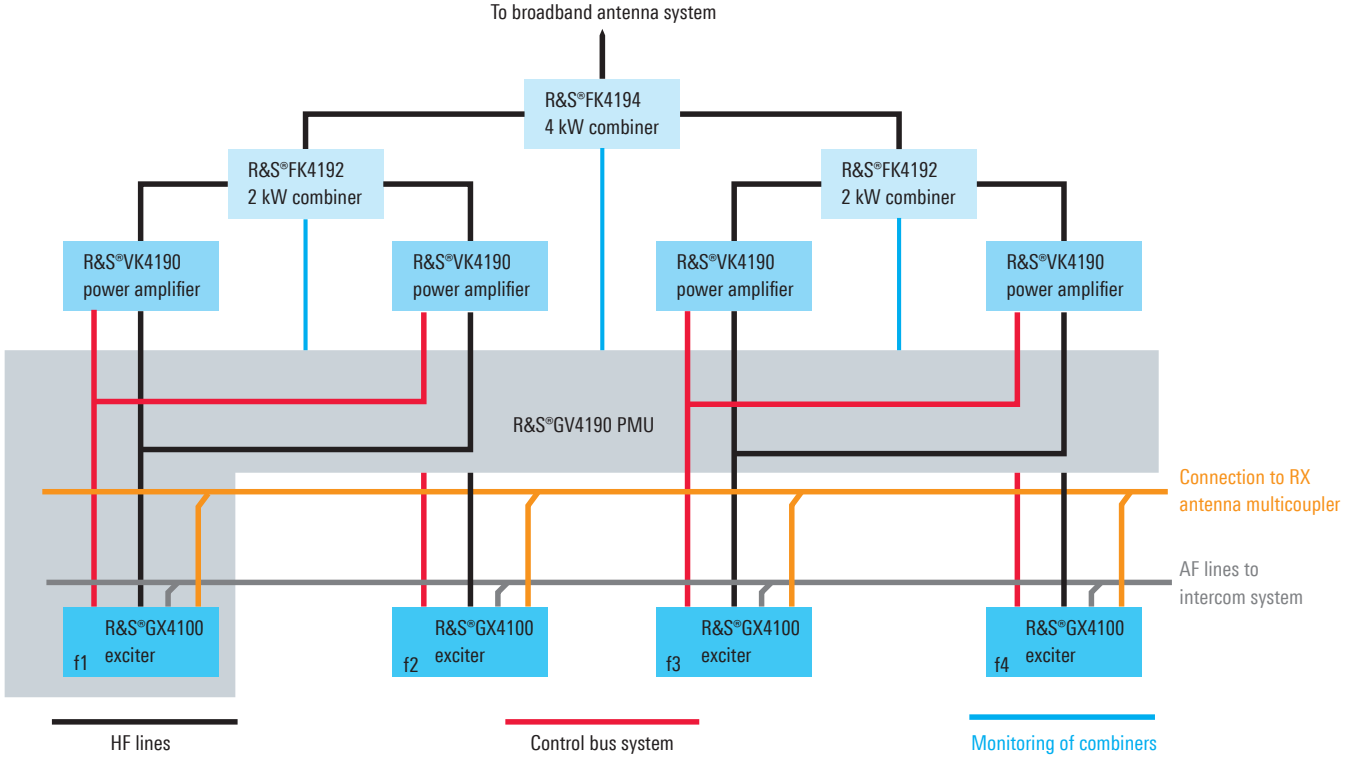
Combiner



1 and 2 noncoherent:
P3 = 0.5 P1 + 0.5 P2
P4 = 0.5 P1 + 0.5 P2

1 and 2 coherent (in phase):
P3 = P1 + P2
P4 = 0

Broadband block: 4 × 1 kW radio lines and power management unit



Case A: At the output of the coupler is the sum of the powers of the two signals (P3 = P1 + P2) . The residual loss is typically less than 0.4 dB.

Case B: At the output of the coupler is the sum of the half powers of the two signals (P3 = 0.5 × P1 + 0.5 × P2). The loss of one signal is typically between 3.2 dB and 3.4 dB. The loss of 3 dB, which is caused by the noncoherent combination, is dissipated in a load resistor connected to the fourth port of the coupler.

The second noteworthy property of a zero-degree power coupler is its isolation. This means that a signal P1 fed into one input (e.g. input 1) appears at output 3, not at input 2.

The two power sources are decoupled, and intermodulation between the signals is virtually eliminated.

R&S®GV4190D power management unit

In addition to power management capability, the R&S®GV4190 offers embedded receiver/exciter functionality.

R&S®GV4190D

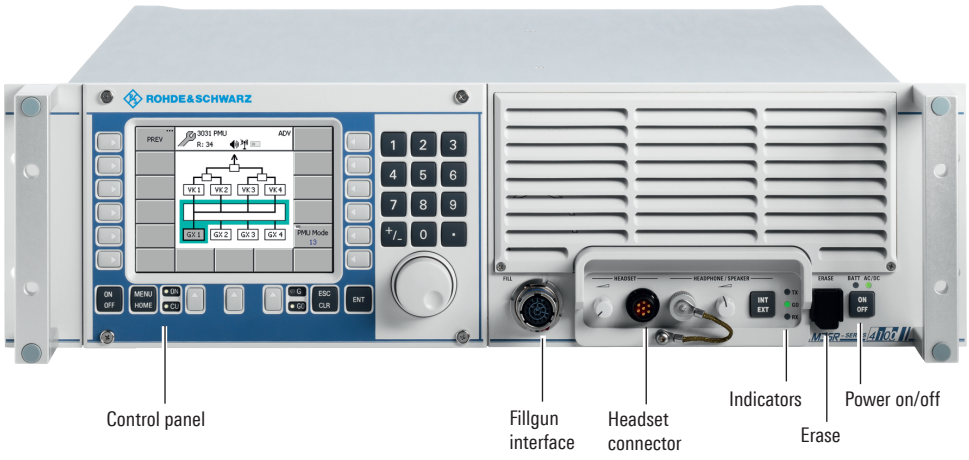
R&S®DS4100D
radio software

Software options

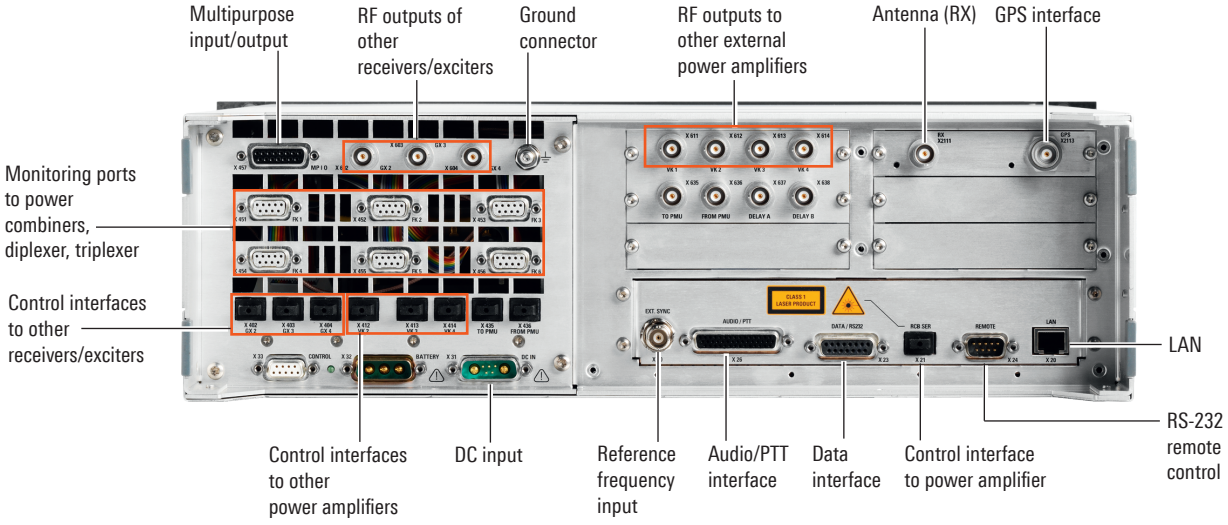
Hardware options

R&S®MR4100G-B
power management unit
incl. receiver/exciter
(base unit)

R&S®GV4190D power management unit: front view



R&S®GV4190D power management unit: rear view



Water cooling equipment

System components

HF broadband (HFBB) systems are integrated into the on-board systems of naval vessels and are used to reduce the total number of required antennas. In larger HF broadband systems (more than four 1 kW transceivers), a water cooling system is required to reduce the wild heat in the equipment room. The main parts of HF broadband systems that produce heat are the transceivers due to their power amplifiers, power supplies and dummy loads (absorbers for the required R&S®FK4192 or R&S®FK4194 RF power combiners).

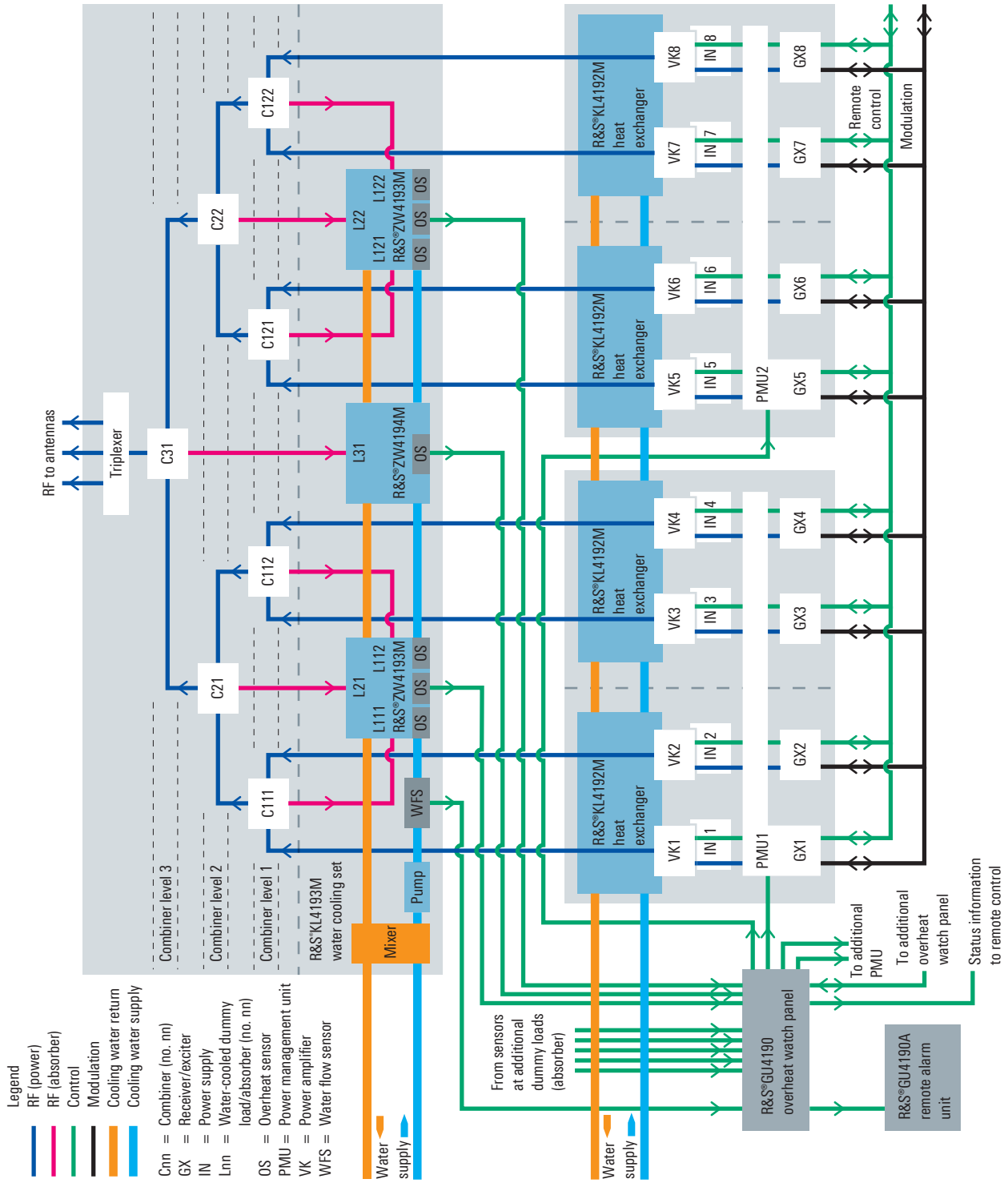
Most HFBB systems consist of eight or more transceivers, subdivided into blocks of four radios each (broadband blocks).

The following components are required for water cooling the HFBB system (see rack layout drawing for an eight-line HFBB system):

- R&S®KL4192M heat exchanger for equipment rack
- R&S®KL4193M water cooling set for equipment rack
- R&S®ZW4193M water-cooled dummy load (1+2+1 kW)
- R&S®ZW4194M water-cooled dummy load (4 kW)
- R&S®GU4190 overheat watch panel
- R&S®GU4190A remote alarm unit to R&S®GU4190 overheat watch panel (for external installation)

Example of an equipment rack type C with R&S®KL4193M water cooling set installed.

Water-cooled HF broadband system (two blocks consisting of four radios each = eight lines)



R&S®KL4192M heat exchanger

Brief description

The task of the R&S®KL4192M heat exchanger is to ensure the required operating conditions for two R&S®M3SR Series4100 radios, preventing excess heat dissipation in the room that houses the system.

The heat exchanger is used to cool the warm air generated by the following units:

- Two R&S®VK4190 power amplifiers
- Two R&S®IN4190 power supplies

These units have to be installed in a single equipment rack. A broadband block (the smallest version available for broadband systems), for example, requires two equipment racks (racks A and B), each equipped with an R&S®KL4192M heat exchanger. The R&S®KL4192M consists of the following main components:

- One heat exchanger
- One automatic air-release valve

Detailed view of heat exchanger.

It also includes an installation kit with connection pipes (flexible tubes), condensation drain and two manual valves.

Key facts

- For the installation of two R&S®VK4190 power amplifiers (1 kW), two R&S®IN4190 power supplies (1 kW) and one R&S®FK4192 RF power combiner (total of 21 HU)
- For installation in standard 19" equipment racks (W × D: 600 mm × 800 mm)
- For installation on board ships with unreliable water quality

Electrical design

The R&S®KL4192M heat exchanger has no electrical components.

Mechanical design

The R&S®KL4192M heat exchanger comprises four blocks, as shown in the schematic diagram on the next page:

- The heat exchanger allows conversion of calorimetric energy from an air stream passing the heat exchanger into calorimetric energy that is dissipated in water supplied as cooling water
- The automatic air-release valve in the pipe feeding into the heat exchanger releases any air that may be inside the pipe system
- Two manual valves are installed into each of the pipes for the cooling water supply and the cooling water return. The manual valves are also the connection point to the ship's water cooling system
- The "vented reservoir" is installed beneath the heat exchanger. It collects condensation water which is conducted by a flexible tube to the drain connection point of the ship's water cooling system

R&S®KL4193M water cooling set

Brief description

The task of the R&S®KL4193M water cooling set is to provide the necessary infrastructure for the water-cooled dummy loads to protect them from damage caused by thermal overload. The R&S®KL4193M also prevents excess condensation water occurring with dummy loads in operating modes where RF power dissipation is not necessary.

RF power is fed from the combiners into the respective dummy load via a coaxial cable and converted into heat.

The R&S®KL4193M water cooling set is designed primarily for use on board ships but can also be used in any system where cooling water is supplied. The R&S®KL4193M provides the operating conditions required by the R&S®ZW4193M/R&S®ZW4194M water-cooled dummy loads. It consists of the following main components:

- One temperature-controlled mixing valve
- One 115 V circulating pump
- One water flow sensor

It also includes an installation kit, including distribution tubes, automatic air-release valves, connection pipes (flexible tubes) and condensation drain.

Key facts

- Connection for two sets of R&S®ZW4193M water-cooled dummy load (1+2+1 kW) (each with two absorbers for level 1 combiners and one absorber for level 2 combiners)
- Connection for one R&S®ZW4194M water-cooled dummy load (4 kW) (absorber for level 3 combiner)
- For use in systems with more than two broadband blocks: sufficient cooling capabilities for connecting an additional R&S®ZW4194M water-cooled dummy load (4 kW; absorbers for level 4 or level 5 combiners)
- Circulating pump with 115 V supply voltage
- Temperature-controlled mixing valve to prevent excess condensation in the components
- Equipped with one water flow sensor (for connecting to R&S®GU4190 overheat watch panel) for monitoring whether the circulating pump is working
- For installation in standard 19" equipment racks (W × D: 600 mm × 800 mm)
- For installation on board ships with unreliable water quality

Electrical design

- Water-cooled dummy loads: The R&S®ZW4193M and R&S®ZW4194M water-cooled dummy loads are not part of the R&S®KL4193M water cooling set (see pages 100 and 101).
- Circulating pump: A 115 V circulating pump installed in the "internal" cooling circuit supplies the water-cooled dummy loads with cooling water. The flow rate can be adjusted manually on the circulating pump.
- Water flow sensor: For monitoring the circulation of cooling water through the dummy loads, a water flow sensor is installed in the pipe feeding the dummy loads. The water flow sensor is a compact, single-point flow monitor. The water flow sensor monitors the flow rate by measuring the temperature difference of the water flowing from the tip. The amount of thermal energy that is dissipated at the tip determines the local flow rate. This temperature-based operating principle makes it possible to reliably monitor the water flow. The sensor tip contains a heating element and two sensing elements: One sensing element is located close to the flowing water to detect changes in water flow velocity; the other is affixed to the cylindrical wall to detect changes in water temperature.

Mechanical design

- Temperature-controlled mixing valve: The main component of the R&S®KL4193M water cooling set is a temperature-controlled mixing valve. This valve makes it possible to combine the "internal" cooling circuit with the circulating pump.
  The temperature-controlled mixing valve consists of a three-way valve with thermostat, capillary tube and temperature sensor. The temperature sensor can be separated from the three-way valve and is installed in the pipe feeding the water-cooled dummy loads. It is connected with the capillary tube to the three-way valve. No electrical control is needed for regulating the temperature.
- Circulating pump: A circulating pump with an operating voltage of 115 V is installed in the "internal" cooling circuit to supply the water-cooled dummy loads with cooling water. The flow rate can be adjusted manually on the circulating pump.
- Water flow sensor: To monitor the water circulation through the dummy loads, a water flow sensor is installed in the pipe feeding the dummy loads.

R&S®ZW4193M water-cooled dummy load (1+2+1 kW)

Brief description

The R&S®ZW4193M water-cooled dummy load (1+2+1 kW) includes two dummy loads (absorbers) for level 1 combiners (see figure, dummy loads 1 and 3 on left and right) and one for a level 2 combiner (see figure, dummy load 2 in middle). All these combiners are part of a four-line broadband block, which is the smallest type of broadband system.

RF power is fed from the combiners into the respective dummy load via a coaxial cable and converted into heat. To prevent thermal overloading of the dummy loads, the heat has to be dissipated by the cooling water. To protect the R&S®ZW4193M from overheating (for example, if the water flow has stopped or is insufficient for the RF power that is supplied), the device is equipped with three overheat sensors (one at each dummy load/absorber).

These overheat sensors have to be connected to the R&S®GU4190 overheat watch panel, which detects overheating on the R&S®ZW4193M and controls the associated R&S®GV4190D power management unit (PMU), which is the main component of a four-line broadband block.

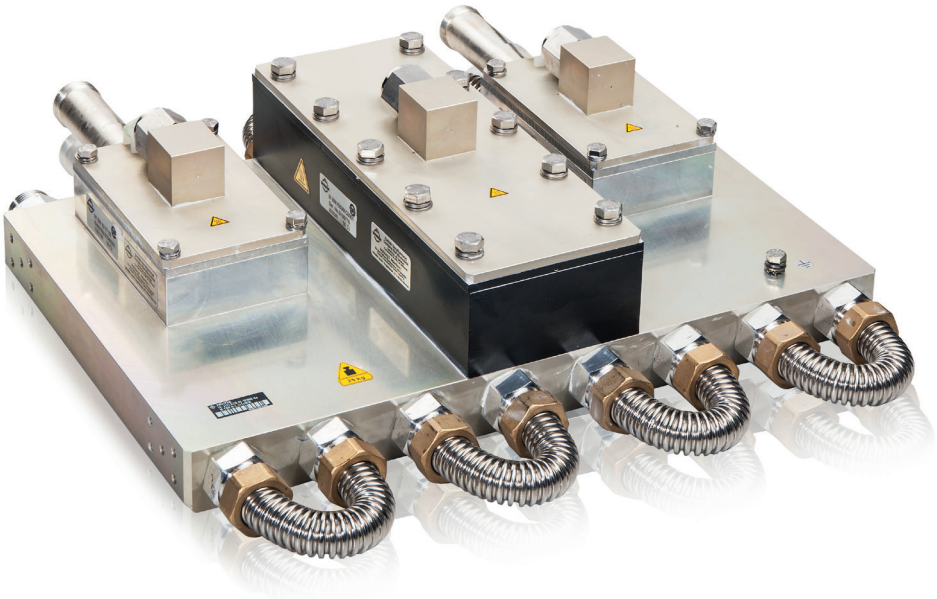
Key facts

- No power supply required
- Similar to a 19" unit with 4 HU for installation in standard equipment racks equipped with an R&S®KL4193M water cooling set
- For installation on board ships with unreliable water quality
- Developed for navy ships (fixed installation on surface ships, metallic, below deck)

Electrical design

- Dummy loads: The dummy loads are designed for dissipating the rated power
  - Dummy load 1 and 3: 1.25 kW
  - Dummy load 2: 2.5 kW
- Overheat sensors: The R&S®ZW4193M is equipped with overheat sensors (bimetallic switches with automatic reset) to monitor the maximum permissible temperature. These sensors have a breaking contact that opens at +80 °C. Because different dummy loads can be supplied with RF power independently of each other, one overheat sensor is installed for each dummy load.

R&S®ZW4193M water-cooled dummy load (1+2+1 kW) (with cooling block below; vented reservoir not shown).



R&S®ZW4194M water-cooled dummy load (4 kW)

Brief description

The R&S®ZW4194M water-cooled dummy load (4 kW) includes one dummy load for the level 3 combiners. These are the highest level combiners in a system with two four-line broadband blocks (eight lines). The largest broadband block system has eight four-line blocks, i.e. with additional combiners at levels 4 and 5. The R&S®ZW4194M water-cooled dummy load (4 kW) is also applicable as absorbers for the combiners at levels 4 and 5.

RF power is fed from the combiner into the dummy load and converted into heat. The R&S®ZW4194M is equipped with one overheat sensor to prevent it from overheating (e.g. if the water flow has stopped or is insufficient for the RF power that is supplied).

The overheat sensor has to be connected to the R&S®GU4190 overheat watch panel, which detects whether the R&S®ZW4194M is overheating and switches off the RF power fed to the dummy load. The overheat watch panel is controlled by all the overheat sensors on the water-cooled dummy loads. It controls the respective R&S®GV4190D power management unit (PMU), which is the main component of a four-line broadband block.

Key facts

- No power supply required
- Similar to a 19" unit with 4 HU for installation in standard equipment racks with R&S®KL4193M water cooling set
- For installation on board ships with unreliable water quality
- Developed for naval ships (fixed installation on board ships, metallic, below deck)

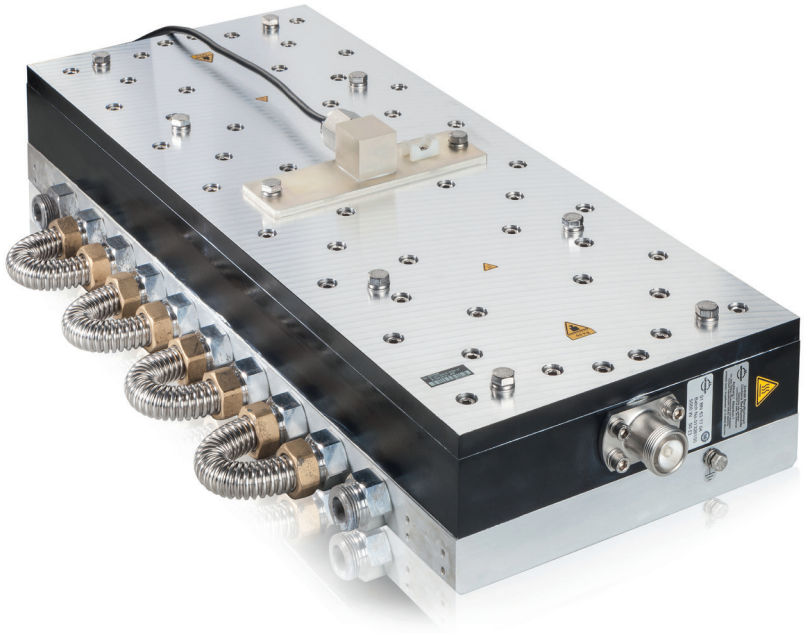
Electrical design

- Dummy load: The dummy load is designed for 5 kW dissipation.
- Overheat sensor: The R&S®ZW4194M is equipped with an overheat sensor (bimetallic switch with automatic reset) to monitor the maximum permissible temperature. The sensor has a breaking contact, which opens at +80 °C.

Mechanical design

- Dummy load: The dummy load is installed on top of a cooling block, which has holes for circulating cooling water.

R&S®ZW4194M water-cooled dummy load (4 kW)
(with cooling block below; vented reservoir not shown).



R&S®GU4190 overheat watch panel, R&S®GU4190A remote alarm unit

Brief description

The R&S®GU4190 overheat watch panel (OWP) monitors the water cooling components and protects them from overloading. The OWP is controlled by overheat sensors at the water-cooled dummy loads and controls the R&S®GV4190D power management units (PMU), which are the main components of a four-line broadband block. The task is to ensure that dummy loads are always protected against damage caused by thermal overload while at the same time preventing transmissions from being aborted unnecessarily.

If one of the connected dummy loads is overloaded, the overheat watch panel indicates this state to the PMU. This interrupts all transmission from the connected radios. The front panel of the overheat watch panel is equipped with LEDs that indicate which overheat sensor has triggered and which PMU has been disabled. The signaling of the disabled PMU has a four-level hierarchy (level 1 + 2, level 3, level 4 and level 5), which is necessary for systems with more than four four-line broadband blocks (two OWP required). In applications with two four-line blocks per OWP, the required hierarchy levels are limited (level 1 + 2 and level 3).

The overheat watch panel is additionally equipped with an input for a water flow sensor (WFS) which is installed in the R&S®KL4193M water cooling set. It is located in the water supply of the water-cooled dummy loads. The sensor indicates whether the required volume of water is circulating throughout the dummy loads. If this is not the case, the overheat watch panel indicates this state to a connected remote alarm unit (RAU). The RAU signals this state with both an acoustic and visual alarm. The acoustic alarm can be reset on the RAU by pressing a reset button. The RAU shows the visual alarm and that the acoustic alarm has been reset. An additional interface at the overheat watch panel with a relay contact is provided to indicate alarms triggered by the water flow sensor on other equipment such as a remote control system.

Key facts

- Monitors one water flow sensor (WFS)
- Controls one remote alarm unit
- Remote control (RC) interface signaling WFS status information
- Monitors up to eight overheat sensors at water-cooled dummy loads:
  - Four at level 1 + 2
  - Two at level 3
  - One at level 4
  - One at level 5
- Controls up to four R&S®GV4190 power management units (PMU)
- Provides an interface for interconnecting several R&S®GU4190 overheat watch panels (required for large systems with more than four four-line blocks)
- Power supply, 100 V to 240 V AC
- Secondary power supply, 19 V to 32 V DC
- 19" unit, 1 HU

R&S®GU4190A remote alarm unit.

R&S®GU4190 overheat watch panel.

Product overview

HF broadband system

Designation	Type
Base units	
Power management unit, incl. HF receiver/exciter functionality, base unit, DC, without local control panel and radio software	R&S®MR4100G-B
HF receiver/exciter, base unit: DC, without local control panel and radio software	R&S®MR4100G
Radio software	
Software CD without export restriction	R&S®DS4100A
Software CD with export restriction	R&S®DS4100D
Hardware options	
Local control panel (without audio, incl. software and LAN)	R&S®GB4000C
Digitally tuned RF selection, 40 dB, functional for transmitting and receiving section (mandatory option)	R&S®FK4140
NMEA (DSC) interface, for connection to an external DSC controller (GMDSS)	R&S®GS4102
Power amplifier	
1000 W HF power amplifier, prepared for R&S®ZW2910 option	R&S®VK4190
Termination resistor, 200 W, for receive path incl. connecting cable (mandatory option)	R&S®ZW2910
Power supply units	
Power supply, 115 V AC, 1 phase + N or 230 V AC, 1 or 3 phases + N/208 V AC, 3-phase Δ	R&S®IN4190
Power supply, 440 V AC, 3 phases (used together with R&S®BV4190 transformer)	R&S®IN4190
Transformer, 440 V AC, 3-phase Δ	R&S®BV4190
System components	
Power combiner, 2 kW	R&S®FK4192
Power combiner, 4 kW	R&S®FK4194
Antenna triplexer	R&S®FK2950
Antenna diplexer	R&S®FK2960

Water cooling equipment for HF broadband systems

Designation	Type
Heat exchanger	R&S®KL4192M
Water cooling set	R&S®KL4193M
Water-cooled dummy load (1+2+1 kW)	R&S®ZW4193M
Water-cooled dummy load (4 kW)	R&S®ZW4194M
Overheat watch panel	R&S®GU4190
Remote alarm unit	R&S®GU4190A

R&S®M3SR Series4400 Software Defined Radios

To ensure secure radiocommunications and successful accomplishment of missions, today's stationary radiocommunications solutions for civil and military applications must meet extremely demanding RF requirements and also provide high operating reliability. The R&S®M3SR Series4400 software defined radio family is designed for stationary civil and military secure voice and data communications. It features high modularity and outstanding specifications.

The R&S®M3SR Series4400 radios provide continuous AM and FM transmission coverage from 100 MHz to 512 MHz. The radios were developed in line with international civil air traffic control guidelines and standards (ICAO Annex 10, EN 300676). The radios also fulfill UHF communications requirements in line with EN 302617.

The R&S®M3SR Series4400 offers military customers a wide range of interfaces and associated proprietary frequency hopping waveforms, as well as radiocommunications in line with NATO standards. Military data transmission methods such as LINK 11 and LINK 22 are supported. To ensure that existing R&S®M3SR Series4400 systems remain up-to-date, their functionality can be enhanced through subsequent software downloads and, if necessary, by using new hardware modules.

Key facts

- Extended frequency range from 100 MHz to 512 MHz for coverage of various civil and military communications modes
- Output power up to 100 W for deployment with EPM (ECCM) waveforms for increased performance
- TCP/IP-based interfaces for remote control, voice over IP (VoIP) and for service/maintenance activities
- Simple network management protocol (SNMP) for establishing radiomonitoring and remote control applications with automated TRAP reporting
- Continuous transmission at temperatures up to +55 °C
- Interfaces for external cipher units and modems

Benefits and key features

Secure communications

- NATO and proprietary EPM (ECCM) waveforms
- 70 MHz up/downconverter for external modems (optional)
- Methods for secure data transmission over TDMA-based radio networks (optional)
- Interface for external encryption devices
- Remote key loading
- Support for various LINK methods

Ease of operation

- Intuitive graphical user interface (GUI)
- Password-protected access
- Plain-text status and warning messages
- Automatic remote control access management

Flexible range of applications
- Software defined radio concept
- VoIP interface (optional)
- Highly modular design enables scalable radios
- Flexibility when selecting the voltage source (multirange AC power supply, direct DC input)

Unrivaled radio parameters
- Excellent RF characteristics
- Robust design for unfavorable RF conditions
- Integratable UHF circulator with VHF bypass function for improved intermodulation rejection (optional)
- Frequency agile pre/postselector for best interference-free operation (optional)
- 70 MHz wideband interface for modem applications (optional)

Flexible and safe investment for the future
- Hardware and software upgrades
- Integrated in the NATO logistics structure
- Low lifecycle costs

Low maintenance
- IP-based maintenance tool supporting radio cloning
- Powerful built-in test (BIT)
- No tuning of the RF modules required
- High reliability

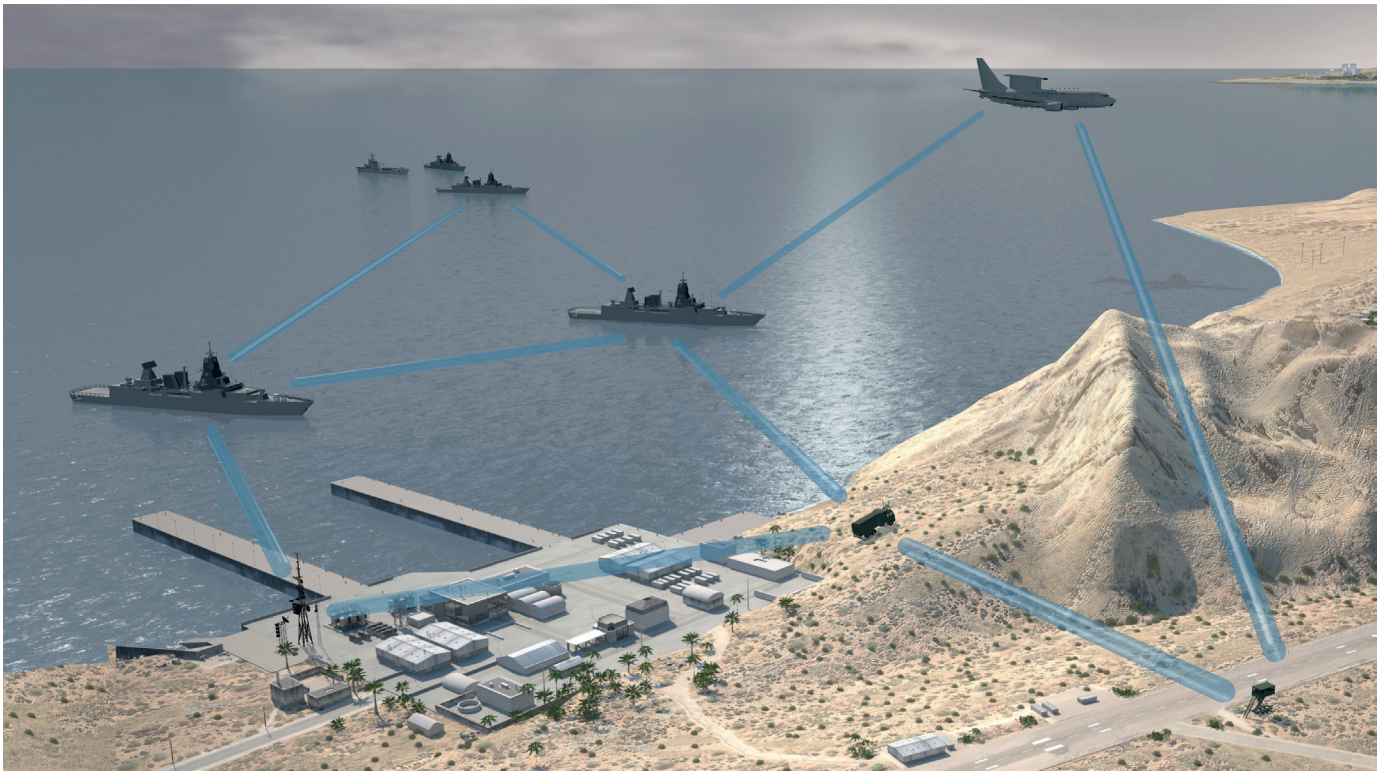
Sample applications
- Radios in the R&S®MX400 mobile ATC tower
- Remote control and monitoring of radios
- High data rate network solutions
- Voice over Internet protocol (VoIP)

Secure communications
The R&S®M3SR Series4400 radio family features a range of different methods for transmitting voice and data. Such functional features are loaded in the radio as software and with optional hardware. The R&S®M3SR Series4400 radio family also has diverse standardized interfaces for connecting external modems in order to support special transmission methods. The wider transmission bandwidths enable higher throughput rates.

NATO and proprietary EPM (ECCM) waveforms
In addition to supporting the well-established NATO EPM (ECCM) UHF waveforms HAVE QUICK I/II and SATURN, the R&S®M3SR Series4400 radio family also features a range of proprietary waveforms.

External encryption devices such as the ELCRODAT 4-2, which are used in NATO applications in conjunction with EPM (ECCM) waveforms, can be easily connected to and operated with the R&S®M3SR Series4400.

R&S®M3SR Series4400 radios used on ground, naval and airborne installations for seamless voice/data communications networks.



Proprietary EPM (ECCM) waveforms such as R&S®SECOS contain embedded software encryption for secure communications. Together with customer-specific algorithms and methods for secure data transfer, users benefit from a comprehensive, versatile communications package.

Multiple EPM (ECCM) waveforms can be loaded into a radio — for instance HAVE QUICK I/II together with R&S®SECOS. The desired waveform can be selected by using the remote control unit or the built-in local control panel.

70 MHz up/downconverter for external modems (optional)

The R&S®UX4401 module with 70 MHz IF converter interface is designed for use with a variety of existing external modems that have a standard IF interface. This RF interface allows the use of diverse waveforms with wider transmission bandwidths, enabling high data rates. Fine adjustment of the radio parameters helps achieve a wider range coverage.

Methods for secure data transmission over TDMA-based radio networks (optional)

Via the R&S®SECOS waveform, the R&S®M3SR Series4400 radio family supports different data transmission modes, including time division multiple access (TDMA). In a TDMA network, a large number of participants can be part of a structured data network over which data information is automatically exchanged. Network participants can switch dynamically between different TDMA networks. Multiple TDMA subnetworks can be combined into a large data network. Data can be exchanged across all subnetworks involved. Data transmission is encrypted using either fixed frequency mode or frequency hopping.

Interface for external encryption devices

The radio wideband interfaces of the R&S®M3SR Series4400 are specially designed for operation with external encryption devices. The radio interface supports a wide range of external encryption devices and supports baseband and diphase transmission modes.

Remote key loading

In conjunction with the proprietary EPM (ECCM) waveform, encrypted configuration data can be loaded directly into the R&S®M3SR Series4400 radios via the remote control interface. This data can consist of new keys or data sets for secure communications. This vastly simplifies the management, structure and configuration of such systems.

Support for various LINK methods

Besides EPM (ECCM) waveforms, the R&S®M3SR Series4400 radio family supports tactical digital information link (TADIL) methods such as LINK 11 and LINK 22. Both methods are an integral part of the current and future NATO communications structure.

Ease of operation

Rohde&Schwarz has extensive experience with stationary radios, which is reflected in the operating concept of the R&S®M3SR Series4400 radios. The display and control elements are arranged in a user-friendly manner and are easy to understand.

Intuitive graphical user interface (GUI)

Complex radio methods require an intuitive user interface. The user interface of the R&S®M3SR Series4400 radio family is clearly laid out and uses icons for intuitive control. These icons allow the user to immediately draw conclusions regarding the current operating mode of the radio without pressing a key, which significantly increases ease of operation. They also simplify orientation in the menu structure of the control unit to ensure fast and reliable configuration of the radio.

The GUI is presented on the TFT display of the R&S®GB4000C control unit, which is available as a standalone or built-in version.

Password-protected access

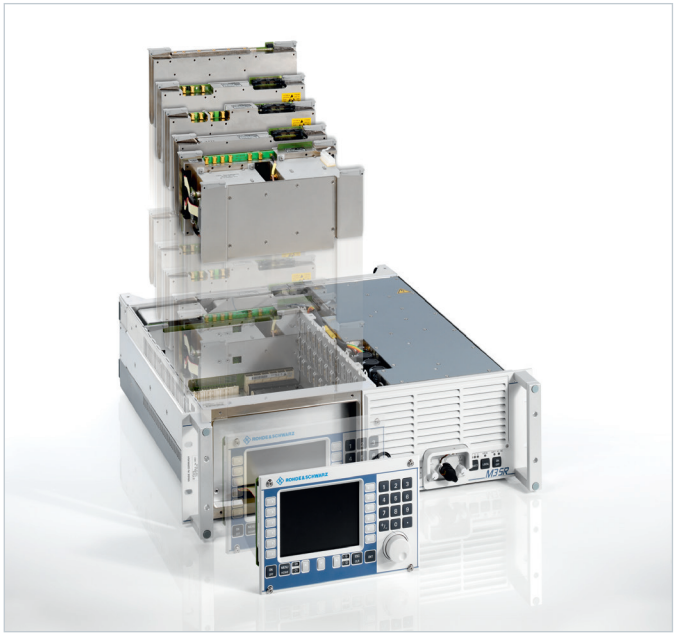
The settings for maintenance and configuration of the radio are protected by a password. This ensures that only authorized personnel can carry out maintenance or in-depth configuration of the radio. This concept is based on many years of practical experience.

Plain-text status and warning messages

Because status and warning messages are highly important to the user, they are visually differentiated from the rest of the display. Messages are displayed in a menu in plain text so that any user can immediately comprehend them. Critical and waveform-dependent status messages are color-coded. All warning messages are stored in the

R&S®GB4000C local/remote control unit.

Modular design of the R&S®M3SR Series4400 radio family.



R&S®M3SR Series4400 used on naval platforms.

R&S®M3SR Series4400 used for civil/military ATC applications.

radio for later analysis. Readout and storage in an external medium is possible with the R&S®ZS4400 service and maintenance tool.

Automatic remote control access management
For large-scale systems that have multiple local or remote control units, access management is necessary in order to enable remote control of the radios. The GUI displays the access authorization level and the status of the radio remote control links for immediate overview.

Flexible range of applications

In order to meet the individual needs of the customers, the R&S®M3SR Series4400 radio family features a highly modular design. Depending on the mission scenario, the radios are configurable to provide the specific functions that are required.

Software defined radio concept
Software can be loaded into the radio using the R&S®ZS4400 service and maintenance tool. Numerous software packages are available for this purpose. This approach also allows functional enhancements to be loaded at a later time. That means existing software functions can be enhanced without opening the radio or replacing hardware modules.

The current status of the software is shown in a comprehensive inventory report, which contains the versions of the software and its components.

Highly modular design enables scalable radios
The R&S®M3SR Series4400 radio family features a highly modular design. The maintenance-friendly structure shortens repair times (MTTR) and makes it easy to adapt the system to customer requirements. All R&S®M3SR Series4400 radios have the same base configuration, a logistical platform for scalability. The radio modules are updated by replacing them with new versions.

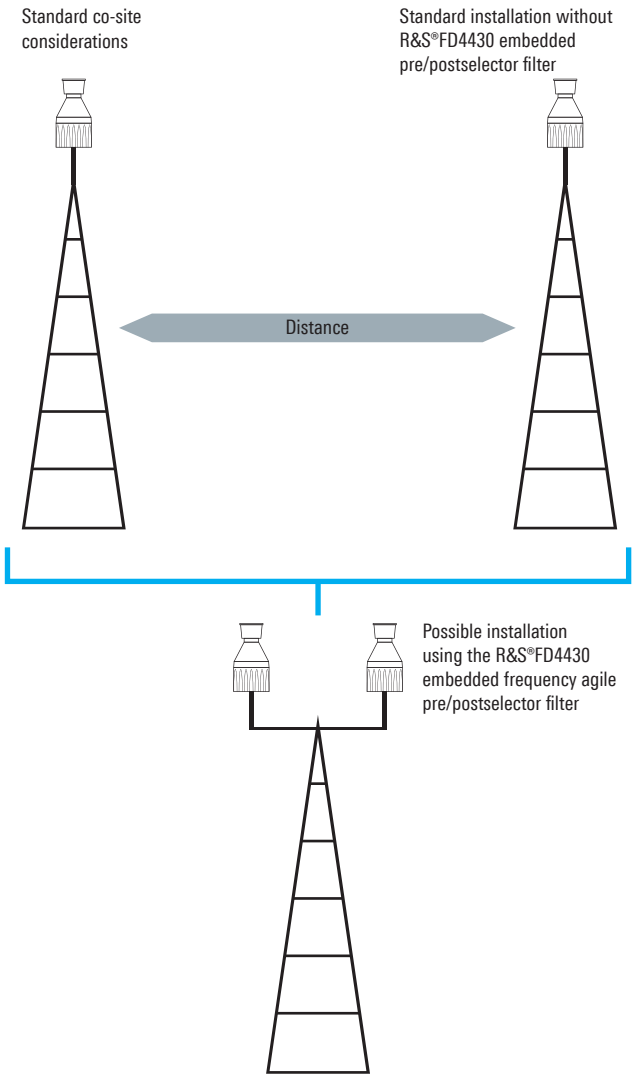
R&S®M3SR Series4400 in an R&S®MX400 mobile tower.

The modular design allows the radio to be equipped with new functions and options.

VoIP interface (optional)
The radio provides a VoIP interface in addition to the analog ports. The VoIP interface allows users to establish redundant and IP-based communications systems using modern system concepts. The radio provides a state-of-the-art voice communications solution in line with the EUROCAE ED-137 standard to ensure international interoperability.

Flexibility when selecting the voltage source (multirange AC power supply, direct DC input)
All R&S®M3SR Series4400 radios come with two independent DC inputs. One input is used for the main power supply, and the other for a redundant source. The radio monitors both inputs. An external multirange AC power supply available from Rohde&Schwarz enables operation of the radio with conventional AC power grids. The power supply is monitored automatically by means of a BIT function in the R&S®M3SR Series4400 radio. The AC power supply complies with current standards and contains active power factor correction. Supply voltage fluctuations are compensated for without affecting radio operation.

Transceiver co-site considerations



Unrivaled radio parameters

Excellent RF characteristics
The R&S®M3SR Series4400 radio family features excellent RF characteristics. The combination of analog and digital technology provides high signal purity that results in optimal transmission quality and extremely clear voice communications. Very fast frequency hopping and compatible filter methods yield an optimal RF signal spectrum, significantly reducing collocation influence typically caused by adjacent transmit and receive stations.

Frequency generation in the R&S®M3SR Series4400 systems is performed by a special, state-of-the-art synthesizer module to provide spectrally pure signals and ensure high-quality radio links. Very rapid frequency generation and frequency setting enables the use of fast EPM (ECCM) waveforms while retaining the high quality of the RF signals.

Robust design for unfavorable RF conditions
R&S®M3SR Series4400 radios are prepared for unfavorable RF environments. Even antennas that create a high voltage standing wave ratio (VSWR) can be connected without difficulty. The impact of high receive levels is compensated for by excellent RF large-signal immunity. Protection circuits prevent damage to the R&S®M3SR Series4400 modules.

Integratable UHF circulator with VHF bypass function for improved intermodulation rejection (optional)
The R&S®M3SR Series4400 radio family can be equipped with an optional UHF circulator. The circulator helps to significantly reduce intermodulation products, which further improves system performance.

Integrating a circulator into the radio eliminates the need for complex external circuitry and measures. The circulator is equipped with a bypass for the VHF band and is available as an upgrade kit.

Frequency agile pre/postselector for best interference-free operation (optional)
Many radios require a large number of antennas that must be properly decoupled to prevent the effects of collocation. To minimize these influences, the R&S®M3SR Series4400 radio family can be equipped with an optional filter. The R&S®FD4430 filter provides additional RF decoupling to permit vastly interference-free op-

eration in demanding RF environments. Wideband noise generated by the radios as well as the influence of cross-modulation are considerably reduced.

The R&S®FD4430 filter works with EPM (ECCM) waveforms. The ability to integrate the filter into the radio saves space and reduces installation effort.

70 MHz wideband interface for modem applications (optional)

The R&S®M3SR Series4400 provides a 70 MHz IF interface for operation with external modem solutions. The interface provides a wideband IF channel for high data rate applications up to Mbps. The module can adapt to different IF operating levels. The user can select the RX gain control mode and the transmitted power.

Flexible and safe investment for the future

R&S®M3SR Series4400 radios offer a safe investment for the future. The flexible concept is designed for long-term use. The functionality of the system can be expanded via hardware and software to adapt it to new requirements.

Hardware and software upgrades

The software defined architecture of the R&S®M3SR Series4400 radios makes it possible to procure equipment with the required, up-to-date functionality. Upgrading and reconfiguring at a later point enables the user to adapt the system to changing requirements and needs. This permits a timely response to new standards and customer requirements and as a result is the most cost-effective approach to procuring radio equipment.

Integrated in the NATO logistics structure

The R&S®M3SR Series4400 radio family is included in the NATO logistics structure. Current R&S®M3SR Series4400 radio models have a corresponding NATO stock number (NSN).

The parts and components were selected specifically with reliability and long-term availability in mind to assure their reliable procurement over a long time frame. When selecting parts, Rohde&Schwarz relied on its decades of experience in the production of high-quality electronic equipment.

Low lifecycle costs

The R&S®M3SR Series4400 radio family features convincingly low lifecycle costs that are achieved through:

- Minimum training due to the user-friendly GUI concept
- Fast on-site repairs due to module replacement; very low MTTR (15 min)
- Integrated, highly-precise, stable clocking source (OCXO)
- Washable, reusable dust protection
- Software-regulated cooling fans
- High MTBF

R&S®M3SR Series4400 radios used in semi-mobile installations.

Low maintenance

The R&S®M3SR Series4400 radios were developed with low maintenance in mind. A variety of control and monitoring functions are available that support the user with detailed status information about the radios. Built-in test functions permit service and maintenance tasks to be carried out in a targeted manner. The radios can be remotely analyzed, eliminating the need for on-site service. Resistance to vibrations and a wide operating temperature range allow the radios to be used in diverse applications.

IP-based maintenance tool supporting radio cloning

The IP-based R&S®ZS4400 service and maintenance tool is a vital accessory for the R&S®M3SR Series4400 radios. It works in any standard IP network, requires no additional cable and can be used on conventional computers.

A wealth of useful functions not only track the status of the radios in detail, but also transfer configurations from one radio to another (cloning). Cloning permits the fast, time-saving and error-free dissemination of radio-specific settings to the R&S®M3SR Series4400 radios. Cloning makes it easier to replace a radio with another radio of the same type if service and maintenance is required. The R&S®ZS4400 service and maintenance tool is also used to load the radio software.

Powerful built-in test (BIT)

In addition to the normal power-on BIT (PBIT) and continuous BIT (CBIT), the R&S®M3SR Series4400 also features an initiated BIT (IBIT) for checking the receive and transmit functions of the system. The transmitter and receiver are tested by means of an internal loopback. The radio analyzes the signal on the receive side and documents any deviations. The R&S®GB4000C remote/local control unit contains an IBIT that can also be used to perform an on-site interactive check of the functions. The IBIT can be carried out after radio upgrade or at regular intervals without external test equipment.

No tuning of the RF modules required

The R&S®M3SR Series4400 radio modules require no calibration. If a module is replaced or if a radio is extended with additional modules, no manual settings are required on the modules.

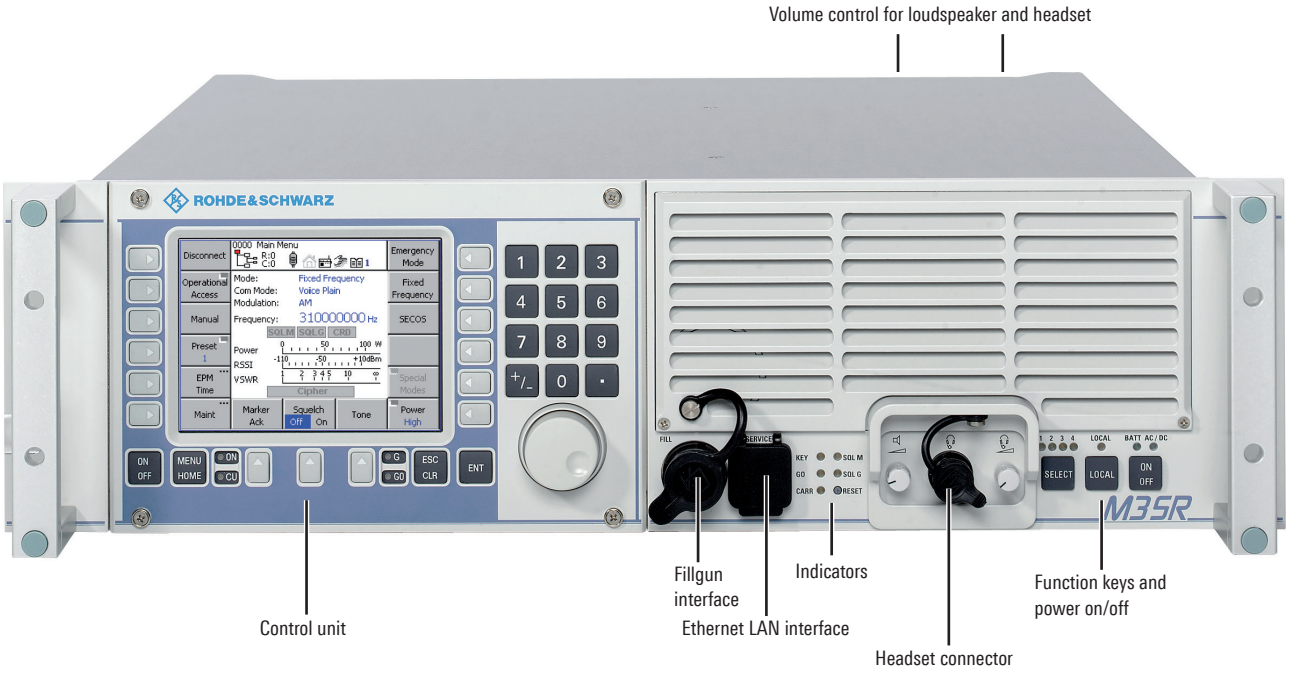
A built-in, high-grade oven-controlled crystal oscillator (OCXO) ensures high frequency accuracy.

