Secure Communications
Catalog 2009/2010

The R&S®Series4200 – the most advanced and compact VHF/UHF radios for civil and military air traffic control. With more than 5000 units sold, the R&S®Series4200 has become the reference on the market worldwide.

▷ For more details, see page 154.

R&S®M3AR

R&S®M3TR

R&S®M3SR

Catalog Contents

ROHDE&SCHWARZ

Secure Communications

For 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 numbers among the market leaders in all of its business fields, including wireless communications and RF test and measurement, terrestrial TV broadcasting and technologies relating to the interception and analysis of radio signals.

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

Our business fields

Test and measurement

T&M instruments and systems for wireless communications, electronics and microwave applications

Secure communications

(Radio) systems providing encrypted communications for police, armed forces, government agencies and industry

Radiomonitoring and radiolocation

Spectrum monitoring systems and radiomonitoring equipment for public safety and national security

Broadcasting

Sound and TV broadcasting and measuring equipment

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. We are a key partner of industry and network operators for all T&M tasks in radiocommunications.

In the past year, Rohde&Schwarz launched new product highlights for signal generation, spectrum analysis and EMC measurement, again proving its innovative strength in RF test and measurement. In the extremely high frequency range, the introduction of products for network analysis in the millimeter-wave range marked the entry in the terahertz technology of the future. On the wireless market, the company strengthened its leading position as a supplier of T&M solutions for next-generation technologies such as LTE, WiMAX™ [1] and MIMO.

[1] "WiMAX Forum" is a registered trademark of the WiMAX Forum. "WiMAX," the WiMAX Forum logo, "WiMAX Forum Certified," and the WiMAX Forum Certified logo are trademarks of the WiMAX Forum.

Our test and measurement portfolio

- Instruments and systems for testing mobile radio and wireless technologies
  - Wireless device testers
  - Infrastructure testers
  - Protocol testers
  - Conformance/preconformance testers
  - Test systems and accessories
- Spectrum and signal analyzers
- Signal generators
- Network analyzers
- Coverage measurement systems
- EMC and field strength test solutions
- Modular instruments
- Power meters and voltmeters
- Audio analyzers
- Video and TV generators and analyzers
- Modulation analyzers
- Power supplies
- RF and microwave accessories
- Industrial PCs

Test and measurement.

Broadcasting

TV viewers and radio listeners in more than 80 countries receive their programs via transmitters from Rohde&Schwarz. By providing an innovative portfolio of broadcasting and measuring equipment, we are driving the development of digital broadcasting worldwide. The company's market leadership in terrestrial TV transmitters, including for mobile TV, was further enhanced in the past year by the installation of Rohde&Schwarz equipment in all regions of the world. One of the primary success factors was the introduction of a new generation of transmitters featuring significantly lower power consumption.

At the bottom end of the transmit power scale, a new family of gap fillers and transposers for TV and DAB now provides cost-effective, seamless coverage even of areas with difficult topography.

To producers of consumer electronics, Rohde&Schwarz supplies all necessary test equipment for the development and production of satellite receivers, TV sets and other user equipment, including for the new high definition formats. The large variety of broadcast and video technologies is covered by Rohde&Schwarz with its multistandard platforms, which allow very flexible use at all stages of the value added chain.

Secure communications

Radiocommunications systems Security organizations and armed forces must be able to exchange information efficiently and securely – also in multinational operations. To ensure the rapid coordination of civil, governmental and military forces in times of crisis, Rohde&Schwarz supplies powerful, interoperable communications systems. Due to their modern encryption methods, the company's solutions fulfill the highest requirements of national and international security standards. Software defined radios ensure the greatest possible flexibility and are in use around the globe. Civil air traffic control agencies in 80 countries and at more than 200 locations – both airports and ATC centers – use Rohde&Schwarz radio systems.

Professional mobile radio (PMR) TETRA radio networks have already been put into operation in more than 30 countries by the Rohde&Schwarz Professional Mobile Radio GmbH subsidiary – for example in the Moscow Metro, at the Panama Canal, in a nationwide network in Malaysia and at major sporting events such as the Asian Games in Qatar.

Communications security Rohde&Schwarz SIT GmbH develops highly secure crypto products and systems for private industry, government agencies and the military. A highlight is the ELCRODAT 4-2 encryption unit, which has been approved for maximum levels of classification and is being used by the German armed forces and NATO.

Our broadcasting portfolio

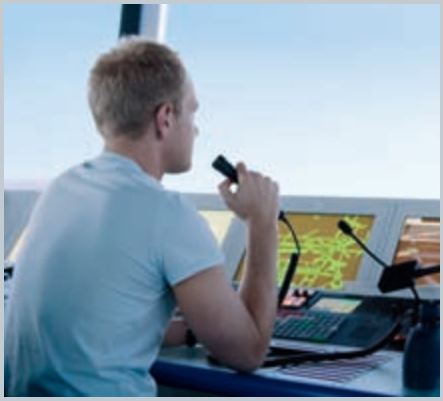
- Digital and analog TV transmitters for all power classes and all conventional standards worldwide, including mobile TV
- Digital and analog sound broadcast transmitters
- Broadcast and video test instruments and systems

Our secure communications portfolio

- Integrated communications systems for the following
  - Civil and military air traffic control (ATC)
  - Army
  - Navy
  - Air force
- Encryption technology
- TETRA mobile radio systems

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. Therefore, 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. Its receivers, direction finders, signal analyzers, antennas and customized systems have made Rohde&Schwarz a reliable partner for its customers for many decades. Applications include public safety and national 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

By cooperating with the regional Rohde&Schwarz service centers as well as the plants and specialized subsidiaries, the company can 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 and logistics

Our radiomonitoring and radiolocation portfolio

- Radio intelligence systems
- Spectrum monitoring systems
- Signal analysis systems
- Receivers
- Direction finders
- Antennas

Service you can rely on
- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

Radiomonitoring and radiolocation.

Services.

Headquarters

At company headquarters in Munich, around 2000 employees work in research and development, central sales and service, marketing and administration.

Rohde&Schwarz GmbH & Co. KG
Mühldorfstraße 15
D-81671 München
Phone +49 89 41 29 0
Fax +49 89 41 29 121 64
info.rs@rohde-schwarz.com
www.rohde-schwarz.com

Plants

Memmingen plant
The plant in Memmingen is responsible for electronic module assembly, microwave engineering, final production, final inspection and delivery of most Rohde&Schwarz products. The plant's extensive know-how is also available to customers from outside the Rohde&Schwarz group of companies.

Rohde&Schwarz Messgerätebau GmbH
Rohde-und-Schwarz-Straße 1
D-87700 Memmingen
Phone +49 8331 108 0
Fax +49 8331 108 11 24
info.rsmb@rohde-schwarz.com

Teisnach plant
The plant in Teisnach is the service center for mechanical and electronic production in the Rohde&Schwarz group. This plant produces housing parts, antennas, printed boards and electromechanical custom-made products of all types. All sound and TV broadcast transmitters are manufactured in Teisnach. As a system supplier, the plant serves customers around the world.

Rohde&Schwarz GmbH & Co. KG Teisnach Plant
Kaikenrieder Straße 27
D-94244 Teisnach
Phone +49 9923 85 70
Fax +49 9923 85 71 174
info.rsdts@rohde-schwarz.com

Vimperk plant
The Vimperk plant is the only one of Rohde&Schwarz production facilities located outside Germany. The plant produces mechanical and electronic modules ranging from individual parts to complete systems.

Rohde&Schwarz závod Vimperk, s.r.o.
Location Spidrova 49
CZ-38501 Vimperk
Phone +420 388 45 21 09
Fax +420 388 45 21 13

Subsidiaries

Rohde&Schwarz Professional Mobile Radio GmbH
Rohde&Schwarz Professional Mobile Radio GmbH, formerly R&S Bick Mobilfunk GmbH, specializes in the development and implementation of professional mobile radio systems. In particular, the company supplies TETRA mobile radio networks and applications for public safety, transportation, oil, gas and industry.

Rohde&Schwarz Professional Mobile Radio GmbH
Fritz-Hahne-Str. 7
D-31848 Bad Münder
Phone +49 5042 998 0
Fax +49 5042 998 105
info.pmr@rohde-schwarz.com

Rohde&Schwarz SIT GmbH
Rohde&Schwarz SIT GmbH provides solutions for information and communications security that have been approved by the German Federal Office for Information Security (BSI) and NATO/SECAN. Key activities of the company are the development of crypto products and systems for the protection of information in modern data processing and communications systems, as well as consulting and IT security analyses for government authorities, armed forces and industry.

Rohde&Schwarz SIT GmbH
Am Studio 3
D-12489 Berlin
Phone +49 30 658 84 0
Fax +49 30 658 84 183
info.sit@rohde-schwarz.com

HAMEG Instruments GmbH
HAMEG, a German T&M equipment manufacturer with a rich tradition, supplements the Rohde&Schwarz portfolio in the lower price segment by offering reliable T&M instruments for science, industry and education. HAMEG has its own product development and production operations.

HAMEG Instruments GmbH
Industriestraße 6
D-63533 Mainhausen
Phone +49 6182 800 0
Fax +49 6182 800 100
info@hameg.com

GEDIS GmbH
GEDIS develops and implements individual solutions for the testing of electronic instruments, modules and submodules and for the management of test and communications systems. The company addresses government authorities, large system houses, the automobile industry and their suppliers.

GEDIS GmbH
Sophienblatt 100
D-24114 Kiel
Phone +49 431 600 51 0
Fax +49 431 600 51 11
sales@gedis-online.de

R&S Systems GmbH
R&S Systems GmbH provides system services within the Rohde&Schwarz business fields – from system development and integration to delivery, assembly and commissioning of turnkey T&M and communications equipment. This includes, for example, infotainment test systems for automobile production, mobile ATC systems as well as complete electronics workshops for technical service.

R&S Systems GmbH
Graf-Zeppelin-Straße 18
D-51147 Köln
Phone +49 2203 495 23 25
Fax +49 2203 495 23 36
info.rssys@rohde-schwarz.com

Arpège S.A.S.
The French company works closely with Munich headquarters to develop and implement customer-specific systems in the areas of satellite monitoring and lawful interception for government security agencies.

Arpège S.A.S.
Z.E. Athélia III
753, Voie Antiope
F-13600 La Ciotat
Phone +33 442 84 47 95
Fax +33 442 84 47 96
contact@arpege-sas.com

Contact

Corporate Communications
Rohde&Schwarz GmbH&Co. KG
Department 9PR
D-81671 München
Phone +49 89 4129 139 58
Fax +49 89 4129 135 63
pr@rohde-schwarz.com

Sales
The addresses of the local sales companies can be found at: www.sales.rohde-schwarz.com

Customer Support
Our regional support centers will be glad to answer any questions regarding our products and service:

Europe, Africa, Middle East
Phone +49 1805 12 42 42 or +49 89 4129 137 74
customersupport@rohde-schwarz.com

North America
Phone 1 888 837 87 72 (1 888 TEST RSA)
customer.support@rsa.rohde-schwarz.com

Latin America
Phone +1 410 910 79 88
customersupport.la@rohde-schwarz.com

Asia/Pacific
Phone +65 65 13 04 88
customersupport.asia@rohde-schwarz.com

Foto: Bundeswehr/Rott

Chapter 1
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 scores of armed forces. After decades, they continue to provide reliable radiocommunications as proof of the quality, reliability and robustness of Rohde&Schwarz products. The R&S®M3AR family of products has been deployed around the world since 2000 and has proven its value.

R&S®M3AR Software Defined Radios

VHF/UHF transceiver family for airborne communications

- 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)

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 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 it's 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.

R&S®GB6500 control unit.

R&S®MR6000R.

R&S®MR6000L.

R&S®MR6000A.

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 & fit compatible. The R&S®MR6000L is equipped with a local control panel while the R&S®MR6000R is remote-controlled. All R&S®M3AR radios can be remote-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.

Excellent RF characteristics
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.

Frequency bands from 30 MHz to 400 MHz
The aviation sector has special applications that must be supported by radiocommunications systems.

- Civil aviation
  - 108 MHz to 117.975 MHz, AM (receive only)
  - 118 MHz to 136.975 MHz, AM, with additional 8.33 kHz channel spacing
- Military aviation
  - 30 MHz to 87.975 MHz, FM
  - 225 MHz to 399.973 MHz, AM and FM
- Civil maritime communications
  - 156 MHz to 173.975 MHz, FM
- Variety of mobile radio services
  - 137 MHz to 155.975 MHz, 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.

Frequency-agile pre-/postselector for best co-site behavior (R&S®MR6000A)
The fast frequency hopping filter effectively reduces wideband noise during transmission. In receive mode, unwanted signals are suppressed by the filter, thus preventing negative effects such as crossmodulation, blocking or desensitization.

The excellent co-site behavior permits the parallel use of multiple radio lines in a minimum of space, which is frequently the case with reconnaissance and transport aircraft.

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 flight 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, thus 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.

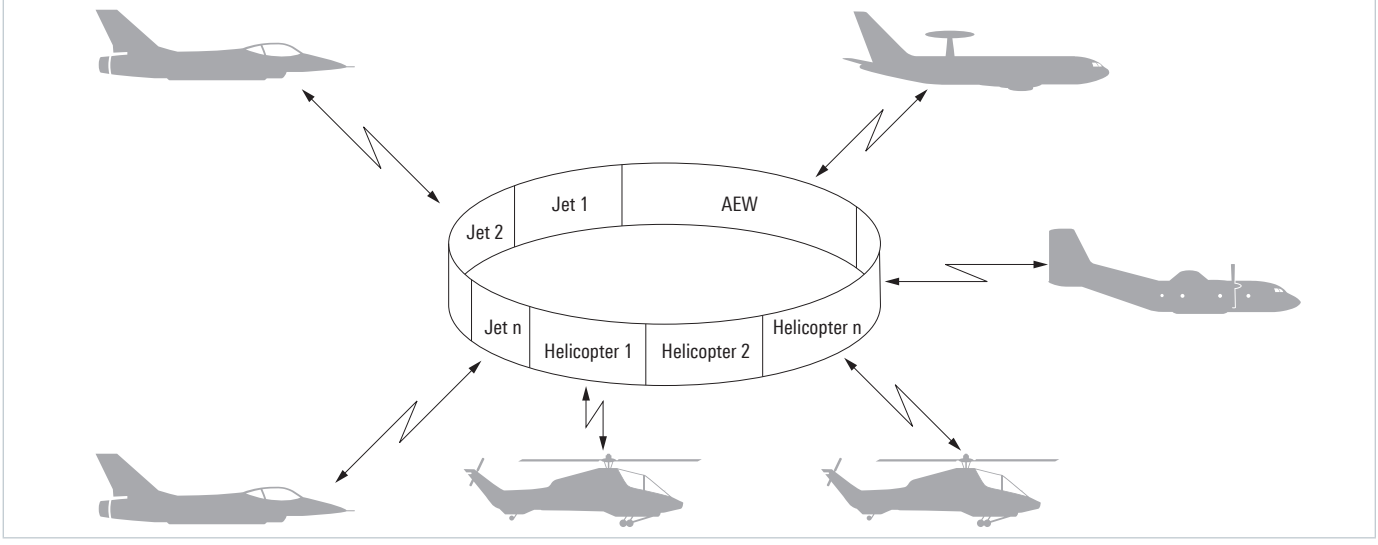
Tap- and spoof-proof communications through integrated encryption
To protect radio links from tapping and spoofing, the information being transmitted can be encrypted. With the R&S®MR6000A from the R&S®M3AR family, Rohde&Schwarz was the first manufacturer to offer embedded NATO encryption. This eliminates 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. To load the encryption keys, different protocols are provided. When using the R&S®SECOS method, the encryption keys can be encrypted and transmitted over non-secure 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.

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



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.

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 from Rohde&Schwarz. 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 for R&S®SECOS, SATURN, HAVE QUICK I/II and encryption keys 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.

R&S®MR6000L – intuitive and simple operation

Suitable for fixed- 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.

For the navy for example, a LINK11 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, ARC-164) or front panel control

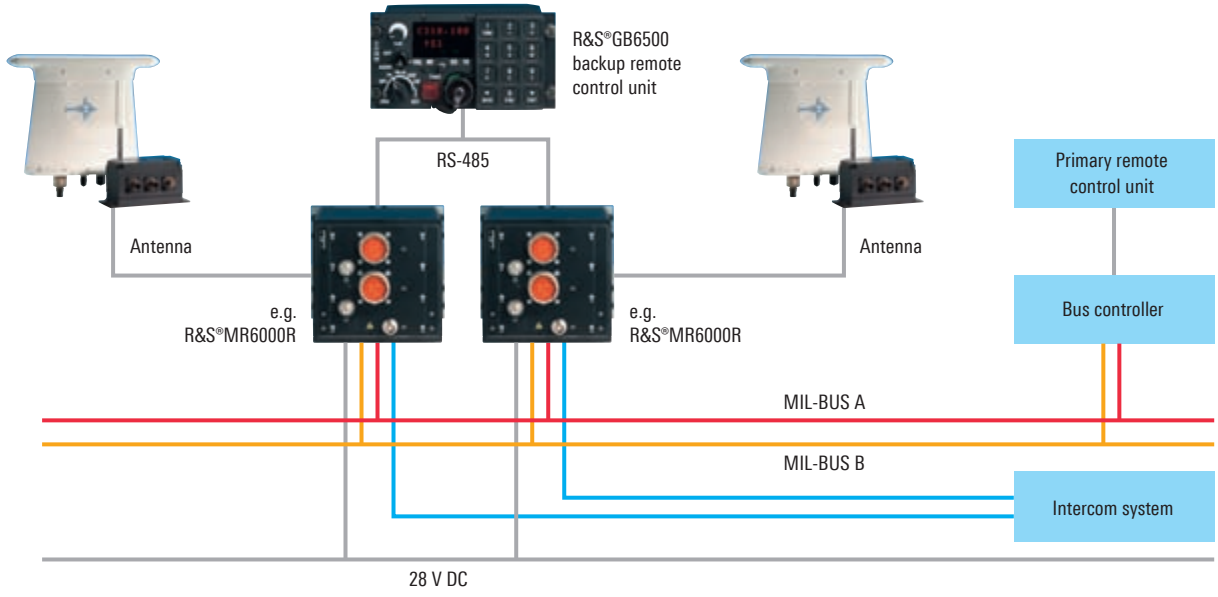
The R&S®M3AR radio family can be flexibly integrated in an aircraft. The R&S®MR6000L with local control panel is easily installed directly in the cockpit.

Alternatively, the R&S®MR6000L offers remote control capability via the MIL-STD-1553B data bus, through the R&S®GB6500 control unit or by means of an RS-485 serial interface in conjunction with the applicable Rohde&Schwarz protocol. An optional ARC-164 serial or parallel interface is available for both the R&S®MR6000R and R&S®MR6000L, which ensures simple form, fit and function replacement of existing AN/ARC-164 radios.

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).

Flexible alternatives for operating the radios



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®TS6030 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&measurement into the area of airborne transceivers, customers have a first-class solution from a single source.

High reliability due to a 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.

Automatic and reliable testing of airborne transceivers with the R&S®TS6030 test system.

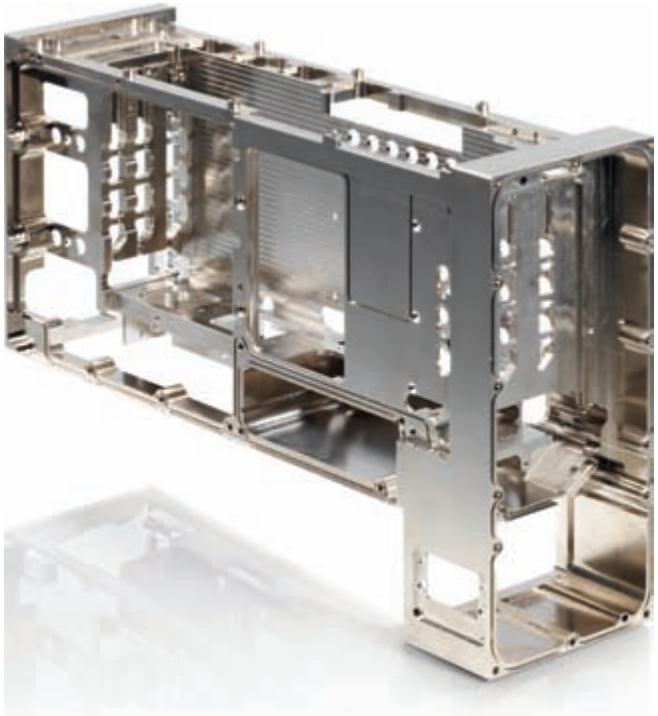
Obsolescence-proof investment

Software can be adapted to changing standards without hardware modifications
All software components and updates can be loaded in the radio by an authorized service center using the R&S®ZS6000 radio loader. Modifications can be made or functionalities can be added without having to change the hardware. The current software status can be queried via the MIL-STD-1553B data bus.

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

R&S®MR6000A

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.

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&cipher voice and data), transmitter break-in, time delay compensation, split synchronization, data message, etc.
- Embedded NATO or R&S®SECOS encryption
- LINK11 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 and 156.525 MHz distress frequencies
- Integrated pre-/postselector
- Tactical VHF frequency range for communications with ground troops (i.e. expanded frequency range from 30 MHz to 399.975 MHz)
- Transmission and reception of digital selective call (DSC) signals from the Global Maritime Distress and Safety System (GMDSS)
- 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 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 RS-485 interface and applicable Rohde&Schwarz protocol (used by the R&S®GB6500 for example), MIL-STD-1553B data bus or a combination of both

R&S®MR6000R and R&S®MR6000L Software Defined Radios

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 10 W (AM) and 15 W (FM)
- Remote control via RS-485 interface and applicable Rohde&Schwarz protocol (used by the R&S®GB6500, for example), MIL-STD-1553B data bus or a combination of both
- Legacy ARC-164 radios can be replaced with the optional ARC-164 serial or parallel interface without additional integration effort

R&S®MR6000R.

R&S®MR6000L.

R&S®MR6000E Software Defined Radio for the Eurofighter Typhoon

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 in addition will be used for voice communications with air traffic control. It supports the SATURN and HAVE QUICK I/II 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.

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

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. A maximum of three R&S®GB6500 units can control up to five R&S®M3AR transceivers via the RS-485 bus. 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.

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 haptics of the controls were optimized for aircraft conditions so that the device switches are easy to press and regulate when wearing gloves. This also makes them easy to operate under harsh flying conditions. The R&S®GB6500 has separate switches for settings that must be frequently or quickly changed in flight:

- Operating mode (transmitting with/without distress frequency monitoring, ADF, transmitting on a distress frequency)
- Deletion of all loaded keys
- Squelch ON/OFF
- Volume control
- Allocation of radio control
- Transmission of a tone

Presets are selected via the keypad. The submenus contain additional settings that can be performed via the control pad. Settings can be made quickly using the user-friendly menu structure without focusing too much of the pilot's attention on the radio controls. The R&S®GB6500 user interface is identical to that of the R&S®MR6000L, which simplifies crew training.

R&S®GB6500 remote control unit.

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.

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

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

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

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-C 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®ZK6000 Maintenance Connection Box

The maintenance connection box is for performing maintenance on the radio outside of the aircraft by means of a standard RS-232-C serial interface. Various maintenance tasks can be carried out such as calibrating the synthesizer with maintenance software or getting an error report readout. 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®ZS6000 Radio Loader

The R&S®ZS6000 radio loader program is primarily for loading the radio with the necessary software in production environments and at authorized service centers. It also allows the synthesizer to be calibrated during maintenance. The software communicates with the radio by means of an RS-232-C interface.

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

R&S®BA6000 base station adapter.

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

Fields of Deployment and Applications

Versatile applications in different frequency ranges

During a mission, military jets, helicopters and propeller aircraft must communicate with a variety of partners that use different frequency ranges. This requires flexible radio systems that can reliably support flight crews in all phases of a mission, from start to landing. By using airborne transceivers from Rohde&Schwarz, crews have a reliable partner on board at all times.

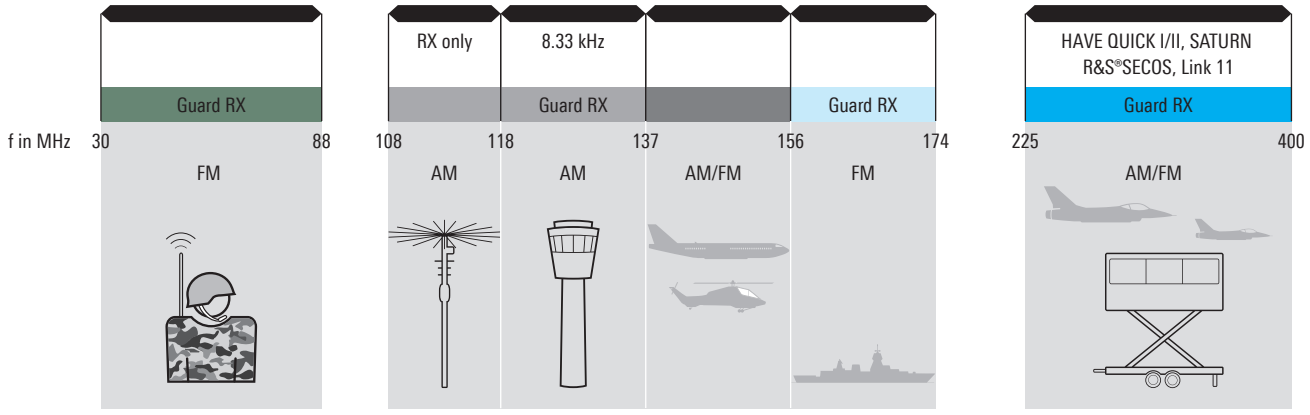
Civil and military air traffic control as well as information services (108 MHz to 136.975 MHz and 225 MHz to 399.975 MHz, AM)

So that military aircraft can also fly in international civil airspace without any restrictions, they must be equipped with appropriate communications systems.

The R&S®M3AR transceivers are developed and tested in line with military and civil standards. The excellent receiver sensitivity and high transmit power consistently ensure high-quality radio links with civil or military air traffic control. In the upper airspace in various countries, an additional 8.33 kHz channel spacing is required, which in the future has to be implemented in offset carrier mode like the 25 kHz spacing already used. This places high demands on the radios, particularly when signals are weak. Apart from excellent receiver characteristics, the R&S®M3AR features a flexible carrier override option, which can be set via the MIL-STD-1553B data bus. This improves sensitivity in offset mode when flying at high altitudes.

Information services such as automatic terminal information service (ATIS) can be received in the 108 MHz to 136.975 MHz frequency range. To avoid incorrect operation, for air navigation services the 108 MHz to 117.975 MHz frequency range is receive only and the 108 MHz to 136.975 MHz frequency range can only be used in AM mode. Military air traffic control uses the 225 MHz to 399.975 MHz frequency range with 25 kHz channel spacing. To enable unrestricted movement in civil and military airspaces, both frequency ranges are required.

Frequency bands of the R&S®M3AR radios



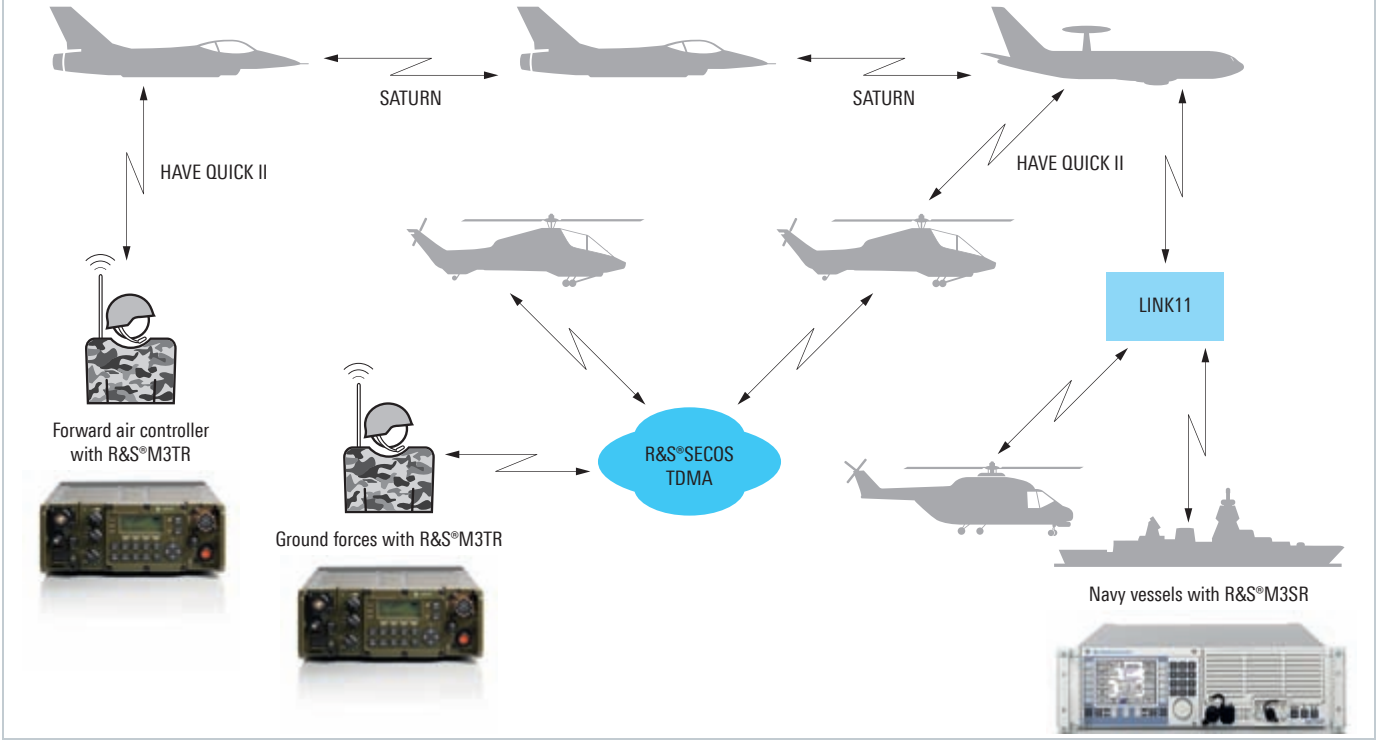
The R&S®M3AR transceivers offer the flexibility to use civil as well as military air traffic control frequencies with the corresponding channel spacing. Furthermore, reception is also possible in offset carrier mode with 25 kHz and 8.33 kHz channel spacing. An additional guard receiver makes it possible to monitor not only the 121.5 MHz and 243 MHz distress frequencies of civil and military aviation, but also of the 40.5 MHz tactical VHF band. The R&S®MR6000A can also monitor the 156.525 MHz maritime distress frequency. The guard receiver has a mode for constantly scanning the frequencies and locking onto the corresponding receive frequency.

VHF combat net radio (30 MHz to 87.975 MHz, FM)
Ground forces use this frequency range to send and receive tactical information in the form of voice or data messages. So that aircraft, particularly army helicopters, can provide effective support to forces on the ground, they must be equipped with an interoperable communications system.

The R&S®M3AR family supports the 30 MHz to 87.975 MHz tactical VHF frequency range and can thus switch to a specific frequency in this range when required. The R&S®MR6000A also features embedded NATO encryption for interoperability with NATO partner combat net radio equipment.

Maritime radio (156 MHz to 173.975 MHz, FM)
This frequency range is particularly important for naval aircraft, to enable communications with civil boats, ships and harbor authorities. All R&S®M3AR series support the maritime band in line with international and U.S. frequency tables. When needed, the R&S®MR6000A also monitors the maritime distress frequency on channel 70 of the GMDSS (156.525 MHz).

Versatile applications in the UHF range with Rohde&Schwarz airborne radios



Military airborne radiocommunications (225 MHz to 399.975 MHz, AM and FM)

Military aircraft rely on the UHF radio band for air-to-air as well as air-to-ground communications for exchanging tactical information with various units.

Military operations are increasingly reliant on radio data capability. Aircraft crews also require mission-critical information in digital form in order to significantly improve situational awareness, for instance. The R&S®M3AR transceivers support radio data transmission with up to 16 kbit/s in different waveforms.

NATO uses the HAVE QUICK I/II and SATURN frequency hopping methods in the UHF range, which can be optionally combined with encryption. These NATO methods can be integrated in the R&S®M3AR transceivers upon request to ensure international interoperability.

R&S®SECOS can operate on any number of frequencies in the entire UHF range. Up to 128 participants can exchange information over a TDMA network. R&S®SECOS supports both voice and data, features embedded encryption and can optionally be installed in parallel with HAVE QUICK I/II. Switching between the methods is made possible by simply changing the preset.

The R&S®MR6000A features a LINK11 interface for participating in tactical data links in the UHF range in line with STANAG 5511 and MIL-STD-188-203-1A.

Outstanding RF characteristics and co-site filter for multiple applications on a single platform

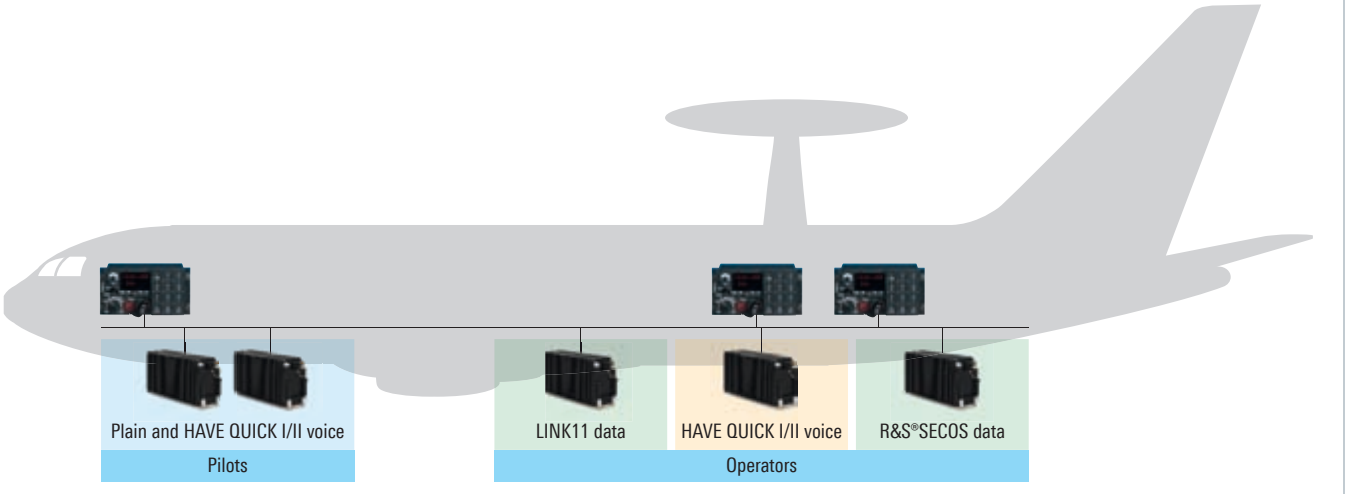
Because communications is vital for operating reconnaissance and transport aircraft, they must be equipped with a variety of radios. Apart from equipment for voice communications with air traffic control and tactical radio via HAVE QUICK I/II for pilots, the aircraft must have the appropriate equipment to support a variety of applications.

LINK11 is a widely deployed solution for exchanging tactical data with naval units in combined missions. On airborne platforms, the air operational picture can be exchanged via R&S®SECOS using the TDMA method, which significantly improves situational awareness. For legacy platforms that lack modern radio data capability, HAVE QUICK I/II can be used for voice communications.

The radios can be flexibly controlled via the MIL-STD-1553B data bus or the R&S®GB6500 remote control unit.

The outstanding RF characteristics of the R&S®MR6000A with integrated co-site filter allow the simultaneous use of multiple radio links in confined spaces and with small antenna spacing.

Multiple applications on a single platform made possible with airborne radios from Rohde&Schwarz



Ordering information

Frequency bands	Waveforms	Interfaces	Type	Order No.
R&S®MR6000A (extract of available equipment), ARINC600 housing – remote control				
30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; fixed frequency	–	RS-485, MIL-STD-1553B trafo coupling; audio output: 600 Ω	R&S®XM6023	6134.6400.62
30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz	EPM (ECCM): HAVE QUICK I/II	RS-485, MIL-STD-1553B trafo coupling; audio output: 600 Ω	R&S®XM6123	6134.7607.67
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	RS-485, MIL-STD-1553B trafo coupling; audio output: 600 Ω	R&S®XM6423D	6134.6800.67
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	RS-485, MIL-STD-1553B trafo coupling; audio output: 600 Ω	R&S®XM6523D	6134.7207.62
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	RS-485, MIL-STD-1553B trafo or direct coupling; audio output: 150 Ω or 600 Ω	R&S®XM6923L	6134.xxxx.yy
R&S®MR6000L (extract of available equipment), ARC-164 housing – local control				
108 MHz to 174 MHz, 225 MHz to 400 MHz; fixed frequency	–	RS-485; illumination: white; display: red; audio output: 600 Ω	R&S®XT6010	6126.0888.52
30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz	EPM (ECCM): HAVE QUICK I/II	RS-485; illumination: NVG (green A); display: green; audio output: 600 Ω	R&S®XM6110	6141.6502.58
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	RS-485, MIL-STD-1553B trafo coupling; illumination: NVG (green A); display: green; audio output: 150 Ω	R&S®XM6412D	6141.7750.18
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	RS-485, MIL-STD-1553B trafo coupling; illumination: NVG (green A); display: green; audio output: 150 Ω	R&S®XM6512D	6111.7000.13
30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz	EPM (ECCM): SATURN, HAVE QUICK I/II	RS-485; illumination: NVG (green A); display: green; audio output: 150 Ω	R&S®XM6910	6111.4701.03
R&S®MR6000R (extract of available equipment), ARC-164 housing – remote control				
108 MHz to 174 MHz; fixed frequency	–	RS-485, MIL-STD-1553B trafo coupling; audio output: 600 Ω	R&S®XU6013	6141.7509.62
30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; fixed frequency	–	ARC-164 serial; MIL-STD-1553B trafo coupling; audio output: 150 Ω	R&S®XM6013	6111.2750.42
30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz; fixed frequency	EPM (ECCM): preplanned, update via software installation	RS-485, MIL-STD-1553B trafo coupling; audio output: 150 Ω	R&S®XM6013P	6111.8007.12
30 MHz to 88 MHz, 108 MHz to 174 MHz, 225 MHz to 400 MHz	EPM (ECCM): HAVE QUICK I/II	RS-485, MIL-STD-1553B trafo coupling; audio output: 150 Ω	R&S®XM6113	6111.7752.17
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	RS-485, MIL-STD-1553B trafo coupling; audio output: 600 Ω	R&S®XM6413D	6111.7500.67
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	RS-485, MIL-STD-1553B trafo coupling; audio output: 600 Ω	R&S®XM6513D	6111.6756.62

Ordering information

Designation	Type	Order No.
Software upgrade		
EPM (ECCM) Software: HAVE QUICK I	R&S®GS6000	6113.0503.02
EPM (ECCM) Software: HAVE QUICK I/II	R&S®GS6000	6113.0503.03
EPM (ECCM) Software: SATURN/HAVE QUICK I/II	R&S®GS6000	6113.0503.04
EPM (ECCM) Software: SATURN/HAVE QUICK I/II; enhanced functionality (with additional STANAG 4372 options)	R&S®GS6000	6113.0503.14
EPM (ECCM) Software: R&S®SECOS 5/16 TDMA (DPP)	R&S®GS6000	6113.0503.10
Mating connector sets		
Mating Connector for R&S®MR6000R; without MIL bus	R&S®ZR6000	6085.0215.02
Mating Connector for R&S®MR6000R; with MIL bus	R&S®ZR6000	6085.0215.03
Mating Connector for R&S®MR6000L; without MIL bus	R&S®ZR6000	6085.0215.04
Mating Connector for R&S®MR6000L; with MIL bus	R&S®ZR6000	6085.0215.05
Mating Connector for R&S®MR6000R with R&S®CI6000F; without MIL bus	R&S®ZR6000	6085.0215.06
Mating Connector for R&S®MR6000R with R&S®CI6000F; with MIL bus	R&S®ZR6000	6085.0215.07
Mating Connector Set for R&S®MR6000A	R&S®ZR6000A	6113.8033.02
Mating Connector Set for R&S®GB6500	R&S®ZR6500	6087.1025.02
Remote control units		
Remote Control Unit; control interface: RS-485; illumination: white; display: yellow	R&S®GB6500	6087.0012.31
Remote Control Unit; control interface: RS-485; illumination: white; display: red	R&S®GB6500	6087.0012.32
Remote Control Unit; control interface: RS-485; illumination: NVG (green A); display: green	R&S®GB6500	6087.0012.33
Remote Control Unit; control interface: RS-485; illumination: red, display: red	R&S®GB6500	6087.0012.34
Remote Control Unit; control interface: RS-485; illumination: NVG (green B); display: green	R&S®GB6500	6087.0012.35
Trays		
Mounting Tray for R&S®MR6000A	R&S®KR6000A	6133.8345.02
Mounting Tray for R&S®MR6000R	R&S®KR6010	6131.5426.02
Cooling Tray for R&S®MR6000R	R&S®KR6010	6131.5426.03
Service and maintenance tools		
Base Station Adapter for R&S®MR6000L (local control)	R&S®BA6000L	6121.6513.02
Base Station Adapter for R&S®MR6000R (remote control)	R&S®BA6000R	6121.6520.02
Maintenance Connection Box for R&S®MR6000A	R&S®ZK6000A	6131.3698.02
Maintenance Connection Box for R&S®MR6000L/R	R&S®ZK6000L/R	6131.3681.02
Radio Commander	R&S®CP6000	6026.9026.20
Radio Loader Software Update	R&S®ZS6000	6026.9032.05
Test system for radio equipment of the R&S®M3xR family		
I-Level Special Test Equipment (I-STE for R&S®M3AR, R&S®M3SR, R&S®M3TR, R&S®Series2000, R&S®Series4200)	R&S®TS6030	5200.7050.02

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 2
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 aircrafts. Embassies, government authorities and armed forces around the world are the users of these radiocommunications solutions. Turnkey communications are our business. Whether ground-to-air VHF and UHF equipment for clear ATC communications on route and during approach, landing and take-off. Or short-wave 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: basic 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.

R&S®M3SR Series4100 Software Defined Radios

HF radio family for stationary and shipborne communications

- 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
- Frequency hopping capability
- Wide operating temperature range from –20 °C to +55 °C
- Interoperability with the R&S®M3TR tactical radio family

Rohde&Schwarz has developed a new 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 government authorities and organizations with security missions as well as military users all over the world.

The R&S®M3SR Series4100 of HF radios represents a new, innovative and versatile generation of software defined radios (SDR) that extends the popular R&S®M3SR radio family to include the HF frequency range. It supports frequency hopping and provides 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.

The most noteworthy feature of these radios is that their entire functionality is already built into the radio software. Desired functions are enabled on an application-specific basis using option keys.

Important equipment functions such as automatic link establishment (ALE) or HF modem are now implemented using purely software defined solutions instead of the old hardware-based approach. This means that the radios of the R&S®M3SR Series4100 have less plug-in modules compared to conventional radios.

Software defined radios save on logistics effort and thus reduce operating costs. In particular, the costs of warehousing spare parts as well as maintenance are reduced tremendously. Having less 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 and future-ready investment for customers.

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

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 in terms of the collocation capability of the radios due to the spatial proximity of the radios and low antenna decoupling values. However, due to the outstanding specifications of the radios of the R&S®M3SR Series4100 (with the optional addition of digitally tuned HF filters), such challenges are easily surmounted. The R&S®M3SR Series4100 radios fulfill the requirements stipulated in STANAG 4203, Annexes B+C. For HF parameters such as 2nd and 3rd order intercept, desensitization and crossmodulation immunity, the R&S®M3SR Series4100 sets new standards. For example, even without preselection the receiver provides 3rd order intercept (IP3) of typically > 40 dBm. 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 (option)
In real-world applications, mutual influences between adjacent transmitter lines due to low antenna decoupling values or close frequency spacing often result in overloading of transmitter output stages and thus to a power reduction due to reflected HF power. 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.

Frequency-agile pre-/postselectors improve the large-signal characteristics (option)
The optional HF pre-/postselectors are steep-edged bandpass filters with a relative bandwidth of a few percent which work at the transmitter and receiver ends. They can be precisely set to the relevant operating frequencies. The HF pre-/postselectors influence the performance of the radios in two ways. On the one hand, they increase the TX phase noise to values better than typ. –165 dBc (1 Hz). On the other, they further significantly increase the large-signal characteristics of the receive section, i.e. crossmodulation immunity, desensitization or 2nd and 3rd 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 is available in all modes with high selectivity and optimized for voice and data communications. Digital signal processing also provides functions for noise suppression.

Flexible range of applications

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.

For radio applications on ship and shore, broadband radio systems are also available with up to 32 radio lines and an output power of up to 4 kW. The R&S®M3SR Series4100 also includes a separate receiver as required in split-site applications, for example. The product portfolio is rounded out by system components such as antenna tuning units (ATUs) and dipole antennas from Rohde&Schwarz.

Local or remote operation
Suitable operating concepts are available to meet any requirement. The R&S®GB4000C control units for local or remote operation are equipped with a high-resolution 5" liquid crystal display which provides excellent readability even under poor lighting conditions. The ability to adjust the contrast and brightness as well as illuminated keys make it much easier to read off information. Hardkeys and softkeys plus a clearly designed user interface ensure ease of use when controlling the radio. Software defined remote control via the serial RS-232-C interface or via Ethernet is another alternative.

Power supplies for all standard electrical networks
For the 500 W and 1000 W transceiver systems of the R&S®M3SR Series4100, Rohde&Schwarz offers a number of power supplies to handle all of the electrical networks encountered in real-world scenarios. These power supplies have high efficiency and excellent power factor compensation.

Software defined radio system
All of the software components can be loaded into the radio using the R&S®RNMS3000 network management system. Relevant software packages are available for downloading. This means that you can expand the functionality without having to open the radio or exchange any hardware modules. You can query the current software status via the local control unit on the radio or remotely in the form of a list (inventory). The inventory contains the version of the radio software and its components.

Secure communications

EPM (ECCM) method for secure and jam-resistant voice and data links
In order to protect communications against tapping and spoofing, transmissions are encrypted (COMSEC). Electronic protection measures (EPM) based on frequency hopping effectively protect radio links against spoofing and jamming as well as against unintentional interference such as changing physical propagation conditions. Rohde&Schwarz developed its powerful R&S®SECOM-H frequency hopping method especially for the HF range. This method enables secure radiocommunications between army and navy over significant distances and in challenging terrains.

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

Powerful crypto algorithm
The COMSEC/TRANSEC crypto algorithm was developed by Rohde&Schwarz. It supports key lengths up to 256 bits. R&S®SECOM-H also includes a suite of modem waveforms that exhibit different degrees of immunity against Doppler effects and multipath propagation as are typical of shortwave links. R&S®SECOM-H was designed to allow secure transmission of voice (vocoder at 1200 bps/2400 bps) and data (300 bps to 2400 bps). R&S®SECOM-H is useful for planning secure radio networks for point-to-point, point-to-multipoint and broadcast operation.

Management of "black" keys offers additional security
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 fillgun. As an extension to its radio product portfolio, Rohde&Schwarz offers system components with frequency hopping capability such as amplifiers and antenna tuning units to allow the setup of radio lines with frequency hopping and up to 1000 W output power.

Data link capability in line with STANAG 5511 and STANAG 5522
Radios often need to fulfill special requirements if they are to be used for tactical data links. Requirements include:
- Fast switchover times between transmit and receive mode
- Special IF filter characteristics
- Fast automatic level control

The R&S®M3SR Series4100 HF transceiver systems are ideally suited for applications involving tactical data links. With their excellent specifications, they meet all requirements of the LINK methods:
- STANAG 5511/MIL-STD-203-1A: LINK11
- STANAG 5522: LINK22 (fixed frequency)

R&S®RNMS3000: centralized network, crypto, and frequency management capabilities for configuring Rohde&Schwarz radio networks

Today's armed forces apply communications planning in order to transform their combat radio equipment into a robustly networked communications system. They need a system that optimally supports the forces in accomplishing the mission at hand. R&S®RNMS3000 provides military leaders with the software they need to create such a system from their Rohde&Schwarz radios.

To provide mission-tailored and secure radio communications networks, the R&S®RNMS3000 software system does the following:

- Management of security keys
- Frequency assignments
- Establishment of logical nets

In particular, the R&S®RNMS3000's capability to manage NATO-specific waveforms, as well as general HF waveforms and Rohde&Schwarz proprietary waveforms, accents its broad scope of application. The R&S®RNMS3000 software supports centralized system management, i.e. where one central organizational unit performs all mission planning steps, as well as decentralized management, where the various configuration steps are accomplished at different echelons in the military hierarchy.

Moreover, the R&S®RNMS3000 software system provides a single data set that – when distributed to the required radios either via a fill device or a LAN connection – includes all parameters relevant to immediately using the radios within the defined logical network structure.