High reliability

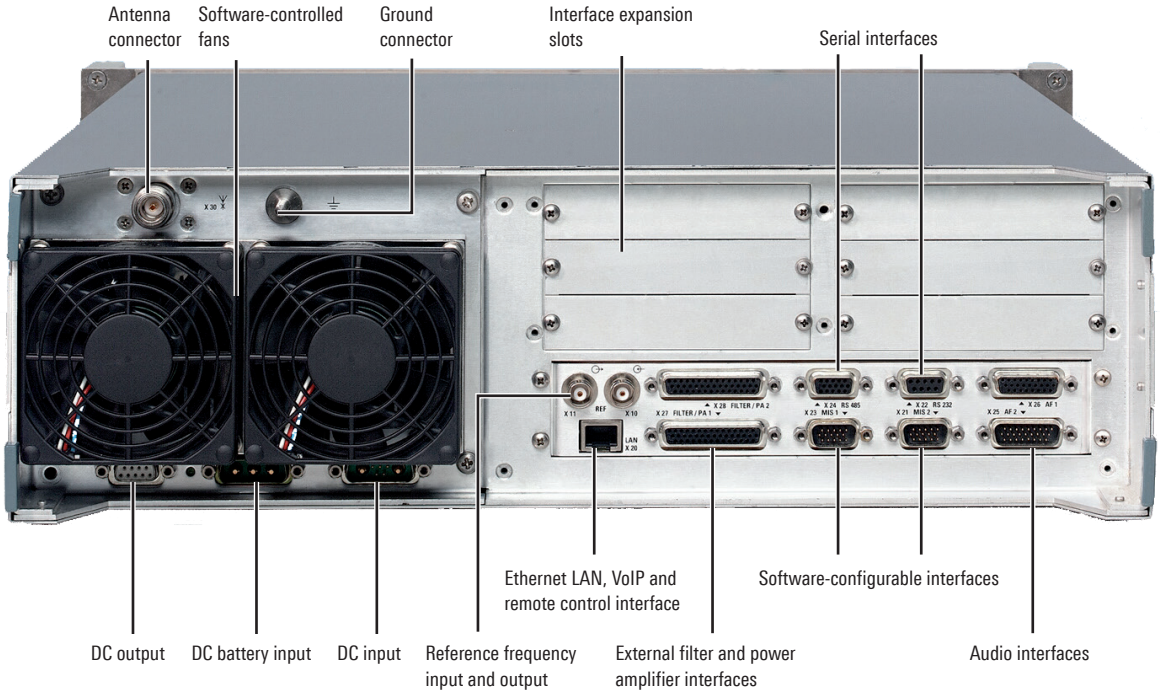
Rohde&Schwarz boasts decades of experience in the design and production of electronic modules, particularly in the field of RF technology, which ensures that its R&S®M3SR Series4400 radios provide a high level of reliability and functional readiness.

The perfect synergy of mechanics, temperature monitoring and cooling makes sure that high ambient temperatures, vibrations and humidity do not impact performance or cause damage to the radio. The extremely powerful, software-controlled cooling assures stable continuous operation and long life even in unfavorable ambient conditions such as low air pressure. The MTBF achieved in practice is more than 80 000 operating hours.

Front view elements



Rear view elements



Options

Thanks to its modular design, the R&S®M3SR Series4400 radio family features a range of interesting options that can be retrofitted in existing systems:

- Hardware options
- Software options
- Combined hardware and software options

The options are managed and activated with the R&S®ZS4400 service and maintenance tool, which belongs to the R&S®M3SR Series4400 equipment family.

Selection of typical retrofittable options for the R&S®M3SR Series4400		
Software option	R&S®DS4400A-U	upgrade kit for LINK 11/LINK Y mode
Software/hardware option	R&S®DS4400J-U	HAVE QUICK I/II upgrade kit with EPM (ECCM) processor
Software/hardware option	R&S®DS4400M-U	SATURN upgrade kit with EPM (ECCM) processor
Software/hardware option	R&S®DS4400L-U	R&S®SECOS 5/16 TDMA upgrade kit with EPM (ECCM) processor
Hardware option	R&S®FD4430-U	integrated frequency agile UHF pre/postselector
Hardware option	R&S®ET4000G-U	guard receiver for VHF and UHF distress frequencies
Hardware option	R&S®UX4401-U	70 MHz IF converter interface for UHF data applications
Hardware option	R&S®GI4403-U	antenna interface upgrade kit for separate receive and transmit antennas
Hardware option	R&S®GI4405-U	main receiver antenna switch

Radio options		
Option key	R&S®GS4000VP	license for voice over Internet protocol (VoIP)
Option key	R&S®GS4000MT	license for multitone modem support

Software package for the R&S®M3SR Series4400 radio family.

Product overview

Transceiver with fixed frequency functionality

Available equipment as listed, other equipment on request.

Designation	Type
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; fixed frequency; with local control unit, OCXO, ruggedized	R&S®XT4410A
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; fixed frequency; with local control unit, OCXO; R&S®ET4400G, UHF circulator and VHF bypass; ruggedized	R&S®XT4410A
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; fixed frequency; without local control unit; with OCXO; ruggedized	R&S®XT4460A
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; fixed frequency; without local control unit; with OCXO, R&S®ET4400G, R&S®GT4403 model .03; ruggedized	R&S®XT4460A

Transceiver with HAVE QUICK I/II; R&S®SECOS functionality

Available equipment as listed, other equipment on request.

Designation	Type
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; HAVE QUICK I/II and R&S®SECOS 5/16; with local control unit, OCXO; ruggedized	R&S®XT4410E
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; HAVE QUICK I/II and R&S®SECOS 5/16; with local control unit, OCXO, R&S®FD4430; ruggedized	R&S®XT4410E

Transceiver with R&S®SECOS functionality

Available equipment as listed, other equipment on request.

Designation	Type
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; R&S®SECOS 5/16; with local control unit, OCXO; ruggedized	R&S®XT4410L
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; R&S®SECOS 5/16 TDMA; with local control unit, OCXO; ruggedized	R&S®XT4410L
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; R&S®SECOS 5/16 TDMA; with local control unit, OCXO, R&S®FD4430; ruggedized	R&S®XT4410L

Transceiver with HAVE QUICK I/II functionality

Available equipment as listed, other equipment on request.

Designation	Type
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; HAVE QUICK I/II; with local control unit, OCXO; ruggedized	R&S®XT4410J
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; HAVE QUICK I/II; with local control unit, OCXO, LINK; ruggedized	R&S®XT4410J

Transceiver with SATURN/HAVE QUICK I/II functionality

Available equipment as listed, other equipment on request.

Designation	Type
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; SATURN/HAVE QUICK I/II; with local control unit, OCXO; ruggedized	R&S®XT4410M
VHF/UHF transceiver, 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; SATURN/HAVE QUICK I/II; with local control unit, OCXO, UHF circulator and VHF bypass; ruggedized	R&S®XT4410M

Accessories

Designation	Type
Mating connector sets	
Mating connector set, suitable for all R&S®M3SR Series4400 radios, with/without circular connector	R&S®ZF4410
Power supplies	
Power supply, AC/DC, front panel with dust filter and prepared for IP32, ruggedized, 19", 1 HU	R&S®IN4000A
Power supply cable, R&S®M3SR Series4400 <--> R&S®IN4000A, length: 0.5 m/1 m/2.5 m	R&S®GK4103
Remote control units	
Control panel for R&S®M3SR, without audio, with software and LAN, DC, ruggedized	R&S®GB4000C
Mating connector set for R&S®GB4000C	R&S®ZF4410
Audio accessories	
Audio unit for R&S®M3SR Series4400 (analog/VoIP), front panel ¼ 19"; for one headset (NF-7 connector)	R&S®GB4000V
Mating connector set for R&S®GB4000V	R&S®ZF4000V
Headset, including microphone, ruggedized, with cable and NF-7 connector	R&S®GA012
Handset, ruggedized, with cable and NF-7 connector	R&S®GA013
Headset, dynamic, with cable and NF-7 connector	R&S®GA015
Headset, ultralight electret microphone, single earphone (dynamic), with cable and NF-7 connector	R&S®GA015L
Microphone, with cable and NF-7 connector, handheld type	R&S®GA016H1
Mechanical accessories	
Protective plate for 19" front panel (for ruggedized R&S®M3SR Series4400 radios only)	R&S®KA4401
Portable case for R&S®M3SR Series4400 and R&S®IN4000A power supply, RAL1002, matt finish, 5 HU	R&S®KK4401
Service and maintenance tool	
Service and maintenance tool (for Windows XP, Windows 7)	R&S®ZS4400

Radio test equipment

Designation	Type
Base system, complete set of radio test equipment including system racks and base software suite	R&S®UCS226XB
R&S®M3SR Series4400 BASE, system interface base; radio adaptation box and cabling set; including specific radio test software package	R&S®UCS-B10

R&S®GT4020 timing system

Description	Type
Timing system	
Epsilon clock model EC2S High-performance reference clock; 4 × 10 MHz, 1 × STANAG 4430	R&S®GT4020

R&S®VD480L UHF power amplifiers

Designation	Type
UHF power amplifier, 100 W, 225 MHz to 400 MHz, 100 W AM carrier/150 W FM linear amplifier with RF bypass relay, 19" rackmount, 6 HU, 230 V/110 V, without control cable	R&S®VD480L
Programming device for R&S®VD480L UHF power amplifier	R&S®ZT480L
Cable	
Control cable, R&S®M3SR <--> R&S®VD480L, length: 1.2 m/2 m	

R&S®Fx221 and R&S®Fx213 VHF/UHF filters and multicouplers

Designation	Type
VHF/UHF filters and multicouplers	
Multichannel (automatic) filters and multicouplers (R&S®Series221)	
UHF automatic filter, 225 MHz to 400 MHz, 300 W FM, 19" rackmount, 5 HU	R&S®FD221
UHF two-port automatic multicoupler, 225 MHz to 400 MHz, 300 W FM, with installation kit for 19" special rack, with two filters	R&S®FD221W2
UHF four-port automatic multicoupler, 225 MHz to 400 MHz, 300 W FM, with installation kit for 19" special rack, with four filters	R&S®FD221W4
UHF three-port automatic multicoupler, 225 MHz to 400 MHz, 300 W FM, with installation kit for 19" special rack, with three filters	R&S®FD221W4
VHF automatic filter, 100 MHz to 162 MHz, 300 W FM, 19" rackmount, 5 HU	R&S®FU221
VHF two-port automatic multicoupler, 100 MHz to 162 MHz, 300 W FM, with installation kit for 19" special rack, with two filters	R&S®FU221W2
VHF four-port automatic multicoupler, 100 MHz to 162 MHz, 300 W FM, with installation kit for 19" special rack, with four filters	R&S®FU221W4
Filter control cable for R&S®M3SR Series4400, length: 2 m/5 m	R&S®ZT297-3
Multichannel (automatic) filters with bypass filter for guard receiver (R&S®Fx213A/214A series)	
UHF automatic filter, 225 MHz to 400 MHz, 50 W AM/100 W FM, 19" rackmount, 3 HU	R&S®FD213A
UHF automatic filter, 225 MHz to 400 MHz, 19" rackmount, 3 HU, with two filters (2 × UHF)	R&S®FD213A2
VHF/UHF automatic filter, 100 MHz to 162 MHz/225 MHz to 400 MHz, 50 W AM/100 W FM, 19" rackmount, 3 HU	R&S®FT213A
VHF automatic filter, 100 MHz to 162 MHz, 50 W AM/100 W FM, 19" rackmount, 3 HU	R&S®FU214A
Control cable for R&S®Fx213A/Fx214A filters, for R&S®M3SR Series4400, length: 2 m	R&S®FU214Z2


WHISKEY
ACTIVE
ROMEO
BETRIEBSGRUPP
WASSERWIRTSCH

Chapter 4
ATC communications

For several decades now, Rohde&Schwarz has supplied radiocommunications systems for a wide range of applications in the aviation sector – from air traffic control and airport communications to airline operational communications, radio test and measurement and the calibration of the equipment used. Rohde&Schwarz has built itself a strong reputation in this safety-critical sector through the outstanding availability and performance of the systems, subsystems and equipment it supplies – a key factor today as the density of air traffic continues to increase steadily.

At the same time, we offer our customers maximum safety of investment. As an independent, global and economically robust company, Rohde&Schwarz is a dependable long-term partner for customers in the aviation sector. The company and its comprehensive portfolio of quality products and solutions possess all the relevant licenses and certifications to serve the industry's requirements.

For air traffic control agencies, airport operators, service providers and the armed forces, absolute system availability is paramount in flight operations. To meet this need, Rohde&Schwarz offers customers an optimized portfolio of solutions and services.

Type	Designation	Description	Page
R&S®Series4200	**Software defined radios**	VHF/UHF radio family for ATC communications	118
Product overview			129
R&S®VCS-4G	**IP-based voice communications system**	Next-generation ATC communications	130

R&S®Series4200 Software Defined Radios

The R&S®Series4200 represents the latest generation of stationary radios for both civil and military air traffic control. Possible applications range from small airport emergency systems requiring only a few radio channels to countrywide communications systems with several hundred radio channels.

Equipment for the VHF and UHF frequency ranges

The R&S®Series4200 is available in six versions: transceiver, transmitter and compact receiver.
The R&S®Series4200 radios for the VHF frequency range (112 MHz to 156 MHz) are suitable for civil applications.

The R&S®Series4200 radios for the UHF frequency range (225 MHz to 400 MHz) are suitable for applications in military air traffic control (air force, navy, army aviation forces). The UHF transceiver allows an external encryption device to be connected.

Wide application range and simplified radio planning, even in challenging environments

The R&S®Series4200 offers an extremely wide range of possible configurations, allowing optimal adaptation to the desired application scenario.
The radios were implemented on a software basis in order to provide users of the R&S®Series4200 with the widest possible range of applications. New functions are implemented through software upgrades that Rohde&Schwarz makes available.

All radios of the R&S®Series4200 are multichannel radios, but they can also be software-configured for reliable operation as single-channel radios. Redundant operation of two radios in order to boost the channel availability is possible without any external monitoring and switching equipment.

Standard functions include 8.33/25 kHz channel spacing for VHF and 8.33/12.5/25 kHz channel spacing for UHF, carrier offset 1 to 5 (VHF), ACARS and VDL mode 2 data mode (VHF), LAN remote control interface, serial interface

Available versions of the R&S®Series4200 radio family

VHF (112 MHz to 156 MHz)

R&S®XU4200
VHF transceiver

R&S®SU4200
VHF transmitter

R&S®EU4200C
compact VHF receiver

for controlling automatic filters, and in-band signaling for push-to-talk (PTT) and squelch (SQ) with the capability to set different tones.

The R&S®Series4200 radios support digital voice transmission using the ITU-T G.703 PCM interface and VoIP in accordance with EUROCAE specifications.

Up to seven VoIP sessions can be established to the receiver or transmitter, allowing multiple VCS or remote audio units to access the radio simultaneously. The radio can be connected to a maximum of two VoIP voice recorders.

One of the highlights of the R&S®Series4200 is the receiver's ability to detect simultaneous transmissions and alert air traffic controllers. Simultaneous transmissions most often occur on radio channels with high traffic volume and can present a safety risk.

Key facts

- VHF frequency range from 112 MHz to 156 MHz
- UHF frequency range from 225 MHz to 400 MHz
- Output power of 50 W for VHF and UHF
- Automatic main/standby operation
- USB service port for configuration and software downloads
- Remote control and remote monitoring via Ethernet interface
- Best signal selection in the receiver
- Data transmission in line with VDL mode 2 standard
- VoIP in line with EUROCAE ED-137
- Detection of simultaneous transmissions in the receiver

Benefits and key features

Easy to use even in challenging environments

- Demanding system requirements of civil air traffic control are met or exceeded
- Excellent RF characteristics
- Adjacent channel power better than required by ETSI standard
- Very low transmitter noise
- High intermodulation rejection
- High output power at high modulation depth
- Very low receiver noise
- Receiver with excellent immunity to interference
- Crossmodulation rejection better than required by ETSI standard
- Two squelch criteria available
- Low noise/low distortion receiver mode

Maintenance-free operation

- Extensive self-test routines
- Simple remote monitoring and remote control
- Automatic adaptation to ambient conditions
- Easy remote switching when using redundant radios
- Electronic inventory and recalibration
- No recalibration for 15 years with optional OCXO

Straightforward operation and configuration

- PC-based tools with graphical user interface
- Reliable protection against operation errors
- Warning messages in case of unauthorized local operation
- Easy remote control and monitoring via IP connection

UHF (225 MHz to 400 MHz)

R&S®XD4200
UHF transceiver

R&S®SD4200
UHF transmitter

R&S®ED4200C
compact UHF receiver

Flexibility for system integration
- Adaptation of in-band signaling for PTT and squelch to existing voice communications systems
- Flexibility in management system selection
- Seamless transition from analog to digital voice transmission in the ground segment
- Support for voice over IP

Small footprint due to compact, modular design
- Very compact design
- Three basic modules: transmitter, receiver, power supply unit

Easy to use even in challenging environments

Particularly in the civil sector, air traffic control places very demanding requirements on the radios used. The VHF radios are operated under conditions involving significant RF interference. High-quality communications are required even in the presence of strong interference. Of course, the radios themselves should generate as little interference as possible.

Demanding system requirements of civil air traffic control are met or exceeded

The transmitters and receivers of the R&S®Series4200 perform as required, particularly in challenging environments. They exhibit outstanding technical characteristics which simplify radio planning. All VHF radios of the R&S®Series4200 comply with or exceed the applicable standards from ICAO (Annex 10, Vol. III) and ETSI (EN 300676).

Excellent RF characteristics

The VHF transmitters use an I/Q modulator with a Cartesian feedback loop. This ensures that the VHF transmitters have excellent RF characteristics.

The following provides a detailed overview of the RF characteristics.

Adjacent channel power better than required by ETSI standard

The adjacent channel power is –70 dB at 25 kHz and –60 dB at 8.33 kHz. This means that these values are 10 dB better than required by the ETSI standard. Receiving stations in the vicinity therefore experience hardly any interference, which gives users increased system reserves and safety of planning.

Very low transmitter noise

The transmitter noise is very low with a value of typ. –145 dBc (1 Hz) at 300 kHz from the carrier or –155 dBc (1 Hz) at 1 % from the carrier. This minimizes spurious emissions from the transmitter, helping to reduce receiver interference particularly in installations involving collocation.

High intermodulation rejection

Due to the high intermodulation rejection, an external circulator is not required in many cases. If an external circulator is used nevertheless, the radio allows evaluation of an external VSWR measurement required in such cases.

High output power at high modulation depth

The 50 W output power at the high modulation depth of 90 % is available even under challenging ambient conditions (temperature, VSWR). The modulation distortion is max. 5 % for a modulation depth of 90 %. A limiter at 95 % prevents overdrive.

The transmitter is designed for 50 W continuous operation (100 % duty cycle). This makes the R&S®Series4200 also ideal for ATIS or VOLMET transmitters.

Very low receiver noise

The VHF receiver has a very low noise factor to provide outstanding reception even under tough conditions. It also offers excellent immunity to interference. In many cases, frequency replanning is therefore not necessary when adding additional channels to existing radio sites.

The receive sensitivity is –107 dBm (measured in accordance with EN 300676). The required –93 dBm receive power in accordance with ICAO Annex 10, Vol. III, provides high planning reserves. This means that high antenna cable losses or insertion losses of receive filters can be tolerated without any impact on receive quality.

Receiver with excellent immunity to interference

The permissible interfering signal for maximum desensitization of 6 dB has a power level of –12 dBm, measured in accordance with EN 300676. This value is 15 dB above the limit specified by ETSI. This ensures reliable and secure reception even under challenging collocation conditions.

Crossmodulation rejection better than required by ETSI standard

The crossmodulation rejection of 95 dB, which is 15 dB above the value specified by ETSI, reduces undesired crossmodulation due to interfering signals. This makes the receiver less susceptible to interference that can hardly be eliminated. External filters are therefore not required in many cases.

Two squelch criteria available

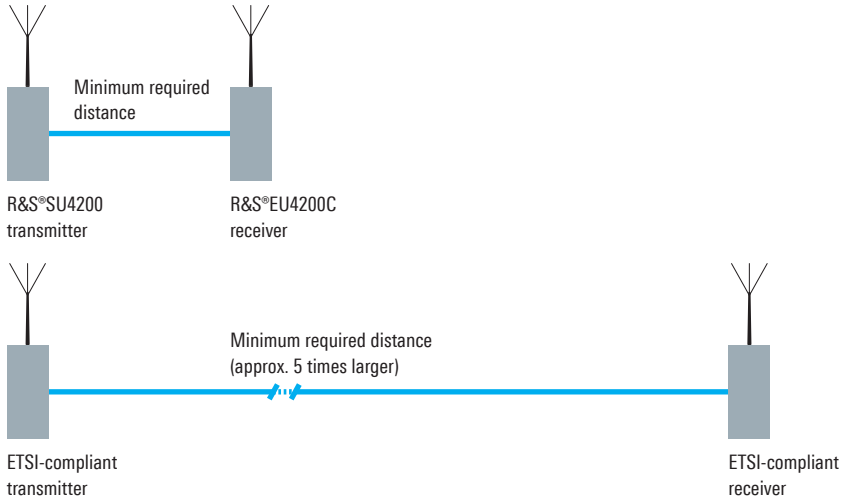
The receiver includes two squelch criteria which can be logically combined (AND, OR). The squelch criterion can be based on the receive power, the S/N ratio of the demodulated useful signal or a logical combination of these two criteria. Both thresholds can be set independently in a wide range.

Low noise/low distortion receiver mode

In an environment with a high noise or interference level, reducing the receiver sensitivity may be necessary in order to achieve better large-signal characteristics. This step makes the receiver less sensitive to interferences. The lower sensitivity is less critical than the gain in signal quality.

The R&S®Series4200 receivers can be configured in the low noise mode or in the low distortion mode; in the low distortion mode, sensitivity is reduced by 6 dB.

Distance between transmitter and receiver



The minimum required distance between transmitter and receiver is about five times larger (worse) in ETSI-compliant radios compared to the R&S®Series4200.

Parameter	ETSI EN 300676	R&S®Series4200
Broadband noise of transmitter (±300 kHz)	≤ –130 dBc	≤ –145 dBc (typ.)
Desensitization of receiver	≥ 80 dB	≥ 95 dB
Minimum distance required	approx. 1.5 km	approx. 350 m

Minimum distance required between transmitter and receiver sites for same SINAD.

Maintenance-free operation

The radios of the R&S®Series4200 are designed for maintenance-free operation. They adapt automatically to the current ambient conditions and offer different functions for remote monitoring and remote control. This nearly eliminates the need to perform on-site maintenance work on the radios.

Extensive self-test routines

Extensive monitoring routines (continuous built-in tests, CBIT) run in the background to keep the user always informed about the status of the equipment. More than 80 parameters are monitored and any deviation from the permissible range is displayed as a CBIT message. There are two urgency levels: warning and alarm. A warning is merely displayed, while an alarm also triggers switchover to a redundant standby radio if one is present.

Simple remote monitoring and remote control

CBIT messages are displayed on the HMI, can be read by the service PC and are also available via the remote control interface. The transmitter can also be keyed remotely via the Ethernet interface. It is then possible to measure the output power, modulation and VSWR in this manner and read out the results via the remote control interface. The receive power can be read off similarly on the receiver.

Automatic adaptation to ambient conditions

When ambient conditions such as the temperature, supply voltage or VSWR are outside the nominal range, the transmitter will decrease its own power stepwise in order to maintain operation as long as possible. If the ambient conditions return to their nominal range, the transmitter will automatically switch back to nominal operation with no manual intervention required.

Easy remote switching when using redundant radios

When redundant radios are used (main/standby operation), it is possible to manually switch from a remote location between the active and passive radio with practically no interruption (< 200 ms). This allows the operator to check and make sure at any time that the nonactive radios are still operational. In case of a problem, operation can be maintained at the appropriate frequency without any on-site intervention.

Electronic inventory and recalibration

The radio and each module have all relevant inventory data such as serial number, device type and software version stored electronically. This data can be retrieved locally or via the remote maintenance tool. In addition, installation or maintenance information can be stored in the radio by the operator.

Maintenance is limited to recalibration of the reference oscillator (TCXO), which is possible with the service PC connected to the radio without having to open the radio. Repair involves simply replacing the defective module. No hardware-related settings are required after repair.

No recalibration for 15 years with optional OCXO

With the use of the optional high-precision oscillator (OCXO) in the transmitter or transceiver, a frequency accuracy of ±0.3 ppm is reached, which is required for five-carrier offset operation. This value is maintained over the entire operating temperature range of –20 °C to +55 °C. The high quality of this oscillator delivers a frequency error of ±1.5 ppm over a lifetime of 15 years with no recalibration. This accuracy permits offset operation with up to four carriers. Use of the OCXO can be enabled at a later time by entering a software option code.

Straightforward operation and configuration

The radios of the R&S®Series4200 offer many diverse functions that help ensure straightforward, secure and error-free operation.

PC-based tools with graphical user interface

The radios are configured using the service PC's graphical user interface in conjunction with the R&S®ZS4200 service and maintenance tool. There is no need to open the radio, e.g. to make configuration settings using DIP switches or jumpers.

Different configurations can be created on the PC for subsequent on-site loading into the radio. To ensure that a faulty radio can be exchanged quickly, its configuration can be cloned and transferred to a new radio. This means that such an exchange is performed very fast (typically in 15 minutes).

Reliable protection against operation errors

All radio versions can be operated in fixed-channel mode. This mode makes it impossible to change the set frequency via HMI or remote control without proper authorization. The radio is configured accordingly using the service PC.

If frequency settings are allowed, the user can exclude one or more channels in the VHF or UHF band from the list of possible configurations. The required frequency blocking table is configured using the service PC and is loaded into the radio. This prevents the radio from accidentally operating on a frequency that is not permitted, e.g. the frequency of a radionavigation system.

Warning messages in case of unauthorized local operation

To prevent unauthorized local operation, a CBIT warning message can be activated that indicates if the radio is switched to local mode or the service PC is connected to the radio. At the same time, such activities are recorded in the radio's internal event log. This makes it possible to track all activities involving the radio at any time. The event log can be read locally or from a remote site.

Easy remote control and monitoring via IP connection

Remote control and monitoring are handled via an Ethernet connection between the radio and the management system. To ensure that only authorized users can connect to the radio, an access control list is saved in the radio. It contains the IP addresses with which the radio is allowed to communicate. Communications requests from other IP addresses are rejected.

Flexibility for system integration

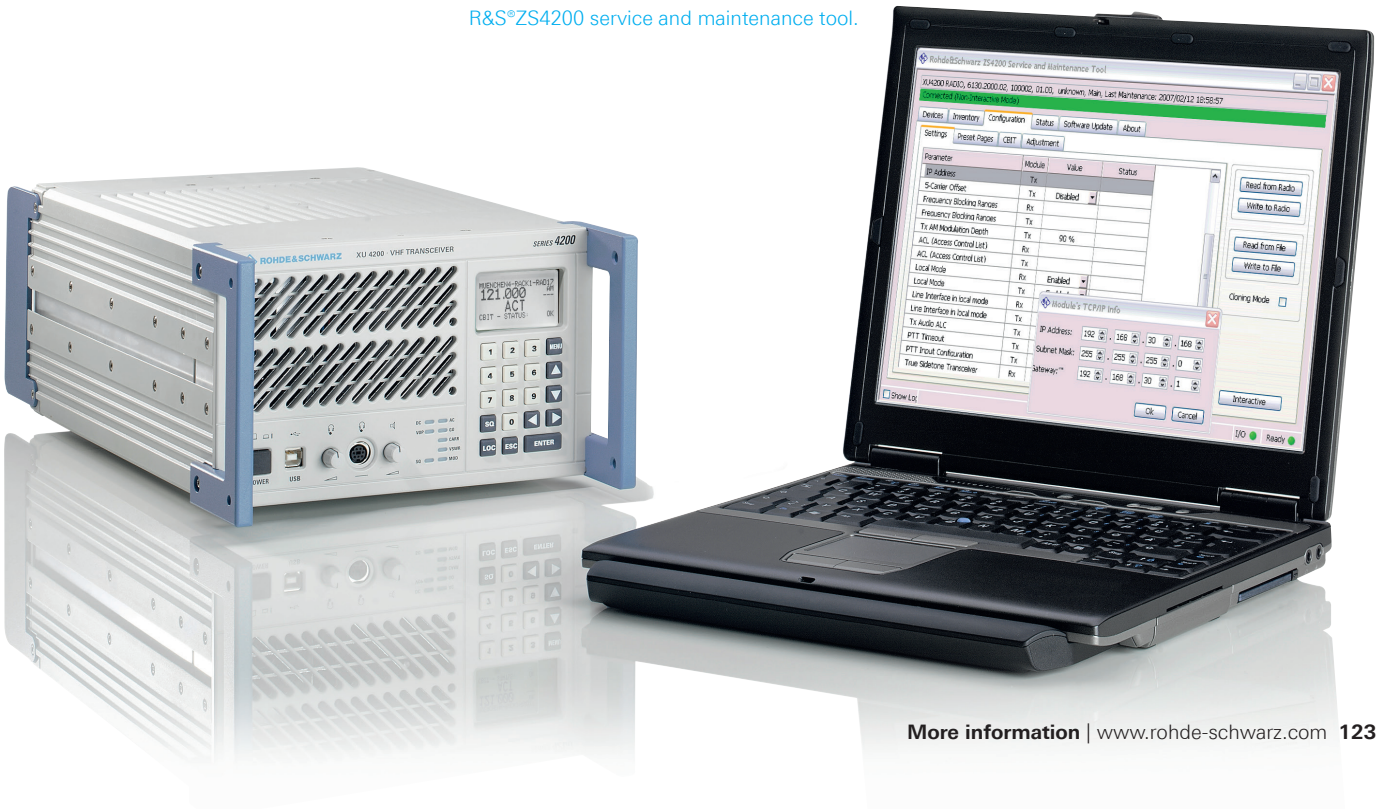
The radios of the R&S®Series4200 provide flexibility when connected to a voice communications system (VCS) and a management system. Software upgrades ensure future viability of the radios.

Adaptation of in-band signaling for PTT and squelch to existing voice communications systems

The in-band signaling for PTT and squelch can be adapted to existing voice communications systems (VCS), making it unnecessary to reconfigure or exchange any of the VCS components.

Signaling techniques that allow quality evaluation of the receive level can also be implemented in a straightforward manner. The in-band signaling used in the radio does not require any external components. Tone generation, filtering and evaluation are all performed by the software using a DSP.

R&S®ZS4200 service and maintenance tool.



Flexibility in management system selection

The radios of the R&S®Series4200 can be controlled and monitored using the Rohde&Schwarz protocol or the simple network management protocol (SNMP). This ensures that users have maximum flexibility when selecting a management system.

Possible choices include the R&S®RCMS II remote control and monitoring system or any commercially available system that is based on SNMP. It is also possible to switch from SNMP to the R&S®RCMS II (or vice versa) at a later point in time. Alternatively, both management systems can be used in parallel.

The radios also support the SNMP MIB as defined by EUROCAE in ED-137B part 5, which can be used in parallel with the R&S®Series4200 MIB. The SNMP MIB, unlike the basic MIB from EUROCAE, allows the setting of all parameters.

Seamless transition from analog to digital voice transmission in the ground segment

In many countries, analog connections for linking the radio sites will soon no longer be available. In these cases, the voice signal will be transmitted digitally over 2 Mbit/s connections.

The R&S®Series4200 radios can therefore be connected to the voice transmission system via a digital E1 interface. This function is made available by activating a software option key, which enables the user to convert from analog to digital voice transmission at some point in the future. This opens the door to fully digital systems – from the microphone to the antenna.

Support for voice over IP

As an important step toward an international communications system with new functions, as is required for the SESAR (Europe) and NextGen (USA) programs, the R&S®Series4200 radios support voice over IP in line with the latest version of EUROCAE ED-137B, released in January 2012.

This means that the R&S®Series4200 radios can handle three different types of interfaces without requiring any hardware or software modifications. The interface to be used is selected via configuration parameter. This functionality keeps users on the safe side, enabling them to easily operate the R&S®Series4200 radios in future VoIP-based communications systems.

Small footprint due to compact, modular design

Due to its very compact and lightweight design, the R&S®Series4200 makes it possible to add new channels at existing sites without having to perform any construction work. New radio installations can also be designed to be smaller, which helps to cut construction costs.

Very compact design

Space requirements are ½ 19", three height units for one transmitter or one receiver (UHF only) or one transceiver. To further decrease the space required, a compact receiver is available as an alternative. This receiver type is accommodated in a housing of half the size, i.e. ¼ 19" width. The receiver module is the same as in the standard housing. This means that the following equipment can be arranged in one 19" row of three height units:

- Two transceivers or two transmitters or any combination of these devices
- Four compact receivers

Up to 24 transmitters or transceivers can be accommodated in the R&S®KG4200 standard 19" rack (or up to 48 compact receivers). No external components are required for operation except any desired optional filters or multicouplers. For remote monitoring, all that is needed is an additional Ethernet switch or router.

Three basic modules: transmitter, receiver, power supply unit

The design of the R&S®Series4200 is based on a modular structure consisting of three modules. These modules are the transmitter, the receiver and the power supply unit. Depending on the required configuration, these modules are accommodated in the appropriate housing. The housing is equipped with keypad, eight-line display, loudspeaker, headset connector and LEDs. The housing is the same for all configurations and frequency bands and is very compact, which enables flexible deployment. It is suitable for 19" system rackmounting.

Transmitter and receiver

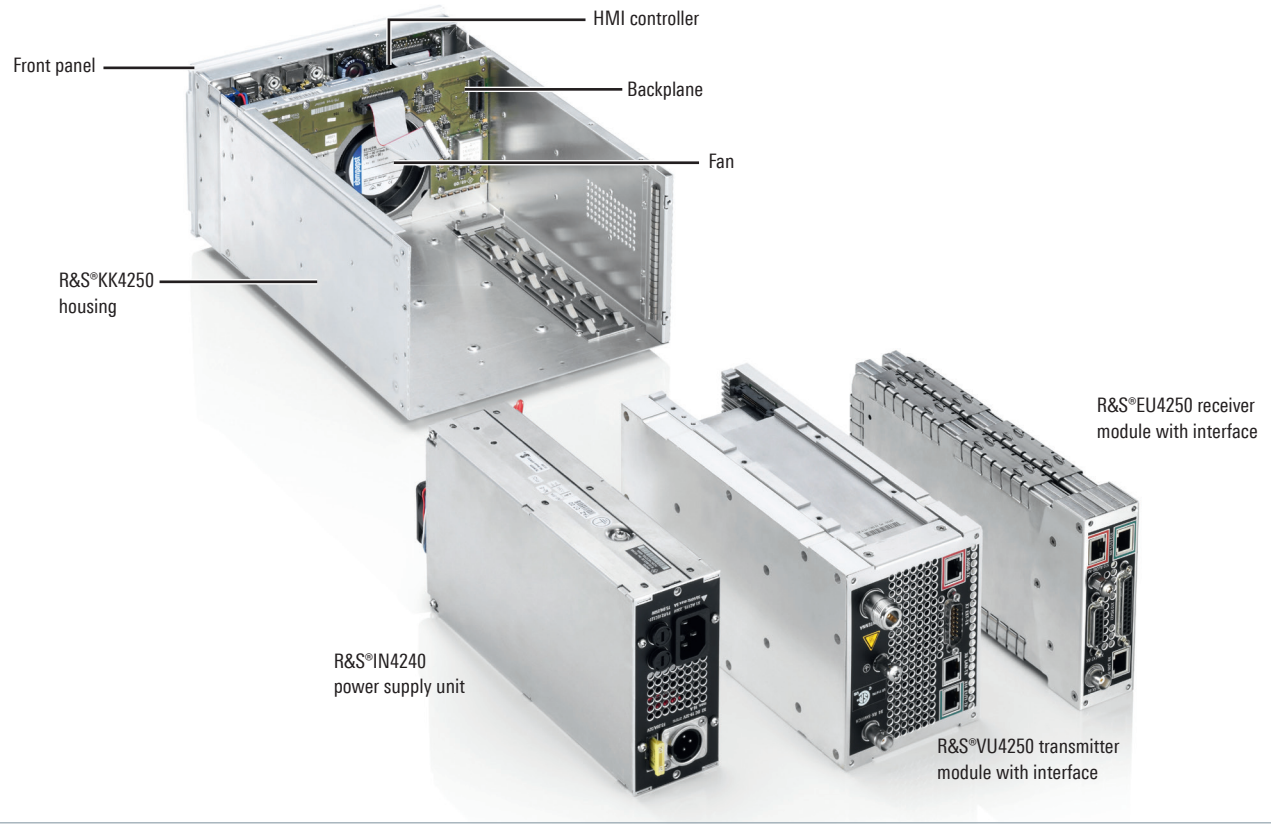
The transmitter and receiver are designed as independent, EMC-shielded modules that contain all required external interfaces. The transmitter, receiver and HMI controller communicate via the USB bus with the R&S®ZS4200 service and maintenance tool.

The transmit and receive modules each contain an Ethernet interface (100BaseT) that is used for control and remote monitoring of the transmitter/receiver.

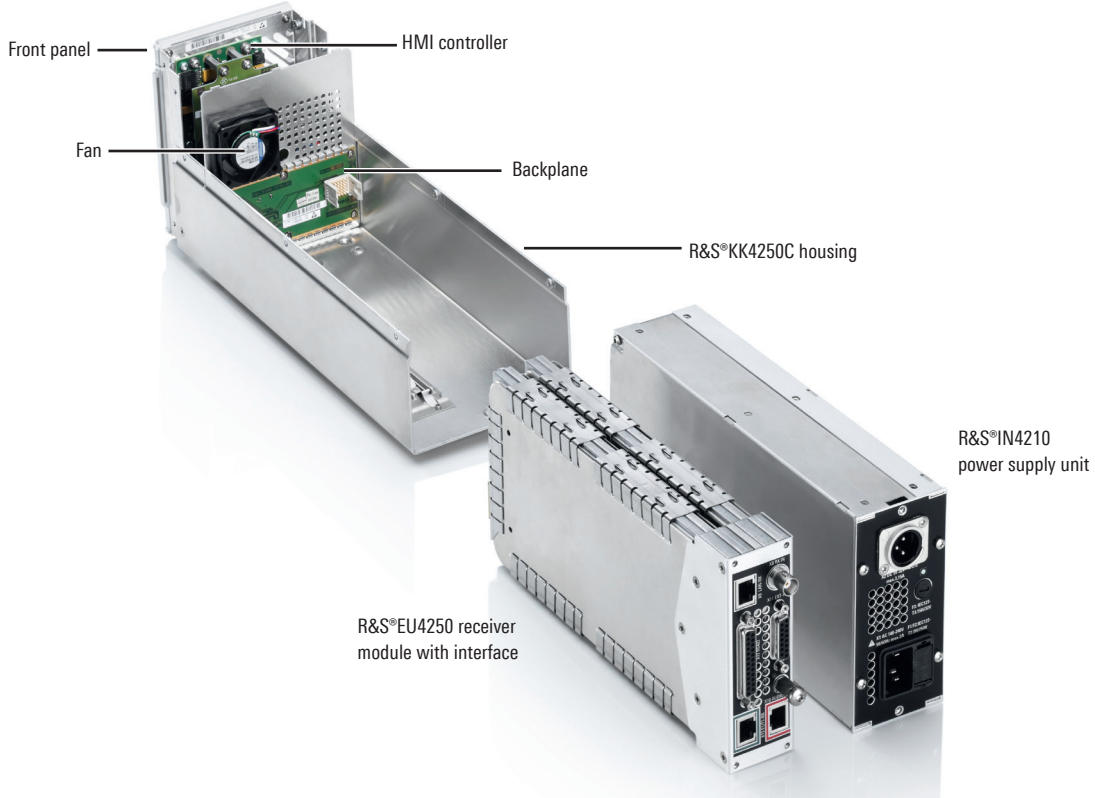
The transmitter and receiver have independent synthesizers that are synchronized to the TCXO reference signal. This allows the transceivers to operate simultaneously in transmit and receive mode, which serves as a basis for true side tone or relay operation.

R&S®EU4200C compact VHF receiver.

Modular design of the R&S®XU4200 VHF transceiver



Modular design of the R&S®EU4200C compact VHF receiver



Integrated transmit/receive switch

The transmit module contains an integrated, wear-free PIN diode switch for switching between transmit and receive mode. This allows users at transceiver sites to choose whether they wish to use separate transmit and receive antennas or a common transmit/receive antenna. No configuration changes or settings are needed on the radio.

Power supply

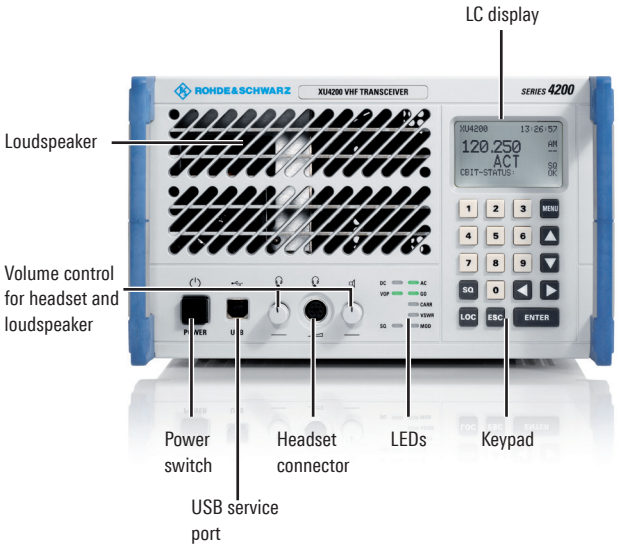
The modules are powered via the backplane, or (in the case of the power amplifier) directly by the power supply module. The power supply is an independent, EMC-shielded module that contains all required external interfaces. It allows operation of the radio from AC, DC or a combination of the two. Interruption-free switchover occurs in case of failure of the AC supply.

The power supply has a wide supply voltage range and can be operated with 230 V AC or 115 V AC without manual switchover. The user stays informed about the availability (or dropout) of the supply voltages using LEDs on the radio as well as warning messages to the management system. The power supply is available as a 400 W and as a 45 W version. The 400 W power supply is used in the transmitter and transceiver while the smaller 45 W power supply is used in the receiver.

Housing with HMI controller

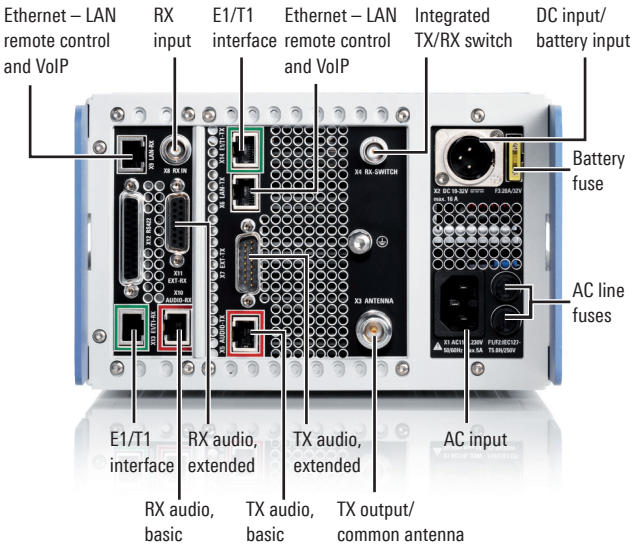
The HMI controller is part of the housing. It includes the control of the radio and the interface to the user. The HMI controller allows the radio to be operated using the integrated keypad and display. Configuration of the radio is possible via the USB interface. Software updates and upgrades are handled via the USB bus as well. The HMI controller with identical functionality is used both in the standard housing and in the compact housing.

Front view of the R&S®Series4200 transceivers and transmitters

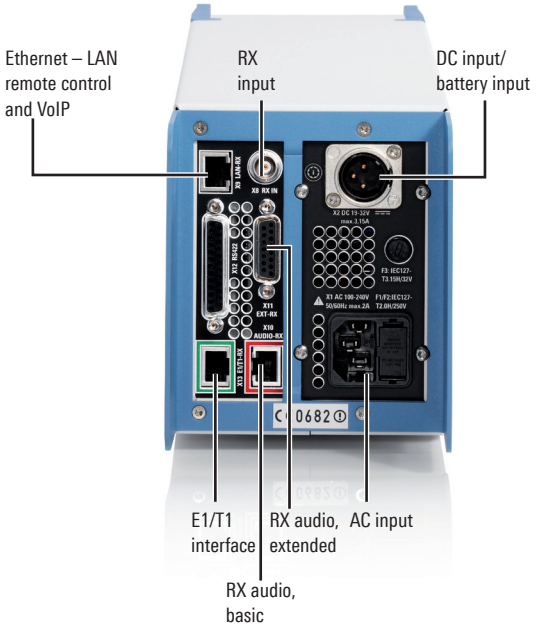


Front view of the R&S®Series4200 compact receivers

Rear view of the R&S®Series4200 VHF transceiver



Rear view of the R&S®Series4200 compact VHF receiver



Product overview

Designation	Type
R&S®Series4200 VHF multichannel radios	
VHF transceiver	
50 W, 112 MHz to 156 MHz	R&S®XU4200
VHF transmitter	
50 W, 112 MHz to 156 MHz	R&S®SU4200
Compact VHF receiver	
112 MHz to 156 MHz	R&S®EU4200C
R&S®Series4200 UHF multichannel radios	
UHF transceiver	
50 W, 225 MHz to 400 MHz	R&S®XD4200
UHF transmitter	
50 W, 225 MHz to 400 MHz	R&S®SD4200
Compact UHF receiver	
225 MHz to 400 MHz	R&S®ED4200C
Accessories (external options)	
Service and maintenance tool	R&S®ZS4200
Headset, dynamic microphone	R&S®GA4200D
Microphone, mini-DIN connector	R&S®GA016H1
Adapter for standard headset	R&S®GA4220
Mating connector set for the R&S®XU4200	R&S®ZF4200
Mating connector set for the R&S®SU4200/R&S®SD4200	R&S®ZF4200
Mating connector set for the R&S®EU4200C/R&S®ED4200C	R&S®ZF4200
Mating connector set for the R&S®XD4200	R&S®ZF4200
½ 19" filler plate	R&S®BP4201
¼ 19" filler plate	R&S®BP4202
System components	
Antennas	
VHF/UHF automatic filters and multicouplers	R&S®FU221/R&S®FD221
Adapter, R&S®Series4200 to R&S®FU221/R&S®FD221	R&S®KG42-Z75
Cavity antenna filter	R&S®HS9043
Circulator module/frame	R&S®KR420
VHF/UHF receive multicoupler	R&S®ATCMC
VHF power amplifier, 200 W	
AF control unit	R&S®GB208
AF distribution splitter/combiner	R&S®GH215
Control unit	R&S®GB4000T
Audio unit	R&S®GB4000V
Multilink controller	R&S®GV4000
ATC system rack	R&S®KG4200

The radio systems described are hardware- and software-configurable. The system delivered has the configuration as confirmed in the order.

R&S®VCS-4G IP-based Voice Communications System

Air travel has become an important part of our lives, and ensuring the highest level of passenger safety is a key goal for air traffic control (ATC) authorities. Passenger safety depends to a large extent on reliable voice communications between air traffic controllers and pilots. The R&S®VCS-4G IP-based voice communications system is a cost-effective solution for all ATC voice communications needs. It meets ATC requirements for availability, reliability and safety.

The R&S®VCS-4G allows communications between air traffic controllers and pilots. It provides the full range of ATC features, including intercom and telephony services, as well as interworking to other ATC systems. A key advantage of this fully IP-based communications system is its high level of scalability. This allows system deployments ranging from a single controller working position (CWP) to fully functional area control centers (ACC). Another key advantage is that the system has been designed to provide full redundancy. Elements can also be installed at various sites to provide geographical redundancy.

In the past, ATC authorities interconnected their VCS and radio sites via narrowband transmission lines. Service providers are, however, currently phasing out their leased line services. As a result, the European Organization for Civil Aviation Equipment (EUROCAE) proposed the ED-137 standard for the use of IP in ATC voice communications environments. This standard was defined jointly by EUROCAE, ATC authorities and ATC equipment manufacturers. The R&S®VCS-4G adheres to this EUROCAE standard. It has been designed as a true IP solution that takes full advantage of IP technology to provide a cost-effective, future-ready VCS solution.

Key facts

- IP technology from the CWP all the way to the radio
- Distributed system architecture to provide high availability and pay-as-you-grow scalability
- New features and applications above and beyond pure voice communications
- Smooth integration into existing ATC systems to make use of existing equipment
- Extensive use of commercial off-the-shelf (COTS) products for reduced system costs
- A single centralized monitoring system for both the R&S®VCS-4G and Rohde&Schwarz radios

Benefits and key features

State-of-the-art, future-oriented technology

- EUROCAE ED-137 compliant, field-proven technology
- High availability with a distributed system architecture

Reduced system costs

- One partner from the microphone to the antenna
- Pay-as-you-grow scalability
- Extensive use of commercial off-the-shelf hardware and software
- Voice and data using the same network infrastructure

Smooth integration into existing ATC systems

- Safeguards capital investment in radio infrastructures
- Interfaces with conventional voice communications systems and the PSTN
- Works on all network topologies

Comprehensive system management

- Easy to deploy, manage, upgrade and expand
- Advanced fault management and diagnostic system
- Centralized monitoring of VCS and radios

Customized system solutions

- Customizable touchscreen interface
- Direct radio control right at the CWP
- Various additional applications available to meet customer-specific needs

State-of-the-art, future-oriented technology

EUROCAE ED-137 compliant, field-proven technology

The R&S®VCS-4G complies with EUROCAE standard ED-137 that defines the use of voice over IP (VoIP) communications in ATC networks. Its innovative system architecture migrates intelligence away from the network core to peripheral equipment, thereby increasing availability and reliability. Each CWP in the R&S®VCS-4G has the computing power needed to enable nonblocking, interruption-free communications with other network elements. No central network node is present in the system.

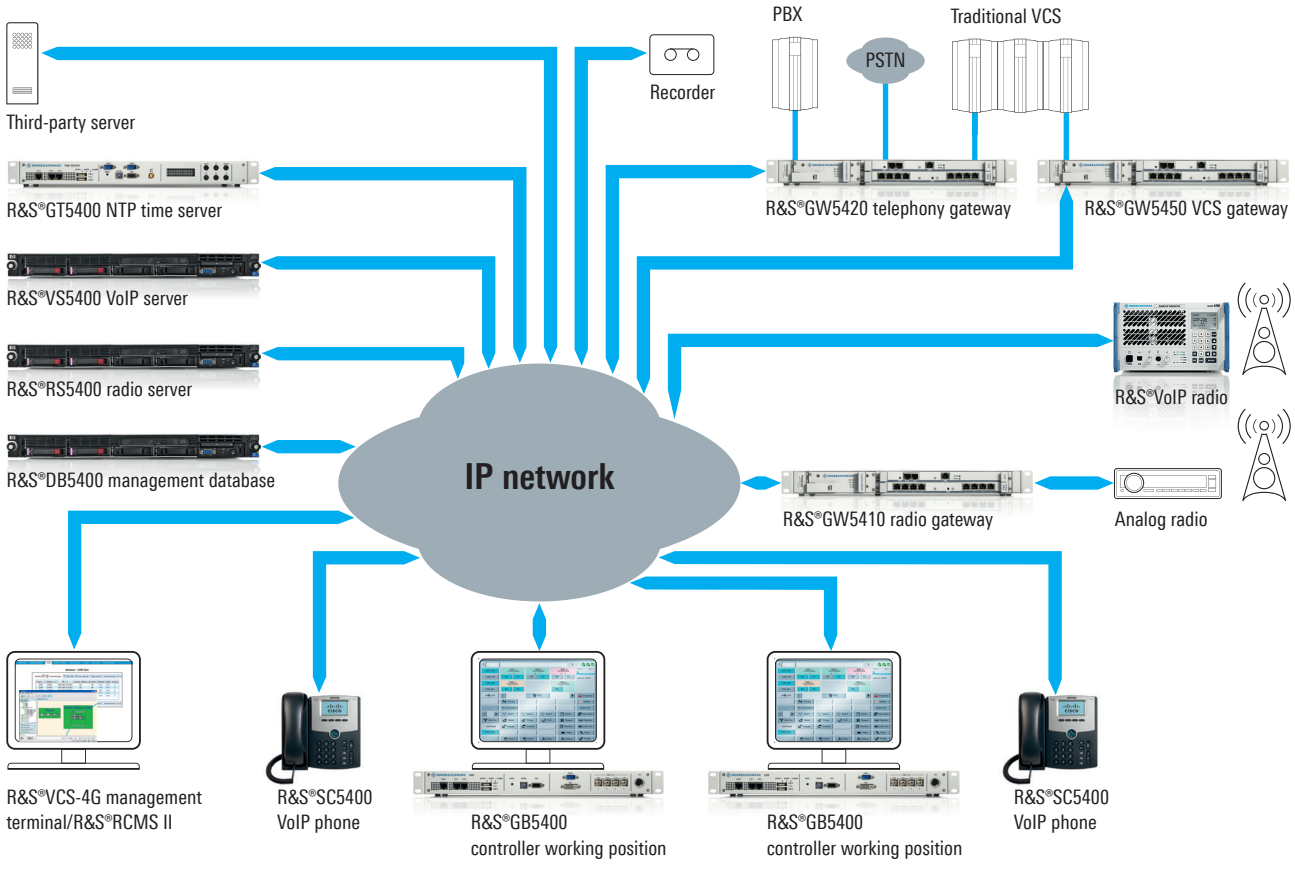
IP technology has been used in telecommunications for decades and has proven itself again and again in safety-critical environments.

High availability with a distributed system architecture

There is no single point of failure within the R&S®VCS-4G architecture. A fault at one CWP does not affect operation at other CWPs. Each R&S®VCS-4G CWP network element has a redundant Ethernet connection that can be used to connect the device to two different Ethernet switches. When two switches are used, two independent paths to the IP backbone are available. If one Ethernet switch were to fail, operation would continue unaffected over the other switch.

Redundant network elements need not be installed at the same site; they can be distributed geographically over various sites. In the event of a complete failure at one site (fire, earthquake, hurricane, etc.) network operation will continue without interruption by using the components at the other sites.

Full-range communications solutions for ATC/AD



Reduced system costs

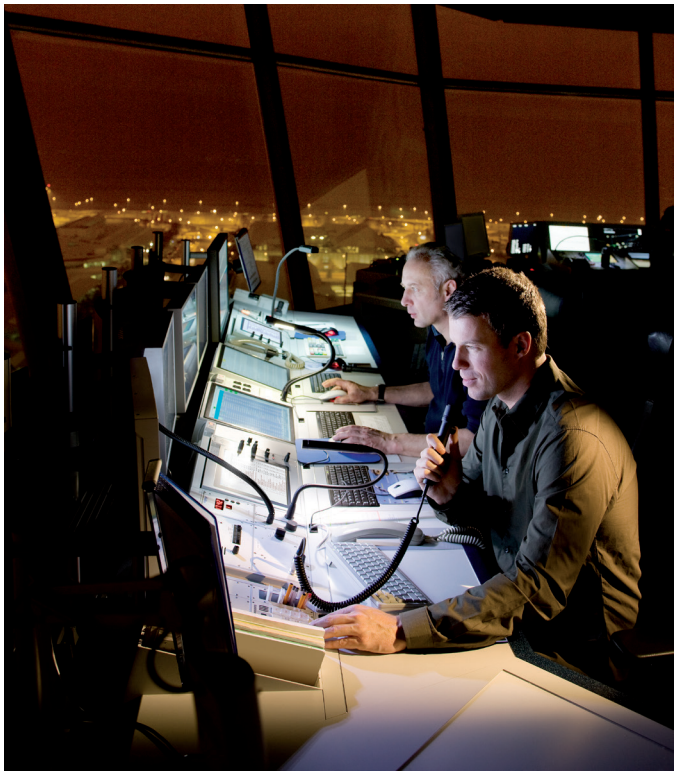
One partner from the microphone to the antenna

The Rohde&Schwarz product portfolio addresses all ATC voice communications needs – from the microphone and the controller working position to the radio and the antenna system. This eliminates the need for complex and costly integration work and helps ATC authorities to keep project risks to a minimum.

Pay-as-you-grow scalability

In the past, TDM-based systems relied on one or more centralized switching nodes in order to transfer voice information between the CWPs and the radios. In contrast, the R&S®VCS-4G, with its distributed network intelligence, does not require a central switching entity. All the intelligence and computing power needed to provide nonblocking communications is included in each CWP. A single, standalone CWP can communicate directly with a large number of VoIP radios, without depending on the services of other R&S®VCS-4G elements.

As a result, ATC authorities no longer need to invest in large systems right from the start. All that is needed to get up and running with the R&S®VCS-4G is a single CWP, a suitable IP connection and IP-enabled radios. Additional components can be added at a later stage as the need for increased capacity arises. This helps to reduce both operating costs and required capital investment.



Extensive use of commercial off-the-shelf hardware and software

When the R&S®VCS-4G was designed, strong emphasis was placed on making extensive use of COTS products. Standard Ethernet switches and IP routers can be used with the R&S®VCS-4G. Other R&S®VCS-4G components are based on professional server platforms from established manufacturers. This means ATC authorities can choose from a wide range of commercially available state-of-the-art-products that suit their specific technical and commercial needs.

Voice and data using the same network infrastructure

Many ATC system operators are already using IP networks to transmit data, such as radar and flight plan information. Using the same IP-based network for voice and data creates synergies in procurement, operation and maintenance, all of which leads to significant savings.

All that is needed is an IP network engineered to handle realtime services such as voice. This requirement can be met today with standard network engineering.

Smooth integration into existing ATC systems

Safeguards capital investment in radio infrastructures

Safeguarding the investments made in existing radio infrastructures is a key issue to consider when making the transition to a VoIP system. The R&S®VCS-4G allows ATC authorities to continue working with their installed base by providing radio gateways for use with legacy non-VoIP radios. Radios from all established manufacturers are supported.

Interfaces with conventional voice communications systems and the PSTN

Because ATC communications systems do not operate as islands, they need to connect with private automatic branch exchanges (PABX) and the public switched telephone network (PSTN) as well as with other voice communications systems. The R&S®VCS-4G telephony gateways interconnect the VoIP system with legacy networks that employ a wide range of transmission and signaling methods. The gateways are available with various capacities and with a variety of different interface types. This facilitates migration of conventional communications solutions to VoIP.

Works on all network topologies

The R&S®VCS-4G uses the Internet protocol for voice and data transmission. As such, it is independent of any specific network topology.

Comprehensive system management

Easy to deploy, manage, upgrade and expand

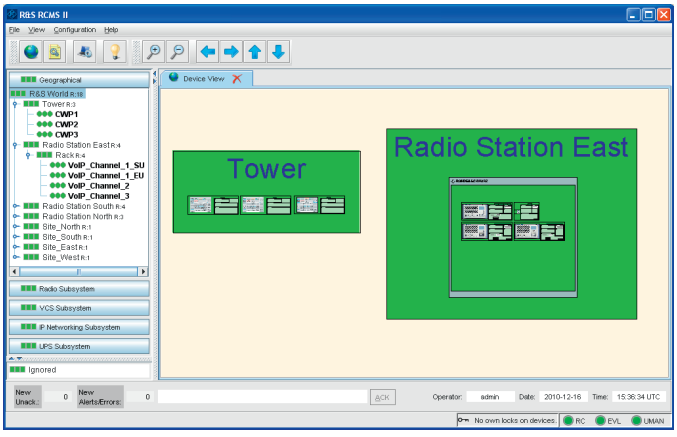
Using the R&S®VCS-4G centralized management system, network elements can be configured and monitored and user roles can be assigned. The system configuration can be stored on a network database and transferred to the system elements in an orderly manner.

From a single location, a service engineer can configure the R&S®VCS-4G and also expand it as required. The service engineer can access the system both locally and remotely using any standard web browser.

Advanced fault management and diagnostic system

Each R&S®VCS-4G network element has built-in test functionality that continuously monitors the equipment status. Faults are immediately displayed on both the central management system and the equipment itself. In addition, the central management system supports statistical event analysis.

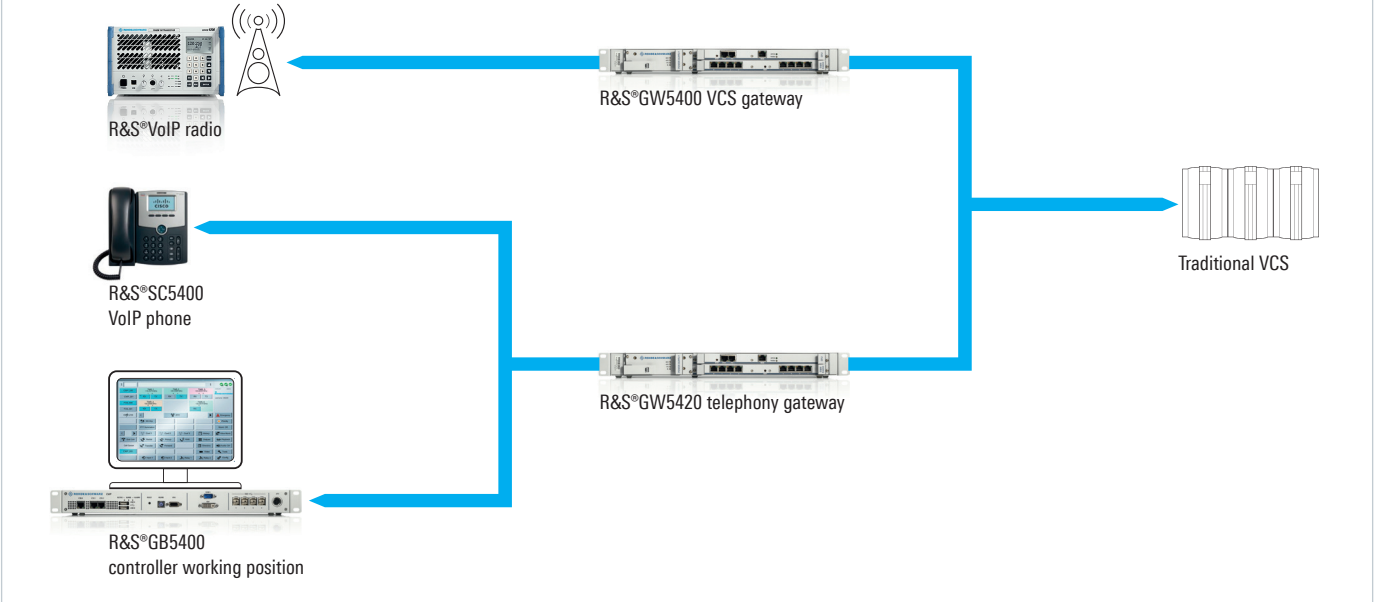
R&S®RCMS II monitoring R&S®VCS-4G elements and R&S®Series4200 radios.



Centralized monitoring of VCS and radios

The R&S®RCMS II remote control and monitoring system, used to monitor Rohde&Schwarz ATC radios, can also include R&S®VCS-4G elements. As such, the R&S®VCS-4G can be monitored from the same system that also monitors the R&S®Series4200 and the R&S®M3SR Series4400 radios. The service engineer only needs one system to monitor all important elements in the ATC voice communications network, including radios, CWPs and other SNMP-capable devices such as IP routers and Ethernet switches. This considerably reduces training requirements as there is no need to install dedicated monitoring software for each type of equipment.

R&S®VCS-4G system solution with legacy interworking



Customized system solutions

Customizable touchscreen interface

The R&S®VCS-4G allows for a high level of customization in the CWP. The graphical user interface (GUI) is intuitive to use, allowing controllers to concentrate on the job at hand instead of worrying about where to find functions on the screen. Various screen sizes are available for use at the controller working position.

Another feature of the R&S®VCS-4G is the ability to assign each controller a specific functional role. When air traffic controllers sign in at their CWP, their role-specific configuration is downloaded from a central database and the GUI is automatically set up so as to allow the controllers to carry out their specific work assignment.

Since the CWP supports many types of touchscreen, the figure below shows a screenshot to illustrate the GUI.

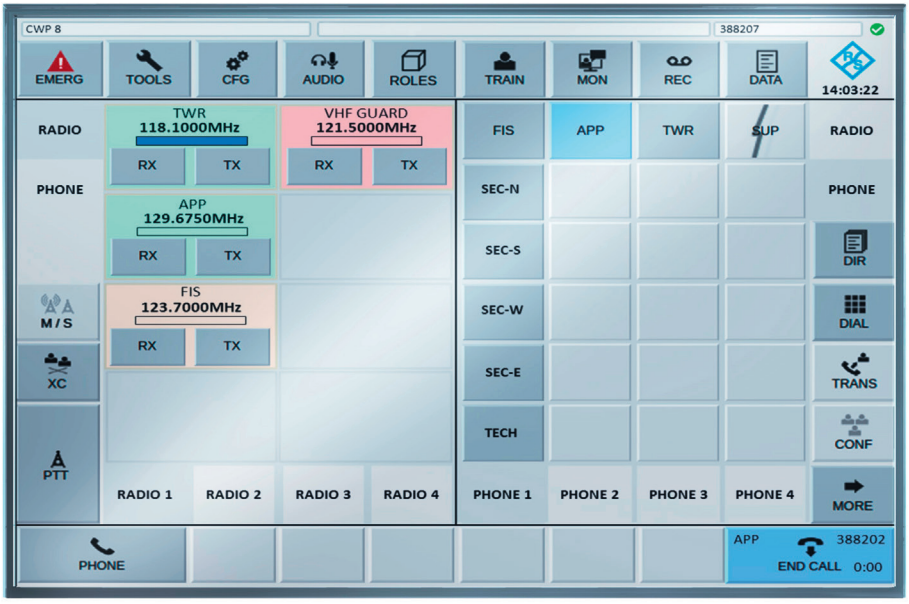
Direct radio control right at the CWP

The R&S®VCS-4G features IP-based remote control and monitoring of ATC radios. This provides air traffic controllers with a graphical indication of radio channel availability, allowing the controller to take appropriate actions in the case of radio malfunction.

Remote control and monitoring functionality is currently supported for the R&S®Series4200 and the R&S®M3SR Series4400 ATC radios. With these radios, air traffic controllers can monitor the radio status and also change the radio frequencies. More remote control operations and other radio types can be integrated according to project-specific requirements.

Various additional applications available to meet customer-specific needs

In addition to voice communications, the R&S®VCS-4G allows the integration of additional applications to provide the controller with improved situational awareness. A variety of IP-based multimedia applications such as video surveillance and weather information can be integrated into the CWP. Such additional information can help to avoid safety-critical situations. Remote control and monitoring of selected SCADA devices can also be integrated into the CWP. As an example, video surveillance images could be displayed on the CWP monitor to provide an overview of various parts of the airport.



Example of the R&S®VCS-4G GUI.

Use cases

Towers

The high scalability of the R&S®VCS-4G, which is tailored to the needs of the customer, allows all sizes of tower installations to be supported with the same system.

Smaller airports and mobile towers can be equipped very efficiently to provide maximum technical performance at an optimized price/performance ratio, in a minimum of space. In large tower installations with a high number of CWPs to configure and maintain – at international airports, for example – the R&S®VCS-4G system can be expanded to meet higher requirements with regard to configuration, flexibility and redundancy.

Area control centers (ACC)

The R&S®VCS-4G is also suitable for use in ACCs with a large number of operator working positions. The system's scalability and distributed network architecture make it possible to set up ACCs requiring minimum space for infrastructure while providing reliable networking with other communications systems and geographical redundancy. Remote radio sites are connected to the ACCs through suitable redundant wide-area connections.

Last resort systems

A last resort system is another typical application for the R&S®VCS-4G. Since the main VCS and the last resort system usually have to be two separate systems, the use of the R&S®VCS-4G provides full isolation between the main VCS and the last resort VCS. With its IP-distributed approach, the R&S®VCS-4G can operate as a last resort system completely independently of a classic, TDM-based, main VCS.

System components

Controller working position (CWP)

At the CWP, the air traffic controller can select radio channels, as well as telephony and intercom services. Features provided by a conventional voice communications system are supported, including frequency cross coupling, short-term recording, conferencing, call queuing, role-based user profiles and much more.

VCMS (R&S®VCS-4G control and monitoring system)

The VCMS is used to configure and manage all the devices in the system from a single point. When air traffic controllers sign in at a CWP, their specific configuration is downloaded from the VCMS database. Even if the database becomes temporarily unavailable, the system will continue to operate in its current state.

R&S®GB5400 controller working position.

R&S®DB5400 VCMS server.

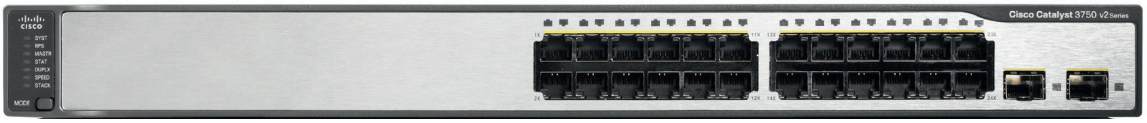
R&S®GW5410 radio gateway (1 HU).

R&S®GW5420 telephony gateway (1 HU).

R&S®GW5420 telephony gateway (2 HU).

R&S®GW5450 VCS gateway.

R&S®GT5400 NTP server.



R&S®GV5400 Ethernet switch.

VoIP telephony server

The VoIP telephony server provides a full range of VoIP telephony features, i.e. means IETF SIP-based VoIP telephony including supplementary services such as call holding/forwarding for IETF SIP-based COTS phones. It is also possible to connect the VCS to a VoIP PBX via IETF SIP.

Radio server

The optional radio server is used to reduce the bandwidth needed for multiple VoIP channels when connecting several CWPs to the same radio. This is especially useful for bandwidth-limited links to remote radio sites. In such scenarios, the radio server acts as a concentrator and establishes single SIP and RTP sessions with each radio, independent of how many CWPs are connected to the radio. The radio server can be operated in main-standby configuration; should the main server experience any problems, the standby will automatically take over. The radio server is therefore a functional add-on and does not represent a single point of failure.

Radio and telephony gateways

Radio and telephony gateways convert VoIP-based communications signals to conventional analog signals. The gateways allow air traffic controllers to communicate with radios that have an analog audio interface, with participants on PABX or PSTN extensions and with conventional VCS stations. The gateways provide interfaces for E&M, FXS, FXO, MFC-R2 and other formats.

VCS gateway

The VCS gateway converts analog and digital audio signals from a conventional VCS to audio signals for modern VoIP-based radios. To this end, the gateway provides interfaces of type E&M and E1 toward the conventional VCS and of type ED137 toward the VoIP-based radio.

Air navigation service providers can leverage the advantages of a future-ready, ED137-compliant VoIP radio infrastructure while still benefiting from maximum reuse of their installed base of conventional VCSs.

Time server

The optional time server provides all the devices in the network with a central time reference via the network time protocol (NTP). The input to the time server is a highly accurate time signal provided by the internal GPS module. The benefit of a standard system time is that, in the event of a fault, the service engineer can compare events in the system log based on synchronized timestamps.

Ethernet switch

The Ethernet switches used to connect the R&S®VCS-4G are professional COTS products.


ROHDE & SCHWARZ
Network Node
Central Unit
Control Panel
HARRIS
SCHWARZ

Chapter 5
Application software and support equipment

Civil and military missions require that all entities involved can communicate efficiently and reliably.

While voice communications continue to play an important role, data communications are increasingly gaining in importance.

Type	Designation	Description	Page
R&S®RNMS SDxR	**Radio network management system**	For the R&S®SDxR software defined radio family	140
Product overview			143
R&S®SMS SDxR	**Security management system**	For the R&S®SDxR software defined radio family	144
Product overview			145
R&S®RNMS3000	**Radio network management system**	For the R&S®M3xR software defined radio family; utilization planning, radio network configuration and data distribution	146
Product overview			151
R&S®RCMS II	**Remote control and monitoring system**	For the R&S®M3xR software defined radio family; for civil ATC and air defense applications	152
Product overview			159
R&S®Postman III	**Radiocommunications system**	For state-of-the-art IP-based data transmission	160
Product overview			169
R&S®MMHS	**STANAG 4406 based military message handling system**	Automatic and reliable exchange of information in radio and wireline communications networks	170
Product overview			179
R&S®STANAG5066	**HF radio data communications system**	E-mail and IP connectivity via HF radio networks	180
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R&S®RNMS SDxR Radio Network Management System

Military radiocommunications are changing. Asymmetric threats, missions across all branches of the armed forces and the resulting demand for timely, situational information are an integral part of military missions today. R&S®RNMS SDxR is a secure network management system for the next generation of software defined radios (SDxR).

Today's armed forces need efficient, easy-to-use communications systems when on missions. Secure tactical radiocommunications requires thorough and comprehensive planning. R&S®RNMS SDxR is a powerful solution for configuring and managing tactical radio networks.

Configuring radio networks with many diverse parameters such as frequencies and users is a complex task.

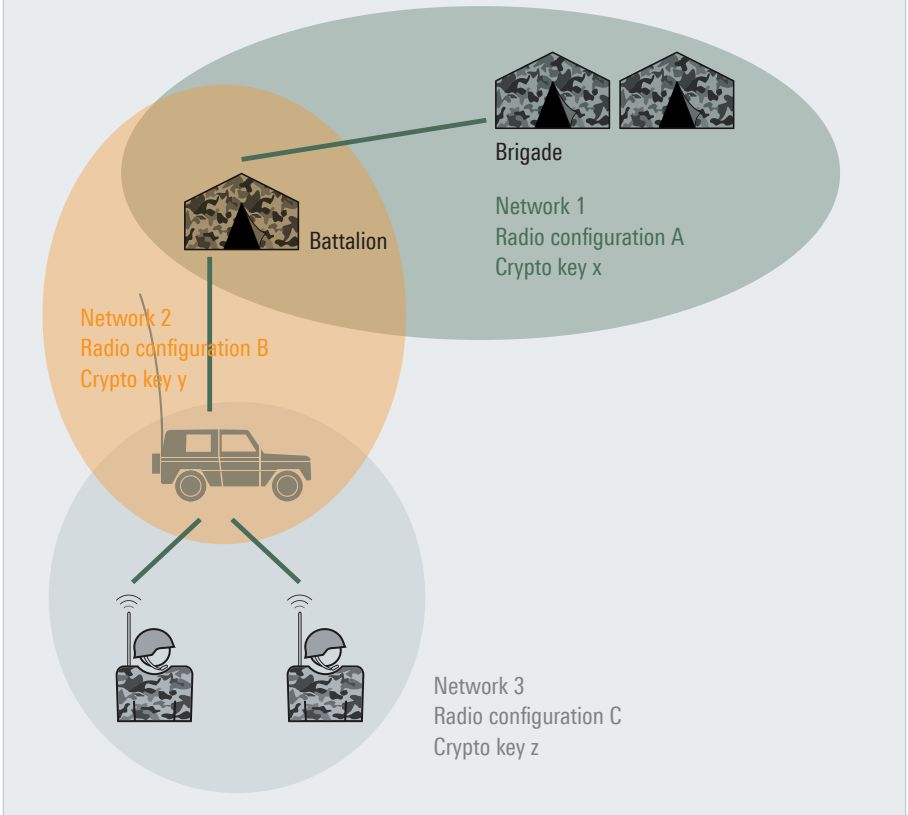
R&S®RNMS SDxR simplifies network planning and ensures that configuration data is securely distributed to the R&S®SDxR radios.

Modern mission scenarios require dynamic communications systems. R&S®RNMS SDxR makes it easy to configure such systems.

Key facts

- Graphical radio and IP network planning with consistency checks
- Highly secure network management
- Ergonomic user interface
- Planning of interoperable networks for army, air force and navy
- Scalable and adaptable to user requirements

Scenario



Benefits and key features

From planning to radiocommunications

- Radio network planning for all mission scenarios
- Storage and distribution of data specific to the radio, radio network and IP network
- Integration of resources from higher-level management systems

User-friendly network management

- Intuitive planning of radio and IP networks
- Simple operation thanks to well laid out GUI
- Network consistency checks

Flexibility for customer-specific mission structures

- Planning of interoperable networks for army, air force and navy
- Seamless integration into customer's network infrastructure
- Modular, configurable applications
- Distribution of configuration data via fill device or LAN

Innovative technologies for today's and tomorrow's missions

- Full support of new generation of R&S®SDxR software defined radios
- Takes full advantage of the powerful new R&S®HDR waveform family
- Standardized transmission protocols (TCP/IP)
- Backward compatible with R&S®M3xR radios

From planning to radiocommunications

Rohde&Schwarz offers a solution for planning radiocommunications networks. R&S®RNMS SDxR is used to configure radio and IP networks and securely manage crypto keys.

Radio network planning for all mission scenarios

Mission planning requires comprehensive radio network planning that covers all possible mission scenarios. The Rohde&Schwarz system solution is ideal for dynamic missions at all tactical command levels.

Storage and distribution of data specific to the radio, radio network and IP network

When R&S®RNMS SDxR network planning has been completed, the data specific to the radio, radio network and IP network is transferred to the radios, either by LAN or by using a fill device that is connected to the radio.

Integration of resources from higher-level management systems

R&S®RNMS SDxR is capable of integrating resource data from higher-level management systems for use in network planning.

User-friendly network management

Configuring radio networks, which have many specific parameters, is a complex task. The intuitive and interactive R&S®RNMS SDxR user interface provides an advanced platform for network planning.

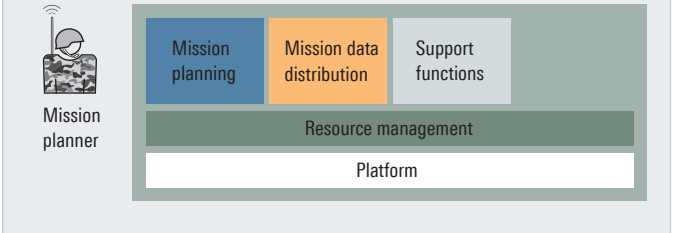
Intuitive planning of radio and IP networks

The units deployed in a mission are characterized by their position in an organization's hierarchy and their specific mission role. In order to represent this structure when configuring a network, roles can be defined in R&S®RNMS SDxR. The battalion commander role, for example, can be assigned the appropriate command and control radio network, and this assignment can be saved as a radio preset. R&S®RNMS SDxR makes it significantly easier to interface tactical mission planning with radio and IP network planning.

Simple operation thanks to well laid out GUI

Operators need a well laid out and clearly structured user interface for radio network planning. R&S®RNMS SDxR provides operators with a structured overview of resources and the radio networks to be configured. R&S®RNMS SDxR also allows users to copy networks so that similar networks do not have to be planned from scratch.

R&S®RNMS SDxR functional blocks



Network consistency checks

A growing challenge in today's mission scenarios are narrow frequency bandwidths, which increase the risk of collisions disrupting or preventing communications. R&S®RNMS SDxR helps to reduce this risk by providing efficient frequency management.

Flexibility for customer-specific mission structures

State-of-the-art radio networks provide armed forces with an optimized communications structure. These networks automatically adapt to mission topologies and cover all tactical areas of operation. R&S®RNMS SDxR combines high flexibility with high performance when planning radio networks.

Planning of interoperable networks for army, air force and navy

R&S®RNMS SDxR offers one user interface for planning radio networks for the army, air force and navy. Each of these forces can separately plan their communications networks and, if required, connect to a higher-level, forces-wide radio network, without causing compatibility problems.

Seamless integration into customer's network infrastructure

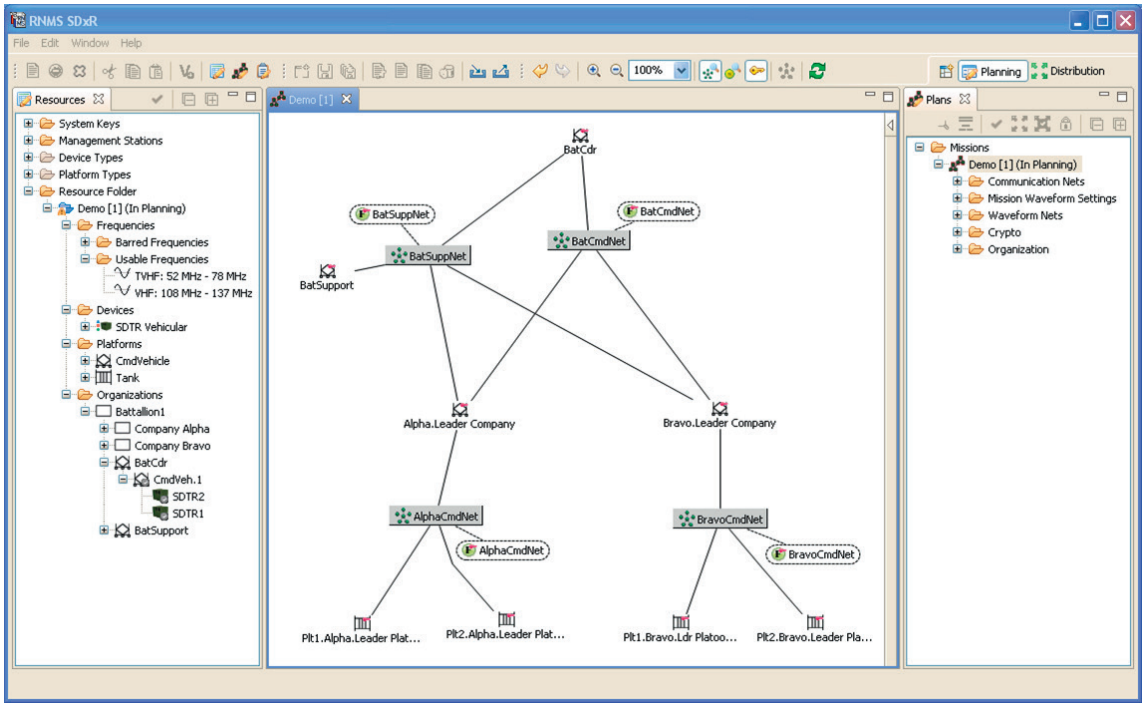
Radio networks can be planned based on frequency ranges or network planning data located on external databases. R&S®RNMS SDxR supports integration by providing a generic interface for exchanging XML formatted planning data with external management systems. R&S®RNMS SDxR can be used on military off-the-shelf (MOTS) PCs.

Modular, configurable applications

Network planning depends on the customer's mission structure. Customers who have decentralized planning at various tactical levels may use several R&S®RNMS SDxR radio network management systems. These modular systems can exchange their specific configuration data over the customer's network.

Distribution of configuration data via fill device or LAN

Radio-specific configuration data can be transferred to the R&S®SDxR radios via LAN or a fill device, which transfers the data directly to the radio.



Graphical user interface.

Innovative technologies for today's and tomorrow's missions

Today's mission scenarios require dynamic, wideband radiocommunications systems.

Full support of new generation of R&S®SDxR software defined radios

The R&S®SDxR radio family comprises state-of-the-art software defined radios for the army, air force and navy. Based on a common platform, the radios ensure interoperability between the different forces. R&S®RNMS SDxR was developed specifically for planning R&S®SDxR radio networks.

Takes full advantage of the powerful new R&S®HDR waveform family

The state-of-the-art R&S®HDR waveforms were developed for the advanced R&S®SDxR radio family. These IP-based waveforms provide robust, wideband communications even under difficult conditions. R&S®RNMS SDxR enables users to configure and use these waveforms in their radio networks.

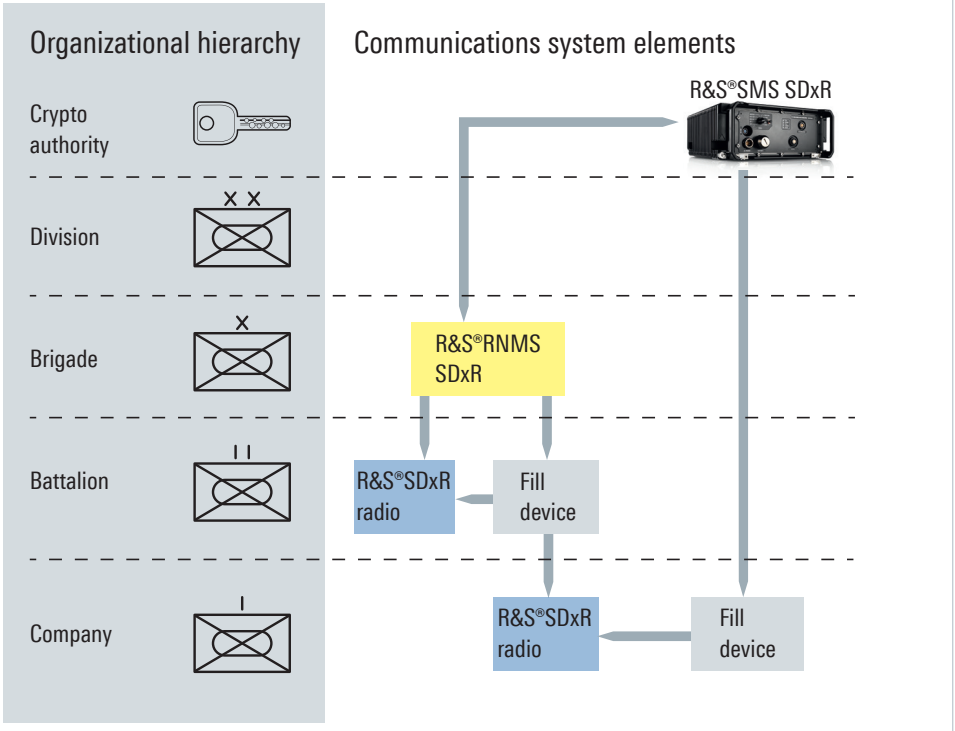
Standardized transmission protocols (TCP/IP)

IP-based radio network planning using R&S®RNMS SDxR is the basis for flexible and efficient communications of the future. The new R&S®SDxR radio family uses TCP/IP-based communications. IP addressing makes it possible to communicate beyond the transmitters' range.

Backward compatible with R&S®M3xR radios

R&S®RNMS SDxR also supports R&S®M3xR radios.

Organizational position



Product overview

Designation	Type
R&S®RNMS SDxR radio network management system	R&S®NS5100
Software options	
Mission planning	R&S®NS5100-KMP
Mission data distribution	R&S®NS5100-KMD

R&S®SMS SDxR Security Management System

The key to military mission success is secure radiocommunications – from radio and IP network planning to deployment. The R&S®SMS SDxR is a state-of-the-art security management system for the R&S®SDxR software defined radio family and has been developed specifically for managing security-critical elements in tactical radio and IP networks.

The security management system is used at the operational level to provide subordinate tactical units with the required crypto keys.

Key facts

- Secure key generation using a high-quality hardware-based random number generator
- Reliable storage of operational and nonoperational crypto keys
- Crypto device with secure tamper protection and zeroize function
- Ruggedized housing for operation under harsh environmental conditions
- Intuitive operation via standard PC or notebook

Benefits and key features

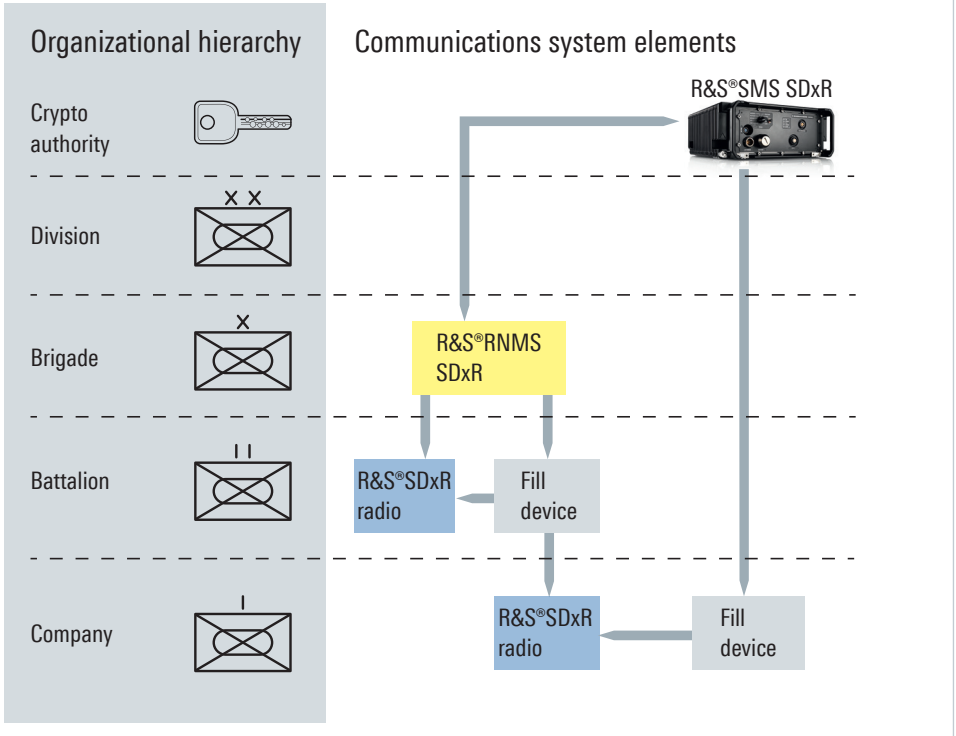
Secure key generation using a high-quality hardware-based random generator

The R&S®SMS SDxR is ideal for generating keys and configuring radio networks to ensure jam-resistant and tap-proof communications. The R&S®SMS SDxR uses controlled, uniformly distributed random sequences utilizing the largest possible key space to generate high-quality crypto keys.

Reliable storage of security keys

The R&S®SMS SDxR ensures reliable storage and secure management of operational, transport and system keys, and provides comprehensive data backup and data recovery options.

Organizational position



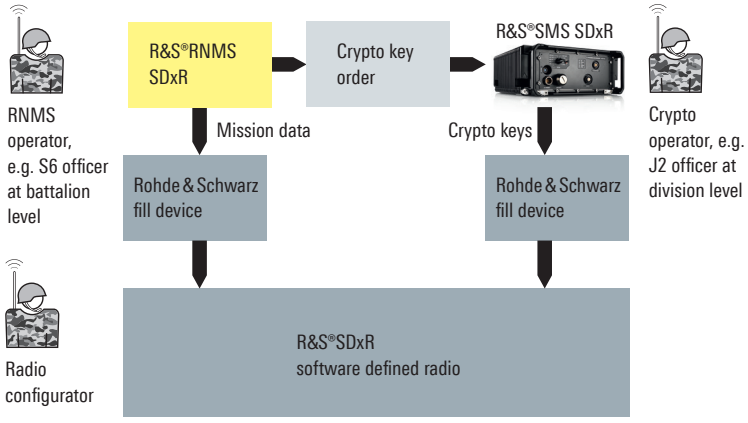
Crypto system with secure tamper protection and zeroize function

The R&S®SMS SDxR includes a multilevel security concept and uses mechanical blocks, sensors and logging features to ensure tamper protection. The security management system also provides a zeroize function for deleting all sensitive data in case of emergency.

Convenient operation

The R&S®SMS SDxR is easy and convenient to use thanks to its straightforward graphical user interface that can be installed on any standard PC or notebook. It comes with an integrated help function.

Organizational position



Product overview

Designation	Type
Security management system for R&S®SDxR	R&S®NS5010M
Software for R&S®SDxR security management system	R&S®GS5010M

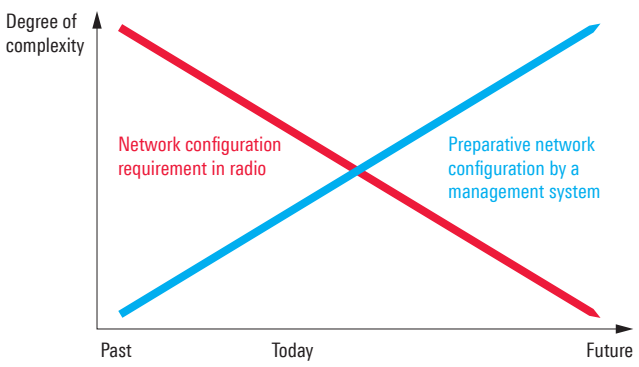
R&S®RNMS3000 Radio Network Management System

The convenient way to empower the capabilities of Rohde&Schwarz radios in networks.

Increased significance for a radio network management system

In today's world, information exchange via voice and data is indispensable for military forces to fulfill their increasing mission requirements. Handling all these communications demands with their complex waveforms requires an extended network management system. By offering R&S®RNMS3000, Rohde&Schwarz provides such a radio network management system. It enables military leaders to turn their Rohde&Schwarz combat radio equipment into a robustly networked communications system based on mission demand and on complex hierarchical structures, especially in joint or combined missions. In the past, many parameters had to be adjusted on the radios, which required highly skilled users. In future, the configuration complexity will be done during the preparative configuration of a management system.

Ease of radio use versus preparative network configuration requirement



R&S®RNMS3000 radio network management system

The R&S®RNMS3000 software supports the centralized network management, where one central organizational unit performs the complete mission planning, as well as the decentralized management, where the various configuration steps are accomplished on different military hierarchical levels. The R&S®RNMS3000 software suite, consisting of the mission planner, the remote device loader and the remote distributor, offers the following functions:

- Management of security keys
- Frequency assignments
- Establishment of logical nets
- Distribution of mission files

The objective is to provide mission-tailored and secured radiocommunications networks. Especially the R&S®RNMS3000 capability to manage NATO-specific waveforms, as well as general HF House waveforms and Rohde&Schwarz proprietary waveforms, underlines its broad range of applications.

Key facts

- Support of all Rohde&Schwarz radios and all frequencies
- Support of voice and data services
- Network planning, mission file generation and distribution with one software suite
- Target-oriented software guidance with wizards

Benefits and key features

Mission planner

Mission-tailored network planning

- Frequency assignment
- Hop set generation and management
- Security key management
- Efficient mission planning

Comprehensive waveform support

- NATO waveforms
- HF House waveforms
- R&S®SECOM waveform
- R&S®SECOS waveform

Remote device loader

Mission-optimized radiocommunications plan transfer

- Secure file transfer
- Effective hardware programming

Remote distributor

Extended mission data distribution

- File distribution over existing IP networks
- Event log and status control

Mission planner

Mission-tailored network planning

The mission planner software creates and configures radiocommunications networks and generates the required radiocommunications plan in one file that includes all relevant parameters to use the radios immediately.

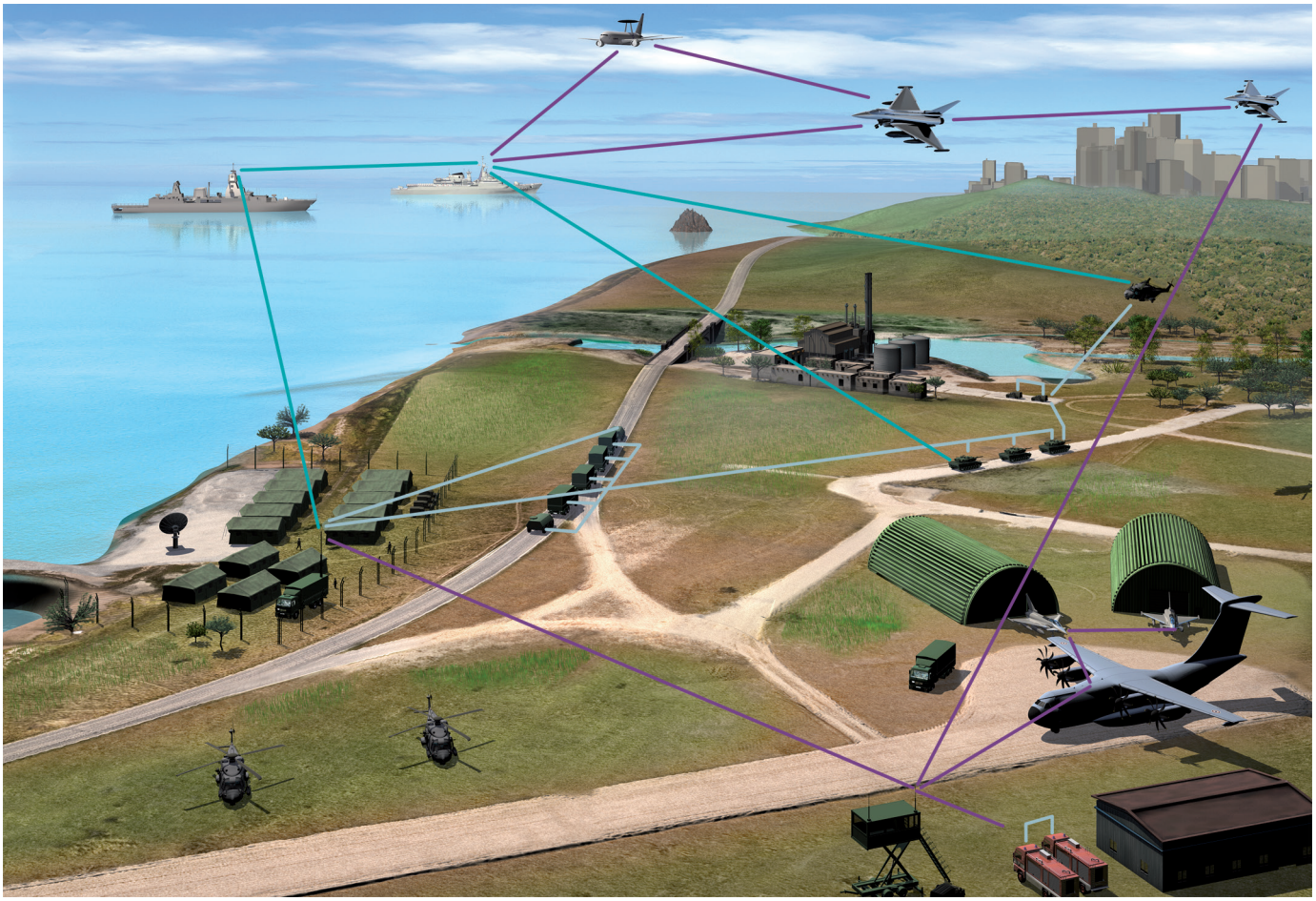
In order to plan radio nets based on operational demands, the mission planner software also allows network planning regarding logical, hierarchical and especially joint or combined mission-tailored structures.

Frequency assignment

The mission planner software supports HF, VHF as well as UHF frequencies and allows the use of fixed frequency mode as well as frequency hopping mode. Especially the frequency hopping modes enable jam-proof and reliable radiocommunications.

Management of barred frequencies is provided additionally. According to frequency plans by the national frequency authority, single frequencies and frequency bands can be barred.

Mission scenario.



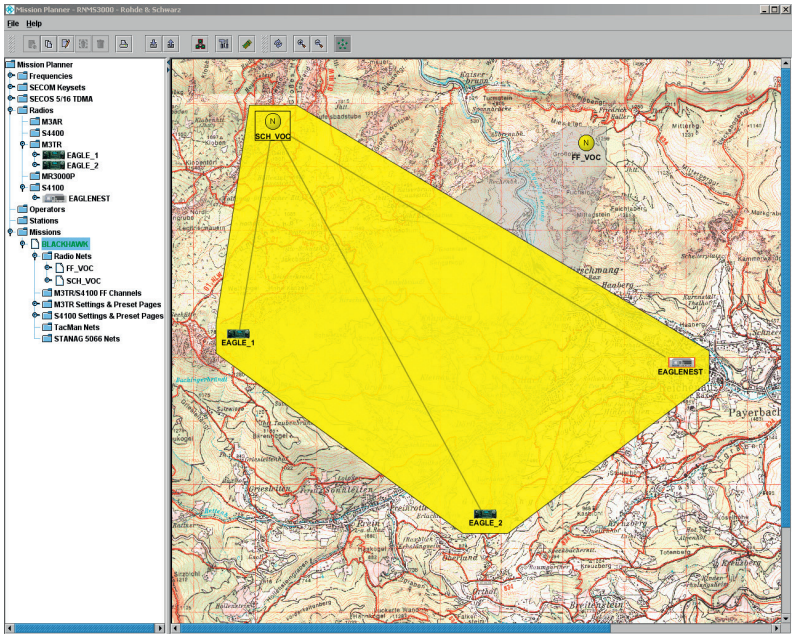
Hop set generation and management

The mission planner software allows individual, mission-specific, hop set generation via manual frequency entry as well as automatic hop set generation via an implemented algorithm.

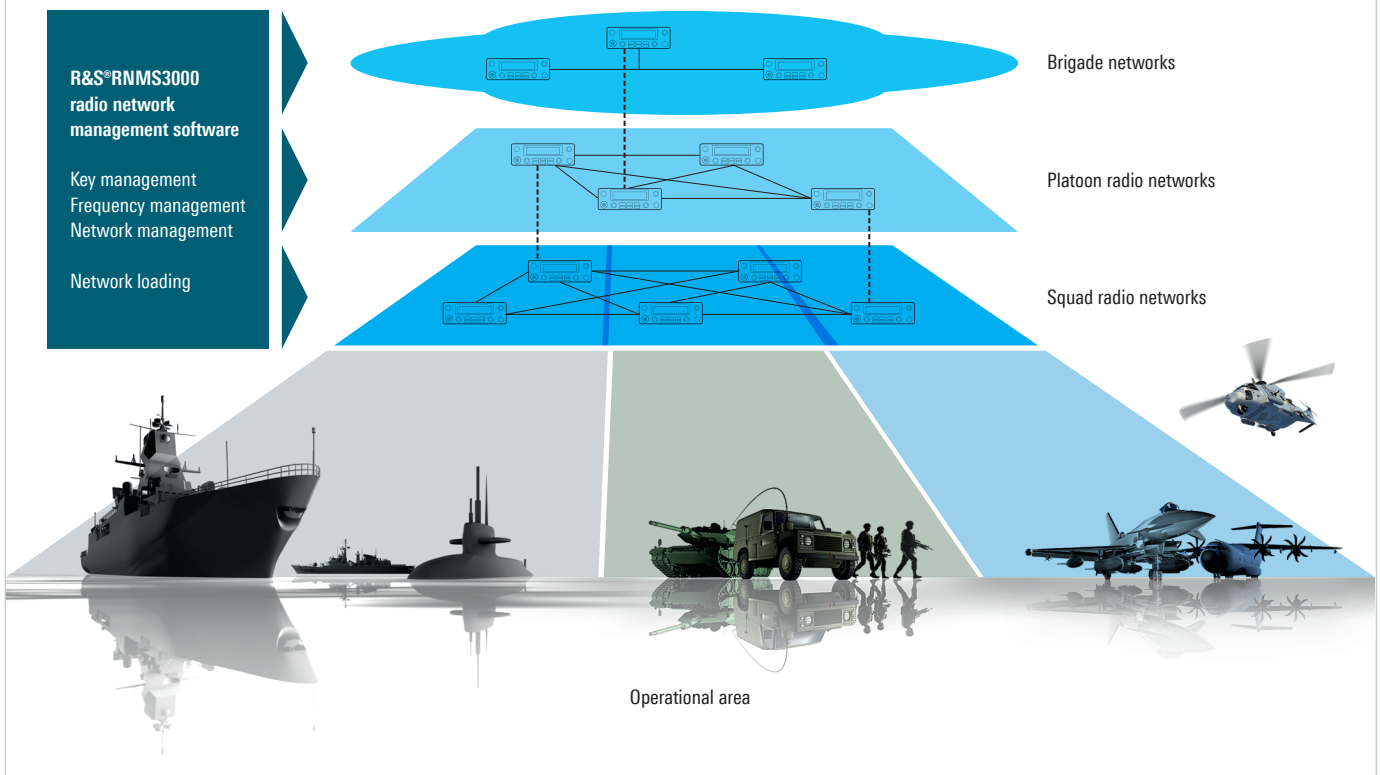
Security key management

To establish a secure radiocommunications network, encryption key management and data ciphering are essential. The Rohde&Schwarz mission planner software enables the import and the assignment of external and waveform-specific encryption keys in black form. They are generated by separate key generation tools. Rohde&Schwarz provides the suitable equipment for customer-specific key generation.

Geographical display of a mission area.



Hierachical radiocommunications structure



Effective mission planning

The mission planner software allows mission-optimized and time-critical software use. The program provides target-oriented software navigation via wizards to allow the operator mission planning with a focus on the essential parameters. In case of a configuration error R&S®RNMS3000 displays a fault message including advice to support the error search process. The created mission file and configuration progress are saved automatically in a database to avoid losing critical mission data due to a hardware failure.

Comprehensive waveform support

R&S®RNMS3000 allows users to apply and to configure several waveforms that meet the corresponding mission requirements.

NATO waveforms

R&S®RNMS3000 supports preset parameter configuration for NATO waveforms. All further waveform-specific parameters are managed via NATO tools.