Easy operation

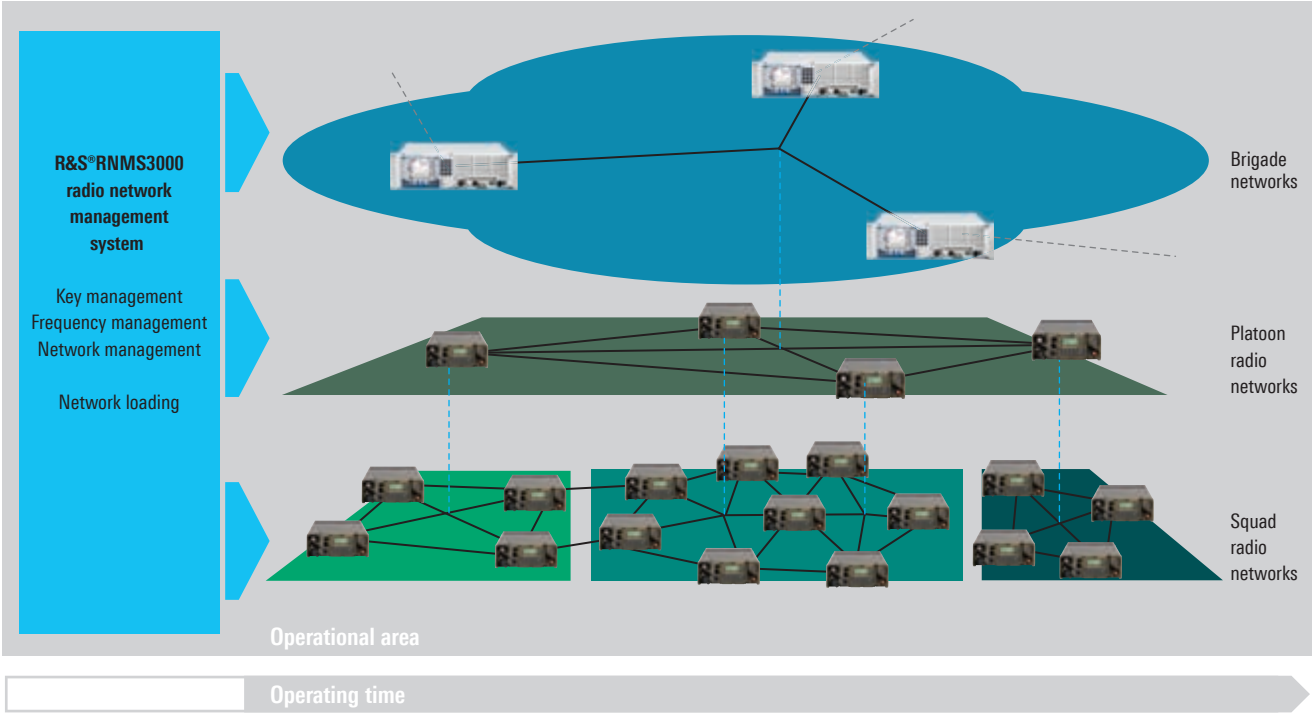
Clear status display

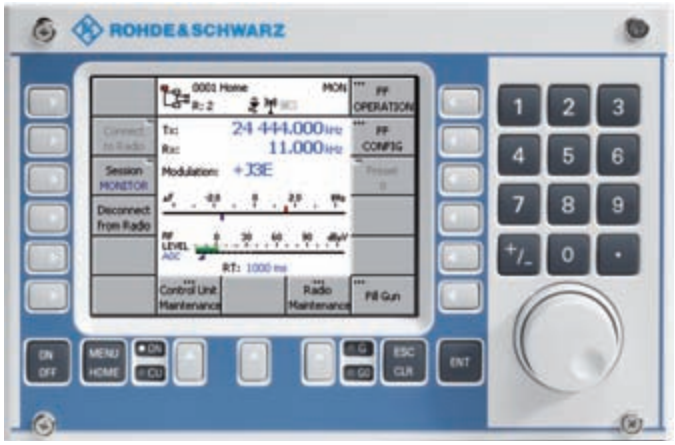
All required settings on the radio can be made locally using the optional R&S®GB4000C (model .35) local control panel. Status information such as the operating mode is displayed in the header area of the user interface. These status displays keep the user informed at a glance about the current mode setting on the radio or the user's access authorization. This increases the operational reliability and reduces the time needed for new users to get familiar with the radio.

Preconfigured menus

The user interface for the R&S®M3SR radio family has clearly structured menus that are divided 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-C or a fillgun.

Centralized network, crypto and frequency management capabilities





The user-oriented design of the GUI allows intuitive operation of the radio.

Low maintenance effort

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 provide support to 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.

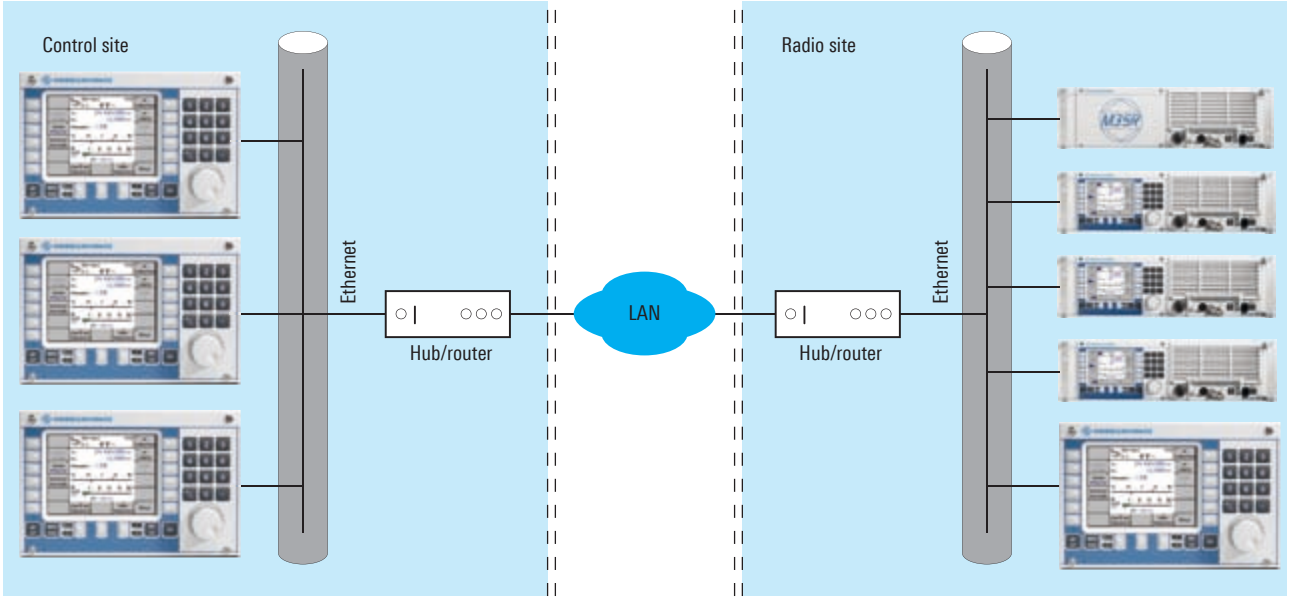
- Power-on BIT (PBIT)
- Continuous BIT (CBIT)
- Initiated BIT (IBIT)

The PBIT is a short self-test which 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 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. The IBIT is performed primarily after the radio has been reconfigured or

Remote control access with different levels of authorization
Using an R&S®GB4000C (model .36) remote control unit, it is possible to operate additional R&S®M3SR Series4100 radio systems if they are part of an IP network. Larger systems with multiple control units require the control of access rights. These access rights, known as sessions, are made available by the remote control unit and can be specified by the user. The status is shown on the display of the remote control unit.

Remote control concept



following software downloads. No additional external test equipment is required. Faulty modules detected by the IBIT can be exchanged quickly and easily. No adjustment of the radio is required.

Excellent reliability

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

Low life-cycle costs

- User-friendly operating concept reduces training costs
- High MTBF (in line with MIL-HDBK-217F) and low MTTR values (< 30 min)

The R&S®M3SR Series4100 contains less modules and components than a conventional radio since almost all of the functionality is implemented using embedded software. This considerably simplifies the supply and warehousing of spare parts. Problems with obsolete hardware modules are now a thing of the past. Radios with older software versions can be upgraded simply by downloading new software. The different standards that make up the "HF house" are also available for the R&S®M3TR family of tactical radios.

Future-ready and safe investment

Standards from the "HF house" can be upgraded as software option

- HF modem 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
- Automatic link establishment (ALE), 2nd generation, MIL-STD-188-141B, App. A + B
- Automatic link establishment (ALE), 3rd generation, STANAG 4538 (fast link setup)
- Data link protocols LDL, HDL from STANAG 4538

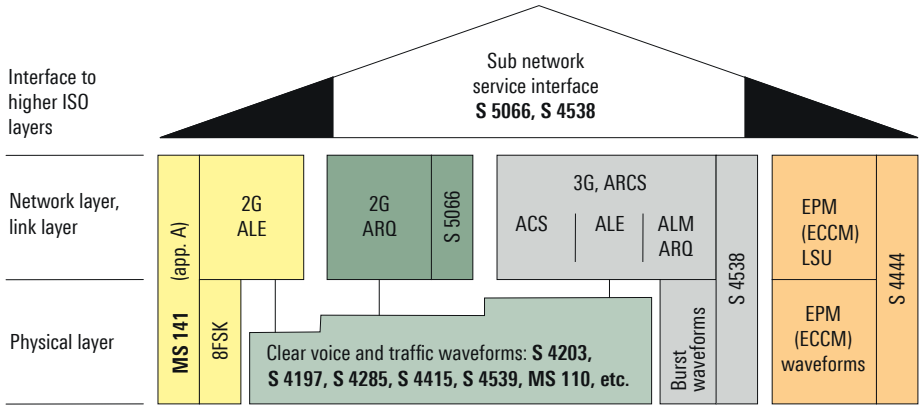
Future changes in standards can be taken into account in product and program planning

The "HF house" is a structured overview of different HF standards that have been ratified by the NATO countries. These are living standards which are revised at regular intervals. These changes are taken into account as part of the product and program planning for the R&S®M3SR Series4100 and provided to customers in the form of software updates.

STANAG 4203	Technical standards for HF radio equipment
STANAG 4415	NATO robust waveform, 75 bit/s
STANAG 4285	Single tone modem, up to 3600 bit/s
STANAG 4529	Single tone modem, up to 1800 bit/s
STANAG 4539	Single tone modem, up to 12800 bit/s
MIL-STD-188-110A/B	Single tone modem, up to 12800 bit/s (≈ STANAG 4539)
MIL-STD-188-141A/B	Automatic link establishment, second generation (FED-STD-1045/1046/1049)
MIL-STD-188-110B App. F	ISB modem, up to 19200 bit/s
STANAG 5066	Profile for HF radio data communications
STANAG 4538	Automated radio control system (ARCS)
STANAG 4444	NATO HF slow hopping waveform

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

"HF house"



The "HF house" is a structured overview of different HF standards that have been ratified by the NATO countries.

Sample applications

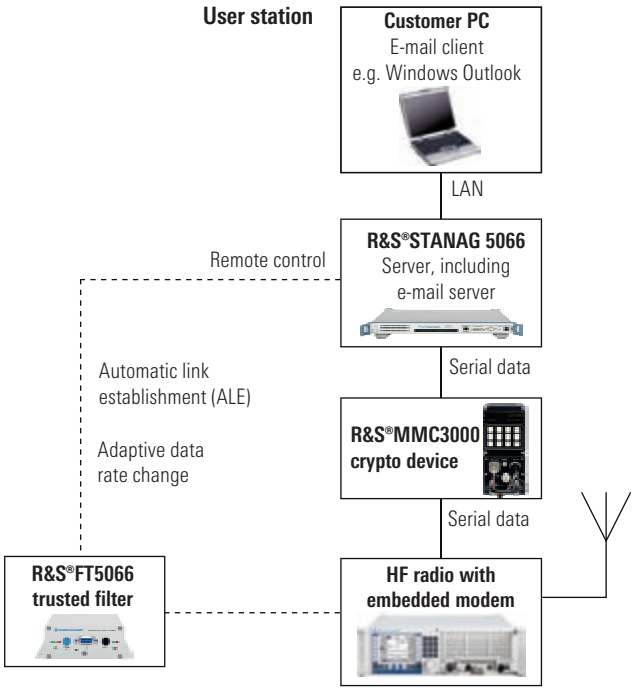
Interoperable data communications with R&S®STANAG 5066

The exchange of e-mail and IP-based information is vital for the successful planning and execution of military operations. Interoperable and robust data exchange within joint and allied forces over long-distance high frequency (HF) radio networks is essential in these operations, especially if communications via other infrastructure means such as satellites are not available.

R&S®STANAG 5066 is a data communications system that exactly meets these requirements. Communications by e-mail, fax, and chat, as well as the capability to use IP-based applications via HF networks in accordance with the leading STANAG 5066 HF NATO protocol provide interoperability and robustness. These applications, the capability to control Rohde&Schwarz radios such as the R&S®M3SR Series4100, and the unique red/black separation by crypto devices and trusted filters build a complete secure communications solution from Rohde&Schwarz.

The standard-conforming R&S®STANAG 5066 data exchange has proven its mettle in various customer installations and has demonstrated its interoperability with competitor STANAG 5066 systems in various international HF interoperability trials.

Interoperable data communications



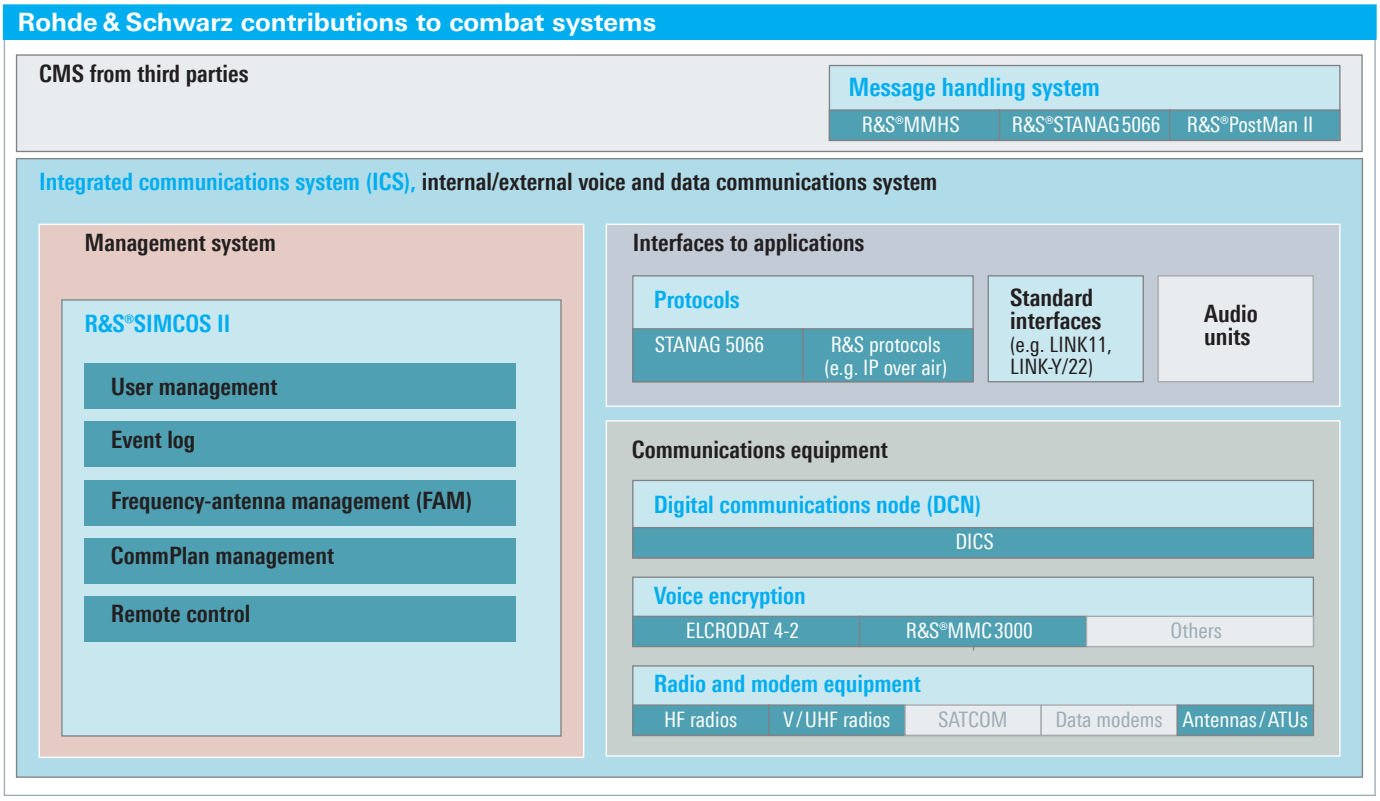
Integrated naval communications systems

Integrated communications systems (ICS) are mandatory for the efficient command and control of modern ships. They must be able to manage ship-internal communications as well as provide the reliable exchange of strategic, tactical and administrative information between ships and naval shore stations.

R&S®SIMCOS II is a signal management and control system which, when combined with a digital communications node, allows the flexible and therefore efficient interconnection of audio consoles, radios, modems, encryption devices, and antennas to form complete radio lines.

The management and control of radio lines includes the wizard-supported creation of communications plans, the configuration of devices under remote control, and continuous monitoring, thus providing a detailed overview of the status of all radio line components.

The R&S®STANAG 5066 and R&S®MMHS message handling systems can be seamlessly integrated into R&S®SIMCOS II.



HF transmit/receive broadband system

It is a flexible and modular multiline radio system for the HF frequency range. The applications range from shore radio stations to navy ships 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.

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.

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 an extremely low-maintenance system with superior reliability.

R&S®GV4190D power management unit – a modular component of the HF broadband system

The broadband block is a modular component of the HF broadband system. It consists of 1000 W transceiver systems, the appropriate passive, highly linear line couplers 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, line couplers and filters. In the case of coherent power addition, the PMU also ensures that the signals to be added are in phase. Multiple broadband blocks can be merged into a maximum of 32 radio lines. Using the PMU, the channel spacing between adjacent radio lines can be adjusted to a minimum of 1 percent. The individual radio lines can be occupied by any of the waveforms supported by the R&S®M3SR Series4100 including:

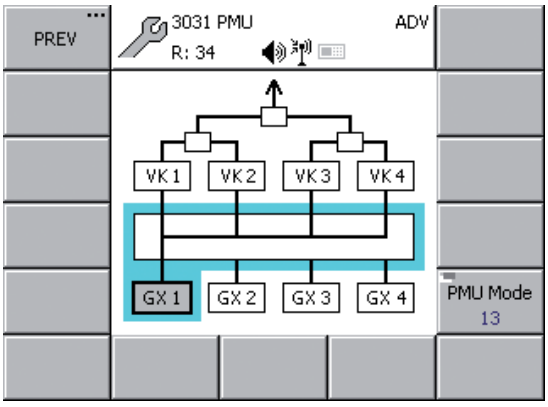
- Voice (SSB, AM, FM)
- Radio teletype (RATT)
- Modem (e.g. STANAG 4285, STANAG 4539)
- Automatic link establishment (ALE-2G/3G)
- Tactical data links (e.g. LINK11, LINK22)
- EPM (ECCM) paths

The HF broadband system comes with its own receive antenna system. Using a splitter, the receive signal is distributed to the transceiver systems, whose receivers are also used in the system. The audio signals (voice and data) are typically fed in via an intercom system.

Example: 16-line HF broadband system.

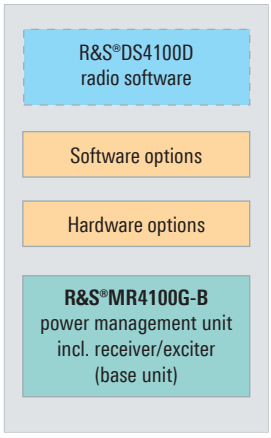
Local control

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.

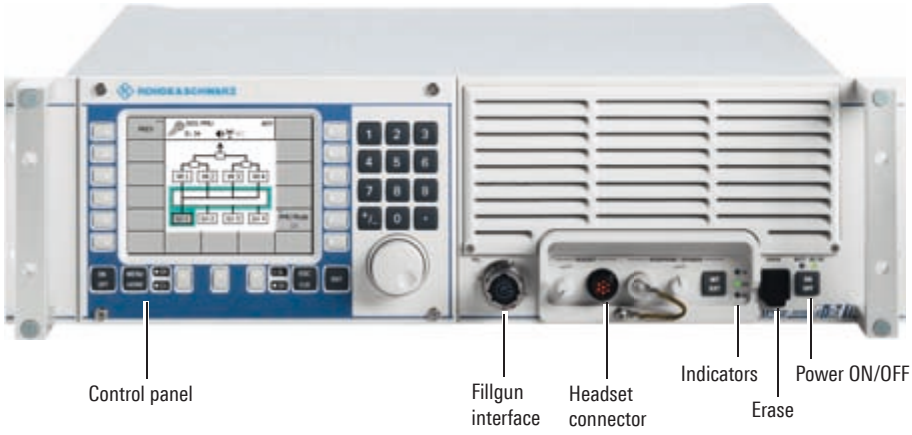


User interface of the R&S®GV4190D power management unit.

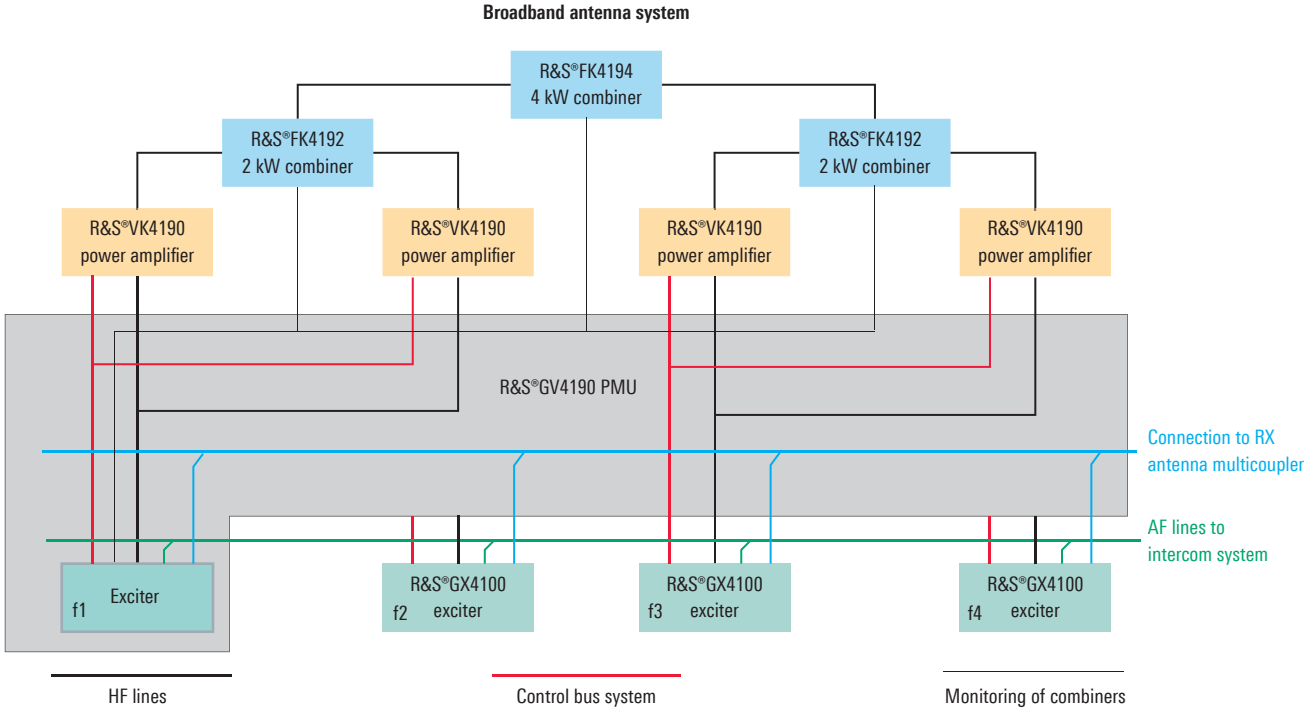
R&S®GV4190D



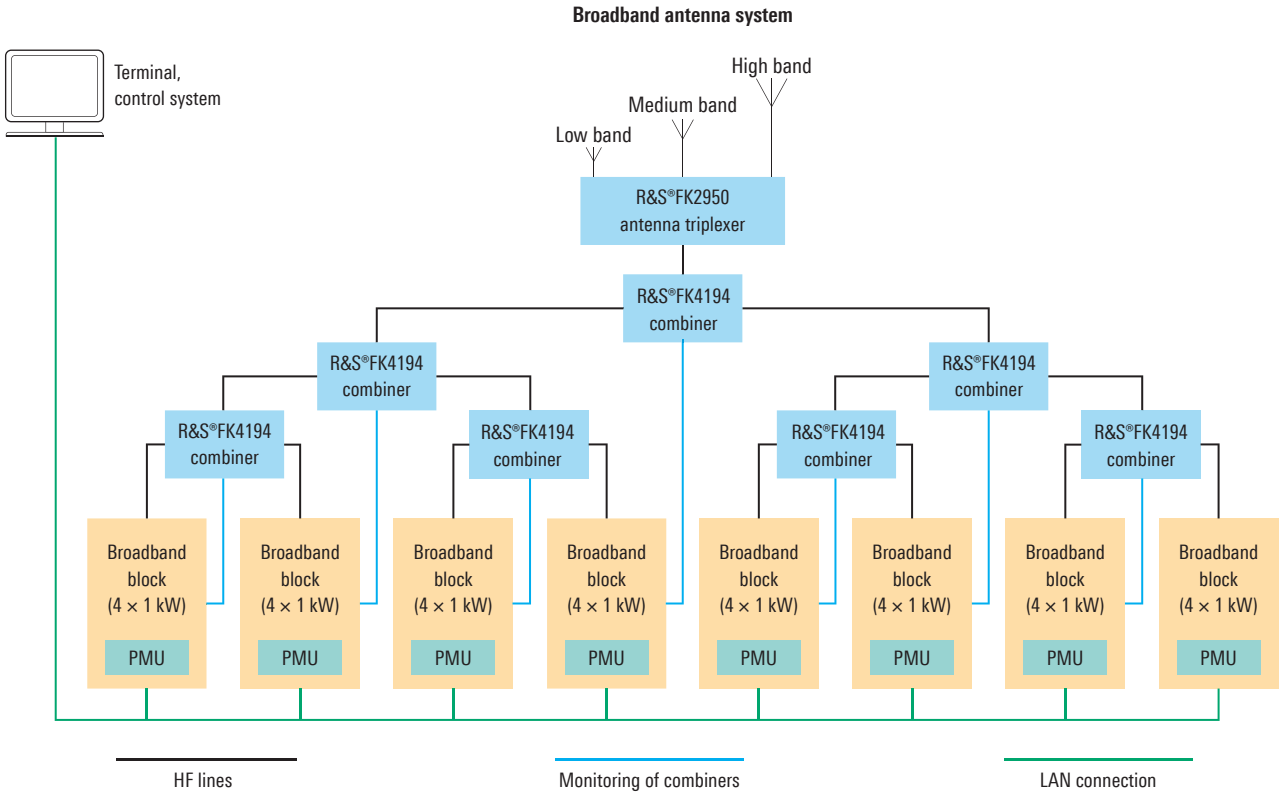
R&S®GV4190D power management unit: front view



4 × 1 kW radio lines and power management unit form a broadband block



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



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

Through the right combination of coherent and non-coherent 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 non-coherent mode and results in attenuation of the input power by 3 dB (= factor of 2).

R&S®FK2950 Antenna Triplexer
R&S®FK2960 Antenna Diplexer

After combining the RF power lines with the cascaded 3 dB coupling devices, the RF transmit signals are routed to an HF broadband antenna system, which 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 1.5 MHz to 30 MHz can be used.

For specifications see data sheet PD 5214.1243.22

R&S®FK4192/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 function is explained by means of the following simple example:

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 and in phase
- B: not identical, not coherent

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

- Case A: At the output of the coupler, the sum of the powers of the two signals (P3 = P1 + P2) appears. The residual loss is typically less than 0.4 dB
- Case B: At the output of the coupler, the sum of the half powers of the two signals (P3 = 0.5 × P1 + 0.5 × P2) appears. 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 non-coherent combination, is dissipated in a load resistor connected to the fourth port of the coupler

This typical behavior of a coupler allows the coupler loss to be controlled by appropriate and intelligent selection of the input signals, which in practice is the task of the power management unit. The unit is controlled by the operator from the communications workstation in the operator console.

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.

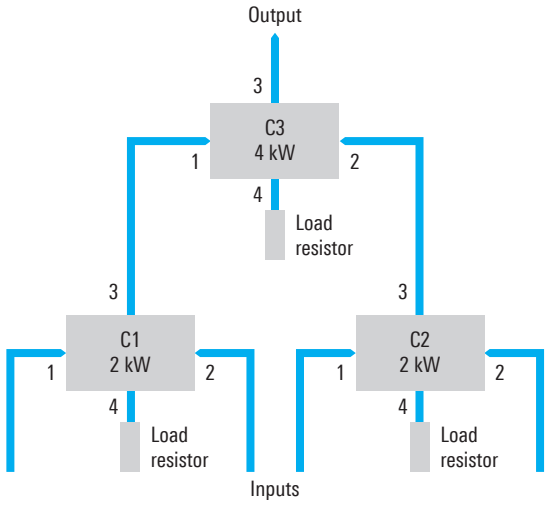
The nominal insertion loss is between 0.2 dB and 0.4 dB. The coupling loss is 0 dB in case A and 3 dB in case B. The isolation of the coupler – typ. 25 dB for adjacent lines, higher for non-adjacent lines – determines the backdoor intermodulation in the power amplifiers. The primary source of backdoor intermodulation is therefore between two adjacent power amplifiers that are combined by a coupler. The amplifier-to-amplifier paths in the combiner add a multiple of 3 dB to the isolation.

Each coupler can accept a maximum of 1122 W (R&S®FK4192) or 2 kW (R&S®FK4194) input power per input port. Since the power combining unit consists only of passive and solid-state devices, there are no limitations on frequency-agile EPM (ECCM) operating modes and frequency separation between the various HF transmitting channels.

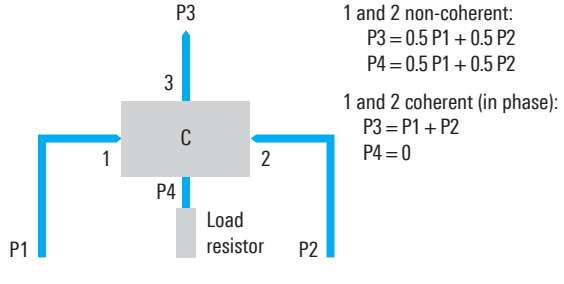
In addition, these passive devices feature an outstanding MTBF of up to 18000 h (depending on the operational configuration, power levels used, coherent or non-coherent, etc.) and thus excellent availability.

For specifications see data sheet PD 5214.1243.22

Configuration



Configuration



Logistical structure

Base radio models

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 exciter and the R&S®XK4115 150 W transceiver. The radio models are available as ruggedized models with a splashproof IP32 front panel. The software for these base models which are known as R&S®MR4100x can be ordered in the form of "A" software (with no export restrictions) or "D" software (requiring an export license).

Hardware and software options

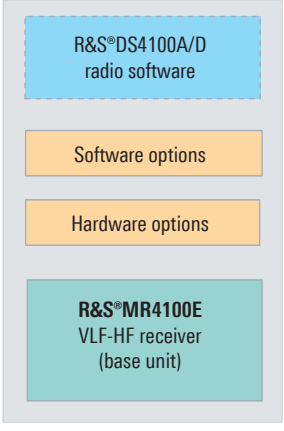
To configure individual hardware and software options plus the appropriate radio software, refer to the ordering information starting page 51.

The final type designation and the associated order number for a custom-configured R&S®EK4100A/D or R&S®XK4115A/D or R&S®GV4190D base unit are order-specific. This makes it possible to clearly identify any customized unit with all of its options using a unique order number.

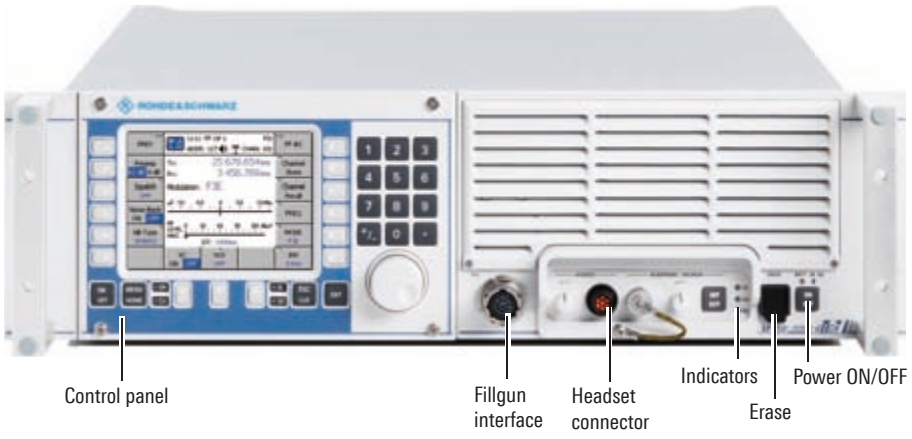
R&S®EK4100A/D VLF-HF receiver

A receiver can be operated on 28 V DC voltage (19 V to 31 V) or 230 V AC voltage (90 V to 264 V, 50/60 Hz).

R&S®EK4100A/D



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



R&S®XK4115A/D 150 W transceiver

A transceiver can be operated on 28 V DC voltage (19 V to 31 V) or, with an external R&S®IN4000A power supply, on 230 V AC voltage (100 V to 240 V, 50/60 Hz).

R&S®IN4000A External Power Supply

The R&S®IN4000A is a compact, all-purpose AC/DC power supply designed for use with air traffic control, air defense and naval radiocommunications systems. The R&S®IN4000A supplies power to a variety of R&S®M3SR radios and system components.

The R&S®IN4000A features a wide AC input range that provides extremely 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. A well-engineered cooling concept keeps the power supply continuously cool, significantly increasing the life of the device. These features allow continuous operation. An integrated built-in test equipment (BITE) constantly checks the status of the power supply. In case of malfunctions, the device status is automatically transferred to a superordinate system. In addition, optical indicators show the status of the device. The unit complies with STANAG 1008 ed. 8 for shipborne applications.

The following conditions are constantly checked:
- Temperature
- Input voltage

The power supply complies with EN 61000-3-2 so that it does not inject harmonic currents into the public supply network. Integrated overvoltage, overload and short circuit protection make the R&S®IN4000A external power supply an extremely robust and reliable system component.

Electromagnetic emissions fall within the limits defined in military specifications. Other characteristics such as high immunity to vibrations and a wide operating temperature range fulfill standard customer requirements.

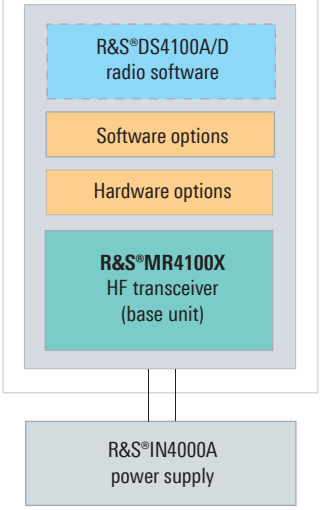
The R&S®IN4000A external power supply is also available with a ruggedized front panel that conforms to protection class IP32. A dust filter protects the power supply against external substances that can impact the life of the device. The device comes with two different DC output voltages. Its housing is designed for installation in standard 19" rackmounts. The low weight and small height of the power supply as well as the utilization of standard connectors ensure a quick and permanently secure installation.

Specifications in brief (R&S®IN4000A)

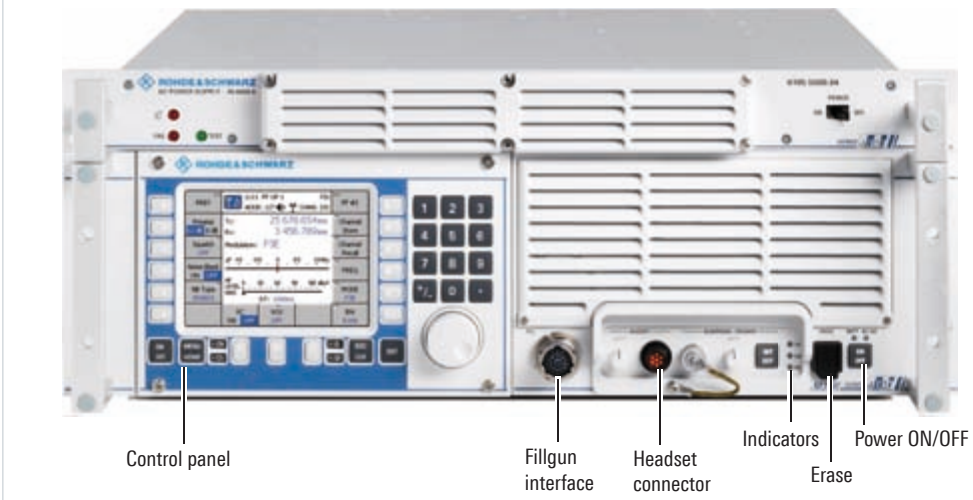
See also Data Sheet PD 5213.5468.32

Input	
Input voltage	100 V to 240 V, 50/60 Hz, 115 V at 50/60/400 Hz
Current drain	8.5 A to 3.4 A
Output (open-circuit- and short-circuit-proof)	
Output voltage	28.4 V (when delivered) 24 V (via jumper)
Output current	25 A
Cooling	built-in fans
Max. output power	700 W
Residual ripple	$V_{pp} \leq 1\%$, $V_{RMS} \leq 5$ mV for f > 50 kHz
MTBF	23000 h GB at +21 °C in line with MIL-HDBK-217F
Permanent short-circuit protection	yes
Overload protection	yes
Electrical safety	in line with EN 60950-1, EN 60215
Mechanical data	
Dimensions	19" plug-in, 1 height unit, depth 420 mm (16.54 in)
Weight	approx. 5.8 kg (12.77 lb)

R&S®XK4115A/D



R&S®XK4115A/D transceiver with external power supply: front view



500 W/1000 W transceiver systems

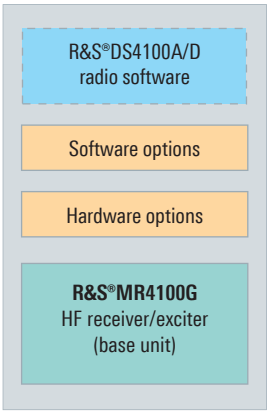
To cover large distances, flexible system solutions with an output power of 500 W and 1000 W are offered. These solutions furthermore provide exceptionally high radio link availability – even under moderate propagation conditions.

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

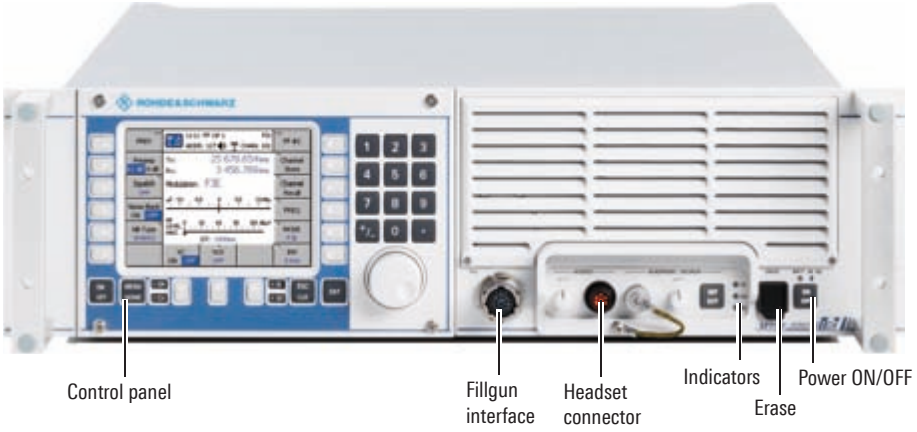
A 500 W or 1000 W transceiver system consists of the following components:

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

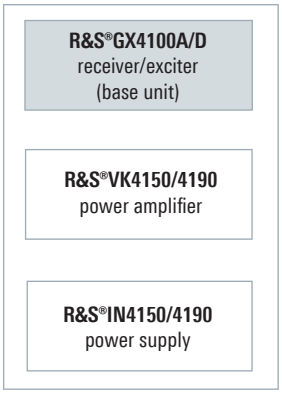
R&S®GX4100A/D



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



Transceiver system



R&S®VK4150/VK4190 power amplifiers

The digitally controlled R&S®VK4150/VK4190 power amplifiers are available in a standard version or a special version with built-in receiver input protection. This option reliably protects the receiver input from destruction in the presence of HF interference on the antenna (caused by nearby transmitters) up to 100 V (RMS) (corresponding to a power of 200 W into 50 Ω).

The R&S®VK4150/VK4190 with built-in receiver input protection should be selected whenever undisturbed reception of useful signals is required under extreme conditions.

- Available for 500 W and 1000 W transceiver systems
- Rugged design, high MTBF
- Special version with built-in receiver input protection available
- Selective level control option prevents power control from being affected during normal operation by in-service transmitters located nearby

Transceiver system

- **R&S®GX4100A/D** receiver/exciter (base unit)
- **R&S®VK4150/4190** power amplifier
- **R&S®IN4150/4190** power supply

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

R&S®IN4150/IN4190 standard power supplies

- CE conformity in line with EN 60945 and ETSI EN 300373-1/-2/-3
- Compliant with MIL-STD-1399, section 300A and STANAG 1008, edition 8
- Different models available for all conventional electrical networks
- Excellent efficiency (> 85 %)
- State-of-the-art power factor compensation (> 95 %)
- Automatic switchover between AC and battery supply in case of power failure
- Compact 19" design, only three height units per radio

Transceiver system

- **R&S®GX4100A/D** receiver/exciter (base unit)
- **R&S®VK4150/4190** power amplifier
- **R&S®IN4150/4190** power supply

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

R&S®IN41x0/BV4190 power supply (top) in three-phase operation at 440 V with external R&S®BV4190 transformer (bottom).

Hardware options for receiver, exciter and transceiver

R&S®GB4000C control unit for controlling and monitoring R&S®M3SR software defined radios

The R&S®GB4000C control unit is used for controlling, configuring and monitoring R&S®M3SR radios via Ethernet. With its large and clearly arranged color display and software defined keys, this unit allows flexible and easy operation. The functionality is exclusively defined by the software loaded.

- Control and monitoring of all operating modes and parameters manually and by presets via Ethernet link
- Monitoring of equipment status
- Acquisition/display of equipment configuration (inventory report)
- Manual setup of equipment configuration
- Control of different user levels with password protection
- Internal self-test functions (BITE)
- Long life and very low life cycle costs

The R&S®GB4000C is available as a stand-alone remote control unit and as an embedded local control panel of the R&S®M3SR Series4100 and Series4400 software defined radios. The control panel comes as a standard model and as a ruggedized model for demanding environmental conditions.

Specifications in brief

General data	
Input	
Input voltage	100 V to 240 V, 50/60 Hz 115 V at 50/60/400 Hz
Current drain	8.5 A to 3.4 A
Output (open-circuit- and short-circuit-proof)	
Output voltage	28.4 V (when delivered) 24 V (via jumper)
Output current	25 A
Cooling	built-in fans
Max. output power	700 W
Residual ripple	$V_{pp} \leq 1\,\%$, $V_{RMS} \leq 5$ mV for f > 50 kHz
MTBF	23000 h GB at +21 °C in line with MIL-HDBK-217F
Permanent short-circuit protection	yes
Overload protection	yes
Electrical safety	in line with EN 60950-1, EN 60215
Mechanical data	
Dimensions	19" plug-in, 1 HU, depth 420 mm (16.54 in)
Weight	approx. 5.8 kg (12.77 lb)

R&S®FK4120/FK4140
Digitally Tuned RF Selection

The R&S®FK4120/FK4140 digitally tuned RF selections are optional plug-in modules for the radios of the R&S®M3SR Series4100. They increase the selectivity of the transmit and receive paths. Receiver parameters such as 2nd and 3rd 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).

These digitally tuned RF selections are recommended if you need to receive 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.

- Five-circuit lowpass filter (0 Hz to 1.5 MHz) for receive frequencies below 1.5 MHz
- Digitally tuned tracking bandpass filters (1.5 MHz to 30 MHz) with 20 dB or 40 dB edge steepness at 10% frequency offset
- Automatic tracking in both receive and transmit modes
- Input voltage protection up to 200 V (RMS)
- Frequency hopping capability in line with R&S®SECOM-H

R&S®GS4102 NMEA (DSC) Interface

The NMEA (DSC) interface is necessary when the R&S®M3SR Series4100 transceiver systems are used to forward distress calls that are located by an external GMDSS monitoring and communications system. The NMEA interface can be added to the R&S®XK4115A/D 150 W transceiver or the R&S®GX4100A/D exciter for the 500 W and 1000 W transceiver systems.

R&S®GP3000 Fillgun for R&S®M3SR Series4100 radios

The fillgun (data load device) is used to transfer configuration data to one or more R&S®M3SR Series4100 radios. Its particular advantage is that data can be distributed to radios without requiring additional hardware such as PCs and power supplies.

Configuration can include the following, for example (depending on loaded software options):

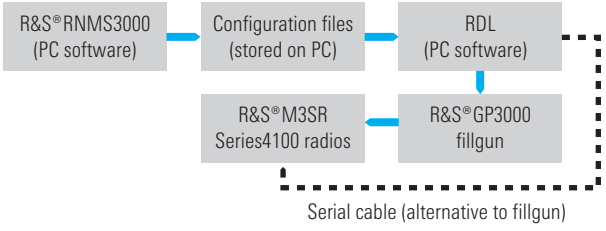
- Transceiver operating modes (FF, FH, ALE, voice/data modes)
- Assignment of nets and channels to preset pages (up to 99)
- Frequencies and hop sets of presets
- Configuration of data modems
- Simplex or semiduplex operation
- Channel parameters (modulation, squelch type, power, voice compression, etc.)
- Address management, SECOM/ALE addresses, ptp, ptm link management
- Modem configuration, modem support
- Security keys for TRANSEC and COMSEC

The fillgun needs no power supply since it is supplied by either the connected PC or the radio. The fillgun status is indicated by LEDs (power on, reading, writing, connected, error). Operation is simple and straightforward. After setting up a net configuration with R&S®RNMS3000, the generated configuration files are stored in the fillgun via the serial interface (USB) of the PC running R&S®RNMS3000 and the remote data loader (RDL).

The fillgun now contains the necessary preset information for all radios of the addressed network(s). Configuration data may differ between the subscribers (radios) of a net; therefore, each radio will download the information that was specifically generated for it during the network management process.

At the radio site, operator action is limited to choosing the appropriate radio global address (RGA) in the radio HMI to assign a radio to its preconfigured configuration. After finishing the download process, the radio will reboot and be fully operational afterwards. All files transferred from and to the fillgun are encrypted before loading. Sensitive data such as keys is therefore stored in the fillgun in black form only.

R&S®GP3000 fillgun configuration



Specifications in brief

Data rate on serial interfaces	up to 115.2 kbit/s
Data rate on USB interface	in line with standard USB 1.1 full speed
External power supply	serial: provided by R&S®M3SR (19 V to 31 V DC) USB: provided by PC (+5 V DC)
Internal supply	no internal battery
Memory	nonvolatile, 32 Mbyte
Connection to radio	connector fitting directly into the DATA connector of the R&S®M3SR radio
Connector to PC	via USB cable
Dimensions (length × diameter) (maximum, cylindrical shape)	100 mm × 40 mm (3.94 in × 1.57 in)
Weight	< 200 g (0.44 lb)

Software options for receiver, exciter and transceiver

The most noteworthy feature of the R&S®M3SR Series4100 radios is that all of the functionality is already contained in the radio software. Desired functions are simply enabled on an application-specific basis using option keys.

R&S®GS4101S ALE-2G Software (FED-STD-1045/1046/1049)

R&S®GS4101S is the ALE software for the 2nd generation of 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®GS4101S can only be enabled in R&S®DS4100D.

R&S®GS4155S ALE-3G

ALE-3G (automatic link establishment, 3rd generation) offers significant benefits compared to ALE-2G, including significantly faster and more robust link setup, improved automatic channel selection algorithms and embedded data link protocols. The layer 2 protocols known as LDL (low latency data link protocol) and HDL (high rate data link protocol) have the benefit of improved robustness at low S/N values compared to conventional protocols.

The R&S®GS4155S option features the following functions:

- ALE-2G (FED-STD-1045/1046/1049)
- ALE-3G (STANAG 4538, fast link setup)
  - LDL (low latency data link protocol)
  - HDL (high rate data link protocol)
  - Linking protection
- Interoperability with ALE-2G

R&S®GS4155S can only be enabled in R&S®DS4100D.

R&S®GS3001S SECOM-H EPM (ECCM) Waveform

The R&S®SECOM-H EPM (ECCM) waveform has set new standards in the area of secure communications. It uses a powerful crypto algorithm to provide optimum protection against detection, tapping or jamming of radiocommunications. The keys required for the EPM (ECCM) method (COMSEC and TRANSEC) can be loaded into the radio using a fillgun. Alternatively, the keys can also be loaded into the radio directly from a PC via the LAN interface.

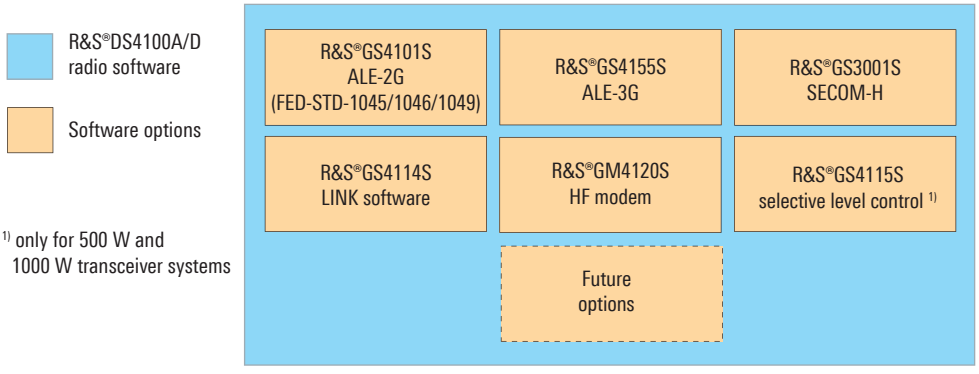
R&S®GS3001S can only be enabled in R&S®DS4100D.

R&S®GS4114S LINK Software

The R&S®GS4114S LINK software makes the radio parameters comply with the STANAG 5511, STANAG 5522, and MIL-STD-188-203-1A standards. External LINK11 as well as LINK-Y or LINK22 modems (fixed frequency) can be connected directly to the radio.

R&S®GS4114S can only be enabled in R&S®DS4100D.

Software options



The radio software can be ordered in the "A" version (without export restrictions) or the "D" version (export license required).

R&S®GM4120S HF Modem

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 STANAG 4539 HF modem provides transmission data rates from 75 bit/s to 12800 bit/s. It is the recommended modem for new projects within NATO. It automatically adapts the receiving data rate and is used preferably with the R&S®STANAG 5066 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 has a very good performance compared to the competition and is robust in case of multipath propagation. STANAG 4539 includes the STANAG 4415 modem standard.

The MIL-STD-188-110B App. F waveform uses independent sidebands for high-speed data transmission with up to 19200 bps. 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 bps to 1200 bps.

STANAG 4481 is a traditional FSK and PSK waveform for navy applications and data rates from 50 bps to 600 bps.

STANAG 5065 allows shore-to-ship broadcast reception using the low frequency band, specially from 60 kHz to 160 kHz.

R&S®GM4120S can only be enabled in R&S®DS4100D.