HF House waveforms

R&S®RNMS3000 allows the planning of ALE scan groups and networks for the HF House waveform. The configuration of several data modems is supported as well as IP configuration according to STANAG 4538.

R&S®SECOM waveform

R&S®SECOM is a proprietary HF, VHF and UHF waveform optimized for tactical use. It provides powerful communications security (COMSEC) via data encryption and also transmission security (TRANSEC) via frequency hopping to prevent electronic attacks like detection, tapping or jamming. R&S®SECOM is compatible with R&S®M3TR, R&S®M3SR Series4100 and R&S®MR3000P.

The key generation device R&S®CP3000 generates the waveform-specific encryption keys which are required in order to achieve a maximum security level for the proprietary R&S®SECOM waveform.

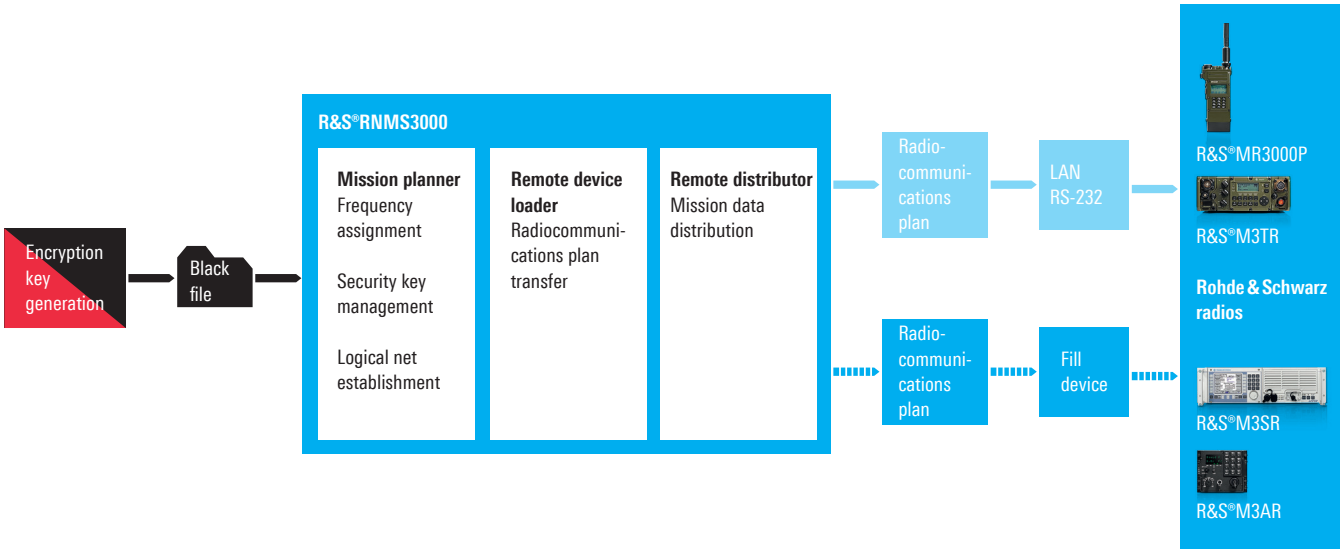
R&S®SECOS waveform

R&S®SECOS is a proprietary waveform optimized for fast moving objects such as aircraft. It provides high resistance to physical effects e.g. the Doppler effect or reflections as well as to electronic attacks such as jamming or eavesdropping.

R&S®SECOS enables secure and reliable UHF communications providing embedded crypto functionality (COMSEC) and transmission security via frequency hopping (TRANSEC). The waveform is compatible with the R&S®M3AR, R&S®M3SR Series4400 and R&S®M3TR to ensure interoperability between several military units.

The key generation device R&S®KMC3750 generates the waveform-specific encryption keys which are required in order to achieve a maximum security level for the Rohde&Schwarz proprietary R&S®SECOS waveform.

Process sequence



Remote device loader

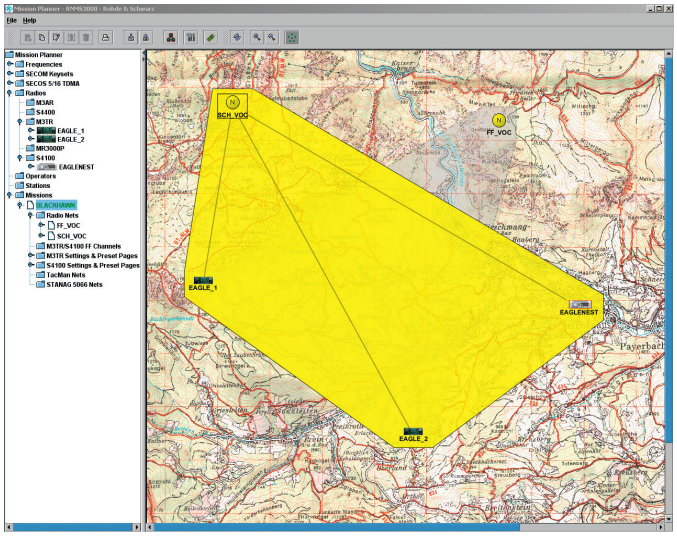
Mission-optimized radiocommunications plan transfer

The remote device loader (RDL) is integrated in the R&S®RNMS3000 software suite and represents the interface between the mission planner software and the Rohde&Schwarz radios or fill devices. The RDL also runs as a standalone software tool to enable detached mission planning and equipment programming.

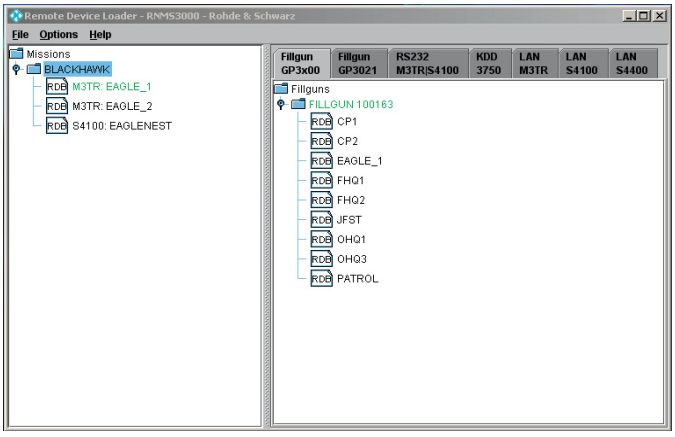
Secure file transfer

- The RDL exports the key files only in black form to meet the military security requirements
- Using R&S®RNMS3000, the mission data set can be transmitted to Rohde&Schwarz fill devices to get a portable and mission-tailored programming tool
- A further capability of the RDL is to transfer the mission data via LAN or via a serial RS-232 interface to the Rohde&Schwarz radios

Bringing radio network missions ...



... onto the radios.



Effective hardware programming

The RDL software automatically displays all connected and available radios or fill devices and allows the user to transfer the mission files usually via a drag&drop operation to enable an effective and time-critical mission file transfer.

Remote distributor

Extended mission data distribution and status control

The remote distributor (RD) extends the capabilities of the R&S®RNMS3000 software suite and enables radiocommunications plan components to be exchanged over long distances. The RD represents an integrated interface in the mission planner for seamless distribution of radiocommunications plans.

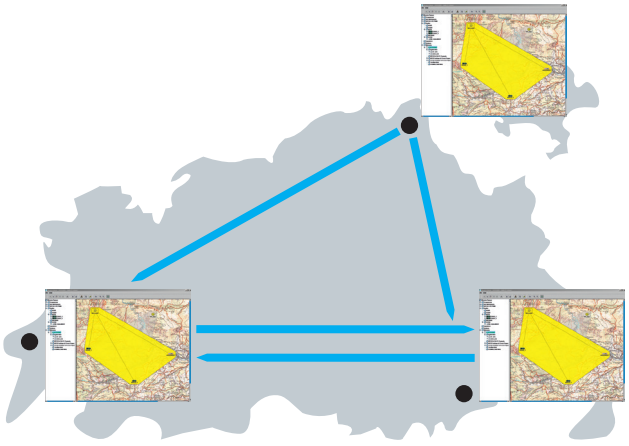
File distribution

The RD allows mission data or encryption keys to be exchanged with other locations or authorities to provide decentralized and hierarchical mission planning. For this purpose the RD provides data exchange via LAN or WAN networks.

Event log

The Rohde&Schwarz remote distributor enables the logging of distribution events. This software feature displays all received data sets in the inbox window and all outgoing data sets in the outbox window. The current distribution data status is also displayed and shows if the data was successfully sent, received or even transferred via LAN to the radios.

Geographically dispersed radio network planning



System requirements

The computer used for R&S®RNMS3000 must meet the following system requirements:

- Standard PC
- Minimum 1 Gbyte RAM (2 Gbyte recommended)
- Processor clock > 1 GHz
- Windows XP or Vista operating system
- 2 × USB port

Product overview

Designation	Type
Mission planner	
R&S®RNMS3000 mission planner (software package)	R&S®DS3100M
Mission planner waveform licenses	
Activation of NATO waveform [1]	R&S®DS3110
License for NATO waveform [2]	R&S®DS3111
Activation of HF House waveform [1]	R&S®DS3120
License for HF House waveform [2]	R&S®DS3121
Activation of R&S®SECOS 5/16 waveform [1]	R&S®DS3130
License for R&S®SECOS 5/16 waveform [2]	R&S®DS3131
Activation of R&S®SECOM waveform [1]	R&S®DS3140
License for R&S®SECOM waveform [2]	R&S®DS3141
Remote device loader	
R&S®RNMS3000 remote device loader (software package)	R&S®DS3300D
Remote distributor	
R&S®RNMS3000 remote distributor (software package)	R&S®DS3321D
Installation service	
Installation of R&S®RNMS3000 on PC	

[1] One per RNMS instance.
[2] One per radio.

R&S®RCMS II Remote Control and Monitoring System

R&S®RCMS II is a software solution for the remote control and monitoring of Rohde&Schwarz radios.

R&S®RCMS II enables operators of civil air traffic control (ATC) and air defense systems to monitor and control Rohde&Schwarz radios from one or more locations. This allows a cost-effective quick response to error conditions and provides the ability to set operational parameters for various ATC scenarios.

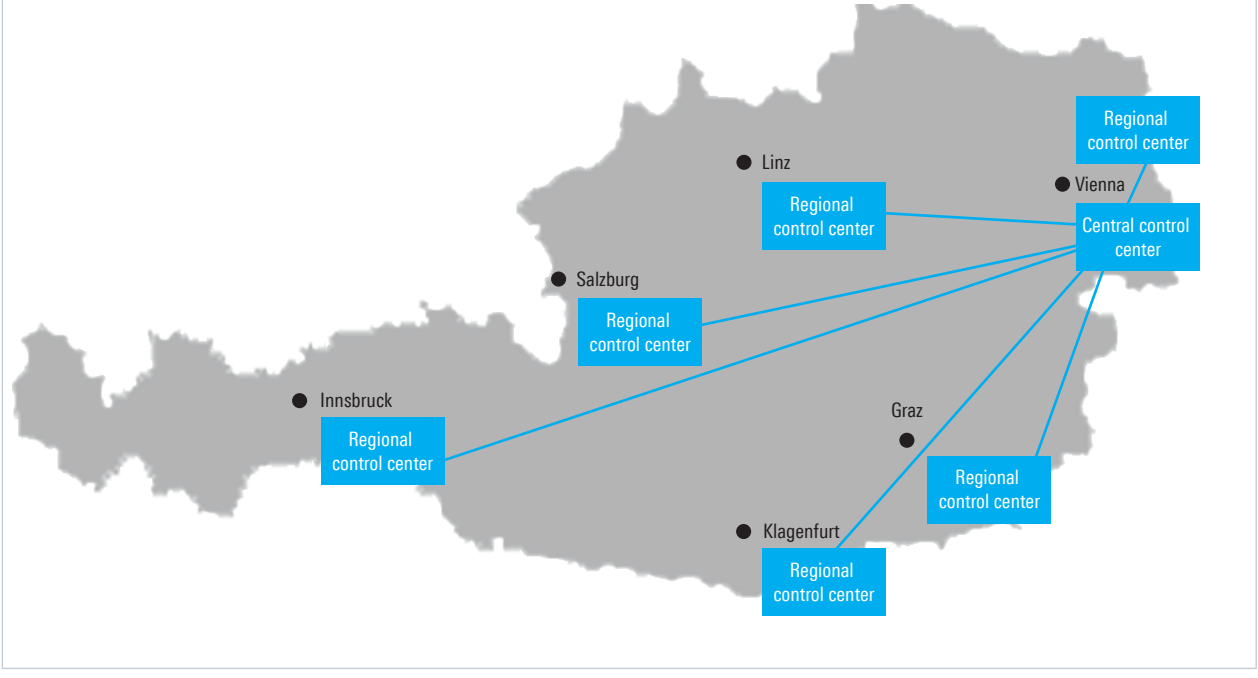
R&S®RCMS II is designed for monitoring scenarios ranging from individual airports to country-wide radio systems. The radios are shown in both a tree view and a map view. The map view shows the location and basic configuration of each radio. Individual radios can be selected and managed quickly and easily. The system data is recorded for customer-specific statistical analysis using third-party applications.

The R&S®RCMS II software can easily be configured for customer-specific ATC systems. By using off-the-shelf computer hardware and existing network infrastructure, the required capital expenditures and operational costs can be kept to a minimum. Additional Rohde&Schwarz radios can be brought into the R&S®RCMS II system quickly and easily, including new radios in existing sites or completely new sites.

Key facts

- No additional hardware required for monitoring and controlling radios at the individual sites
- Support for Rohde&Schwarz radios with EPM capabilities for military applications
- Redundant system for continuous monitoring and control
- Overall status report sent to higher-level monitoring system via SNMP
- Complete situational overview of the radio sites through monitoring of SNMP-capable devices

Country-wide R&S®RCMS II in Austria (AustroControl)



Benefits and key features

Optimum operational efficiency

- Remote monitoring of radios
- Remote control of radios

Wide range of analysis features

- Recording and analysis of system events
- Data stored for customer-specific statistical analysis

Customized system solutions

- High level of scalability
- Expandability of existing R&S®RCMS II systems

State-of-the-art technology with off-the-shelf hardware

- Windows platform
- IP technology
- Time synchronization via network time protocol (NTP)

Secure and reliable operation

- Flexible user management
- High availability

Interoperation with other components in the ATC system

- Integration of SNMP-capable devices
- Status information for higher-level monitoring center

Optimum operational efficiency

Remote monitoring of radios

R&S®RCMS II enables comprehensive monitoring of Rohde&Schwarz radios and their operational parameters. The easy-to-use graphical user interface provides an overview of the entire radio system as well as information regarding the status of each individual radio.

Information about each radio is displayed on the screen with specific colors to indicate the status of the link and the radio itself. The user-friendly interface makes it easy to navigate between a country-wide overview of the system and detailed information about each individual radio, including its parameters and status. In this way, details can quickly be determined regarding the status of individual modules, error messages and current settings.

Remote control of radios

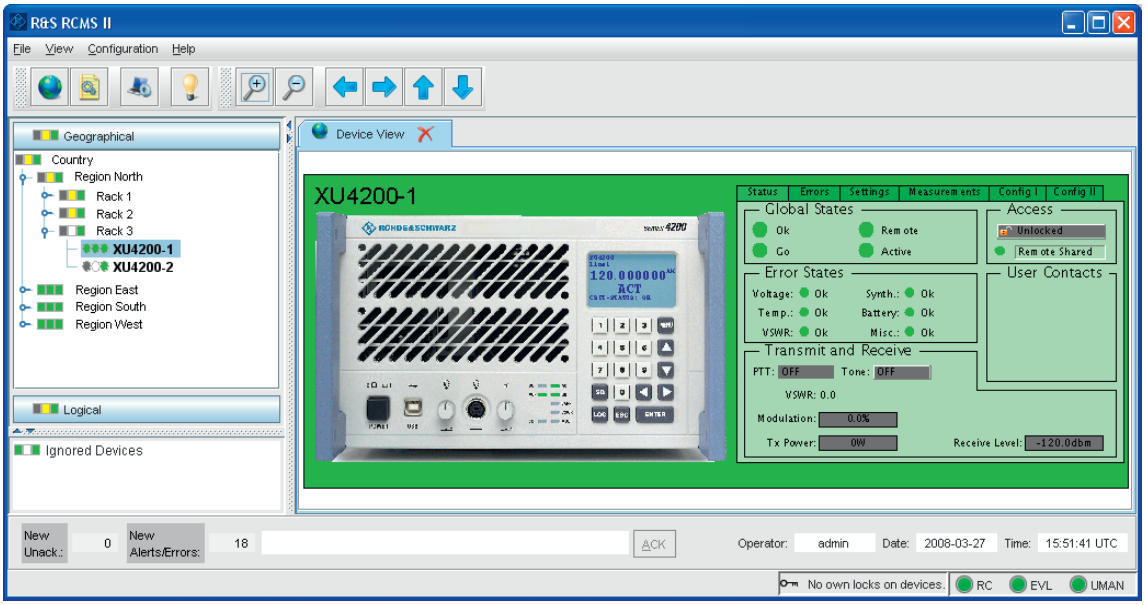
Using R&S®RCMS II, radio parameters can easily be set and/or changed in order to adapt the radio system to current operational needs. This can be accomplished from one or more locations. In addition to monitoring, the radios can also be managed without any interruption of the monitoring activities in progress.

Wide range of analysis features

Recording and analysis of system events

The R&S®RCMS II remote control and monitoring system stores all system events for the radios being monitored in a database. In addition to error messages and warnings, information such as user login or logout is also stored. This information is displayed in tabular form and can be filtered according to various criteria such as time frame, message type, message code or radio name. As a result, the history of an individual radio or the entire system can be tracked at any time.

Standard RCMS configuration for the R&S®Series4200.



Data stored for customer-specific statistical analysis

R&S®RCMS II stores the incoming status messages from the radios being monitored in a database and can export them for external analysis. The customer can use this data for carrying out further analysis such as determining the frequency of errors.

Customized system solutions

High level of scalability

R&S®RCMS II is based on a client/server architecture. The system can be sized to support a single airport, a region or an entire country in accordance with the customer's requirements.

The client/server architecture permits the operation of systems distributed across various locations. An example of this would be an R&S®RCMS II server at a central location, workstations at regional centers and radios at remote sites.

Expandability of existing R&S®RCMS II systems

R&S®RCMS II can easily be adapted when civil and military air traffic control operators need to expand their radio systems. Radios at a new site can be added to an existing R&S®RCMS II system cost-effectively. R&S®Series4200, R&S®M3SR Series4400 and R&S®M3SR Series4100 radios can be connected directly to existing IP infrastructure without requiring additional hardware.

State-of-the-art technology with off-the-shelf hardware

Windows platform

R&S®RCMS II uses off-the-shelf computer hardware running Windows 7 Professional.

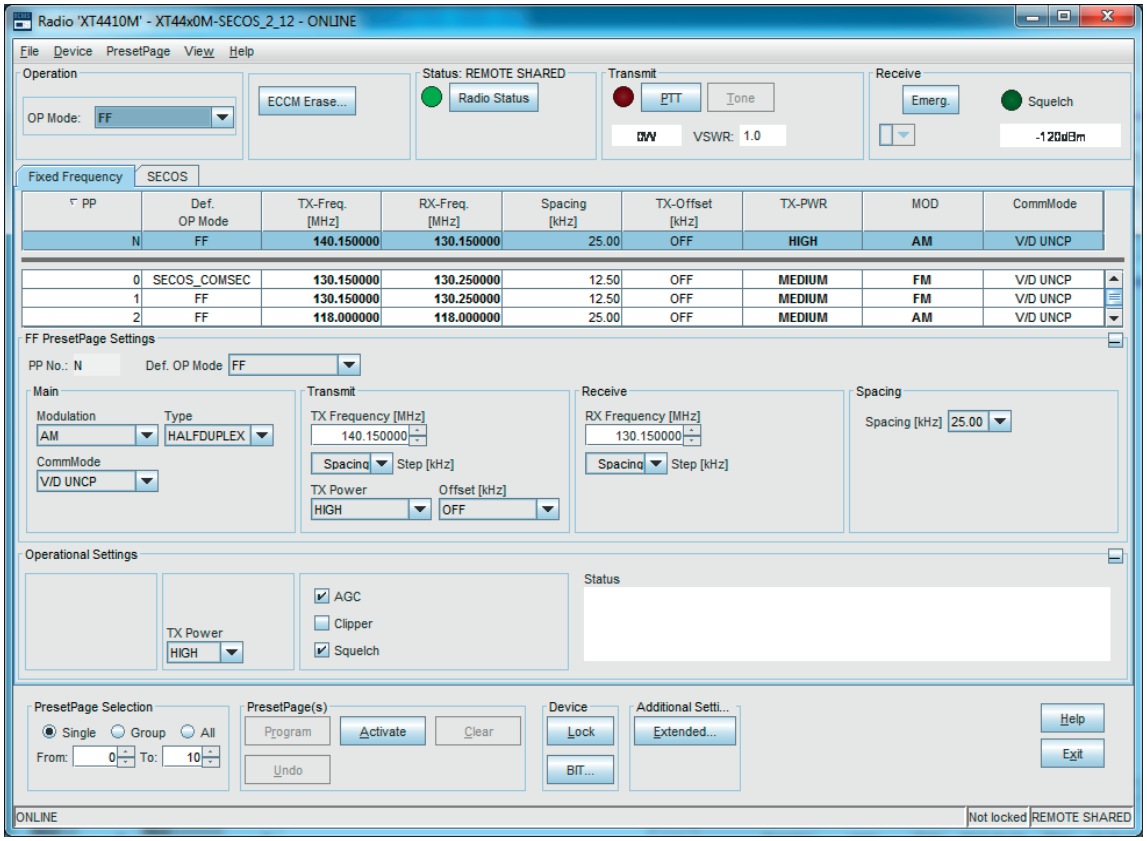
IP technology

R&S®RCMS II uses IP technology. Communications between R&S®RCMS II workstations, servers and radios are handled via IPv4. Additionally IPv6 is supported for the communications from R&S®RCMS II servers to R&S®Series4200, MultiServers and SNMP devices. Existing LAN/WAN infrastructure can be used if it meets the requirements of R&S®RCMS II.

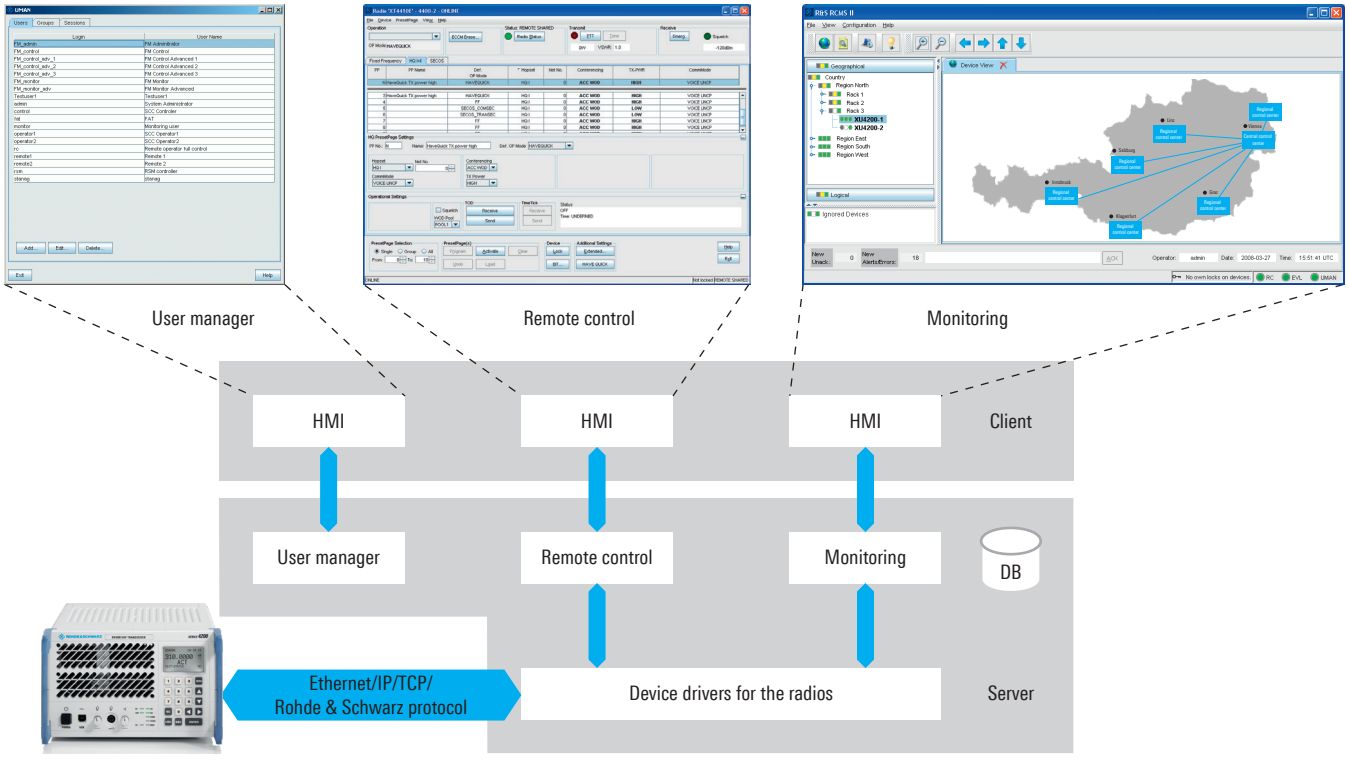
Time synchronization via network time protocol (NTP)

The system time on the R&S®RCMS II server can be synchronized with the central time provisioning system by means of NTP. In this way, events in the R&S®RCMS II database will have a precise timestamp and can be compared to other events in the radio system much more conveniently.

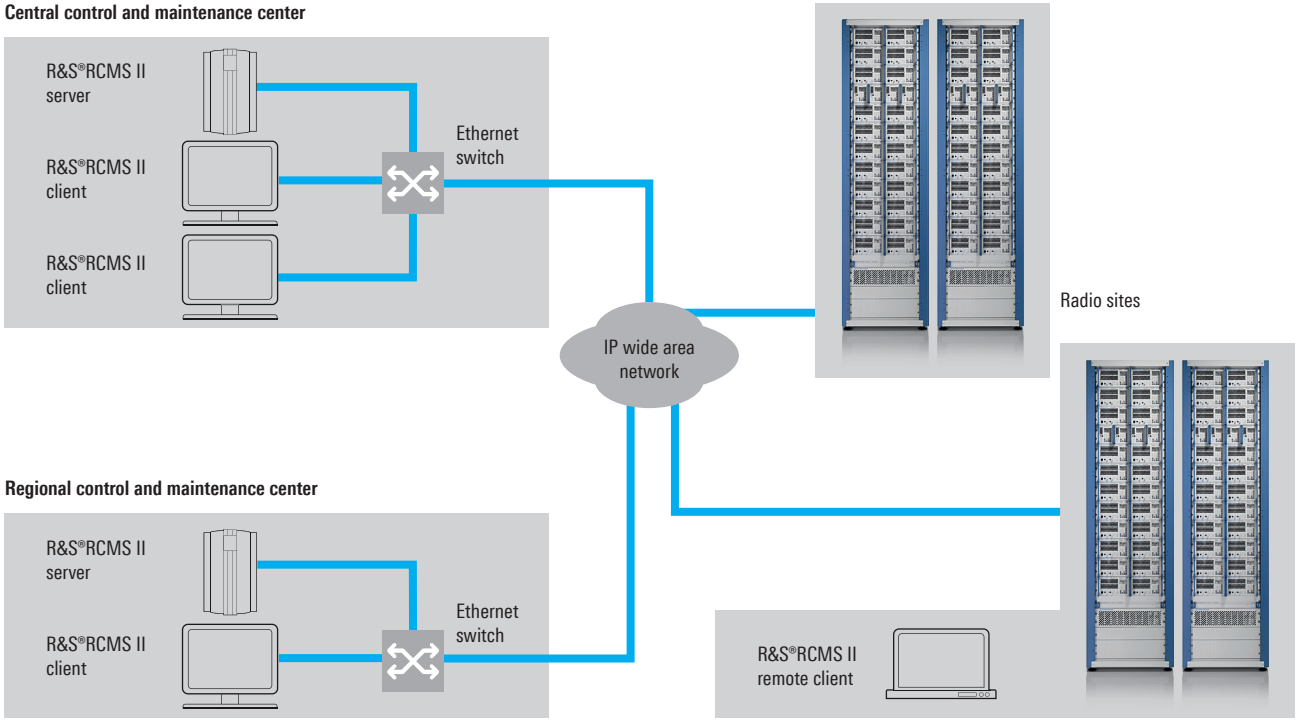
Extended RCMS configuration for the R&S®M3SR Series4400.



Various applications using the R&S®RCMS II architecture



Connecting the radio sites using IP technology



Secure and reliable operation

Flexible user management

The user management features facilitate the assigning of access rights. Authorizations for monitoring and/or controlling the radios can be assigned with various user levels. System administrators can revise existing authorizations and create new users and user groups.

High availability

Radio voice and data transmission remains unaffected in the event that the R&S®RCMS II system is not available. It is possible to increase system availability for monitoring and controlling R&S®Series4200, R&S®M3SR Series4400 and R&S®M3SR Series4100 radios by expanding R&S®RCMS II to include a secondary server. The secondary server can be used for monitoring and control activities in the case that the primary server fails.

Interoperation with other components in the ATC system

Integration of SNMP-capable devices

SNMP-capable devices from other manufacturers can be monitored with R&S®RCMS II as long as the device has a suitable SNMP MIB. Furthermore, off-the-shelf SNMP-capable sensors can also be integrated and monitored. Using a single monitoring system saves both time and money.

Status information for higher-level monitoring center

The role of a central monitoring center is to collect and display an overview of the status information for all applications and active devices within an ATC system. R&S®RCMS II supports this by sending a status summary for the radio system to the central monitoring center via SNMP. The details and the status of the individual radios are available in the R&S®RCMS II system.

R&S®RCMS II system configuration

The number of workstations, servers, radios and radio sites in the R&S®RCMS II system is easily scalable. Small, mid-sized and country-wide radio systems can be supported by means of various configurations:

- Single server solution for small and mid-sized radio systems
- MultiServer solution for large-scale radio systems with central monitoring center

Single server solution for small and mid-sized radio systems

The R&S®RCMS II single server solution operates on a single desktop or laptop on which the server applications and the graphical user interface are installed. In this way, a small radio system for a single airport can be implemented cost-effectively using just one off-the-shelf desktop or laptop.

Moreover, additional R&S®RCMS II workstations can be connected to the R&S®RCMS II server via IP to enable the simultaneous monitoring and operation of the radios by several users, even from multiple locations.

MultiServer solution for large-scale radio systems with central monitoring center

Large-scale country-wide ATC and air defense operators often establish regional structures for their radio systems in the form of regional management centers. A regional center is responsible for a specific region and operates autonomously with its own R&S®RCMS II server and multiple workstations. Additionally, the overall status of the radios in the regions can be monitored from a central location. In this case, the monitoring activities are handled by an additional R&S®RCMS II server with MultiServer option in the central maintenance center, retrieving summarized radio status information from each regional R&S®RCMS II server.

R&S®RCMS II supported radios

R&S®RCMS II supports R&S®Series4200 [1], R&S®M3SR Series4400, R&S®M3SR Series4100, R&S®Series2000 [2] and R&S®Series200 [3] radios. R&S®Series400U [2] radios can be integrated into the R&S®RCMS II system upon request.

[1] Including n+m redundancy via R&S®GV4000 model .31, .32 or .33.

[2] For radios that do not support monitoring and control via IP, the radio site must provide a converter from Ethernet to the radio interface. Radios with an RS-232 interface can only be monitored and controlled from a single system.

[3] The following types of R&S®Series200 radios are supported via R&S®GV4000 model .03: R&S®EU231, R&S®SU251, R&S®XU251, R&S®XU221*, R&S®XD231, R&S®EU230, R&S®SU250, R&S®XU250A, R&S®XU251 MS, R&S®EU230 MS, R&S®SU250 MS*, R&S®EU231 MS, R&S®SU251 MS and R&S®XU221 MS*. For radio types marked with * additional release tests have to be planned on a customer-specific project basis.

The R&S®RCMS II data sheet contains a list of all parameters that can be monitored and controlled for each of the Rohde&Schwarz radio types supported.

R&S®RCMS II platform requirements

The hardware requirements for the R&S®RCMS II server and workstations depend on the number of radios to be monitored and/or controlled by each server. The following example illustrates the hardware configuration for one R&S®RCMS II server and workstation for monitoring and controlling a mid-sized radio system.

Server

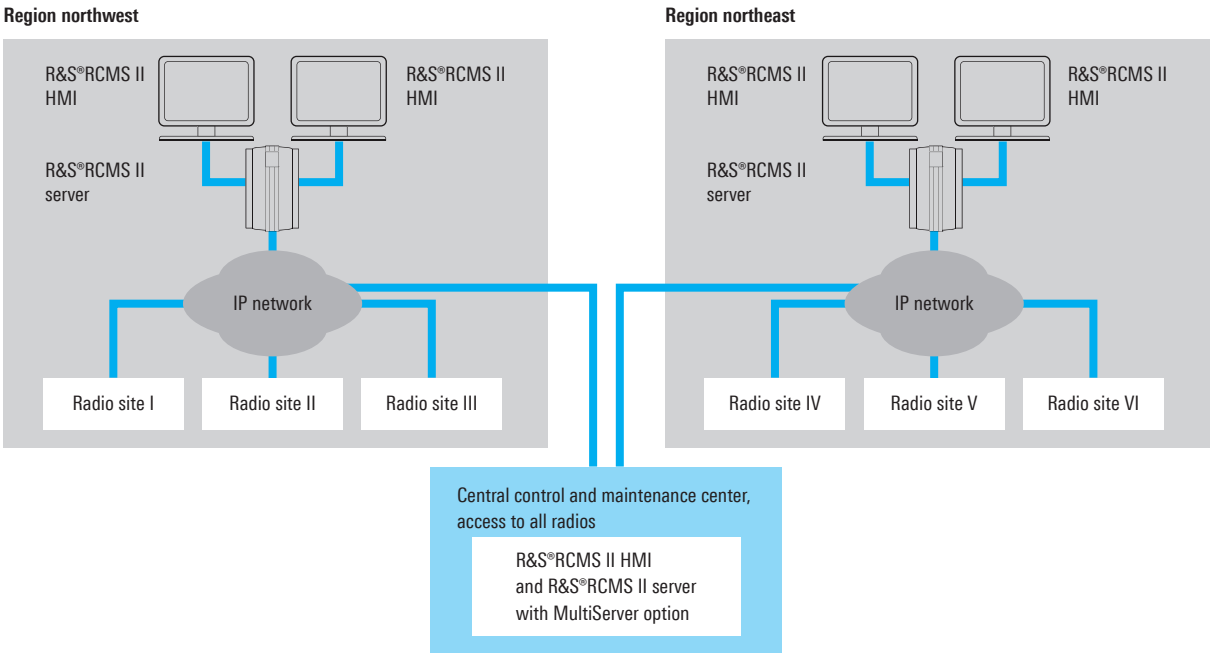
- Intel Core 2 Quad core 2.4 GHz processor, 3 Gbyte RAM, > 100 Gbyte HDD, CD-ROM, mouse with scroll wheel, keyboard, USB interface, 100 Mbit/s Ethernet interface, 19" monitor
- Operating system: Windows 7 Professional (64 bit), English

Workstation

- Intel Core 2 Dual core 3.0 GHz processor, 3 Gbyte RAM, 20 Gbyte HDD, CD-ROM, mouse with scroll wheel, keyboard,
  100 Mbit/s Ethernet interface, 19" monitor
- Operating system: Windows 7 Professional (64 bit), English

The hardware will be scaled according to the size of the radio system to be monitored. R&S®RCMS II

Example of MultiServer solution



R&S®RCMS II application scenarios

Scenario 1: Failure of a radio at an airport

One of the radios at an airport with separate transmitter and receiver locations has exhibited a fault. The corresponding standby radio was activated automatically and is now in operation. R&S®RCMS II registers the event and displays it on the R&S®RCMS II workstation in the management center. By selecting the radio with the fault, more detailed information about the fault is shown, such as temperature, voltage and VSWR. Upon command, R&S®RCMS II instructs the radios to carry out a built-in test, which will then provide additional information about the fault condition. This information is forwarded to the maintenance center where the appropriate repair measures are initiated.

Scenario 2: Country-wide ATC system with multilevel monitoring

Radios at various locations around the country are monitored by regional ATC centers throughout the day. At night, when traffic volumes are low, radio activities are monitored from a central location. R&S®RCMS II monitors all the radios at night from this central location as well.

Scenario 3: Changing radio parameters for an air defense application

A military operation requires changing the frequencies and modes of operations used for each mission. For a new mission, a predefined mission parameter set is selected. Upon command, R&S®RCMS II in the control center activates the mission parameter set (preset page) in the ground radios at the remote sites.

R&S®M3SR Series4400 in operation in an R&S®MX400 mobile tower.

Software options

Options	Description
The R&S®RCMS II software is available as a basic package with additional software options.	
Standard RCMS (basic package)	Complete monitoring and basic control functionality for Rohde&Schwarz radios. The supported parameters depend on the types of radio used. [1]
Extended RCMS	Complete remote control functionality for R&S®M3SR Series4400 and R&S®Series2000 radios, including EPM parameters. The supported parameters depend on the types of radio used. [1]
MultiServer RCMS	Supervision of multiple regional Standard RCMS servers and connected radios (summarized status information).
Remote firmware upload for R&S®Series4200	Remote firmware upload for one or more R&S®Series4200 radios in parallel
Additional R&S®RCMS II client software	Software licenses for additional R&S®RCMS II workstations.
Licenses for radios	In order for the R&S®RCMS II system to support various Rohde&Schwarz radios, the corresponding license for each radio is required.
License for SNMP-capable devices	In order for the R&S®RCMS II system to support multiple SNMP-capable devices, one license per R&S®RCMS II server is required.
R&S®RCMS II status information via SNMP v2c	Communications of the overall status information for all radios being monitored by an R&S®RCMS II server to a primary monitoring system.

[1] The R&S®RCMS II data sheet contains a list of all parameters that can be monitored and controlled for every supported Rohde&Schwarz radio.

Product overview

Designation	Type
Basic software	
Standard RCMS server software with one client license ▪ Fault management and remote control ▪ For R&S®Series200, R&S®Series4200, R&S®M3SR Series4400, R&S®M3SR Series4100 and R&S®Series2000 ▪ For up to 500 RX/TX radios or 250 transceiver radios	R&S®DS3800
Software options ("Extended RCMS" functionality for the basic software package)	
Extended RCMS server software for one Standard RCMS server ▪ Enhanced remote control for fixed frequency ▪ For R&S®M3SR Series4400, R&S®M3SR Series4100 and R&S®Series2000	R&S®DS3801
Extended RCMS server software for one Standard RCMS server ▪ Enhanced remote control for fixed frequency and R&S®SECOS waveform ▪ For R&S®M3SR Series4400	R&S®DS3802
Extended RCMS server software for one Standard RCMS server ▪ Enhanced remote control for fixed frequency and HAVE QUICK I/II waveform ▪ For R&S®M3SR Series4400	R&S®DS3803
Extended RCMS server software for one Standard RCMS server ▪ Enhanced remote control for fixed frequency and SATURN/HAVE QUICK I/II waveform	R&S®DS3804
Software options ("MultiServer RCMS" functionality for the basic software package)	
MultiServer RCMS server software for one Standard RCMS server ▪ For supervision of multiple regional Standard RCMS servers and connected radios	R&S®DS3808
Remote firmware upload software for R&S®Series4200 for Standard RCMS servers ▪ Software can be used for multiple Standard RCMS servers within one R&S®RCMS II system	R&S®DS3809
Licenses for additional R&S®RCMS II workstations	
One client license ▪ For operational access to one R&S®RCMS II server (Standard or Extended)	R&S®DS3820
Licenses for radios	
RCMS license for one R&S®Series4200 transmitter or receiver	R&S®DS3830
RCMS license for one R&S®Series4200 transceiver	R&S®DS3831
RCMS license for one R&S®M3SR Series4400 or R&S®Series2000 radio	R&S®DS3833
RCMS license for one R&S®M3SR Series4100 radio	R&S®DS3834
RCMS license for one R&S®Series200 receiver or transmitter via R&S®GV4000 model .03 (R&S®EU231, R&S®SU251, R&S®EU230, R&S®SU250)	R&S®DS3838
RCMS license for one R&S®Series200 transceiver via R&S®GV4000 model .03 (R&S®XU251, R&S®XU221, R&S®XD231, R&S®XU250)	R&S®DS3839
SNMP support	
RCMS license for monitoring of third-party SNMP-capable devices connected to an R&S®RCMS II server	R&S®DS3840
RCMS license to provide R&S®RCMS II summary status information via SNMP v2c to a third-party monitoring system	R&S®DS3841
Services	
R&S®RCMS II server installation and configuration	on request
R&S®RCMS II configuration of a specific third-party SNMP device (LUA script)	on request

R&S®Postman III Radiocommunications System

Civil and military missions require that all entities involved can communicate efficiently and reliably. While voice communications continue to play an important role, data communications are increasingly gaining in importance. R&S®Postman III is a forward-looking radiocommunications solution for IP-based data transmission.

R&S®Postman III enables efficient data transmission over radio networks, thus significantly contributing toward the success of civil and military missions. In addition to naval and coast guard scenarios, such missions will be carried out in disaster situations and as part of border control or rescue operations. In the event of a failure of wired communications media, such as used by embassies and consulates, R&S®Postman III can replace existing infrastructures by providing shortwave radiocommunications.

R&S®Postman III offers IP-based applications and can therefore use standard IP infrastructures such as LAN/WAN or SatCom. R&S®Postman III has been optimized for communications over HF and VHF/UHF radio networks with low and variable data rates. The system supports the use of modern IP enabled radios as well as radios with a serial data interface.

R&S®Postman III supports multiline operation. In radiocommunications, this means that information can be exchanged simultaneously with multiple entities over the same or different radio networks. R&S®Postman III automatically selects a line suitable for communicating with the remote entity.

E-mail and chat capabilities and the display of position data are some of the key applications that are made available through the intuitive user interface. Based on the data gained from these applications, R&S®Postman III can generate and display a force's situation picture. This is a crucial prerequisite for enabling coordinated action in both civil and military operations.

Key facts

- IP-based data transmission for narrowband radio channels
- Multiline capability for simultaneous communications with multiple radio network entities
- Generation of common situation picture based on position data from all radio network entities

Benefits and key features

State-of-the-art, forward-looking technology

- Efficient, IP-based data transmission methods for narrowband radio channels
- Extending communications beyond the line of sight (LOS)
- Multiline capability for simultaneous communications with multiple radio network entities
- Secure and reliable information exchange over radio networks
- Conflict-free data and voice communications on a radio line

Role-based task division for efficient, convenient operation

- Reducing the user's workload
- Operator focus on data traffic management
- Integrated management tools facilitate operator tasks

Simple and comprehensive communications applications

- The right application for every mission
  - E-mail
  - Fax
  - Voice mail
  - File transfer
  - Chat
- Realtime data transfer

Blue force tracking

- Graphical display of current positions and movements of subunits
- Reliable alarm function
- Detailed analysis
- Export of tracks to navigation systems

State-of-the-art, forward-looking technology

R&S®Postman III features multiline capability, allowing the simultaneous use of multiple HF and VHF/UHF radio lines. Its integrated radio protocols enable high-performance data transmission. R&S®Postman III also supports LAN/WAN and satellite communications.

Efficient, IP-based data transmission methods for narrowband radio channels

R&S®Postman III employs robust and adaptive radio transmission methods to accommodate for different mission scenarios. It offers special radio protocols to support national and multinational missions. The STANAG 5066 standard HF radio protocol is available as an option to allow the exchange of e-mails with NATO partners.

Modern radios using frequency hopping and encryption techniques can be integrated to make communications jam-resistant and tap-proof.

Variations in channel quality, as encountered especially in HF radiocommunications, lead to variations in usable data rates; poor channel quality may even disrupt data transmission. R&S®Postman III, in conjunction with modern Rohde&Schwarz radios, provides special mechanisms to ensure optimal control of the data flow.

Different communications scenarios call for different data transmission methods. For data exchange between two entities, R&S®Postman III employs a point-to-point method. For data exchange among multiple radio network entities, a point-to-multipoint radio protocol is used.

Extending communications beyond the line of sight (LOS)

To reach a destination beyond the sender's line of sight, R&S®Postman III can be configured as a relay station that automatically forwards messages to the other station.

R&S®Postman III therefore eliminates the line-of-sight restriction for data communications in VHF/UHF radio networks.

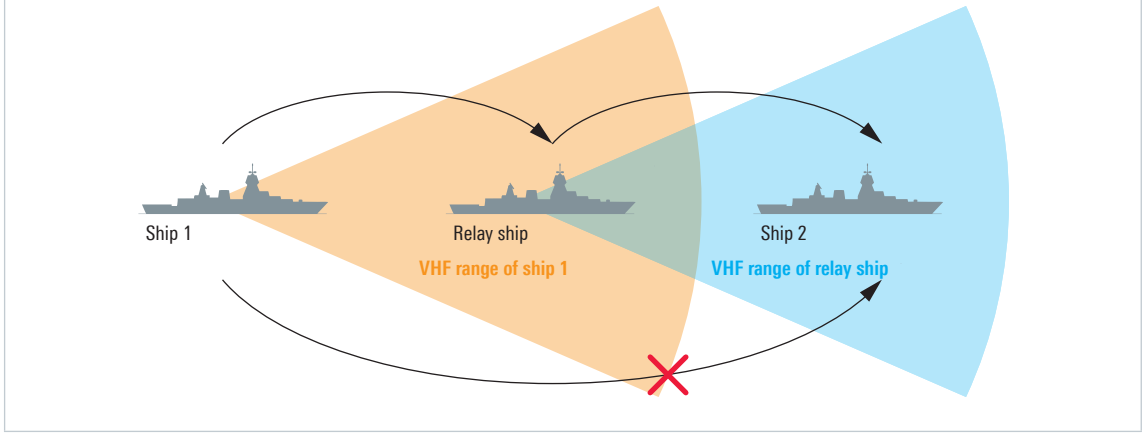
Multiline capability for simultaneous communications with multiple radio network entities

R&S®Postman III allows data to be transmitted simultaneously over multiple HF and VHF/UHF radio lines, and also supports the integration of SatCom and LAN/WAN infrastructures. This enables naval communications scenarios such as ship-to-ship and ship-to-shore.

When used by ground forces, this capability makes it possible for a battalion command post to communicate with its companies and with its superordinate regiment at the same time.

Further radio lines can be added, and existing ones reconfigured, on the R&S®Postman III graphical user interface by using the drag&drop function. This can be done during radio operation.

R&S®Postman III relay stations extend communications beyond the line of sight (LOS)



Secure and reliable information exchange over radio networks

The R&S®Postman III applications support various state-of-the-art radiocommunications methods for secure and reliable data exchange over radio networks.

In HF radio networks, automatic link establishment (ALE) is supported. This method offers the advantage that it automatically selects a suitable, unused frequency.

In VHF/UHF radio networks, the Rohde&Schwarz R&S®SECOS 5/16 TDMA method is used. With TDMA-based data transmission (TDMA – time division multiple access), each entity is allocated fixed timeslots for transmission and reception. As a result, all entities can utilize the available data transmission capacity without colliding or interfering with each other. R&S®SECOS 5/16 TDMA also offers frequency hopping capability (TRANSEC) to protect data transmission against interference.

R&S®Postman III supports both COMSEC encryption integrated in Rohde&Schwarz radios and encryption by means of external devices for tap-proof data transmission.

Conflict-free data and voice communications on a radio line

Voice communications over radio networks continues to play an important role in many missions.

With data communications gaining in significance, conflicts may arise if data and voice are to be transmitted over the same radio line. When voice is to be transmitted over a radio line during an ongoing data transmission, R&S®Postman III detects this as a voice-priority-over-data condition, interrupts data transmission for voice transmission, and resumes it when voice transmission is over. See "Supported devices and data transmission methods" on page 168 for the data transmission methods (waveforms) and radios supporting this feature.

Role-based task division for efficient, convenient operation

The R&S®Postman III role concept allows tasks to be divided between users and the operator in order to optimize working efficiency and convenience.

Reducing the user's workload

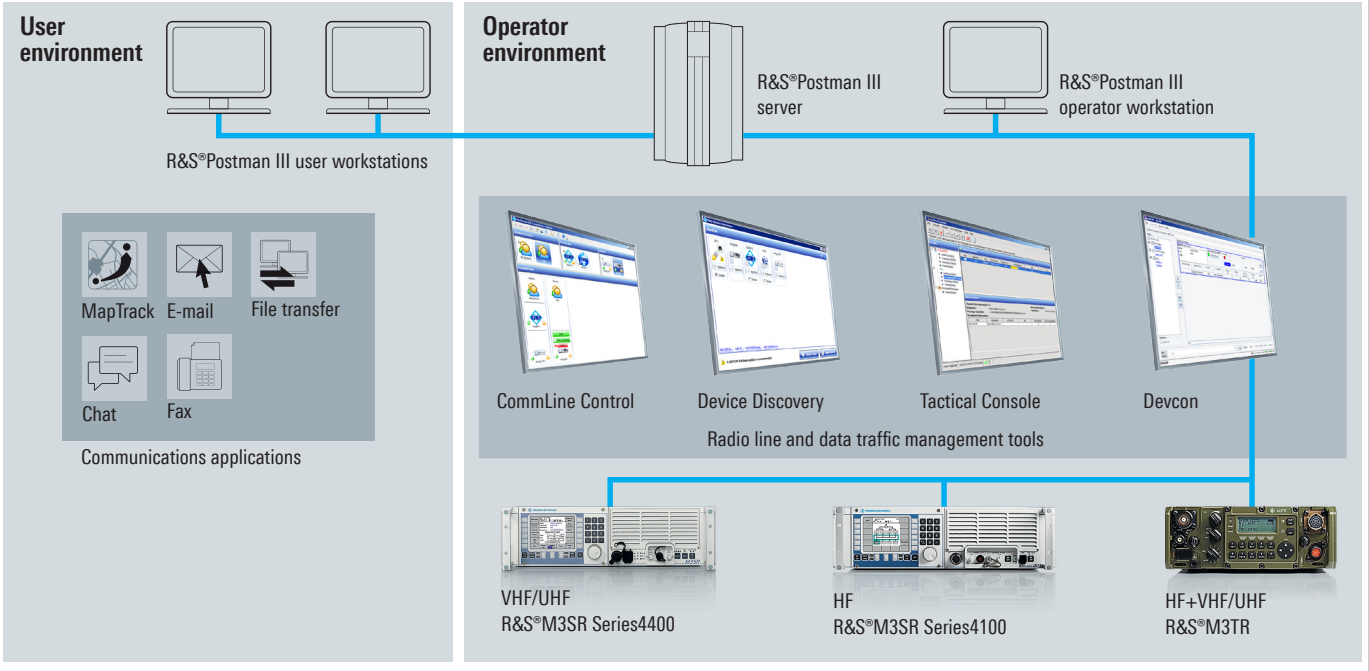
Users are assigned the following tasks:

- Handling e-mail messages
- Exchanging chat messages
- Exchanging files
- Analyzing the position data of subunits

The R&S®Postman III intuitive user interface allows fast and smooth communications with other network entities. Users can perform their tasks efficiently without requiring any expert knowledge.

Since, under the R&S®Postman III role concept, the operator is responsible for data traffic management, users are free to focus on their tasks.

R&S®Postman III role-based task division



Operator focus on data traffic management

The operator is responsible for ensuring smooth data transmission and is assigned the following tasks:

- Configuring the system (system setup)
- Defining and monitoring radio lines
- Monitoring data transmission
- Remote control of radio line components

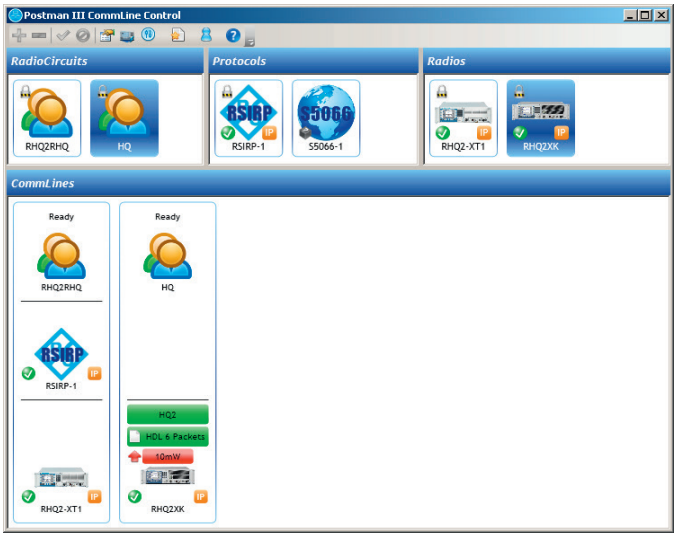
The management tools integrated in R&S®Postman III help the operator perform these tasks efficiently and reliably.

Integrated management tools facilitate operator tasks

The operator is responsible for ensuring correct and reliable data transmission. A set of management tools integrated in R&S®Postman III help the operator accomplish this task.

Plug & play configuration tool.

Radio line management tool.



Device Discovery

The Device Discovery tool assists the operator in configuring an R&S®Postman III system. Similarly to a plug & play mechanism, the tool detects the available radios, radio protocols and services. It automatically reads and displays the main configuration data for these components, and it detects and displays any modifications made to system components, for example when a radio has been replaced. Available system components are graphically displayed by category and are used by the CommLine Control tool for configuring radio lines.

CommLine Control

The CommLine Control tool helps to accomplish three tasks:

- Defining radio lines
- Monitoring radio line components
- Monitoring data transmission

The operator defines a radio line by selecting a radio, its operating mode and, if necessary, a radio protocol. The operator drags and drops the required components from the system component pool, thus making them available for the R&S®Postman III system for data transmission. Radio lines configured in this way can be stored, loaded and activated as required.

During radio line component monitoring, CommLine Control indicates the operating status of the individual radios and radio protocols. When data is transmitted on a radio line, the name of the opposite station is displayed together with the main transmission parameters.

A service message concept integrated in R&S®Postman III allows frequent radiocommunications activities to be executed largely automatically. Such activities include:

- Circuit testing: functional testing of a radio line
- EMCON (emission control) message: signaling of radio silence condition
- Address localization: query as to which station hosts a user for e-mail communications

Devcon

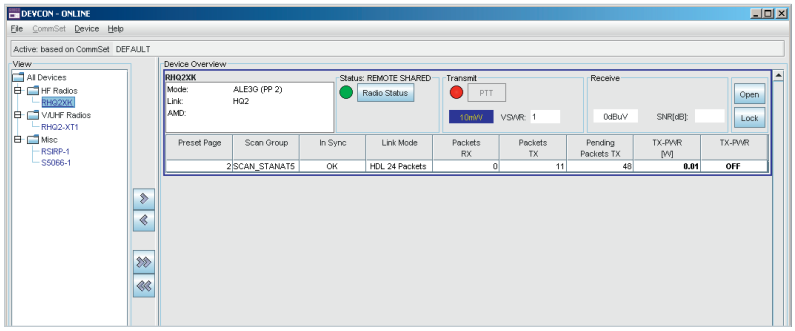
The Devcon (device control) tool allows the operator to swiftly respond to changing operational conditions by adapting the configuration parameters of the radio and radio protocol as required. Devcon provides two different views: a condensed overview showing the key parameters of all radio line components used in a system, and a detailed view displaying a large number of configuration parameters that the operator can check and modify on the R&S®Postman III workstation by remote control.

Tactical Console

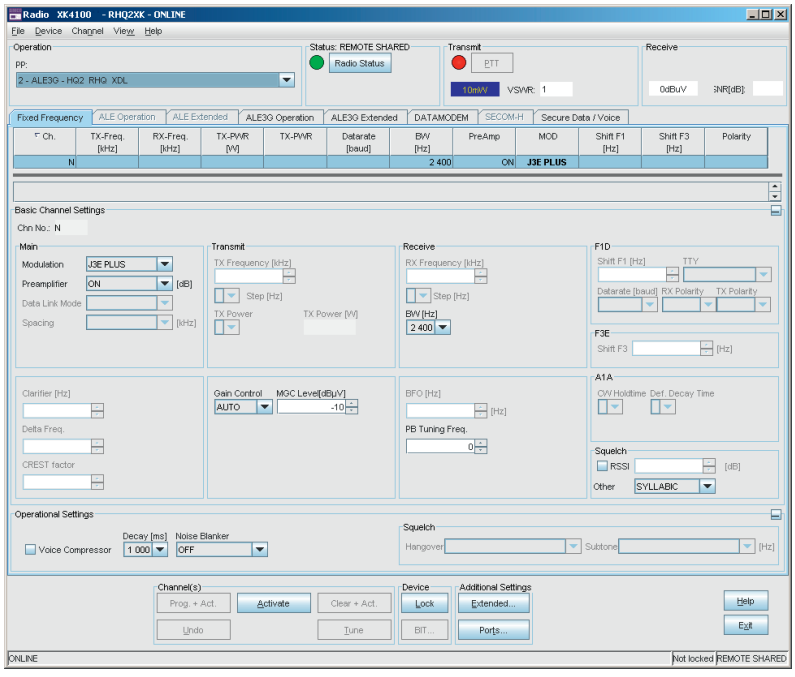
The Tactical Console tool offers a wide range of functions for monitoring and analyzing data traffic in an R&S®Postman III system.

The Tactical Console user interface shows detailed information for all data transmissions that are currently active or planned. Transmissions are assigned to the available radio lines and categorized according to their status (waiting, outgoing, incoming, failed). This provides a clear picture of the local TX and RX transmission activities, and the operator can intervene in automatic data transmission if necessary. For example, the operator can stop ongoing transmissions, reassign a message for transmission over a different radio line, or manually enable specific radio lines and messages, thereby controlling the data flow.

Remote control application (overview; figure shows upper portion of screenshot).



Remote control application (detailed view).



The Tactical Console tool also offers a journal function that provides a detailed, chronological record of the events in a radiocommunications system. Similar to a logbook function, this function records all transmitted and received e-mails, files and service messages. This enables the operator to analyze in full detail the events that have occurred in a radio system during a selected period of time.

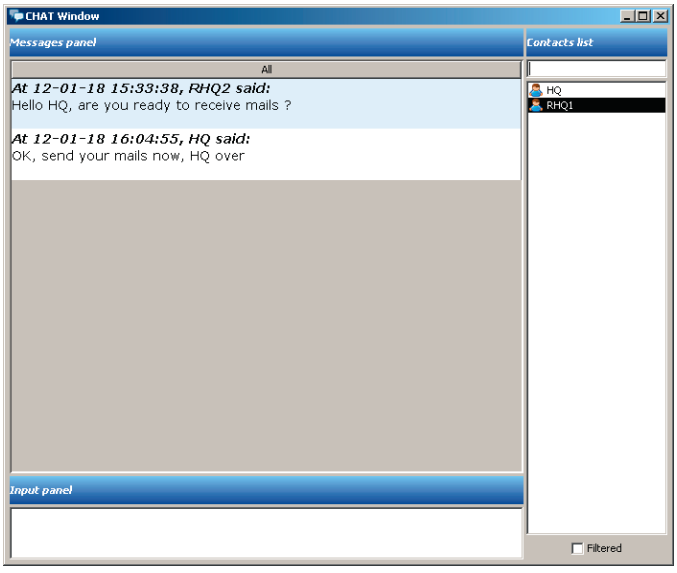
Simple and comprehensive communications applications

The right application for every mission

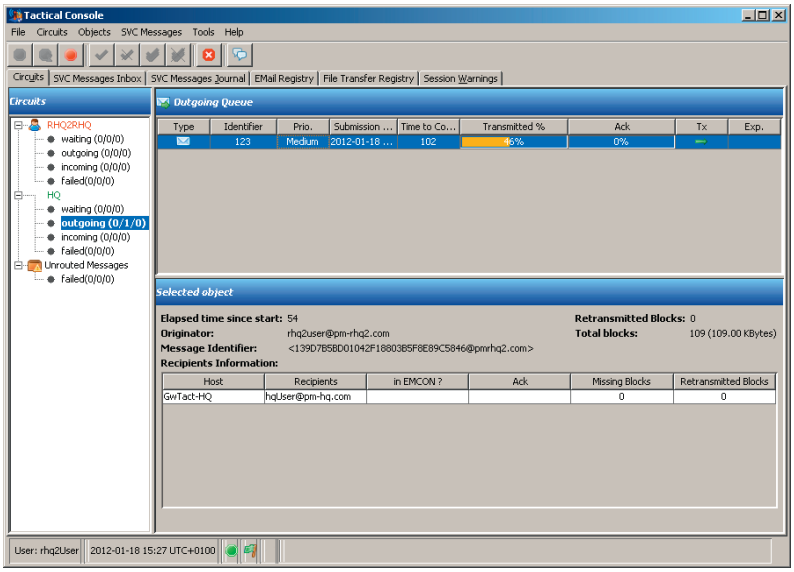
Communications requirements of civil and military subunits can differ widely for different mission scenarios. A stationary environment allows the detailed exchange of information using e-mails and e-mail attachments. In vehicles, on the other hand, short chat messages can be sent, for example, to indicate a vehicle's position. Position information delivered by all subunits involved in a mission makes it possible to plan missions and coordinate actions in civil and military operations.

R&S®Postman III provides reliable exchange of information for many different mission scenarios, offering the different applications required in a single product.

Chat application.



Radio line and data traffic monitoring tool.



E-mail

E-mails play a key role in today's information exchange. The standards used in R&S®Postman III support widely employed and established e-mail clients such as Outlook Express. These clients do not as standard limit the size of e-mail attachments. To prevent large files being sent inadvertently, the user can define size limits above which automatic message transmission will be blocked.

For example, a JPEG picture to be sent as an e-mail attachment will automatically be compressed to a user-definable size. The user can view the compressed picture and enable its transmission.

Fax

The fax application integrated in R&S®Postman III allows documents to be sent via a fax machine. For fax users, the document will be output on the fax machine; for e-mail users, it will be included as an attachment.

Voice mail

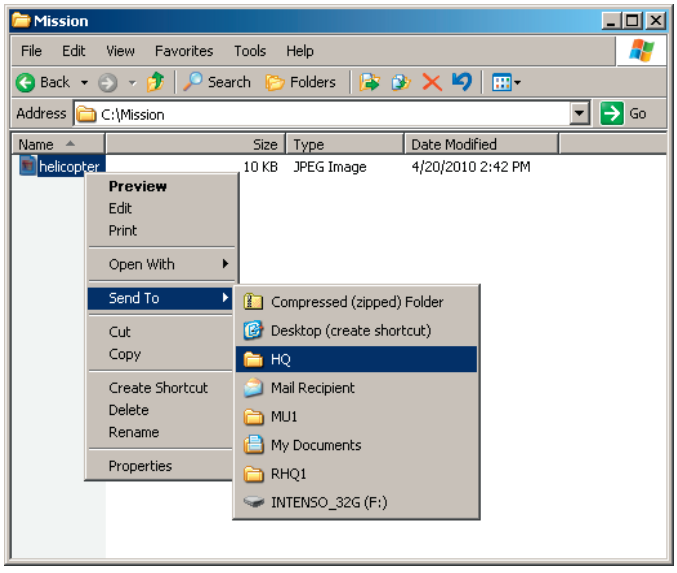
R&S®Postman III makes it possible to record a voice mail message from a phone on a PC and send it as an attachment to an e-mail user in the R&S®Postman III system. The recipient can listen to the message and forward it as an e-mail attachment.

File transfer

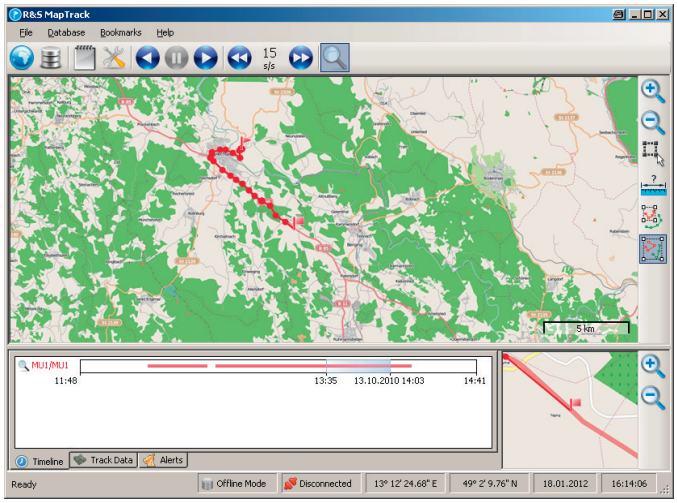
R&S®Postman III offers a file transfer application for scenarios that require no more than the transfer of information between radio stations. For this, R&S®Postman III includes a directory structure that contains an input and an output directory for each station in a network. When a user places a file into the output directory of a specific station, R&S®Postman III will automatically transfer that file to the input directory of the target station. The file transfer application can be employed by users or, if appropriate for a given mission scenario, by customer-specific applications, for example to identify persons based on database information.

Whenever an application creates a file in a station's output directory, the file will be automatically transmitted, regardless of its type or content.

File transfer application.



Blue force tracking.



Chat

The chat application allows the fast exchange of short messages with other, directly accessible radio stations. Unlike e-mail messages, chat messages are transmitted immediately after they are created. If a chat message is to be sent during an ongoing data transmission, such as an e-mail transmission, R&S®Postman III inserts the chat message as the higher-priority message into the data transmission. This is done automatically; no intervention is required on the part of the user. Chat is the preferable application for scenarios that call for fast, prioritized information transmission.

Realtime data transfer

R&S®Postman III allows the transmission of time-critical data among multiple entities in an R&S®SECOS 5/16 TDMA radio network. Using this Rohde&Schwarz UHF transmission method, data of any content can be transmitted deterministically between predefined radio stations within a network.

R&S®Postman III includes a socket interface that allows the transmission of data generated by customer-specific applications, such as radar or position data.

Blue force tracking

The R&S®Postman III MapTrack function visualizes the positions and movements of subunits on a map, enabling a fast situational assessment. Position data can be exported and used for a subsequent, detailed operational analysis.

Graphical display of current positions and movements of subunits

State-of-the-art Rohde&Schwarz tactical radios automatically exchange the GPS position data of all mobile entities in a network (see "Supported devices and data transmission methods" on page 168). The optional R&S®Postman III MapTrack function displays the current geographical positions and movements of subunits on a map, using data that is publicly available on the Internet in the OpenStreetMaps and ESRI shapefile formats, which are used as standard. Other map formats can be integrated into MapTrack on request. Easy-to-use control functions and tools such as a distance meter, zooming, and continuous centering of an entity on a map, make operation very convenient.

The position and movement data of the entities in a network can be forwarded via file transfer or e-mail to other R&S®Postman III stations. At the operations center, this data is used to generate a consolidated situation picture encompassing all subunits involved in a mission. This makes it significantly easier to coordinate the activities within one subunit and among multiple subunits.

Reliable alarm function

The R&S®M3TR and R&S®MR3000P tactical radios include an alarm function that can be activated on the radio. If an alarm is received indicating an emergency situation for an entity, MapTrack displays the alarm along with the entity's current position data.

Detailed analysis

The position data is stored for each subunit. A replay function makes it possible to subsequently analyze and assess the movements of individual subunits or a mission as a whole. The information delivered by MapTrack is used to gain insight into operational issues, and it serves as a basis for debriefing. Easy-to-use control functions and tools, such as a distance meter, provide fast access to the required information.

Export of tracks to navigation systems

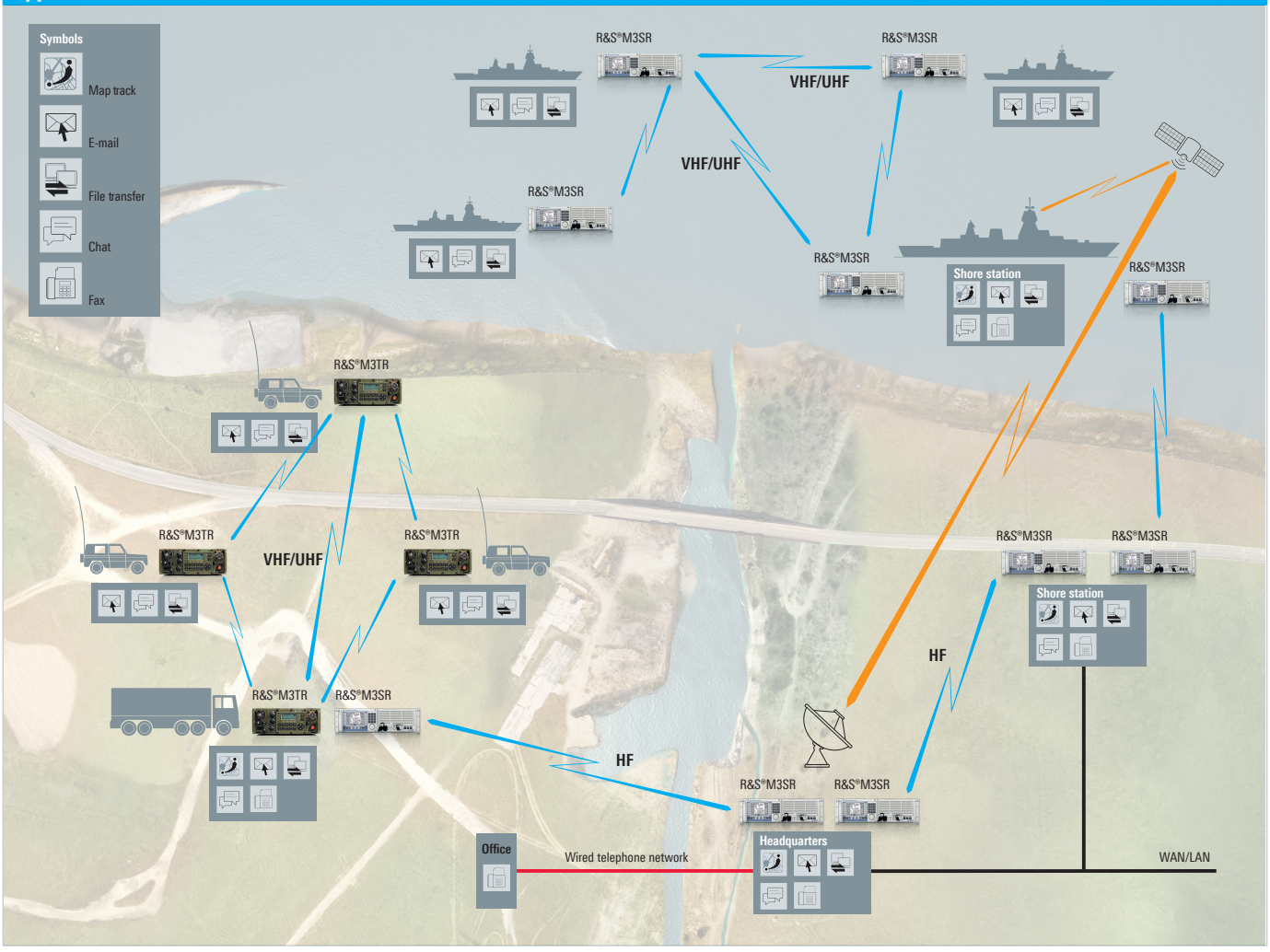
Recorded tracks can be exported to navigation systems via the R&S®Postman III import/export interface. Tracks can also be exported to a USB stick for further processing. R&S®Postman III uses the GPX standard data format, which makes it easy to import tracks into waypoint navigation systems. For example, a rescue vehicle can be immediately given the shortest possible route for reaching a subunit in distress.

Tracks exported from MapTrack can be imported into Google Earth, where a wide range of display modes are available.

Typical mission scenario

The figure shows, as an example, how R&S®Postman III can be used for civil and military missions on land and at sea.

Typical mission scenario



Supported devices and data transmission methods

The upper table presents the applications supported by R&S®Postman III in conjunction with the data transmission methods implemented on Rohde&Schwarz radios.

The lower table shows the data transmission methods used by Rohde&Schwarz radios.

R&S®Postman III – supported applications and data transmission methods

			Data transmission methods					Applications			
			Max. data rate in bit/s	Data interface	COMSEC	TRANSEC	Voice priority over data	E-mail	Chat	File transfer	MapTrack
Frequency range	HF	STANAG 4285	2400 [1]	serial	• [4]	–	–	•	–	•	–
		STANAG 4539	9600 [1]	serial	• [4]	–	–	•	–	•	–
		STANAG 4538-xDL	8500 [2]	Ethernet	• [5]	–	•	•	•	•	–
	VHF/UHF	R&S®SECOM-P	7100	serial	• [5]	•	–	–	–	–	• [6]
		R&S®SECOM-V	16000	Ethernet	• [5]	•	•	•	•	•	• [6]
		R&S®SECOS 5/16	16000	serial	• [5]	•	–	•	•	•	–
		R&S®SECOS 5/16 TDMA	2400 [3]	serial	• [5]	•	–	•	•	•	–

[1] Data rate of serial modem.
[2] 8500 bps UDP/IP payload data rate with ARQ protocol.
[3] Depending on the number of entities, e.g. 2400 bit/s with four entities.
[4] External encryption device is supported.
[5] Integrated Rohde&Schwarz encryption is supported.
[6] The MapTrack function utilizes the ability of R&S®SECOM-V and R&S®SECOM-P radio networks to automatically transfer GPS position data to a network master.

R&S®Postman III – supported radios and data transmission methods

		Data transmission methods	R&S®M3TR	R&S®M3SR Series4100	R&S®M3SR Series4400	R&S®Series2000 with internal modem	R&S®Series2000 with external modem
Frequency range	HF	STANAG 4285	•	•	–	•	•
		STANAG 4539	•	•	–	• [1]	•
		STANAG 4538-xDL	•	•	–	–	–
	VHF/UHF	R&S®SECOM-V	•	–	–	–	–
		R&S®SECOS 5/16	•	–	•	–	–
		R&S®SECOS 5/16 TDMA	•	–	•	–	–

[1] Limitation of autobauding capability.

Product overview

Designation	Type
Basic software package	
R&S®Postman III server software with one workstation license supporting one radio line using one radio (R&S®M3SR Series4100 or R&S®M3TR) with an IP capable waveform. Applications included: e-mail, chat, file transfer, remote control (R&S®M3SR Series4100, R&S®M3SR Series4400 and R&S®M3TR radios).	R&S®NS5150
Software options	
License for one additional workstation enabling the use of the R&S®Postman III applications. R&S®Postman III supports up to six workstations.	R&S®NS5150-KWL
License for support of multiple communications lines on one R&S®Postman III server (communications lines include radio, SatCom, LAN/WAN).	R&S®NS5150-KML
Software for fax/voice mail service for analog fax machines (group 3) including 56 kbps fax modem (hardware).	R&S®NS5150-KFS
Software for position data transfer and display (MapTrack). Note: maps are not included.	R&S®NS5150-KPD
License for R&S®SECOS 5/16 TDMA-based transfer of customer-specific data. R&S®Postman III has a configurable interface to customer-specific applications. Customer applications must be analyzed to ensure that the interface can meet the requirements. Please contact Rohde&Schwarz Munich for details. [1)]	R&S®NS5150-KS5
Radio protocol licenses	
License for data transmission using one VHF/UHF radio (R&S®M3TR, R&S®M3SR Series4400) with R&S®SECOS 5/16 DPP operating mode for R&S®Postman III applications. [1)]	R&S®NS5150-KV1
License for data transmission using one HF radio (R&S®M3TR, R&S®M3SR Series4100) with STANAG 4285 or STANAG 4539 waveform for R&S®Postman III applications. E-mail interoperability with STANAG 5066 systems is included. [1)]	R&S®NS5150-KH1

[1)] R&S®Postman III supports a maximum of six radio lines using R&S®SECOS 5/16, STANAG 4285 or STANAG 4539 operating mode/waveforms. Each radio line requires one of licenses R&S®NS5150-KV1, R&S®NS5150-KH1 or R&S®NS5150-KS5. More than six radio lines can be supported on request.

R&S®MMHS STANAG 4406 Based Military Message Handling System

The powerful, state-of-the-art R&S®MMHS military message handling system covers broadband communications on land, via satellite and, above all, as one of the first systems on the market, radiocommunications defined in Annex E of STANAG 4406 NATO standard.

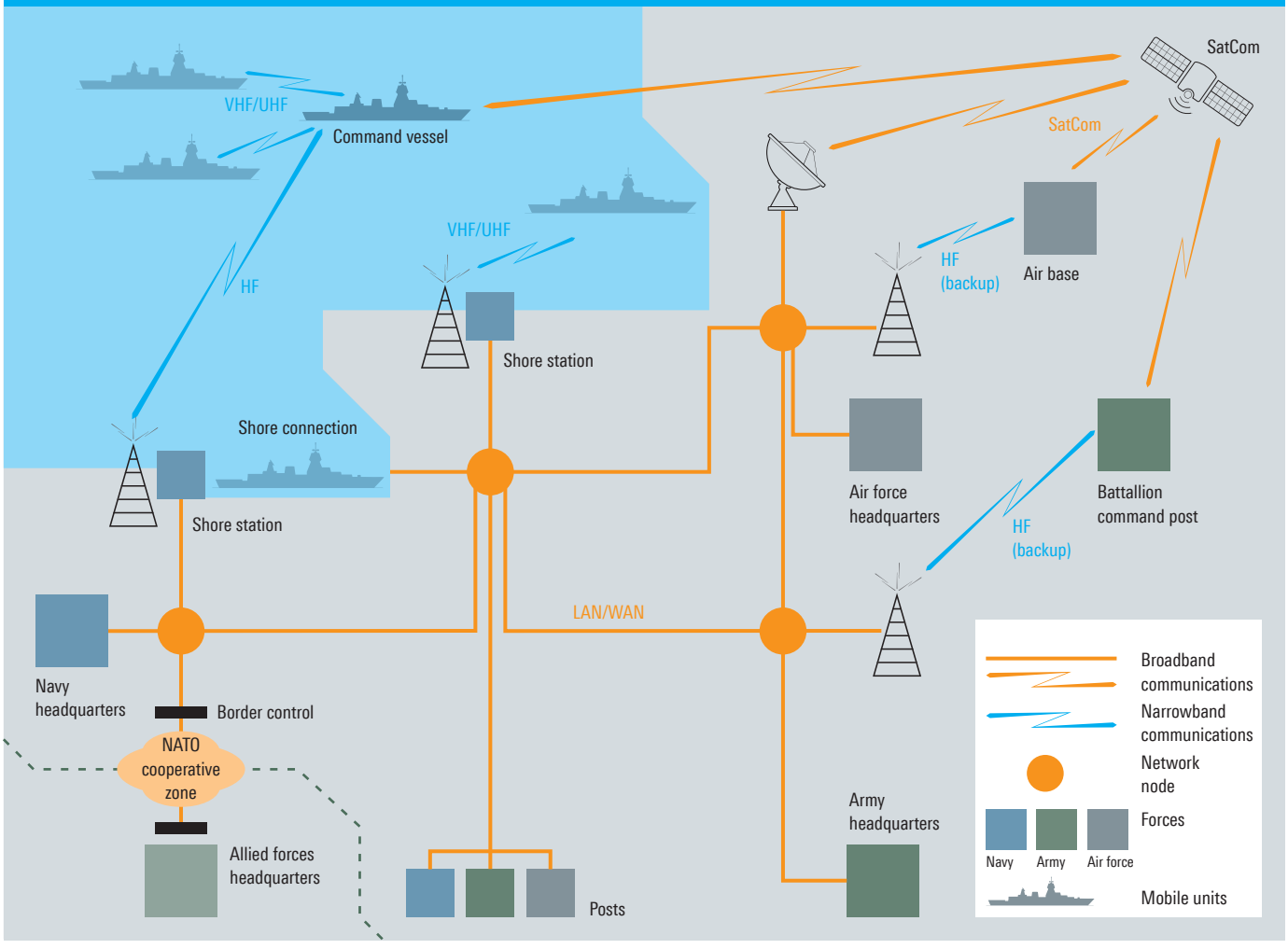
STANAG 4406 – the standard for IP-based military communications

Today's military missions require the secure and fast exchange of information between all forces at sea, on land and in the air. Armed forces increasingly rely on IP technology to use modern network infrastructures.

Besides requiring systems to exchange complex situation awareness information, military command and information technology must also be able to exchange messages between and within organizations.

Wireline LAN/WAN or satellite communications offer stable connections with high data rates. The exchange of information by means of radio networks requires that radio-specific characteristics be taken into account, especially the small bandwidth available.

Communications between branches of the armed forces in radio and wireline networks



STANAG 4406 defines a uniform, modern military message handling system based on IP data traffic for radio and wireline communications between all branches of the armed forces (see figure). In comparison with civil e-mail solutions, STANAG 4406 message handling systems fulfill military-specific additional requirements.

At a glance

R&S®MMHS is an all-in-one solution for communications using wireline LAN/WAN infrastructure as well as radio networks. Especially the implementation of STANAG 4406 Annex E provides significant improvements for data exchange in radiocommunications scenarios.

R&S®MMHS supports the most important military message formats, i.e. STANAG 4406, STANAG 5066 and ACP 127, as well as e-mail, and it provides gateways to ensure message exchange between these format-specific networks. The format of the messages to be transported via different networks is adapted automatically. Independent of message formats, one common mailbox gives an overview of all messages to be handled by the user.

An integrated security framework based on public key infrastructure (PKI) allows messages to be encrypted and to have a digital signature, which ensures confidential handling of messages as well as the authenticity of the user and the message.

Central management makes it possible to administer a nationwide message handling system from a single location with only a minimum of staff. Organizational changes or changes in the communications structure are consistently distributed to all stations via replication mechanisms.

R&S®MMHS meets the requirements for broadcast and ship-shore systems (BRASS) and is ideal as a state-of-the-art addition to or replacement of ACP 127 systems.

R&S®MMHS can be used to complement existing STANAG 4406 solutions from other manufacturers. As a result, an existing land-based, broadband STANAG 4406 system can be enhanced so that mobile units can also benefit from the advantages of STANAG 4406.

Unlike other MMHS manufacturers, Rohde&Schwarz provides both STANAG 4406 MMHS system solutions and communications components, including antennas, radios and encryption.

Key facts

- STANAG 4406 including Annex E for radio and wireline communications
- Automatic message adaptation for different communications networks
- PKI security framework
- Central management of configuration data with little effort
- System solutions from the PC to the antenna

Benefits and key features

More than just e-mail

- Numerous enhancements for formal exchange of military messages

High-performance radiocommunications

- STANAG 4406 Annex E

Variety of message categories – one application

- Reception of messages via different communications paths
- Automatic adaptation of messages in different formats
- One mailbox for all message formats

Military security requirements

- Security from login to encryption

Central management

- Central creation and distribution of complex nationwide configuration

Service messages

- User support for standard radiocommunications scenarios

Cost-optimized solution

- Free-of-charge standards instead of expensive components

Integrated system solution

- Ease of operation and management

More than just e-mail

Numerous enhancements for formal exchange of military messages

R&S®MMHS is a system solution that goes far beyond the capabilities of civil COTS e-mail products. These enhancements make it possible to fulfill the requirements of military command. Similarly to standard e-mail systems, R&S®MMHS provides a user-friendly display of the wide-ranging message handling functions on easy-to-operate user interfaces.

Military message attributes and processes

Military messaging uses special message attributes that classify, for example, the security level of the message or the priority level for the message transmission.
R&S®MMHS ensures that classified messages can only be accessed by users who have the required authorization.
R&S®MMHS maps conventional military processes, which are still largely paper-based, onto paperless electronic workflows, allowing military workflows to be precisely defined and observed. The workflows are monitored to help ensure that messages are created, processed and released by authorized users in the correct sequence.

Automatic message distribution

Messages received by an organization are automatically delivered to the appropriate post on the basis of distribution criteria, i.e. subject indicator codes (SIC) or defined logical rules such as keywords or message attributes. These criteria can be defined independently by any organization. As a result, all messages are delivered to the correct post in charge without manual intervention and according to an organization-specific, role-oriented scheme. In the case of flash messages, a rule can be defined so that a copy of such a message is, for example, always sent to a permanently staffed, central post. This allows the time-criticality of such a message to be taken into account as well.

On-time message processing

R&S®MMHS monitors the on-time delivery and acknowledgment of messages. If a message is not delivered or processed within a defined period of time, it is automatically forwarded to a deputy. Messages that cannot be delivered or have not been processed are routed to an alternative location, e.g. to a communications center (COMCEN), ensuring on-time message processing.

Comprehensive archiving functions

A central archive enables all LAN/WAN-networked organizations to centrally store their messages. Consequently, failsafe backup equipment is only needed at one location nationwide. In addition, R&S®MMHS provides the flexibility to use a local archive and also save messages permanently on storage media such as DVD.

Archives provide an overview of all messages received and transmitted within a defined period of time. Several filter criteria enable the user to search for messages that meet certain criteria of interest.

Support of standardized electronic forms

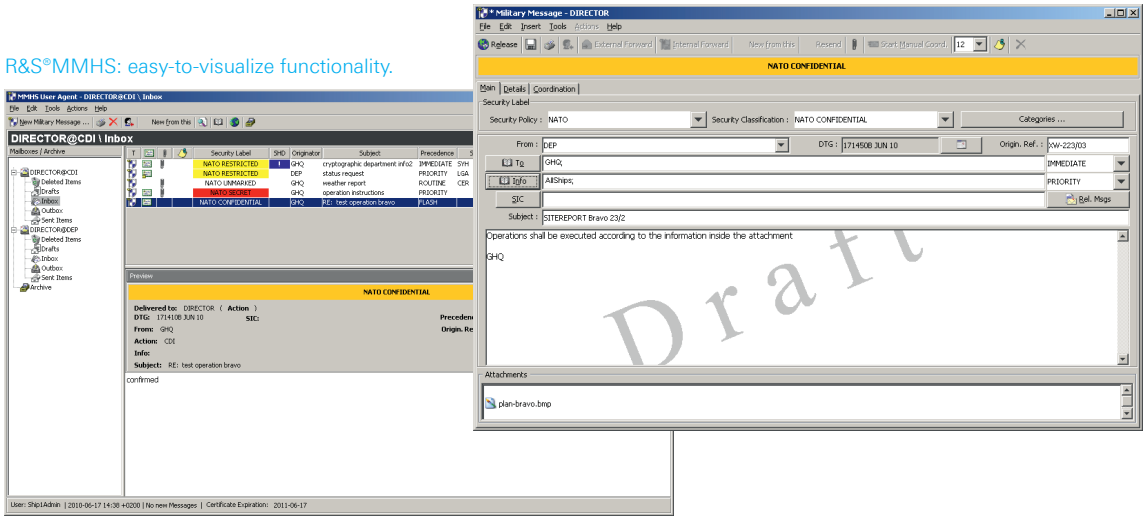
Standardized electronic forms in military use make it possible to display information in a clear, well-structured manner, which allows processes and actions to be automated and, in turn, cuts down on personnel and eliminates errors. R&S®MMHS is ready for supporting the ADatP-3 format (Allied Data Publication No. 3), which is the NATO standard for formatted messages.

High-performance radiocommunications

STANAG 4406 Annex E

R&S®MMHS complies with STANAG 4406 Annex E. This standard defines an efficient method for exchanging messages between military units via HF and VHF/UHF radio networks.

R&S®MMHS: easy-to-visualize functionality.



Optimization for narrowband radio networks

Currently, wireline communications between units on land run via stable connections using a data transmission bandwidth of several Mbit/s. These high bandwidths are not available in HF and VHF/UHF radio networks. In addition, extremely varying bandwidths and even complete interruption of the data transmission must be taken into account. For this reason, STANAG 4406 Annex E defines a gateway between wireline networks and radiocommunications networks that accommodates different network characteristics. This Annex E is implemented in the R&S®MMHS tactical gateway.

Message handling without STANAG 4406 Annex E

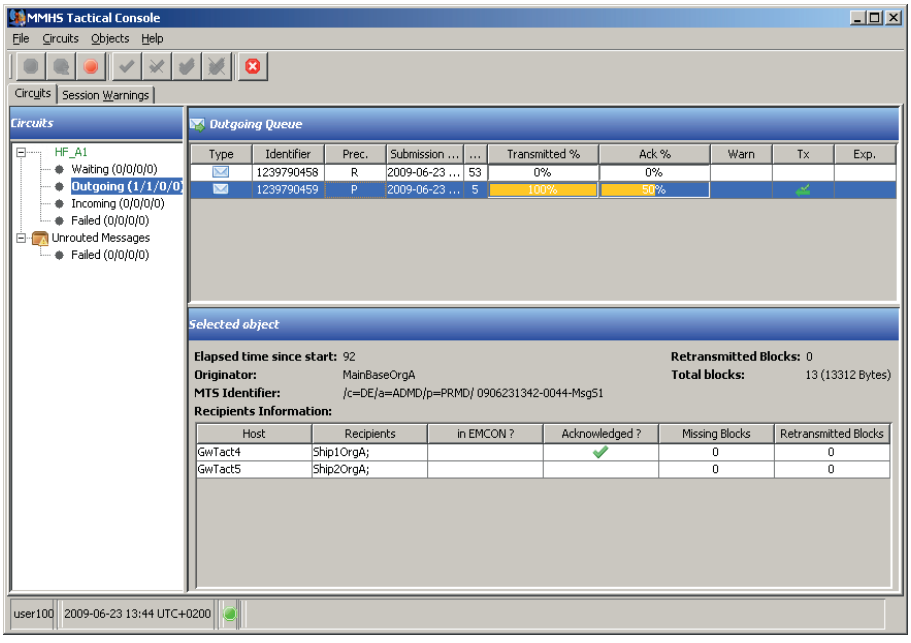
ACP 127: Radiocommunications systems in line with ACP 127 do not feature error correction during the transmission phase and do not support attachments. Broadcasting with continuous repetition of emissions increases the probability of correct message reception, but cannot ensure it.

STANAG 5066: In point-to-point connections, communications based on STANAG 5066 provide an error control method (advanced repeat request, ARQ) that allows the receiving station to automatically re-request incorrect or incomplete data packets from the transmitter. This helps to ensure the correctness of received data, but reduces performance in networks that have multiple communications partners.

Advantages of the R&S®MMHS tactical gateway with integrated STANAG 4406 Annex E

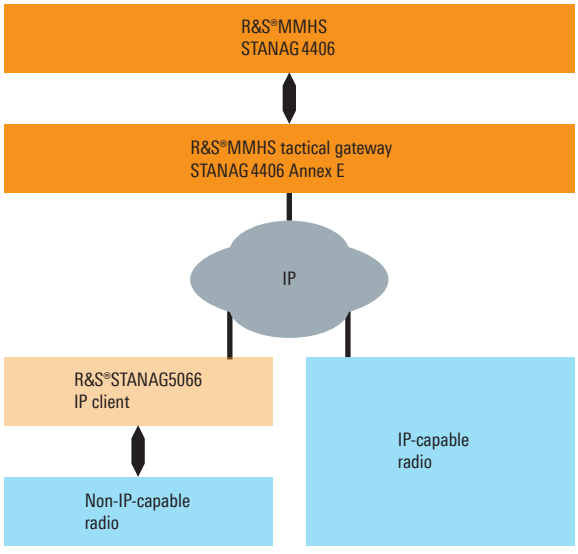
- Point-to-multipoint communications with efficient automatic error correction: STANAG 4406 Annex E specifies the use of the P_MUL point-to-multipoint radio protocol, which is defined in ACP 142.
  A complete message is sent to all addressees only once. Subsequently, all receiving stations sequentially re-request incorrect or incomplete packets. The transmitter station then resends the sum of all requested packets.
  This minimizes radio channel occupancy, makes optimum use of the available bandwidth and ensures the correctness of transmitted data without manual intervention.
- Support of EMCON (radio silence) situations: Emission control (EMCON) defines the status of a unit in which messages may be received via radio, but transmission is strictly prohibited. As a result, the sender receives no information as to whether a message has been successfully transmitted.
  For this reason, R&S®MMHS automatically retransmits messages to EMCON units to increase the probability that a message is transmitted completely.
- Radio activities at a glance: The user interface of the R&S®MMHS tactical gateway shows all information in an easy-to-read display
  - Status of all defined radio circuits
  - Activities on the radio circuits
  - Data transmission status
  - Status of individual messages
  - Data transmission errors

R&S®MMHS STANAG 4406 Annex E tactical gateway.



- Support of legacy and next-generation radios: The Internet protocol (IP) has established itself as the communications standard in civil and increasingly also in military communications. STANAG 4406 including Annex E is therefore based on this standard network protocol. The R&S®MMHS tactical gateway supports radios that have no IP interface, as well as cutting-edge software defined radios (SDR) that feature an integrated IP protocol stack.
  The R&S®MMHS tactical gateway communicates directly with IP-capable radios, whereas radios without an IP interface require an additional layer to the Annex E gateway. This layer is implemented in R&S®MMHS by means of the IP client of the R&S®STANAG5066 HF radio protocol (see figure).
  This flexible support of different radio generations allows customers to integrate existing non-IP-capable radios into R&S®MMHS and to add state-of-the-art IP-capable radios in the future.
  Despite different radios, R&S®MMHS provides users with a uniform operating concept for their daily operational tasks.
- Support of MARLIN: Maritime relayed line-of-sight network (MARLIN) describes a self-organizing network technology for broadband transmission of IP data in tactical line-of-sight radiocommunications for naval use. R&S®M3SR Series4400 radios enhanced with MARLIN network components allow wideband data transmission. R&S®MMHS is able to use this technology in a very easy way to send messages with large attachments in a short period of time.

R&S®MMHS supports radios with and without IP capability



Variety of message categories – one application

Reception of messages via different communications paths

Military communications run via various communications paths using different message formats. R&S®MMHS combines the following message categories:

Format	Type	Channel
STANAG 4406	Military message	WAN/LAN, satellite
STANAG 4406 Annex E	Military message	HF/VHF/UHF radio
ACP 127 SUPP-3	Military message	Leased line, satellite
ACP 127 SUPP-1	Military message	HF/VHF/UHF radio
STANAG 5066	E-mail	HF radio
SMTP	E-mail	LAN/WAN

Land-based communications in line with STANAG 4406

R&S®MMHS enables communications between stationary land-based units via LAN/WAN infrastructure, as well as broadband communications to mobile units via satellite.

Radiocommunications in line with STANAG 4406

As an essential component of a military message handling system, R&S®MMHS implements Annex E of STANAG 4406, which defines communications in small-bandwidth HF as well as VHF/UHF radio networks on the basis of ACP 142 (P_MUL).

ACP 127 integrated in R&S®MMHS

R&S®MMHS optionally includes a full-featured ACP 127 communications system that allows exchange of messages with ACP 127 systems of other nations and that represents a gateway to existing customer ACP 127 systems.

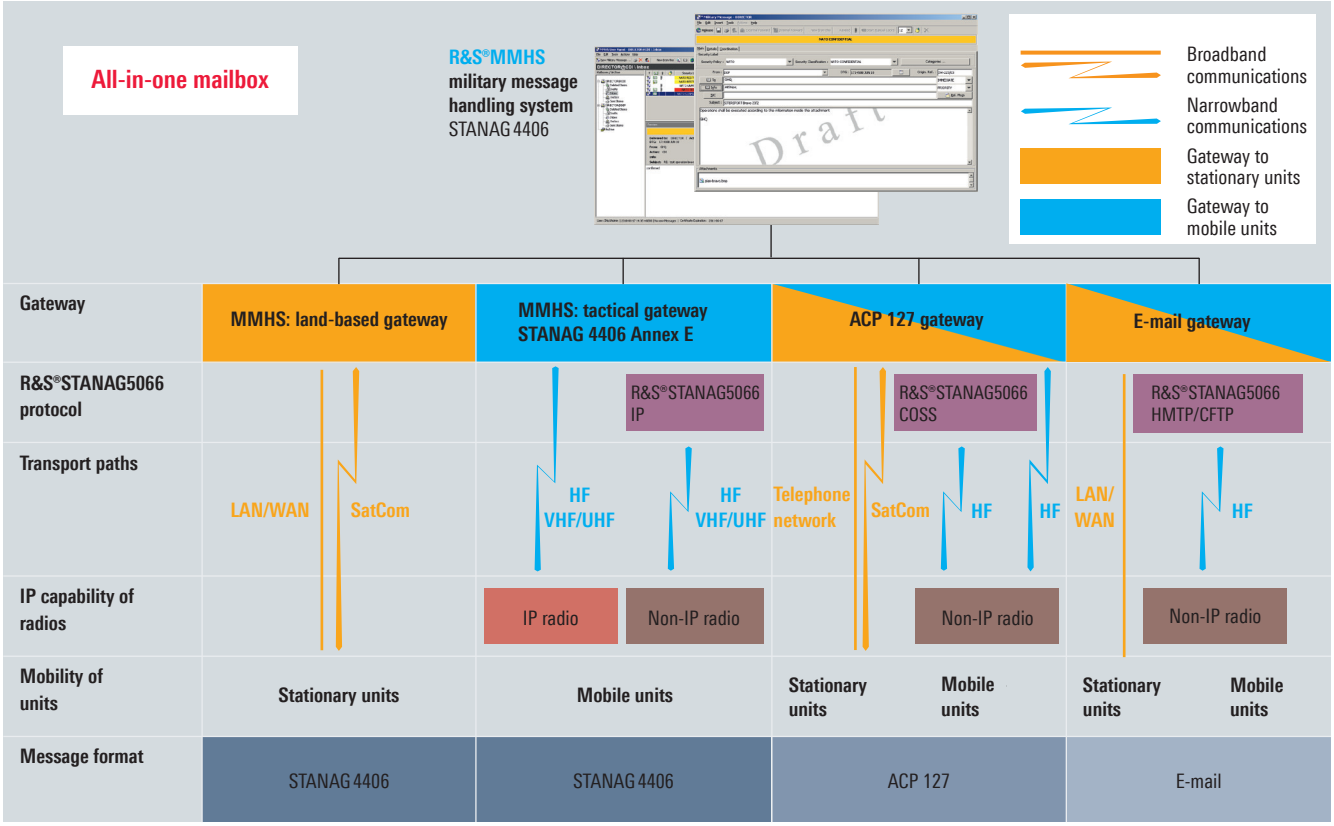
Land-based communications in line with ACP 127

The R&S®MMHS ACP 127 gateway is based on Annex D of STANAG 4406. Annex D defines interoperability with the ACP 127 SUPP-3 transmission protocol, which utilizes land-based teletype systems using telephone leased lines.

Radiocommunications in line with ACP 127

The R&S®MMHS ACP 127 gateway uses the ACP 127 SUPP-1 protocol to support area broadcast, task group broadcast, ship-to-shore and ship-to-ship communications. R&S®MMHS supports interoperability with ACP 127 systems and allows the successive transition to a modern homogeneous STANAG 4406 communications network.

Different message categories combined in R&S®MMHS



Communications with e-mail systems

The e-mail gateway of R&S®MMHS allows the integration of government organizations using e-mail communications (e.g. Exchange/Outlook or Lotus Notes/Domino) instead of military message handling. R&S®MMHS makes it possible to select defined e-mail users directly from the R&S®MMHS address book.

Automatic adaptation of messages in different formats

Different military message categories have different message formats. For this reason, the formats and, if necessary, also the contents of the messages must be adapted to transport messages via different communications channels.

ACP 127 limitations

R&S®MMHS automatically detects whether messages containing attachments will be transmitted via an ACP 127 gateway. Since ACP 127 does not support attachments, it is possible to define whether attachments should be automatically deleted or the message prevented from being sent. If the message is sent, the receiving station is informed that an attachment has been deleted.

E-mails do not support military message attributes

E-mail systems cannot process military attributes. But even if military messages are sent via the R&S®MMHS e-mail gateway, the military message attributes, such as the security classification, are not lost. R&S®MMHS converts this information so that it is displayed in the text area of the e-mail.

Configurable filter criteria help to ensure that beginning with a defined security level, a military message is no longer converted to an e-mail nor sent.

One mailbox for all message formats

All messages to be sent are created in a single editor, regardless of the message category. Message senders do not have to select a special message format to reach a particular post or a civil e-mail addressee. They simply select the addressee from their address book. R&S®MMHS performs all further steps automatically.

All received messages are displayed in a single mailbox, regardless of their message format. As a result, the user can see all messages at a glance on a GUI and does not have to switch between format-specific applications or views.

Military security requirements

Security from login to encryption

Security framework

To ensure that messages can only be processed by authorized users, R&S®MMHS features a security framework. This framework provides the following security:

- Authenticity of sender and message
- Security against message manipulation
- Protection against unauthorized access

In order to fulfill specific military security requirements for the processing of classified messages, additional encryption devices for encrypting wirelines, radio lines and IP networks may be required.

Central management of certificates

R&S®MMHS uses a public key infrastructure (PKI), where certificates for all R&S®MMHS servers, organizations and users are centrally created and managed.

User authenticity

Users log on by first entering their password at a workstation. Then the user's certificate, which is stored on a personal USB token, is checked. Owing to its integrated crypto module, this USB token offers additional security for ensuring user authenticity.

Message authenticity

Messages can be digitally signed in order to ensure the authenticity of the message and of the sender when the message is received. This prevents any manipulation of the message during transport from going unnoticed.

Message encryption

R&S®MMHS allows users to encrypt a message prior to sending it. This safeguards the message against unauthorized access.

Network security

The use of the secure sockets layer (SSL) encryption protocol for secure data transmission between an R&S®MMHS workstation and the R&S®MMHS server is an additional security measure at network level. This prevents unauthorized access to unencrypted messages in the local network.

Central management

Central creation and distribution of complex nationwide configuration

Central configuration

R&S®MMHS provides a unique management component that makes it possible to create a nationwide configuration for all units at a central location. This ensures an initially consistent configuration across all organizations and units with a minimum of staff.

Updating of configuration data

If configuration data is locally changed at a later date, these changes are automatically made available to all wire-line-connected units via replication mechanisms. To ensure efficient replication, the changes are replicated on mobile units only if these units have a broadband IP connection to a land-based station, such as a shore connection cable, an IP-based satellite or MARLIN communications equipment. If a broadband IP connection is unavailable, replication is suspended until connection is established, for example, as soon as a ship connects to the land-based network via a shore connection in the harbor.

Configuration data needs to be updated mainly when address information or the validity of security certificates changes. In all cases, only the modified data is transmitted. This incremental update places only a minimal load on the communications network.

Service messages

User support for standard radiocommunications scenarios

R&S®MMHS provides service messages that enable the user to handle frequently recurring tasks in radiocommunications scenarios very easily and, if possible, automatically.

The following services are available:

Free text

Similarly to a chat application, the user can send short text messages to other organizations within one radio area. This feature is needed primarily for service purposes.

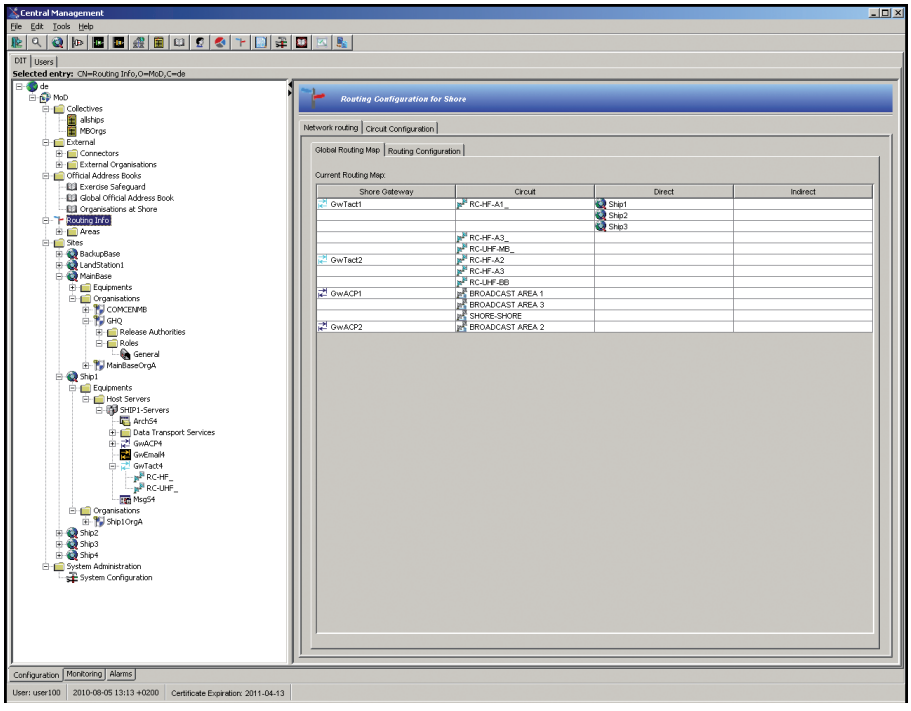
Radio circuit tests

A predefined message prompts a remote station to respond. This is used for testing a data radio connection between two stations.

Routing request/acknowledge

If a mobile unit moves into a new radio area, it informs the appropriate radio network coordinating station (in maritime communications, the shore station). After this station has responded with an acknowledge message, the required address information is automatically distributed to all organizations on land by means of directory replication. In addition, all mobile units in this radio area are informed of this new mobile unit.

R&S®MMHS central management.



EMCON report

The "radio silence" status can be defined for a mobile unit. In this case, the appropriate land-based station is informed by the EMCON service message and automatically switches its communications with this unit to EMCON. In this operating mode, acknowledgments from this unit will no longer be expected.