R&S®GS4115S Selective Level Control

In real-world applications, mutual influences between adjacent transmitter lines as a result of low antenna decoupling values or insufficient frequency spacing can cause overloading of transmitter output stages as well as power reductions due to reflected HF power. The optional selective directional coupler in the power amplifiers makes it possible to perform narrowband weighting of the transmit signal and the reflected antenna power. This ensures that the transmitter power control is not influenced by extraneous signals during normal operation.

R&S®GS4115S can be enabled in R&S®DS4100A and R&S®DS4100D.

System overview

R&S®M3SR Series4100 power classes

Please note: All base units are also available as ruggedized models

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

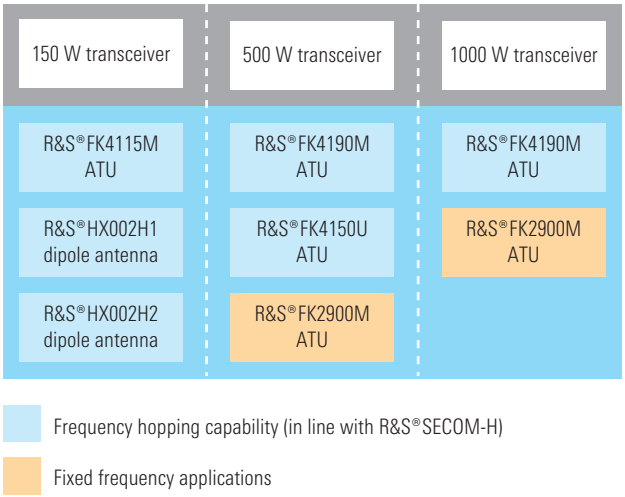
R&S®IN4190 power supply

Antenna tuning units/HF dipole antennas

Optimal narrowband antenna matching of the radio equipment for each power class is provided by means of highly efficient antenna tuning units (ATUs) and dipole antennas as follows:

Type	Designation	Page
R&S®FK4115M	Antenna Tuning Unit	104
R&S®FK4150U	Antenna Tuning Unit	107
R&S®FK4190M	Antenna Tuning Unit	109
R&S®FK2900M	Antenna Tuning Unit	112
R&S®HX002H1	HF Dipole	122
R&S®HX002H2	HF Dipole	123
R&S®HX002M1	HF Dipole	124

R&S®M3SR Series4100 overview



Ordering information

Designation	Type	Order No.
R&S®EK4100A/D receiver		
Base unit		
VLF-HF Receiver; AC/DC; without local control panel and radio software; ruggedized model	R&S®MR4100E	6118.9609.12
Radio software		
Software CD without export restriction	R&S®DS4100A	6119.7800.xx
Software CD with export restriction	R&S®DS4100D	6119.7900.xx
Hardware options		
Local Control Panel (without audio; including software and LAN), ruggedized model	R&S®GB4000C	6105.6006.35
Digitally Tuned RF Selection, 20 dB, functional for transmitting and receiving section	R&S®FK4120	6119.5007.02
Digitally Tuned RF Selection, 40 dB, functional for transmitting and receiving section	R&S®FK4140	6119.6003.02
NMEA (DSC) Interface, for connecting an external DSC controller (GMDSS)	R&S®GS4102	6119.3504.02
Software options (option keys)		
ALE-2G (FED-STD-1045/1046/1049)	R&S®GS4101S	6120.6003.02
ALE-2G (FED-STD-1045/1046/1049), STANAG 4538/ALE-3G (FLSU, LP, HDL, LDL)	R&S®GS4155S	6142.7560.02
LINK Capability in line with STANAG 5511, STANAG 5522 (fixed frequency), LINK-Y	R&S®GS4114S	6142.7619.02
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®GM4120S	6142.7519.02
Mating connector set		
Mating Connector Set for R&S®MR4100E	R&S®ZF4101	6120.5007.05
R&S®XK4115A/D transceiver		
Base unit		
HF Transceiver, 150 W; DC; without local control panel and radio software; ruggedized model	R&S®MR4100X	6119.7251.12
Radio software		
Software CD without export restriction	R&S®DS4100A	6119.7800.xx
Software CD with export restriction	R&S®DS4100D	6119.7900.xx
Hardware options		
Local Control Panel (without audio; including software and LAN), ruggedized model	R&S®GB4000C	6105.6006.35
Digitally Tuned RF Selection, 20 dB, functional for transmitting and receiving section	R&S®FK4120	6119.5007.02
Digitally Tuned RF Selection, 40 dB, functional for transmitting and receiving section	R&S®FK4140	6119.6003.02
NMEA (DSC) Interface, for connecting an external DSC controller (GMDSS)	R&S®GS4102	6119.3504.02
Software options (option keys)		
R&S®SECOM-H EPM (ECCM) Software	R&S®GS3001S	6095.4859.02
ALE-2G (FED-STD-1045/1046/1049)	R&S®GS4101S	6120.6003.02
ALE-2G (FED-STD-1045/1046/1049), STANAG 4538/ALE-3G (FLSU, LP, HDL, LDL)	R&S®GS4155S	6142.7560.02
LINK Capability in line with STANAG 5511, STANAG 5522 (fixed frequency), LINK-Y	R&S®GS4114S	6142.7619.02
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®GM4120S	6142.7519.02
Power supply units		
Power Supply, 230 V AC, 1 phase, ruggedized model	R&S®IN4000A	6105.5500.04
Mating connector sets		
Mating Connector Set for R&S®MR4100X	R&S®ZF4101	6120.5007.02
Mating Connector Set for R&S®IN4000A	R&S®ZF4001	6105.7002.02
Power supply cables		
Power Supply Cable, R&S®XK4115 ↔ R&S®IN4000A; 0.5 m length	R&S®GK4103	6120.5807.05
Power Supply Cable, R&S®XK4115 ↔ R&S®IN4000A; 1 m length	R&S®GK4103	6120.5807.10
Power Supply Cable, R&S®XK4115 ↔ R&S®IN4000A; 2.5 m length	R&S®GK4103	6120.5807.25

Ordering information

Designation	Type	Order No.
500 W and 1000 W transceiver systems		
Base unit		
HF Receiver/Exciter, DC; without local control panel and radio software; ruggedized model	R&S®MR4100G	6118.9750.12
Radio software		
Software CD without export restriction	R&S®DS4100A	6119.7800.xx
Software CD with export restriction	R&S®DS4100D	6119.7900.xx
Hardware options		
Local Control Panel (without audio; including software and LAN); ruggedized model	R&S®GB4000C	6105.6006.35
Digitally Tuned RF Selection, 20 dB, functional for transmitting and receiving section	R&S®FK4120	6119.5007.02
Digitally Tuned RF Selection, 40 dB, functional for transmitting and receiving section	R&S®FK4140	6119.6003.02
NMEA (DSC) Interface, for connecting an external DSC controller (GMDSS)	R&S®GS4102	6119.3504.02
Software options (option keys)		
R&S®SECOM-H EPM (ECCM) Software	R&S®GS3001S	6095.4859.02
ALE-2G (FED-STD-1045/1046/1049)	R&S®GS4101S	6120.6003.02
ALE-2G (FED-STD-1045/1046/1049), STANAG 4538/ALE-3G (FLSU, LP, HDL, LDL)	R&S®GS4155S	6142.7560.02
LINK Capability in line with STANAG 5511, STANAG 5522 (fixed frequency), LINK-Y	R&S®GS4114S	6142.7619.02
Selective Level Control (PA)	R&S®GS4115S	6120.6703.02
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®GM4120S	6142.7519.02
Power amplifiers		
500 W HF Power Amplifier	R&S®VK4150	6119.9002.03
500 W HF Power Amplifier with receiver input protection	R&S®VK4150	6119.9002.13
1000 W HF Power Amplifier	R&S®VK4190	6120.1501.03
1000 W HF Power Amplifier with receiver input protection	R&S®VK4190	6120.1501.13
Power supply units for 500 W transceiver system		
Power Supply 230 V AC; 1 or 3 phases + N/208 V AC; 3-phase Δ	R&S®IN4150	6120.0705.02
Power Supply 440 V AC; 3 phases (used together with R&S®BV4190 transformer)	R&S®IN4150	6120.0705.03
Power Supply 220 V DC	R&S®IN4150	6120.0705.12
Power Supply 115 V AC; 1 phase + N	R&S®IN4190	6120.2708.02
Transformer 440 V AC; 3-phase Δ	R&S®BV4190	6120.2908.02
Power supply units for 1000 W transceiver system		
Power Supply 230 V AC; 1 or 3 phases + N/208 V AC; 3-phase Δ	R&S®IN4190	6120.2708.02
Power Supply 440 V AC; 3 phases (used together with R&S®BV4190 transformer)	R&S®IN4190	6120.2708.03
Transformer 440 V AC; 3-phase Δ	R&S®BV4190	6120.2908.02
Mating connector sets		
Mating Connector Set for R&S®MR4100G	R&S®ZF4101	6120.5007.04
Mating Connector Set for R&S®VK4150/R&S®VK4190	R&S®ZF4103	6120.5207.02
Mating Connector Set for R&S®IN4150/R&S®IN4190	R&S®ZF4107	6120.2808.02
Mating Connector Set for R&S®BV4190	R&S®ZF4108	6120.7700.02
Connecting cables		
Fiber-Optic Connecting Cable; R&S®VK ↔ R&S®GX; 1 m length	R&S®GK4101	6120.5620.10
Fiber-Optic Connecting Cable; R&S®VK ↔ R&S®GX; 3.5 m length	R&S®GK4101	6120.5620.35
Fiber-Optic Connecting Cable; R&S®VK ↔ R&S®GX; 50 m length	R&S®GK4101	6120.5620.50
DC Cable; R&S®GX ↔ R&S®VK; 2.5 m length	R&S®GK4104	6120.5907.25
RF Cable; R&S®GX ↔ R&S®VK; 3 m length	R&S®GK4105	6120.3604.03
Control Cable; R&S®VK ↔ R&S®IN; 3 m length	R&S®GK4106	6120.3656.03
DC Cable; R&S®VK ↔ R&S®IN; 3 m length	R&S®GK4107	6120.3704.03
Power Cable; R&S®BV ↔ R&S®IN; 3 m length	R&S®GK4108	6120.3756.03

Ordering information

Designation	Type	Order No.
HF transmit/receive broadband system		
Base units		
Power Management Unit incl. HF receiver/exciter functionality; DC, without local control panel and radio software; ruggedized model	R&S®MR4100G-B	6119.6255.12
HF Receiver/Exciter, base unit, DC; without local control panel and radio software, ruggedized model	R&S®MR4100G	6118.9750.12
Radio software		
Software CD with export restriction	R&S®DS4100D	6119.7900.xx
Hardware options		
Local Control Panel (without audio; incl. software and LAN), ruggedized model	R&S®GB4000C	6105.6006.35
Digitally Tuned RF Selection, 40 dB, functional for transmitting and receiving section (mandatory option)	R&S®FK4140	6119.6003.02
NMEA (DSC) Interface, for connecting an external DSC controller (GMDSS)	R&S®GS4102	6119.3504.02
Termination Resistor, 200 W, for receive path incl. connecting cable (mandatory option)	R&S®ZW2910	6090.8756.02
Software options		
R&S®SECOM-H EPM (ECCM) Software	R&S®GS3001S	6095.4859.02
ALE-2G (FED-STD-1045/1046/1049)	R&S®GS4101S	6120.6003.02
ALE-2G (FED-STD-1045/1046/1049), STANAG 4538/ALE-3G (FLSU, LP, HDL, LDL)	R&S®GS4155S	6142.7560.02
LINK Software, tactical data link capability in line with STANAG 5511, STANAG 5522 (fixed frequency), LINK-Y	R&S®GS4114S	6142.7619.02
Selective Level Control (mandatory option)	R&S®GS4115S	6120.6703.02
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®GM4120S	6142.7519.02
Power amplifier		
1000 W HF Power Amplifier	R&S®VK4190	6120.1501.03
Power supply units		
Power Supply 230 V AC; 1 or 3 phases + N/208 V AC; 3-phase Δ	R&S®IN4190	6120.2708.02
Power Supply 440 V AC; 3 phases (used together with R&S®BV4190 transformer)	R&S®IN4190	6120.2708.03
Transformer 440 V AC; 3-phase Δ	R&S®BV4190	6120.2908.02
Mating connector sets		
Mating Connector Set for R&S®MR4100G	R&S®ZF4101	6120.5007.04
Mating Connector Set for R&S®MR4100G-B	R&S®ZF4101	6120.5007.06
Mating Connector Set for R&S®VK4190	R&S®ZF4103	6120.5207.02
Mating Connector Set for R&S®IN4190	R&S®ZF4107	6120.2808.02
Mating Connector Set for R&S®BV4190	R&S®ZF4108	6120.7700.02
Mating Connector Set for R&S®FK4192	R&S®ZF4109	6120.7800.02
Mating Connector Set for R&S®FK4194	R&S®ZF4110	6120.7900.02
Connecting cables		
Fiber-Optic Connecting Cable; R&S®VK ↔ R&S®GX; 1 m length	R&S®GK4101	6120.5620.10
Fiber-Optic Connecting Cable; R&S®VK ↔ R&S®GX; 3.5 m length	R&S®GK4101	6120.5620.35
Fiber-Optic Connecting Cable; R&S®VK ↔ R&S®GX; 50 m length	R&S®GK4101	6120.5620.50
DC Cable R&S®GX ↔ R&S®VK; 2.5 m length	R&S®GK4104	6120.5907.25
RF Cable R&S®GX ↔ R&S®VK; 3 m length	R&S®GK4105	6120.3604.03
Control Cable R&S®VK ↔ R&S®IN; 3 m length	R&S®GK4106	6120.3656.03
DC Cable R&S®VK ↔ R&S®IN; 3 m length	R&S®GK4107	6120.3704.03
Power Cable R&S®BV ↔ R&S®IN; 3 m length	R&S®GK4108	6120.3756.03
System components		
Power Combiner 2 kW	R&S®FK4192	6120.0005.02
Power Combiner 4 kW	R&S®FK4194	6120.0257.02
Antenna Triplexer	R&S®FK2950	6090.3502.02
Antenna Diplexer	R&S®FK2960	6096.7000.02

Ordering information

Designation	Type	Order No.
Auxiliary equipment		
Remote Control Unit, ruggedized model	R&S®GB4000C	6105.6006.36
Headset including microphone, ruggedized model, with cable and NF-7 connector	R&S®GA012	0693.7664.02
Headset including microphone, ruggedized model, with cable and NF-7 connector	R&S®GA013	0693.7712.02
Headset, dynamic, with cable and NF-7 connector	R&S®GA015	0583.6012.02
Microphone with PTT, handheld	R&S®GA2100	6064.5001.02
Handset with PTT, standard	R&S®GA2120	6064.6008.03
Morse Key with cable and connector	R&S®GA2180	6075.3763.02
Fillgun	R&S®GP3000	6099.3805.02
USB Cable (fillgun ▷ PC)	R&S®GK3021	6118.1750.02
HF antenna tuning units		
150 W transceiver		
HF Antenna Tuning Unit for land-based and shipborne applications	R&S®FK4115M	6120.4000.03
HF Dipole Antenna for land-based applications	R&S®HX002H1	6120.7000.02
HF Dipole Antenna for shipborne applications	R&S®HX002H2	6120.8006.02
500 W/1000 W transceiver systems		
HF Antenna Tuning Unit for land-based and shipborne applications	R&S®FK2900M	6097.1005.02
HF Antenna Tuning Unit for land-based applications, mast antennas 30 m to 50 m	R&S®FK2900M	6097.1005.05
HF Antenna Tuning Unit for land-based and shipborne applications, frequency hopping capability	R&S®FK4190M	6120.9002.02
HF Antenna Tuning Unit for submarine applications, frequency hopping capability	R&S®FK4150U	6120.9254.07
Mating connector sets		
Mating Connector Set for R&S®FK4115M/R&S®HX002H1/R&S®HX002H2	R&S®ZF4102	6120.5107.03
Mating Connector Set for R&S®FK4190M and R&S®FK2900M	R&S®ZF4105	6120.5407.02
Mating Connector Set for R&S®FK4150U	R&S®ZF4106	6120.5507.02
Control cables for antenna tuning units		
Optical Control Cable for connecting R&S®FK4115M/HX002H1/HX002H2; xx = 10/25/50 ▷ 10/25/50 m length	R&S®GK4102	6120.5720.xx
Control Cable for connecting R&S®FK4150U; xx = 10/20/30/40/50 ▷ 10/20/30/40/50 m length	R&S®GK2903	6117.9505.xx
Control Cable for connecting R&S®FK4190M, R&S®FK2900M; xx = 10/20/30/40/50 ▷ 10/20/30/40/50 m length	R&S®GK2903M	6117.9757.xx
Test system for radio equipment of the R&S®M3xR family		
I-Level Special Test Equipment (I-STE for R&S®M3AR, R&S®M3SR, R&S®M3TR, R&S®Series2000, R&S®Series4200)	R&S®TS6030	5200.7050.02
Other types on request.		

For specifications see data sheets:

R&S®M3SR Series4100 Software Defined Radios PD 5213.9557.22
R&S®M3SR Series4100 HF Transmit/Receive Broadband System PD 5214.1243.22

R&S®Series2000 HF Radio Family

Advanced digital shortwave communications

With the R&S®Series2000 HF radio family, Rohde&Schwarz is continuing its long-standing tradition in the field of shortwave communications. The R&S®Series2000 line includes transceiver and receiver systems for mobile and stationary use with powers of 150 W, 500 W and 1000 W.

The R&S®Series2000 not only provides the full range of standard radiocommunications functions; it also offers a wide variety of applications by means of useful options.

- Shortwave telephone
- Data transmission up to 9.6 kbit/s
- LINK expandability
- SELCAL expandability
- User-friendly HMI
- Plug-in options
- Conformance certification by Defense Information Systems Agency (JITC)
  - MIL-STD-188-141B, App. A+B
  - STANAG 5511
  - STANAG 4203, Annexes B+C

Communications take place in line with international standards. Fast and reliable data transmission as well as message handling allow the R&S®Series2000 to be integrated into modern multimedia systems, thus providing the basis for reliable, worldwide communications independent of existing infrastructures. It is possible to set up high-power broadband communications systems on the basis of the R&S®Series2000 components for transmissions on multiple channels with low frequency separation and in different emission modes.

Versatility built into the basic configuration

The R&S®Series2000 in its basic configuration is capable of transmitting Morse, speech and teletype data. All common classes of emission such as J3E (USB, LSB), B8E, H3E, A1A, F1B, weather fax and F3E are available. The system can thus be used both for high-quality J3E, H3E, F3E radiotelephony and for teletype and data transmissions with a rate of up to 600 Bd. With a lower frequency limit of 1.5 MHz, radiocommunications via ground waves are possible, which results in particularly reliable communications links. Completely new areas of application are opened up by a variety of options, provided mostly as plug-in modules for the base unit.

Options for versatile application

Automatic link establishment (ALE)
The R&S®GS2200 data link processor automatically sets up the optimum radiocommunications link using the adaptive Rohde&Schwarz ALIS procedure or MIL-STD-188-141B, App. A+B. ALIS is 100% compatible with R&S®Series850 radio equipment.

High RF selectivity
The optional R&S®FK2020/FK2040 digitally tuned RF selectors with a tuning time of only 10 ms enable fast frequency changes. Selectivity is up to 40 dB at 10% frequency spacing in the transmission and reception mode, while far-off selectivity exceeds 70 dB. The input is protected against overvoltages up to 200 V EMF.

High-speed data transmission
The transmission rate can be markedly increased (up to 9.6 kbit/s) by means of the internal R&S®GM2200 HF modem. This enables the transmission and reception of telefax messages, computer data, and color video still pictures, for example. Connection between the data terminal and the R&S®Series2000 is made by a commercial off-the-shelf (COTS) PC with the appropriate software.

Remote control facilities
One or more R&S®Series2000 transceivers can be remotely controlled – over any distance and for all settings – from either the R&S®GB2000 remote control unit, the R&S®GP2000 RC processor and/or from a PC.

Simultaneous connection of two remote control facilities (as above) is possible. Operating in addressed mode, up to 99 transceivers are controllable using the integrated (bus-capable) serial RS-485 interface. On the R&S®GB2000 remote control unit, various hardware- or software-configured AF (in/out) and PTT modes can be selected. This facilitates adaptations and integration into existing voice/data/control (PTT) facilities. Full PC control of one or more R&S®Series2000 transceivers from a PC can easily be implemented either with remote control software or with customer-written programs. The transparent ASCII command format required for the R&S®Series2000 control will be accepted by any software language.

Shortwave telephone links
The optional R&S®GN2100 automatic phone patch (APP) allows a telephone to be linked to a private automatic branch exchange (PABX). The R&S®GS2200 data link processor establishes the radio link with the called subscriber, who can be dialed directly in half-duplex mode; transmit/receive switchover is voice-controlled by means of a VOX circuit. The R&S®GN2100 automatically adapts itself to telephone lines of varying quality. Instead of connection to the PABX, direct connection can be made to the public switched telephone network (PSTN), provided official regulations make allowance for this. As a matter of course, the R&S®Series2000 offers all the amenities of a modern telephone set: short-code dialing memory, optional pulse or dual-tone multifrequency dialing (DTMF).

Three power classes

The system is available in three versions with different output powers:
- R&S®XK2100 with 150 W
- R&S®XK2500 with 500 W
- R&S®XK2900 with 1000 W

Each transceiver system comprises a receiver-exciter, an amplifier, a power supply, an antenna tuning unit and internal and external options. All units are available as rackmount models.

The R&S®Series2000 is used for reception in the range 10 kHz to 30 MHz and for transmission in the range 1.5 MHz to 30 MHz. Broadband antennas can be connected directly to the system. Optimum antenna matching is provided for each power class by means of the R&S®FK2100, R&S®FK855 and R&S®FK2900M antenna tuning units.

Worldwide communications with high reliability and great ease of operation: R&S®Series2000 HF radio family.

Tried and tested technology

The R&S®Series2000 HF radio family is highly modern both in terms of hardware and software. This includes, for example, digital signal processing (DSP) in the transmitting and receiving sections, and internal instrument control by means of a fast, serial control bus. This allows hardware extensions (options) to be integrated quickly and easily and software updates to be made conveniently via an RS-232-C interface. Plain-text display of faults down to the module level by means of the built-in test system (BIT) greatly facilitates troubleshooting and servicing.

Great importance has been attached to electromagnetic compatibility (EMC). The relevant requirements of MIL-STD-461 are fulfilled.

The core of the R&S®Series2000 family is formed by the R&S®XK2100 (150 W transceiver) and R&S®GX2900 (transceiver for the 500 W and 1000 W versions) base units. These units include, in their basic configuration, six exchangeable modules and a number of spare slots for options (see block diagram on page 60). The options are detected by the unit upon plug-in and are immediately operational following a simple software update.

The central control unit incorporates a powerful microprocessor that coordinates all internal control sequences for the modules via the SERBUS and communicates with external equipment via two data interfaces (RS-232-C, RS-485) and via the keypad, which can be used for making phone calls, for example. The microprocessor also generates the messages and indications output on the graphic display.

A total of approx. 1000 complete channel settings can be stored in an EEPROM without a buffer battery being required. The channel memory is allocated as follows:

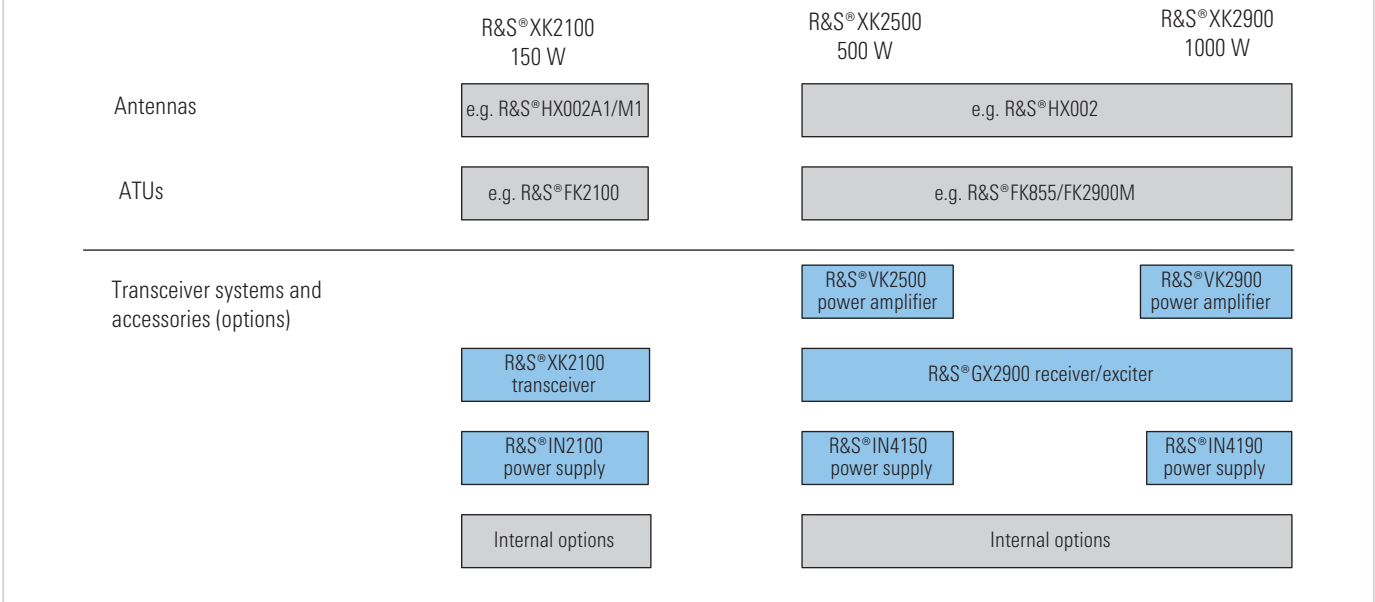
- 401 user-programmable channels, including 100 frequency pairs for half-duplex operation
- Fixed programmed ITU channels with allocated numbers between 401 and 2240
- 120 half-duplex channels for operation using automatic link establishment (ALE)

The use of digital signal processing in the IF/AF processor affords a number of special features:

- Variety of classes of emission such as
  - H3E, A1A, J3E (USB, LSB), F3E
  - B8E (ISB)
  - F1B (FSK, AFSK)
  - J2D (with external modem)
- 17 bandwidths from 50 Hz to 8 kHz with group-delay-equalized filters for data transmission
- Five decay time constants between 25 ms and 3 s
- Passband tuning (with bargraph indication)
- Notch filter (with bargraph indication)
- Noise blanker (interference suppression)
- Syllabic squelch (no threshold setting)
- Voice compression (increase of output power for voice transmission)

The R&S®Series2000 HF radio family is available in three power classes: 150 W, 500 W and 1000 W. The diagram shows the basic system configuration with recommended ATUs and antennas.

R&S®Series2000 HF radio family



Excellent large-signal characteristics are obtained by means of a high-power mixer stage in the RF/synthesizer section. Intercept points are typically at +70 dBm (IP2) and +35 dBm (IP3); crossmodulation is 10 % with an interference source of +20 dBm.

The sensitivity of the receiving section is considerably increased by means of a switchable preamplifier, yielding a noise figure of 9 dB. This ensures good reception also with short rod or whip antennas. The unit will withstand overvoltages up to 100 V EMF for an indefinite period of time owing to an input voltage protection circuit.

The amplifier incorporated in the R&S®XK2100 outputs a transmit signal of 150 W (PEP) or 100 W in the CW mode. For CW and data operation, it is mandatory to use a blower unit (option). In the R&S®GX2900 for the 500 W and 1000 W systems, the 150 W amplifier is replaced by an amplifier interface for connecting the R&S®VK2500/VK2900 power amplifiers.

The power will automatically be cut back in the event of mismatch or thermal overload in all three power classes of the transceiver. If one of the 500 W output stages fails in systems with the R&S®VK2900 power amplifier, transmission can be continued with an output power of 500 W.

The R&S®ZW2900 option can be integrated into the R&S®VK2500/VK2900 to provide additional overvoltage protection for the receiver input.

In conjunction with the optional R&S®FK2020/FK2040 digitally tuned RF selectors, the R&S®ZW2900 enables operation with voltages up to 100 V (RMS).

All interface lines pass through an integrated EMC filter. Radiated and conducted interference is effectively suppressed by filters and protective diodes.

User-friendly operation

The R&S®Series2000 HF radio family is outstanding for its high user-friendliness, featuring menu guidance on a high-contrast, large-size LC graphic display and providing a number of convenient controls and displays such as:

- Softkeys
- Cursor keys
- Step keys (rollkey editor)
- Message, selection and editing windows
- Numeric editor
- Icons for menu and system status indication

In addition to plain-text messages, bargraphs are used to indicate the receive field strength, output power, etc. The control functions are logically combined in the menus and can thus be found easily.

The clear-cut display makes operation of the R&S®Series2000 easy even for the non-specialist. Users with expertise can go to a more complex menu level upon entering a password and configure the equipment as required to suit a wide variety of applications.

R&S®VK2900 1000 W HF power amplifier.

R&S®GX2900 receiver/exciter.

R&S®IN4190 power supply.

Suitable for use in harsh environments

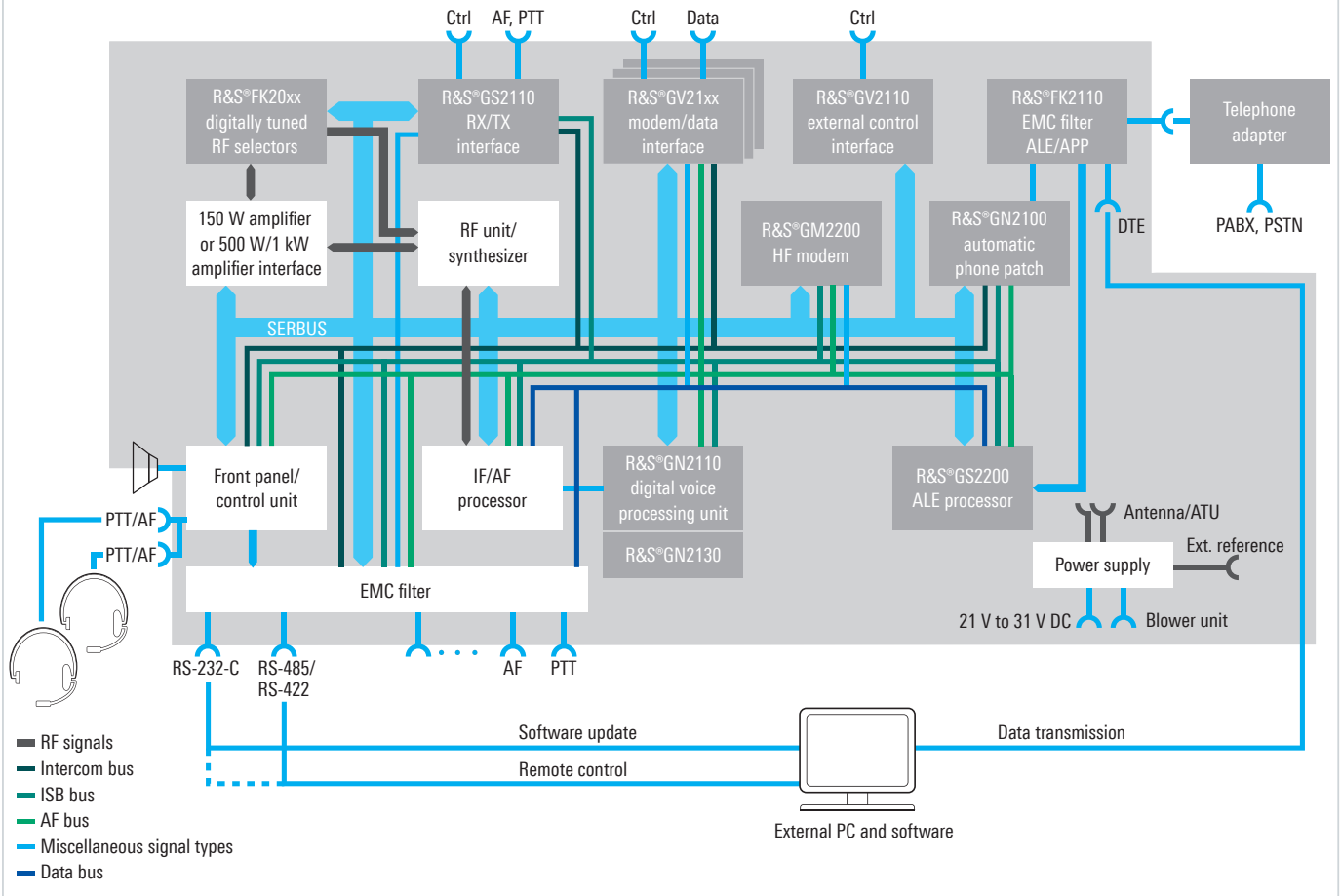
The R&S®Series2000 HF radio family was designed for operation under adverse environmental conditions and can be used not only in fixed stations but also on vehicles and ships. Shock absorbers are available for the R&S®XK2100 to protect the units in applications involving high levels of shock and vibration. Proper operation of the system will not be impaired by varying climatic conditions, problematic EMC environments or supply voltage fluctuations.

Selective level control

The usual transmitter power control using broadband directional couplers as sensors can often not be employed, since backdoor power components from neighboring transceivers activate the transmitter power control and thus reduce the transmitter power, although there is no actual mismatch in the line under observation. Problems of this kind are likely to occur in applications where antennas are closely co-sited (e.g. collocation on board ships), or where frequency spacing is very small. The HF transceivers with selective level control feature narrowband evaluation of the forward and reflected power at the wanted frequency so that the transmitter power control is not affected by RF power coupled in from other transmitters in the system.

The base units of the R&S®Series2000 systems are equipped with six standard modules and provide spare slots for options (blue). Software updates are conveniently performed from a PC via the RS-232-C interface.

Block diagram of the R&S®XK2100 and R&S®GX2900



Optimum matching

Optimum matching of the antennas is achieved by means of the R&S®FK2900M for the 500 W and the 1000 W systems, and by means of the R&S®FK2100/FK2100M for the 150 W system.

All ATUs are fully arc-protected against direct lightning strokes. They are tested to withstand arcs of 10 kV/10 kA. An automatic built-in test (BIT) provides fault detection and reporting to the R&S®Series2000 transceiver/exciter respectively.

The antenna tuning unit provides automatic matching of antennas. Two ATU versions are available:

- Land-mobile version
- Naval version (for shipboard use)

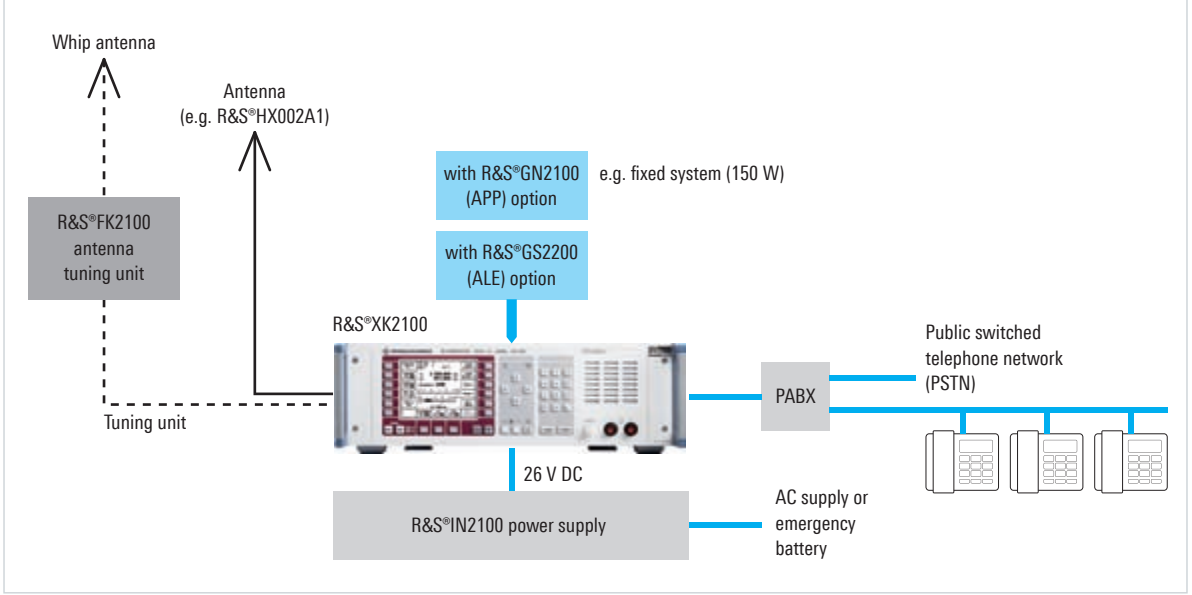
The R&S®FK2100M, which is a seawater- and drop-resistant version, is especially designed for shipboard applications and can match antennas with very low ohmic resistance.

Microprocessor-controlled tuning allows self-learning of a maximum of 1500 settings that, together with the channels stored in the R&S®XK2100 transceiver (including ALE, APP, ITU and 100 silent channels), are retained in non-volatile memory. The stored channels can be called up with very short setting times.

R&S®FK2100 antenna tuning unit.

Transceivers of the R&S®Series2000 family (in this example R&S®XK2100) can be connected to a private automatic branch exchange (PABX), allowing telephone communications via shortwave independent of the available infrastructure.

Block diagram of the R&S®Series2000 transceivers



Failsafe power supply

The external power supplies are intended for stationary applications. They are in the form of a primary switched-mode power supply for all three power classes of the transceiver and comply with the relevant safety and EMC regulations.

The R&S®IN4150 and R&S®IN4190 were designed for single- or three-phase operation. For special AC supply voltages, e.g. in maritime applications, the R&S®BV2900 transformer is available as an option, which can be incorporated in the transceiver rack.

When an emergency power supply (e.g. a 24 V battery) is used, AC supply/battery switchover will be effected instantaneously in the event of a power failure, thus ensuring uninterrupted radiocommunications.[1)]

System expansion options

The base R&S®XK2100 transceivers as well as the R&S®GX2900 receiver-exciter are already fully prepared to accommodate optional interfaces that are available as plug-in units and are located at the rear of the equipment. Various interface options are available for easy matching and proper connection of external (e.g. customer-provided) HF modems, link processors, data terminal sets, or system processors, encryption devices, etc., as well as for the control and operation of system-specific options such as RF filters, power selectors, duplex receivers, naval distress and alarm facilities (DSC/GMDSS), and remote control units. For HF telephone operation along with the integrated ALE and APP options, direct connection of a PABX or a PSTN line is possible using the ALE/APP interface option. Up to four interface options can be accommodated at a time.

High-speed data mode

Depending on the system configuration, either with integrated or external ALE and/or HF modem, various interface options such as the R&S®FK2110 EMC filter or the R&S®GV2130 modem data interface are available for connection to external HF modems, data sources, data-protection or link processors.

Data link expandability

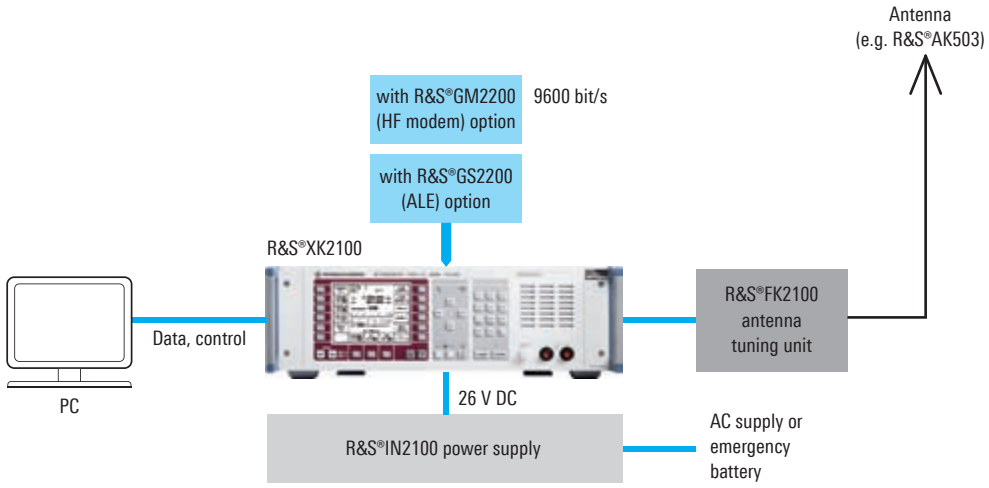
The R&S®GV2120 data link interface is provided for connecting an external data terminal set (DTS) that complies with MIL-STD-188-203-1A and STANAG 5511.

Full-duplex or split-site operation

The R&S®GS2110 RX/TX interface is available for full-duplex operation (controlling an external receiver or transmitter). For operations at different sites, an R&S®GP2000 split-site controller is available to control separate transmitter and receiver sites from one center, also allowing ALE, fast data, and HF telephone modes.

[1)] At reduced power with 500 W and 1000 W systems.

Block diagram: configuration example



With the optional HF modem incorporated in the transceiver, transmission rates of up to 9600 bit/s can be achieved. This allows the transmission and reception of data files, for example.

Specifications

	R&S®XK2100	R&S®XK2500	R&S®XK2900
Transmission			
Frequency range	1.5 MHz to 30 MHz	1.5 MHz to 30 MHz	1.5 MHz to 30 MHz
Output power into 50 Ω, VSWR ≤ 1.5	150 W ± 1 dB PEP 100 W ± 1 dB CW	500 W ± 1 dB PEP or CW (400 W ± 1 dB with R&S®FK855 ATU)	1000 W ± 1 dB PEP or CW
Power levels	10/30/100 W	40/100/500 W	100/500/1000 W
Spurious suppression [1]	> 70 dBc	> 70 dBc	> 70 dBc
Harmonics suppression	typ. 60 dBc	typ. 60 dBc	typ. 60 dBc
Intermodulation products (referenced to PEP)	> 32 dB	> 36 dB	> 36 dB
S/N ratio [2]	> 150 dBc (1 Hz)	> 150 dBc (1 Hz)	> 150 dBc (1 Hz)
Carrier suppression	typ. 70 dB	typ. 70 dB	typ. 70 dB
Suppression of unwanted sidebands	> 60 dB	> 60 dB	> 60 dB
Voice compression (VC)	built-in, power increase with radiotelephony		
Frequency setting	decadic in 1 Hz steps		
Channel memory			
User-programmable channels	401		
Including half-duplex channels	100 (transmit and receive frequencies separately programmable)		
Fixed programmed channels (ITU)	channel numbers between 401 and 2240 (half-duplex)		
Additional channels for ALE	120 (half-duplex)		
Frequency error			
Standard (TCXO)	< 2×10^{-8}/°C		
Optional (OCXO)	< 1×10^{-9}/°C, < 1×10^{-9}/day		
Aging			
Standard (TCXO)	< 1×10^{-6}/year		
Optional (OCXO)	< 1×10^{-7}/year		
Classes of emission	A1A (CW), J3E (SSB, USB/LSB), H3E (AME), B8E (ISB), F1B (FSK, AFSK, 50 Bd to 600 Bd, shift 42.5 Hz to 425 Hz), F3E (FM), F3C, A3E (AM) (reception only), J2D (with external modem), MIL-STD-188-203-1A (optional)		
Reception			
Frequency range	10 kHz to 30 MHz		
Input impedance	50 Ω, VSWR < 3		
Input sensitivity (for S/N = 10 dB, f = 0.2 MHz to 30 MHz)			
Without preamplifier and preselection A1A (CW) J3E (SSB) H3E (AME), 1 kHz, m = 60 %	 typ. 0.4 µV EMF, BW = 300 Hz [3] typ. 1.0 µV EMF, BW = 2.7 kHz [4] typ. 2.7 µV EMF, BW = 6 kHz [4]		
With preamplifier, without preselection A1A (CW) J3E (SSB) H3E (AME), 1 kHz, m = 60 %	 typ. 0.15 µV EMF, BW = 300 Hz [3] typ. 0.4 µV EMF, BW = 2.7 kHz [4] typ. 1.0 µV EMF, BW = 6 kHz [4]		
Receiving bandwidths			
3 dB	±25 Hz, ±75 Hz, ±150 Hz, ±200 Hz, ±300 Hz, ±400 Hz, ±500 Hz, ±750 Hz, ±900 Hz, ±1050 Hz, ±1200 Hz, ±1350 Hz, ±1550 Hz, ±1850 Hz, ±2250 Hz, ±3000 Hz, ±4000 Hz		
60 dB	±125 Hz, ±150 Hz, ±215 Hz, ±335 Hz, ±430 Hz, ±650 Hz, ±770 Hz, ±1000 Hz, ±1440 Hz, ±1600 Hz, ±1760 Hz, ±1900 Hz, ±2100 Hz, ±2850 Hz, ±3220 Hz, ±4100 Hz, ±5100 Hz		
AGC	< 3 dB (1 µV to 1 V EMF)		
Response to a 60 dB step variation			
Attack time	< 10 ms		
Decay time	25/150/500 ms, 1 s/3 s (selectable)		
AF distortion			
Line output, 0 dBm	< 1 %		
Headphones, loudspeaker	< 3 % at rated power		

Specifications

	R&S®XK2100	R&S®XK2500	R&S®XK2900
Weighted S/N ratio (H3E)	> 46 dB SINAD for 1 mV EMF, weighted with filter in line with ITU-T (O.41/P53)		
Nonlinearities (1.5 MHz to 30 MHz, without preamplifier)			
Blocking	3 dB signal attenuation (Δf = 30 kHz, useful signal 2 mV EMF, interfering signal 5 V EMF)		
Desensitization	> 20 dB SINAD (Δf > 30 kHz, BW = 2.7 Hz, useful signal 30 µV, interfering signal 100 mV)		
Intercept point IP3	typ. 35 dBm (Δf > 30 kHz, interfering signals 2 × 0 dBm)		
Crossmodulation	< 10% (Δf > 30 kHz, useful signal 1 mV EMF, interfering signal 4 V EMF, 1 kHz, m = 30%)		
Noise figure			
Without preamplifier	17 dB		
With preamplifier	9 dB		
Inherent spurious signals	in line with MIL-STD-188-141B		
Immunity to interference			
Image-frequency rejection	typ. 90 dB		
IF rejection	typ. 90 dB		
Oscillator reradiation	< 10 µV (at antenna input)		
Protection of receiver input	up to 100 V EMF (f < 30 MHz)		
With digitally tuned RF selectors	up to 200 V EMF (f < 30 MHz)		
Antenna tuning units (ATUs) and antennas			
Frequency range	1.5 MHz to 30 MHz		
Recommended ATUs	R&S®FK2100, R&S®FK2100M	R&S®FK2900M, R&S®FK855C1/C3	R&S®FK2900M, R&S®FK859
NVIS antennas	R&S®HX002A1/M1	R&S®HX002	
General data			
Temperature range	MIL-STD-810E, methods 501.3 and 502.3		
Operation	–25 °C to +55 °C	–25 °C to +55 °C	
Storage	–40 °C to +85 °C		
Humidity	MIL-STD-810E, method 507.3		
Vibration			
Sinusoidal	EN 60068-2-6 [5]	EN 60068-2-6	
Random	MIL-STD-T-28800 (0.01 g^2/Hz, 10 Hz to 300 Hz, 1.9 g RMS)		
Shock	(MIL-STD-810E, method 516.4, proc. I)[5]		
EMC	MIL-STD-461E: CE102, CS101, CS114, RS101, RS103 (CE103, CS102, CS106, RE102)[6]	MIL-STD-461E: CE102, CS101, CS114, RE102, RS101, RS103	
MTBF	> 9600 h	> 5500 h	> 5000 h
Class of protection	IP 43/32[6]	IP 43/20[6]	IP 43/20[6]
CE conformity mark	in line with EN 60945, ETSI EN 300373-1/-2/-3 (with restrictions)[7]		
Dimensions: W × H × D (without options)	R&S®XK2100: 443 × 127 × 386 mm (17.4 × 5.0 × 15.2 in) R&S®IN2100: 440 × 82 × 350 mm (15.7 × 3.2 × 13.8 in)	R&S®GX2900: 483 × 132 × 340 mm (19.0 × 5.2 × 13.4 in) R&S®VK2500: 483 × 281 × 570 mm (19.0 × 11.0 × 22.4 in) R&S®IN4150: 483 × 132 × 570 mm (19.0 × 5.2 × 22.4 in)	R&S®GX2900: 483 × 132 × 340 mm (19.0 × 5.2 × 13.4 in) R&S®VK2900: 483 × 281 × 570 mm (19.0 × 11.0 × 22.4 in) R&S®IN4190: 483 × 192 × 570 mm (19.0 × 7.6 × 22.4 in)
Weight (without options)	R&S®XK2100: 15 kg (33.1 lb) R&S®IN2100: 9 kg (19.8 lb)	R&S®GX2900: 13 kg (28.7 lb) R&S®VK2500: 34 kg (75.0 lb) R&S®IN4150: 24 kg (52.9 lb)	R&S®GX2900: 13 kg (28.7 lb) R&S®VK2900: 42 kg (92.6 lb) R&S®IN4190: 24 kg (52.9 lb)

[1] Measured at < 0.95 f_c and > 1.05 f_c (f_c = center frequency of bandwidth).
[2] Measured at f ± 10%, at maximum rated output power, A1A (CW).
[3] At 10 dB S/N.
[4] At 10 dB SINAD.
[5] Tests in brackets were not verified in conjunction with the R&S®IN2100.
[6] Front-panel exciter/rest of transceiver.
[7] R&S®XK2100: ETSI EN 300373-1, 7.6, 9.3, 10.7 (see user manual); R&S®XK2500/XK2900: ETSI EN 300373-1, 7.6, 8.3, 9.3, 10.1.1, 10.7 (see user manual); EN 61000-3-2 (see user manual).

Specifications

Options	
R&S®FK2020 digitally tuned RF selectors	attenuation > 20 dB at > 10% from operating frequency
R&S®FK2040 digitally tuned RF selectors	attenuation > 40 dB at > 10% from operating frequency
R&S®GS2200 data link processor	automatic link establishment (ALE) in line with ALIS or MIL-STD-188-141B, App. A + B, for speech and data transmission
R&S®GN2100 automatic phone patch	call transfer to private automatic branch exchange (PABX) with automatic line matching
R&S®GM2200 HF modem	advanced multimode HF modem with selectable waveforms up to 9.6 kbit/s in line with STANAG 4285, STANAG 4529, STANAG 4539, Annex B, Section 4, 2.7 kbit/s + 5.4 kbit/s (proprietary)
R&S®GN2110 digital voice processing unit	noise and interference suppression, speech squelch, VOX with digital signal processing
R&S®GN2130 digital voice option	2.4 kbit/s VLP vocoder, OFDM multicarrier HF modem plus encryption module
R&S®KL2100 blower unit (R&S®XK2100)	required for continuous data transmission
R&S®GB2000 remote control unit	with modems for distances > 50 m; class of protection IP 42 in line with DIN 40050
R&S®GP2000 remote control processor	for establishing split-site configurations
R&S®FK2110 EMC filter ALE/APP	APP interface to PABX interface, ALE-DTE interface
R&S®GS2110 RX/TX interface	NMEA-183 interface ❙ for naval GMDSS systems (an external DSC controller drives an HF transceiver of the R&S®Series2000 family) ❙ control of a detached receiver of the R&S®Series2000

Specifications

Power supplies	**R&S®IN2100**	**R&S®IN4150**	**R&S®IN4190**
AC supply	230 V (1 phase + N)	230 V (1 phase + N) 208 V (Δ, 3 phases) 230 V (Y, 3 phases + N)	230 V (1 phase + N) 208 V (Δ, 3 phases) 230 V (Y, 3 phases + N)
Input voltage tolerance	88 V to 264 V	+10%, –15%, 47 Hz to 63 Hz	+10%, –15%, 47 Hz to 63 Hz
Input power consumption			
1 phase	max. 0.8 kVA	max. 2.5 kVA	max. 4.5 kVA
3 phases (Y)	–	max. 3.6 kVA	max. 6.5 kVA
3 phases (Δ)	–	max. 3.0 kVA	max. 5.0 kVA
Battery	24 V DC emergency supply		
General data			
Temperature ranges	MIL-STD-810E, method 501.3/ 502.3	MIL-STD-810F, method 501.4/502.4, EN 60068-2-1/2	
Operating temperature range	0°C to +50°C	–25°C to +55°C	
Storage temperature tange	–40°C to +85°C	–40°C to +70°C	
Humidity	MIL-STD-810E, method 507.3	MIL-STD-810F, method 507.4	
Vibration (sinusoidal)	–	MIL-STD-167-1, type 1	
Vibration (random)	MIL-STD-T28800	MIL-STD-810F, method 514.5	
Shock resistance	MIL-STD-810E, method 516.4, proc. I	MIL-STD-810F, method 516.5, proc. I, EN 60068-2-27	
EMI/EMC	MIL-STD-461E: CE102, CS101, CS114, RS101, RS103	MIL-STD-461E: CE102, CS101, CS114, RE101, RE102, RS101, RS103	

R&S®EK2000 VLF-HF Receiver

- 10 kHz to 30 MHz
- For all modulation types used in military, government, and civil radiocommunications

With the R&S®EK2000 VLF-HF receiver Rohde&Schwarz adds an attractive product to its R&S®Series2000 family of shortwave radio equipment. This receiver is able to handle all modulation types relevant for professional use and includes a fast data modem (option). The R&S®EK2000 moreover features a built-in power supply.

Receiving characteristics

- Frequency range from 10 kHz to 30 MHz
- 1 Hz frequency resolution
- Outstanding large-signal characteristics
- Immunity to input interference up to 200 V EMF
- 17 group-delay-compensated IF filter bandwidths from 50 Hz to 8 kHz
- Settable notch filter
- Passband tuning
- Syllabic squelch
- Noise blanker
- Fast channel/frequency scan with user-selectable step size, dwell time, hold time, and RF thresholds
- Digitally tuned RF selectors as plug-ins, maximum attenuation 40 dB at 10% frequency offset

Signal processing

- Digital IF signal processing
- Data link operation in line with MIL-STD-188-203-1A
- High-speed data transmission (for text, fax, data, video pictures, etc.) including operation in line with STANAG 4285, STANAG 4529 and MIL-STD-188-110A, MIL-STD-188-110B, App. C
- ISB/DATA LINKmodulator/demodulator (optional)

Operation, benefits for customer

- Remote control via control unit, PC or R&S®GP2000 remote control processor
- Optimized graphical HMI
- 19" version or rackmount
- Built-in power supply with input voltage range from 97 V to 253 V
- Easy upgrading to exciter by means of exchange of modules

Applications

The R&S®EK2000 is above all ideal for all applications and platforms in communications networks, but it is also suited for radio interception and radiomonitoring. Its excellent RF characteristics, its comprehensive remote control features, and its high reliability even under difficult operating conditions make this receiver the first choice for navy vessels. In addition to classic reception modes, the R&S®EK2000 also enables broadcast reception (e.g. BRASS = broadcast and ship to shore) and is often used in split-site configurations. The R&S®GP2000 remote control processor and the R&S®GB2000 remote control unit are available for controlling the R&S®EK2000.

The use of sophisticated DSP technology throughout allows the R&S®EK2000 to handle all types of modulation used in military, government, and civil radiocommunications. For the reception of Morse, speech, teletype, and data signals, the R&S®EK2000 can be operated in the SSB (USB/LSB), ISB, AME, CW, FSK, AFSK, F1C and FM modes, and in line with MIL-STD-188-141B, App. A + B specifications for receivers. The following modes can optionally be implemented:

- LINK11 mode in line with MIL-STD-188-203-1A or STANAG 5511
- SLEW (single tone link eleven waveform) mode
- LINK-Y (with Mk2 modem)

The optional R&S®GM2200 multistandard HF modem enables the reception and demodulation of data signals transmitted in single-tone mode (PSK) in line with MIL-STD-188-110A, MIL-STD-188-110B, App. C, STANAG 4285, and STANAG 4529. In the FSK and PSK modes (STANAG 4285, 4529 and MIL-STD-188-110A), the R&S®EK2000 receiver can also be used as a modulator for detached transmitters.

Design

The R&S®EK2000 is of modular design and is equipped with the modules of the R&S®Series2000 transceiver family. This ensures a uniform logistics concept and the convenient integration of the receiver into existing and new systems. The R&S®EK2000 provides menu-guided operation and has versatile, flexible interfaces. The sturdy design and the water- and dustproof front panel (protection class IP42) allow use of the receiver even under adverse environmental conditions. The R&S®EK2000 complies with the environmental specifications of MIL-STD-810E.

Options for R&S®EK2000 applications

The base sets of the R&S®EK2000 are already factory-prepared and prewired to accept plug-in options. These internal options can be placed in specific slots on the mainboard (e.g. for VPU, HF modem, digital selection modules) and/or inserted as interface options at the rear of the units.

These interface options allow the simple connection of external system options or peripheral system equipment and accessories. They offer suitable matching and isolation as well as comprehensive EMC filtering and protection.

The cabinet design with rear-panel three-slot interfaces makes for the connection of an external HF modem, GMDSS-DSC set, DATA LINKmodems, PABX/PSTN telephone facilities, remote control facilities, etc.

The full advantages of all these applications are mostly a matter of detailed system knowledge, planning, and engineering, and therefore cannot be covered by this catalog.

Available options:

- R&S®GM2200 HF modem
- R&S®GV2120 data link interface
- R&S®GV2130 modem data interface
- R&S®GS2120 modem control interface
- R&S®FK2020/FK2040 digitally tuned RF selectors
- R&S®GF2010 OCXO frequency standard

For more information, see R&S®Series2000 HF radio family (page 56).

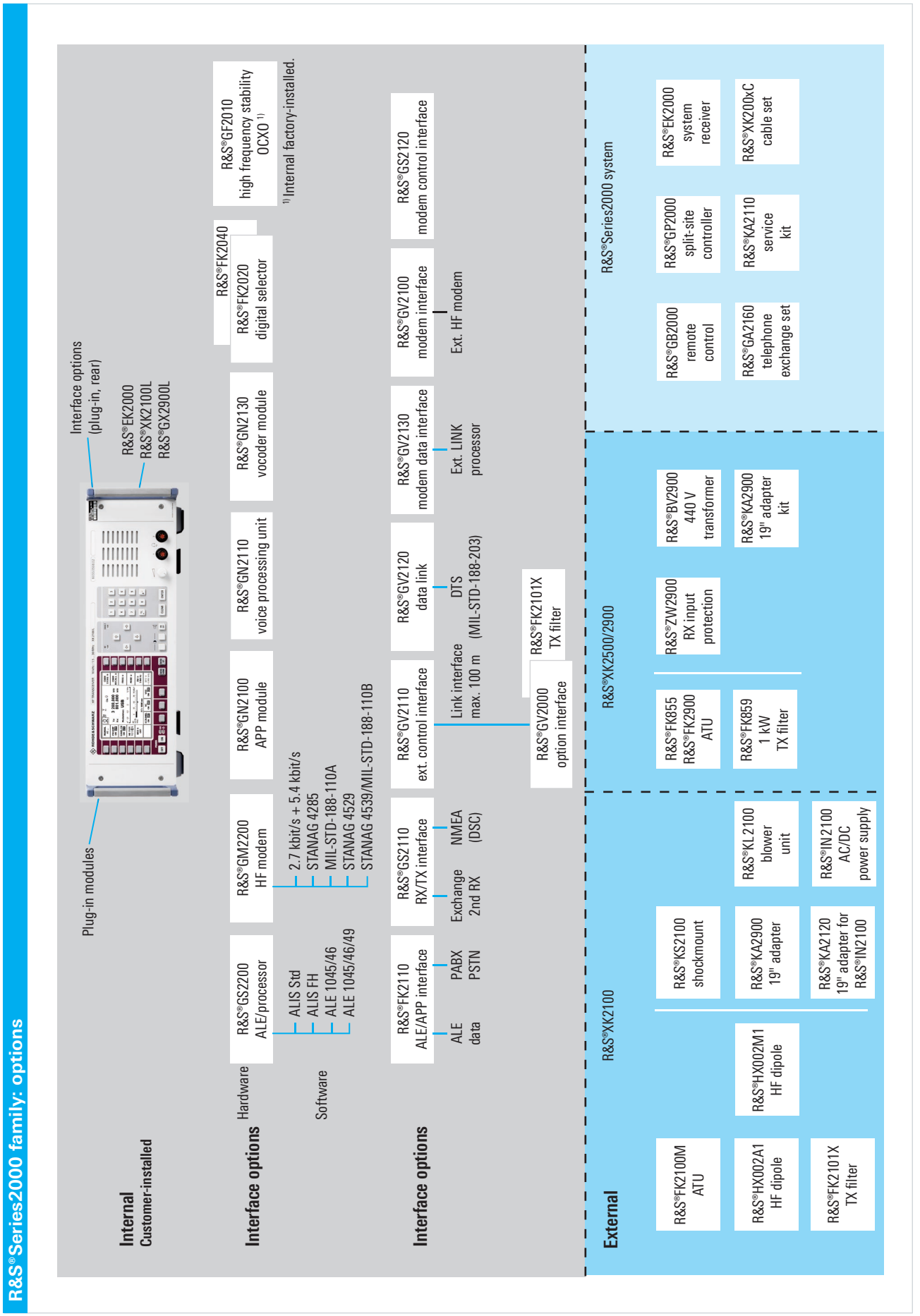
To install the R&S®EK2000 in a 19" console or rack, the R&S®KA2900 19" adapter set (model .03) is required.

For detailed specifications of the R&S®EK2000 VLF-HF receiver, see page 63

Specifications	
Power supply	97 V to 246 V AC, 47 Hz to 440 Hz and/or 19 V to 31 V DC , I < 2 A (without options)
Environmental data	
Operating temperature range	–25 °C to +55 °C
Storage temperature range	–40 °C to +85 °C
Altitude	max. 3000 m, max. +35 °C (operation), max. 10 000 m (transport)
Humidity	in line with MIL-STD-810E, meth. 507.3
Vibration	
Sinusoidal	3 Hz to 10 Hz/2 mm; 10 Hz to 150 Hz, 1 g const., 3 axes
Random	MIL-STD-T-28800 (0.01 g^2/Hz, 10 Hz to 300 Hz, 1.9 g RMS)
Shock	MIL-STD-810E, meth. 516.4, proc. I
MTBF	> 14 000 h
MTTR	0.5 h (module exchange)
Class of protection	IP43/32
EMC	MIL-STD-461B, part 4 (CE03, RE02, CS02, CS06), EN 50081-1, EN 50082-2
CE conformity mark	in line with DIN EN 60945, ETSI EN 300373-1/-2/-3 (with restrictions)[1)]
Mechanical data	
Dimensions (W × H × D)	483 mm × 132 mm × 340 mm (19" 3 HU), (19 in × 5.20 in × 13.39 in)

[1)] ETSI EN 300373-1, 7.6, 9.3 (see user manual).

Ordering information		
Designation	**Type**	**Order No.**
VLF-HF Receiver	R&S®EK2000	6093.6002.02
19" Rackmount Adapter	R&S®KA2900	6072.6010.03


R&S®Series2000 family: options
Internal
Customer-installed
Interface options
Hardware
Software
Plug-in modules
Interface options (plug-in, rear)
R&S®EK2000
R&S®XK2100L
R&S®GX2900L
R&S®GS2200 ALE/processor
ALIS Std
ALIS FH
ALE 1045/46
ALE 1045/46/49
R&S®GM2200 HF modem
2.7 kbit/s + 5.4 kbit/s
STANAG 4285
MIL-STD-188-110A
STANAG 4529
STANAG 4539/MIL-STD-188-110B
R&S®GN2100 APP module
R&S®GN2110 voice processing unit
R&S®GN2130 vocoder module
R&S®FK2040
R&S®FK2020 digital selector
R&S®GF2010 high frequency stability OCXO 1)
1) Internal factory-installed.
Interface options
R&S®FK2110 ALE/APP interface
ALE data
PABX PSTN
R&S®GS2110 RX/TX interface
Exchange 2nd RX
NMEA (DSC)
R&S®GV2110 ext. control interface
Link interface max. 100 m
R&S®GV2120 data link
DTS (MIL-STD-188-203)
R&S®GV2130 modem data interface
Ext. LINK processor
R&S®GV2100 modem interface
Ext. HF modem
R&S®GS2120 modem control interface
R&S®GV2000 option interface
R&S®FK2101X TX filter
External
R&S®XK2100
R&S®FK2100M ATU
R&S®HX002A1 HF dipole
R&S®FK2101X TX filter
R&S®KS2100 shockmount
R&S®KA2900 19" adapter
R&S®KA2120 19" adapter for R&S®IN2100
R&S®KL2100 blower unit
R&S®IN2100 AC/DC power supply
R&S®XK2500/2900
R&S®FK855 R&S®FK2900 ATU
R&S®FK859 1 kW TX filter
R&S®ZW2900 RX input protection
R&S®BV2900 440 V transformer
R&S®KA2900 19" adapter kit
R&S®Series2000 system
R&S®GB2000 remote control
R&S®GA2160 telephone exchange set
R&S®GP2000 split-site controller
R&S®KA2110 service kit
R&S®EK2000 system receiver
R&S®XK200xC cable set

Plugin modules

R&S®GS2200 Data Link Processor

Two different procedures are available for the ALE (automatic link establishment) radio link processor, i.e. proprietary ALIS and ALE in line with MIL-STD-188-141B. One of these ALE standards can be loaded into the R&S®GS2200 data link processor.

Using the Rohde&Schwarz ALIS procedure with the R&S®Series2000 radio family provides unequaled operating features:

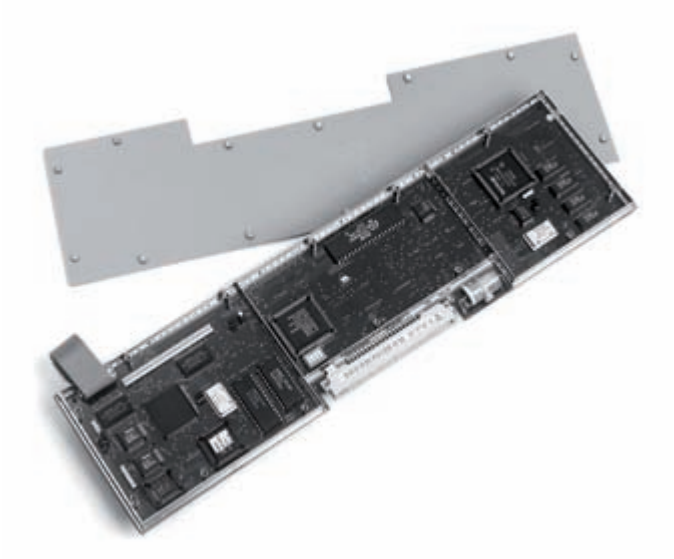
- Simple link setup by entering a four-digit address
- Realtime channel analysis
- Best-channel calculation and setting
- Automatic link setup
- Ongoing channel monitoring
- Adaptive response in case of interference
- 100% error-free transmission

Rohde&Schwarz offers the following ALE software options:

- ALE in line with Rohde&Schwarz standard ALIS
- Federal Standard 1045/1046 (MIL-STD-188-141B, App. A)
- Federal Standard 1045/1046/1049 (MIL-STD-188-141B, App. A + B)

Both the ALIS and ALE software options come with a built-in ARQ protocol (packet radio protocol, PRP) that can be used together with an R&S®GM2200 internal modem and the R&S®GM2200S modem software for data transmission after the link setup procedure. The ALIS or ALE options are also necessary to achieve full APP capability with the R&S®GN2100.

For the selection of the data link processor option, the R&S®GS2200 plus user-specific software (basic software) have to be ordered as follows:



Ordering information

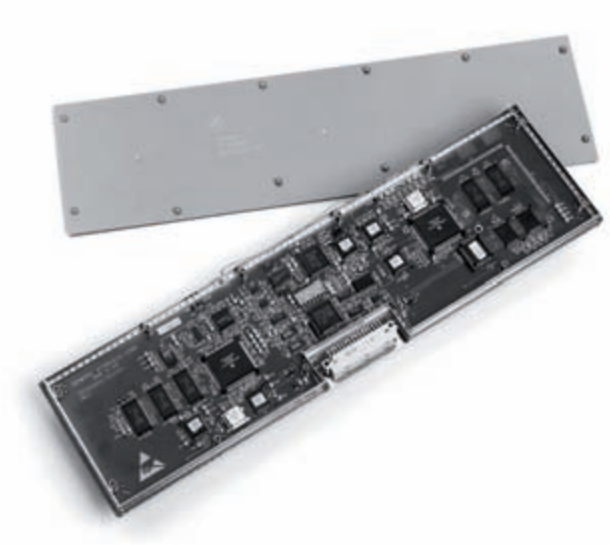
Designation	Type	Order No.
Data Link Processor (hardware) Module not operational without loaded software	R&S®GS2200	6091.5009.02
ALE Software In line with FED-STD-1045/1046 (MIL-STD-188-141B, App. A) APP and fast data PRP capability	R&S®GS2200S	6091.5709.02
ALE Software In line with FED-STD-1045/1046/1049 (MIL-STD-188-141B, App. A + B) APP and fast data PRP capability	R&S®GS2201S	6091.5809.02
ALE Software to ALIS (adaptive) Consisting of: ALIS R&S®HF850 compatibility APP and fast data PRP capability	R&S®GS2210S	6091.5909.02

R&S®GN2100 Automatic Phone Patch (APP)

The APP option ensures automatic (as well as manual) routing of telephone calls to and from an HF link. When the option is used together with the R&S®GS2200 data link processor option and ALE software, the telephone number of the called subscriber can be reliably transmitted in addition to the automatic selection of the HF channel (link setup).

The called partner may be the phone itself or a local (PABX) or public (PSTN) network.

Fully featured DTMF phones (short-code dialing, etc.) serve as terminals in an HF radio system equipped with APP and ALE options at both ends.



The talk/listen switchover in semiduplex operation is voice-controlled by means of a VOX circuit. The APP automatically adapts itself to the telephone line (hybrid balance) during the linkup to the end subscriber (to PABX or PTT network) to achieve optimal transmission from radio to line network and vice versa. Via voice and tone prompts the subscribers receive information on the state and progress of the automatic linkup to the called subscriber.

The APP is operated from the front panel via keys, a graphic display, softkeys, and a menu-guided user interface. If an R&S®Series2000 radio is the terminal unit, the numeric keypad is used for entry, the loudspeaker for signaling, and the phone receiver as the talk/listen facility.

The optional voice processing unit enables the voice signals not only to be freed from transmission interference but also to be encrypted, i.e. protected against interception.

Note
Any access to a public telephone network must be in compliance with the applicable local PTT regulations.

The technical interface specifications of the APP's telephone box are designed to comply with German regulations FTZ 1 TR 2 and FTZ 144 TV 41 governing equipment connected to telephone lines.

Specifications [1]	
Output level to phone line	nominal –7 dBm (adjustable: –16 dBm to –4 dBm in 3 dB steps)
Input level from phone line	nominal –7 dBm (adjustable: –16 dBm to –4 dBm in 3 dB steps)
Frequency response	±2 dB, 300 Hz to 3200 Hz
Output impedance to phone line	600 Ω
Ultimate hybrid balance (into 600 Ω)	typ. –50 dB over 300 Hz to 3200 Hz bandwidth, measured with single tone
Hybrid impedance matching capability	0 Ω to ∞ Ω complex impedance
Dialing	DTMF or pulse dialing, all timing parameters are configurable
Functional control (from the phone line)	DTMF tones (from normal 12-key pad)
Phone line connections	screw terminals

[1] For R&S®GN2100 plug-in APP as well as telephone connecting box.

Ordering information		
Designation	**Type**	**Order No.**
Automatic Phone Patch	R&S®GN2100	6033.9505.02

R&S®GM2200 HF Modem

Multimode HF modem, plug-in for R&S®Series2000
The R&S®GM2200 multimode HF modem is currently the most advanced serial HF data modem available from Rohde&Schwarz and is fully integrated in the R&S®Series2000 radio equipment family. This modem can form the backbone of a fast and reliable data transmission system. Large volumes of data such as fax, color video still pictures, and electronic mail from PC to PC can be sent rapidly anywhere in the world.

The modem makes it possible to transmit data economically and reliably via shortwave at high speed (up to 9600 bit/s) in contrast to conventional data transmission techniques such as radioteletype (RTTY) that allow only 50 baud or 100 baud.

- Multistandard HF modem
- Single-tone modem technology
- Short preamble (Rohde&Schwarz waveforms)
- Forward error correction (FEC)
- Remote control (ASCII code)
- CW suppression
- Compact plug-in module
- Built-in test (BIT)
- Software in line with:
  - Rohde&Schwarz advanced waveforms
  - STANAG 4285
  - MIL-STD-188-110A
  - STANAG 4529
  - STANAG 4539/MIL-STD-188-110B

These waveforms can be ordered in any combination, i.e. separately and independently of each other.

Of course, they are interoperable with the corresponding waveforms of the previous R&S®GM2000 and R&S®GM2100 modems, which enables problem-free communications with existing systems and with modems of other makes. In conjunction with a system processor/communications server and appropriate software and interfaces from Rohde&Schwarz, office communications terminals such as fax machines, color video cameras/monitors or PCs may be connected, and the associated data (in compressed form to save time) is transmitted via shortwave.

A system with the R&S®GM2200 HF modem and a system processor/communications server coupled with ARQ-supported RSX.25 data protection yields 100% error-free data when taking all software error correction facilities and data compression techniques into account. The transfer time for an A4-size text page is only about 3 s to 6 s and that for a color picture including compression less than half a minute, using the 5400 bit/s waveform.

The waveforms constitute the basis for reliable and error-free HF data transmission. An ARQ data link protocol ensures error-free data flow. Owing to our information technology and software solutions such as COM2000 or R&S®PostMan II, the Rohde&Schwarz 2700 bit/s and 5400 bit/s waveforms are used in connection with the ARQ RSX.25 protocol. If it is used for the ALIS or ALE link establishment method, this protocol is specially adapted to the Rohde&Schwarz 2700 bit/s and 5400 bit/s waveforms. However, waveforms in line with STANAG and MIL-STD such as the new 9600 bit/s high-speed waveform (STANAG 4539) cannot be used together with the RSX.25 protocol. For these waveforms, radio protocols such as STANAG 5066 are available on request.

Ordering information

Designation	Type	Order No.
HF Modem, multimode plug-in for R&S®Series2000 equipment; to be ordered together with R&S®GM2200S through R&S®GM2204S software	R&S®GM2200	6117.5500.02
Software for R&S®GM2200		
Rohde&Schwarz 2700 bit/s + 5400 bit/s		
Useful data rate (with FEC[1]), autobaud capability but without interleaving) from 900 bit/s to 4500 bit/s; 5400 bit/s with FEC switched off	R&S®GM2200S	6117.6006.02
MIL-STD-188-110x Single Tone		
MIL-STD-188-110 A section 5.3 or MIL-STD-188-110 B section 5.3.2; useful data rate (with FEC, interleaving) from 75 bit/s to 2400 bit/s; 4800 bit/s with FEC and interleaving switched off	R&S®GM2201S	6117.6258.02
STANAG 4285		
Useful data rate (with FEC, interleaving but without autobaud capability) from 75 bit/s to 2400 bit/s; 1200 bit/s, 2400 bit/s, and 3600 bit/s even with FEC and interleaving switched off	R&S®GM2202S	6117.6506.02
STANAG 4529		
Useful data rate (with FEC, interleaving but without autobaud capability) from 75 bit/s to 1200 bit/s; 600 bit/s, 1200 bit/s, and 1800 bit/s even with FEC and interleaving switched off; occupies half the bandwidth of the STANAG 4285 waveform	R&S®GM2203S	6117.6758.02
STANAG 4539, MIL-STD-188-110B		
MIL-STD-188-110B App. C or STANAG 4539, Annex B, Section 4; useful data rate (with FEC, interleaving capability) from 3200 bit/s to 9600 bit/s; 12800 bit/s without FEC and interleaving switched off	R&S®GM2204S	6117.7002.02

[1] Forward error correction.

R&S®FK2020/FK2040 Digitally Tuned RF Selectors

Embedded, automatically tuned selectors, 20 dB and 40 dB selectivity

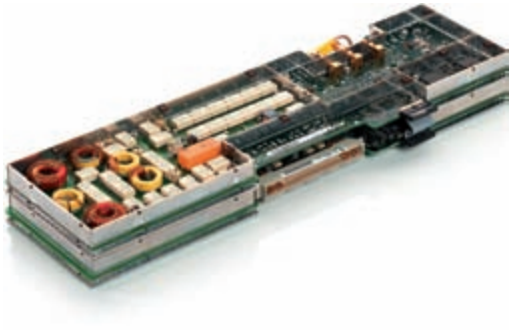
The use of the R&S®FK20xx digitally tuned RF selectors is recommended in strongly disturbed RF environments, i.e. for collocation problems such as they occur on board ships. Using digitally tuned filters, the R&S®FK20xx selectors improve the receiver input selectivity and the phase noise at the transmitter (> 170 dB (1 Hz)) and reduce harmonics and spurious. The bidirectional function in R&S®Series2000 radios coupled with very short tuning times (< 10 ms) also allows frequency-agile operation. The automatically tuned selectors provide the following functions:

- Seven-pole lowpass (0 Hz to approx. 30 MHz) for suppressing interference < 30 MHz
- Five-pole lowpass (0 Hz to 1.5 MHz) for suppressing strongly interfering shortwave signals
- Single-tuned tracking filter (1.5 MHz to 30 MHz) with stopband attenuation of up to 40 dB at 10% offset (R&S®FK2040)
- Automatic tracking either in reception or transmission mode
- Remote control on/off (can be bypassed)
- Input voltage protection up to 200 V EMF

The R&S®FK20xx digitally tuned RF selectors are plug-in modules and can be retrofitted into the R&S®XK2100L, R&S®GX2900L, and R&S®EK2000 transceivers/receivers.

Specifications

	R&S®FK2020	R&S®FK2040
Frequency range	0 Hz to 30 MHz at f < 1.5 MHz lowpass function	0 Hz to 30 MHz at f < 1.5 MHz lowpass function
Stopband attenuation	> 20 dB at 10% offset from operating frequency	> 40 dB at 10% offset from operating frequency
Gain	0 dB to +2 dB	–2 dB to +2 dB
Inband TOI	> 34 dBm	> 30 dBm
Tuning time	< 10 ms	< 10 ms
Input voltage protection	max. 200 V EMF (with Z_{in} = 50 Ω)	max. 200 V EMF (with Z_{in} = 50 Ω)
Threshold level for protection circuit	approx. > 10 V EMF or RF current > 4 A	> 10 V EMF or RF current > 4 A



Ordering information

Designation	Type	Order No.
Digitally Tuned RF Selectors		
20 dB selectivity	R&S®FK2020	6096.9502.02
40 dB selectivity	R&S®FK2040	6096.9902.02

R&S®GN2130 plug-in vocoder module

The R&S®GN2130 is a plug-in vocoder module with integrated crypto processor for the R&S®Series2000 HF equipment. It can be used together with the R&S®XK2100 150 W transceivers, the R&S®GX2900 exciters, the R&S®EK2000 receivers or the R&S®GP2000 remote control processors. The option considerably enhances the quality of voice links and, above all, provides digital ciphering of voice signals.

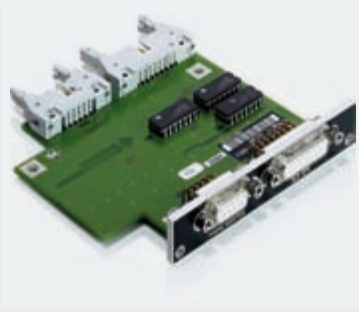
The COMSEC part of the R&S®GN2130 is based on the SCR95 crypto algorithm. This strong algorithm uses key lengths of up to 256 bits (approx. 10^{77} variants). Assuming even uninterrupted transmission, the same bit sequence would not be repeated for about 2×10^9 years. The algorithm can be adapted to user requirements (option).

With this concept, each user can benefit from a unique user key set. The keys required for ciphering are stored inside the module but can be distributed by appropriate hardware. A stored key set contains 4096 independent keys that can be selected from the key set menu of the R&S®Series2000 HMI. The R&S®GN2130 supports plain override. This feature allows reception of analog voice on the currently selected channel with the transceiver set to digital operation. This prevents analog calls from being missed while working in digital voice mode. To answer an analog call, the operator simply has to switch to analog (SSB) mode temporarily.

R&S®GN2110 voice processing unit

Using digital signal processing (DSP), the R&S®GN2110 digital voice processing unit considerably improves speech intelligibility by suppressing noise and interference in the transmission or the reception mode. This option also allows voice control of squelch and VOX circuits.

Interface Options

Designation	Description	Main features	Order No.
R&S®FK2110 **EMC Filter ALE/APP** 	This interface plug-in module matches the options ❙ R&S®GS2200 data link processor and/or ❙ R&S®GN2100 automatic phone patch (APP) to external system components and is to be fitted into the R&S®XK2100L or R&S®GX2900L together with one or both of the above options. ALE DTE is the external data interface to the radio processor (FED-STD-1045/46/49 or ALIS 2000) for fast data transmission with the R&S®GM2200 modem. With the R&S®GN2100 automatic phone patch (e.g. HF phone), the phone adapter, which is part of the APP option, is connected to the APP interface of the R&S®FK2110 and thus enables linking up with an external PABX or PSTN.	❙ Plug-in module with 15- and 9-contact Cannon connectors ❙ Designation ALE DTE, PHONE ADAPTER	6054.9491.02 Note: This option is obligatory for ALE fast data and/or APP operation
R&S®GV2100 **Modem Interface** 	This interface plug-in module is used to connect an external HF data modem to the transceivers of the R&S®Series2000 family. It performs AF level matching for different types of modems, configuration of the PTT line (V.28/TTL) and provides a serial control interface (of the R&S®GS2200 data link processor) to the external modem. The modem interface allows the use of Rohde&Schwarz HF modems such as R&S®GM857C4 and R&S®GM857C5, as well as of other qualified HF modems (assuming that link setup and ARQ/data protection are performed in the R&S®Series2000) or data processors (assuming a complete external set, including HF modem, data protection, i.e. ARQ or PRP). This interface is not required for operation with the R&S®GM2200 internal HF modem.	❙ Plug-in card with 15-contact Cannon male and 9-contact Cannon female connector ❙ Designation CONTROL, AUDIO	6033.8509.02
R&S®GS2110 **RX/TX Interface**	NMEA-183 for three applications: ❙ For naval applications in line with GMDSS/SOLAS regulations, an external digital selective call (DSC) controller drives an HF transceiver of the R&S®Series2000 family via a standardized NMEA-183 interface. It is thus possible to receive emergency calls with an external receiver, to evaluate them, and to answer or send out emergency calls at HF distress frequencies in line with internationally accepted GMDSS/SOLAS procedures ❙ Control of a detached receiver from the transceiver or receiver/exciter of the R&S®Series2000 family. A typical example is duplex operation involving the simultaneous transmission and reception at two frequencies. The receiver (R&S®EK895/896 or R&S®EK2000) up to 2 km away is controlled via this interface, and the received AF is available in the transceiver ❙ Transceiver control/audio/data from a detached control device	Usable in three applications: ❙ DSC-NMEA interface for transceiver control ❙ Control interface for a detached receiver (R&S®EK895) ❙ Control interface for a detached transceiver (R&S®Series2000) Plug-in interface with two Cannon connectors ❙ NMEA-183: DSC R&S®Series2000 control interface ❙ REMOTE RX/TX: RS-232-C serial control and receiver audio, to/from the R&S®EK895, R&S®GX2900.xx or transceiver (R&S®Series2000)	6033.5500.02

Designation	Description	Main features	Order No.
R&S®GV2000 **Option Interface**	This option interface is a programmable interface card and usually integrated into the external option/peripheral device. Its outputs are application-specific interfaces to control the connected option from the R&S®Series2000 set. One typical output is the current frequency information (set at the R&S®Series2000) in parallel code as well as the RF connections to the selective devices.	On request	6090.7008.02
R&S®GV2110 **External Control Interface**	This plug-in interface to be built in at the rear of the R&S®XK2100L/R&S®GX2900L is for the control of external options/peripheral equipment. It requires an R&S®GV2000 option interface. The R&S®GV2000 option interface is used for postselection (TX filter), 150 W, R&S®FK2101X Serial control is in line with RS-485; more than one R&S®GV2000 can be connected to an R&S®GV2110 (cascaded).	❙ Permissible length between R&S®GV2110 and R&S®GV2000 approx. 100 m ❙ Provides a serial RS-485 control bus as well as four RF inputs/outputs ❙ The I/O connector has also four embedded coax connectors for the RF link to the external filter unit (R&S®FK2101x)	6033.6006.02
R&S®GV2120 **Data Link Interface**	The R&S®GV2120 data link interface is provided for connecting an external data terminal set (DTS) as required, for example for DATA LINK-Y or LINK11 transmission and reception. This interface complies with MIL-STD-188-203-1A and STANAG 5511. In addition to and irrespective of the standard audio inputs/outputs of the R&S®Series2000 transceivers, the R&S®GV2120 supplies the levels required for data link at a separate 15-contact D-Sub connector. The R&S®GV2120 is a plug-in interface card for data link control; data and audio inputs/outputs, all AF inputs and outputs settable, 2 keyline inputs (+6 V, contact to ground), D-Sub connector, 15 contacts.	❙ LINK11 and/or LINK-Y operation ❙ Single tone (SLEW) and/or ❙ Multitone (CLEW) operation in ISB and/or ❙ USB/LSB	6079.1013.02 For LINK-Y operation only: 6079.1013.03
R&S®GV2130 **Modem Data Interface**	This interface is used for system applications where an internal modem (R&S®GM2200) is operated with an external system processor, e.g. PC with RSX.25 data protection.	Plug-in interface to be connected at the rear of the R&S®XK2100L/R&S®GX2900L	6090.3254.02
R&S®GF2010 **OCXO Frequency Standard**	To achieve higher frequency stability, an oven-controlled crystal oscillator (OCXO) rather than the standard crystal oscillator can be employed in the HF unit/synthesizer of the transceiver. The R&S®GF2010 option (which can only be fitted in the factory) must be specified in the customer's order. The higher requirements for transceiver frequency stability are needed for the DATA LINK-modes, for example, and can be met by using the R&S®GF2010 option.	❙ Frequency 10 MHz ❙ Short-term stability ≤ 1×10^{-9}/day (after 30 days) ❙ Long-term stability ≤ 1×10^{-7}/year ❙ Drift versus temperature ≤ 1×10^{-9}/°C	6033.5000.02 To be installed in the factory
R&S®GS2120 **Modem Control Interface**	The R&S®GS2120 modem control interface is required if the R&S®GM2200 internal HF modem is operated without the R&S®GS2200 internal data link processor.	–	6033.5751.02

Designation	Description	Main features	Order No.
R&S®KL2100 **Blower Unit for R&S®XK2100L** 	For the use of the R&S®XK2100L transceiver in continuous transmit mode, the R&S®KL2100 blower unit is recommended for keeping the operating temperature and the quality parameters within specified tolerances even under harsh environmental conditions. This option is particularly required for continuous radio data or radiotelephony operation with voice compression or in relay mode. The blower unit is fixed mechanically and electrically to the rear of the transceiver behind the heat sink and connected to the power supply of the transceiver. The blowers are temperature-controlled from the output stage.	❙ Twin blower with housing and air filter ❙ Supply voltage 24 V DC (from transceiver)	6050.2992.02
R&S®KS2100 **Shockmount for R&S®XK2100L** Groundplate not supplied with R&S®KS2100 shockmount 	The sturdy R&S®KS2100 shockmount fitted with absorbers is available for the fully mobile use of the R&S®XK2100L 150 W transceiver, i.e. in applications subject to high levels of shock and vibration. The R&S®KS2100 shockmount can accommodate an R&S®XK2100L transceiver as well as an R&S®IN2100 AC power supply and an additional 1 HU device (e.g. R&S®PostMan II server). For the integration into the R&S®KS2100, all devices must be fitted with 19" adapters. MIL-STD-810E (for R&S®KS2100): ❙ Random in line with method 514.4 ❙ Shock in line with method 516.4, with 40 g when fully equipped	**R&S®KS2100** Shockmount for R&S®XK2100L ❙ R&S®XK2100L + R&S®IN2100 + additional 1 HU device R&S®KA2900 19" adapter (R&S®XK2100L) R&S®KA2120 19" adapter (R&S®IN2100) Extra groundplate	6050.3999.04 6072.6010.03 6064.0751.02 On request
R&S®ZW2900 **RX Input Protection** 	An optional RF protection for the input of the 500 W and 1000 W R&S®Series2000 transceivers is available. The R&S®ZW2900 add-on module ensures destructive-free reception in the case of RF interference at the antenna (caused by very close transmitters) of up to 100 V (V_{RMS}) corresponding to a power of 200 W into 50 Ω. The protection function is provided by a power PTC resistor looped into the R&S®VK2500/ VK2900 power amplifier between the antenna and the receiver input. The PTC resistor goes high impedance when RF interference is present and thus protects the receiver input. The use of the R&S®ZW2900 option is required whenever collocation problems caused by RF irradiation impair reception or make it impossible. This situation is frequent on ships and can be overcome by using the R&S®ZW2900 option.	Protection against RF overloading 100 V (RMS) (corresponding to 200 W RF into 50 Ω)	6072.2514.02
R&S®BV2900 **440 V Transformer**	For supplying the R&S®XK2500L and R&S®XK2900L transceivers, the R&S®IN4150 and R&S®IN4190 power supplies can be configured for the following input voltages/modes/phases: The R&S®BV2900 440 V transformer is required for the following special application: 3 × 440 V, 3-phase, triangle. This 5 kVA autotransformer is built into the R&S®KG2900 adapter. It is thus possible to operate transceivers also in special nets (STANAG 1008) such as on ships.	**Voltage** / **Mode** / **Phase** 230 V / – / 1 Ø 3 × 230 V + N / star / 3 Ø 3 × 208 V / triangle / 3 Ø	6072.7016.02

System components

R&S®GB2000 Remote Control Unit

For remote control of all transceivers of the R&S®Series2000 family

The R&S®GB2000 remote control unit enables the remote control of all members of the R&S®Series2000 transceivers. The use of the R&S®GB2000 is recommended whenever remote operation – regardless of the distance – is required for reasons of space or system layout (central control unit and radio equipment are at different locations). An integrated, serial interface affords point-to-point and addressable operation for up to 99 radios in a system.

With more than 10 radios, line drivers must be provided. At distances less than 100 m (between R&S®GBxx and R&S®XKxx) a three-core screened cable is sufficient.

The front-panel layout and operating concept of the R&S®GB2000 remote control unit is identical to that of the R&S®XK2100L transceiver and R&S®GX2900L receiver/exciter. An optional swivel adapter allows the operator to make adjustments for optimal viewing angle and ergonomic operation.

- Layout and function of control and display elements identical to local front panel
- Remote control (operation, prograHMIng, and configuration)
- Remote control of auxiliary equipment and antennas via the R&S®GV2110 external control interface
- Simultaneous connection of local (front panel) and remote unit (R&S®GB2000 or PC)
- Remote control over any distance via telephone or directional radio channels by means of line modems
- Direct connection of a PC/printer for teletype (TTY) operation via the R&S®XK2010C standard cable set
- Very good system flexibility due to easy configuration of various AF and PTT assignments, serial control ports, hardware or software switching of PTT
- Robust design, dust-protected front panel (IP43 protection)
- Remote ALE operation

Specifications

AF interfaces	
AF input/output to R&S®Series2000	at AF/REMOTE connector
AF input/output for local mode	at AF/LOCAL connector
AF output for headphones	50 mW, 300 Ω (adjustable)
AF output for loudspeaker	3 W, 4 Ω, adjustable, switchable
Microphone inputs	2
Serial interfaces (control)	
Remote control for long distances (via modems)	RS-485/RS-422
Remote control (via modems) and software updates (direct downloading from PC)	RS-232-C
Transmission rates	100/200/300/600/1200/2400/4800/ 9600 baud
PTT control interface	
AF/LOCAL connector	linked with AF/REMOTE, TTL and V.10 levels
AF/REMOTE connector	activated by ORed combination of the two PTTs of AF/LOCAL connector, V.10 level
PTT	with remote telegram or configurable line
Current drain (DC)	approx. 800 mA
Remote switch-on	R&S®Series2000 can be switched on separately or together with R&S®GB2000; programmable port output for remote switch-on with V.10 level
General data	
Dimensions, desktop version	3 HU, 443 mm (17.44 in) wide, approx. 140 mm (5.51 in) deep, (without connectors)
Power supply	16 V to 31 V DC , and 90 V to 260 V AC, with automatic switchover from AC to DC (if AC fails)
Environmental data	
Operating temperature range	–25 °C to +55 °C
Storage temperature range	–40 °C to +85 °C
Altitude	max. 3000 m, max. +35 °C (operation) max. 10 000 m (transport)
Humidity	in line with MIL-STD-810E, meth. 507.3
Vibration	
Sinusoidal	EN 60068-2-6
Random	MIL-STD-T-28800 (0.01 g^2/Hz, 10 Hz to 300 Hz, 1.9 g RMS)
Shock	MIL-STD-810E, meth. 516.4, proc. I
International protection code	IP43/IP20[1]
EMC	EN 50081-1, EN 50082-1
CE conformity mark	in line with DIN EN 60945, ETSI EN 300373-1/-2/-3 (with restrictions)[2]
Safety	EN 60950-1/VDE0805
MTBF	> 10 600 h

[1] Front panel/rest of R&S®GB2000.
[2] ETSI EN 300373-1, 7.6, 9.3 (see user manual).

Ordering information

Designation	Type	Order No.
Remote Control Unit	R&S®GB2000	6064.2002.02
Swivel Adapter	R&S®KA2000	6064.3250.02

R&S®GP2000 Remote Control Processor

For upgrading radios to R&S®Series2000 standard or split-site control

The R&S®GP2000 remote control processor considerably enhances the flexibility of both existing and newly designed HF communications systems. Technical concept, outer appearance, and user interface of the remote control processor are largely identical to that of the transceiver or R&S®GB2000 remote control unit, which is a clear advantage for service, logistics, and operation. In contrast to the R&S®GB2000, the R&S®GP2000 remote control processor can be equipped with options and interface modules such as ALE processor or HF data modem.

Key applications

- Split-site applications with remote transmitters and/or receivers (R&S®Series2000, R&S®Series850, R&S®Series890); for full-duplex operation in fixed frequency mode, requires the use of different RX/TX frequencies
- Local applications using non-R&S®Series2000 equipment (R&S®Series850, R&S®Series890, R&S®XK516 transceiver) for adaptation to R&S®Series2000 systems
- Upgrading of available HF systems to R&S®Series2000 standard
- Applications using ARINC-429 equipment

Split-site applications

Split-site solutions are necessary wherever collocation problems are to be expected because of high transmitter power or the use of several transmitting antennas. Transmitters and receivers then must be set up separately at a certain distance from each other. In the ideal case, all the transmitters are set up at one site and all the receivers at another location far away. In many cases it is sufficient to install only the transmitters remotely and leave the receivers in the central station. All members of the R&S®Series2000 or R&S®Series850 transceivers can be used as transmitters.

Flexible networking

For interconnection of the individual system components, different transmission media can be used depending on the distance to be covered:

- For distances up to approx.
  - 100 m: transmission directly via cable
  - 50 km: transmission via microwave link
  - 100 km: transmission via dedicated/PSTN lines by means of modems

Like the R&S®Series2000, the R&S®GP2000 can be fully remote-controlled from a system processor (PC) via its remote-control interface.

Upgrading of available HF systems to R&S®Series2000 standard

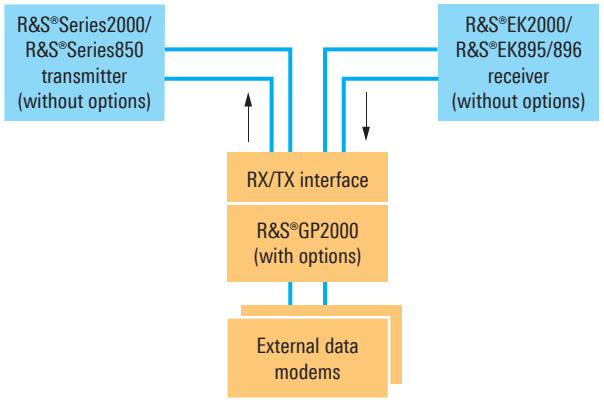
Applications using R&S®Series850:
The R&S®GP2000 allows upgrading of legacy systems to R&S®Series2000 standard. This means more than mere functional compatibility between the R&S®Series850 and R&S®Series2000 systems. Through the use of new R&S®GP2000 features such as ALE (FED-STD-1045/46/49), the R&S®GM2200 HF data modem can be combined with available transceivers from the R&S®Series850 family.

The following R&S®Series2000 features are available when using the R&S®Series850 together with the R&S®GP2000:

- User interface (HMI) identical to R&S®XK2100L and R&S®GB2000
- ALIS
- ALE (FED-STD-1045/46/49)
- Fast data mode with up to 9600 bit/s
- Automatic phone patch (APP)
- R&S®GN2110 voice processing unit (VPU)
- Support of automatic modes ALIS/ARQ, ALIS/PRP, ALIS/FAST DATA, ALE/PRP, ALE/FAST DATA

Applications using ARINC-429 equipment:
If the R&S®GP2000 with RX/TX interface is equipped with the ARINC option, it can be used for controlling transceivers having an interface in line with ARINC-429, as for instance the R&S®XK516 transceiver.

Split-site operation



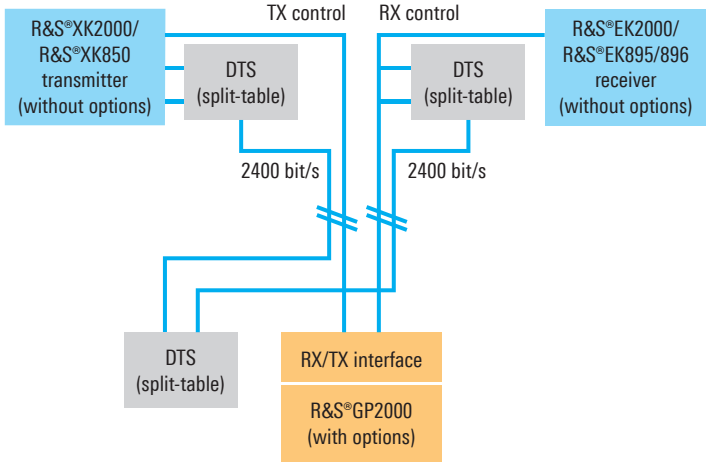
ISB operation with remote transmitter and remote receiver (implemented with R&S®GP2000 and RX/TX interface)

Options

The R&S®GP2000 as well as the R&S®GX2900L are able to accommodate several options and interface modules from the R&S®Series2000 HF radio family.

The following modules can be used	
R&S®GS2200	Data link processor (with ALIS or ALE software)
R&S®GN2100	Automatic phone patch (APP)
R&S®GN2110	Voice processing unit (VPU) (with/without scrambling)
R&S®FK2110	EMC filter ALE/APP
R&S®GM2200	HF modem
R&S®GV2100	Modem interface
R&S®GV2130	Modem data interface
R&S®GN2130	Vocoder and encryption unit
R&S®GH2000	ARINC interface

LINK11 operation with split-table DTS



LINK11 operation with split-table DTS (implemented with R&S®GP2000 and RX/TX interface). Prerequisite for this configuration: The PTT line must be taken directly as a hardware line from the DTS.

Rear view of the R&S®GP2000.