Transmission request/release

To prevent uncoordinated transmission of messages in a radio area, R&S®MMHS allows users to manually release and block radio circuits for radio operation. If messages are to be sent via a radio circuit, their transmission must usually be coordinated by a land-based station. R&S®MMHS provides service messages for occupying and subsequently releasing a radio circuit, which makes it easy for users to coordinate transmission.

Cost-optimized solution

Free-of-charge standards instead of expensive components

STANAG 4406 defines the X.500 standard as the directory service and X.400 as the transmission protocol. To reduce costs significantly, these two components are replaced in R&S®MMHS by standards included in the Windows server operating system.

LDAP instead of X.500

Using the Active Directory, R&S®MMHS saves all address data in a directory service based on the lightweight directory access protocol (LDAP).

Interoperability with an X.500 system can be provided on request.

SMTP instead of X.400

In contrast to STANAG 4406 systems from other manufacturers, R&S®MMHS uses the SMTP protocol standard expanded by military message attributes. This solution provides the same operational capabilities as X.400.

For communications with joint or allied forces that use an X.400-based MMHS, R&S®MMHS offers the X.400 border gateway to provide interoperability.

Integrated system solution

Ease of operation and management

In advanced complex communications systems, radiocommunications are no longer limited to one radio circuit.

Complex systems consist of various radio components, which have to be switched dynamically to radio lines depending on operational scenarios. To perform these management tasks, Rohde&Schwarz provides R&S®SIMCOS II, a signal management and control system which ideally complements R&S®MMHS.

Automatic information exchange in an integrated communications system together with R&S®SIMCOS II

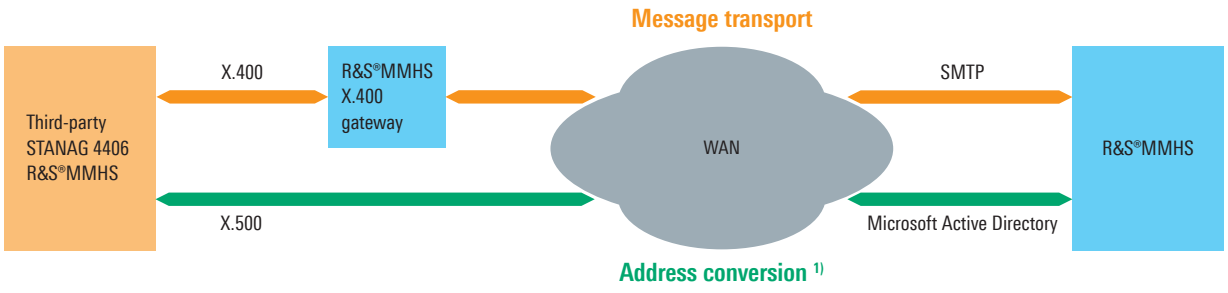
R&S®SIMCOS II manages radio circuits and continuously provides information about the current status of all remotely-controllable radio circuit components. Only the selective exchange of this information with R&S®MMHS and the included radio protocols ensures smooth operation.

Consequently, R&S®MMHS responds immediately to status changes of radio components. If a radio component is defective, the system stops trying to transmit a message and promptly informs the user.

Scalable from laptop to redundant servers

For small mobile units with one radio circuit, R&S®MMHS can be installed on a laptop. In complex systems containing many radio circuits, the required failsafety is ensured by a main/standby server solution. Continuous data synchronization with a standby server automatically enables R&S®MMHS to continue operating without restriction if the main server fails. Server redundancy is provided on request.

Use of SMTP and AD instead of X.400 and X.500



1) Customer-specific address conversion on request.

All components from Rohde&Schwarz

R&S®MMHS is a state-of-the-art military message handling system that can be ideally complemented by the R&S®SIMCOS II signal management and control system. Moreover, Rohde&Schwarz is able to deliver an all-in-one system solution, including radiocommunications and encryption equipment, in which all components are optimally matched to each other.

Product overview

Designation	Type
Software	
R&S®MMHS base software package consisting of user agent, message routing agent, message store and local message archive	R&S®DS3700
Software options	
License for central archive for central archiving messages within the strategic R&S®MMHS network	R&S®DS3701
License for ACP 127 gateway for exchanging R&S®MMHS messages with ACP 127 networks	R&S®DS3702
License for E-mail gateway for exchanging R&S®MMHS messages with other SMTP-based e-mail systems	R&S®DS3704
License for X.400 border gateway for interfacing a R&S®MMHS network with STANAG 4406 systems of other manufacturers Note: An X.400 message transfer agent (MTA) is not included and has to be requested separately.	R&S®DS3705
License for the central management of an R&S®MMHS network regarding system-wide configuration and address information	R&S®DS3706
License for STANAG 4406 Annex E gateway Each concurrent STANAG 4406 Annex E radio line requires a separate license	R&S®DS3710
License for one workstation	R&S®DS3720
Hardware options	
USB token for secure storage of certificates for one user	R&S®DS3770

R&S®STANAG5066 HF Radio Data Communications System

Global data communications

The exchange of e-mail and IP-based information is vital for the successful planning and execution of military operations. Interoperable data exchange within joint and allied forces over long-distance HF radio networks is essential, especially if communications via other infrastructures such as satellites is unavailable, too expensive or vulnerable.

STANAG 5066 is the leading NATO radio protocol for HF data communications. The standard is widely accepted and used by the forces of NATO, PfP (Partnership for Peace) and other nations around the globe.

R&S®STANAG5066 data communications system

R&S®STANAG5066 is a communications solution for the robust and highly secure exchange of data using HF radio networks in line with STANAG 5066.

R&S®STANAG5066 supports data exchange via e-mail, chat, fax and IP-based applications. It controls radios from Rohde&Schwarz as well as from other suppliers. A unique red/black separation technique using crypto devices and trusted filters satisfies the highest security demands. Interoperability with the widely used ACP 127 legacy message handling system is supported by means of a gateway.

R&S®STANAG5066 is fully integrated in the R&S®SIMCOS II signal management and control system and is an important component of the R&S®MMHS military message handling system.

R&S®STANAG5066 is deployed in a variety of customer systems where it has proven its standard-conforming data exchange capability. Interoperability with other STANAG 5066 systems has also been demonstrated during international HF radio trials.

Key facts

- Highest security level
- Extended remote control and monitoring features
- Optimal system integration capabilities
- Support of legacy ACP 127 systems

Benefits and key features

Interoperability

- Proven interoperability with other STANAG 5066 solutions available on the market
- Interoperable with BFEM 66

Integrated communications system (ICS) solution together with R&S®SIMCOS II

- Highly integrated solution for efficient and powerful control and management of HF radiocommunications

Highest security level
- Proven red/black separation using crypto equipment and trusted filters
  - Support of various crypto equipment
  - Integration of trusted filters
  - Security accreditation procedures

Expansion of IP connections via HF radio lines
- Use of IP-based customer applications via HF radio networks
- Support of IP type-of-service (TOS) field
- Support of IP unicast, multicast and broadcast

Efficient e-mail and fax transmission
- Transmission of e-mails and faxes via HF radio networks
- Available STANAG 5066 e-mail clients
  - STANAG 5066 CFTP client
  - STANAG 5066 HMTP client
- Integrated standard e-mail server
- Interoperability with standard e-mail programs
- Reliability in HF radio transmissions
- Fax transmission

Interoperability with legacy applications
- Support of legacy message handling (ACP 127)
- COSS client
- ACP 127 support
  - Reliable data exchange
  - Delivery confirmation message

HF chat for simplified information exchange
- Alternative to e-mail
- Easy and fast information exchange
- Orderwire messages

Mastery of changing HF transmission conditions
- Methods for automatically adapting to various HF transmission conditions
- Selection of the optimal configuration prior to a transmission
- Adaptive data rate change during a transmission

Remote system control and monitoring
- Support of various HF equipment
- Integration of customer HF equipment
- Synchronous serial data interfaces
- Full remote control and monitoring

Interoperability

Proven interoperability with other STANAG 5066 solutions available on the market
R&S®STANAG5066 has been successfully deployed by a variety of customers and has also demonstrated its data exchange capability and its interoperability with other STANAG 5066 systems during international HF radio trials. R&S®STANAG5066 is fully compliant with STANAG 5066, edition 1.2, amendment 1.

Interoperable with BFEM 66
R&S®STANAG5066 is interoperable with NATO's widely used BFEM 66 e-mail transmission system.

Interoperability of R&S®STANAG5066 with other STANAG 5066 solutions

Integrated communications system solution together with R&S®SIMCOS II

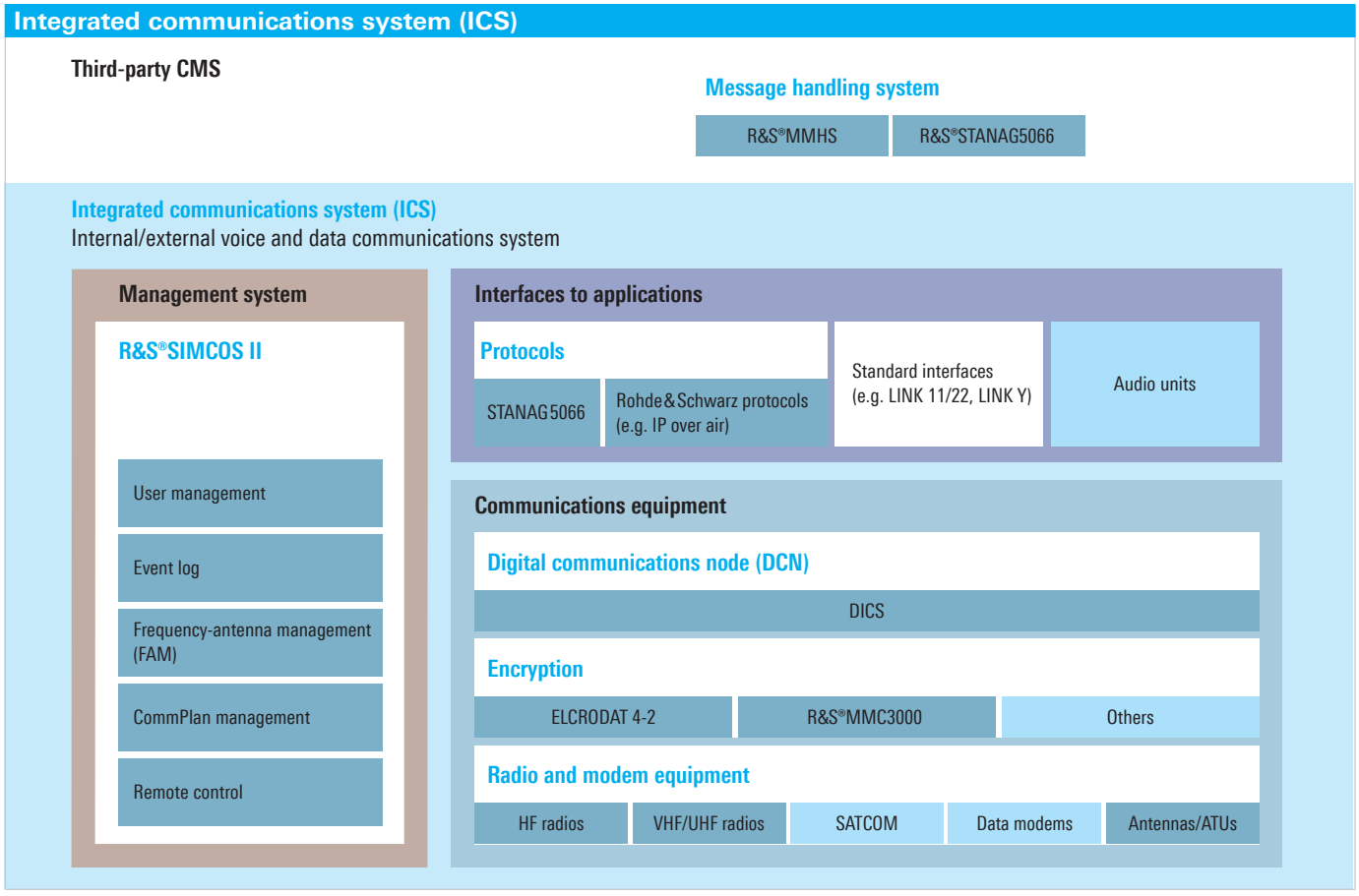
R&S®STANAG5066, together with R&S®SIMCOS II, creates a powerful combination of communications, control and management functions for naval applications.

Highly integrated solution for efficient and powerful control and management of HF communications

As part of an integrated communications system (ICS) solution, R&S®STANAG5066 provides the communications (message handling) capability while the R&S®SIMCOS II signal management and control system handles the management and control functions.

In this environment, R&S®STANAG5066 is integrated into the planning, monitoring, fault management and remote control mechanisms of the R&S®SIMCOS II.

For ICS solutions with two or more STANAG 5066 radio lines, each line requires a separate R&S®STANAG5066 system.



Highest security level

Proven red/black separation using crypto equipment and trusted filters

R&S®STANAG5066 meets the most stringent customer security requirements by providing strict red/black separation through modern crypto devices and trusted filters in the control lines.

Support of various crypto equipment

For the encryption of mission-critical data, external online crypto devices can be installed on the data path between the R&S®STANAG5066 server (red side) and the HF radio/modem (black side).

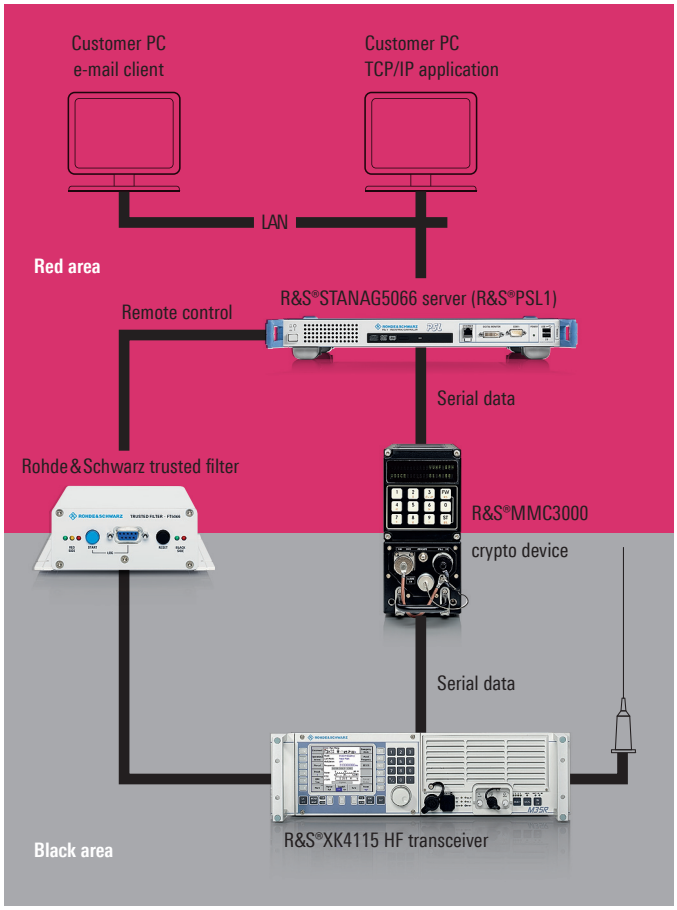
The following crypto devices are supported:

- ELCRODAT 4-2
- R&S®MMC3000
- BID 1650
- Crypto AG HC 2650

Other crypto devices can be integrated on request.

Integration of trusted filters

To support full red/black separation for HF data communications systems, Rohde&Schwarz provides a trusted filter. This filter is inserted into the remote control path between the R&S®STANAG5066 server and the HF radio or modem. Only a limited and precisely defined set of remote control commands are allowed to pass through. The trusted filter will block any other data that appears on the serial control lines. A list of supported radios and modems is available. Additional devices can be supported on request.



Highest security level.

Expansion of IP connections via HF radio lines

Use of IP-based customer applications via HF radio networks

R&S®STANAG5066 enables LAN/WAN IP-based customer applications to communicate via wireless HF networks. TCP/UDP/IP-based data exchange is provided for various IP applications. However, the limited data throughput and the larger transmission delay of HF radio links must be taken into consideration. These constraints influence the type of TCP/UDP/IP-based applications that can reasonably be supported over HF.

Support of IP type-of-service (TOS) field

The STANAG 5066 standard calls for support of version 4 of the IP protocol (IPv4). To ensure the most suitable radio link service for the HF radio transmission, based on data priority and reliability, the R&S®STANAG5066 IP client supports the type-of-service (TOS) field in the IP header and interprets it as a differentiated service field. If the customer application and the underlying TCP/UDP/IP operating system support the relevant settings in this IP header field, the information is used by R&S®STANAG5066 to classify different IP packets. This is done by mapping the IP data packets to different radio link services as provided by the STANAG 5066 protocol stack.

Support of IP unicast, multicast and broadcast

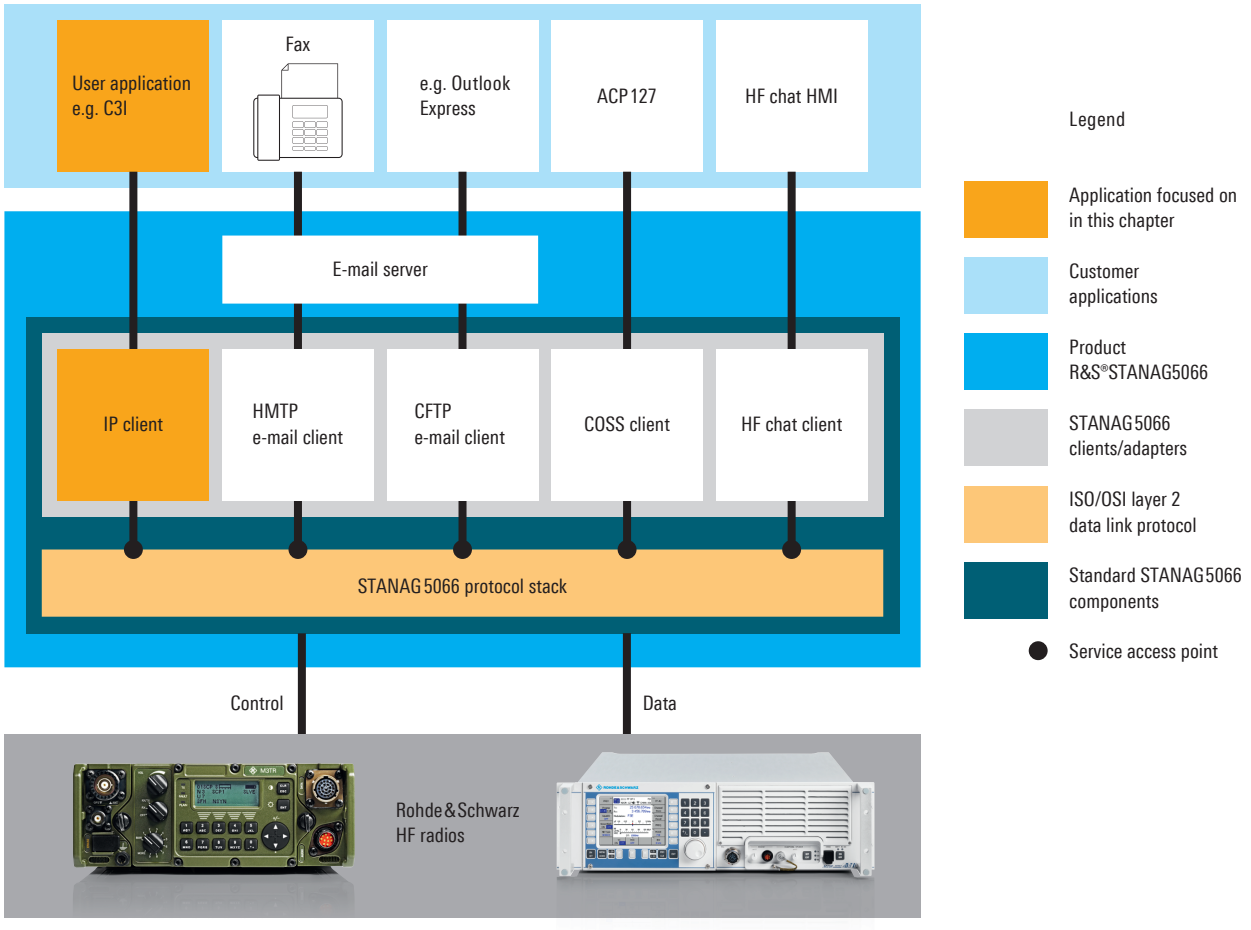
R&S®STANAG5066 supports IP unicast as well as IP multicast and IP broadcast data transmissions. IP multicast makes efficient use of the STANAG 5066 multicast capability if two or more recipients are in the same HF network. All IP unicast and multicast addresses must be statically preconfigured to match the corresponding STANAG 5066 node or group addresses.

Efficient e-mail and fax transmission

Transmission of e-mails and faxes via HF radio networks

R&S®STANAG5066 supports the exchange of plain-text e-mails and attachments using the STANAG 5066 CFTP or HMTP clients. STANAG 5066 clients are defined as adapters that applications can connect to.

IP connectivity with R&S®STANAG5066



Available STANAG 5066 e-mail clients

STANAG 5066 CFTP client

The compressed file transfer protocol (CFTP) client provides the most bandwidth-efficient exchange of data. For this reason, CFTP is the preferred client for the transmission of e-mails via HF.

STANAG 5066 HMTP client

The HF mail transfer protocol (HMTP) client is an alternative for the exchange of e-mails. HMTP was standardized much earlier than CFTP and can thus be found in many older STANAG 5066 implementations. Because HMTP is less bandwidth-efficient than CFTP, it is recommended for e-mail transmissions only if interoperability with older STANAG 5066 installations is an issue.

Integrated standard e-mail server

R&S®STANAG5066 features a standard e-mail server, which provides SMTP/POP3/IMAP services.

Interoperability with standard e-mail programs

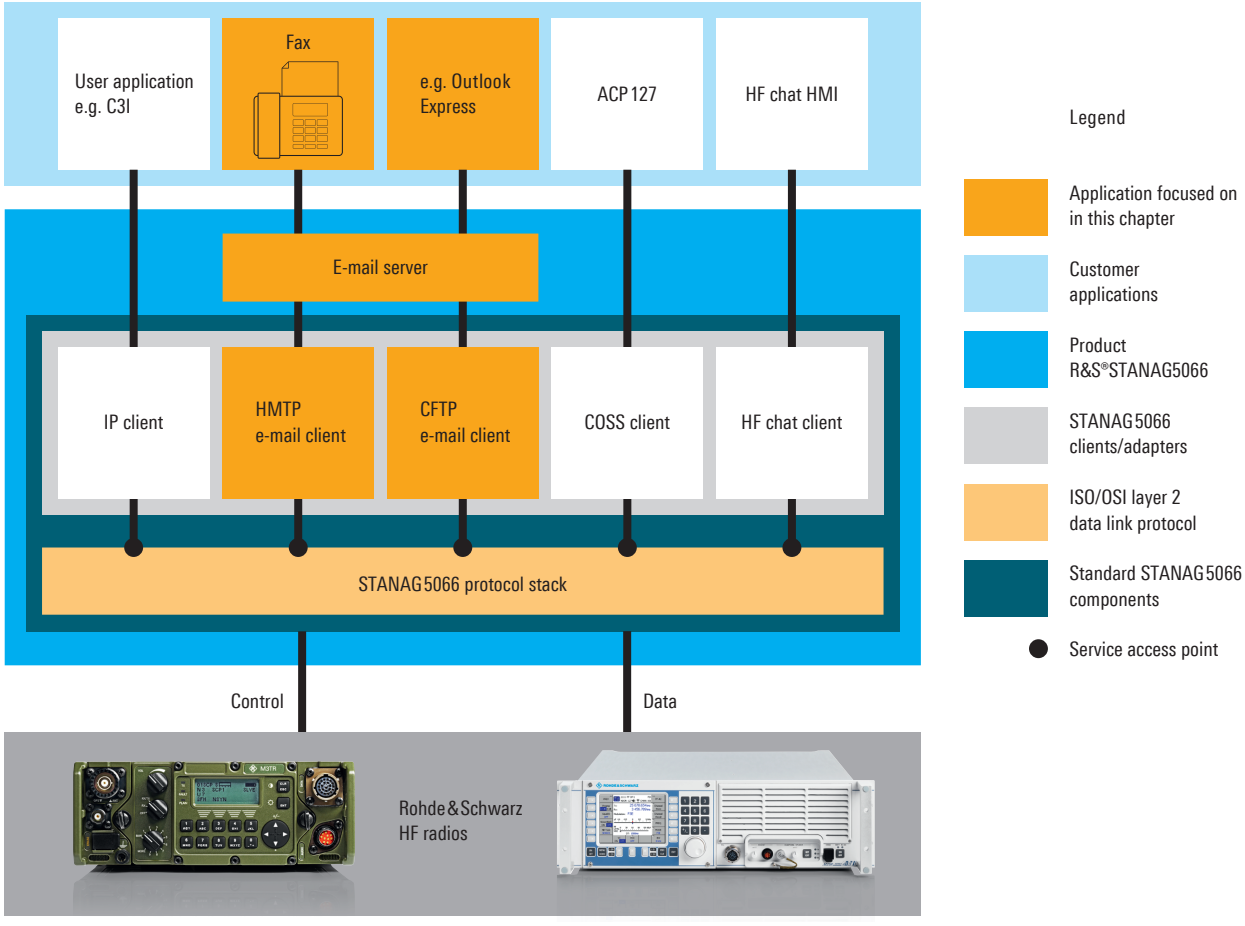
Customers' e-mail programs such as Outlook Express, which are not included with R&S®STANAG5066, can be configured to connect directly to the R&S®STANAG5066 e-mail server.

Reliability in HF radio transmissions

When an e-mail is forwarded to the R&S®STANAG5066 e-mail server, the server must ensure reliable transmission of this e-mail over the HF network. If HF transmission conditions do not allow immediate error-free delivery, multiple automatic retries are performed.

If the server is not able to transmit the e-mail within a predefined period (configurable from several minutes to several hours), it automatically generates an SMTP-based delivery failure notification and returns it to the originator of the e-mail.

Interoperability of R&S®STANAG5066 with other STANAG 5066 solutions



Fax transmission

R&S®STANAG5066 supports Group 3 fax transmission via HF radio networks. Fax messages in line with CCITT standards T.30 and T.4 are converted and transmitted as e-mail attachments. The R&S®STANAG5066 e-mail option (HMTP/CFTP) is a prerequisite for providing this fax service.

The fax can be generated electronically by an e-mail client or placed in a fax machine as a hardcopy. Faxes can be transmitted worldwide if access to the public switched telephone network (PSTN) is available. Faxes from a regular fax machine connected to a PSTN can also be received.

The fax transmission capability requires that a separate fax machine, a fax modem and a telephone system, neither of which are included with R&S®STANAG5066, be connected to the R&S®STANAG5066 server.

Interoperability with legacy applications

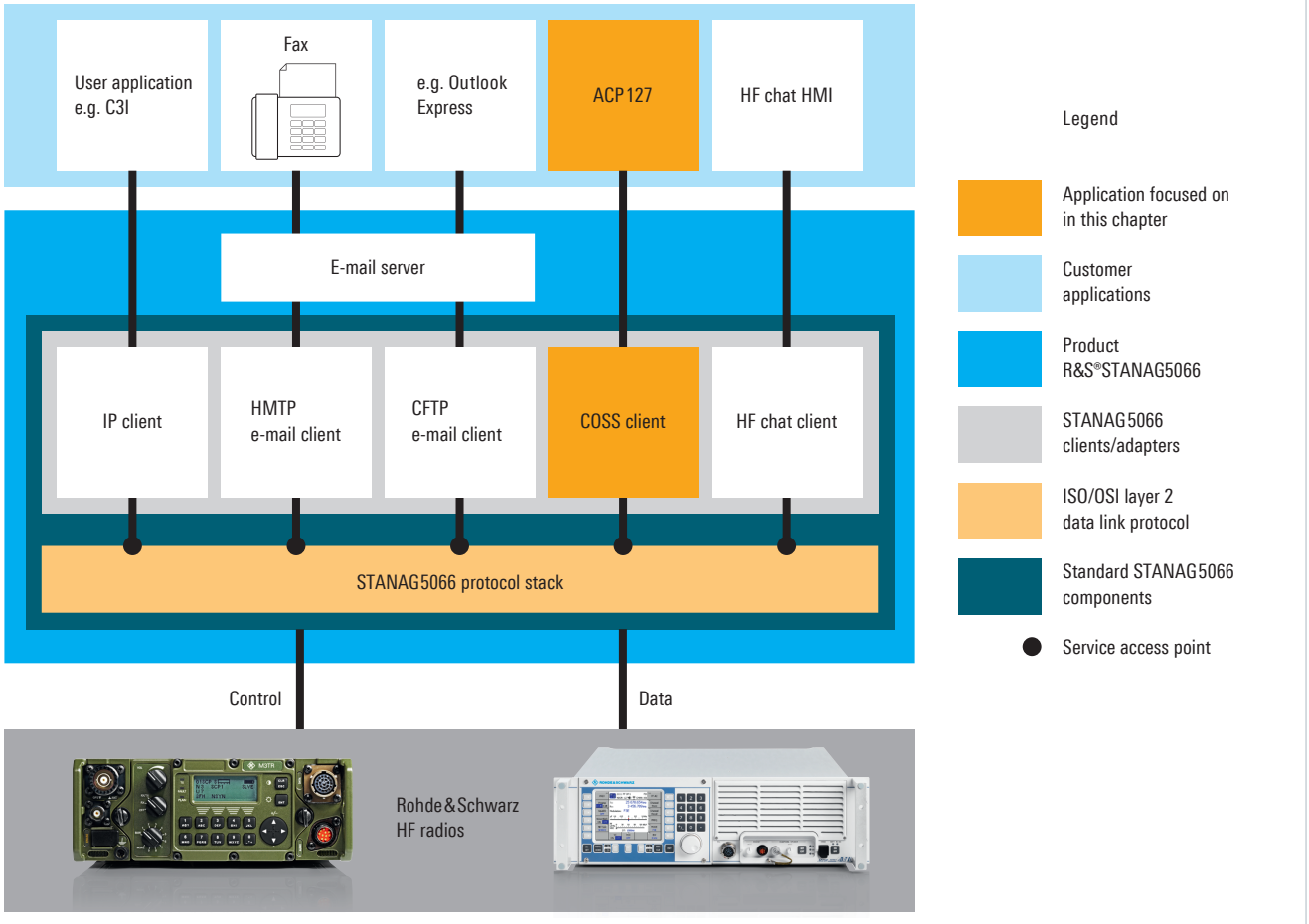
Support of legacy message handling (ACP 127)

COSS client

R&S®STANAG5066 provides a character-oriented serial stream (COSS) client to integrate applications based on serial line communications (e.g. ACP 127) for interoperable HF data exchange.

This COSS client provides a serial interface for applications that exchange data according to any serial data format defined in Annex F of the STANAG 5066 standard.

ACP 127 with R&S®STANAG5066



ACP 127 support

In military applications, formal message handling in line with ACP 127 is widely used. The COSS client provides two enhancements for ACP 127 message exchange.

Reliable data exchange

ACP 127 exchanges text messages without using any error detection or correction mechanisms. In order to reduce the effort required for manual error correction, the R&S®STANAG 5066 COSS client provides an ARQ method, which allows automatic repetition of corrupted data packets for point-to-point communications.

Delivery confirmation message

ACP 127 automatically generates a delivery status message to the originator to confirm successful message transmission. The ACP 127 delivery confirmation message is an optional extension of the STANAG 5066 standard.

HF chat for simplified information exchange

Alternative to e-mail for easy and fast information exchange

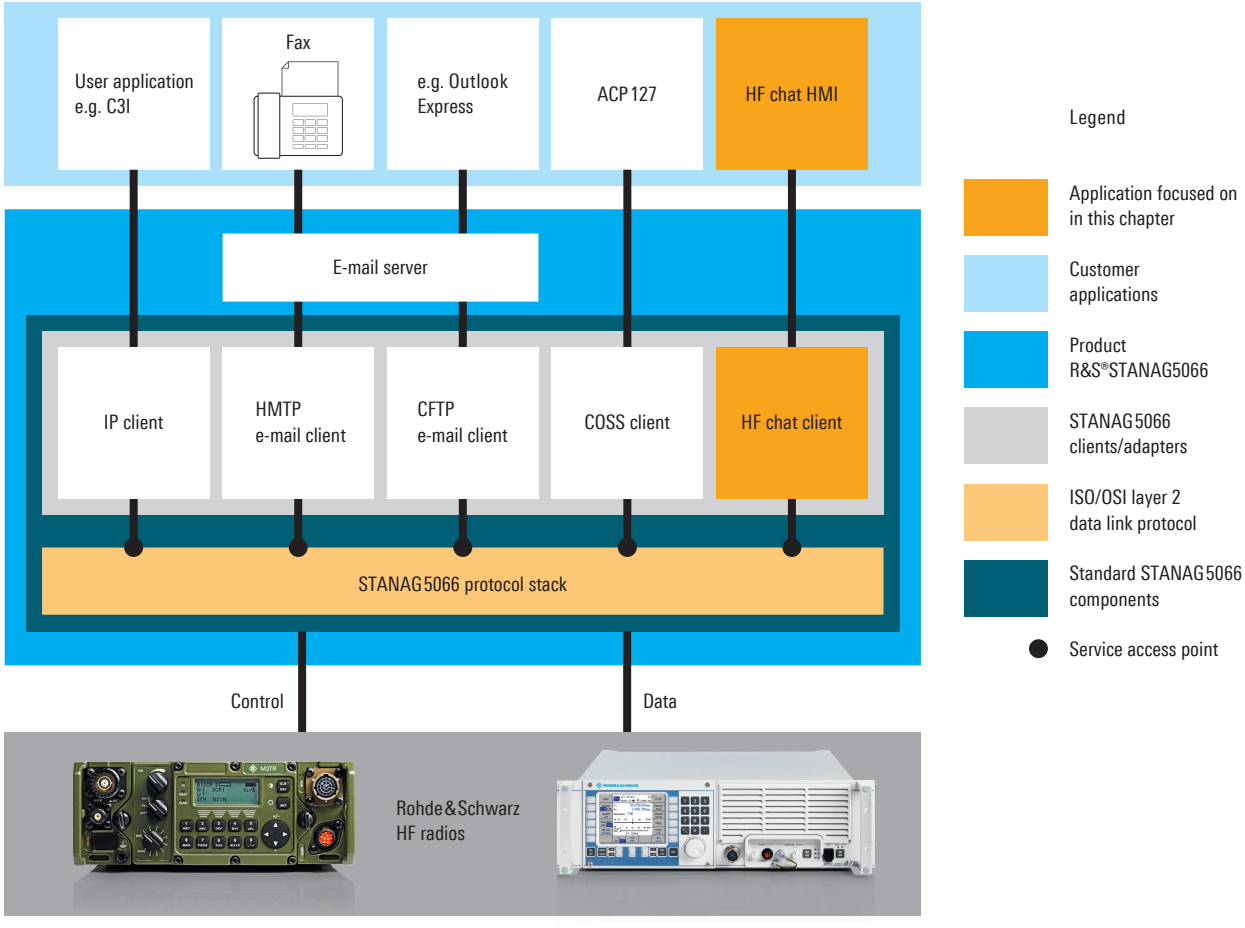
Easy and fast information exchange

R&S®STANAG5066 features an HF chat application that conforms to the STANAG 5066 standard. R&S®STANAG5066 HF chat allows simple ASCII text-based message exchange using unicast, multicast or broadcast addressed HF radio transmission to one or more STANAG 5066 stations.

Orderwire messages

HF chat is mainly used for orderwire messages to check the communications settings of the partners during mission setup.

Chat with R&S®STANAG5066



Mastery of changing HF transmission conditions

Methods for automatically adapting to various HF transmission conditions

Long-haul HF communications are subject to a wide range of different and time-dependent HF propagation and transmission conditions. R&S®STANAG5066 automatically manages most of these changing HF conditions, meaning the operator does not require in-depth knowledge of HF radiocommunications.

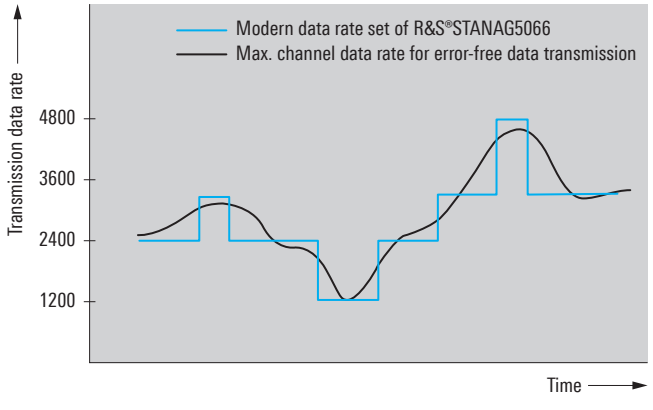
Selection of the optimal configuration prior to a transmission

A prerequisite for efficient HF data transmission is the definition of suitable STANAG 5066 protocol timing and configuration parameters for the various HF transmission conditions. For this reason, R&S®STANAG5066 allows the definition of preconfiguration sets. The operator simply selects the configuration that best matches the expected HF propagation conditions.

Adaptive data rate change during a transmission

Adaptive data rate change (ADRC) uses an intelligent algorithm to select the optimal data rate for reliable and efficient data communications. The appropriate data rate depends on the current HF radio propagation conditions, which can change considerably within a short period of time.

Automatic data rate change



Remote system control and monitoring

Support of various HF equipment

R&S®STANAG5066 supports various HF transceivers and modems with synchronous or asynchronous data interfaces.

Supported HF radios

The following Rohde&Schwarz HF transceiver families (including the built-in modems) are supported:

- R&S®M3SR Series4100
- R&S®Series2000 [1)]
- R&S®M3TR

Supported external HF modems

- DRS GA123A [1)]
- Rapid Mobile RM6
- Harris RF 5710A

Supported waveforms

- STANAG 4539 Annex B
- STANAG 4285
- STANAG 4529
- MIL-STD-188-110A
- MIL-STD-188-110B Appendix C [2)], Appendix F

Integration of customer HF equipment

For customers with HF radios or crypto devices not yet supported by R&S®STANAG5066, integration of their equipment is available on request.

Synchronous serial data interfaces

Most crypto devices use a synchronous serial data interface at their data terminal equipment (DTE), which handles the "red" data from and to the R&S®STANAG5066 server. To support this functionality, R&S®STANAG5066 features the optional R&S®GR110 asynchronous/synchronous converter. The R&S®GR110 is recommended even without crypto devices, because its use can reduce the data volume by at least 20 percent compared to asynchronous mode.

[1)] Two operating modes with STANAG 4539 Annex B: 75 bps to 2.4 kbps or 3.2 kbps to 9.6 kbps.

[2)] Data rates in line with STANAG 4539 Annex B.

Full remote control and monitoring

R&S®STANAG5066 simultaneously provides both data transmission as well as comprehensive remote control and monitoring of the entire R&S®STANAG5066 system

Extensive remote control capabilities

In addition to the STANAG 5066 control commands (e.g. data rate change), R&S®STANAG5066 features extended remote control of the radios and modems as well as of the STANAG 5066 clients and the protocol stack.

Administrators can easily configure the system (fully integrated into the R&S®STANAG5066 HMI) for a specific mission by adapting the required settings for the following:

- R&S®STANAG5066 clients
- CFTP, HMTP, chat, IP, COSS
- HF radios
- HF modems

Extensive monitoring capabilities

During active HF data transmissions the system status is monitored and displayed. The following information is provided, for example:

- Queue of incoming/outgoing messages
- Current data transmission error rate
- Actual data transmission rate
- Current links

The parameter settings can be efficiently optimized using this information.

Continuous system monitoring capabilities

Monitoring mechanisms periodically check the system components for malfunctions. Problems are indicated to enable the user to take action or perform fault management.

Technology

Full compliance with STANAG 5066, edition 1.2, amendment 1

Layer model defined in STANAG 5066

R&S®STANAG5066 is designed as a modular multiuser system consisting of a data link protocol and various STANAG 5066 clients. These clients feature standard application interfaces and connect to the STANAG 5066 HF radio protocol via service access points (SAP). The implemented data link protocol architecture is fully compliant with the sublayer model defined in the STANAG 5066 standard:

- Subnet interface sublayer – SIS
- Channel access sublayer – CAS
- Data transfer sublayer – DTS

This model supports point-to-point, point-to-multipoint and broadcast communications.

Transmission services of the STANAG 5066 radio protocol

The interface between the STANAG 5066 protocol and its clients is formed by a standardized subnetwork interface sublayer (SIS). The SIS enables the clients to request ARQ and non-ARQ data link services.

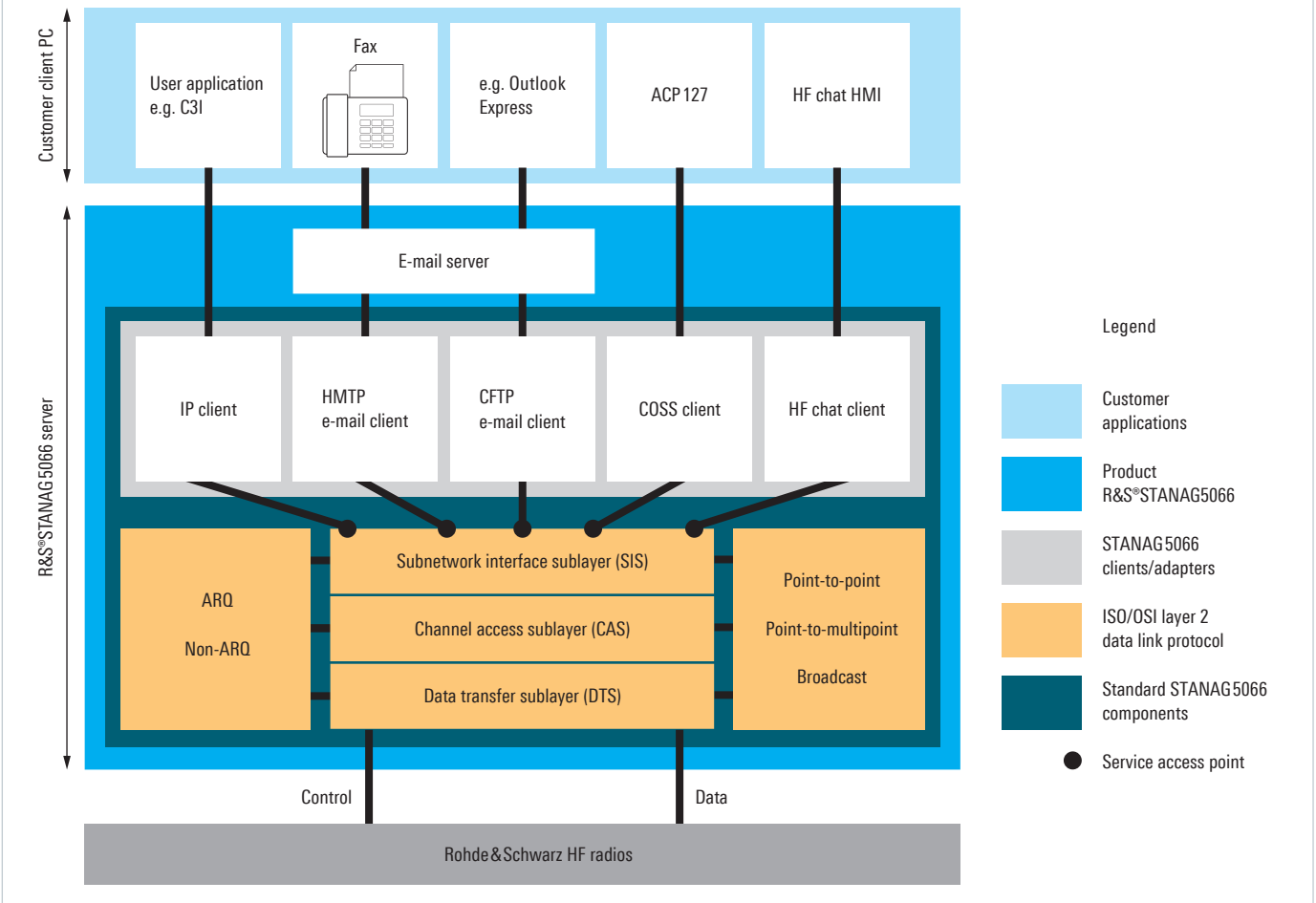
ARQ transmission for reliable data exchange

When data transmission reliability is critical, e.g. for e-mail or TCP/IP data, the corresponding STANAG 5066 client requests an automatic repeat request (ARQ) data link service. ARQ services are provided for applications that use bidirectional (point-to-point) data communications. As the HF channel is prone to transmission errors, the ARQ mode ensures reliable transfer of user data at the risk of possible retransmission, which can result in major delay variations for the data transfer.

Non-ARQ transmission for time-critical data exchange

For more time-critical applications, e.g. for UDP/IP data or chat, the non-ARQ modes speed up delivery of the data at the risk of receiving incomplete data packets.

ISO/OSI layer architecture of the R&S®STANAG5066 system



Product overview

Designation	Type
Required components	
R&S®STANAG5066 server software, including one client (for one radio link), IP connectivity (IP client), remote control of R&S®Series2000/R&S®M3SR Series4100/R&S®M3TR radios and STANAG 4285/STANAG 4539 waveforms	R&S®DS3600
Software options	
R&S®STANAG5066 clients	
E-mail function with R&S®STANAG5066 HMTP and CFTP clients	R&S®DS3602
Chat function with R&S®STANAG5066 HF chat	R&S®DS3603 [1]
R&S®STANAG5066 COSS adapter (e.g. for connection to an ACP 127 system)	R&S®DS3604
Customer-specific services	
Installation of R&S®STANAG5066 on the R&S®PSL1	
Creation of one R&S®STANAG5066 configuration	
Hardware option	
Asynchronous/synchronous converter	R&S®GR110

[1] Available on request.

Chapter 6
Crypto devices

For more than 20 years, the name Rohde&Schwarz SIT has been synonymous with high-performance encryption and IT security products and solutions. The company offers exceptionally effective means of protecting information in areas such as intellectual property and national security. In 2004, Rohde&Schwarz SIT was chosen as a security partner of the Federal Republic of Germany. Key customers are military services, governmental institutions and operators of critical infrastructures relying on high-tech security solutions "made in Germany". Moreover, the company is involved in various NATO equipment programs and supplies products to the global marketplace.

Type	Designation	Description	Page
ELCRODAT 4-2	**Encryption device**	New release eases integration into radio systems	194
R&S®MMC3000	**Multimode multirole crypto device**	Ruggedized HF/VHF/UHF/SatCom security for voice and data	196
Product overview			203
R&S®FT5066	**Trusted filter**	Radio control information filter – red/black separation to STANAG	204
Product overview			207
R&S®SITLine ETH	**Ethernet encryptor**	Secure data transmission via landline, radio relay and satellite links	208
Product overview			216
R&S®SITGate	**Next-generation firewall**	Secure access to Internet and cloud services	217
Product overview			220
TopSec Mobile	**Secure voice encryption**	For smartphones and laptops	221
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ELCRODAT 4-2 Encryption Device

With its mature technology and universal support for heterogeneous radiocommunications platforms, the ELCRODAT 4-2 NATO encryption device is in demand worldwide. Its field-proven reliability for operation on land, on water and in the air and its steady refinement as a product (new release 4.0) ensure its long-term success.

Deployed in NATO

Since series production began in 2003, the ELCRODAT 4-2 encryption device, approved for communications up to NATO COSMIC TOP SECRET, has been a proven standard component in the field of highly secure communications and will remain so for many years to come. Its integration in multinational programs such as Eurocopter Tiger, A400M and ground-air-ground communications helps safeguard interoperability between NATO allies. The encryption device is not only in service with Germany's armed forces (its biggest user), it is currently also being deployed on a large scale by the French navy and is used by armed services in numerous other NATO countries as well (see figure).

Same hardware, new firmware

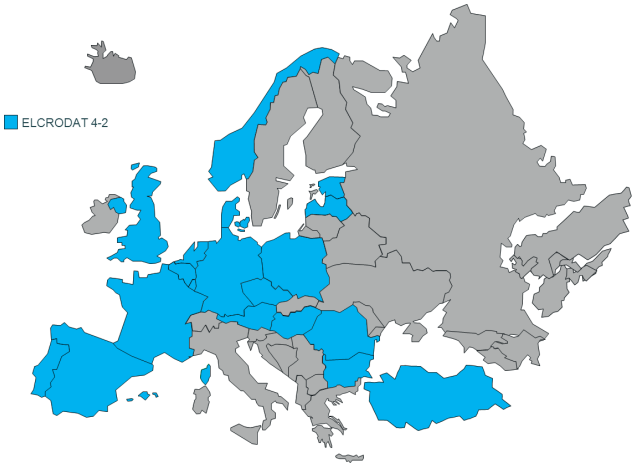
All the new additions in this release of the ELCRODAT 4-2 are implemented entirely in firmware; this means that the existing user base can benefit from the latest enhancements by upgrading the device software. The latest firmware, version 4.0, also supports a new connecting cable with an additional optical interface for controlling the devices remotely.

New applications focus on ease of use

The ELCRODAT 4-2 now provides eight presets for each of its four operating modes (plain voice, plain data, crypto voice, crypto data). The presets significantly speed up configuration in dynamic scenarios that involve, for example, switching transceivers from HF to VHF/UHF – a process that previously consisted of many individual steps.

In the latest release of the ELCRODAT 4-2 encryption device, the hardware remains unchanged. All of the new functionality can be added by a firmware upgrade.

The ELCRODAT 4-2 is deployed and in service across Europe



Release 4 of the encryption device opens up new applications, thanks to a fourfold increase in its data rate: Instead of 64 kbit/s, it now supports 256 kbit/s (synchronous) – sufficient to allow ISDN channel aggregation and video stream encryption, for instance. In asynchronous operation, the data rate has doubled, from 57.6 kbit/s to 115 kbit/s. To improve support for STANAG 5066 and address customer requests for slower transmission rates, the working range of the ELCRODAT 4-2 has also been extended by decreasing the lower the data rate limit from 600 bit/s (synchronous) to 200 bit/s and from 1200 kbit/s (asynchronous) to 300 bit/s.

Remote control of up to 32 encryption devices

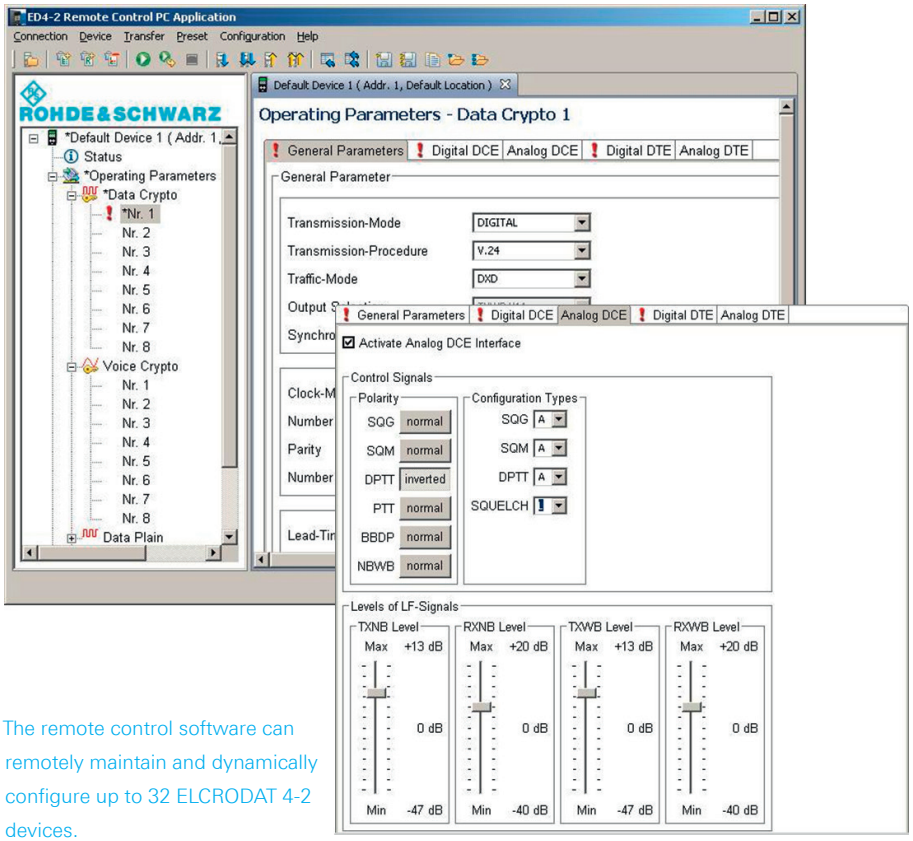
The new ED4-2 RCS remote control software (see screenshot), which enables a single host to control, maintain and monitor up to 32 ELCRODAT 4-2 devices, introduces new compelling applications. This capability is particularly valuable in command and control centers and on board ships – two operating scenarios that typically involve large numbers of detached, external encryption devices and transceivers. At the same time, the familiar user interfaces and configuration options are still available. Existing configuration profiles can now be copied and adapted. This means new devices being readied for installation no longer need to be configured individually – and laboriously – by hand. Configuration can be carried out in a new preset management environment. During operation, device configurations can either be left static or, if necessary, can be adapted dynamically via ED4-2 RCS. The software continuously monitors the connected encryption devices, allowing the system to respond rapidly to external changes – by adjusting signal levels, for example. An interface control document available from Rohde&Schwarz SIT GmbH details the interface to ED4-2 RCS, enabling integrators to develop custom remote control software. As a result, the ELCRODAT 4-2 can be seamlessly integrated into higher-level management systems. In addition, ED4-2 RCS is executable on standard PCs, making its incorporation into existing system environments easy.