Specifications	
General data	
Display	high-contrast LC graphic display with softkeys for menu-guided operation, text display for frequency, channel, modulation, BITE information, bargraph display of receive field strength in dBµV, output power in W, frequency shift in kHz, manual gain control (MGC) in dBµV
Manual control	step keys (rollkey editor) for selection of modulation modes, bandwidths, output power stages, etc.
Remote control	fully remote-controlled from PC via remote-control interface
User interfaces	
2 × AF input (line)	rear panel, 0 dBm, 600 Ω, floating, –10 dBm to +10 dBm, selectable
2 × AF output (line)	rear panel, 0 dBm, 600 Ω, floating, –10 dBm to +10 dBm, selectable
2 × microphone	front panel, 1 mV to 30 mV, 150 Ω or 10 mV to 300 mV, 150 Ω
AF headphones	front panel, 50 mW into 300 Ω, controlled on front panel
AF loudspeaker	front panel and rear panel, 3 W into 4 Ω, controlled and switched off on front panel
Morse key	front panel, contact to ground
2 × teletype	rear panel, for V.28 teletype
5 × PTT	front panel, TTL, transmission = contact to ground rear panel, TTL and V.10 (separate for voice and TTY)
2 × PC interface	RS-232-C (V.24/V.10) and RS-422/RS-485 asynchronous, 300 baud to 9600 baud, 7/8 bit
Radio interfaces (RX/TX interface)	
2 × AF output for TX	0 dBm, 600 Ω, floating, –10 dBm to +10 dBm, selectable
2 × AF input for RX	0 dBm, 600 Ω, floating, –10 dBm to +10 dBm, selectable
3 × PTT for TX	V.10, transmission = +5 V; V.10, transmission = –5 V; TTL, transmission = contact to ground
2 × RX disable	V.10, RX disable = HIGH; TTL, RX disable = contact to ground

Specifications	
FSK output for TX	V.10, 50 baud to 600 baud
FSK input for RX	V.10, 50 baud to 600 baud
TX control	V.10, asynchronous, 300 baud to 38400 baud, 7/8 bit + parity (odd/even/none)
RX control	V.10, asynchronous, 300 baud to 38400 baud, 7/8 bit + parity (odd/even/none)
ARINC-429 interface (optional)	
TX/RX command	in line with ARINC-429
TX/RX answer	in line with ARINC-429
Power supply	
Battery	19 V to 31 V DC
Power consumption	< 100 W
Environmental data	
Operating temperature range	–20 °C to +55 °C
Storage temperature range	–40 °C to +85 °C
Vibration	
Sinusoidal	EN 60068-2-6
Random	MIL-STD-T-28800 (0.01 g^2/Hz, 10 Hz to 300 Hz, 1.9 g RMS)
Shock	MIL-STD-810E, meth. 516.4, proc. I
Int. protection code	EN 60529 / IP43
EMC	MIL-STD-461C, part 4/5, CE03, RE02, CS02, CS06, EN 50081-1, EN 50082-1
CE conformity mark	in line with DIN EN 60945, ETSI EN 300373-1/-2/-3 (with restrictions) [1]
MTBF	6100 h (R&S®XK2100L)
Mechanical data	
Dimensions (W × H × D)	
Desktop model	443 mm × 132 mm × 340 mm (17.44 in × 5.20 in × 13.39 in)
19" model	483 mm × 127 mm × 340 mm (19 in × 5.00 in × 13.39 in)
Weight	approx. 10 kg without options (22.05 lb)

[1] ETSI EN 300373-1, 7.6, 9.3.

Standard cable sets

The standard cable sets are available from Rohde&Schwarz for system applications of the R&S®GP2000 with other instruments.

System component	Type	Quantity	Length	Order No.
Control Cable between R&S®GP2000 and R&S®EK2000	R&S®GP2001C	1 cable	2 m	6092.3739.02 [1]
AF Input/Output Cable between R&S®GP2000 and R&S®XK2x00	R&S®GP2002C	1 cable	2 m	6092.3751.02 [1]
Control Cable between R&S®GP2000 and R&S®XK2x00 (RS-232-C)	R&S®GP2003C	1 cable	2 m	6092.3774.02 [1]
Control Cable between R&S®GP2000 and R&S®EK89x (RS-232-C)	R&S®GP2004C	1 cable	2 m	6092.3716.02 [1]
Control Cable between R&S®GP2000 and R&S®EK89x (RS-485)	R&S®GP2005C	1 cable	2 m	6092.3697.02 [1]
AF Output Cable for R&S®EK89x	R&S®GP2006C	1 cable	2 m	6092.3674.02 [1]
Control Cable between R&S®GP2000 and R&S®XK852/XK855	R&S®GP2007C	1 cable	2 m	6092.3616.02 [1]
Control Cable between R&S®GP2000 and R&S®XK859	R&S®GP2008C	1 cable	2 m	6092.3645.02 [1]
Control Cable between R&S®GP2000 and R&S®XK2x00 (RS-485)	R&S®GP2009C	1 cable	2 m	6092.3797.02 [1]

[1] Other cable lengths on request.

Ordering information		
Designation	**Type**	**Order No.**
Remote Control Processor	R&S®GP2000	6092.3000.02
19" Rackmount Adapter	R&S®KA2900	6072.6010.03

R&S®XK200xC Standard Cable Sets

Standard cable sets are available from Rohde&Schwarz for system applications of the R&S®Series2000 family with external components. These applications include the following:

- Fast data modes
- Extended TX/RX operation
- ATU control cable
- Remote control cable

Fast data transmission

Standard ready-made cable sets are available for expanding radio systems of the R&S®Series2000 to an ALE-supported system with fast data capability.

The cables interconnect the radio equipment with the external system processor (e.g. PC) or an external HF modem.

The cable sets can be used for standard radio equipment well as for standard components in project-specific systems. The cable sets supplied differ in the following respects:

- System processor (PC)
- I/O device of the system processor (COM port or ICOM multi I/O board)
- With or without RSX.25 data protection protocol
- Internal or external HF modem

Description and ordering information

Sytem component/application	Type	Quantity	Length	Order No.
Fast data modes				
For use of a PC or with COM port and internal HF modem (R&S®GM2200), with ALE	R&S®XK2002C	2 cables	2 m each 3 m each	6063.6504.02 6063.6504.03
Extended RX/TX operation				
Antenna (coax) Cable to connect transceiver with 1) ATU 2) broadband antenna, e.g. R&S®HX002 (A1) Note: Lightning protection should be considered.	R&S®XK2001C	1 cable		6063.5508.xx [1]
Antenna Cable for VLF reception with R&S®XK2100 and R&S®FK2100	R&S®XK2008C	1 cable	10 m	6063.8507.10
ATU control cable				
Standard Cable; between R&S®XK2500/XK2900 transceivers and R&S®FK855C1/R&S®HX002	R&S®GK2903	1 cable		6117.9505.yy [2]
Cable for naval use; between R&S®XK2500/XK2900 transceivers and R&S®FK855C3/ R&S®FK2900M ATUs	R&S®GK2903M	1 cable		6117.9757.yy [2]
Remote control cable				
Connecting Cables for remote control between R&S®GB2000 and R&S®XK2100/R&S®GX2900	R&S®XK2009C	2 cables		6077.2012.zz [3]

[1] xx depending on cable length:

02	length 2 m
25	length 25 m
30	length 30 m
50	length 50 m

[2] yy depending on cable length:

10	length 10 m
20	length 20 m
30	length 30 m
40	length 40 m
50	length 50 m

[3] zz depending on cable length:

20	length 20 m
30	length 30 m
91	length 100 m

R&S®GA2160 Telephone Exchange Set

For the optional telephone-operated service within the R&S®Series2000 family, the radio must be equipped with the internal ALE, APP and EMC filter ALE/APP options. Moreover, the accessory R&S®GA2160 telephone exchange set – which consists of a PABX and one standard telephone set – must be connected to the telephone connection box of the APP. This allows telephone-like operation of the entire radio system, with full radio operation (link setup), ringing, signaling, and (semiduplex) operation from the telephone set. For further extensions regarding the number of subscribers or access to the telephone network, other (higher capacity) PABXs can be used, or a direct PSTN line can be connected to the APP's telephone connection box.

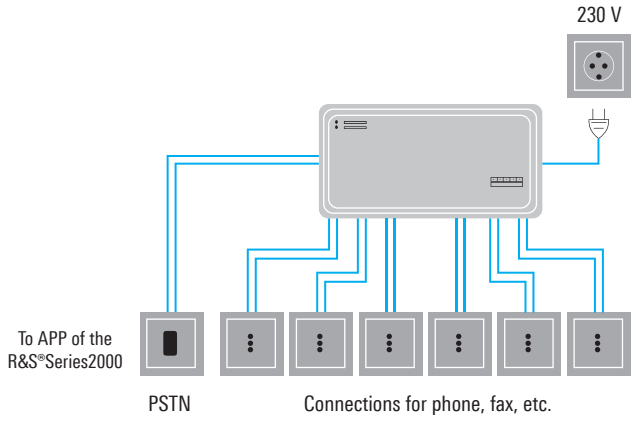
Note

Any access to a public telephone network must be in compliance with the applicable local PTT regulations. The technical interface specifications of the APP's telephone box are designed to comply with German regulations FTZ 1 TR 2 and FTZ 144 TV 41 governing equipment connected to telephone lines, but the box is not officially certified.

Specifications

Power supply	230 V AC ±10%, 50 Hz
PSTN line	
Technical transfer	in line with BAPT 223 ZV 5
Voltage at exchange	20 V to 75 V DC
Call impedance	approx. 17 kΩ at 25 Hz
Extension	
DC voltage	29 V to 38 V DC
Circuit current	approx. 23 mA
Operating range	2 × 50 m, 790 m at Ø 0.6 mm
Call voltage	approx. 45 V (V_{RMS}), 50 Hz
Reference tones	425 Hz ±5%, interval ±10%
Serial interface	standard RS-232-C, V.24 for configuration with external PC
Subscriber telephone set (1×)	Siemens Euroset 2015 (for example) or compatible
General data	
Temperature range	
Operating	0°C to +40°C
Storage and shipping	–20°C to +70°C
Humidity	10% to 75%, without condensation
Dimensions	217 mm × 157 mm × 63 mm (8.54 in × 6.18 in × 2.48 in)
Weight	approx. 1050 g (2.31 lb)

Overview



Ordering information

Designation	Type	Order No.
Telephone Exchange Set	R&S®GA2160	6064.9507.02

R&S®KA2110 Service Kit

The R&S®KA2110 service kit together with the associated repair manual allows service and repair to be carried out on the following units of the R&S®Series2000 family: R&S®XK2100L, R&S®FK2100, R&S®GX2900L, R&S®VK2500, R&S®VK2900, and R&S®GB2000. The R&S®KA2110 service kit is intended for on-site troubleshooting/repair of defective units or internal modules with the aid of a functional reference unit. Recommended test equipment listed in the repair manual should be available.

The service kit consists of a variety of adapter cards, cables, adapters, and a connection box which makes the data, PTT and signal outputs for the basic functions of the DUT available for switching and measurement. All components of the service kit are accommodated in a portable case.

Ordering information

Designation	Type	Order No.
Service Kit	R&S®KA2110	6050.4995.02

Antenna tuning units/HF dipole antennas

Optimal narrowband antenna matching of the radio equipment for each power class is provided by means of highly efficient antenna tuning units (ATUs) and dipole antennas as follows:

Type	Designation	Page
R&S®FK2100/2100M	Antenna Tuning Unit	111
R&S®FK855C1	Antenna Tuning Unit	114
R&S®FK855C3	Antenna Tuning Unit	116
R&S®FK855U	Antenna Tuning Unit	118
R&S®FK859C1	Line Flattener	120
R&S®HX002A1	HF Dipole	121
R&S®HX002M1	HF Dipole	124
R&S®FK859X1	HF Postselector	125
R&S®FK2101X	HF Postselector	125

Ordering information

Designation	Type	Order No.
HF Transceiver 150 W[1]		
Desktop model	R&S®XK2100L	6033.0508.02
19" Rackmount Adapter		
R&S®XK2100	R&S®KA2900	6072.6010.03
R&S®IN2100	R&S®KA2120	6064.0751.02
Naval Software Option	R&S®XK2101S	6090.2758.07
HF Transceiver 500 W[1]		
Model for installation in 19" racks[2]	R&S®XK2500L	6071.0518.72
Model for installation in 19" racks[2], selective level control	R&S®XK2500L	6071.0518.73
Naval Software Option	R&S®GX2901S	6090.2506.07
HF Transceiver 1000 W[1]		
Model for installation in 19" racks[2]	R&S®XK2900L	6057.9992.72
Model for installation in 19" racks, selective level control[2]	R&S®XK2900L	6057.9992.73
Naval Software Option	R&S®GX2901S	6090.2506.07
Mechanical adapters for 500 W/1000 W transceiver		
Telescopic slides (R&S®GX2900)		6019.5129.00
Telescopic slides (R&S®VK2500/R&S®VK2900)		0062.8334.00
Data Link Processor	R&S®GS2200	6091.5009.02
Software for R&S®GS2200		
MIL-STD-188-141B, App. A (ALE)	R&S®GS2200S	6091.5709.02
MIL-STD-188-141B, App. A + B, linking protection (ALE)	R&S®GS2201S	6091.5809.02
ALIS (Rohde&Schwarz standard)	R&S®GS2210S	6091.5909.02
Modem Control Interface	R&S®GS2120	6033.5751.02
Data Link Interface[3]		
LINK-Y + LINK11 (CLEW|SLEW)	R&S®GV2120	6079.1013.02
LINK-Y (CLEW|SLEW)	R&S®GV2120	6079.1013.03
GMDSS Kit		
Expansion of R&S®Series2000 to naval applications in line with GMDSS regulations, consisting of: receiver interface for the control of an external receiver or as DSC-NMEA interface controller	R&S®GS2110	6033.5500.02
HF Modem, multistandard[3]	R&S®GM2200	6117.5500.02
Modem Software		
Rohde&Schwarz 2.7 + 5.4 kbit/s	R&S®GM2200S	6117.6006.02
MIL-STD-188-110A Section 5.3 (Single Tone)	R&S®GM2201S	6117.6258.02
STANAG 4285	R&S®GM2202S	6117.6506.02
STANAG 4529	R&S®GM2203S	6117.6758.02
MIL-STD-188-110B, App. C or STANAG 4539 Annex B, Section 4	R&S®GM2204S	6117.7002.02
Further options		
High-Precision Frequency Standard (OCXO) (factory-installed only)	R&S®GF2010	6033.5000.02
Blower Unit (for R&S®XK2100L)	R&S®KL2100	6050.2992.02
Automatic Phone Patch with Telephone Adapter	R&S®GN2100	6033.9505.02
Digital Voice Processing Unit (NRU)	R&S®GN2110	6033.7502.02
Digital Voice Option (with powerful 256 bit crypto module)	R&S®GN2130	6117.4549.02
ARINC Interface	R&S®GH2000	6892.3297.02
Digitally Tuned RF Selector, 20 dB	R&S®FK2020	6096.9502.02
Digitally Tuned RF Selector, 40 dB	R&S®FK2040	6096.9902.02
External Control Interface	R&S®GV2110	6033.6006.02
Option Interface for R&S®GV2110	R&S®GV2000	6090.7008.02
RX/TX Interface	R&S®GS2110	6033.5500.02
EMC Filter ALE/APP	R&S®FK2110	6054.9491.02
Modem Interface	R&S®GV2100	6033.8509.02
Modem Data Interface	R&S®GV2130	6090.3254.02
Receiver Input Protection	R&S®ZW2900	6072.2514.02

Ordering information

Designation	Type	Order No.
External options		
Remote Control Unit	R&S®GB2000	6064.2002.02
Remote Control Processor	R&S®GP2000	6092.3000.02
System Receiver	R&S®EK2000	6093.6002.02
Power Supply (R&S®XK2100)	R&S®IN2100	6050.1996.02
Power Supply 230 V AC; 1 or 3 phases + N/208 V AC; 3-phase Δ	R&S®IN4150	6120.0705.02
Power Supply 220 V DC	R&S®IN4150	6120.0705.12
Power Supply 230 V AC; 1 or 3 phases + N/208 V AC; 3-phase Δ	R&S®IN4190	6120.2708.02
440 V Transformer (used in 500 W and 1000 W systems)	R&S®BV2900	6072.7016.02
Antenna tuning units		
Antenna Tuning Unit, 150 W	R&S®FK2100	6046.8948.02
Antenna Tuning Unit, 150 W, naval applications[4]	R&S®FK2100M	6046.9550.02
Antenna Tuning Unit, 500 W, naval applications[4]	R&S®FK855C3	0724.8908.07
Antenna Tuning Unit, 1 kW, naval applications[4]	R&S®FK2900M	6097.1005.02
Antenna Tuning Unit, 1 kW, naval applications[4], mast antennas length 30 m to 50 m	R&S®FK2900M	6097.1005.05
Recommended extras		
Audio accessories		
Microphone with PTT	R&S®GA2100	6064.5001.02
Handset with PTT	R&S®GA2120	6064.6008.03
Headset, dynamic	R&S®GA015	0583.6012.02
Telephone Exchange Set	R&S®GA2160	6064.9507.02
Shock absorber		
For R&S®XK2100	R&S®KS2100	6050.3999.04
For R&S®XK2500/XK2900	R&S®KS2900	6072.6510.02
Service kit	R&S®KA2110	6050.4995.02
Mating connector sets (R&S®Series2000)		
For R&S®XK2100L	R&S®GK2100	6064.1506.02
For R&S®GB2000	R&S®KA2000B	6070.1633.00
For R&S®GX2900L	R&S®KA2900G	6070.1591.00
For R&S®VK2500/VK2900	R&S®KA2900V	6070.1604.00
For R&S®IN4150/IN4190	R&S®ZF4107	6120.2808.02

[1] HF transceivers equipped with front panel for local and remote control.
[2] Mating connector sets and cables have to be ordered separately.
[3] Requires R&S®GF2010 high-precision frequency standard.
[4] Requires naval software option.

R&S®XB2900 HF Transmit/Receive Broadband System

- HF broadband system with four 1 kW transceivers
- Especially designed for naval operations

The R&S®XB2900 HF transmit/receive broadband system is a modern and high-performance communications system especially designed for the naval operational environment. The R&S®XB2900 is used by various NATO navies. It is based on the idea of combining the ship's various HF transmission signals at the high power level and using only one broadband antenna system. The system provides independent operational circuits in any available transmission mode such as the following:

- Voice
- RATT
- High-speed data
- Data link operation, e.g. LINK11/22 (FF)
- Automatic link establishment (ALE), etc.

The use of the R&S®XB2900 HF transmit/receive broadband system is not limited to naval applications, but is also very effective in stationary scenarios.

Main features

- Full HF frequency band (2 MHz to 30 MHz) for voice, data, and ALE operation
- Operating frequency separation of 1%
- Flexible system configuration from 2 to 32 lines in steps of 1
- Very low levels of intermodulation
- Very high flexibility with regard to system configuration and power management
- High system reliability and MTBF figures
- Extensive BITE and continuous monitoring facilities
- Exciter/receiver sections with optional plug-in modules for:
  - ALE operation
  - Fast data transmission
  - Pre-/postselection
  - Digital speech processing
  - Automatic phone patch
- High efficiency through optimum use of power amplifier stages
- Full integration into a central remote control system
- Common, tried and tested standard components for narrowband and wideband systems
- Compact system design
- Max. output power 4 kW

Characteristics

The R&S®XB2900 HF transmit/receive broadband system operates in the frequency range from 2 MHz to 30 MHz (RX down to 10 kHz) with an antenna system consisting of two or three broadband antennas. The frequency spacing between the transmit channels can be reduced to about 1 % separation.

The power management system provides a wide variety of RF power levels for the output signals by combining several lines up to 4 kW and more (P^3I). The RF high-power signals are combined in highly linear 3 dB coupler units so that there are no active switching elements at the high power levels. The configuration of the system is based on standard Rohde&Schwarz components such as the following:

- R&S®XK2900L transceivers
- R&S®GV2900 power management unit (PMU)
- R&S®FK4192 and R&S®FK4194, 2 kW and 4 kW power combiners
- R&S®RBS1000 load resistors
- R&S®FK2950 triplexer and R&S®FK2960 diplexer for broadband antenna system (WBL, WBM, WBH)

The R&S®XB2900 broadband system (in operation on a frigate).

The R&S®XB2900 is able to handle the following transceiver operating modes:

- Embedded fast data modem with waveforms such as
  - MIL-STD-188-110A
  - MIL STD-188-110B, App. C/ STANAG 4538, Annex B, Sec. 4
  - STANAG 4285
  - STANAG 4529
- Data link operation e.g.:
  - LINK11 (CLEW)
  - LINK11 (SLEW)
  - LINK22 (FF)
  - LINK-Y (Mk2)
- Automatic link establishment in line with FED-STD-1045/1046/1049

Tailored to your specific requirements

Using these standard components the system can be precisely configured to the required number of lines and the power requirements for each line, i.e. it can be tailored to the actual operational requirement, e.g. 2 to 32 HF lines in steps of 1 in an HF broadband antenna system. Each HF broadband line is equipped with an R&S®XK2900L transceiver. The HF receiver sections are connected to a separate receive antenna distribution system.

RF distribution

RF output signals are routed to the broadband antenna system via an antenna diplexer or triplexer. The frequency ranges of the different antenna ports overlap so that coverage of the entire HF frequency band is ensured.

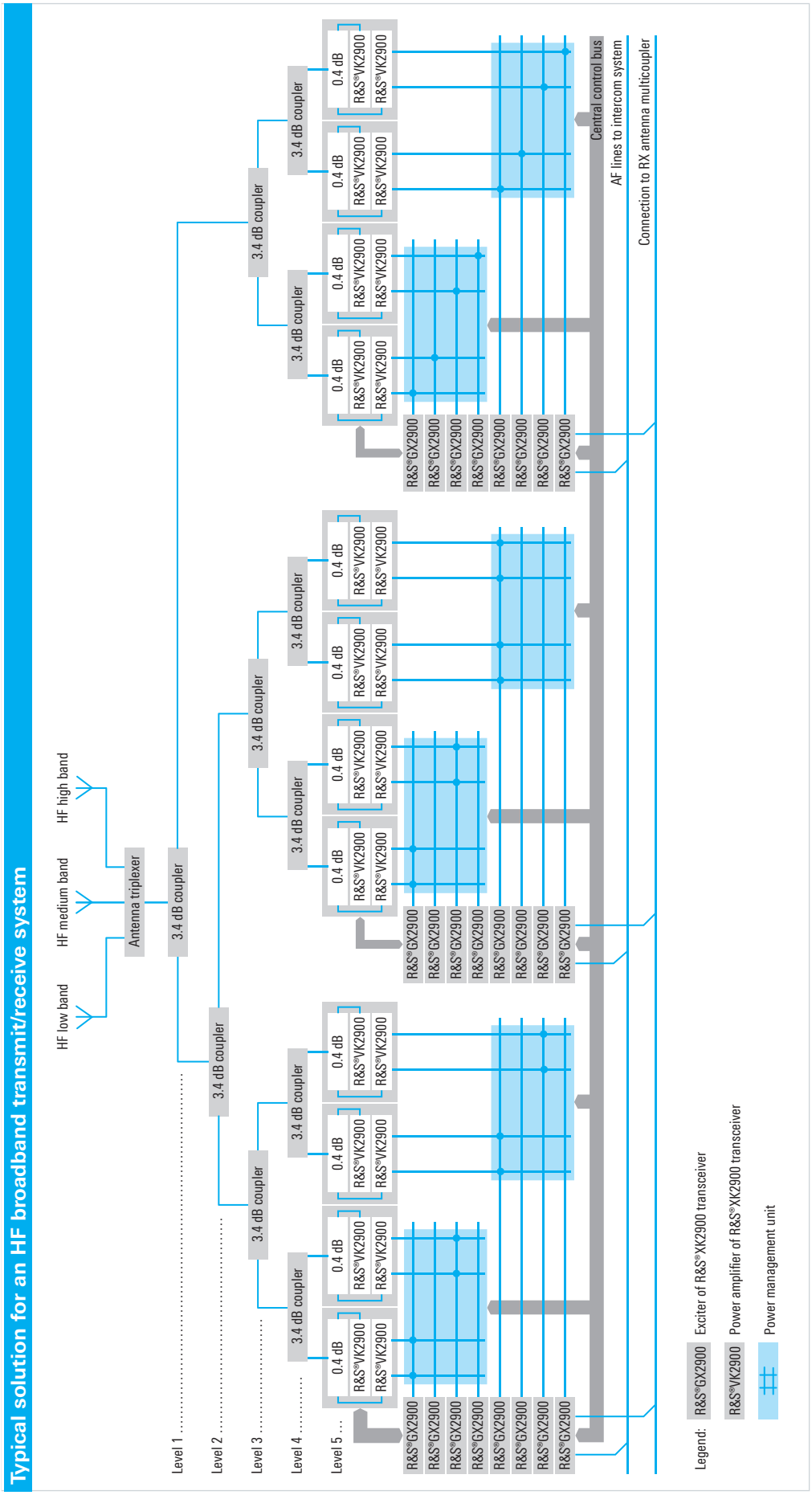
The fact that output signals are transmitted by two antennas in slightly overlapping frequency ranges has no particular influence on the radiation pattern, since the overall ship superstructure determines the radiation characteristics of the antenna system.

System control

The integration of the R&S®XB2900 HF transmit/receive broadband system into a remote control system provides control and monitoring from one control terminal for all operations of the overall ship communications system.

Logistic aspects

A significant logistic advantage of both the broadband and narrowband systems is that all power amplifiers and exciters are components of the same transceiver type – the R&S®XK2900. These identical transceivers provide extremely high system availability and reliability.


Typical solution for an HF broadband transmit/receive system
HF low band
HF medium band
HF high band
Antenna triplexer
3.4 dB coupler
Level 1
Level 2
Level 3
Level 4
Level 5
0.4 dB
R&S®VK2900
R&S®GX2900
Central control bus
AF lines to intercom system
Connection to RX antenna multicoupler
Legend:
R&S®GX2900 Exciter of R&S®XK2900 transceiver
R&S®VK2900 Power amplifier of R&S®XK2900 transceiver
Power management unit

Outstanding reliability and viability

The RF power amplifier stages are based on MOSFET semiconductor technology providing very high linearity and very low RF noise figures.

The passive RF combining system, without active electronic elements at high power levels but with power management, results in a very high reliability and MTBF figure for the overall system and each individual communications line.

The total power consumption of the HF broadband system depends on the number of transmit lines actually in use and their respective output power. Power amplifier stages that are not transmitting operate in idle mode, i.e. their power consumption is less than 250 W per amplifier.

All components are equipped with extensive continuous monitoring and BITE facilities that provide status information for the central control system and the front-panel displays of the individual units.

The system components can be changed easily and quickly without recalibration. Due to the compact design of the standard components the system can be installed in a minimum number of 19" standard racks.

Ordering information

Designation	Type	Order No.
HF Transmit/Receive Broadband System [1]		
Installed in 19" rack (R&S®KG2900)	R&S®XK2900L	6057.9992.12
Installed in 19" rack (R&S®KG2900), selective level control	R&S®XK2900L	6057.9992.13
Separate units for installation in 19" racks [2], consisting of: R&S®GX2900L + R&S®VK2900 + R&S®IN4190 + R&S®KA2900	R&S®XK2900L	6057.9992.82
Separate units for installation in 19" racks [2], consisting of: R&S®GX2900L + R&S®VK2900 + R&S®IN4190 + R&S®KA2900, selective level control	R&S®XK2900L	6057.9992.83
Digitally Tuned RF Selector 40 dB (mandatory option)	R&S®FK2040	6096.9902.02
Power Management Unit	R&S®GV2900	6077.3519.02
Passive HF Power Combiner 2 kW	R&S®FK4192	6077.8510.02
Passive HF Power Combiner 4 kW	R&S®FK4194	6090.0003.02
Load Resistor 1 kW	R&S®RBS1000	0207.4010.55
Triplexer	R&S®FK2950	6090.3502.02
Diplexer	R&S®FK2960	6096.7000.02

[1] HF transceiver only available with front panel and display for local and remote control.
[2] Mating connector sets and cables have to be ordered separately.

Hardware options

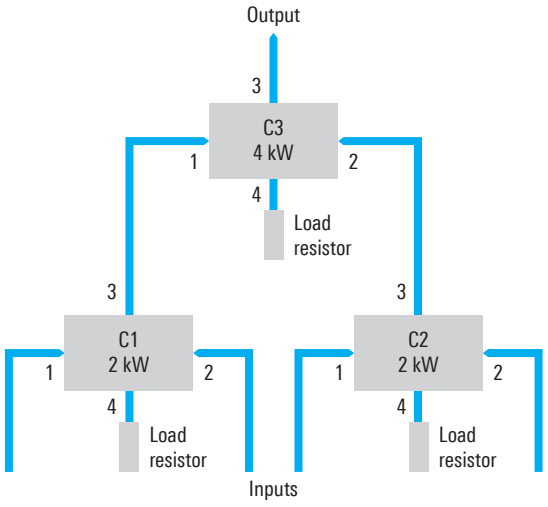
R&S®FK4192/FK4194 Passive HF Power Combiners

- R&S®FK4192: 2 kW
- R&S®FK4194: 4 kW

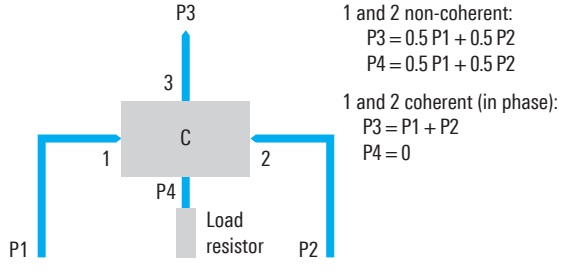
The power combiner section consists of three individual couplers, arranged at two levels so as to maximize the power management possibilities.

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 function is explained by means of the following simple example:

Configuration



Configuration



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 and in phase
- B: not identical, not coherent

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

- Case A: At the output of the coupler, the sum of the powers of the two signals (P3 = P1 + P2) appears. The residual loss is typically less than 0.4 dB
- Case B: At the output of the coupler, the sum of the half powers of the two signals (P3 = 0.5 × P1 + 0.5 × P2) appears. 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 non-coherent combination, is dissipated in a load resistor connected to the fourth port of the coupler

This typical behavior of a coupler allows the coupler loss to be controlled by appropriate and intelligent selection of the input signals, which in practice is the task of the power management unit. The unit is controlled by the operator from the communications workstation in the operator console.

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.

The nominal insertion loss is between 0.2 dB and 0.4 dB. The coupling loss is 0 dB in case A and 3 dB in case B. The isolation of the coupler – typ. 25 dB for adjacent lines, higher for non-adjacent lines – determines the backdoor intermodulation in the power amplifiers. The primary source of backdoor intermodulation is therefore between two adjacent power amplifiers that are combined by a coupler. The amplifier-to-amplifier paths in the combiner add a multiple of 3 dB to the isolation.

Each coupler can accept a maximum of 1122 W (R&S®FK4192) or 2 kW (R&S®FK4194) input power per input port. Since the power combining unit consists only of passive and solid-state devices, there are no limitations on frequency-agile EPM (ECCM) operating modes and frequency separation between the various HF transmitting channels.

In addition, these passive devices feature an outstanding MTBF of up to 18000 h (depending on the operational configuration, power levels used, coherent or non-coherent, etc.) and thus excellent availability.

For specifications see data sheet PD 5214.1243.22

R&S®FK2950 Antenna Triplexer
R&S®FK2960 Antenna Diplexer

After combining the RF power lines with the cascaded 3 dB coupling devices, the RF transmit signals are routed to an HF broadband antenna system, which 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 1.5 MHz to 30 MHz can be used.

For specifications see data sheet PD 5214.1243.22

R&S®GV2900 Power Management Unit

Assigns the exciter signals to the inputs of the power amplifiers

The R&S®GV2900 power management unit (PMU) assigns the exciter signals to the inputs of the power amplifiers, and ensures that the number of HF transmitting lines and the RF power of each HF line are configured in line with the current user requirements of the HF transmission system.

The radio operator configures the R&S®XB2900 HF broadband system via the central control system, installed in the console in the radio room, using a user-friendly human-machine interface. For emergency purposes, a predefined configuration is activated immediately. In addition, the system can be controlled manually by the operator, since all components of the R&S®XB2900 HF transmit/receive broadband system are equipped with a local control unit.

Inside the power management unit, the RF signals are distributed by high-performance switching devices at low power levels. The system is designed so that no high-power RF switching is necessary, thus ensuring high reliability and instantaneous channel changing for frequency-adaptive and EPM (ECCM) applications.

The following operating modes are possible	
Single-line mode	Each R&S®VK2900 amplifier is allocated to a single R&S®GX2900 exciter
2 kW mode	Two R&S®VK2900 power amplifiers are driven with the same exciter signal, i.e. Nos. 1 and 2 and Nos. 3 and 4
4 kW mode	All four R&S®VK2900 amplifiers are coherently driven with the same exciter signal
Mixed mode	One exciter unit controls two power amplifiers, i.e. coherent driving; two exciters operate on independent lines, and one exciter remains free for receiver operation

Specifications

HF data	
Frequency range	1.5 MHz to 30 MHz
Intermodulation – output signals (P_{in} = 7 dBm PEP)	> 50 dB referenced to single tone
Decoupling, single lines	> 40 dB
Harmonic suppression (P_{in} = 7 dBm CW)	> 40 dB
Frequency response	< 2 dB
Mode switching time	< 3 s
Environmental data	
Operating temperature range	–25 °C to +55 °C
Storage temperature range	–40 °C to +85 °C
Altitude	3000 m above sea level, T = +35 °C
Humidity	+26 °C/+41 °C, 95 %, 5 days, MIL-STD-810E, method 507.3 with slight condensation
Vibration	IEC 60068-2-6
Random	IEC 60068-2-64, equipment class B
Shock	MIL-STD-810E, method 516.4
Protection	DIN 40050, IP20
EMC	MIL-STD-461-C, class 4 (CE 03, RE 02, RS 03), EN 300339
Noise level	< 55 dBA at a distance of 1 m
Electrical safety	EN 60950
Mechanical data	
Dimensions (W × H × D)	483 mm × 132 mm × 566 mm (19 in × 5.2 in × 22.3 in)
Weight	14.7 kg (32.4 lb)
MTBF	9800 h
MTTR	0.5 h

Ordering information

Designation	Type	Order No.
Power Management Unit	R&S®GV2900	6077.3519.02

R&S®Series890 VLF-HF Receivers

10 kHz to 30 MHz

Compact DSP-based receivers for radiomonitoring and radiodetection, radiocommunications, search operation, DF systems, and as frontend for HF intelligence tasks

The compact and modular VLF-HF receivers are ideal for use in stationary, mobile, and remote receiving systems. Due to the modern and flexible concept, the receivers can be used as communications receivers in communications networks and for fast search, scanning, radiodetection, and radiomonitoring tasks. Moreover, they are optimally suitable as high-performance frontend units (e.g. for special postprocessing applications (COMINT)) as well as for DF systems.

The R&S®Series890 VLF-HF receivers use digital signal processing (DSP) for IF, demodulation, and AF. The DSP, equipped with a very powerful microprocessor, offers the user a variety of additional features such as automatic signal processing, signal optimization, and high operating convenience. All this significantly improves the attainable reception quality.

The very compact ½ 19" single receivers or 19" (rack-mount) single or dual receivers allow any type of system combinations in the form of operator positions or handoff receivers (master-slave operation). Handoff or remote receiving operation over any distance is possible without any constraints using master (R&S®EK896)/slave (R&S®EK895) concepts (see page 101).

Moreover, the R&S®GB899 remote control unit or serial computer interfaces (also bus-compatible) for PC-controlled operation of single receivers or up to 99 handoff receivers (addressable) are available in the system.

All the tried and tested features of the R&S®Series890 family such as RF characteristics, operating and remote-control concept, applications, high immunity to spurious emission, as well as high reliability (especially in the RF field and under environmental stress) are provided by these two receivers.

Tried and tested system concept

- Two different models:
  - R&S®EK895 ½ 19" receiver: compact, multipurpose receiver for local and remote control
  - R&S®EK896 19" receiver: search receiver with extended keyboard for direct access to the most important functions, ideal for use as a master receiver in receiving systems
- Receiving range with 1 Hz resolution throughout
- 13 or 128 bandwidths
- Excellent large-signal behavior
- Very short frequency change time (typ. 10 ms)
- Built-in test (BIT) down to module level
- Digital signal processing (DSP) for convenient and versatile operation

R&S®EK895 and R&S®EK896.

Operational features

- Easy operation via terminal, computer, remote control unit, or front panel
  - Menu-guided settings
- Remote control of all settings – over any distance when using modems
  - R&S®GB899 realtime remote control unit available
  - Master/slave operation
  - Bus-controllable (RS-232-C, RS-485, 2/4-wire)
- 1000 programmable channel memory locations
- Scan mode for programmable frequency ranges and any channel sequences
- Ideal handoff receivers in stationary, mobile, and remote receiving systems

Customer benefits

- Extremely reliable operation under harsh environmental and EMC conditions (MTBF >14 000 hours)
- High availability due to long MTBF and short MTTR
- Easy adaption to special requirements by means of optional plug-in modules and standardized interfaces
- Excellent price/performance ratio
- Powerful microprocessor for bus interfacing, menus, and user programs
- Free slots for retrofitting of options
- Integrated self-test down to module level with plain-text result display
- Low power consumption <25 VA (R&S®EK895 base model), therefore little self-heating
- Highly compact design, width ½ 19" (R&S®EK895) or 19" (R&S®EK896)
- Dual receiver as 19" desktop or rack model

Overview of R&S®Series890 models

Type	Model	Use (typ.)	Special features	Size	Bandwidths	Local and remote control	Remote control
R&S®EK895	.02	Remote control version (without control panel)		½ 19"	13	–	•
	.12	Local and remote control version (with control panel)		½ 19"	13	•	
	.14	Local and remote control version (with control panel)	Built-in OCXO	½ 19"	13	•	
	.17	Local and remote control version (with control panel)	LINK11 reception (built-in OCXO)	½ 19"	13	•	
	.37	Local and remote control version (with control panel)	LINK11 reception (for use with external frequency standard)	½ 19"	13	•	
	.63	Local and remote control version (with control panel)	Additional 1.44 MHz IF output	½ 19"	13	•	
R&S®EK896	.12	Local and remote control version (with control panel)		19"	128	•	
	.14	Local and remote control version (with control panel)	Built-in OCXO	19"	128	•	
	.17	Local and remote control version (with control panel)	LINK11 reception (built-in OCXO)	19"	128	•	
	.37	Local and remote control version (with control panel)	LINK11 reception (for use with external frequency standard)	19"	128	•	

R&S®EK895 VLF-HF Receiver

Compact ½ 19" DSP-based high-end receiver for radiocommunications, radiomonitoring and radiodetection, search operation, DF systems, and as frontend for HF intelligence tasks

Due to the excellent RF characteristics and the uncomplicated and full remote-control capability, the R&S®EK895 is suitable for all civil, administrative, and military shortwave applications. The R&S®EK895 is the ideal choice for receiving systems that have to fulfill extremely high reliability requirements, in particular under harsh environmental and EMC conditions.

- Digital signal processing (DSP) for convenient and versatile operation
- Clear-cut front panel for simple, menu-guided operation
- Realtime remote control or master-slave mode
- Tried and tested system concept
- Excellent price/performance ratio
- Extremely reliable operation under harsh environmental and EMC conditions
- Application-specific options and accessories available

The R&S®EK895 is a powerful VLF-HF receiver that is a top-end product benefiting from many years of experience in this field. Due to the advantages of digital signal processing embedded in the R&S®EK895 receiver, a number of additional features and operator convenience have been added. The operational features additionally incorporated into the R&S®EK895, such as preamplifier (PREAMP), noise blanker (NB), squelch (SQ), notch filter (NOTCH), and passband tuning (PBT), are selected in submenus using softkeys. If one of these features is active, a bargraph appears on the display above the relevant inscription (PREAMP, NB, SQ, NOTCH, PBT).

Clearly organized, menu-guided selection and programming of the receiver settings ensure excellent processing and handling of the received signal content. Due to its full system compatibility, the receiver provides the basis for extremely economical customer-specific solutions.

The R&S®EK895 thus fulfills the requirements for versatile use in voice receiving and data communications systems as well as for all radiomonitoring, radiodetection and radio intelligence (COMINT) applications.

Operation

The built-in memory has capacity for nonvolatile storage of 1000 complete channel settings so that an external computer is not required for channel management and control (but can of course be used in addition).

Receivers with remote-control panel

The receivers can be remote-controlled by ASCII command sequences via a multistandard interface (RS-232-C, RS-485, RS-422/423, 2/4-wire). In the simplest case, a terminal can be used as the control unit. For more convenience, a computer can be used to handle complex tasks and to create special user interfaces.

A remote control unit (R&S®GB899) permits full remote control via the serial interface and, with external line modems, over any distance.

Two wired and bus-integrated slots for plug-in modules are provided in the R&S®EK895 for expansions.

The comprehensive sequence control can be used for all demanding shortwave reception tasks. Due to flexible programming of the processor, the following operating modes are possible:

- Manual operation
- Remote control or master-slave operation
- Channel scanning, sequential and programmable
- Frequency scan
- Channel reception
- Password-protected channel reception

Special features

- Excellent large-signal behavior, very good intercept points
- High resolution of tuning frequency down to 1 Hz
- Fast and low-noise synthesizer
- Demodulators for AM, CW, LSB, USB, ISB, FM, FSK, AFSK, and FAX included in basic configuration
- 13 bandwidths from 150 Hz to 8 kHz (128 bandwidths as option)
- LINK11 reception (models .07/.17/.37)
- RF preamplifier, switchable (noise figure 8 kT_0)
- Double notch filter
- Noise blanker
- Passband tuning
- Syllabic and RSSI squelch
- Special RTTY (FSK/AFSK) mark and space filters, matched to the selected shift
- Digital data output (data, clock, frame)
- Maximum input voltage protection up to 100 V (EMF)
- Control interface fully complying with international standards
- Low power consumption <25 VA (R&S®EK895 base model), therefore little self-heating
- Powerful microprocessor for bus interfacing, menus, and user programs
- Dual receiver as 19" desktop or rack model
- Free slots for retrofitting of options
- Integrated self-test down to module level with plain-text result display
- Available with operator front panel or remote-control-only front panel
- Highly compact design, width ½ 19"

Specifications

Frequency range	10 kHz to 30 MHz	
Resolution	1 Hz	
Frequency drift	–10 °C to +45 °C	aging/year
Frequency standard (TCXO)	5×10^{-7}	1×10^{-6}
Option (OCXO)	1×10^{-7}	1×10^{-7}
External frequency standard	1/5/10 MHz, 0.2 V to 1 V (RMS)	
Antenna input	BNC connector, 50 Ω	
Max. input voltage (30 MHz)	100 V EMF	
Demodulation modes	▮ CW/MCW (A1A, A1B, A2A, A2B) ▮ FAX1 (F1C) ▮ AM/AME (A3E, H2A, H2B, H2E), USB/LSB (R2A, R3E, J2A, J3E) ▮ ISB (B8E) ▮ FSK/AFSK (F1A, F1B), F6 (F7B) ▮ FAX2 (F3C), FM (F3E) ▮ DATA LINKin line with MIL-STD-188-203-1A (on request)	
IF bandwidth (standard values)	13, selectable between 150 Hz and 8 kHz	
Quasi-continuous bandwidth selection	128 steps, between 100 Hz and 9 kHz (with R&S®EK895S7 option)	
Sensitivity (for S/N = 10 dB, f = 0.1 MHz to 30 MHz)		
A1A (CW)	0.4 µV EMF (–121 dBm), BW = 300 Hz	
J3E (SSB), J7B	1.0 µV EMF (–113 dBm), BW = 2.7 kHz	
H3E (AME), 1 kHz, m = 60 %	2.7 µV EMF (–104 dBm), BW = 6 kHz	
With preamplifier, f = 0.2 MHz to 30 MHz		
A1A (CW)	0.2 µV EMF (–127 dBm), BW = 300 Hz	
J3E (SSB), J7B	0.4 µV EMF (–121 dBm), BW = 2.7 kHz	
H3E (AME), 1 kHz, m = 60 %	1.0 µV EMF (–113 dBm), BW = 6 kHz	

Specifications

Immunity to interference, nonlinearities	
Intermodulation (1.5 MHz to 30 MHz)	
SOI	>60 dBm (typ. 70 dBm)
TOI	>30 dBm (typ. 35 dBm)
Gain control	automatic (AGC), manual (MGC) or remote (DGC)
AGC error	≤3 dB (1 µV to 1 V EMF)
Time response constants	
Attack time	<10 ms
Decay time	25/150/500 ms, 1 s, 3 s
DGC range	0 dBµV to 120 dBµV EMF in 1 dB steps
AFSK/FSK demodulator	transfer rate (50 baud to 600 baud) and deviation range (±42.5 Hz to ±425 Hz) adjustable; V.28 interface and audible tone circuit
Diplex telegraphy demodulator (F7B)	2 × V.28 interface
Channel memory	for 1000 channels, nonvolatile, storage of complete receiver setup for each channel
Data interface	RS-232-C, RS-485 (bus-compatible)
Transfer rate	50 baud to 38400 baud
Power supply	100/120/230/240 V –15/+10%, 47 Hz to 420 Hz (approx. 25 VA to 75 VA, depending on model)
Dimensions (W × H × D)	211 mm × 132 mm × 460 mm (8.31 in × 5.2 in × 18.11 in)
Weight	approx. 8 kg (17.64 lb)
General data	
Environmental data	
Storage temperature range	in line with MIL-STD-810D, meth. 501.2 proc. 1/meth. 502.2 proc. 1, –40°C to +80°C
Operating temperature range	in line with MIL-STD-810D, meth. 501.2 proc. 1/meth. 502.2 proc. 1, –25°C to +55°C
Damp heat, constant	in line with EN 60068-2-3, 95% relative humidity
Vibration test, sinusoidal	in line with EN 60068-2-6, 10 Hz to 55 Hz; 0.4 mm double amplitude
Shock	in line with MIL-STD-810D, method 516.3 proc. I, 30 g, 11 ms functional
EMC, emission, immunity	in line with EN 50081-1, EN 50082-1, MIL-STD-461C, CE01, CE03, CE06, CS01, CS02, CS06, RE01, RE02, RS01, RS02, RS03
Electrical safety	in line with EN 61010-1/VDE0411, EN 60950-1/VDE 0805
CE conformity mark	in line with ETSI EN 300373-1/-2/-3, EN60945 (with restrictions)[1]
MTBF	>14000 h

[1] ETSI EN 300373-1/-2/-3, operating temperature range (–10°C to +45°C), ETSI EN 300373-1, 7.6.

Ordering information

Designation	Type	Order No.
VLF-HF Receiver		
Only remote-controlled via serial interface	R&S®EK895	6057.8996.02
With control panel; for local and remote control	R&S®EK895	6057.8996.12
With control panel; for local and remote control; with built-in OCXO	R&S®EK895	6057.8996.14
With control panel; for local and remote control; with built-in OCXO; LINK11 reception	R&S®EK895	6057.8996.17
With control panel; for local and remote control; for use with external frequency standard; LINK11 reception	R&S®EK895	6057.8996.37
With control panel; for local and remote control; with 1.44 MHz IF output	R&S®EK895	6057.8996.63
Accessories supplied	user manual	
Recommended extras		
Remote Control Unit	R&S®GB899	6037.3501.03
19" Adapter Kit	R&S®ZZA98	0827.4533.00
19" Adapter Kit for 2 × R&S®EK895	R&S®KA890L1	6041.6699.03
Service manual		6045.6712.62
Line Current Source	R&S®GH890	6007.6054.02
Plug-in modules		
Input Filter Unit	R&S®FK890H1	6007.7750.02
BCD Interface	R&S®GC890	6007.7809.02
Broadband Output	R&S®GM893	6051.8494.03
Transfer Software Package[1]	R&S®EK890S3	6015.4492.02
IF Converter (submodule of IF/AF processor)	R&S®UX895	6077.0261.02
Quasi-Continuous IF Bandwidth Control (128 bandwidths)	R&S®EK895S7	6077.0510.02

[1] For editing, comparing, and transfering channel files.

R&S®EK896 VLF-HF Receiver

19" DSP-based receiver for radiomonitoring and radiodetection, radiocommunications, master receiver for radio workstations

The R&S®EK896 has especially been designed for complex radiodetection and search reception tasks; its operating principle and configuration perfectly match the relevant requirements. It is fitted as standard with panel controls and an LC display for local and remote-control operation since radiomonitoring practically always requires manual optimization of receive parameters. High-speed and reliable radiomonitoring is supported by temporary storage of a complete receiver setup and its transfer to or readout from the connected slave. The R&S®EK896 is the optimal operator's position in modern radiomonitoring systems. In the usual master-slave mode, a master receiver can control up to 99 slave receivers via additional line drivers to handle simultaneous radiomonitoring or specific radiodetection tasks. Due to its outstanding characteristics, the R&S®EK896 is also ideal for use as a standalone receiver. All R&S®EK895 options can be fitted.

- Digital signal processing (DSP) for convenient and versatile operation
- Digital RF selection (optional)
- Realtime remote control or master-slave mode
- Tried and tested system concept
- Excellent price/performance ratio
- Extremely reliable operation under harsh environmental and EMC conditions
- Application-specific options/accessories available

The R&S®EK896 is based on the R&S®EK895 base model, see page 95.

Special operations

- Master-slave operation
- Complete erasure of channel memory

In addition, the following functions can be selected on the front panel:

- Display of interface configuration
- Fast channel storage
- Channel buffer storage
- Default settings ON/OFF
- Password for channel service
- Local/remote mode
- Rotary knob increments

R&S®EK896 search receiver with front panel for local/remote control.