Summary

With its excellent system compatibility and the ability to support a wide variety of operating scenarios, the ELCRODAT 4-2 encryption device is a dependable core component in highly secure radiocommunications systems in global, mobile and stationary operations. It is field-proven, exceptionally reliable and robust. With the new functionality available in version 4.0, it offers numerous advantages that significantly expand its deployment scope and integratability.

References

The French navy is rolling out the ELCRODAT 4-2 as part of its RIFAN II program (réseau IP de la force aéronavale). The encryption device has also been qualified for operation in advanced airborne platforms such as the Eurocopter Tiger (in Germany and Spain) and the A400M transport aircraft (in Belgium, Germany, Spain, France, Great Britain, Luxembourg and Turkey). The R&S®MMC3000, a variant of the encryption device aimed at the global market, is in demand by customers outside Europe.



The remote control software can remotely maintain and dynamically configure up to 32 ELCRODAT 4-2 devices.

R&S®MMC3000 Multimode Multirole Crypto Device

The R&S®MMC3000 is a fully ruggedized tactical crypto device used to encrypt and decrypt voice and data communications at the highest security levels. TEMPEST-proof, it is interoperable with HF/VHF/UHF radio, satellite communications and line transmission equipment. It is perfectly suited for deployment on stationary and mobile platforms in rugged terrain and in naval and airborne environments.

The R&S®MMC3000 device supports simplex, half-duplex and duplex modes to satisfy the requirements of the widest range of digital and analog applications for both local and remote operation. The R&S®MMC3000 can be operated either with a control unit or the MIL-bus module. A customizable crypto algorithm provides the uniqueness and exclusivity needed for different national and coalition scenarios.

In data crypto mode, the device is seamlessly integrated into data transmission systems equipped with standard military interfaces (most standard military interfaces are supported). The vocoder used in voice mode optimizes speech clarity even in noisy transmissions. The flexible and future-ready design includes a protected software download process and a slot for an additional crypto board for upgrading the device to meet future requirements.

The R&S®MMC3000 has a wide range of accessories to integrate the device in complex communications infrastructures. A security management system (R&S®SMS3000) is augmented by a data loading device (DLD), crypto ignition key (CIK), mounting frame, power supply unit and components for the remote operation of the control unit.

Key facts

- Voice and data encryption to the highest security levels
- Protects HF/VHF/UHF, SatCom and line transmission
- Fully rugged, tamper protected, TEMPEST-proof
- Stationary and mobile deployment in all military branches (army, navy, air force)
- Customizable crypto algorithms for specific user requirements

Benefits and key features

Dedicated operator interfaces for various applications

- Remote control software systems management interface
- MIL-bus communications systems management interface
- Control unit user interface
- Headset/intercom interface

Comprehensive protection through elaborate security concept

- Audited production environment
- Hardware red-black separation and tamper protection
- Secure key generation and management

Versatility through multiple traffic/operating modes and transmission methods

- Traffic modes according to operating modes and transmission methods
- Operating modes for voice and data transmissions
- Teletype for extremely reliable communications
- Ready for transmissions over IP
- Synchronous and asynchronous transmissions over the red and black interfaces

High quality of service and flexible operation with state-of-the-art technology

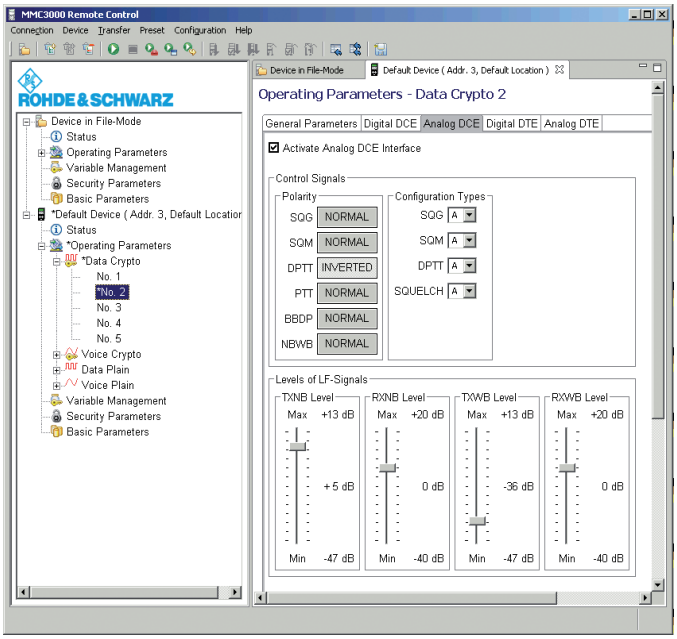
- High quality of service
- Flexible configuration
- Upgradeability

Individualization using customizable crypto algorithms for specific user requirements

Simplified operation and commissioning by wide selection of accessories

- Configuration PC increases the efficiency and accuracy of the preset loading process
- Crypto ignition key (CIK) adds extra level of security and increases the flexibility in deployment
- Mounting frame secures the device in physically demanding environments
- R&S®GP3000 data loading device (DLD) enables key distribution to geographically dispersed units
- Seamlessly adjustable external power supply unit (110 V/240 V)

R&S®MMC3000 remote control PC application.



Dedicated operator interfaces for various applications

The R&S®MMC3000 offers a wide range of operator interface options supporting different application platforms and scenarios.

Remote control software systems management interface

Full remote control in a defined software environment manages devices in inaccessible locations, e.g. cramped quarters in an aircraft or a naval environment. The application increases flexibility, accuracy and speed in managing a complex system, as up to 31 R&S®MMC3000 can be connected to the RS-485-to-serial adapter. It reduces the probability of error and saves resources by copying repetitive or downloading prepared settings. Presets for a larger number of devices can be stored.

The application also copies and downloads preset parameters (e.g. from one device to another). The five views for each device (status, operating parameters, variable management, security parameters and basic parameters) as well as supervisory activities provide a comprehensive and swift overview of all devices in a group or an overview of all individual device settings at a glance.

Using the remote control application, the operator can change easily between presets, adapt the device configuration or initiate a logical zeroize in the event of a threat of disclosure.

MIL-bus communications systems management interface

The electronic control of the R&S®MMC3000 MIL-bus interface is accommodated in a separate housing which can be attached to the base unit. It is in line with the MIL-STD-1553B standard including redundant access. The remote control is integrated into an existing communications application and targeted at complex communications systems with a number of R&S®MMC3000 – primarily in an airborne environment, e.g. helicopters or fixed-wing aircraft.

The R&S®MMC3000 MIL-bus module allows full operational capability as well as preset changes and logical zeroize functionality.

Control unit user interface

The R&S®MMC3000 control unit is accommodated in a separate housing which can be attached to the base unit. It is aimed at simple communications systems with a single R&S®MMC3000, where it enables a local operator to change between presets and to gain access to all logical, physical and security parameter settings (e.g. voltage, physical and logical zeroize, zeroize revocation). Additionally, the control unit can be operated detached from the base unit via a cable link with a cable length of up to 50 m. The connecting parts for the detached control unit are available on request.

Headset/intercom interface

The headset/intercom interface supports both active and passive microphones and squelch for better speech comprehension. It is typically used for local emergency communications or troubleshooting and eliminates the need to reconfigure the connected equipment or applications.

Comprehensive protection through elaborate security concept

The R&S®MMC3000 is based on a security concept covering the entire crypto life cycle to deliver comprehensive protection.

Audited production environment

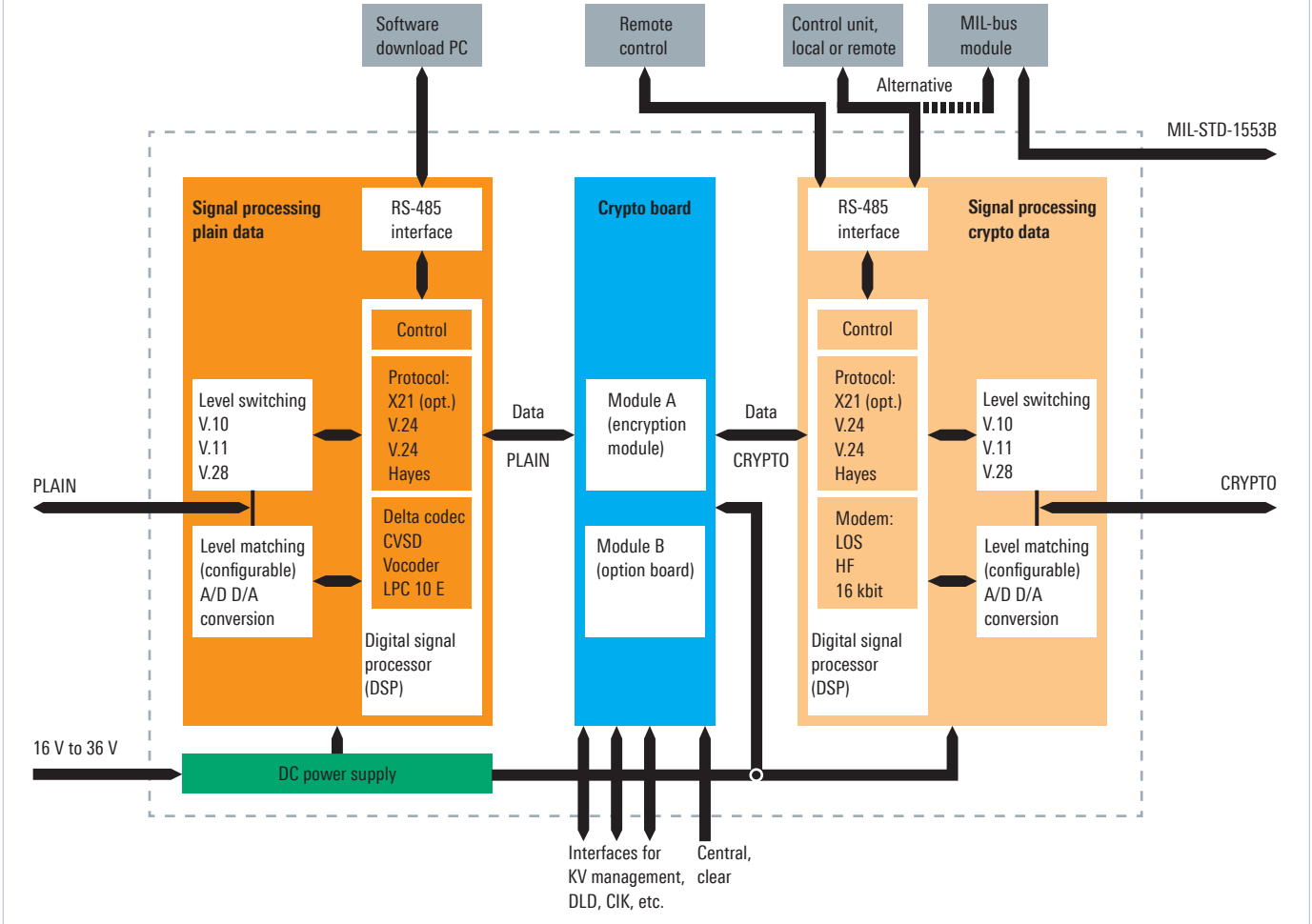
The R&S®MMC3000 security concept starts during production, as it is manufactured entirely in a high security environment at audited Rohde&Schwarz plants in Germany.

Hardware red-black separation and tamper protection

Its hardware red-black separation provides the basis for information security on a physical level.

During operation, the R&S®MMC3000's integrity is ensured by providing sophisticated tamper protection mechanisms against unauthorized access. In case of emergency, the device can be zeroized automatically or manually

Block diagram of the R&S®MMC3000 crypto device



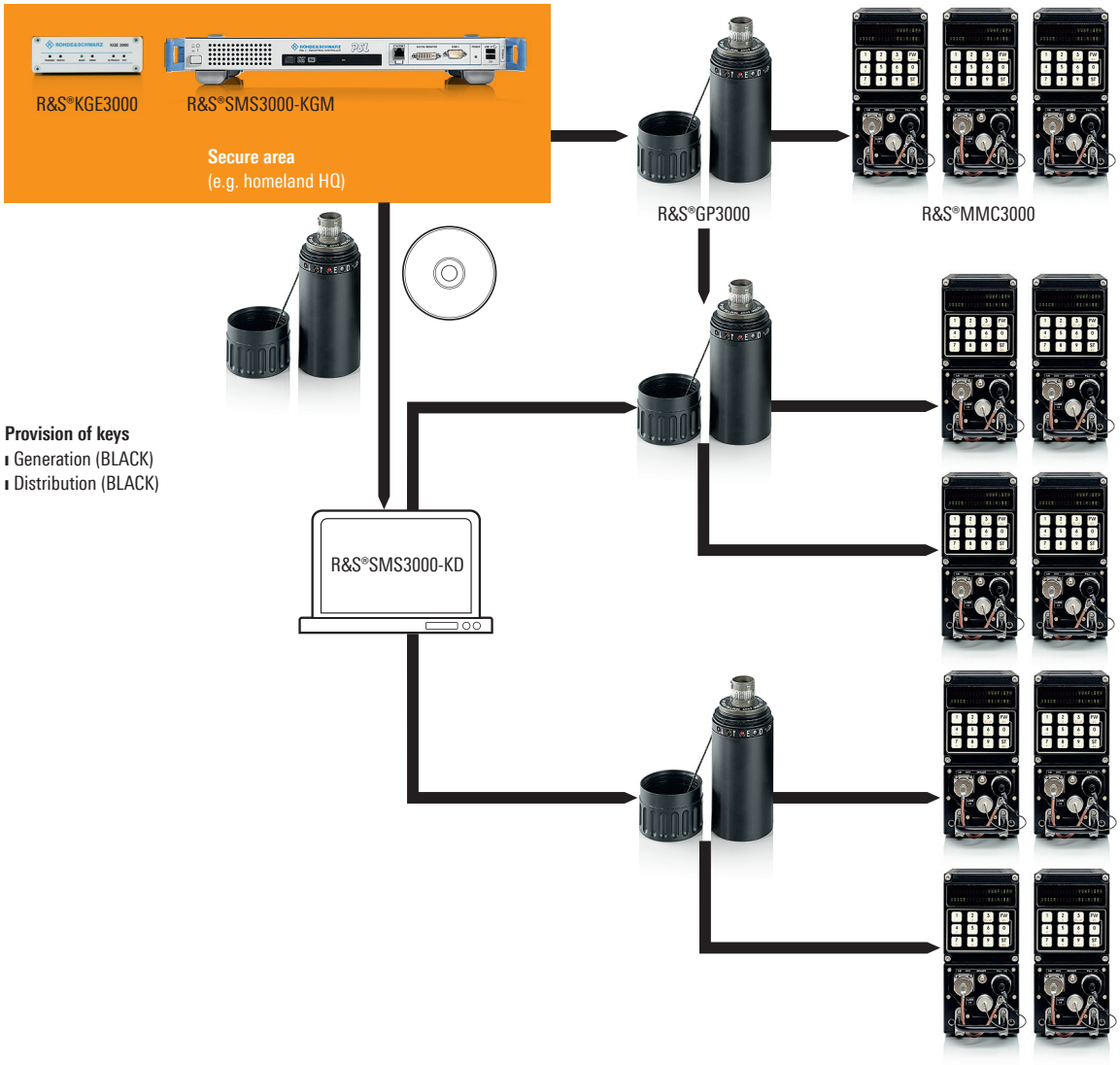
at each of the available physical interfaces. Its built-in test (BITE) continuously monitors the device's operation, ensuring correct system behavior. The TEMPEST-proof design eliminates risk of interception.

Secure key generation and management

The R&S®MMC3000 features modern black crypto variable management as well as a high-performance security management system. Black keys made available by the R&S®SMS3000 security management system are loaded securely from the ruggedized R&S®GP3000 data loading device (DLD) into the R&S®MMC3000. The key generation process is performed on the dedicated R&S®KGE3000 key generation equipment which contains a high quality physical true random noise generator (TRNG).

If no key infrastructure is available, the R&S®MMC3000 can generate operational keys at the crypto device.

Key generation and management with the R&S®MMC3000



Versatility through multiple traffic/operating modes and transmission methods

The R&S®MMC3000 flexible interface concept with analog and digital communications interfaces supports a variety of traffic and operating modes and transmission methods.

Traffic modes according to operating modes and transmission methods

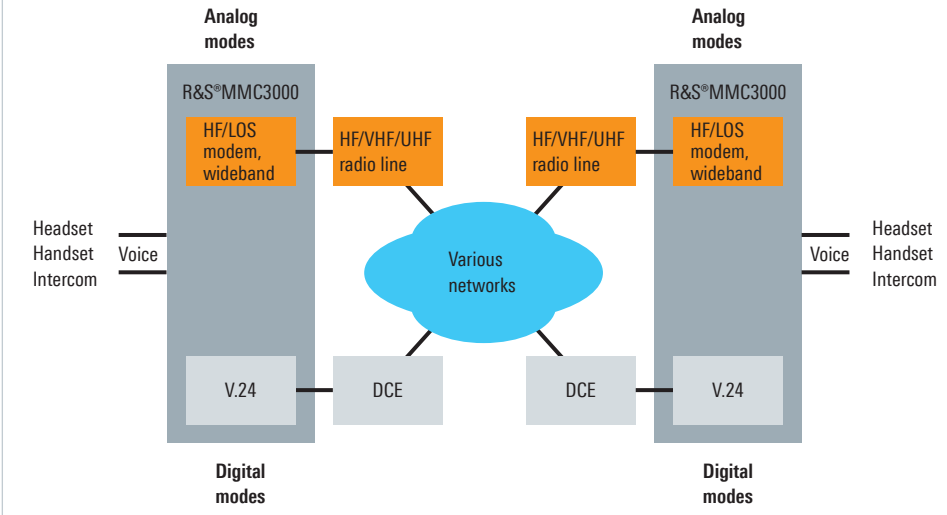
The mode the R&S®MMC3000 uses to send voice and data depends on the selected operating mode and transmission method. The available traffic modes are simplex, half-duplex (HDX), duplex, double simplex (DX), late entry (DX-LE) and duplex with acknowledgment (DXD).

Operating modes for voice and data transmissions

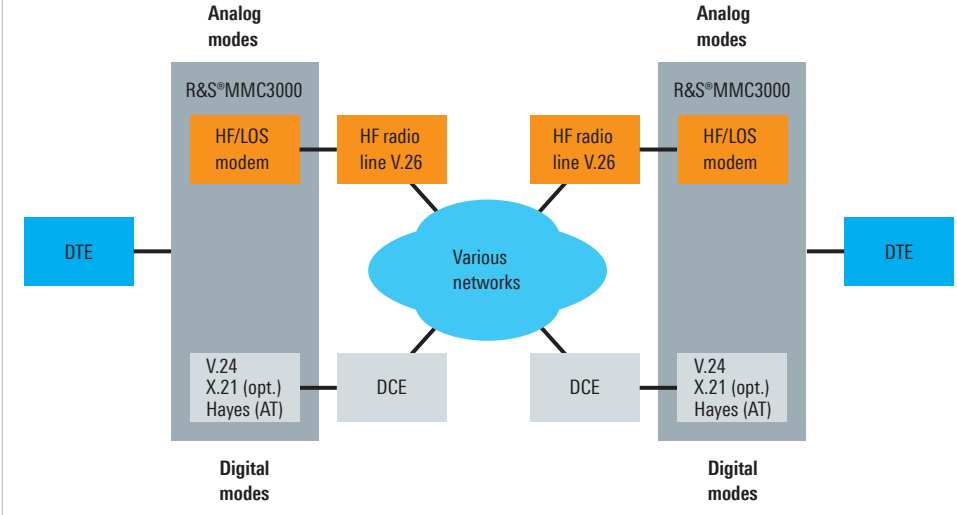
The R&S®MMC3000 features four operating modes which are determined by the wiring of the external interfaces and by parameterization. The individual operating modes are parameterized via the control unit. The set parameters are stored in the R&S®MMC3000 base unit. The parameterized operating modes are:

- Data crypto: in data crypto mode, the R&S®MMC3000 can be integrated into data transmission systems equipped with interfaces compatible with ITU-T V.24/V.10/V.11/V.28 or X.21/V.11 (optional); dialing protocols or Hayes commands (AT commands) can be used; after the Hayes commands sent by the data terminal equipment (STE) have been identified and checked, the R&S®MMC30000 forwards the Hayes commands, synchronizes to the called station and activates the encrypted data mode; if an analog interface is used, the integrated LOS modem (in line with ITU-T V.26) or HF modem (in line with STANAG 4197) is used

Voice encryption in various communications networks



Data encryption in various communications networks



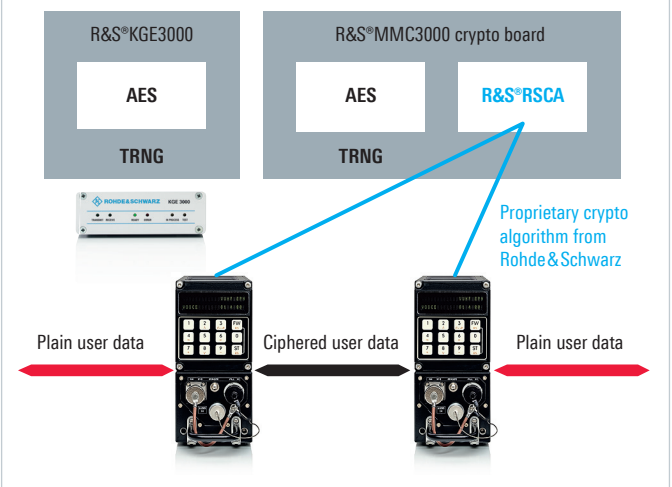
- Voice crypto: in voice crypto mode, the voice signals are digitized either by the LPC 10e vocoder or the CVSD delta codec, depending on the traffic mode; an HF modem (in line with STANAG 4197), a LOS modem (in line with ITU-T V.26), baseband/diphase or V.24 mode can be selected, depending on the selected voice digitization method
- Plain voice/plain data: several plain modes are available for voice and data depending on the different applications (voice: HF, VHF, UHF modes; data; digital V.24 mode)

Teletype for extremely reliable communications
Teletype provides extremely reliable communications in environments with low, varying bandwidth but requires flexible adaptation to low voltage levels.

- Baud rates from 50 bit/s up to 64 kbit/s allow communications in a wide range of extreme, specialist scenarios, e.g. low baud rates in helicopter communications, VHF/UHF transmissions
- The headset interface supports both active and passive microphones and squelch for better comprehension; the device can be configured to support guard channel; local emergency communications are possible over the interface and/or troubleshooting can be carried out without the need to configure connected equipment/ applications

Ready for transmissions over IP
The transition to IP traffic for payload information is supported for Ethernet infrastructures. The data is tunneled through Ethernet using standard converters, removing the distance restrictions for serial transmissions.

R&S®MMC3000 security technologies



Synchronous and asynchronous transmissions over red and black interfaces
All combinations of synchronous and asynchronous transmissions are supported by both the red and black interfaces. Different clocking requirements within the separate networks are met without the need to introduce additional equipment or modifications to the network.

High quality of service and flexible operation with state-of-the-art technology

High quality of service
The R&S®MMC3000 meets the demand for high quality of service under a wide range of conditions:

- Late entry for heavy duty and uninterrupted crypto communications even under demanding transport channel conditions
- High quality voice codecs optimized for each transmission type

Flexible configuration
Five preset pages for each operating mode provide fast and flexible configuration.

Upgradeability
The R&S®MMC3000 provides an extra slot for the integration of a future crypto board.

The R&S®MMC3000 can be upgraded via a protected software download using a PC and a dedicated software download package. This mechanism is secured by the customer-specific crypto algorithm.

Individualization using customizable crypto algorithms for specific user requirements

Encryption in the R&S®MMC3000 is based on the high-performance Rohde&Schwarz SIT GmbH crypto board. Specific customer requirements can be accommodated with the proprietary R&S®RSCA algorithm and/or the specific implementation of the AES 256 algorithm. The extent of customization can be tailored to suit the exact, unique requirements of various customers and applications. Rohde&Schwarz SIT GmbH controls all aspects of the crypto life cycle so that additional elements, e.g. crypto containers, keying materials, key encryption keys and key loaders, are configured to ensure the seamless and consistent integration of implemented algorithms.

Simplified operation and commissioning by wide selection of accessories

Configuration PC increases the efficiency and accuracy of the preset loading process

The application to (pre)configure presets and to load them into a number of R&S®MMC3000 devices avoids operator-induced errors when commissioning the device.

Crypto ignition key (CIK) adds extra level of security and increases the flexibility in deployment

With this option, the R&S®MMC3000 is only operational when the CIK has been inserted into the device. The CIK protects access to the crypto variable memory and, once removed, the R&S®MMC3000 can be left unsupervised with no danger that secrets can be retrieved from the device. This not only increases the possible application scenarios, it also allows for quick reaction in times of immediate threat.

Mounting frame secures the device in physically demanding environments

A military-standard mounting frame ensures that the R&S®MMC3000 can be securely fitted in environments particularly prone to jolts, bumps and heavy vibration, e. g. helicopters.

R&S®GP3000 data loading device (DLD) enables key distribution to geographically dispersed units

The DLD eliminates the need to regather all the units to a single location close to the key generation equipment or process. Because it loads black keys into the R&S®MMC3000, the key loading process is secure even if DLDs should be lost.

Seamlessly adjustable external power supply unit (110 V/240 V)

The power supply voltage ranges from 16 V to 36 V. It is EC-protected and features interface options for different plugs.

R&S®MMC3000 components and equipment

Product overview

Designation	Type
Base unit (including base unit, control unit, mounting frame, compact user guide)	
Multimode multirole crypto device	R&S®MMC3000
Accessories	
MIL-bus module	
Control unit	
Mounting frame	
AC power supply	
Detached control unit	
Remote control software	R&S®MMC3000-RC
Fillgun (incl. adapter cable)	R&S®GP3000
Key management station (incl. R&S®KGE3000)	R&S®SMS3000-KGM

R&S®FT5066 Trusted Filter

The R&S®FT5066 trusted filter is developed for a scenario consisting of a STANAG 5066 message handling application involving a radio and/or modem interface and a remote control protocol. The device provides firewall functionality for the radio's control information. Inserted in the control path of a system, the filter provides a strict red/black separation. This ensures that only explicitly permitted control commands are transmitted and prevents (un)intentional data leakage over the control interface.

One aspect often neglected in a communications system is the threat caused by the transmission of control information. The path for control information is necessarily nearly always plain. As a result, it can be deliberately or unwittingly abused, e.g. through a programming error, to circumvent the encryption mode and transmit sensitive information openly. The R&S®FT5066 protects the control path and prevents the accidental diversion of red data to the black side of the system.

A potential security leak results because the message handling system to be protected processes red data (payload data) as well as the data required to control the modem and radio equipment on the black side of the system. An error condition occurring inside the message handling system can lead to an unintentional transfer of payload information to the black side, bypassing the cryptographic engine. The R&S®FT5066 detects, blocks, signals and logs these compromising error conditions.

Separate, independent and autonomous built-in tests ensure the ongoing integrity of the R&S®FT5066's firewall functionality. A read-only logging function has been implemented to deny any possible access to the device over the external interfaces, which further enhances the integrity of the device.

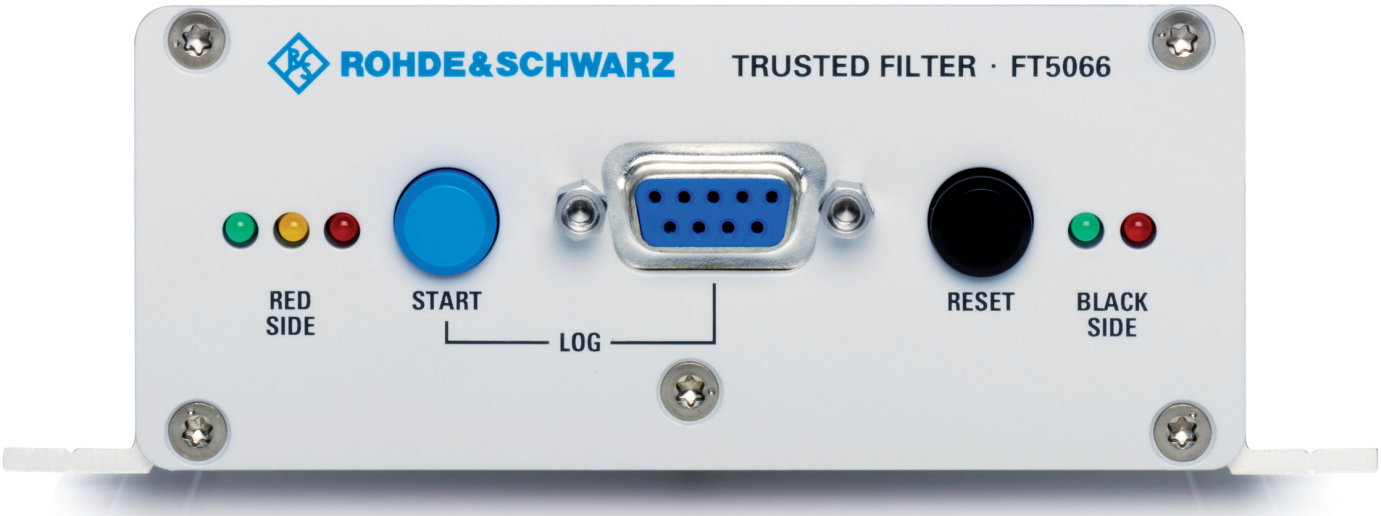
Key facts

- Rigid enforcement of classification boundary between red and black data
- Prevents data leakage over the control interface
- Operates in systems classified up to "SECRET"
- Built-in tests and access control
- Audiovisual status indicators and detailed logging function
- Supports R&S®M3SR radios, Harris and RM6 as well as GA-123 modems

Benefits and key features

Red/black separation provides system integrity

- Managed communications relationships and flows avoid security leaks
- Two independent processors cross-check the integrity of red/black separation
- Mathematical checksums prevent control data bypass within the device



Verifiable and security-conforming mapping of overall system

- White list function with zero tolerance for secure operation
- Exhaustive testing of the system ensures overall integrity

Detailed and direct system status and logging

- Clear signals provide precise information on current system status
- Detailed logging for maintenance and adjustment

Design concept protects against manipulation and secures device integrity

- Physical and logical measures prevent undetected manipulation
- Comprehensive self-testing ensures the permanent reliability of the system

Red/black separation provides system integrity

Managed communications relationships and flows avoid security leaks

The R&S®FT5066 has two processors that control the flow of communications within the device, as well as to the message handling system (MHS) and the radio/modem. One processor is responsible for communications with the MHS on the red side, while the second processor handles communications with the radio/modem on the black side.

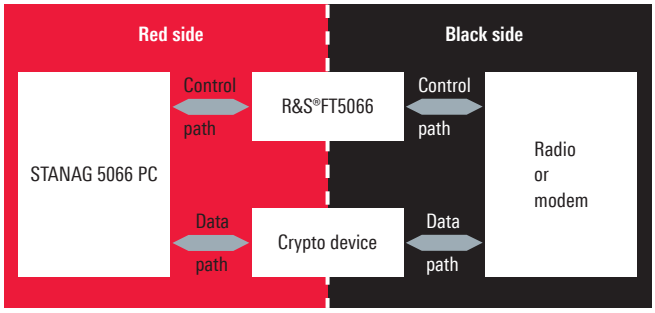
Control commands flow over two separate paths. A uni-directional driver allows information from the black side (radio/modem) to enter the red area (MHS) but, critically, prevents data from the red side from using this path. Data from the red side can only flow to the black side through the path using the two independent processors.

Log information can only be output over the read-only interface, which is on the red side. No information can enter the device via the log interface, i.e. leave the red side, nor can the R&S®FT5066 be accessed and compromised over the log interface.

Two independent processors cross-check the integrity of red/black separation

The R&S®FT5066 has been designed with two independent processors: one for the red and one for the black side. Each processor has been independently initialized with its own program (filter policy) in the manufacturing process and has its own physical flash memory and RAM in which the respective boot loader and firmware of each processor has been stored. Both processors initialize independently and check that the firmware is operating on the correct processor side. The red processor then confirms that the black processor firmware version is correct. The device will only operate after all tests have been completed successfully.

Red/black separation for the control path



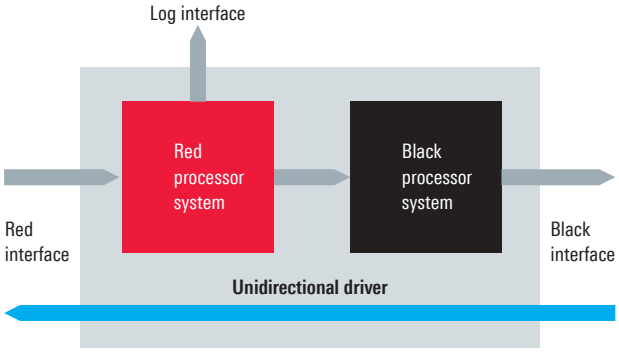
Mathematical checksums prevent control data bypass within the device

During operation, the red processor receives a control data package from the message handling system, examines it and, if deemed valid, encapsulates it with a start byte, header byte and end byte. The header byte includes a checksum (CRC) and the data length.

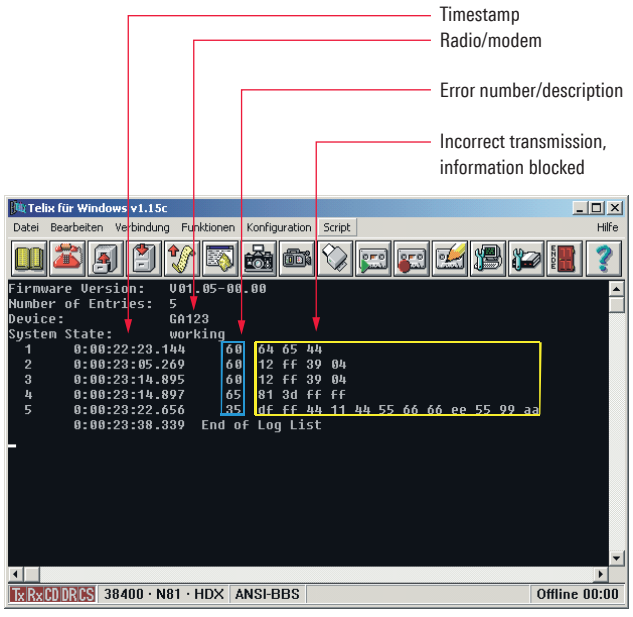
The black processor receives and processes the data and checks the results. The black processor will forward the information to the radio/modem and send an acknowledge to the red processor only if all mathematical parameters coincide.

Data from the MHS is forwarded to the radio or modem only when both processors operate correctly on their own and in tandem.

Data flow within the R&S®FT5066



Log data



Detailed and direct system status and logging

Clear signals provide precise information on current system status

Audiovisual signals provide immediate and easily recognizable information on the status of the system. Clearly visible LEDs on the front panel of the device indicate the proper functioning of the system or the device warning level. Separate LEDs for the red and black side help to pinpoint the source of nonpermitted behavior.

A clearly audible tone is activated as soon as the device is in blocking mode, which is the state the device enters after it has received the maximum number of warnings or a critical error has occurred.

Detailed logging for maintenance and adjustment

The logging function provides further information on the operational status of the system. Faulty control commands are listed with the relevant error code to pinpoint the origin of the errors. The details help to differentiate between red and black processors, other components and implementations and enable a quicker resolution of the problem. Three different error levels indicate the potential risk of compromising the system due to a faulty transmission.

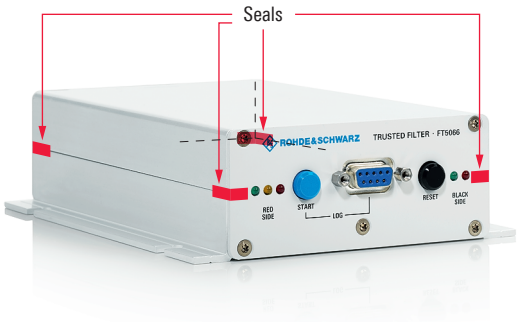
Design concept protects against manipulation and secures device integrity

Physical and logical measures prevent undetected manipulation

Various physical and logical procedures and processes protect the R&S®FT5066 against malfunction and manipulation. Separate filter lists for each processor are loaded into the device in a secure environment during production. The R&S®FT5066 is sealed afterwards to prevent access to its internal interfaces.

CRC processes are used within the device for communications between the processors (file names, control commands, etc.), and the external interfaces (logging functionality) can only be used to read out data.

Seals provide tamper detection



Comprehensive self-testing ensures the permanent reliability of the system

The R&S®FT5066 performs a built-in test (BIT) after power on or after the RESET button has been activated. The red to black transmission channel is blocked while the BIT is being performed. Both green LEDs light up after the successful, error-free completion of the BIT. A continuous audio tone is emitted and at least one red LED flashes if the BIT fails. In this case, the device must be returned to Rohde&Schwarz for reinitialization.

Product overview

Designation	Type
Trusted filter, for R&S®XK2100, RM6, GA-123	R&S®FT5066
Trusted filter, for R&S®XK4115	R&S®FT5066
Trusted filter, for Harris 5710A	R&S®FT5066

R&S®SITLine ETH Ethernet Encryptor

The R&S®SITLine ETH is a family of devices for Ethernet encryption and for creating secure "layer 2 virtual private networks" (L2 VPN). The R&S®SITLine ETH protects companies and organizations against espionage and manipulation of data that is transported via Ethernet over landline, radio relay or satellite links. The devices in this product family are approved by the German Federal Office for Information Security (BSI) and can be used in a flexible manner in many stationary and mobile applications.

The R&S®SITLine ETH performs encryption on an Ethernet basis – in the ISO/OSI model's data link layer (layer 2) – which makes it ideal for protecting applications where throughput and time are critical. Communications links over public and private networks can be protected. The R&S®SITLine ETH makes it possible to accommodate security requirements in a way that is fully independent of the existing or planned network structure.

Due to the significant cost savings they enable, Ethernet VPNs have become established in recent years as a true alternative to "managed IP connections" (IP VPN) when it comes to site networking. The R&S®SITLine ETH provides different models and performance classes. The R&S®SITLine ETH family of devices is a flexible solution for meeting changing requirements and offers a high level of investment protection.

Key facts

- Ethernet encryptors in performance classes from 25 Mbit/s to 1 Gbit/s
- Advanced cryptographic methods and standards (elliptic curves, AES, X.509)
- Flexible deployment in advanced transmission networks
  - Encryption based on port, VLAN or group assignment (multipoint)
  - Maximum bandwidth efficiency, avoidance of overhead
  - Convenient online management capabilities for device configuration and for security and networks settings
- Very compact design (1 HU for single-port and multiport devices), very low energy consumption, low total cost of ownership (TCO)
- Approved by the German Federal Office for Information Security (BSI) up to the German restricted ("VS-NfD") and NATO restricted classification levels

Benefits and key features

Safeguarding civil, official and military communications

- Confidential communications between sites and within a single site (L2 VPN)
- Safeguarding radio relay and satellite links (SatCom)
- Securing rail control and monitoring networks
- Secure interconnection of data centers and storage area networks (SAN)

Low system costs

- Minimal investment for installation and configuration
- Low space and energy costs
- Lower transmission costs than with managed IP
- Low maintenance and service requirements
- Bandwidth efficiency through group encryption (multipoint approach)
- No need for central or internal key servers
- Better transmission performance than with IPsec

R&S®SITLine ETH100.

R&S®SITLine ETH50.

Professional, certified security

- Securing point-to-point Ethernet lines and Ethernet VLANs
- Innovative group encryption for multicast topologies (ELAN)
- Secure authentication
- Automatic operation of encrypted links
- Flexible encryption hardware
- Manipulation-proof devices

Central security management over the network

- Online, convenient and secure
- Virtualization capability and high availability
- Clearly defined roles
- Central point for log files and audits

SNMP-based network management

- Support of SNMP v1, v2c and v3
- Extensive monitoring and diagnostic capabilities
- Network management through service providers

Safeguarding civil, official and military communications

Originally used only in local area networks (LAN), today Ethernet is a reliable and universal transmission technology for wide area networks (WAN). This makes site interconnection via global networks just as easy as in-house cabling. Unfortunately, this also means a greater susceptibility to attacks from public networks: Eavesdropping, manipulation and disruption are as easy as in any computer network. The BSI-approved R&S®SITLine ETH safeguards communications through encryption on the Ethernet layer.

The R&S®SITLine ETH safeguards public and private connections over landline, radio relay and satellite links.

Confidential communications between sites and within individual sites (L2 VPN)

Video conferences, VoIP calls, database queries – organizations must safeguard the confidentiality of their internal communications links in order to prevent espionage and undesired manipulation of data. This is especially important when parts of the communications links are established over long distances, as is the case for organizations with geographically dispersed sites, and for networking within a large campus. In such cases, the R&S®SITLine ETH's flexibility and variability are highly beneficial because all devices are interoperable. Depending on the site to be integrated, the optimal device can be selected based on criteria such as the required transmission capacity, the number of connections that are needed and the environmental characteristics. From the encryption of individual lines or applications to the safeguarding of complex structures, interoperability allows the security solution to scale with the network. This provides long-term investment protection for users.

Safeguarding radio relay and satellite links (SatCom)

Precise, timely information is necessary for strategic command and control of forces in the field. Situation reports with image and video material often need to be transmitted over long distances. Radio relay and SatCom links are used to connect field units to a central station (e.g. control center, headquarters), which in many cases might even be on a different continent. In order to ensure information superiority, the data must be protected against manipulation, and it must not fall into the hands of third parties – reason enough to use strong encryption. However, the encryption must not place any additional load on the already very narrow bandwidth of the radio relay or SatCom link.

Especially scenarios with narrow bandwidths make the R&S®SITLine ETH design advantages clear: The R&S®SITLine ETH requires significantly less protocol information (overhead) to provide encrypted transmission than is required for classic IP encryption. Despite throughput limitations, the information is protected against eavesdropping and manipulation during the entire radio relay transmission or during satellite hops.

R&S®SITLine ETH1G.

For more information on securing satellite networks, see application brochure PD 3606.8189.92 and www.rohde-schwarz.com.

Securing rail control and monitoring networks
Public transport networks are managed in central control centers, which receive information from transport hubs (e.g. railway stations, signal boxes) that may be unattended. Automation enables tighter scheduling of trains and greater punctuality. However, unattended transport hubs require a higher level of protection against manipulation, especially when they are connected to the control center over public networks. In such cases, cryptographic functions can safeguard the integrity of the transmitted data. Special R&S®SITLine ETH models are available for use in more challenging environments (e.g. extended temperature range, installation with top-hat rail/DIN rail, external emergency erasure).

For more information on securing rail control networks, see application brochure PD 3606.6505.92 and www.rohde-schwarz.com.

Secure interconnection of data centers and storage area networks (SAN)
Central corporate data centers often feature a redundant design. These centers must be securely interconnected via high-performance lines. The state-of-the-art transmission technology for this application is Ethernet services with a transmission capacity of at least 100 Mbit/s, and typically several Gbit/s. The R&S®SITLine ETH can be scaled for connections in the Mbit/s and Gbit/s ranges. In addition, the multiport version of R&S®SITLine ETH can be used to efficiently safeguard dedicated Ethernet lines that are connected in parallel.

The R&S®SITLine ETH protects rail control and monitoring networks.

Low system costs

Compared with other encryption solutions, Ethernet carrier services protected by the R&S®SITLine ETH make it possible to reduce operating costs significantly while maintaining a high level of security.

Minimal investment for installation and configuration
The R&S®SITLine ETH integrates into a network in a fully transparent manner. Except for the security parameters, no other network-specific configuration steps are required. As a plug&play technology, Ethernet requires almost no configuration effort to get started. That saves installation time and expense.

Low space and energy costs
The compact design, low module height and different device classes make it possible to save both installation space and energy. The multiport device provides the functionality of up to four devices while consuming only the space and power of a single device. The option of safeguarding up to four physical lines with a single device is unique worldwide.

Lower transmission costs than with managed IP
The significantly lower overhead for Ethernet encryption improves the net-to-gross transport ratio. Depending on the traffic profile and the selected security functions, the net payload rate only drops by 0% to 13% when using Ethernet encryption. For the sake of comparison: An IPsec-secured L3 VPN reduces the net payload rate by as much as 60%.

Low maintenance and service requirements
Ethernet operates independently of the logical IP network structures. This eliminates the need for adaptations when integrating new applications, changing providers or migrating of higher-level network protocols (e.g. from IPv4 to IPv6). Experience has shown that, due to the long update and upgrade cycles, the service costs for layer 2 systems are significantly lower than for other solutions.

Bandwidth efficiency through group encryption (multipoint approach)
Classic encryption systems (such as IPsec) establish multiple dedicated connections between the encryption devices, which are each secured using a separate key. Data that is meant for more than just one site (e.g. video conference data) must be duplicated and then sent to the different sites via individual connections.

For such applications, the R&S®SITLine ETH has been equipped with innovative group encryption functionality. This approach employs the multicast capabilities offered by advanced carrier networks without compromising the level of security for the transmitted data. Regardless of the number of recipients, the data is encrypted and transmitted only once; the carrier or network distributes the data.

No need for central or internal key servers

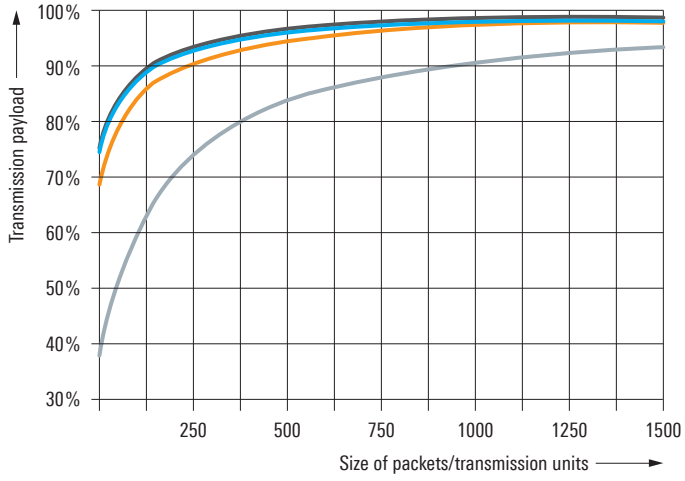
The R&S®SITLine ETH devices employ fully automatic processes to negotiate the session keys required for operation and to distribute them securely to the authorized communications partners. No dedicated encryption key servers are required. Failure of one device has no influence on the operation of the rest of the network, because partner devices find each other automatically and regularly re-establish secure links.

R&S®SITScope, the central security management system for R&S®SITLine ETH (see page 213), is primarily required for installation and monitoring. Once operational, the R&S®SITLine ETH devices organize the encryption on their own without any additional components.

Better transmission performance than with IPsec

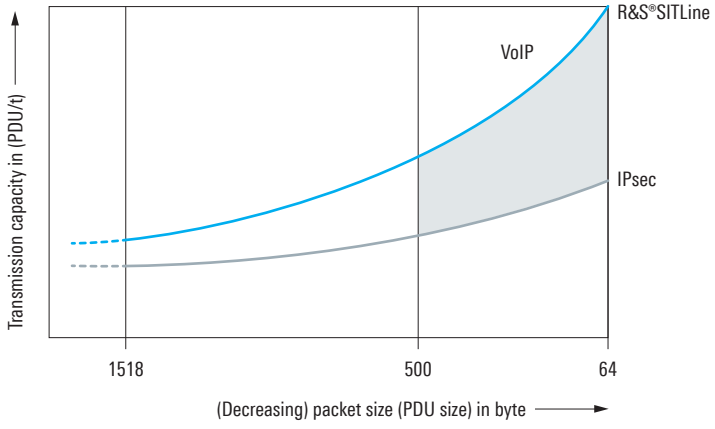
The R&S®SITLine ETH's reduced overhead has a positive effect on transmission quality. This becomes especially clear when using services that employ small packet sizes, such as voice over IP. The shorter response times and lower latencies noticeably improve service quality compared with connections secured with IPsec. It is also possible to establish a higher number of VoIP connections.

Net payload rate (capacity utilization)



For a medium-sized packet of 250 byte, the R&S®SITLine ETH offers a significantly higher net payload rate than IPsec encryption:
R&S®SITLine ETH: > 90 % (L2 encryption)
IPsec encryption: 75 %

Transmission performance: Ethernet and IPsec encryption



Transmission performance for Ethernet encryption (layer 2) compared with IPsec encryption (layer 3):
Using the R&S®SITLine ETH to provide security offers clear advantages, especially for applications with small packet sizes, such as voice.

Professional, certified security

Ethernet is a well-established, universal standard for wireline and wireless data transmission. However, it does not protect the confidentiality or integrity of the transmitted data. The R&S®SITLine ETH provides significantly more efficient and effective protection than other solutions. It has been approved by the German Federal Office for Information Security (BSI) for handling classified documents up to the German restricted ("VS-NfD") level.

Securing point-to-point Ethernet lines and Ethernet VLANs

The R&S®SITLine ETH was developed in compliance with the Metro Ethernet standard and is able to encrypt point-to-point Ethernet lines referred to as Ethernet private lines (EPL). With this approach, two encryption devices communicate directly with one another using either transport or tunnel mode. The transport mode only encrypts the payload data (e.g. the IP packet) and leaves the Ethernet address information unchanged. In tunnel mode, all traffic – including addresses – is encrypted and then sent as payload data in new Ethernet packets.

In scenarios in which two devices are directly interconnected without a switch, R&S®SITLine ETH100 devices and R&S®SITLine ETH1G devices can be operated in bulk mode. Bulk mode encrypts all Ethernet packets (including address information) without adding overhead, which offers a higher degree of confidentiality while maintaining maximum data throughput.

When a central site needs a secure network connection to multiple remote sites in a star topology, the R&S®SITLine ETH can, based on the VLAN that is being used, allocate the Ethernet traffic to a corresponding R&S®SITLine ETH. This requires the network provider to offer multiple Ethernet virtual private lines (EVPL) that can be encrypted in a VLAN-specific way using the R&S®SITLine ETH.

Innovative group encryption for multicast topologies (ELAN)

In fully meshed Ethernet local area networks (ELAN), classic encryption obstructs the carrier network's multicasting capabilities by establishing dedicated paths between the encryption devices. Videos and other live streams that are meant for multiple recipients and are transmitted via multicast have to be duplicated prior to transmission and then encrypted individually for each recipient.

In this kind of environment, the R&S®SITLine ETH can be employed for group encryption of the network traffic – without affecting the multicasting capabilities. The security level is identical to that of classic encryption over dedicated channels, because – despite grouping – each R&S®SITLine ETH device continues to use its own session key for the outgoing network traffic.

In addition, group encryption takes any MPLS network into consideration that is present. The MPLS labels that are required in plain form for routing (which are normally part of the encrypted payload data) are detected and then transmitted without encryption.

Secure authentication

The R&S®SITLine ETH uses the following technologies and standards to ensure secure authentication:

- Asymmetric cryptography using elliptic curves with a 257-bit key (roughly corresponds to a 3200-bit RSA key)
- X.509 v3 certificates for persons and equipment
- Secure storage and transport of confidential parameters using smart card technology

Secure authentication of the users based on individual device certificates precedes each link setup. A unique set of keys is generated for each management connection and for each data connection that is to be secured.

Key agreement is performed in accordance with the Diffie-Hellman process. For key generation, the R&S®SITLine ETH uses a hardware-based random number generator that is certified in accordance with Common Criteria EAL4+.

R&S®SITLine ETH50.

Automatic operation of encrypted links

The device certificates determine which partners are authorized to establish a connection. Secure links are set up with each authorized communications partner and then monitored from end to end to ensure that they are working without error. Expired device certificates and session keys are renewed automatically. Secure connections are re-established automatically when changes are made in the network configuration. This rules out the possibility of unintentional or unnoticed communications taking place via unencrypted links.