Special features

- Excellent large-signal behavior, very good intercept points
- High resolution of tuning frequency down to 1 Hz
- Fast and low-noise synthesizer
- Demodulators for AM, CW, LSB, USB, ISB, FM, FSK, AFSK, and FAX included in basic configuration
- 128 bandwidths from 100 Hz to 9 kHz
- RF preamplifier, switchable (noise figure 8 kT_0)
- Double notch filter
- Noise blanker
- Passband tuning
- Syllabic and RSSI squelch
- Special RTTY (FSK/AFSK) mark and space filters, matched to the selected shift
- Direct, fast-access key panels
- Digital data output
- Maximum input voltage protection up to 100 V EMF (up to 200 V EMF, see option)
- Control interface fully complying with international standards
- Digitally tuned RF selectors (optional)
- Built-in speaker, switchable
- Large rotary knob
- Low power consumption <25 VA (R&S®EK896 base model), therefore little self-heating
- Powerful microprocessor for bus interfacing, menus, and user programs
- Receiver as 19" desktop or rack model
- Free slots for retrofitting of options
- Integrated self-test down to module level with plain-text result display

Specifications

Frequency range	10 kHz to 30 MHz	
Resolution	1 Hz	
Frequency drift	–10 °C to +45 °C	aging/year
Frequency standard (TCXO)	5×10^{-7}	1×10^{-6}
Option (OCXO)	1×10^{-7}	1×10^{-7}
External frequency standard	1/5/10 MHz, 0.2 V to 1 V (RMS)	
Antenna input	BNC connector, 50 Ω	
Max. input voltage (30 MHz)	100 V EMF, optional 200 V EMF	
Demodulation modes	▮ CW/MCW (A1A, A1B, A2A, A2B), FAX1 (F1C) ▮ AM/AME (A3E, H2A, H2B, H2E), USB/LSB (R2A, R3E, J2A, J3E) ▮ ISB (B8E) ▮ FSK/AFSK (F1A, F1B), F6 (F7B) ▮ FAX2 (F3C), FM (F3E) ▮ DATA LINKin line with MIL-STD-188-203-1A (on request)	
IF bandwidth	13, selectable between 150 Hz and 8 kHz and 128 steps between 100 Hz and 9 kHz	
Sensitivity	(for S/N = 10 dB, f = 0.1 MHz to 30 MHz)	
A1A (CW)	0.4 µV EMF (–121 dBm), BW = 300 Hz	
J3E (SSB), J7B	1.0 µV EMF (–113 dBm), BW = 2.7 kHz	
H3E (AME), 1 kHz, m = 60 %	2.7 µV EMF (–104 dBm), BW = 6 kHz	
With preamplifier, f = 0.2 MHz to 30 MHz		
A1A (CW)	0.2 µV EMF (–127 dBm), BW = 300 Hz	
J3E (SSB), J7B	0.4 µV EMF (–121 dBm), BW = 2.7 kHz	
H3E (AME), 1 kHz, m = 60 %	1.0 µV EMF (–113 dBm), BW = 6 kHz	
SOI and TOI	same as R&S®EK895	
Gain control	automatic (AGC), manual (MGC), or remote (DGC)	
AGC error	≤3 dB (1 µV to 1 V EMF)	
Time response constants		
Attack time	<10 ms	
Decay time	25/150/500 ms, 1 s, 3 s	
DGC range	0 dBµV to 120 dBµV EMF in 1 dB steps	
AFSK/FSK demodulator	transfer rate (50 baud to 600 baud) and deviation range (±42.5 Hz to ±425 Hz) adjustable; V.28 interface and audible tone circuit	
Diplex telegraphy demodulator	2 × V.28 interface	
Channel memory	for 1000 channels, nonvolatile, storage of complete receiver setup for each channel	
Data interface	RS-232-C, RS-485 (bus-compatible)	
Transfer rate	50 baud to 38400 baud	
Power supply	100/120/230/240 V –15/+10 %, 47 Hz to 420 Hz (approx. 25 VA to 75 VA, depending on model)	
Dimensions (W × H × D)	426 mm × 132 mm × 460 mm (16.77 in × 5.2 in × 18.11 in)	
Weight	11 kg (25.24 lb)	

Specifications

Environmental data	
Storage temperature range	in line with MIL-STD-810D, method 501.2 procedure 1/method 502.2 procedure 1, –40 °C to +80 °C
Operating temperature range	in line with MIL-STD-810D, method 501.2 procedure 2/method 502.2 procedure 2, –25 °C to +55 °C
Damp heat, constant	95 % relative humidity in line with EN 60068-2-3
Vibration test, sinusoidal	in line with EN 60068-2-6, 10 Hz to 55 Hz; 0.4 mm double amplitude
Shock	in line with MIL-STD-810D, method 516.3 procedure I, 30 g, 11 ms functional
EMC, emission, immunity	in line with EN 50081-1, EN 50082-1, MIL-STD-461C, CE 01, CE 03, CE 06, CS 01, CS 02, CS 06, RE 01, RE 02, RS 01, RS 02, RS 03
Electrical safety	in line with EN 60950-1/VDE 0805
CE conformity mark	in line with EN 60945, ETSI EN 300373-1/-2/-3 (with restrictions)[1]
MTBF	>14 000 h

[1] ETSI EN 300373-1/-2/-3, operating temperature range –10 °C to +45 °C.
ETSI EN 300373-1, 7.6.

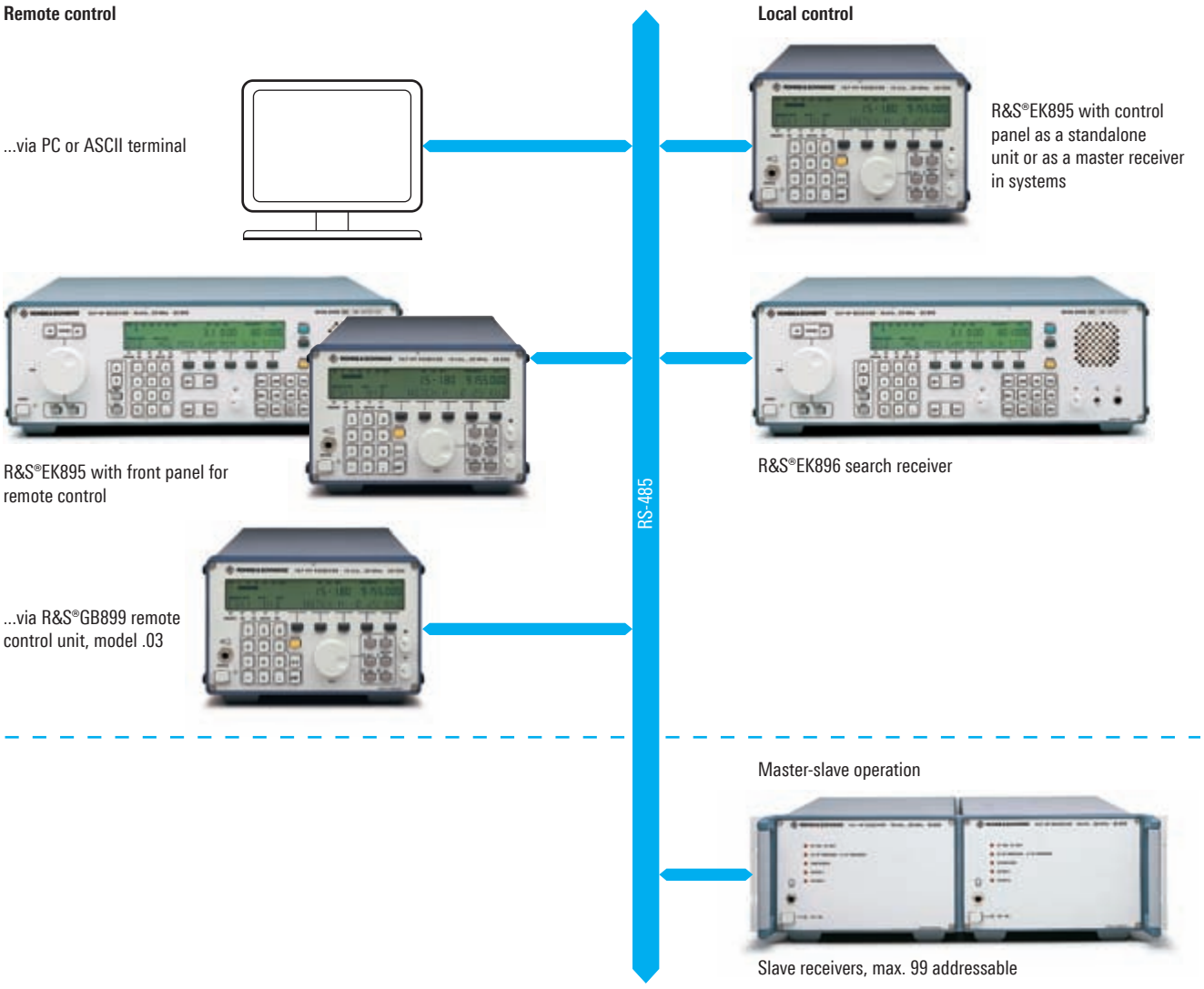
Ordering information

Designation	Type	Order No.
VLF-HF Receiver		
With control panel		
Standard Receiver with TCXO	R&S®EK896	6038.2509.12
With oven-controlled frequency standard (OCXO)	R&S®EK896	6038.2509.14
For LINK11 reception (int. OCXO)	R&S®EK896	6038.2509.17
For LINK11 reception (for use with external frequency standard)	R&S®EK896	6038.2509.37
Accessories supplied	user manual	
Recommended extras		
Remote Control Unit	R&S®GB899	6037.3501.03
Service manual		6045.7783.62
Line Current Source	R&S®GH890	6007.6054.02
Plug-in modules		
Input Filter Unit	R&S®FK890H1	6007.7750.02
BCD Interface	R&S®GC890	6007.7809.02
Broadband Output	R&S®GM893	6051.8494.03
Transfer Software Package[1]	R&S®EK890S3	6015.4492.02
IF Converter (submodule of IF/AF processor)	R&S®UX895	6077.0261.02
Digitally Tuned RF Selector 20 dB	R&S®FK896D	6077.3019.02
Digitally Tuned RF Selector 40 dB	R&S®FK896D	6077.3019.04
19" Rackmount Adapter for R&S®EK896	R&S®ZZA-93	0396.4892.00

[1] For editing, comparing, and transfering channel files.

Control Concepts for the R&S®Series890 VLF-HF Receivers

Overview

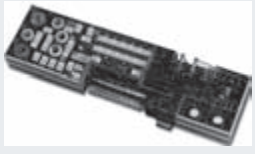


Internal options for R&S®Series890 VLF-HF receivers – overview

	R&S®EK895 (model .02 to .14)	R&S®EK896 (model .12, .14)
R&S®UX895 IF converter	•	•
R&S®FK890H1 input filter	•	•
R&S®GM893, model .03, broadband output	•	•
R&S®GC890 BCD interface	•	•
R&S®GH890 line current source	•	•
R&S®FK896 digital selection	–	•
R&S®EK895S7 quasi-continuous bandwidths (128)	•	•

– not available. • optional.

Internal options for the R&S®Series890 VLF-HF receivers

Designation	Description	Main features		Order No.
R&S®UX895 **IF Converter**	The R&S®UX895 IF converter is a submodule for the IF/AF (DSP) processor. Instead of the analog IF output (0 Hz to 40 kHz), the R&S®UX895 linearly converts the set receive parameters to the IF of 455 kHz (100 kHz output frequency on request). This option allows the connection of external signal processing units/analyzers operating with an input frequency of 455 kHz.	Level Connector Impedance	0 dBm BNC 50 Ω	6077.0261.02
R&S®FK890H1 **Input Filter Unit** 	The input filter module comprises a lowpass filter, a bandpass filter, and eight suboctave filters which are automatically selected with the receive frequency. It is also equipped with a signal input protection up to 30 V EMF (for the HF bands). The input filter unit has a very low insertion loss (<1 dB) and an excellent large-signal behavior matching the receiver (no inherent distortion/hysteresis). The input filter unit is recommended to ensure unimpaired reception in an environment subject to RF interference (collocation). In this case, unwanted (interfering) frequency ranges are strongly suppressed.	Lowpass filter Bandpass filter Suboctave filters (8×) Insertion loss Input voltage protection Design	0 Hz to 0.5 MHz 0.5 to 1.5 MHz 1.5 to 30 MHz <1 dB 30 V EMF plug-in module	6007.7750.02
R&S®GC890 BCD Interface	The BCD interface provides the current receive frequency information with a resolution of 100 Hz to a parallel BCD output.	Frequency information Design	22 bit parallel, CMOS, 5 V plug-in board	6007.7809.02
R&S®GH890 **TTY Line Current Source** 	This option supplies the line current (40 mA at 60 V, or ±20 mA at ±30 V) required for direct connection of teletype units provided that FSK/AFSK demodulation (e.g. with the R&S®GM890) – standard for the R&S®EK895/896 – is used. This option is recommended for older teletype units that still need line current. It is not required for modern teletype units that are operated under V.28 or TTL control.	Line current Double current (can be selected) Design	40 mA/60 V ±20 mA/±30 V printed circuit	6007.6054.02
R&S®FK896D **Digitally Tuned RF Selector** **(for R&S®EK896 only)** 	This option is available in two versions, providing 20 dB or 40 dB selectivity. The automatically tuned tracking selection circuit offers the following functions: Digitally tuned RF selectors are recommended for use in environments with strong RF interference (i.e. collocation problems). They improve input selection by automatic tracking of the receive frequency and increase the input voltage protection (overload protection) of the receiver.	▮ Seven-circuit lowpass (0 Hz to approx. 30 MHz) ▮ Five-circuit lowpass (0 Hz to approx. 1.5 MHz) for rejection of strong shortwave interfering signals ▮ Tracking single-circuit filter 1.5 MHz to 30 MHz with stopband attenuation of up to >40 dB at 10% spacing ▮ Power on/off by remote control (can be bypassed) ▮ Input voltage protection to 200 V EMF		6077.3019.02 6077.3019.04
DATA LINKdemodulator	This software option is used for the demodulation of DATA LINKemissions in line with MIL-STD-188-203-1.	Further information supplied on request		

Designation	Description	Main features		Order No.
R&S®EK895S7 Quasi-Continuous IF Bandwidth Control	This software option allows the fine selection of the IF bandwidth between 100 Hz and 9 kHz in 128 steps and thus permits optimization of the bandwidth required for the different types of modulation or of the adjacent-channel suppression. This option provides either 13 (standard) or 128 bandwidths. The advantage lies – especially important for radiodetection and analyzing receiving equipment – in the optimum S/N ratio setting for the received and demodulated signal. The optimum bandwidth can be stored with DEF OFF and is then automatically set again depending on the modulation type. This option has to be ordered together with the receiver (factory installation).	Bandwidth steps Shape factor (max. at 3 dB)	128 steps between 100 Hz and 9000 Hz, displayed, variable by means of knob 1.2 to 1.5	6077.7051.02 Note: This option is standard in the R&S®EK896 receiver.
R&S®GM893 Broadband Output	The optional broadband output (plug-in module) supplies a signal of approx. 1 MHz bandwidth at the first IF of 41.44 MHz (at the receive frequency ±500 kHz). To avoid impairment of the receiver sensitivity of the main (information) channel, the path to the broadband channel is decoupled by approx. 10 dB. For broadband spectrum analysis, different spectrum displays can be connected to this broadband output.	Output frequency Bandwidth Min. gain Impedance	41.44 MHz >1 MHz (at 3 dB) –10 dB related to antenna input 50 Ω	6051.8494.03
Oven-controlled Crystal Oscillator (OCXO)	To obtain a higher frequency stability of the receiver, an OCXO module can be incorporated into the synthesizer instead of a standard crystal oscillator (TCXO) This option has to be ordered together with the receiver (factory installation).	Stability Short-term Long-term Drift versus temperature (–10 °C to +45 °C)	 <1 × 10^{-9}/day <1 × 10^{-7}/year <5 × 10^{-7}	for R&S®EK895: 6057.8996.14 for R&S®EK896: 6038.2909.14
R&S®GB899 Remote Control Unit 	The R&S®GB899 can be used to remote-control one or more receivers of the R&S®Series890 family via the serial and bus-compatible interface. The receivers can be selected and operated via addresses 01 to 99. The R&S®GB899 has the same look and dimensions as the R&S®EK895.	Interface Data transfer Standard line modems are recommended for distances of more than 100 m	RS-232-C, RS-485 (bus) 50 baud to 19200 baud	6037.3501.03

External options for R&S®Series890 VLF-HF receivers

R&S®KA890C1 Service Kit

R&S®EK895/896 service kit: comes in a small hard-foam-lined case with the following contents (see table below):

No.	Quantity	Designation	Order No.	Used for	
1	1	Adapter Card	6030.9104.02	Motherboard to: ▌Synthesizer ▌RF unit ▌IF section ▌IF unit/demodulator ▌IF/AF processor	For optional modules: ▌Preselection unit ▌IF signal processor ▌IF converter ▌BCD interface ▌Control unit 2
2	1	Adapter, 96-pin	6007.7680.02	Control processor	
3	4	Coaxial Cable	699.4196		
4	1	BNC-SMB Adapter	FJ 080.2270		

Ordering information

Designation	Type	Order No.
Service Kit	R&S®KA890C1	6030.9004.02

Antenna Tuning Units, Dipole Antennas, Postselectors

R&S®FK4115M HF Antenna Tuning Unit

The R&S®FK4115M matches rod, whip and wire antennas, as they are used in naval and stationary applications, to the RF output of the 150 W transceiver of the R&S®M3SR Series4100 and R&S®M3TR family. 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 operates in the frequency range from 1.5 MHz to 30 MHz, where it performs an antenna impedance transformation into 50 Ω in both the receive and transmit modes. Additionally, it provides preselection in the receive mode. 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.

Particular attention was paid to obtaining an effective lightning protection. The ATU is fully arc-protected against direct lightning strokes. It is tested to withstand arcs of 10 kV/10 kA.

- 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
- Low probability of intercept (LPI)
- Maintenance-free, rugged design
- Frequency hopping capability (R&S®SECOM-H)

Tuning functionality
The R&S®FK4115M offers a silent tuning feature over the entire frequency range from 1.5 MHz to 30 MHz. Before this feature can be used, the ATU must be connected to the antenna to "learn" its characteristic. Learning takes place in a user-defined frequency range in the HF band (1.5 MHz to 30 MHz).

The ATU learns the antenna characteristic by obtaining tuning data at certain fixed frequencies in the HF frequency band. Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is less than 5 ms. The advantage for the user is low probability of intercept (LPI), since ATU frequency setting is performed very quickly and without any emission of RF power.

Repeated tuning
A change in environmental conditions may slightly alter the actual antenna tuning data as compared to the stored data. The quality of antenna matching is therefore checked during operation by means of an integrated VSWR measuring device. If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (non-silent mode) in less than typ. 100 ms.

Rugged design
The rugged design of the R&S®FK4115M allows it to be operated 24 hours a day.

BITE
The ATU is 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 strokes to the antenna, the R&S®FK4115M output is provided with lightning protection.

Specifications

General data		
Frequency range		
TX frequency range		1.5 MHz to 30 MHz
RX frequency range		10 kHz to 30 MHz
RF input power		150 W PEP + 0.5 dB, 100 W CW + 0.5 dB
Duty cycle		100 % at temperatures < +35 °C
	3 m to 5 m whip antenna, 1.5 MHz to 2 MHz	1:1 (TX:RX)
Matchable antennas		whip antennas 3 m to 7 m
		rod antennas 7 m to 12 m
		long-wire antennas < 10 m
	with long-wire adapter	long-wire antennas > 10 m
Frequency hopping capability		in line with R&S®SECOM-H
MTBF	in line with MIL-HDBK-217E	14600 h
MTTR		< 30 min
Overvoltage protection	control interface	lightning and overvoltage protection in line with VG 96903
Mechanical data		
Dimensions (without shockmount)	W × H × D	389 mm × 338 mm × 168 mm (15.31 in × 13.31 in × 6.61 in)
Weight (without shockmount)		7.5 kg (16.53 lb)
Weight (with shockmount)		11.5 kg (25.35 lb)
Mounting position		all positions allowed
Color		grey
Electrical connectors		
RF connector		N female
Control interface	in line with MIL-STD-29504	optical control interface
Voltage supply		via RF cable, inner conductor
Antenna connection		M8 bolt
Earthing screw		M8 bolt
Maximum cable length		
ATU to antenna feeder		≤ 30 cm
ATU to transceiver		≤ 50 m
Electrical data		
Input impedance		50 Ω, VSWR < 1.5 (typ. 1.3)
Tuning time		
First-time tuning		typ. 1.5 s (max. 4 s)
Repeated tuning		typ. < 0.2 s
Silent tuning		< 5 ms
RF tuning power		30 W ±1 dB, VSWR < 3 (during tuning)
Max. extrinsic RF power during active tuning/learning	measured at antenna feedpoint	1 W
Max. extrinsic RF power during silent operation	measured at antenna feedpoint	150 W
Power supply	via RF connecting cable	19 V DC to 33 V DC, max. 1.5 A
Environmental data		
Temperature ranges		
Operating	in line with MIL-STD-810F, methods 501.4 and 502.4	–30 °C to +55 °C
Storage	in line with MIL-STD-810F, methods 501.4 and 502.4	–40 °C to +85 °C
Humidity (operation)	in line with MIL-STD-810F, method 507.4	+26 °C/+41 °C, 95 % relative humidity, 5 days
Vibration resistance		
Random vibration (without shockmount)	in line with MIL-STD-810F, method 514.5, proc. I, cat. 21, marine vehicles	4 Hz to 100 Hz, 0.03 g^2/ Hz, 40 min per axis
Random vibration (with shockmount)	in line with MIL-STD-810F, method 514.5, proc. I, cat. 20, ground mobile	5 Hz to 500 Hz, 20 Hz to 350 Hz 0.04 g^2/Hz 5 Hz to 20 Hz +6 dB/octave 350 Hz to 500 Hz –6 dB/octave 1 hour in each axis
Sinusoidal vibration (without shockmount)	in line with MIL-STD-167-1	1.5 mm to 0.15 mm double amplitude, 40 min per axis

Specifications		
Shock resistance		
Shock resistance (random) (without shockmount)	in line with MIL-STD-810F, method 516.5 proc. I	40 g, crossover frequency, 45 Hz
Shock resistance (half sine) (without shockmount)	in line with MIL-STD-810C, method 516.2, figure 516.2, proc. III	18 shocks, 40 g/11 ms
Shock resistance (half sine) (with shockmount)	in line with MIL-STD-810C, method 516.2, figure 516.2, proc. III	18 shocks, 50 g/11 ms
International protection code	in line with EN 60529	IP66
Electromagnetic compatibility	in line with MIL-STD-461E, class A3 (harmonics, spurious and transmission frequency excluded)	CE 106, CS 114, RE 102, RS 103
Electrical safety	EN 60215	
CE conformity mark	in line with EN 60945, ETSI EN 300373-1/2/3	
Salt fog	in line with MIL-STD-810F, method 509.4	
Solar radiation	in line with MIL-STD-810F, method 505.4, proc. II	
Fungus	in line with MIL-STD-810F, method 508.5	
Lightning and NEMP protection	fully arc-protected against lightning strokes	tested to withstand 10 kV/10 kA

Ordering information		
Designation	**Type**	**Order No.**
Antenna Tuning Unit (R&S®M3SR Series4100)	R&S®FK4115M	6120.4000.03
Mating Connector Set (R&S®M3SR Series4100)	R&S®ZF4102	6120.5107.03
Antenna Tuning Unit (R&S®M3TR)	R&S®FK4115M	6120.4000.02
Mating Connector Set (R&S®M3TR)	R&S®ZF4102	6120.5107.02
Shockmount	R&S®KS2110	6090.5905.02
Fiber-Optic Connecting Cable		
10 m length	R&S®GK4102	6120.5720.10
25 m length	R&S®GK4102	6120.5720.25
50 m length	R&S®GK4102	6120.5720.50
100 m lenght	R&S®GK4102	6120.5720.99

R&S®FK4150U HF Antenna Tuning Unit

The R&S®FK4150U matches rod, whip and wire antennas, as they are 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 operates in the frequency range from 1.5 MHz to 30 MHz, where it performs an antenna impedance transformation into 50 Ω in both the receive and transmit modes. Additionally, it provides preselection in the receive mode. 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.

For protection against overvoltage as produced by lightning strokes to the antenna, the R&S®FK4150U output is provided with lightning protection.

- Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz
- Tuning of rod, whip, and wire antennas
- Frequency hopping capability (R&S®SECOM-H)
- 500 W CW and PEP with 7 m to 10 m rod/whip antennas
- Low probability of intercept (LPI)
- Maintenance-free, extremely rugged design
- Continuous monitoring of operational status

Tuning functionality
The R&S®FK4150U offers a silent tuning feature over the entire frequency range from 1.5 MHz to 30 MHz. Before this feature can be used, the ATU must be connected to the antenna to “learn” its characteristic. Learning takes place in a user-defined frequency range in the HF band (1.5 MHz to 30 MHz).

The ATU learns the antenna characteristic by obtaining tuning data at certain fixed frequencies in the HF frequency band. Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is less than 5 ms. The advantage for the user is low probability of intercept (LPI), since ATU frequency setting is performed very quickly and without any emission of RF power.

Repeated tuning
A change in environmental conditions may slightly alter the actual antenna tuning data as compared to the stored data. The quality of antenna matching is therefore checked during operation by means of an integrated VSWR measuring device. If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (non-silent mode) in less than typ. 100 ms.

Rugged design
The extremely rugged design of the R&S®FK4150U allows it to be operated 24 hours a day when installed in a submarine communications mast.

BITE
The ATU is 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 strokes to the antenna, the R&S®FK4150U output is provided with lightning protection.

Specifications[1)]

General data		
Frequency range		
TX frequency range		1.5 MHz to 30 MHz
RX frequency range		10 kHz to 30 MHz
RF input power	7 m to 10 m rod/whip antennas	500 W PEP + CW
Duty cycle		100 %
Matchable antennas		rod/whip antennas, 5 m to 10 m
Frequency hopping capability		in line with R&S®SECOM-H
MTBF	in line with MIL-HDBK-217E	12 000 h
MTTR		< 30 min
Mechanical data		
Dimensions (without shockmount)	W × H × D	310 mm × 290 mm × 516 mm (12.2 in × 11.42 in × 20.31 in)
Depth including antenna insulator		614 mm (24.17 in)
Weight (without shockmount)		30 kg (66.14 lb)
Mounting position		all positions allowed
Color		grey, RAL7001
Electrical connectors		
RF connector		N female
Control and voltage supply		proprietary R&S®HF850 interface
Antenna connection		M5 bolt
Earthing		M8 bolt
Maximum cable length		
ATU to antenna feeder		≤ 30 cm
ATU to transceiver		≤ 50 m
Electrical data		
Input impedance		50 Ω, VSWR < 1.5 (typ. 1.3)
Tuning time		
First-time tuning		< 0.5 s (max. 6 s)
Repeated tuning		< 0.1 s
Silent tuning		< 5 ms
RF tuning power		40 W ± 1 dB, VSWR < 2 (during tuning)
Max. extrinsic RF power during active tuning/learning	measured at antenna feedpoint	1 W
Max. extrinsic RF power during silent operation	measured at antenna feedpoint	150 W
Power supply	via control cable	19 V DC to 31 V DC, approx. 1.2 A
Environmental data		
Temperature range		
Operating	in line with MIL-STD-810E, methods 501.3 and 502.1, cat. A2 + C2	–40 °C to +55 °C
Storage	in line with MIL-STD-810E, methods 501.3 and 502.1, cat. A2 + C2	–40 °C to +85 °C
Humidity (operation)	in line with MIL-STD-810E, method 507.3, proc. III	+30 °C/+55 °C, 95 % relative humidity, duration of 10 days
Random vibration (without shockmount)	in line with MIL-STD-810E, method 514.4, proc. I, cat. 9	4 Hz to 100 Hz, 0.01 g^2/Hz, 2 h per axis
Shock resistance (random) (without shockmount)	in line with MIL-STD-810E, method 516.4, proc. I	max. 40 g, 45 Hz to 2000 Hz spectrum
	in line with BV 043, edition 1985, for submarines	400 g, shock response spectrum
International protection code	in line with EN 60529 (VDE 0470)	IP53
Electromagnetic compatibility	in line with MIL-STD-461E	CS 114, RE 101, RE 102, RS 101, RS 103

Ordering information

Designation	Type	Order No.
Antenna Tuning Unit	R&S®FK4150U	6120.9254.07
Mating Connector Set	R&S®ZF4106	6120.5507.02
ATU Control Cable, 10 m length	R&S®GK2903	6117.9505.10
ATU Control Cable, 20 m length	R&S®GK2903	6117.9505.20
ATU Control Cable, 30 m length	R&S®GK2903	6117.9505.30
ATU Control Cable, 40 m length	R&S®GK2903	6117.9505.40
ATU Control Cable, 50 m length	R&S®GK2903	6117.9505.50

R&S®FK4190M HF Antenna Tuning Unit

The R&S®FK4190M matches rod/whip and wire antennas, as they are 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 o 11 m length and up to 1000 W with 12 m rod antennas. The R&S®FK4190M operates in the frequency range from 1.5 MHz to 30 MHz, where it performs an antenna impedance transformation into 50 Ω in both the receive and transmit modes. 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.

For protection against overvoltage as produced by lightning strokes to the antenna, the R&S®FK4190M output is provided with lightning protection.

- Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz
- Tuning of rod/whip antennas
- Frequency hopping capability (R&S®SECOM-H)
- 500 W CW and PEP at 100 % duty cycle
- 1000 W CW and PEP (12 m rod antennas only)
- Low probability of intercept (LPI)
- Maintenance-free, rugged design
- Continuous monitoring of operational status

Tuning functionality

The R&S®FK4190M offers a silent tuning feature over the entire frequency range from 1.5 MHz to 30 MHz. Before this feature can be used, the ATU must be connected to the antenna to “learn” its characteristic. Learning takes place in a user-defined frequency range in the HF band (1.5 MHz to 30 MHz).

The ATU learns the antenna characteristic by obtaining tuning data at certain fixed frequencies in the HF frequency band. Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is less than 5 ms. The advantage for the user is low probability of intercept (LPI), since ATU frequency setting is performed very quickly and without any emission of RF power.

Repeated tuning

A change in environmental conditions may slightly alter the actual antenna tuning data as compared to the stored data. The quality of antenna matching is therefore checked during operation by means of an integrated VSWR measuring device. If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (non-silent mode) in less than typ. 100 ms.

Rugged design

The rugged design of the R&S®FK4190M allows it to be operated 24 hours a day.

BITE

The ATU is 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 strokes to the antenna, the R&S®FK4190M output is provided with lightning protection.

Ordering information

Designation	Type	Order No.
Antenna Tuning Unit	R&S®FK4190M	6120.9002.02
Mating Connector Set	R&S®ZF4105	6120.5407.02
Shockmount, RAL7001	R&S®KS855C3	0729.4900.04
ATU Control Cable, 10 m	R&S®GK2903M	6117.9757.10
ATU Control Cable, 20 m	R&S®GK2903M	6117.9757.20
ATU Control Cable, 30 m	R&S®GK2903M	6117.9757.30
ATU Control Cable, 40 m	R&S®GK2903M	6117.9757.40
ATU Control Cable, 50 m	R&S®GK2903M	6117.9757.50

Specifications

General data		
Frequency range		
TX frequency range		1.5 MHz to 30 MHz
RX frequency range		10 kHz to 30 MHz
RF input power	7 m to 11 m rod/whip antennas	500 W PEP + CW
	12 m rod antennas	1000 W PEP + CW
Duty cycle	500 W input power (7 m to 11 m antenna)	100 %
	1000 W input power (12 m rod antenna, f > 3.5 MHz)	100 %
	1000 W input power (12 m rod antenna, f < 3.5 MHz)	2:1 (RX:TX), max. 10 min TX
Matchable antennas		rod/whip antennas, 7 m to 12 m
		wire antennas, 15 m to 30 m
		broadband antennas, nominal impedance 50 Ω, VSWR < 4:1
Frequency hopping capability		in line with R&S®SECOM-H
MTBF	in line with MIL-HDBK-217E	12000 h
MTTR		< 30 min
Mechanical data		
Dimensions (without shockmount)	W × H × D	378 mm × 292 mm × 493 mm (14.88 in x 11.5 in x 19.41 in)
Depth including antenna insulator		554 mm (21.81 in)
Weight (without shockmount)		33 kg (72.75 lb)
Mounting position		all positions allowed
Color		grey, RAL7001
Electrical connectors		
RF connector		N female
Control and voltage supply		proprietary R&S®HF850 interface
Antenna connection		M5 bolt
Earthing		M8 bolt and mounting feet
Maximum cable length		
ATU to antenna feeder		≤ 30 cm
ATU to transceiver		≤ 50 m
Electrical data		
Input impedance		50 Ω, VSWR < 1.5:1, typ. 1.3:1
Tuning time		
First-time tuning		typ. < 0.5 s (max. 6 s)
Repeated tuning		typ. < 0.1 s
Silent tuning		< 5 ms
RF tuning power		40 W ± 1 dB, VSWR < 2 (during tuning)
Max. extrinsic RF power during active tuning/learning	measured at antenna feedpoint	1 W
Max. extrinsic RF power during silent operation	measured at antenna feedpoint	150 W
Power supply	via control cable	19 V DC to 31 V DC, approx. 1.2 A
Environmental data		
Operating temperature range	in line with MIL-STD-810E, methods 501.3 and 502.3, cat. A2+C2	–40 °C to +55 °C
Storage temperature range	in line with MIL-STD-810E, methods 501.3 and 502.3, cat. A2+C2	–40 °C to +85 °C
Humidity (operation)	in line with MIL-STD-810E, method 507.3, proc. III	30 °C/55 °C, 95 % rel. humidity, duration of 10 days
Random vibration (without shockmount)	in line with MIL-STD-810F, method 514.5, proc. I, cat. 21	4 Hz to 100 Hz, 0.01 g^2/Hz, 2 h per axis
Random vibration (with shockmount)	in line with MIL-STD-810F, method 514.5, proc. I, cat. 21	4 Hz to 100 Hz, 0.02 g^2/Hz, 2 h per axis
Shock resistance, random (without shockmount)	in line with MIL-STD-810F, method 516.5, proc. I	40 g, 45 Hz to 2000 Hz
Shock resistance, half sine (without shockmount)	in line with EN 60068-2-27	30 g/11 ms
International protection code	in line with EN 60529 (VDE 0470)	IP56
Electromagnetic compatibility	in line with MIL-STD-461E	CS 114, RE 101, RE 102, RS 101, RS 103
Electrical safety		EN 60215/VDE 0866
CE conformity mark		in line with EN 60945, ETSI EN 300373-1/2/3

R&S®FK2100/FK2100M Antenna Tuning Units

The R&S®FK2100/FK2100M antenna tuning units automatically match antennas, in particular very short antennas, to the R&S®XK2100L 150 W HF transceiver. The sturdy and waterproof plastic casing of the R&S®FK2100 is shock- and UV-resistant and thus ideally suited for mobile applications. The R&S®FK2100M is a sea- water- and drop-resistant version of the R&S®FK2100 and is especially designed for shipborne applications. It can match antennas with very low ohmic resistance.

Particular attention was paid to effective lightning protection. Both ATUs are fully arc-protected against direct lightning strokes. They are tested to withstand arcs of 10 kV/10 kA. An automatic bit (built-in test) is provided for fault detection and reporting to the R&S®XK2100L transceiver.

The microprocessor-controlled tuning allows the self-learning of a maximum of 1500 tuning settings, which together with the channels stored in the R&S®XK2100L transceiver (including ALE, APP, ITU, and 100 silent channels) are retained in a nonvolatile memory. In the R&S®FK2100M, up to 1500 silent tuned channels are provided in addition to the learn channels. The stored channels can be called with very short setting times both in the R&S®FK2100 and R&S®FK2100M.

A single cable between the transceiver and the ATU carries RF, supply voltage, and all bidirectional control data. The R&S®FK2100 is therefore highly installation-friendly and at the same time has less EMC problems.

R&S®KS2110 Shockmount
(for R&S®FK2100 and R&S®FK2100M)
To operate the ATU under extremely harsh environmental conditions, a rugged shockmount is available. Typical applications of the R&S®KS2110 are installations on board small ships or armored vehicles.

Specifications

Frequency range	1.5 MHz to 30 MHz
Matchable antennas	
Whip antennas	5 m to 8 m
Rod antennas	7 m to 12 m
Long-wire antennas	up to 15 m
Channels	1500 channels for silent tuning, in addition to 1500 learn channels and ITU channels, ALE and APP channels
Tuning time	
Initial tuning	typ. 1000 ms
Retuning	< 100 ms
SWR (tuned)	< 1.5, typ. 1.2
Cable	1 coax cable for RF, control and supply voltage
VLF output	N connector
Dimensions (W × H × D)	389 mm × 338 mm × 168 mm (15.31 in × 13.31 in × 6.61 in)
Weight	7.5 kg (16.53 lb)
MTBF	14600 h
MTTR	0.8 h
Environmental data	
Storage temperature range	–40 °C to +85 °C
Operating temperature range	–30 °C to +65 °C
Safety class (DIN 40050)	IP56
Vibration/shock	in line with MIL-STD-810D/E
EMC	EN 50081-1, EN 50082-1
CE conformity mark	in line with EN 60945, ETSI EN 300373-1/-2/-3
Salt fog	in line with MIL-STD-810D, method 509.2 proc. II
Solar radiation	in line with MIL-STD-810E, method 505.3 proc. II

Ordering information

Designation	Type	Order No.
Antenna Tuning Unit	R&S®FK2100	6046.8948.02
Antenna Tuning Unit [1]	R&S®FK2100M	6046.9550.02
Recommended extras		
Shockmount	R&S®KS2110	6090.5905.02

[1] Requires naval software option when operated with R&S®Series2000 radio equipment.

R&S®FK2900M 1 kW HF Antenna Tuning Unit

The R&S®FK2900M antenna tuning unit is a member of the R&S®Series2000 and R&S®M3SR Series4100 HF transceiver families. The R&S®FK2900M matches the amplifier outputs of the transceivers to rod and wire antennas. It is designed for stationary or shipboard applications. It can handle power up to 1000 W CW and PEP at a 100% duty cycle. The R&S®FK2900M operates in the frequency range from 1.5 MHz to 30 MHz where it performs an antenna impedance transformation into 50 Ω in both the receive and transmit mode. Additionally, it provides preselection in the receive mode.

Owing to the silent tuning feature of the transceivers, low probability of intercept (LPI) is enhanced.

- Tuning range from 1.5 MHz to 30 MHz
- Fully automatic tuning
- 1000 W CW and PEP at 100% duty cycle
- Tuning of all rod antennas from 10.5 m to 12 m
- Tuning of long-wire antennas
- Low probability of intercept (LPI)
- Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz
- Maintenance-free
- MTBF 12000 h
- Continuous monitoring of operational status
- Rugged design

Tuning functionality
The R&S®FK2900M offers a silent tuning feature over the entire frequency range from 1.5 MHz to 30 MHz. Before this feature can be used for an application, the ATU must be connected to an antenna to "learn" its characteristic. Learning takes place in a user-defined frequency range in the HF band (1.5 MHz to 30 MHz).

The ATU learns the antenna characteristic by receiving tuning data for a maximum of 1500 predefined frequencies. Once the tuning data for these frequencies is known and stored, the ATU setting time is less than 40 ms. The advantage for the user is the low LPI, since ATU frequency setting takes place very quickly and without any emission of RF power.

Repeated tuning
A change in environmental conditions may slightly alter the actual antenna tuning data as compared to the stored data. The quality of antenna matching is therefore checked during operation by means of an integrated VSWR measuring device. If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned in less than 200 ms.

Rugged design
The rugged, waterproof and dustproof construction of the R&S®FK2900M allows its use in stationary, land-mobile and shipboard applications, even in harsh environments and continuous 24-hour operation.

BITE
The antenna tuning unit is included in the continuous monitoring of the system BITE so that status reports are displayed at the control unit of the transceiver system.

ECM and overvoltage protection
All boards have ECM filters. For protection against overvoltage as produced by lightning strokes to the antenna, the R&S®FK2900M output is provided with lightning protection.

Specifications

Frequency range	1.5 MHz to 30 MHz
RF input power (max.)	1000 W + 0.5 dB PEP 1000 W + 0.5 dB CW
Duty cycle	continuous
RF tuning power	40 W ± 1 dB, max. VSWR 3:1
Tuning accuracy	automatic tuning to 50 Ω to within a VSWR of 1.5:1 (typ. 1.3:1)
Suitable antennas	
Model .02	
Rod antennas	length 10.5 m to 12 m
Long-wire antennas	length 15 m to 22 m
Model .05	
Long-wire antennas	length 30 m to 50 m
First-time tuning	typ. 1 s
Repeated tuning	typ. < 0.2 s
Silent tuning	< 40 ms
Silent tuning (memory size)	1500 predefined frequencies for learning antenna characteristic
Connections	
RF input	built-in connector, N female
Antenna	insulator (ceramics), screw terminal
Grounding	by means of screw terminal
Permissible distances	
Antenna feeder – R&S®FK2900M	≤ 30 cm
Transceiver – R&S®FK2900M	≤ 50 m
Note: For cable lengths > 50 m, a special cable or an external power supply is required.	
General data	
Power supply	21 V to 31 V DC, approx. 1.2 A, supplied via ATU control cable or external power supply
Dimensions (with insulator) (W × H × D)	432 mm × 435 mm × 631 mm (17.0 in × 17.1 in × 24.8 in)
Weight	43 kg (94.9 lb)
Material of case	aluminum
Installation position	all positions allowed
Color	RAL 7001, navy gray
MTTR	30 min., without sealing finish
MTBF	12 000 h in line with MIL-HDBK-217E
Environmental data	
Temperature range	
Operating temperature range	–40 °C to +55 °C in line with MIL-STD-810E, method 501.3 and 502.3, cat. A2 and C2
Storage temperature range	–40 °C to +85 °C in line with MIL-STD-810E, meth. 501.3 and 502.3
Maximum altitude	3000 m above sea level, T_{amb} < 35 °C in line with MIL-STD-810E, method 500.3, procedure I + II
Humidity	
Operation	in line with MIL-STD-810E, method 507.3, +26 °C/+41 °C, 95 % rel. humidity, duration of test: 5 days
Storage	in line with MIL-STD-810E method 507.3, +26 °C/+41 °C, 95 % rel. humidity, duration of test: 5 days

Specifications

Vibration (without shockmount)	in line with MIL-STD-810E, meth. 514.4, cat. 9
Random	4 Hz to 50 Hz, 0.01 g^2/Hz, 2 h per axis
Vibration (with shockmount)	in line with MIL-STD-810E, meth. 514.4, cat. 9
Random	4 Hz to 50 Hz, 0.02 g^2/Hz, 2 h per axis
Shock (without shockmount)	max. 40 g, 45 Hz to 2000 Hz spectrum, in line with MIL-STD-810E, method 516.4
Shock (with shockmount)	50 g, 11 ms, half sine
Class of protection	IP 66 in line with DIN IEC 40050, waterproof
Solar radiation	in line with MIL-STD-810E, meth. 505.3, proc. II, basic hot
Salt fog	in line with MIL-STD-810E, meth. 509.3
Sand and dust	in line with MIL-STD-810E, meth. 510.3, proc. I and II
Icing/freezing rain	in line with MIL-STD-810E meth 521.1
Safety features	built-in lightning, overvoltage and overcurrent protection, protection against overtemperature and static charges on antenna
Electromagnetic compatibility	in line with MIL-STD-461E, CE 102, CS 101, CS 114, RE 101, RE 102, RS 101, RS 103, EN 55022, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-6
CE conformity mark	in line with EN 300373-1/-2/-3

Ordering information

Designation	Type	Order No.
Antenna Tuning Unit [1]	R&S®FK2900M	6097.1005.02
Antenna Tuning Unit [1] (mast antennas, length 30 m to 50 m)	R&S®FK2900M	6097.1005.05
Recommended extras		
Shockmount, horizontal mounting	R&S®KS2900M	6116.2507.03
Shockmount, vertical mounting	R&S®KS2900M	6116.2507.02
Cables and connectors		
ATU Control Cable (between R&S®XK2500/XK2900 and R&S®FK2900M)		
10 m length	R&S®GK2903M	6117.9757.10
20 m length	R&S®GK2903M	6117.9757.20
30 m length	R&S®GK2903M	6117.9757.30
40 m length	R&S®GK2903M	6117.9757.40
50 m length	R&S®GK2903M	6117.9757.50
Mating Connector Set	R&S®ZF4105	6120.5407.02

[1] Requires the R&S®GX2901S naval software option when operated with R&S®Series2000 radio equipment.

R&S®FK855C1 HF Antenna Tuning Unit

The R&S®FK855C1 is a member of the R&S®Series2000 HF transceiver family. It matches the R&S®XK2500 transceiver to rod, whip, and broadband antennas.

It can handle power up to 400 W CW and PEP at a 100% duty cycle. The input power is adapted automatically by the R&S®Series2000 transceiver. The R&S®FK855C1 operates in the frequency range from 1.5 MHz to 30 MHz, where it performs an antenna impedance transformation into 50 Ω in both the receive and transmit modes. Additionally, it provides preselection in the receive mode.

Tuning functionality
To achieve perfect matching of a specific antenna to the transceiver output, the digital control and tuning concept uses different methods to obtain the necessary ATU tuning data.

Silent tuning of 100 user-programmable channels
Prior to silent tuning, active tuning (with RF power radiation) takes place. The data received by means of this tuning process is stored in the ATU's internal memory, which enables the repeated tuning of these "learnt" frequencies in less than 100 ms. Additionally, silent tuning of these learnt frequencies in less than 5 ms is possible. The ATU is able to store as many as 100 user-selectable silent channels.

Rugged design
The rugged design of the R&S®FK855C1 allows it to be operated continuously 24 hours a day.

BITE
The ATU is 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 strokes to the antenna, the R&S®FK855C1 output is provided with lightning protection.

R&S®FK855C1 400 W antenna tuning unit for land-mobile applications of the R&S®Series2000 HF radio family.

Specifications

Frequency range	
TX frequency range	1.5 MHz to 30 MHz
RX frequency range	10 kHz to 30 MHz
RF input power	max. 400 W PEP and CW
Duty cycle	100 % for 400 W input power
Input impedance	50 Ω, VSWR < 1.5:1, typ. 1.3:1
Antennas	
Rod/whip antennas	> 5 m
Broadband antennas	nominal impedance 50 Ω, VSWR < 4:1
Silent tuning (memory size)	100 user-selectable silent channels
Tuning time	
First-time tuning	typ. < 0.5 s, max. 3 s
Repeated tuning	typ. < 0.1 s
Silent tuning	< 5 ms
Antenna connection	unbalanced isolated M5 connection for antennas, 50 Ω adapter with coaxial N-type connector on request, e.g. for broadband antennas
Power supply	19 V to 31 V, approx. 1.2 A
RF tuning power	40 W ± 1 dB, VSWR < 2
Connectors	
RF connector	N female
Control and power supply	round, 26-contact
Antenna connector	M5
Earthing screw	M8
Maximum cable lengths	
Between antenna base and ATU	≤ 30 cm
Between transceiver and ATU	≤ 50 m
Environmental data	
Temperature range	
Operating temperature range	–40 °C to +55 °C in line with MIL-STD-810E, method 501.3 and 502.1, category A2+C2
Storage temperature range	–40 °C to +85 °C in line with MIL-STD-810E, method 501.3 and 502.1, category A2+C2
Humidity (operational)	+30 °C/+55 °C, 95 % rel. humidity, duration of 10 days; in line with MIL-STD-810E, meth. 507.3, proc. III
Random vibration (without shockmount)	10 Hz to 55 Hz, 0.3 mm double amplitude, VG95332, sheet 24, degree of severity A2
Random vibration (with shockmount)	4 Hz to 50 Hz, 0.01 g^2/Hz, 2 h per axis; in line with MIL-STD-810E, method 514.4, proc. I, cat. 9
	10 Hz to 500 Hz, 0.7 mm double amplitude, max. 5 g, VG95332, sheet 24, degree of severity C5
Shock resistance (without shockmount)	30 g, 11 ms
Shock resistance (with shockmount)	40 g, 11 ms
Class of protection	IP56 in line with EN 60529 (VDE 0470)
Electromagnetic compatibility	in line with MIL-STD-461E (CS 114, RE 101, RE 102, RS 101, RS 103)
MTTR	30 min
MTBF	12 000 h in line with MIL-HDBK-217E
General data	
Dimensions without shockmounts (W × H × D)	378 mm × 292 mm × 493 mm (14.88 in × 11.5 in × 19.41 in)
Depth (including antenna insulator)	554 mm (21.81 in)
Weight	33 kg (72.75 lb)
Color	dark/light grey

Ordering information

Designation	Type	Order No.
HF Antenna Tuning Unit, stationary and land-mobile version	R&S®FK855C1	0729.1001.02
Recommended extras		
Cables and connectors		
ATU Control Cable (between R&S®XK2500 and R&S®FK855C1)		
Length 10 m	R&S®GK2903	6117.9505.10
Length 20 m	R&S®GK2903	6117.9505.20
Length 30 m	R&S®GK2903	6117.9505.30
Length 40 m	R&S®GK2903	6117.9505.40
Length 50 m	R&S®GK2903	6117.9505.50

R&S®FK855C3 HF Antenna Tuning Unit

The R&S®FK855C3 matches rod and whip antennas, as they are used in naval applications, to the RF output of the R&S®XK2500 transceivers.

It can handle power up to 400 W CW and PEP at a 100% duty cycle. The input power is adapted automatically by the R&S®Series2000 transceiver. The R&S®FK855C3 operates in the frequency range from 1.5 MHz to 30 MHz, where it performs an antenna impedance transformation into 50 Ω in both the receive and transmit modes. Additionally, it provides preselection in the receive mode.

The R&S®FK855C3 has an extremely fast setting time for silent channels (switching time < 5 ms and life > 10^9 switching operations). Owing to the silent tuning feature of the R&S®XK2500 transceiver, low probability of intercept (LPI) is enhanced.

R&S®FK855C3 antenna tuning unit for shipborne applications of the R&S®Series2000 HF radio family.

Tuning functionality
The R&S®FK855C3 offers a silent tuning feature over the entire frequency range from 1.5 MHz to 30 MHz. Before this feature can be used for an application, the ATU must be connected to an antenna to "learn" its characteristic. Learning takes place in a user-defined frequency range in the HF band (1.5 MHz to 30 MHz).

The ATU learns the antenna characteristic by receiving tuning data for a maximum of 1500 predefined frequencies. Once the tuning data for these frequencies is known and stored, the typical ATU setting time is less than 5 ms. The advantage for the user is low probability of intercept (LPI), since ATU frequency setting is performed very quickly and without any emission of RF power.

Repeated tuning
A change in environmental conditions may slightly alter the actual antenna tuning data as compared to the stored data. The quality of antenna matching is therefore checked during operation by means of an integrated VSWR measuring device. If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned in less than typ. 100 ms.

Rugged design
The rugged design of the R&S®FK855C3 allows it to be operated continuously 24 hours a day.

BITE
The ATU is included in the continuous monitoring of the entire system so that deviations from the normal operating status are displayed on the control unit.

ECM and overvoltage protection
All circuit boards are equipped with ECM filters. For protection against overvoltage as produced by lightning strokes to the antenna, the R&S®FK855C3 output is provided with lightning protection.

Specifications

Frequency range	
TX frequency range	1.5 MHz to 30 MHz
RX frequency range	10 kHz to 30 MHz
RF input power	max. 400 W PEP and CW
Duty cycle (all antennas)	100 % for 400 W input power
Input impedance	50 Ω, VSWR < 1.5:1, typ. 1.3:1
Antennas	
Rod/whip antennas	7 m to 12 m
Wire antennas	15 m to 30 m
Broadband antennas	nominal impedance 50 Ω, VSWR < 4:1
Silent tuning	1500 predefined frequencies for learning antenna characteristic
Tuning time	
First-time tuning	typ. < 0.5 s, max. 3 s
Repeated tuning	typ. < 0.1 s
Silent tuning	< 5 ms
Antenna connection	unbalanced isolated M5 connection for antennas, 50 Ω adapter with coaxial N-type connector on request, e.g. for broadband antennas
Power supply	19 V to 31 V, approx. 1.2 A
RF tuning power	40 W ± 1 dB, VSWR < 2
Connectors	
RF connector	N female
Control and power supply	round, 26-contact
Antenna connector	M5
Earthing screw	M8
Maximum cable lengths	
Between antenna base and ATU	≤ 30 cm
Between transceiver and ATU	≤ 50 m
Environmental data	
Operating temperature range	–40 °C to + 55 °C in line with MIL-STD-810E, method 501.3 and 502.1, category A2+C2
Storage temperature range	–40 °C to + 85 °C in line with MIL-STD-810E, method 501.3 and 502.1, category A2+C2
Humidity (operational)	30 °C/55 °C, 95 % rel. humidity, duration of test: 10 days; in line with MIL-STD-810E, meth. 507.3, proc. III
Random vibration (without shockmount)	10 Hz to 55 Hz, 0.3 mm double amplitude, VG95332, sheet 24, degree of severity A2
	4 Hz to 50 Hz, 0.01 g^2/Hz, 2 h per axis; in line with MIL-STD-810E, meth. 514.4, procedure I, cat. 9
Random vibration (with shockmount)	4 Hz to 12.5 Hz, 1.6 mm double amplitude, 12.5 Hz to 63 Hz, max. 1 g (BV044, test characteristic 9)
	4 Hz to 50 Hz, 0.02 g^2/Hz, 2 h per axis; in line with MIL-STD-810E, meth. 514.4, procedure I, cat. 9
Shock resistance (without shockmount)	30 g, 11 ms
Shock resistance (with shockmount)	50 g, 11 ms
Class of protection	IP 56 in line with EN 60529 (VDE 0470)
Electromagnetic compatibility	in line with MIL-STD-461E (CS 114, RE 101, RE 102, RS 101, RS 103)
CE conformity mark	in line with EN 60945, ETSI EN 300373-1/-2/-3
MTTR	30 min
MTBF	12000 h in line with MIL-HDBK-217E
Dimensions without shockmounts (W × H × D)	378 mm × 292 mm × 493 mm (14.88 in × 11.5 in × 19.41 in)
Depth including antenna insulator	554 mm (21.81 in)
Weight	33 kg (72.75 lb)
Color	RAL 7001

Ordering information

Designation	Type	Order No.
HF Antenna Tuning Unit[1] (silent tuning over full frequency range)	R&S®FK855C3	0724.8908.07
Recommended extras		
Shockmount, navy grey	R&S®KS855C3	0729.4900.04
ATU Control Cable (between R&S®XK2500/XK2900 and R&S®FK855C3)		
10 m lenght	R&S®GK2903M	6117.9757.10
20 m lenght	R&S®GK2903M	6117.9757.20
30 m lenght	R&S®GK2903M	6117.9757.30
40 m lenght	R&S®GK2903M	6117.9757.40
50 m lenght	R&S®GK2903M	6117.9757.50
Mating Connector Set	R&S®ZF4105	6120.5407.02

[1] Requires naval software option when operated with R&S®Series2000 radio equipment.

R&S®FK855U HF Antenna Tuning Unit

The R&S®FK855U matches rod and whip antennas, as they are used in submarine applications, to the RF output of the R&S®XK2500 transceivers. It can handle power up to 400 W CW and PEP at a 100% duty cycle. The input power is adapted automatically by the R&S®Series2000 transceiver.

The R&S®FK855U operates in the frequency range from 1.5 MHz to 30 MHz, where it performs an antenna impedance transformation into 50 Ω in both the receive and transmit modes. Owing to the silent tuning features of the R&S®XK2500 transceivers, low probability of intercept (LPI) is enhanced.

- Tuning range from 1.5 MHz to 30 MHz
- Fully automatic tuning
- 400 W CW and PEP at 100% duty cycle
- Tuning of all rod and whip antennas used in submarine applications
- Low probability of intercept (LPI)
- Extremely short setting time
- Silent tuning over the entire fequency range from 1.5 MHz to 30 MHz
- Maintenance-free
- MTBF 12000 h
- Continuous monitoring of operational status
- Extremely rugged design

Tuning functionality
The R&S®FK855U offers a silent tuning feature over the entire frequency range from 1.5 MHz to 30 MHz. Before this feature can be used for an application, the ATU must be connected to an antenna to "learn" its characteristic. Learning takes place in a user-defined frequency range in the HF band (1.5 MHz to 30 MHz).

The ATU learns the antenna characteristic by receiving tuning data for a maximum of 1500 predefined frequencies. Once the tuning data for these frequencies is known and stored, the typical ATU setting time to these channels is less than 5 ms. The advantage for the user is low probability of intercept (LPI), since ATU frequency setting is performed very quickly and without any emission of RF power.

Repeated tuning
A change in environmental conditions may slightly alter the actual antenna tuning data as compared to the stored data.

The quality of antenna matching is therefore checked during operation by means of an integrated VSWR measuring device. If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned in less than typ. 100 ms.

Rugged design
The rugged design of the R&S®FK855U allows it to be operated continuously 24 hours a day especially on board submarines, installed in a submarine communications mast.

BITE
The ATU is included in the continuous monitoring of the 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 strokes to the antenna, the R&S®FK855U output is provided with lightning protection.

Specifications

Frequency range	
TX frequency range	1.5 MHz to 30 MHz
RX frequency range	10 kHz to 30 MHz
RF input power	max. 400 W PEP and CW
Duty cycle (all antennas)	100 % for 400 W input power
Input impedance	50 Ω, VSWR < 1.5:1, typ. 1.3:1
Matchable antennas (rod/whip antennas)	7 m to 10 m
Silent tuning (memory size)	1500 predefined frequencies for learning antenna characteristic
Tuning time	
First-time tuning	typ. < 0.5 s, max. 3 s
Repeated tuning	typ. < 0.1 s
Silent tuning	< 5 ms
Antenna connection	unbalanced isolated M5 connection for antennas, 50 Ω adapter with coaxial N-type connector on request, e.g. for broadband antennas
Power supply	19 V to 31 V, approx. 1.2 A
RF tuning power	40 W ± 1 dB, VSWR < 2
Connectors	
RF connector	N female
Control and power supply	round, 26-contact
Antenna connector	M5
Earthing screw	M8
Maximum cable lengths	
Between antenna base and ATU	≤ 30 cm
Between transceiver and ATU	≤ 50 m
Environmental data	
Operating temperature range	–40 °C to +55 °C in line with MIL-STD-810E, method 501.3 and 502.1, category A2+C2
Storage temperature range	–40 °C to +85 °C in line with MIL-STD-810E, method 501.3 and 502.1, category A2+C2
Humidity (operation)	30 °C/55 °C, 95 % rel. humidity, duration of test: 10 days; in line with MIL-STD-810E, meth. 507.3, proc. III
Vibration (without shockmount), random	4 Hz to 50 Hz, 0.01 g^2/Hz, 2 h per axis; in line with MIL-STD-810E, method 514.4, procedure I, cat. 9
Shock resistance (without shockmount)	max. 40 g, 45 Hz to 2000 Hz spectrum, in line with MIL-STD-810E, method 516.4, procedure I
	400 g, shock response spectrum, in line with BV043
International protection code	IP53 in line with EN 60529 (VDE 0470)
Electromagnetic compatibility	MIL-STD-461E, CS 114, RE 101, RE 102, RS 101, RS 103
MTTR	30 min
MTBF	12 000 h in line with MIL-HDBK-217E
Dimensions without shockmounts (W × H × D)	310 mm × 290 mm × 516 mm (12.2 in × 11.42 in × 20.31 in)
Depth (including antenna insulator)	614 mm (24.17 in)
Weight	30 kg (66.14 lb)
Installation position	user-selectable
Color	RAL 7001

Ordering information

Designation	Type	Order No.
Antenna Tuning Unit [1]	R&S®FK855U	6116.3503.07
Recommended extras		
ATU Control Cable		
10 m lenght	R&S®GK2903	6117.9505.10
20 m lenght	R&S®GK2903	6117.9505.20
30 m lenght	R&S®GK2903	6117.9505.30
40 m lenght	R&S®GK2903	6117.9505.40
50 m lenght	R&S®GK2903	6117.9505.50
Mating Connector Set	R&S®ZF4106	6120.5507.02

[1] Requires naval software option when operated with R&S®Series2000 radio equipment.

R&S®FK859C1 Line Flattener

The R&S®FK859C1 line flattener with an input VSWR of ≤ 1.3 can be used for matching transmitting/receiving systems to shortwave broadband antennas (e.g. log-periodic antennas, cage antennas, broadband dipoles).

Matching is achieved with microprocessor control by switching binary-stepped line sections and series capacitors into circuit.

The tuning information for 100 channels can be stored in a nonvolatile memory. The R&S®FK859C1 is accommodated in a 19. rackmount of three height units. Cooling is provided by a blower.

- Suitable for all kinds of shortwave broadband antennas
- Low insertion loss
- Integration in R&S®XK859 transceiver or R&S®Series2000 – R&S®KG2900 rack
- Short tuning time

Specifications

Frequency range	1.5 MHz to 30 MHz
Power-handling capacity	1125 W
Input VSWR (transmitter)	≤ 1.3:1
Output VSWR (antenna)	≤ 3:1
Tuning time	
Between any two frequencies	≤ 5 s
Between any two channels	≤ 20 ms
Required RF power	approx. 100 W
Power supply (from R&S®XK859)	19 V to 31 V DC
Operating temperature range	–25 °C to +55 °C
Storage temperature range	–40 °C to +60 °C
MTBF	10000 h

Ordering information

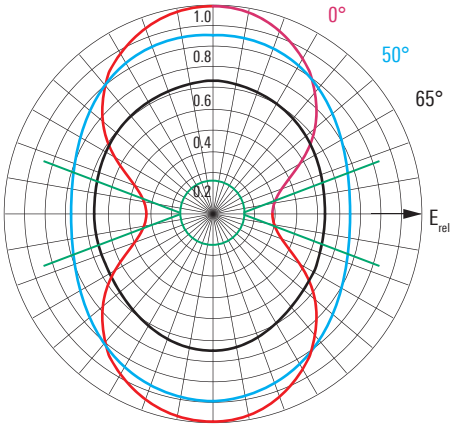
Designation	Type	Order No.
Line Flattener	R&S®FK859C1	0680.3013.02
Control Cable		
10 m lenght	R&S®FK895C1	6070.5274.10
20 m lenght	R&S®FK895C1	6070.5274.20
30 m lenght	R&S®FK895C1	6070.5274.30
40 m lenght	R&S®FK895C1	6070.5274.40
50 m lenght	R&S®FK895C1	6070.5274.50

R&S®HX002A1 150 W HF Dipole

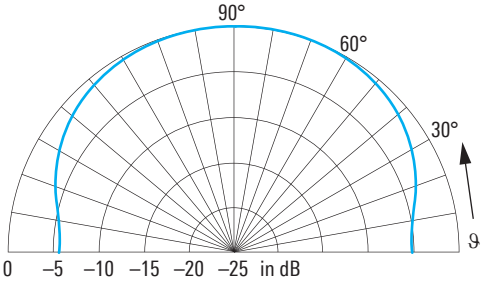
The R&S®HX002A1 150 W HF dipole is highly suitable for setting up radio links over any distance range. The antenna design ensures high transmission reliability over short and medium distances. The antenna can easily be integrated in existing systems since no control lines are required. All control signals and the power for the ATU are fed via the coaxial cable. The R&S®HX002A1 HF dipole can be directly connected to the R&S®XK2100 HF transceiver. For operation with other transmitters, the R&S®GX002A1 junction unit is available to provide power supply and antenna control. The automatic adaptive behavior of the integrated antenna tuning unit allows antennas to be set up close to neighboring antenna systems and on difficult terrain (e.g. built-on roofs).

- Omnidirectional coverage with high-angle radiation (NVIS)
- No skip zone
- Automatic adaptive operation
- Silent tuning
- No control line required
- Can be set up close to neighboring antennas

Typical horizontal radiation pattern for various elevation angles ϑ



Typical vertical radiation pattern (relative field strength) on a 5 m mast above a large roof area



Specifications

Frequency range	1.5 MHz to 30 MHz
Polarization	linear/horizontal
Input impedance	50 Ω
VSWR	< 1.5 (typ. < 1.3)
Max. input power	100 W CW/150 W PEP
Tuning time	
Without retuning	typ. 200 ms
Initial tuning	≤ 6 s (typ. 3 s)
Silent tuning [1]	< 30 ms
Tuning power	
With Rohde&Schwarz transmitters	30 W to 100 W
With R&S®GX002A1	50 W to 100 W
Gain (5 m above perfectly conducting ground)	typ. –12 dBi to 8 dBi
Power supply (via R&S®GX002A1)	
AC supply	100/120/230 V AC ± 10%, 47 Hz to 63 Hz (100 VA)
Battery	22 V to 32 V DC (typ. 2.5 A at 24 V DC)
Connector	N female
MTBF	> 8000 h
Operating temperature range	–25°C to +55°C
Max. wind speed (survival)	
Without ice deposit	250 km/h
With 20 mm radial ice deposit	130 km/h
Dimensions	
Length	approx. 10.7 m (approx. 421.3 in)
Width	approx. 4.4 m (approx. 173.2 in)
Height of ATU	approx. 0.42 m (approx. 16.5 in)
Weight	approx. 38 kg (approx. 83.8 lb)

[1] Supported by Rohde&Schwarz transceivers only.

Ordering information

Designation	Type	Order No.
150 W HF Dipole	R&S®HX002A1	4031.8009.02
Recommended extras		
Junction Unit	R&S®GX002A1	4031.9005.02
Cable Set for R&S®XK852 and R&S®GX002A1	R&S®GX002K1	4031.8909.03
Tiltable Mast, 5 m, for roof mounting	R&S®KM002A1	4035.7359.02
Lattice Mast, 10 m	R&S®KM451B1	4028.3351.02
Lattice Mast, 15 m	R&S®KM451B2	4028.3400.02
Mast Adapter for 10 m or 15 m mast	R&S®KM451Z4	4032.2904.02
Mast Adapter on R&S®KM451Z4	R&S®KM451Z5	4039.8308.02

R&S®HX002H1 150 W HF Dipole

The R&S®HX002H1 150 W HF dipole is suitable for setting up radio links over any distance. In particular, the optimized omnidirectional coverage ensures high transmission reliability over short and medium distances. The R&S®HX002H1 can be directly connected to R&S®M3SR Series4100 HF transceivers by means of the R&S®GK4102 fiber-optic control cable. The antenna enables silent tuning across the entire frequency range from 1.5 MHz to 30 MHz. However, the antenna tuning unit must first learn the correct tuning settings for the antenna in a user-defined frequency range. The antenna then achieves tuning times of < 5 ms. Special attention was paid to lightning protection. The integrated antenna tuning unit is protected against direct lightning strikes and was tested with 10 kV/10 kA discharges.

- Omnidirectional coverage with high-angle radiation (NVIS)
- No skip zone
- Integrated antenna tuning unit supports fast frequency hopping in line with R&S®SECOM-H
- Silent tuning
- Compatible with R&S®M3SR Series4100 HF transceivers
- Can be set up close to neighboring antennas

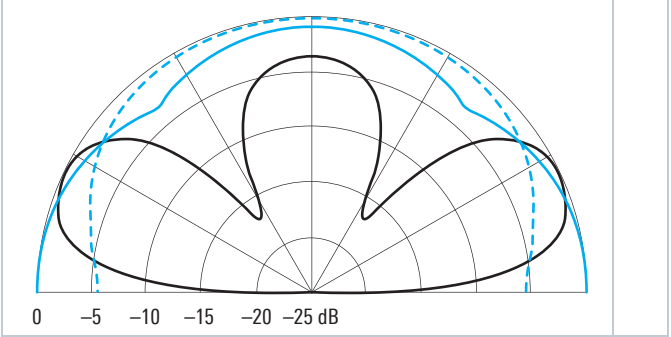
Specifications

Frequency range	1.5 MHz to 30 MHz
Polarization	linear/horizontal
Input impedance	50 Ω
VSWR	< 1.5 (typ. < 1.3)
Max. input power	100 W CW/150 W PEP
Tuning time	
Initial tuning	< 4 s (typ. 1.5 s)
Repeated tuning	typ. < 0.2 s
Silent tuning	< 5 ms
Tuning power	30 W ± 1 dB
Connector	N female
MTBF	> 14600 h
Operating temperature range	–30 °C to +55 °C
Max. wind speed (survival)	
Without ice deposit	250 km/h
With 20 mm radial ice deposit	130 km/h
Dimensions	
Length	approx. 10.7 m (approx. 421.3 in)
Width	approx. 4.4 m (approx. 173.2 in)
Weight	approx. 43 kg (approx. 94.8 lb)

Ordering information

Designation	Type	Order No.
150 W HF Dipole	R&S®HX002H1	6120.7000.02
Recommended extra		
Fiber-Optic Control Cable	R&S®GK4102	
10 m lenght		6120.5720.10
25 m lenght		6120.5720.25
50 m lenght		6120.5720.50

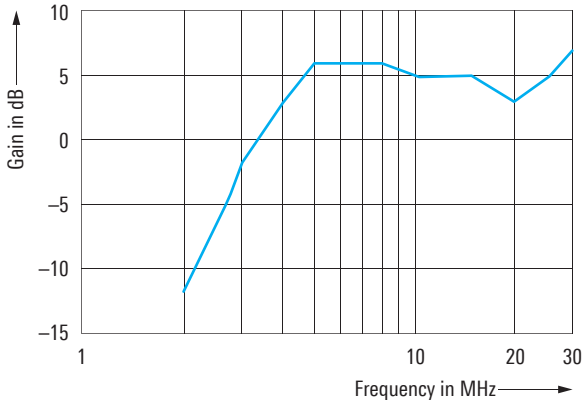
Vertical radiation pattern



Left: vertical radiation pattern on a 5 m mast above perfectly conducting ground: 2 MHz (solid blue line), 10 MHz (dotted blue line), 30 MHz (black line).

Typical gain

On a 5 m mast above perfectly conducting ground



R&S®HX002H2 150 W HF Dipole

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

The R&S®HX002H2 can be directly connected to R&S®M3SR Series4100 HF transceivers by means of the R&S®GK4102 fiber-optic control cable.

The antenna enables silent tuning across the entire frequency range from 1.5 MHz to 30 MHz. However, the antenna tuning unit must first learn the correct tuning settings for the antenna in a user-defined frequency range. The antenna then achieves tuning times of < 5 ms.

Special attention was paid to lightning protection. The integrated antenna tuning unit is protected against direct lightning strikes and was tested with 10 kV/10 kA discharges.

- Omnidirectional coverage with high-angle radiation (NVIS)
- No skip zone
- Integrated antenna tuning unit supports fast frequency hopping in line with R&S®SECOM-H
- Silent tuning
- Compatible with R&S®M3SR Series4100 HF transceivers
- Can be set up close to neighboring antennas
- Optimized for use on ships

Specifications

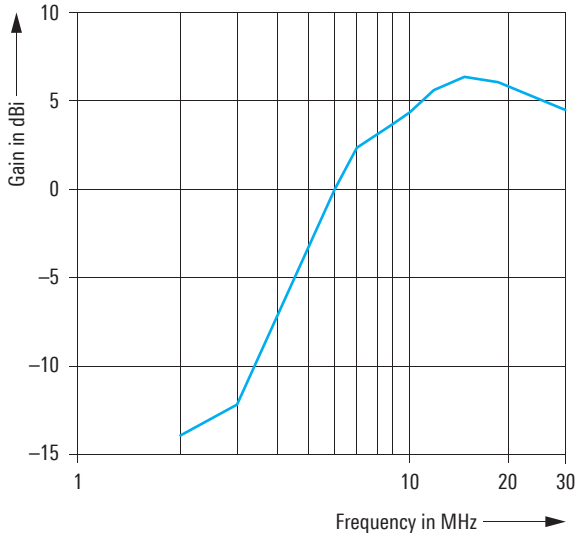
Frequency range	1.5 MHz to 30 MHz
Polarization	linear/horizontal
Input impedance	50 Ω
VSWR	< 1.5 (typ. < 1.3)
Max. input power	100 W CW/150 W PEP
Tuning time	
Initial tuning	< 4 s (typ. 1.5 s)
Repeated tuning	typ. < 0.2 s
Silent tuning	< 5 ms
Tuning power	30 W ± 1 dB
Connector	N female
MTBF	> 14600 h
Operating temperature range	–30 °C to +55 °C
Max. wind speed (survival)	
Without ice deposit	250 km/h
With 20 mm radial ice deposit	140 km/h
Dimensions	
Length	approx. 5.2 m (approx. 204.7 in)
Width	approx. 2.2 m (approx. 86.6 in)
Weight	approx. 32 kg (approx. 70.6 lb)

Ordering information

Designation	Type	Order No.
150 W HF Dipole	R&S®HX002H2	6120.8006.02
Recommended extra		
Fiber-Optic Control Cable	R&S®GK4102	
10 m lenght		6120.5720.10
25 m lenght		6120.5720.25
50 m lenght		6120.5720.50

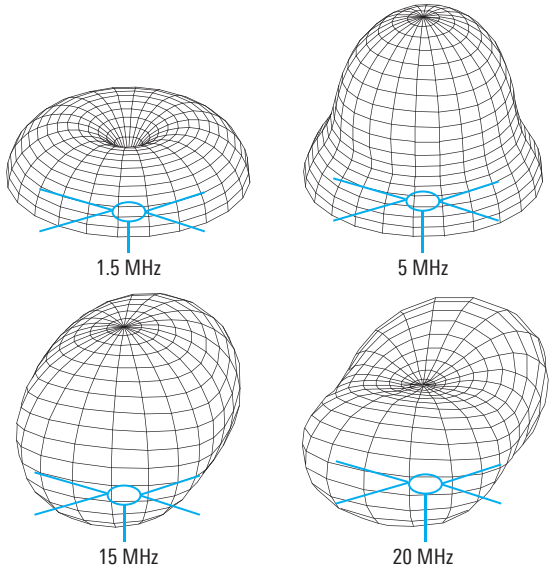
Typical gain

On a 5 m mast above perfectly conducting ground



Typical three-dimensional radiation patterns

Above perfectly conducting ground



R&S®HX002M1 150 W HF Dipole

The R&S®HX002M1 150 W HF dipole provides good coverage over any distance. It is optimized for omnidirectional coverage and ensures high transmission reliability over short and medium distances.

The antenna can easily be integrated into existing systems since no separate control lines are required. All control signals and the power for the ATU are fed via the coaxial cable. The R&S®HX002M1 HF dipole can be directly connected to the R&S®XK2100 HF transceiver. For operation with other transmitters, the R&S®GX002A1 junction unit is available to provide power supply and antenna control.

The antenna with its small size and improved environmental data is particularly suitable for use on ships.

- Omnidirectional coverage through high-angle radiation (NVIS)
- No skip zone
- Automatic adaptive operation
- Silent tuning
- No control line required
- Can be set up close to neighboring antennas
- Optimized for use on ships

Specifications

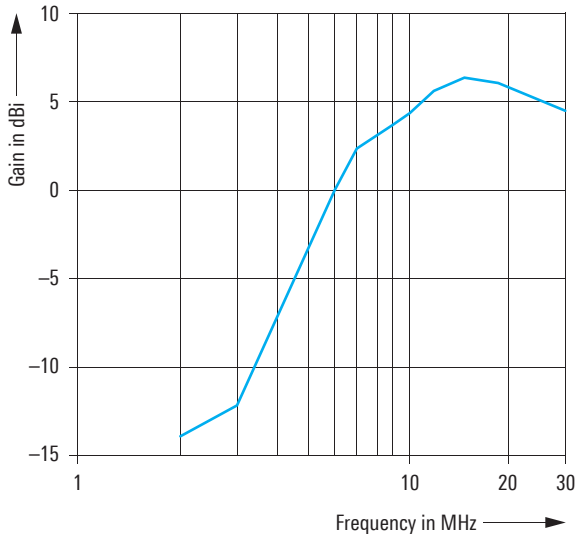
Frequency range	1.5 MHz to 30 MHz
Polarization	linear/horizontal
Input impedance	50 Ω
VSWR	< 1.5 (typ. < 1.3)
Max. input power	100 W CW/150 W PEP
Tuning time	
Without retuning	typ. 200 ms
Initial tuning	≤ 6 s (typ. 3 s)
Silent tuning	< 30 ms
Tuning power	
With Rohde&Schwarz transceivers	30 W to 100 W
With R&S®GX002A1	50 W to 100 W
Power supply	21 V to 31 V DC (typ. 1 A)
Connector	N female
MTBF	> 12000 h
Operating temperature range	–30 °C to +55 °C
Max. wind speed (survival)	
Without ice deposit	250 km/h
With 20 mm radial ice deposit	140 km/h
Dimensions	
Length	approx. 5.2 m (approx. 204.7 in)
Width	approx. 2.2 m (approx. 86.6 in)
Weight	approx. 34 kg (approx. 75 lb)

Ordering information

Designation	Type	Order No.
150 W HF Dipole	R&S®HX002M1	4021.6003.02
Recommended extras		
Junction Unit	R&S®GX002A1	4031.9005.02
Cable Set for R&S®XK852 and R&S®GX002A1	R&S®GX002K1	4031.8909.03

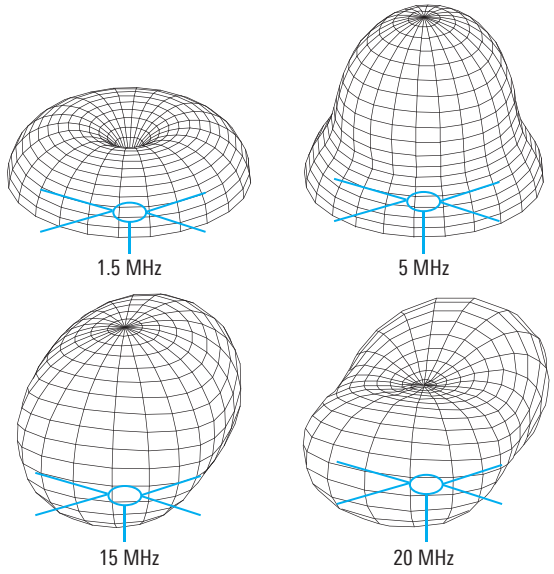
Typical gain

On a 5 m mast above perfectly conducting ground



Typical three-dimensional radiation patterns

Above perfectly conducting ground



R&S®FK859X1 1 kW HF Postselector

This filter with a power rating of 1000 W is used together with the R&S®XK2500L and R&S®XK2900L transceivers 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_o > 15 MHz) at f_o ± 10%. Tuning is digital by means of RF relays. The frequency information is derived from the control line to the ATU which is looped through the filter. Alternatively, the frequency information can be derived directly from the RF signal.

Specifications	
Frequency range	1.5 MHz to 30 MHz
Max. RF input power	1000 W CW and PEP
Input impedance	50 Ω
Max. VSWR	1.4:1
Stopband attenuation	
1.5 MHz to 15 MHz, f_o ± 10%	> 30 dB
15 MHz to 30 MHz, f_o ± 10%	> 20 dB
Operating temperature range	–25 °C to +55 °C
Storage temperature range	–40 °C to +85 °C
Dimensions (W × H × D)	483 mm × 355 mm × 655 mm (19 in × 14 in × 25.79 in), 19" rackmount
Weight	37 kg (81.57 lb)
MTBF	5600 h

Ordering information		
Designation	**Type**	**Order No.**
1 kW HF Postselector	R&S®FK859X1	6012.5498.04

R&S®FK2101X 150 W HF Postselector

The R&S®FK2101X is a postselector especially designed for the R&S®XK2100 HF transceiver. Since the R&S®XK2100 is capable of tuning without using a separate control line to the ATU, the control data transmitted together with the RF signal is taken via a modem bypass in the R&S®FK2101X. The filter is controlled via the R&S®GV2110 external control interface.

Specifications	
Electrical data	
Frequency range	1.5 MHz to 29.999 MHz
Maximum input power	100 W + 1 dB CW 150 W + 1 dB PEP
Transmission loss	
Without modem bypass	< 1 dB
With modem bypass	< 1.5 dB
Stopband attenuation	
1.5 MHz to 29.999 MHz, f_o ± 10%	≥ 8 dB
Input impedance	50 Ω
Tuning time	50 ms
Power supply (from R&S®IN2100)	26.5 V
Current input	≤ 3 A
Mechanical and environmental data	
Dimensions (W × H × D)	483 mm × 177 mm × 358 mm (19 in × 7 in × 14.09 in)
Depth (overall)	413 mm (16.26 in)
Weight	11 kg (24.25 lb)
Color	RAL 7035
Safe shock load	30 g, 11 ms
Vibration	10 Hz to 55 Hz, 0.3 mm double amplifier

Ordering information		
Designation	**Type**	**Order No.**
150 W HF Postselector	R&S®FK2101X	6079.2010.02

R&S®Series4200 Software Defined Radios

VHF/UHF radio family for ATC communications

- 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
- Suitable for data transmission in line with VDL mode 2 standard

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 seven versions: transceiver, transmitter, receiver 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 at regular intervals.

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 data mode (VHF), LAN remote-control interface, serial interface 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 are prepared to support digital voice transmission using the ITU-T G.703 PCM interface and VoIP in accordance with EUROCAE specifications. This function is made available for the VHF radios by means of a software update.

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.

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 that is 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) up to an ambient temperature of +40 °C. 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.

Available versions of the R&S®Series4200 radio family

UHF (225 MHz to 400 MHz)

R&S®XD4200
UHF transceiver.

R&S®SD4200
UHF transmitter.

R&S®ED4200
UHF receiver.

R&S®ED4200C
compact UHF receiver.

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

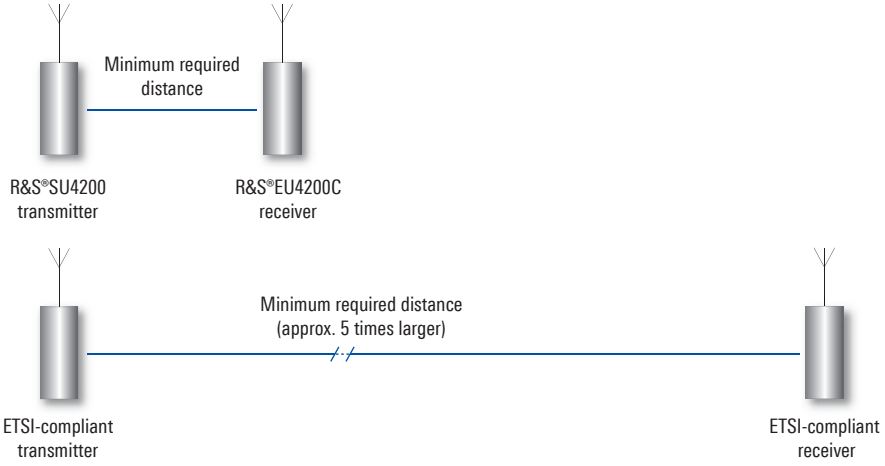
The receiver includes two squelch criteria which can be logically combined (AND, OR). The squelch criterion can be based on the receive power, the S/N ratio of the demodulated useful signal or a logical combination of these two criteria. Both thresholds can be set independently in a wide range.

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	typ. ≤–145 dBc
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 non-active 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 VHF transmitter or VHF 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).

R&S®ZS4200 service and maintenance tool.

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. Regular 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.

Extreme 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.

Seamless transition from analog to digital voice transmission on the network side
In many countries, analog connections for linking the transmitting 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 as a software update, which also 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 via software upgrade
A further step toward a future-ready radiocommunications system is the voice over IP (VoIP) alternative. The cost-effective IP links make it possible to set up a high-availability transmission network.

The R&S®Series4200 radios can be enhanced to handle the EUROCAE-compatible VoIP technology by means of a software upgrade. Conversion to VoIP at some point in the future therefore becomes possible – provided that the remaining infrastructure is available. This means that the one-off investment in radiocommunications will continue to pay off over the long term.

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 19"/2, 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. 19"/4 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 receivers or two transmitters or any combination of these devices
- Four compact receivers

Up to 24 transmitters or transceivers can thus 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.

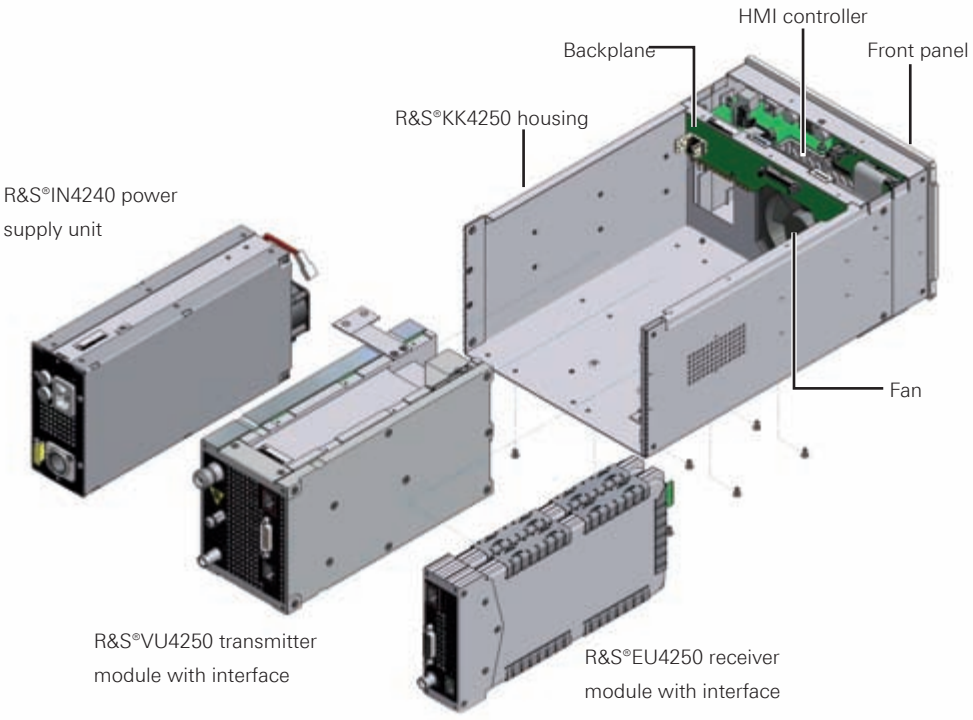
Integrated transmit/receive switch

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.

Modular design of the R&S®XU4200 VHF transceiver

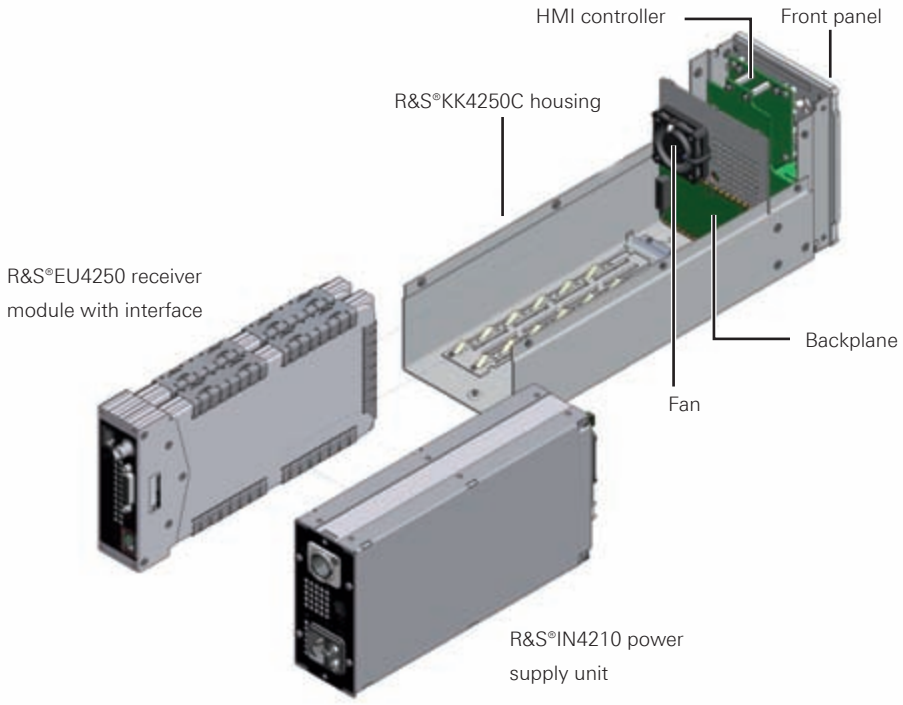


The power supply has a wide supply voltage range and can be operated with 230 V AC or 115 V AC without manual switchover. The user stays informed about the availability (or dropout) of the supply voltages using LEDs on the radio as well as warning messages to the management system. The power supply is 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

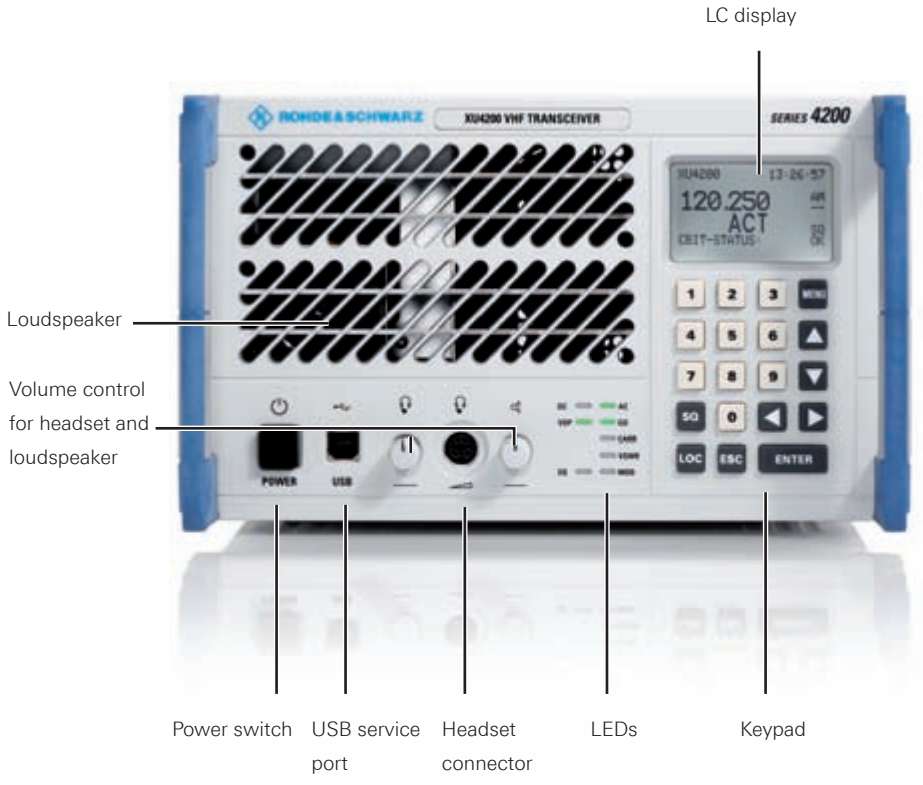
The HMI controller is part of the housing. It includes the control of the radio and the interface to the user. The HMI controller allows the radio to be operated using the integrated keypad and display. Configuration of the radio is possible via the USB interface. Software updates and upgrades are handled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

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



Front view

Transceiver/transmitter/receiver



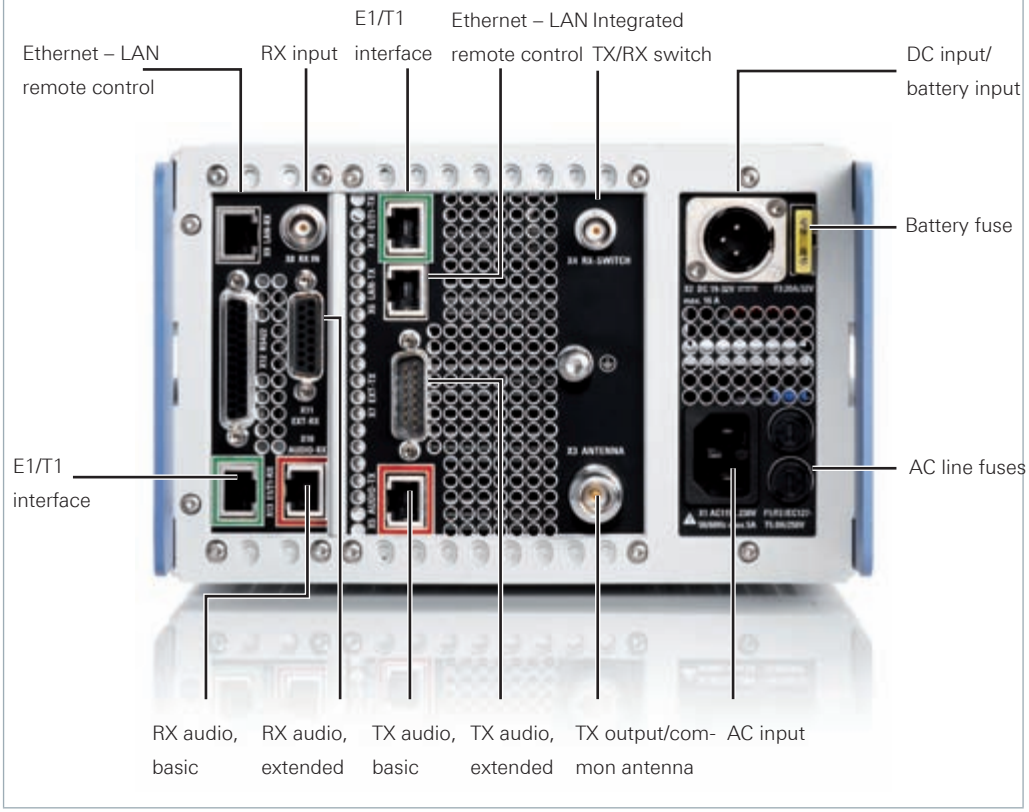
Front view of the transceivers, transmitters and receivers (UHF only) of the R&S®Series4200.

Compact receiver

Front view of the compact receivers of the R&S®Series4200.

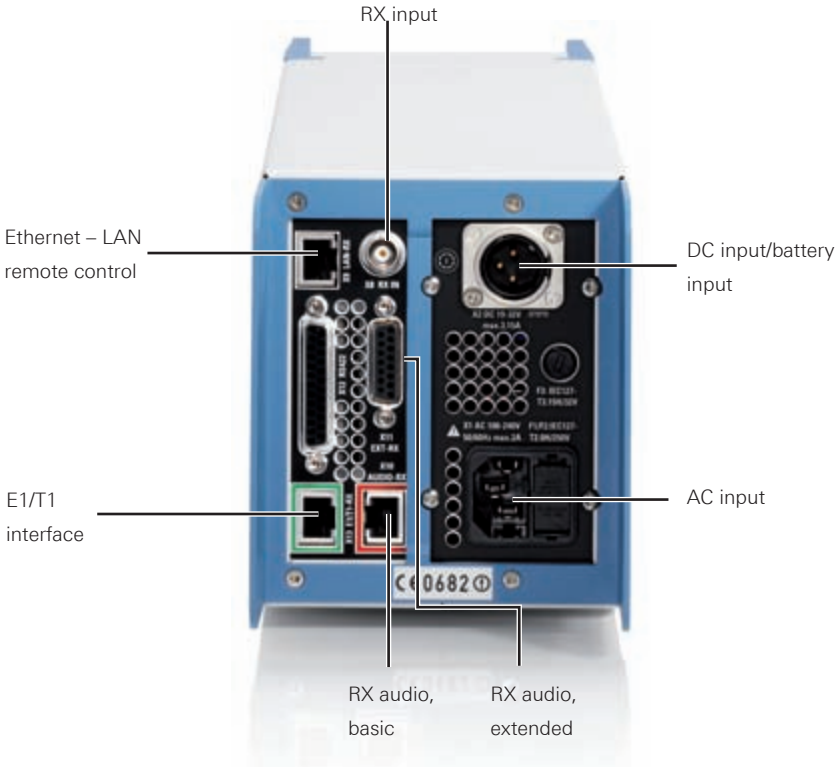
Rear view

Transceiver



Rear view of the VHF transceiver of the R&S®Series4200.

Compact receiver



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

Applications

Tower application

The R&S®Series4200 transceivers are ideal for standalone applications without a voice communications system (VCS) being necessary. The transceivers can be used directly as desktop radios merely by connecting an antenna and a headset or microphone. For remote operation, an audio panel that can be integrated into an operator console is available.

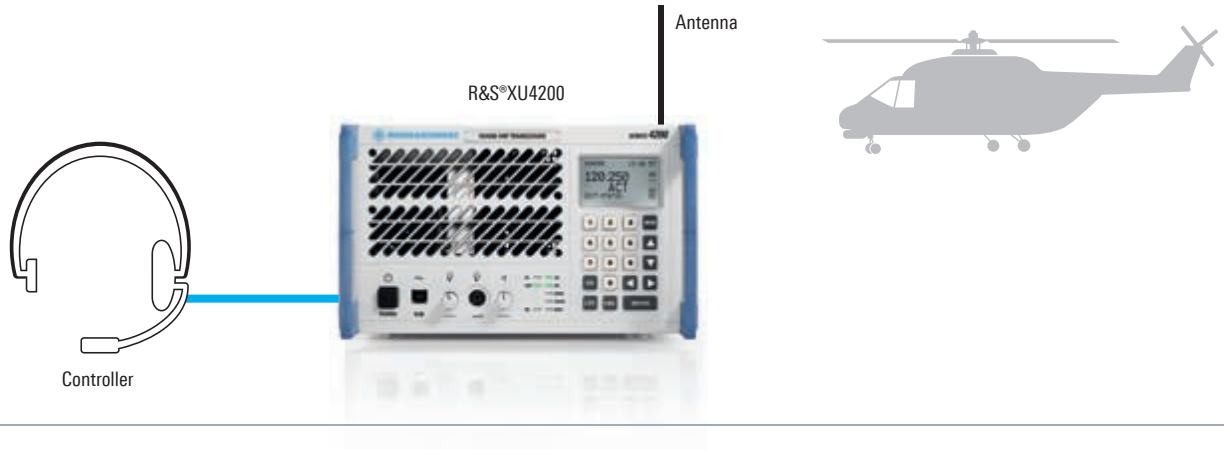
If a controller needs to access multiple radios, the R&S®GB208 remote audio unit allows up to eight transceivers to be connected. Cascading of the R&S®GB208 enables multiple controllers to share a set of radios.

Radio site

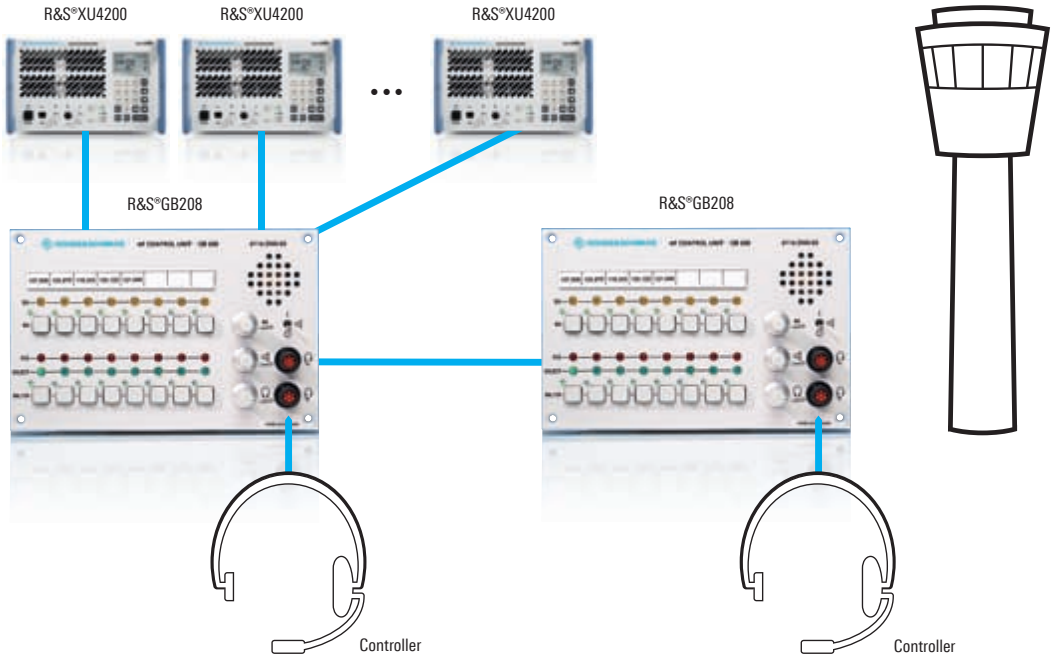
In large radiocommunications systems, transmitters and receivers are often located at different sites to prevent them from affecting each other. The R&S®SU/SD4200 transmitters and the R&S®EU/ED4200 receivers are the right choice for these applications.

Rohde&Schwarz offers all components necessary for a complete radio site. This includes racks, multicouplers, filters and antennas. To support applications that require a change in the transmit frequency, automatic filters are available. These filters are switched to the new frequency by the radio. To monitor the radio systems, operators can rely on the R&S®RCMS II. It can output the status of all radios available in the network for the operator at any time.