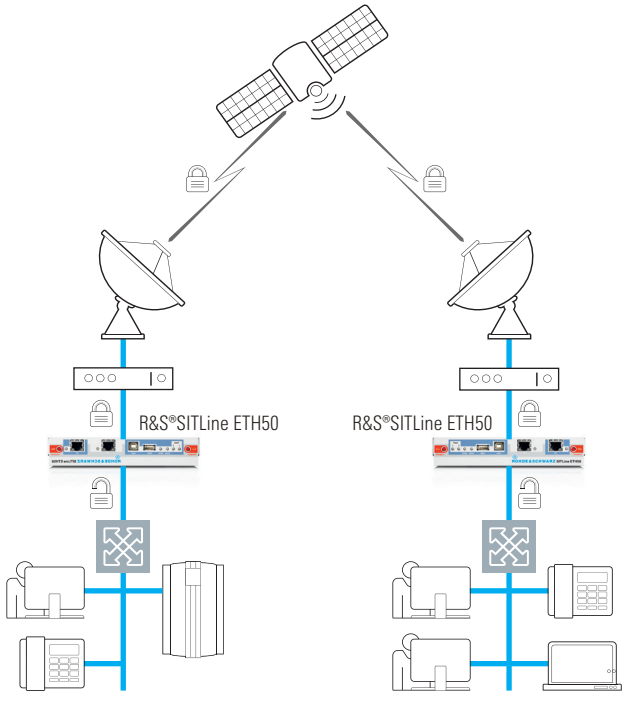
Flexible encryption hardware

The system employs symmetric algorithms (AES 256) that are integrated into high-performance hardware. Special customer requests regarding the cryptographic method can be taken into account upon request.

Manipulation-proof devices

The R&S®SITLine ETH features not only cryptographic core functions but also an intricate system of mechanical and electromechanical security functions. This includes layered security zones, protected memory, protection mechanisms against mechanical manipulation, and other security functions for counteracting attempts to steal or manipulate encrypted confidential information.

Automatic setup and operation of secure links



The R&S®SITLine ETH is preconfigured before it is sent to the operating site. On startup, it automatically sets up encrypted L2 links. The same applies to backup devices.

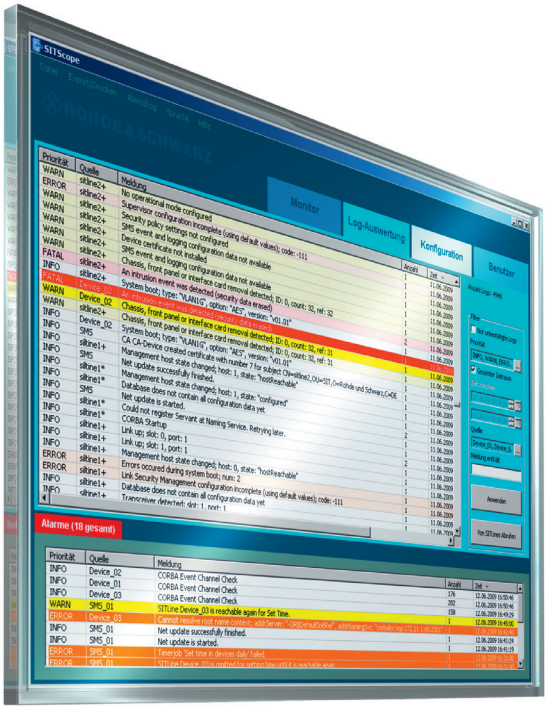
Central security management over the network

R&S®SITScope is the security management system for the R&S®SITLine ETH Ethernet encryptor. R&S®SITScope is based on a client-server architecture and is available as a pre-installed appliance or as separate software for Windows. Smart cards that have been integrated into USB tokens are used to ensure secure handling of user and device certificates.

Online, convenient and secure

The R&S®SITScope server acts like the certificate authority (CA) in a public key infrastructure and is operated in a secure environment (computer center with access control). The client runs on the administrators' workstation computers. Communications between server and client and between server and encryption device take place via TLS/SSL-secured links. R&S®SITScope communicates with the R&S®SITLine ETH via the network that is to be encrypted (in-band) or via a dedicated management network (out-of-band).

A central network plan is generated in R&S®SITScope for configuring the R&S®SITLine ETH encryption devices. This network plan contains device parameters (e.g. IP addresses for device management), the devices' operating modes (e.g. bulk and VLAN) and the communications relationships between the devices (encrypted/unencrypted). The device certificates and their private keys are generated and distributed to R&S®SITLine ETH devices in accordance with the network plan.



The R&S®SITScope security management system is available to administrators for configuring security-relevant settings on the R&S®SITLine ETH.

After the R&S®SITLine ETH has been initialized once using a USB device token, it is available online for all management tasks. Whether they need to reconfigure settings, change a certificate or update firmware – with R&S®SITScope, administrators can accomplish all management tasks from their workstation.

Should any R&S®SITLine ETH devices be stolen, or even compromised, R&S®SITScope adds them to certificate revocation lists (CRL) which are published online in the network. R&S®SITScope is only required for managing the individual devices; during operation, the R&S®SITLine ETH determines the session key itself independently of R&S®SITScope.

Virtualization capability and high availability

If R&S®SITScope is procured as software, the server can also be run in virtual environments (Virtual Box, VM Ware). To ensure hardware security, R&S®SITScope uses a smart card that has been integrated into a USB stick. This root token is used to securely generate and apply the secret upon which the keys are based and must be constantly available on the server during operation.

By employing redundant instances, it is also possible to achieve high availability for R&S®SITScope operations. The network plan and device parameters are synchronized between these instances.

After activation, each R&S®SITLine ETH device searches independently for a path to the R&S®SITScope server. This is accomplished using IP protocols (layer 3) on all available network connections and by querying partner devices via Ethernet (layer 2) for possible R&S®SITScope instances. Should a management connection fail during operation, the R&S®SITLine ETH searches independently and automatically for alternative connections ("self-healing").

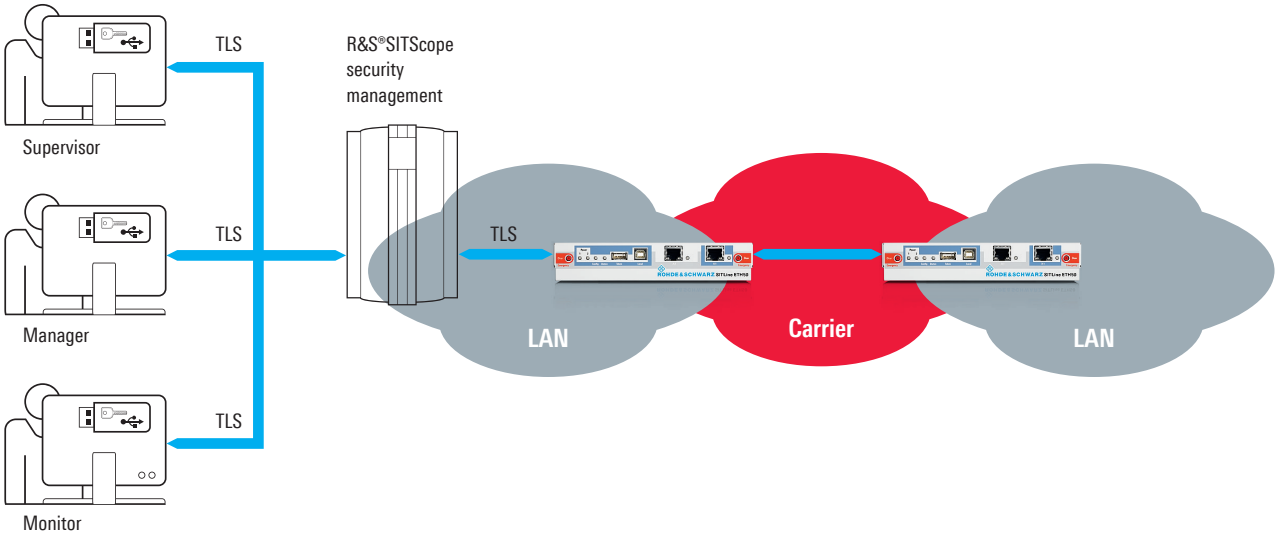
Clearly defined roles

R&S®SITScope offers the possibility of using roles to assign, manage and seamlessly log clearly defined administrator rights. Roles are bound to specific USB user tokens and the related certificate, making it impossible to abuse or manipulate rights. There are supervisor, manager and monitor roles available.

A supervisor is allowed to configure fundamental security management settings and functions and manage user accounts. Supervisors do not manage devices. Managers are responsible for configuring and monitoring the R&S®SITLine ETH devices. Managers are not able to manage user accounts. Monitors are only allowed to monitor the operating status; they cannot make any changes.

Unauthorized access to the independent, closed security management functionality is not possible.

Security management



Administrators can conveniently configure the security parameters for all devices from their own workstation via the network.
They only need their USB user token to authenticate themselves to R&S®SITScope. R&S®SITLine ETH100/R&S®SITLine ETH1G also have ports for a separate management network (outband).

Central point for log files and audits

R&S®SITScope collects all log information from the individual R&S®SITLine ETH devices and stores this data until it is confirmed by an administrator. R&S®SITScope offers professional audit capabilities for summarizing and analyzing the processes that take place on different R&S®SITLine ETH devices. In addition, log information can be passed on from R&S®SITScope to Syslog servers in the network.

SNMP-based network management

Network settings on R&S®SITLine ETH devices can be configured using the simple network management protocol (SNMP). Furthermore, the devices offer detailed data for monitoring as well as extensive diagnostic capabilities via SNMP using any SNMP browser or the R&S®SITLine Admin program delivered with the R&S®SITLine ETH.

Support of SNMP v1, v2c and v3

Network-relevant settings on the R&S®SITLine ETH encryption devices are configured via the network management. This includes basic configuration settings, such as the Ethernet connection speed and duplex behavior. Extended configurations are also possible, such as Ethernet operation and maintenance (OAM) or preset VLANs for network searches. The necessary user identification is accomplished using community strings when SNMP v1/2c is used. With SNMP v3, the log-in details (user name/password) are set and verified securely.

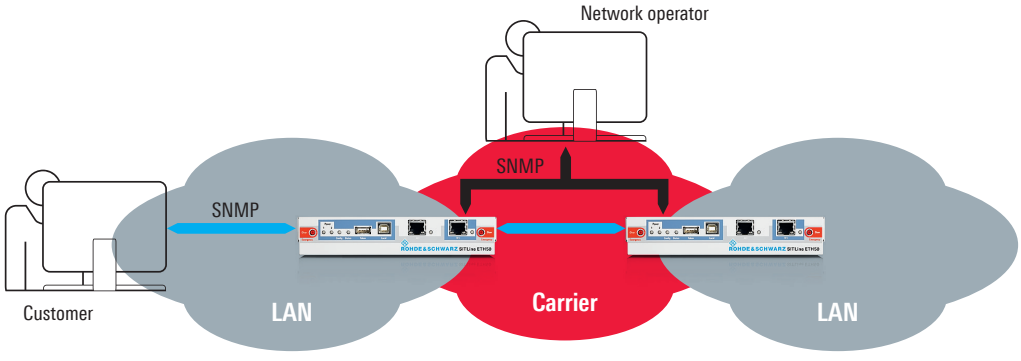
Extensive monitoring and diagnostic capabilities

Each R&S®SITLine ETH device provides extensive statistics that can be called up via SNMP, such as the number of encrypted/unencrypted Ethernet frames transmitted. If Ethernet frames have been blocked because they were redundant (replay attacks), this is also recorded. The R&S®SITLine ETH uses traps (SNMP v1) or notifications (SNMP v2c/3) to actively inform the SNMP network management about network events. For troubleshooting, loopback diagnostics can be performed for every port (using quick payload diagnostics or long inward diagnostics).

Network management through service providers

For security management using R&S®SITScope and for SNMP-based network management, separate IP addresses can be assigned to each encryption device. Network management can also be accomplished from the carrier network. This permits the use of outsourcing models in which a service provider can reach the R&S®SITLine ETH for network management via SNMP, although the entire security functionality remains under the customer's direct control.

SNMP-based network management



In order to configure network settings and query status information, SNMP is used either within the local network (blue arrows) or from the carrier network (black arrows). Administrators and service providers authenticate themselves to the R&S®SITLine ETH using SNMP community strings or SNMP credentials. Security settings remain unaffected.

Product overview

Designation	Type
R&S®SITLine ETH50, half-rack format (7.5"), 1 HU	
Ethernet encryptor, 1 line, 25 Mbit/s	R&S®SITLine ETH50-25
Ethernet encryptor, 1 line, 50 Mbit/s	R&S®SITLine ETH50-50
Ethernet encryptor, 1 line, 100 Mbit/s	R&S®SITLine ETH50-100
R&S®SITLine ETH100, rack format (19"), 1 HU	
Ethernet encryptor, 1 line, 100 Mbit/s	R&S®SITLine ETH100-110
Ethernet encryptor, 2 lines, 100 Mbit/s	R&S®SITLine ETH100-210
Ethernet encryptor, 4 lines, 100 Mbit/s	R&S®SITLine ETH100-410
R&S®SITLine ETH1G, rack format (19"), 1 HU	
Ethernet encryptor, 1 line, 1 Gbit/s	R&S®SITLine ETH1G-110
R&S®SITLine device token (one token required per device)	
Device token, USB/smart card	
R&S®SITScope, security management	
Set consisting of software and tools on CD (server and client software, R&S®SITLine Admin, R&S®SITLine Terminal), USB tokens (3 root tokens, 2 supervisor tokens, 2 manager tokens), USB cable (type A to B)	R&S®SITScope Set
R&S®SITScope Set, pre-installed on server hardware	R&S®SITScope Appliance
Accessories for R&S®SITLine ETH50	
USB cable (type A to B), for local initialization	
External power supply for R&S®SITLine ETH50, 110 V to 240 V, 50/60 Hz	
Accessories for R&S®SITLine ETH100/R&S®SITLine ETH1G	
Electric SFP transceiver (10/100/1000BaseT) for R&S®SITLine ETH100 and R&S®SITLine ETH1G	
Optical SFP transceiver (1000BaseSX) for R&S®SITLine ETH1G	
Optical SFP transceiver (1000BaseLX) for R&S®SITLine ETH1G	
Accessories for R&S®SITScope	
Manager token, USB/smart card	
Root token, USB/smart card	
Supervisor token, USB/smart card	

R&S®SITGate Next-Generation Firewall

The R&S®SITGate is a multifunctional, next-generation firewall that uses the latest technology for analyzing data traffic at very high speed. The firewall blocks hazardous or unauthorized use and warns of attacks and abuse.

The R&S®SITGate is a next-generation firewall featuring advanced single-pass technology. The innovative deep packet inspection of incoming and outgoing network traffic protects against current and future threats, without neglecting rising performance requirements. This is made possible by running the decoded data stream through a series of security checks that are bundled on multiple levels.

Current IT threats are not only highly complex – they change practically every day. The emergence of layer 7 malware and rapidly transforming threats render most conventional network security solutions useless. It is no longer possible to protect networks effectively with conventional IP and port-based firewalls. Simple intrusion prevention systems can no longer keep pace with the technical development of evasive malware, which is sometimes hidden deep within legitimate layer 7 applications.

R&S®SITGate L500.

R&S®SITGate M series.

R&S®SITGate S series.

Today's business processes require a variety of applications that often have to communicate with business sites and mobile users that are very far away. Modern Web 2.0 applications increase customer proximity and the productivity of many companies, but also provide attack vectors for malware. This can also interfere with staff productivity.

Key facts

- Next-generation firewall with deep packet inspection, intrusion prevention and malware protection
- Context-based protocol analysis for uncovering threats posed by botnets, Web 2.0 applications and zero-day attacks
- Complete TCP reassembly even detects hidden attacks on encrypted connections
- Powerful VPN concentrator for secure connection of external sites and mobile users
- Seamless integration in Active Directory and LDAP makes it possible to create user-specific rules

Benefits and key features

Maximum security despite growing threats

- More secure than stateful firewall and more effective than unified threat management
- Comprehensive application detection and continuous protocol validation, even for encrypted connections
- Powerful malware protection
- Intrusion prevention system (IPS) with daily updates

Simple implementation of security guidelines in existing infrastructures

- Seamless integration into Active Directory and LDAP [1] directories
- Precise application of organizational guidelines for stringent Internet access
- Secure integration of remote locations, mobile users and cloud services

Advanced single-pass technology made in Germany

- Content-based and context-specific screening of each connection
- Decoding of all major application protocols
- Data leakage prevention
- IT security made in Germany

[1] Lightweight directory access protocol.

Maximum security despite growing threats

More secure than stateful firewall and more effective than unified threat management

The idea of the next-generation firewall incorporates all UTM [2)] technologies to create a unified and consistent screening method on all levels. This minimizes the danger of conflicting configurations and unknown threats. The various compatible screening methods simplify administrative tasks and increase network throughput.

Comprehensive application detection and continuous protocol validation, even for encrypted connections

The application detection feature implemented in the R&S®SITGate analyzes network traffic and detects hundreds of network applications with the greatest possible accuracy and maximum throughput rate. Even applications such as BitTorrent® and Skype®, which communicate via encrypted connections, are detected and can be allowed or blocked.

The various communications protocols undergo constant validation. Connections showing protocol violations are blocked immediately. The R&S®SITGate is therefore also able to protect against potential attacks that exploit zero-day security gaps.

Powerful malware protection

Downloaded documents and files are constantly screened for malware using protection based on Bitdefender® anti-malware technology. The screening is already performed in the data stream, so there are no file size restrictions.

Intrusion prevention system (IPS) with daily updates

The R&S®SITGate currently has a database containing over 9000 decoder-based IPS signatures that are updated on a daily basis.

[2)] Unified threat management.

Simple implementation of security guidelines in existing infrastructures

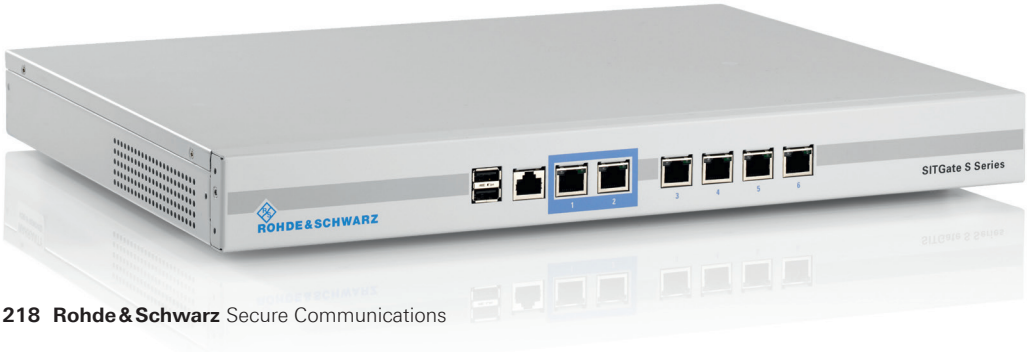
Seamless integration into Active Directory and LDAP directories

External and internal users are identified by their IP addresses. For the sake of simplicity, security guidelines can be implemented by specifying user names or groups, since the R&S®SITGate accesses internal directories such as Active Directory or other LDAP-compatible directory services.

Precise application of organizational guidelines for stringent Internet access

The web filter integrated in the R&S®SITGate contains millions of well-known and categorized websites. Access to these sites is controlled by the user name or group membership.

The R&S®SITGate provides a port-based and IP-based stateful firewall, which is complemented by comprehensive application detection. This allows security guidelines to be implemented in a highly detailed way for each user or group. (Example: “Marketing department may view but not post to Twitter.“) Whitelisting and blacklisting are also supported.



The R&S®SITGate protects against current and future threats.

Secure integration of remote locations, mobile users and cloud services

The R&S®SITGate terminates incoming VPN connections. The resulting data traffic is treated as a separate security zone, which allows other security guidelines to be applied.

Secure TLS/SSL[3] connections such as HTTPS can be analyzed even though they are encrypted. This exposes potential threats or even unauthorized data leaks that exploit encrypted connections.

Advanced single-pass technology made in Germany

Content-based and context-specific screening of each connection

The R&S®SITGate is built with future-oriented single-pass technology that runs network traffic through several security checks that screen both the content and the context of the connection. Single-pass technology has been implemented in the R&S®SITGate with a high degree of parallelism. The maximum configuration can process several million connections simultaneously.

[3] Transport layer security/secure sockets layer.

Decoding of all major application protocols

Single-pass technology uses the most advanced deep packet inspection method, which detects hundreds of applications and can decode a great variety of different protocols. The connection can be examined closely for all important applications. Traffic is screened rigorously for malware and undesirable content.

The protocol decoders make it possible to forgo complex sets of rules and excessive use of regular expressions. This results in better performance and greater transparency for administrative tasks. False positives and false negatives are minimized.

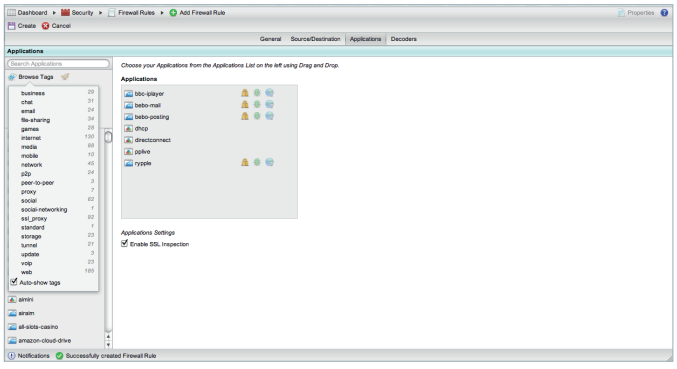
Data leakage prevention

The R&S®SITGate provides maximum protection against unwanted data leaks because it is able to block the entire flow of network traffic and connections originating from unknown activities.

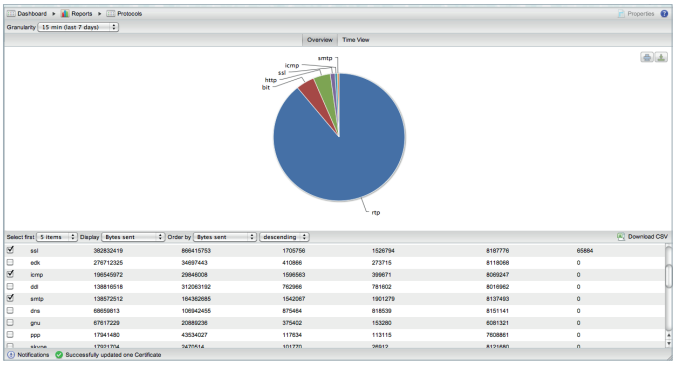
IT security made in Germany

For more than 20 years, the name Rohde&Schwarz SIT GmbH has been synonymous with encryption and IT security. The company is the security partner of the Federal Republic of Germany and provides its customers around the world with innovative solutions for protecting their information and telecommunications equipment.

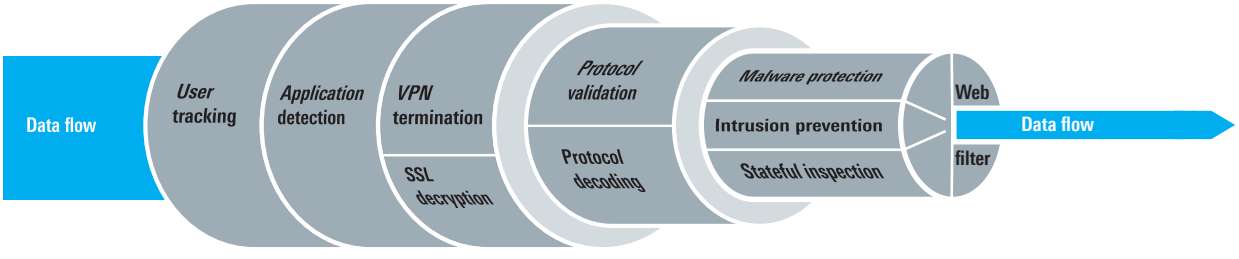
Security guidelines can be adapted to specific applications in a highly granular fashion.



R&S®SITGate reporting feature.



Single-pass technology checks data traffic on various levels in near realtime speed



Product overview

Designation	Type
S series	
Base unit, 6 × 1 Gigabit Ethernet	R&S®SITGate S100 Base Unit
Full protection, one year	R&S®SITGate S100 FP1Y
Full protection, three years	R&S®SITGate S100 FP3Y
M series	
Base unit, 9 × 1 Gigabit Ethernet	R&S®SITGate M200 Base Unit
Full protection, one year	R&S®SITGate M200 FP1Y
Full protection, three years	R&S®SITGate M200 FP3Y
Base unit, 9 × 1 Gigabit Ethernet	R&S®SITGate M400 Base Unit
Full protection, one year	R&S®SITGate M400 FP1Y
Full protection, three years	R&S®SITGate M400 FP3Y
L series	
Base unit, 16 × 1 Gigabit Ethernet	R&S®SITGate L500 Base Unit
Full protection, one year	R&S®SITGate L500 FP1Y
Full protection, three years	R&S®SITGate L500 FP3Y
Base unit, 12 × 1, 2 × 10 Gigabit Ethernet	R&S®SITGate L800 Base Unit
Full protection, one year	R&S®SITGate L800 FP1Y
Full protection, three years	R&S®SITGate L800 FP3Y

TopSec Mobile Secure Voice Encryption

The TopSec Mobile is a mobile encryption device for secure worldwide VoIP-based communications on smartphones and laptops.

The TopSec Mobile securely encrypts voice communications end-to-end on IP-based communications networks and on BGAN and Thuraya satellite links. Users access these communications networks with the TopSec Mobile connected to smartphones and laptops via Bluetooth®.

The TopSec Mobile is easy and intuitive to operate using apps that are available for the most widely used operating systems. Because the TopSec Mobile is a smartphone-independent encryption device, it cannot be manipulated by malware.

Key facts

- Encryption device offering maximum security
- For flexible connection to smartphones and laptops via Bluetooth®
- Intuitive operation thanks to easy-to-use apps
- Universal VoIP encryption via mobile radio, Internet and satellite connections

Benefits and key features

Versatile

- Bluetooth® interface for connection to smartphones and laptops
- USB cable connection to laptops
- TopSec Phone app for smartphones and laptops
- Connection to IP networks via smartphones, laptops or satellite terminals
- Call setup over public or private VoIP servers

TopSec encryption concept

- Method for maximum security
- Key agreement with elliptical curves, 384 bit
- Certificate-based authentication
- Voice encryption using the Advanced Encryption Standard (AES) 256-bit key

Available models and software

- TopSec Mobile encryption device
- TopSec Phone app for iPhone
- TopSec Phone app for Android smartphones
- R&S®VoIP-SERVER S110

Telephone as usual: For a secure call, simply hold the TopSec Mobile to your ear.

Versatile

Bluetooth® interface for connection to smartphones and laptops

The TopSec Mobile is a highly versatile voice encryption device in terms of its ability to connect to communications terminal equipment and networks. With its Bluetooth® interface, it provides a dependable wireless connection to communications terminal equipment such as smartphones and laptops.

Users can make confidential calls either directly with the TopSec Mobile or with a headset (included); the calls are encrypted and decrypted in the TopSec Mobile. The voice data sent from and to the TopSec Mobile is already secured to the highest possible level while it is transmitted via the Bluetooth® interface.

USB cable connection to laptops

As an alternative to the wireless Bluetooth® interface, the TopSec Mobile can be connected to a laptop via a USB cable. This enables users to set up an encrypted connection to an IP network in surroundings where a wireless connection is undesirable.

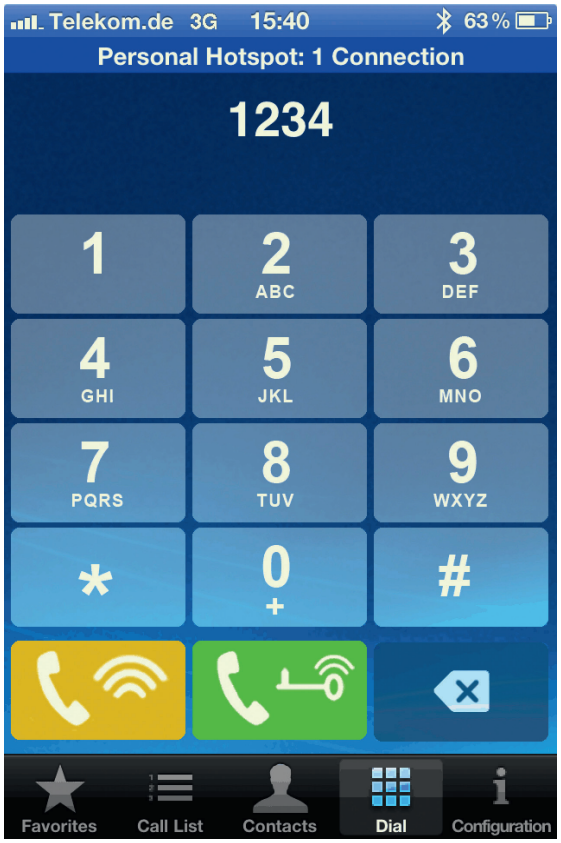
TopSec Phone app for smartphones and laptops

The TopSec Mobile can be used with advanced smartphones and laptops. Users choose the numbers of the persons they want to call from a contact list on their smartphone or laptop. They do this with the TopSec Phone app. TopSec Phone can be used to make unencrypted VoIP calls directly with the smartphone as well as encrypted VoIP calls over the TopSec Mobile.

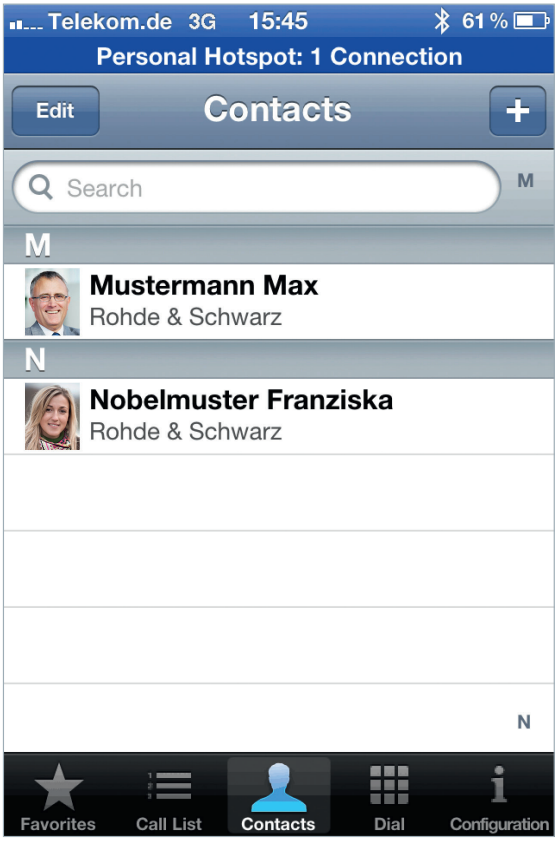
Users accept encrypted VoIP calls directly on the TopSec Mobile. The encryption and decryption is carried out in the TopSec Mobile itself, without involving the smartphone or laptop. When making secure calls, users talk and listen through the TopSec Mobile's own microphone and speaker. This prevents possible manipulation by malware.

TopSec Phone also supports unencrypted VoIP. Users can access the full feature set available on their smartphone or laptop, and can simply choose secure calls when they wish.

The dialer interface for Internet telephony: The green call button sets up an encrypted call with the TopSec Mobile; the yellow call button is for unencrypted VoIP calls.



The TopSec Phone contact list.



Connection to IP networks via smartphones, laptops or satellite terminals

Users connect to IP networks via the communications terminal equipment. Smartphones provide wireless access to UMTS networks and WLANs. Laptops generally have a LAN port in addition to enable a wireline connection to IP networks. With the TopSec Mobile, users are also able to encrypt communications via BGAN and Thuraya IP satellite terminals.

Call setup over public or private VoIP servers

To place and receive VoIP calls, users must be registered on VoIP servers. The TopSec Mobile can set up encrypted connections using two common signaling protocols, SIP and IAX2. It works both with public SIP servers and with the R&S®VoIP-SERVER S110. The R&S®VoIP-SERVER S110 is especially suited to user groups with special security requirements who prefer to operate their own VoIP server.

TopSec encryption concept

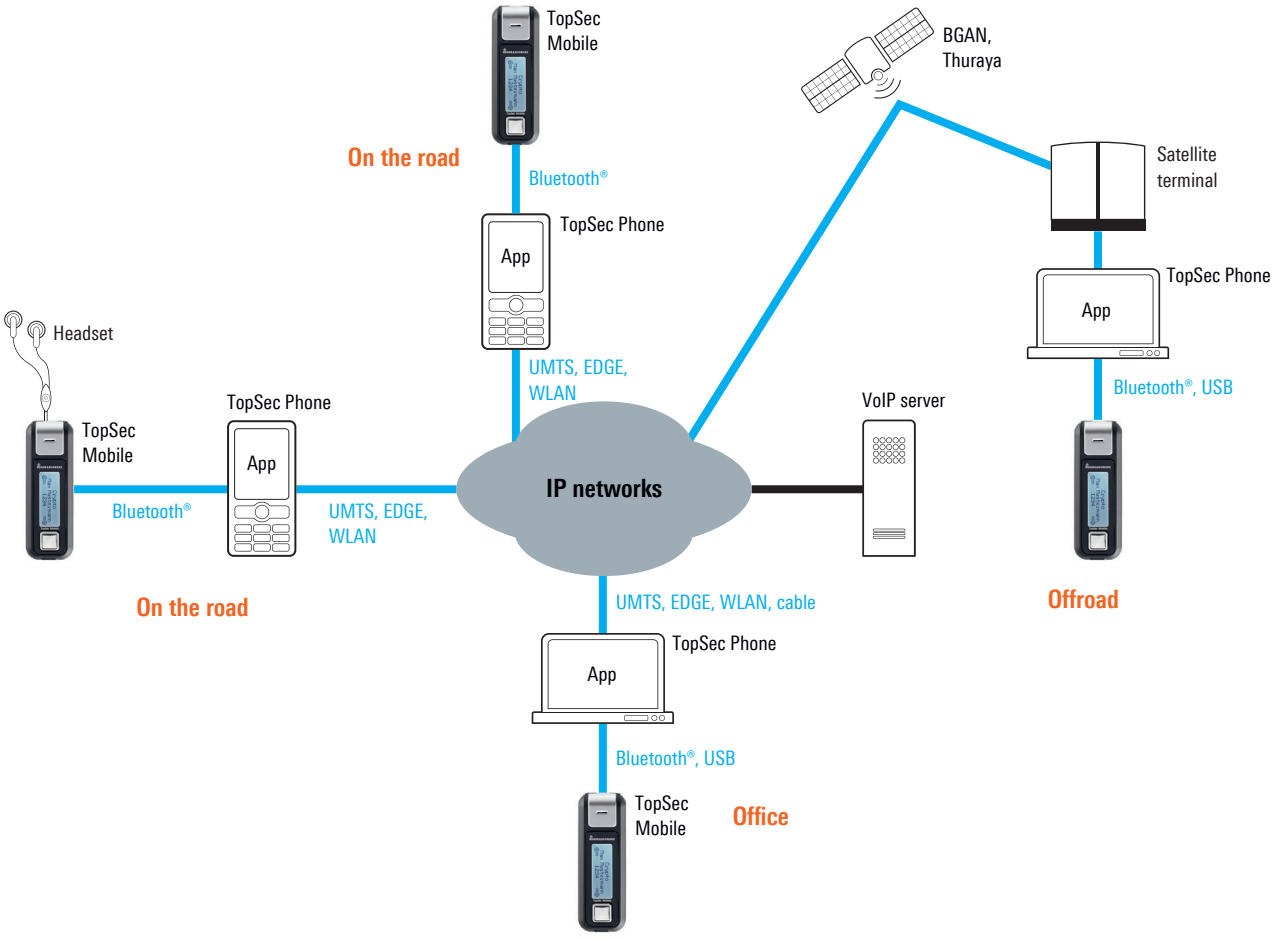
Method for maximum security

Encryption in the TopSec Mobile is based on a hybrid process to achieve the highest level of security. This method requires that the partner encryption devices have the same mathematical parameters and that they use identical algorithms.

Key agreement with elliptic curves, 384 bit

The Diffie-Hellman key agreement protocol enables encrypted communications between two partner encryption devices without the need for central administrative services. This is referred to as an open system, because it is possible to establish a secure crypto connection with other TopSec Mobile encryption devices without the need for certificate-based authentication. The session key "K" calculated by the two partner encryption devices is used by the symmetric algorithms to encrypt or decrypt the digitized and compressed voice information.

Voice encryption with the TopSec Mobile



This open system uses a four-digit security code to prevent man-in-the-middle attacks. A new code is calculated on both TopSec Mobile encryption devices for each encrypted call and is displayed on the TopSec Mobile's built-in screen. When the security codes are identical, a secure call is established.

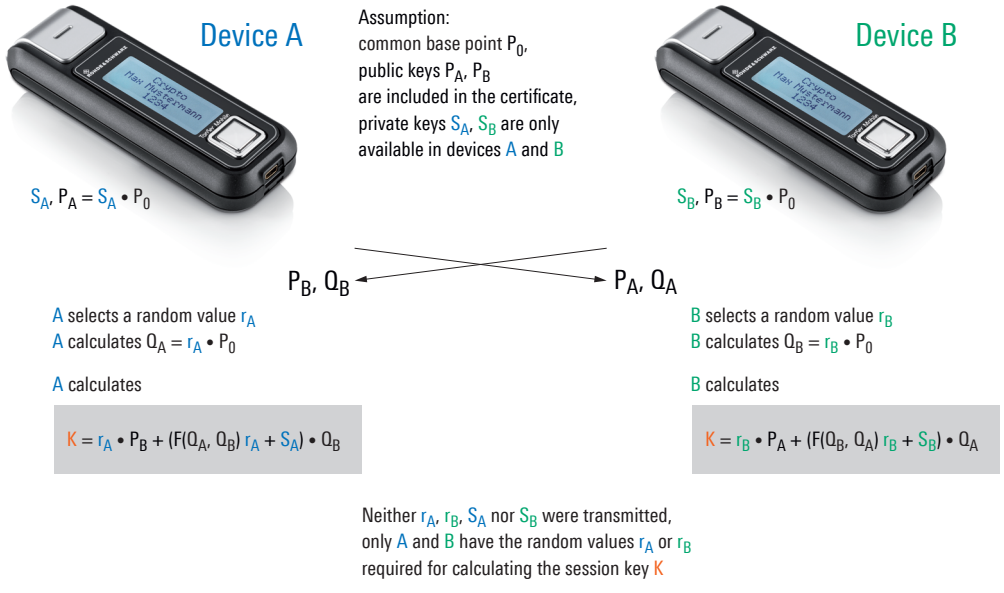
Certificate-based authentication

Another measure to prevent man-in-the-middle attacks is to create closed user groups. This requires the TopSec Administrator, which combines the functions of a trust center with the centralized administration of operational parameters. During an initialization process, the TopSec devices receive a certificate and generate a public key pair that is used for authentication. In closed systems, authentication between the TopSec encryption devices takes place automatically. An encrypted connection is only established if authentication is successful. Consequently, calls made using the TopSec encryption devices meet the highest security requirements.

Voice encryption using the Advanced Encryption Standard (AES) 256-bit key

The TopSec Mobile and the partner encryption device automatically agree on a new 256-bit key during each call setup. A key is randomly selected from a pool of 10^{76} possible keys and then deleted immediately upon completion of the call.

Combined key agreement and authentication



Product overview

Designation	Type
Voice encryption device	TopSec Mobile
App for Android	TopSec Phone for Android
App for iPhone	TopSec Phone for iPhone
VoIP server	R&S®VoIP-SERVER S110
Administrator software	TopSec Admin

Appendix
Service and support

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Rohde & Schwarz worldwide

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At company headquarters in Munich, around 2500 employees work in research and development, central sales and service, marketing and administration.

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Contact

Sales
For the addresses of the local sales companies in more than 70 countries, visit www.sales.rohde-schwarz.com

Customer support – worldwide live support
Whatever problem you have, our support center is there to help you. Your question will be dealt with fast and in detail. There are three support centers in three different time zones: Munich, Washington and Singapore. Support is available 24 hours a day, Monday through Friday excluding public holidays. The staff of our support center is optimally trained to assist you in solving your problems. Our regional support centers will be glad to answer any questions regarding our products and service:

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info@swissqual.com

Home

Service you can rely on

Contractually assured services

Rohde&Schwarz offers full-range service at your command. You can mix and match our services according to your technical and budgetary requirements.

Service contracts

As the original equipment manufacturer (OEM), we provide the most qualified, responsive and thorough service available. Customer care is especially important to us. We support you with services tailored to your needs:

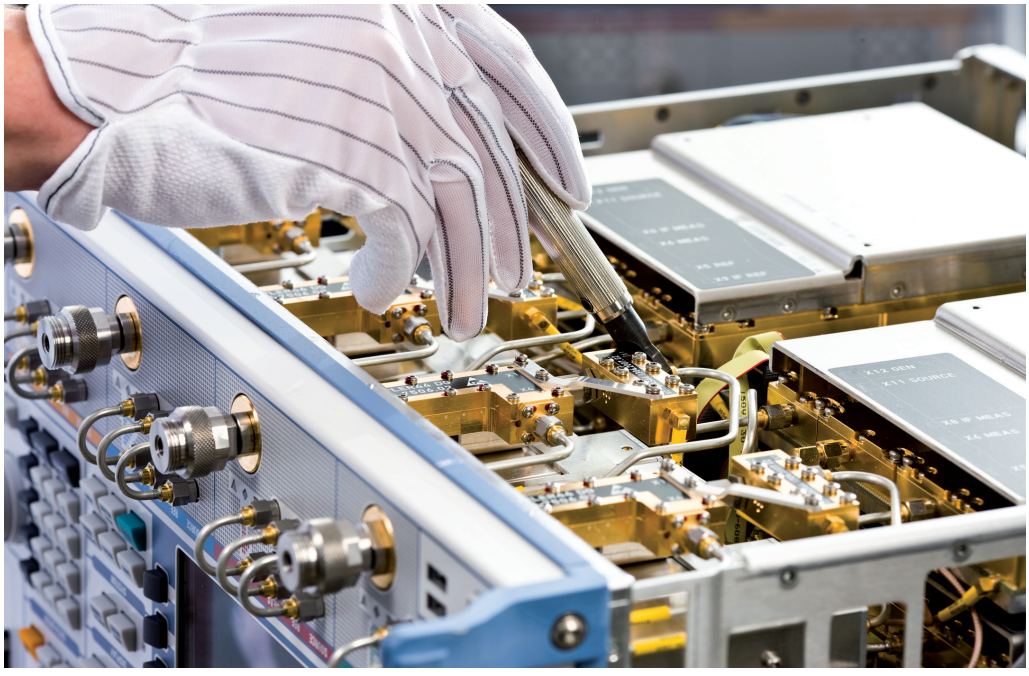
- Short and reliable turnaround times
- Efficient logistics for pickup and return of your equipment
- High spare-part availability
- Flexible adjustment of terms during the contract period
- Services tailored to your needs

Service options

Service options are powerful service contracts that are offered exclusively when you purchase a new product. Taking advantage of a service option ensures optimum performance and availability of your Rohde&Schwarz product at low, predictable operating costs.

Asset management

Our service portal allows you to manage all your measurement instruments serviced by Rohde&Schwarz. Register for your secure account at http://www.rohde-schwarz.com/service_portal and request access to the service portal. Once your request is processed, you can access the key data of your instruments and check the status of current service jobs.



Calibration | Repair			
Factory standard calibration ▮ Full calibration (ISO 17025 conformant), returning the instrument to the same state as when it originally left the factory ▮ Traceability to national/ international standards ▮ Certificate and test report ▮ Software updates and hardware modifications included ▮ Instrument adjustment	**Accredited calibration** ▮ Same features as factory standard calibration ▮ Directly traceable calibration in accordance with ISO 17025 ▮ Controlled by national accreditation authority (NIST, DKD/DAkkS) ▮ Certificate and test report ▮ Software updates and hardware modifications included ▮ Instrument adjustment	**Performance calibration (only available under service contract)** ▮ Competitive price ▮ Complete measurement of all specifications as with factory standard calibration ▮ Certificate and test report ▮ Quality-related software updates and hardware modifications ▮ No instrument adjustments	**Adjustment** ▮ Includes adjustment and incoming equipment test report ▮ Can only be ordered in connection with performance calibration
Standard price repair ▮ Fixed repair price which covers the cost of materials and work performed ▮ Twelve-month service warranty on the entire equipment (does not apply in case of improper handling or alteration of the equipment) ▮ Calibration in line with ISO 9001 including documentation of test results ▮ Latest hardware and software updates	▮ Pickup and return of the equipment (only for shipping by a Rohde&Schwarz logistics partner in the country of the Rohde&Schwarz service organization) ▮ If it turns out that only little work and material are needed to eliminate the fault, you pay merely a small lump sum instead of the standard price	**Time and material repair** ▮ Repair based on the amount of material and work required to repair the equipment ▮ Twelve-month service warranty on the work performed	

Rohde&Schwarz service offers you further advantages

Service request

Service from the start – higher efficiency, smooth handling and greater visibility through on-line tracking. Just call or visit our website at http://rohde-schwarz.com/RMA to register your instrument. You will immediately receive shipping instructions, the service reference number, preliminary service pricing options and the estimated turnaround time via e-mail.

Service for third-party maintenance (TPM) products

Rohde&Schwarz also offers the services mentioned here for TPM products.

On-site calibration

You can opt for on-site calibration of your Rohde&Schwarz equipment and TPM products. On-site calibration is convenient and reduces downtime to the absolute minimum. Various calibrations and minor repairs can be performed at your company; minimum quantities apply.

Pickup service

On request we pick up your equipment at your company. We can also arrange for the packaging.

Loan equipment

Your local service center can offer a loaner to bridge the repair time – subject to availability.

Service order tracking

The www.servicestatus.rohde-schwarz.com portal allows you to verify the repair or calibration status of your instrument. Service order tracking provides effective transparency. You only need the service reference number and the serial number of your equipment to track its status.

Home

Training and application support

The product portfolio of Rohde&Schwarz is accompanied by a comprehensive choice of training seminars and detailed application notes. By offering comprehensive application notes and practice-oriented training, we want to show you how to use our products most effectively. This ranges from first-time users who can choose from detailed introductory courses for operation and maintenance up to seasoned users who can be trained on complete high-performance communications solutions from Rohde&Schwarz.

Training

The extensive choice of seminars includes everything from standard training classes on numerous topics in radio engineering and test and measurement to practice-oriented product training for Rohde&Schwarz solutions.
If needed, customer-specific training programs specially designed to meet your wishes and requirements are held in order to achieve optimum benefit for the participants. Skilled trainers convey concise, practice-oriented knowledge at our state-of-the-art, fully equipped training center in Munich. Alternatively, training can also be held on the customer's premises or at any other location of choice.

Comprehensive choice of training seminars		
Standard seminars Detailed seminars are offered on numerous topics in radio engineering and T&M such as RF and EMC testing, as well as classes covering the fields of wireless communications, television and antennas from the basics up to workshop level.	**Customized seminars** These seminars aim at providing optimum benefit for customers and their participants. The training content is tailored specifically to the customer's wishes and requirements.	**Hands-on experience** Practical exercises are an essential part of all seminars to help ensure that the material just learned can be tried out immediately using state-of-the-art test setups. This is crucial for understanding and clarifying the training content in detail.
Small groups The number of participants is intentionally kept small so that everyone has sufficient time for questions as well as the opportunity to try out the class content in a hands-on environment.	**Trainers/training staff** The trainers continuously keep their technical knowledge up to date. They possess not only technical expertise, they are also able to convey it in an understandable and lasting manner.	**Location** Classes may be held at the state-of-the-art training center at company headquarters in Munich. Optionally, seminars can take place on the customer's premises or at any other suitable location.
Timetable Standard training classes are scheduled twice a year. For dates, see the Rohde&Schwarz homepage. The schedule for customized seminars is drawn up together with the individual customer.	**Languages** The seminars are conducted either in German or English. If needed, special training classes can be held in other languages.	**Registration and organization** All detailed information regarding the seminars – including class descriptions, registration, cost, procedure and content – is provided on the Rohde&Schwarz homepage under Service&Support.

Limiting the number of participants helps ensure better communications between participant and trainer. Knowledge is conveyed more intensely, and extra time is available for questions so that the participants can put their newly gained knowledge and skills into practice immediately after the seminar.

Skill and up-to-date knowledge are top priorities in all our seminars. The company's intensive participation in relevant bodies – such as for the standardization of state-of-the-art wireless communications – is reflected in training classes that are always cutting-edge both in theory and communications expertise. Our customers also benefit from this.

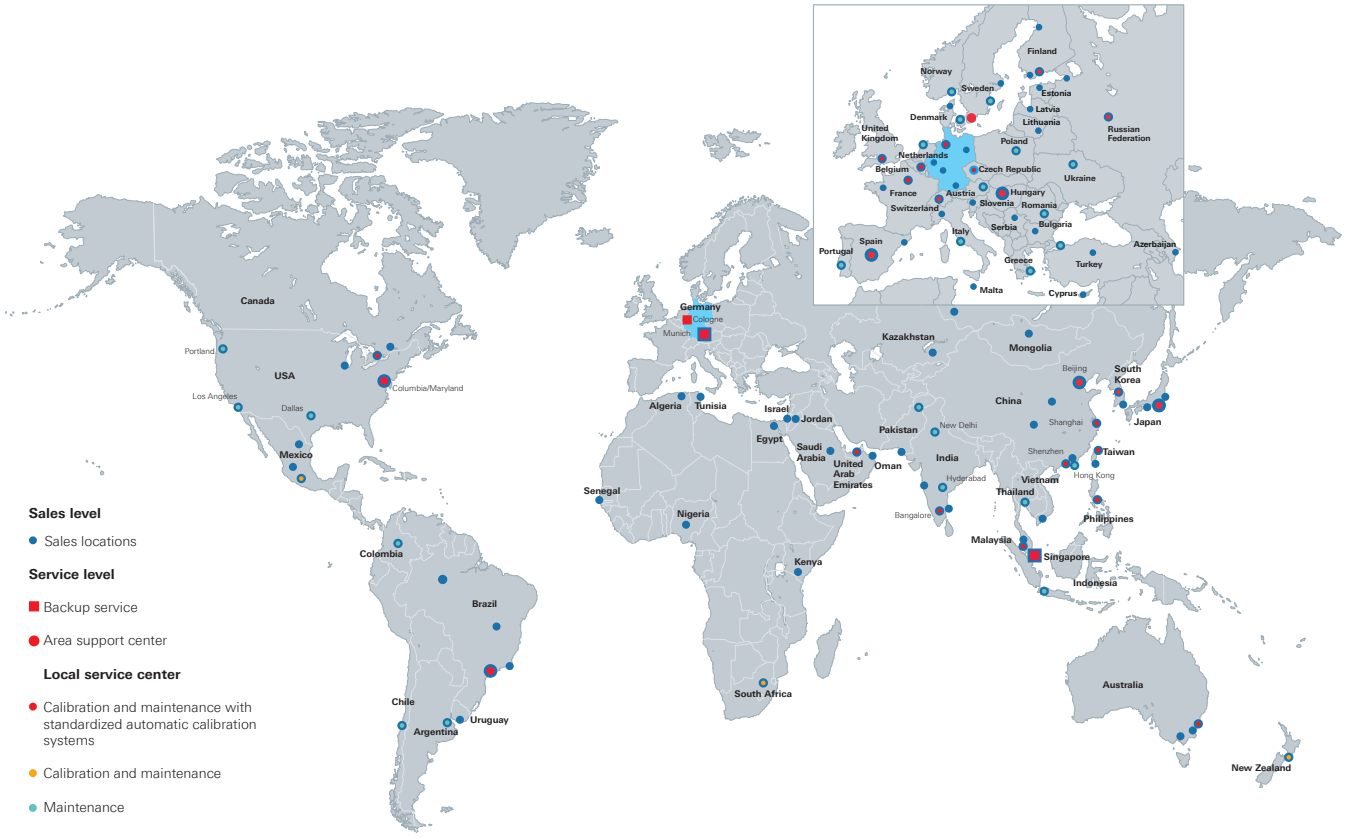
Application support

Rohde&Schwarz offers you support for any applications and categories of industry. We look forward to sharing the knowledge and the experience of our worldwide network of experts with you:

- Local application engineers help you successfully implement your specific application on site by using Rohde&Schwarz solutions, and provide advice for all communications matters
- A large number of application notes, are available on request from your local sales contact

Home

Global sales and service locations



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- R&S® is a registered trademark of Rohde&Schwarz GmbH&Co. KG. Example: R&S®SDTR software defined tactical radios
- Windows is a registered trademark of Microsoft Corp., USA
- CORBA is a registered trademark of the Object Management Group, Inc.
- The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Rohde&Schwarz is under license.

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Home

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