Local operation



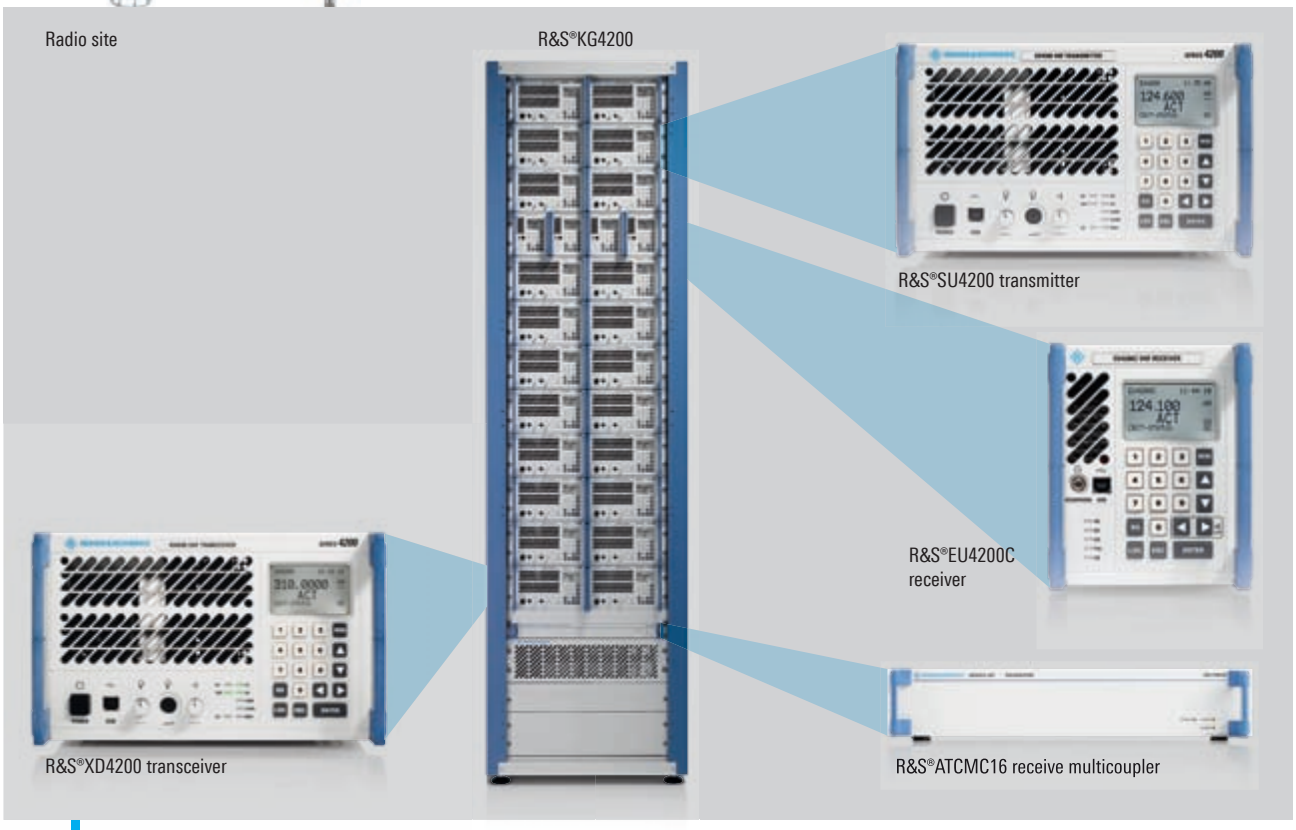
Remote operation

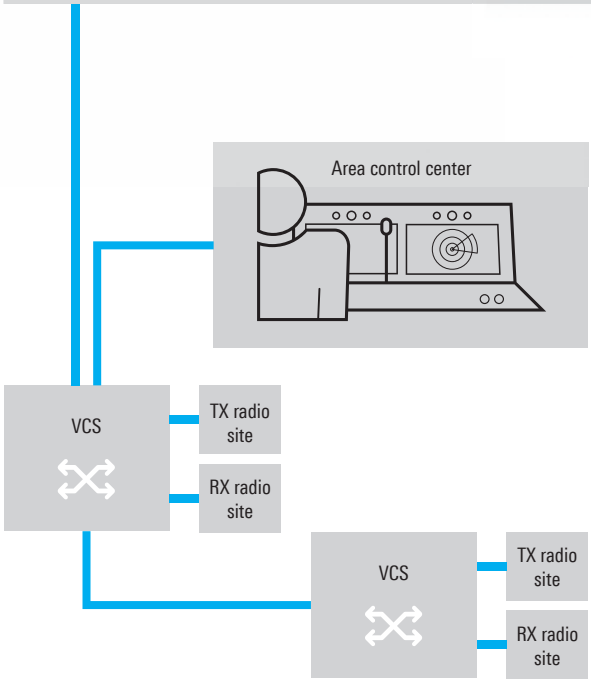


Radio site configuration

R&S®HK012
VHF antenna

R&S®HK014
VHF/UHF antenna



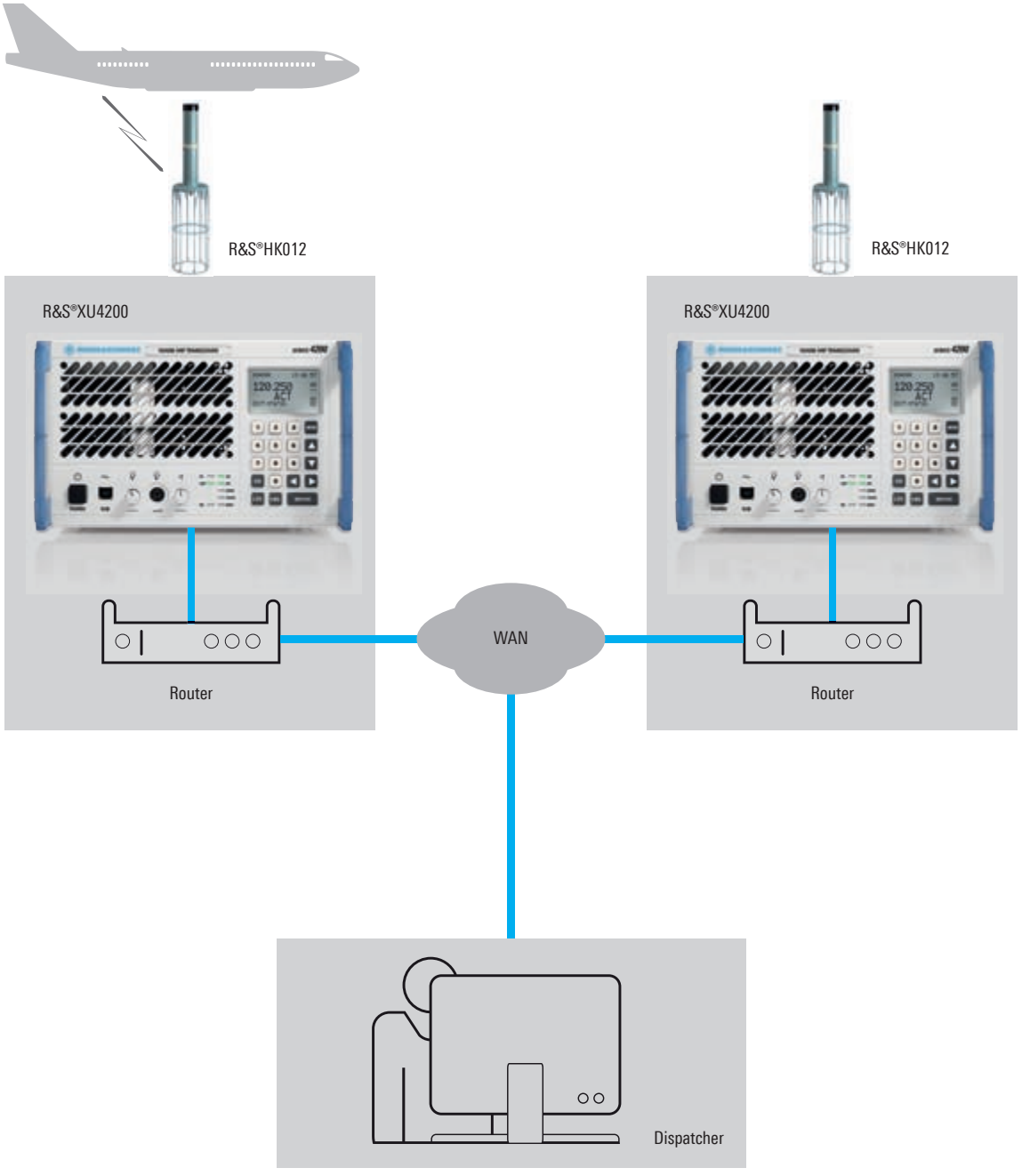


R&S®RCMS II remote control and monitoring system

Data application

Data communications between the aircraft and the airline's flight operations center can be sent over communications networks operated by commercial service providers. The radio systems operate in the same VHF frequency range as the voice communications for air traffic control (ATC) so that the same radios can be used on board the aircraft. Data communications on the ground are handled by the VHF radios from the R&S®Series4200. These transceivers can be operated both in the ACARS mode and in VDL mode 2.

Airline operational communications



R&S®ZS4200 Service and Maintenance Tool

For the R&S®Series4200 ATC radio

- PC-based service tool for equipment setup, software download and local maintenance
- Windows operating system
- Convenient graphical user interface
- Plug & play via USB interface

Description

The R&S®Series4200 is the latest generation of VHF and UHF radios for use in civil or military air traffic control. For easy local setup of the R&S®Series4200 radio equipment, a PC-based service and maintenance tool is available. This tool makes it possible to configure the radio equipment via a graphical user interface or read the event messages stored in the radio. This tool is also used to download new software available for the R&S®Series4200.

The service and maintenance tool consists of the software for the notebook PC needed for accessing the radio equipment. After the R&S®ZS4200 has been connected to the radio's USB port via cable, the user can browse through the current setup, change parameters, store the current configuration or retrieve a previously stored configuration.

For local maintenance, the event log in the radio can be uploaded. It stores all relevant warnings, alarms and other events. Inventory information stored in the radio can be read out, giving a clear overview of the serial numbers of modules and their software/firmware versions. Finally, as new software releases become available for the radio equipment, they can be downloaded using this tool. All data retrieved from the radio equipment can be saved on the local drive of the service PC.

Features

- PC-based tool for radio setup, local maintenance and software download
- Plug & play connectivity via USB
- Graphical user interface based on Windows
- Setup, configuration and cloning of radio equipment
- Read-out of radio status and event log, saving of event logs to local hard disk drive
- Display of complete inventory of radio equipment, including hardware, firmware and software version, saving of data to local hard disk drive
- Download of software updates to the radio equipment

System requirements

- Portable PC, min. 1 GHz processor, min. 256 Mbyte RAM (Windows 2000 and XP), min. 512 Mbyte RAM (Windows Vista Home Basic), min. 1 Gbyte RAM (Windows Vista Home Premium, Vista Business, Vista Enterprise and Vista Ultimate), min. 80 Mbyte free space on hard disk drive, CD-ROM drive, USB port (version 1.1 or 2.0)
- Windows 2000/XP, or Windows Vista operating system

R&S®KG4200 ATC System Rack

The cost-effective solution for R&S®Series4200 radio systems

- Specially developed for ATC systems with R&S®Series4200 radio equipment
- Standardization
- High capacity for up to 24 receivers, 48 compact receivers, 24 transmitters or 24 transceivers in one rack
- Up to eight channels (main/standby) + filter in one rack
- Mixed RX, TX, RX/TX configuration in one rack
- 46 HU of space available for mounting equipment
- Free space for additional units (e.g. LAN switch or filters)
- Removable rear panel and side panels
- Ease of installation due to precabling
- Different options available for rack expansion

Characteristics of rack options

- DC power interface, 24 V DC connector: One fuse for each RX, TX or RX/TX
- AF and signal interfaces in the rack: Connecting terminals: LSA-PLUS®10-pair termination modules from KRONE® (no soldering, no wire-stripping, no screw connection)
- AF via telephone line (leased line): Electric isolation of AF line via transformers
- Overvoltage protection (AF and signal lines): 90 V charge eliminators directly connectable to the KRONE® LSA-PLUS®10 terminal
- RF relay: for main/standby configuration
- 3 dB coupler: RF interconnection of 2 × RX to an antenna

R&S®KG4200 receiver/transmitter/transceiver racks

The R&S®KG4200 rack can accommodate up to 24 receivers, 48 compact receivers, 24 transmitters or 24 transceivers of the R&S®Series4200. In addition, combining filters, LAN switches or PC components can be installed (provided there is space available).

Overall rack dimensions

The racks have a height of max. 2180 mm (2200 mm with adjustable feet), a length of 800 mm and a width of 600 mm (85.88 in (86.61 in with adjustable feet) × 31.50 in × 23.62 in).

Material

The high-quality racks are made of a stainless steel frame and light gray aluminum panels with blue stripes on the side, front and rear. The front door (optional) as well as the rear and side panels can be removed.

Cabling

All racks optionally can be cabled and connected on request. Cabling is via the bottom or top of the rack. Rack interfaces with installation-friendly KRONE® blocks are available for connecting the racks and the VCS.

Power supply

In the basic version, each rack is equipped for direct connection to a 230 V power supply. The rack units are supplied with up to four separately fed outlet socket strips with protective earthing. The main units and standby units can be powered from different AC supplies to increase channel availability. A 22 V to 31 V DC power supply can be supported as an option.

Cooling

Due to the design of the rack, no separate cooling unit is required.

Specifications

R&S®KG4200 rack equipped only with transmitter or transceiver				
Model	**.06**	**.12**	**.18**	**.24**
Number of receivers, transmitters or transceivers	max. 6	max. 12	max. 18	max. 24
TX power consumption				
Peak power, all transmitters keyed (max.)	2880 VA AC 2340 W DC	5760 VA AC 4680 W DC	8640 VA AC 7020 W DC	11520 VA AC 9360 W DC
Average power, transmitters keyed 10 % of time (max.) 10:1 (RX:TX)	528 VA AC 414 W DC	1056 VA AC 828 W DC	1584 VA AC 1242 W DC	2112 VA AC 1656 W DC
Max. AC current	12.5 A	25 A	37.5 A	50 A
Recommended fusing for 230 V AC	2 × 16 A (2 phases), wire cross-section 2.5 mm²	2 × 16 A (2 phases), wire cross-section 2.5 mm²	4 × 16 A (4 phases), wire cross-section 2.5 mm²	4 × 16 A (4 phases), wire cross-section 2.5 mm²
Recommended fusing for 24/28 V DC	95 A	2 × 95 A	3 × 95 A	4 × 95 A
28 V DC connection points in rack (one point for 6 units each), one basic option for 6 units each	1	2	3	4
Empty weight	approx. 96 kg (211.64 lb)	approx. 102 kg (224.87 lb)	approx. 108 kg (238.10 lb)	approx. 114 kg (251.34 lb)
Weight with transmitters/transceivers (including options)	approx. 144 kg (317.46 lb)	approx. 198 kg (436.51 lb)	approx. 252 kg (555.56 lb)	approx. 306 kg (674.61 lb)
R&S®KG4200 rack equipped only with receiver				
Model	**.06**	**.12**	**.18**	**.24**
Number of receivers	max. 6	max. 12	max. 18	max. 24
RX power consumption				
Peak power, all receivers	270 VA AC 180 W DC	540 VA AC 360 W DC	810 VA AC 540 W DC	1080 VA AC 720 W DC
Max. AC current	1.2 A	2.4 A	3.5 A	4.7 A
Recommended fusing for 230 V AC	2 × 16 A (2 phases), wire cross-section 2.5 mm²	2 × 16 A (2 phases), wire cross-section 2.5 mm²	4 × 16 A (4 phases), wire cross-section 2.5 mm²	4 × 16 A (4 phases), wire cross-section 2.5 mm²
Recommended fusing for 24/28 V DC	7.5 A	2 × 7.5 A	3 × 7.5 A	4 × 7.5 A
28 V DC connection points in rack (one point for 6 units each), one basic option for 6 units each	1	2	3	4
Empty weight	approx. 96 kg (211.64 lb)	approx. 102 kg (224.87 lb)	approx. 108 kg (238.10 lb)	approx. 114 kg (251.34 lb)
Max. weight with receivers (with options)	approx. 129 kg (284.40 lb)	approx. 168 kg (370.38 lb)	approx. 207 kg (456.36 lb)	approx. 246 kg (542.38 lb)
R&S®KG4200 rack equipped only with compact receiver				
Model	**.62**	**.74**	**.86**	**.98**
Number of receivers	max. 12	max. 24	max. 36	max. 48
RX power consumption				
Peak power, all compact receivers	540 VA AC, 360 W DC	1080 VA AC, 720 W DC	1620 VA AC, 1080 W DC	2160 VA AC, 1440 W DC
Max. AC current	2.4 A	4.8 A	7 A	9.4 A
Recommended fusing for 230 V AC	2 × 16 A (2 phases), wire cross-section 2.5 mm²	2 × 16 A (2 phases), wire cross-section 2.5 mm²	4 × 16 A (4 phases), wire cross-section 2.5 mm²	4 × 16 A (4 phases), wire cross-section 2.5 mm²
Recommended fusing for 24/28 V DC	2 × 7.5 A	4 × 7.5 A	6 × 7.5 A	8 × 7.5 A
28 V DC connection points in rack (one point for 6 units each), one basic option for 6 units each	2	4	6	8
Empty weight	approx. 96 kg (211.64 lb)	approx. 102 kg (224.87 lb)	approx. 108 kg (238.10 lb)	approx. 114 kg (251.34 lb)
Max. weight with compact receivers (with options)	approx. 150 kg (330.7 lb)	approx. 210 kg (463 lb)	approx. 270 kg (595.25 lb)	approx. 330 kg (727.53 lb)

General data	
Power supply	same as units of R&S®Series4200: AC: 230 V AC –10/+15 %, 47 Hz to 63 Hz DC: 22 V to 31 V DC, negative pole to ground with R&S®KG42-Z5/-Z51 options
Color of frame	frame of stainless steel (front blue, RAL 5014)
Color of paneling	aluminum (RAL 7047)
Dimensions (H × D × W)	2180 mm (2200 mm with adjustable feet) × 800 mm × 600 mm (85.88 in (86.61 in with adjustable feet) × 31.50 in × 23.62 in)
Operating temperature range	–20 °C to +55 °C (equipped with permanent working transmitters –20 °C to +40 °C)
Storage temperature range	–40 °C to +70 °C
Vibration and shock (industry standard)	IEC 60721-3-3 Cl. 3M2 – 3M3 IEC TR 60721-4-3 Cl. 3M3 IEC 60068-2-6: 1995-03, Part 2 (Vibration) IEC 60068-2-27: 1987, Part 2 (Shock)
Postal lines standard (leased lines)	ES 203 021, June 2005, fulfilled with R&S®KG42-Z3 option
Overvoltage protection (R&S®KG42-Z6 option)	type KRONE® ÜsAg 8x6, MK 90 V

Ordering information: ATC system racks[1)]

Designation	Type	Order No.
The model depends on the number of units to be installed. Corresponding options are available for each model. To create a rack in line with customer requirements, the options have to be combined with the basic racks. Example: A transmitter rack with four transmitters is a model .06 rack. To equip the rack with a DC mounting kit, two DC installation kits need to be ordered as well.		
RX/TX Cabinet Rack 19", 46 HU, AC	R&S®KG4200	6137.1751.xx
Basic Rack		
For up to 6 × TX, 6 × RX/TX or 6 × RX	R&S®KG4200	6137.1751.06
For up to 12 × TX, 12 × RX/TX or 12 × RX	R&S®KG4200	6137.1751.12
For up to 18 × TX, 18 × RX/TX or 18 × RX	R&S®KG4200	6137.1751.18
For up to 24 × TX, 24 × RX/TX or 24 × RX	R&S®KG4200	6137.1751.24
For up to 12 × compact RX	R&S®KG4200	6137.1751.62
For up to 24 × compact RX	R&S®KG4200	6137.1751.74
For up to 36 × compact RX	R&S®KG4200	6137.1751.86
For up to 48 × compact RX	R&S®KG4200	6137.1751.98
For all basic rack types: blank panels at all empty positions; openings for air circulation on rear and top, AC cables and AC terminals		
Rack Configuration per Rack, incl. configuration sheet (mandatory)	R&S®KG42-Z0	6137.2206.02

[1)] RX = receiver, compact RX = compact receiver, TX = transmitter, RX/TX = transceiver.

Ordering information: options for the racks

Designation	Type	Order No.
Installation Kit, mechanical ❙ For up to 2 × RX, TX or RX/TX ❙ For up to 4 × RX compact	R&S®KG42-Z1	6137.2635.02
Installation Kit, electrical (type 1) ❙ For up to 2 × RX, 2 × TX or 1 × RX/TX ❙ For single or MAIN/STBY configuration ❙ 2 × cable, connection board	R&S®KG42-Z2	6137.2693.02
Installation Kit, electrical (type 2) ❙ For up to 2 × RX, 2 × TX or 2 × RX/TX ❙ Only for MAIN/STBY configuration ❙ Electric isolation of AF lines via transformers ❙ For leased telephone lines ❙ 4 × cable, connection board	R&S®KG42-Z3	6137.2812.02
Installation Kit, RF relay ❙ For 2 × TX or 2 × RX/TX ❙ Only for MAIN/STBY configuration ❙ 1 × RF relay, 2 × RF cable, 1 × DC cable, mounting plate	R&S®KG42-Z4	6137.2935.02
Basic Installation Kit, DC (for TX) ❙ For up to 6 × TX, 6 × RX/TX ❙ 6 × fuse holder with interconnection ❙ 6 × fuse (25 A), 2 × spare fuse (25 A) ❙ Mounting plate, clamps	R&S®KG42-Z5	6137.2993.02
Basic Installation Kit, DC (for RX and RX compact) ❙ For up to 6 × RX ❙ 6 × fuse holder with interconnection ❙ 6 × fuse (6 A), 2 × spare fuse (6 A) ❙ Mounting plate, clamps	R&S®KG42-Z5	6137.2993.03
Installation Kit, DC ❙ For up to 2 × TX, RX/TX or RX ❙ 2 × DC cable	R&S®KG42-Z51	6137.3054.02
Overvoltage Protection ❙ For 1 × connection board type 1 or type 2 ❙ 1 × holder and 20 × arrester (90 V)	R&S®KG42-Z6	6137.3119.02
Control Cable for TELSA® automatic filter ❙ For one filter, controlled by TX or RX/TX radio, 2 m length	R&S®KG42-Z71	6137.3231.02
Control Cable for TELSA® automatic filter ❙ For one filter, controlled by RX radio, 2 m length	R&S®KG42-Z71	6137.3231.03
Installation Kit, 3 dB coupler ❙ For 2 × RX/TX (RX part) or 2 × RX, ❙ 1 × 3 dB coupler, 2 × RF cable, mounting plate	R&S®KG42-Z8	6137.3354.02
Installation Kit, filter ❙ For mounting one 19" filter unit, (e.g. 2 × single filter or 1 × two-port multicoupler) ❙ 2 × RF cable, sliding rails	R&S®KG42-Z9	6137.3419.02

Ordering information: options for the racks

Designation	Type	Order No.
Cable Set, LAN ❙ 2 × LAN cable, 1 m length	R&S®KG42-Z10	6137.2493.02
Cable Set, LAN ❙ 6 × LAN cable, 1 m length	R&S®KG42-Z10	6137.2493.03
Installation Kit, 19" unit ❙ For one 19" unit (e.g. additional COTS component), sliding rails	R&S®KG42-Z11	6137.2564.02
Front Door ❙ With opening for air circulation, hand gear with lock	R&S®KG42-Z12	6137.2341.02
Back Door ❙ With opening for air circulation, hand gear with lock, replaces original rear panel	R&S®KG42-Z13	6137.2429.02
Installation Kit, mechanical (for LAN switch) ❙ Mounting plate with TS35 rail, for a small MOXA® LAN switch (up to 16 ports)	R&S®KG42-Z14	6137.3477.02
Installation Kit, AC, for 1 × MOXA® LAN switch ❙ 1 × power supply, mounting material, cables	R&S®KG42-Z15	6137.2058.02
Installation Kit, AC, for 2 × MOXA® LAN switch ❙ 1 × power supply, mounting material, cables	R&S®KG42-Z15	6137.2058.03
Installation Kit, AC, for 3 × MOXA® LAN switch ❙ 2 × power supply, mounting material, cables	R&S®KG42-Z15	6137.2058.04
Installation Kit, AC, for 4 × MOXA® LAN switch ❙ 2 × power supply, mounting material, cables	R&S®KG42-Z15	6137.2058.05
Installation Kit, DC, for MOXA® LAN switch ❙ Fuse holder, fuses, mounting material, cables	R&S®KG42-Z16	6137.2129.02
RF Cable Kit ❙ 8 × RF cables to 8-port R&S®ATCMC8 Multicoupler	R&S®KG42-Z20	6148.9894.02
RF Cable Kit ❙ 16 x RF cables to 16-port R&S®ATCMC16 Multicoupler	R&S®KG42-Z20	6148.9894.03

Ordering information: accessories for rackmounting of radios

Designation	Type	Order No.
Installation Kit, mechanical ❙ 1 × dummy plate 19"/2 with two hand gears ❙ Mounting material	R&S®BP4201	6130.2269.02
Installation Kit, mechanical ❙ 1 × dummy plate 19"/4 with two hand gears ❙ Mounting material	R&S®BP4202	6137.1616.02
KRONE® LSA-PLUS® Tool, automatic wire cutter (or other supplier)		6137.1974.02
KRONE® LSA-PLUS® Tool, simple version, plastic		6137.1980.02

Ordering information: AF devices

Designation	Type	Order No.
Active AF Line Amplifier ❙ 4 x in/out, installation: central station	R&S®GH215A	6127.4958.02
Power Supply ❙ 24 V DC, 1.25 A, profile rail mounting	R&S®NGRA24	6109.9868.02
Passive AF Splitter/Combiner		
❙ 4 x in/out, installation: central station	R&S®GH215P	6123.7500.02
❙ 4 x in/out, 2 x optocoupler; installation: remote station	R&S®GH215P	6123.7500.03

Ordering information: R&S®Series4200 Software Defined Radios

Designation	Type	Order No.
R&S®Series4200 VHF multichannel radios		
VHF Transceiver 50 W, 112 MHz to 156 MHz	R&S®XU4200	6144.7300.02
VHF Transmitter 50 W, 112 MHz to 156 MHz	R&S®SU4200	6144.7500.02
Compact VHF Receiver, 112 MHz to 156 MHz	R&S®EU4200C	6144.7800.02
R&S®Series4200 UHF multichannel radios		
UHF Transceiver		
50 W, 225 MHz to 400 MHz	R&S®XD4200	6133.8500.02
50 W, 225 MHz to 400 MHz, WB interface	R&S®XD4200	6133.8500.06
UHF Transmitter 50 W, 225 MHz to 400 MHz	R&S®SD4200	6133.8700.02
UHF Receiver, 225 MHz to 400 MHz	R&S®ED4200	6133.8600.03
Compact UHF Receiver, 225 MHz to 400 MHz	R&S®ED4200C	6133.8645.02
Accessories (external options)		
Service and Maintenance Tool	R&S®ZS4200	6133.8722.07
Headset, dynamic microphone	R&S®GA4200D	6133.8780.00
Headset, electret microphone	R&S®GA4200E	6133.8797.00
Microphone, mini-DIN connector	R&S®GA016H1	0583.5568.03
Adapter for Standard Headset	R&S®GA4220	6137.1274.00
Headset	R&S®GA4210	6137.1245.00
Mating Connector Sets		
For the R&S®XU4200	R&S®ZF4200	6137.1568.02
For the R&S®SU/SD4200	R&S®ZF4200	6137.1568.03
For the R&S®EU/ED4200	R&S®ZF4200	6137.1568.04
For the R&S®XD4200	R&S®ZF4200	6137.1568.05
Filler Plate 19"/2	R&S®BP4201	6130.2269.02
Filler Plate 19"/4	R&S®BP4202	6130.1616.02
System components		
Antennas	see "Antennas" catalog	
AF Control Unit	R&S®GB208	see page 189
ATC System Racks	R&S®KG4200	see page 168
VHF Power Amplifier 200 W	R&S®VU220L	see page 163
Air Traffic Control Multicoupler	R&S®ATCMC	see page 174
Manually Tunable Filters	R&S®Fx2x	see page 167
Remote Control and Monitoring System	R&S®RCMS II	see page 233
I-Level Special Test Equipment	R&S®TS6030	see page 258

R&S®M3SR Series4400 Software Defined Radios

VHF/UHF radio family for stationary and shipborne communications

- Extended frequency range from 100 MHz to 512 MHz
- Output power up to 100 W for deployment with EPM (ECCM) waveforms
- Very high frequency stability by means of state-of-the-art OCXO technology
- Highly modular design, enabling subsequent expansion and easier service
- TCP/IP interface for remote control and for service/maintenance activities
- Continuous transmission at temperatures up to +55 °C

The R&S®M3SR Series4400 VHF/UHF radio family is designed for stationary air defense, civil and military air traffic control and shipborne applications. It belongs to a generation of stationary VHF/UHF radios that feature innovative designs, high modularity and in particular outstanding specifications.

For civil applications, the R&S®M3SR Series4400 systems were developed in line with international civil air traffic control guidelines (EN 300676) while integrating the requirements for the UHF band I 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 schemes that conform to NATO standards. Military data transmission methods such as LINK11 and LINK22 are also 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.

With this range of functions, the R&S®M3SR Series4400 radio family serves as a seamless communications bridge between the various military forces and civil units.

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 configured to provide the specific functions that are required. Furthermore, the functional characteristics of the R&S®M3SR Series4400 radios are defined by means of the specially-designed software.

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 in addition to compatible filter methods yield an optimal RF signal spectrum. This significantly reduces collocation influence that is 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 to ensure high-quality radio links. Very rapid frequency generation and frequency setting enables the use of fast EPM (ECCM) waveforms without having to sacrifice the high quality of the RF signals.

Robust design for unfavorable RF conditions
R&S®M3SR Series4400 radio systems are prepared for operation in unfavorable RF environments. Even antennas that create a high voltage standing wave ratio (VSWR) can be connected without difficulty.

The negative impact of high receive levels is compensated for by the excellent RF large-signal immunity, leading to outstanding voice and data transmission quality. Protection circuits prevent damage from occurring to the R&S®M3SR Series4400 modules.

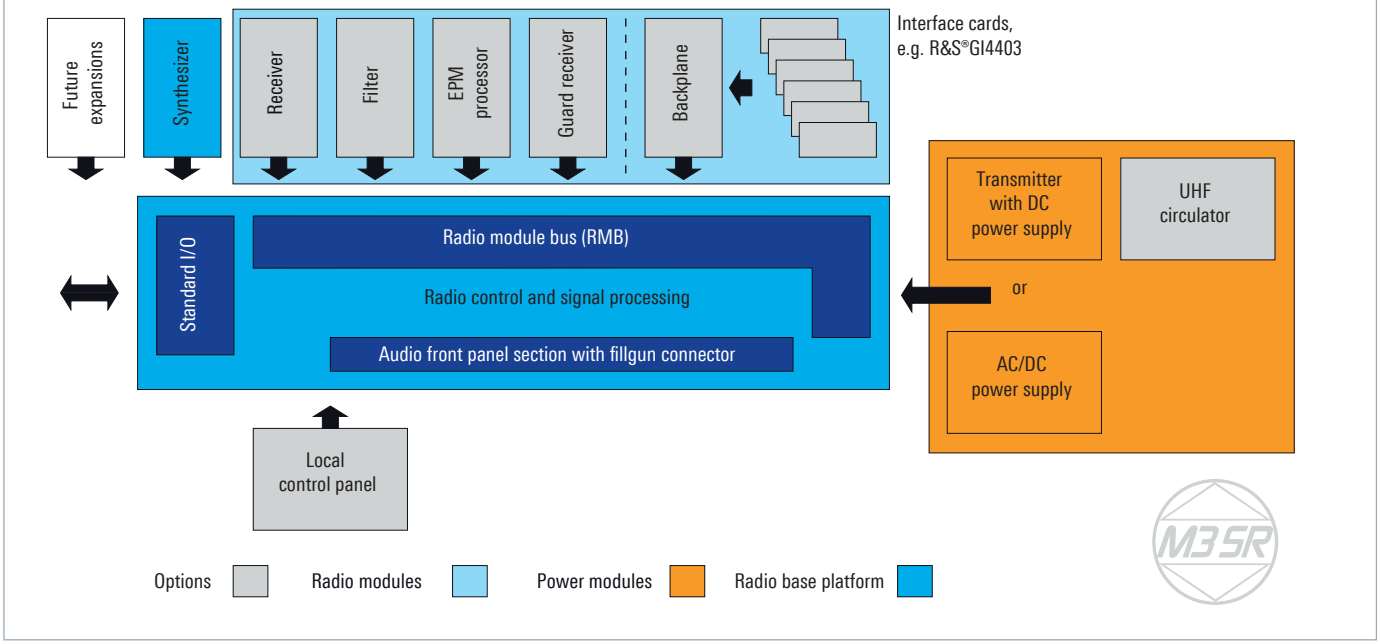
Integratable UHF circulator with VHF bypass function (optional)
The R&S®M3SR Series4400 radio family can be equipped with an optional UHF circulator. These circulators help to significantly reduce intermodulation products, which further improves system compatibility.

Integrating a circulator in the radio avoids the need for complex external circuitry and measures. The R&S®GD4400 circulator is equipped with a bypass for the VHF band and is available as an upgrade kit.

Frequency-agile pre-/postselector for best RF characteristics (optional)
Many radios require a large number of antennas that must be properly decoupled to prevent the effects of collocation from influencing the operation of the radio system. To minimize these influences, the R&S®M3SR Series4400 radio family can be equipped with an optional filter system. The R&S®FD4430 filter is bidirectional and provides additional RF decoupling of adjacent equipment to permit vastly interference-free operation in demanding RF environments. Wideband noise generated by the radio system as well as the influence of crossmodulation are considerably reduced.

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

Technical concept of the R&S®M3SR Series4400



Highly modular design enables scalable radio systems

The R&S®M3SR Series4400 radio family features a highly modular design. This structure is maintenance-friendly, leads to correspondingly short repair times (MTTR) and makes it easy to adapt the system to customer requirements. All R&S®M3SR Series4400 radio systems have the same base configuration that serves as a logistical platform for adapting them as needed.

The radio modules are updated by replacing them with new versions, which offers scalability. The modular design allows the radio system to be equipped with new functions and options.

Flexibility when selecting the voltage source (multirange AC power supply, direct DC input)
All R&S®M3SR Series4400 radios come standard with two independent DC inputs. One input is used for the main power supply, and the second for a redundant source. The radio monitors both inputs and automatically switches them when required. 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 operation of the radio.

Software defined radio concept
All software elements of the radio system, including the waveforms and software options, can be loaded into the radio as needed by 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 status of all versions of the software and its components.

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

Secure communications

The R&S®M3SR Series4400 radio family features a range of different methods for transmitting voice and data, which are loaded in the radio as software. The R&S®M3SR Series4400 radio family also has diverse standardized interfaces for connecting external modems in order to support special transmission methods. This leads to higher data throughput rates due to the larger transmission bandwidth.

NATO and proprietary EPM (ECCM) waveforms (optional)

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 schemes. For HAVE QUICK I/II and SATURN, the R&S®M3SR Series4400 radio family has interfaces that permit the use of NATO-standard fillgun devices for loading the EPM (ECCM) configuration. The required voice and data interfaces conform to NATO specifications.

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. 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 method can be selected by using the remote control unit or the built-in local control panel.

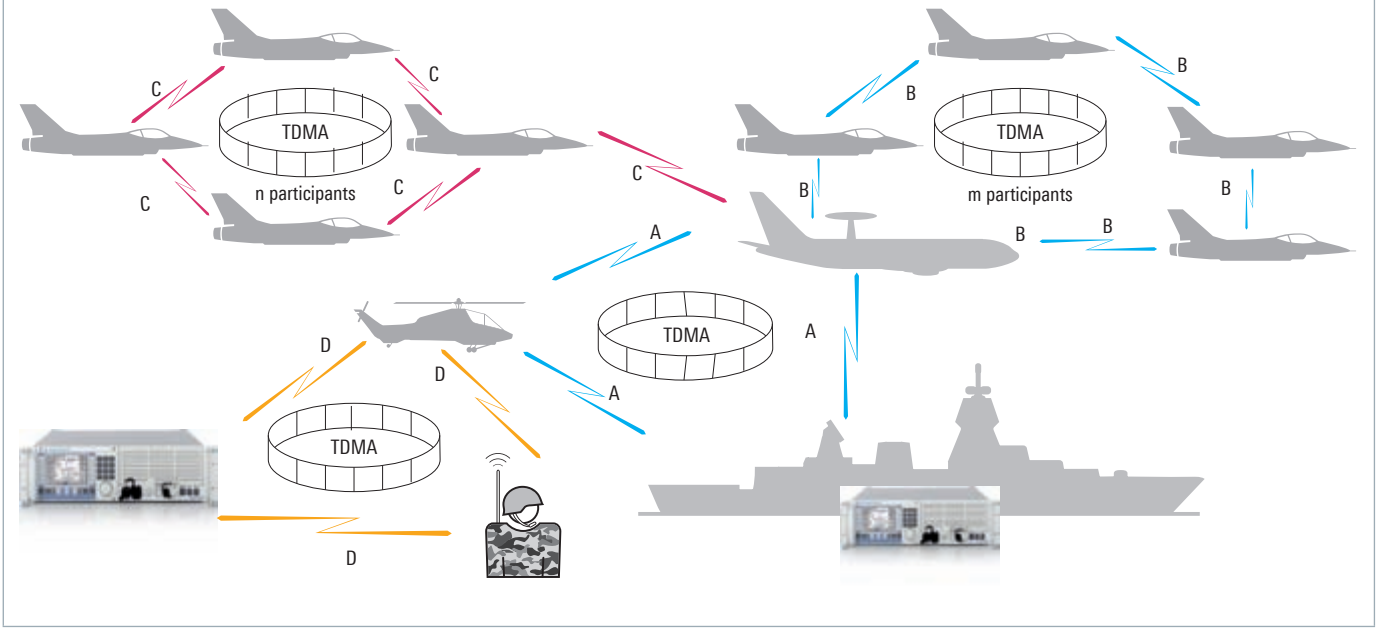
Interface module for connecting IP-based UHF data modems (optional)

The R&S®UX4401 IF interface module with 70 MHz IF 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 larger transmission bandwidths, through which high data rates can be achieved. The external UHF amplifiers and integrated UHF filters of the R&S®M3SR Series4400 can continue to be utilized in this case. These waveforms can thus be used even in demanding RF environments with unfavorable collocation conditions. Fine adjustment of the radio parameters helps achieve low bit error rates, which makes it possible, in particular, to attain longer ranges. The R&S®UX4401 IF interface module can also be integrated in existing R&S®M3SR Series4400 systems at a later point with the R&S®UX4401-U upgrade kit.

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

The R&S®M3SR Series4400 radio family supports different data transmission modes via the R&S®SECOS method. One of these modes is based on 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.

R&S®M3SR Series4400 as part of a TDMA network



Network participants can also switch dynamically between different TDMA networks. Multiple TDMA data networks can be combined into a large data network. Data can be exchanged across all subnetworks involved. Data transmission is encrypted with the option of using either fixed frequency mode or frequency hopping. The figure above depicts a typical scenario. An R&S®SECOS TDMA network can be utilized for joint armed forces operations. In addition to the R&S®M3SR Series4400, R&S®M3AR and R&S®M3TR radios are also deployed.

Interface for external encryption devices
The wideband interfaces of the R&S®M3SR Series4400 are specially designed for operation with external encryption devices. The required frequency responses and bandwidths are optimized accordingly. This leads to optimal transmission results, which are reflected in the attainable range and the high transmission quality.

Network management for "black keys"
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 LINKmethods
Besides EPM (ECCM) waveforms, the R&S®M3SR Series4400 radio family supports tactical digital information link (TADIL) methods such as LINK11 and LINK22. Both methods are an integral part of the current and future NATO communications structure.

Low maintenance effort

The R&S®M3SR Series4400 radios were developed with low maintenance effort in mind. A variety of control and monitoring functions are available that furnish 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.

IP-based maintenance tool
The IP-based R&S®ZS4400 service and maintenance tool is a vital accessory for the R&S®M3SR Series4400 radio systems. It works in any standard IP network, requires no additional cable or device drivers and is ready to be used on conventional laptop computers.

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

R&S®ZS4400 service
and maintanance tool.

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 simultaneously by means of an internal loopback that routes the transmitter signal directly back to the receiver. The radio then analyzes the signal on the receive side and documents any deviations. The R&S®GB4000C remote/local control panel 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 expanding and reconfiguring the radio, following a software download or also in regular cycles, all without external test equipment.

Automatic adaptation to ambient conditions
When ambient conditions such as temperature, supply voltage or VSWR are outside the permissible range, the transmitter will decrease its own power stepwise in order to maintain operation as long as possible. If ambient conditions return to normal, the transmitter will revert to normal operation without requiring any manual intervention. The user is notified of this status via a message. The radio is monitored by means of temperature sensors. Cooling levels are automatically adapted to the ambient conditions.

No tuning of the RF modules required
The R&S®M3SR Series4400 radio family requires neither additional settings nor calibration. Even if a module is replaced or if a radio is retrofitted with additional modules, no manual settings are required on the modules. The module parameters can be modified after delivery by using the R&S®GB4000C remote/local control panel.

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 (10000 m above sea level). The MTBF achieved in practice is more than 50000 operating hours.

Easy operation

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

Intuitive graphical user interface (HMI)
Complex radio methods require a simple user interface (human-machine interface, HMI). 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 the orientation in the menu structure of the control unit to ensure fast and reliable configuration of the radio system.

Configuration of the radio and the modules, including their comprehensive functions, is displayed via clearly-arranged tabs, which can be used to quickly select and configure the settings. This makes navigation fast, straightforward and simple.

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

Password-protected access
The areas that contain 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.

R&S®GB4000C remote/local control panel.

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 and a warning tone is generated. All warning messages are stored in the radio for later analysis. Readout and storage in an external medium is possible with the R&S®ZS4400 service and maintenance tool.

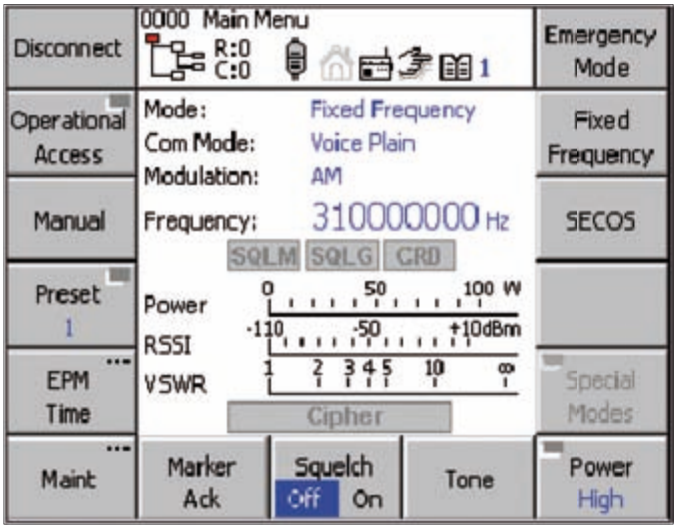
Automatic remote-control access management

For large-scale systems that have multiple local or remote control units, access management is necessary in order to enable remote control of the radio systems using several control units and to coordinate access. The HMI graphically displays the access authorization level and the status of the links for immediate identification.

PC-based training software

The human-machine interface (HMI) of the R&S®M3SR Series4400 is available as a software-based training version. This makes it possible to conduct training on the operation of the radio using a commercially available PC. Simulations and training can be performed in a near-real environment.

R&S®M3SR human-machine interface (HMI).



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 so that it scales 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 system to adapt 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 longer time frame. For selection, Rohde&Schwarz relied on its decades of experience in the production of high-quality electronic equipment.

Low life-cycle costs

The R&S®M3SR Series4400 radio family features convincingly low life-cycle costs that are achieved through the following features:

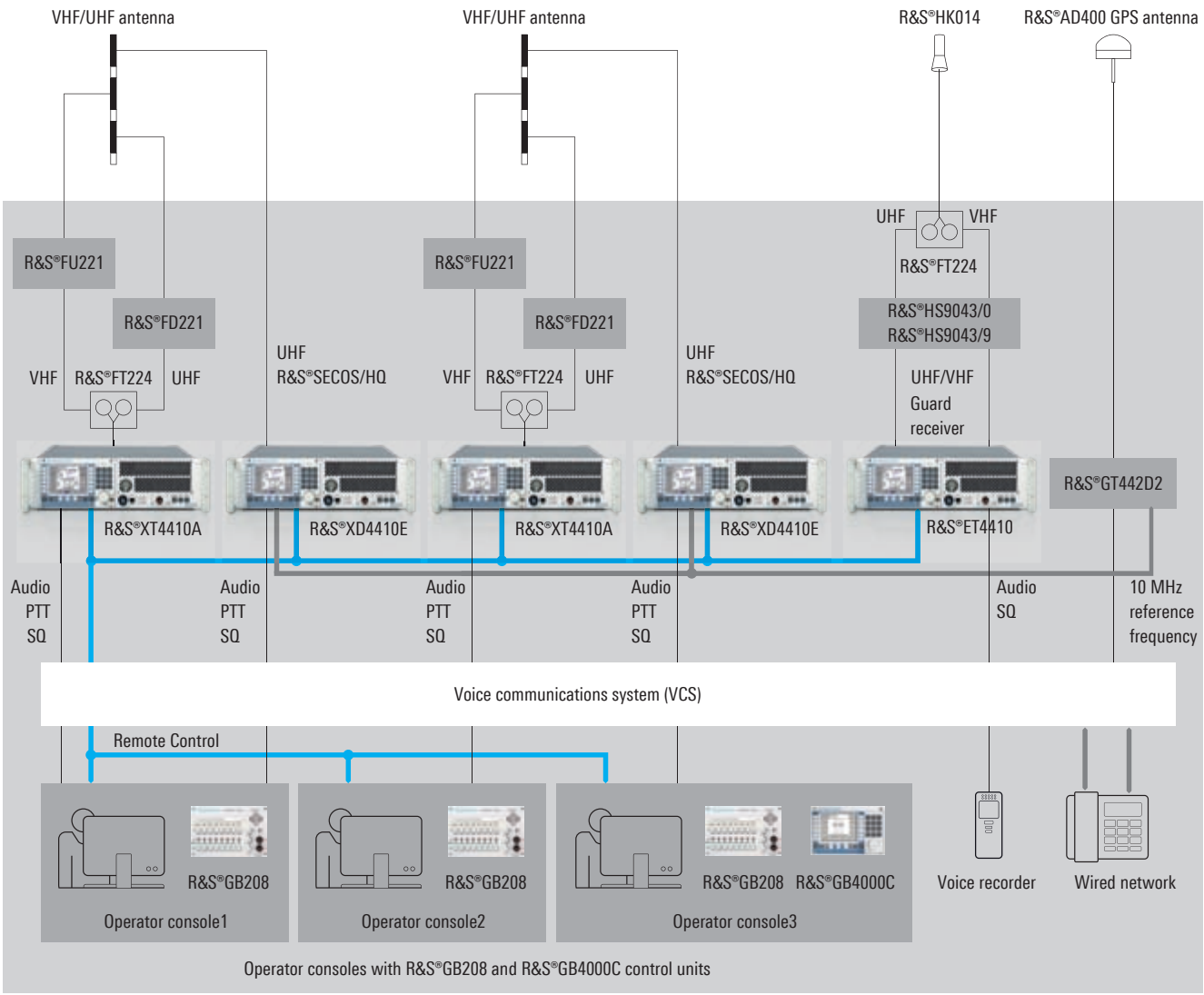
- Minimum training effort due to the user-friendly HMI concept
- No cyclical calibration of the radio required
- Fast on-site repairs due to module replacement; very low MTTR (15 min)
- Integrated, highly-precise, maintenance-free and stable clocking source (OCXO)
- Washable and reusable dust protection
- Software-regulated cooling fans
- High MTBF

Sample applications

Radio systems in the R&S®MX400 mobile ATC tower
R&S®M3SR Series4400 radios in conjunction with the R&S®MX400 tower provide mobile solutions for military and civil ATC applications. Since multiple radio systems and their associated antennas must be simultaneously operated in extremely tight quarters, users face a highly demanding RF environment. This can be overcome by deploying integrated R&S®M3SR Series4400 filters and by using external VHF/UHF filter units from Rohde&Schwarz. Such filter concepts are essential, particularly for voice and data applications that use EPM (ECCM) waveforms. The radio systems are operated with local and remote control units from Rohde&Schwarz.

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

Typical ATC/air defense solution with the mobile air traffic control tower



Monitoring and control of radio systems

A vast majority of the military and civil ATC radio systems within a country are interlinked via secure networks. These networks enable the functional and seamless monitoring and remote control of nationwide ATC/air defense systems. Depending on the requirements, multiple remote control and monitoring stations are deployed.

To support this need, the R&S®RCMS II system is available for the centralized remote control and monitoring of Rohde&Schwarz radios from one or more sites. Operators can use this solution to cost-effectively and rapidly react to error conditions and to configure operational parameters for the respective scenarios.

R&S®RCMS II is designed for monitoring scenarios ranging from individual airports to nationwide 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 quickly selected and managed. For customers who wish to perform their own statistical analysis, R&S®RCMS II records the relevant data and makes it available via a data export interface. R&S®RCMS II can be flexibly configured for customer-specific radio systems. The control and monitoring of a nationwide radio system is carried out from a central station. Depending on the requirements, R&S®RCMS II systems can also be utilized locally. For maintenance purposes, R&S®RCMS II clients are deployed at the radio sites. Additional Rohde&Schwarz radios can be brought into the R&S®RCMS II system quickly and easily, including new radios in existing stations or completely new stations.

ATC/air defense applications of the R&S®M3SR Series4400.

Options, accessories

R&S®GB4000C Control Unit

The R&S®GB4000C control unit is used for controlling, configuring and monitoring R&S®M3SR radios via Ethernet. With its large and clearly arranged color display and software-defined keys, this unit allows flexible and easy operation. The functionality is exclusively defined by the software loaded.

- Control and monitoring of all operating modes and parameters manually and by presets via Ethernet link
- Monitoring of equipment status
- Acquisition/display of equipment configuration (inventory report)
- Manual setup of equipment configuration
- Control of different user levels with password protection
- Internal selftest functions (BITE)
- Long life and very low life cycle costs

The R&S®GB4000C is available as a stand-alone remote control unit and as an embedded local control panel of the R&S®M3SR Series4100 and Series4400 software defined radios. It comes as a standard version and as a ruggedized version for demanding environmental conditions.

Specifications in brief	
Display	5" color LCD graphical display, ¼ VGA resolution, dimmable
Numeric keypad	telephone-compatible, illuminated, dimmable
Softkeys	15, illuminated, dimmable
Rotary knob	to fit values
LEDs	BITE results, dimmable
LAN	D-Sub (9-contact), 10BaseT, in line with Ethernet IEEE 802.3, for controlling, configuring and monitoring R&S®M3SR radios and for remote software download to control unit
Electrical safety	in line with Directive 2006/95/EC, IEC 60950-1, EN 60950-1
Power supply	18 V to 31 V, DC, 28 V/ max. 17 W nominal in line with Directives 89/336/EEC and 72/23/EEC
Environmental data	
Operating temperature range	–20 °C in line with EN 60068-2-1 to +55 °C in line with EN 60068-2-2
Storage temperature range	–40 °C to +70 °C
Humidity	≤95 % tailored to +55 °C in line with MIL-STD-810F, method 507.4 and EN 60068-2-30, +25 °C/+55 °C
Dust/water protection	IP 54 in line with EN 60529
Fungus protection	in line with MIL-STD-810C, method 508.2
Permissible altitude, permanent operation,	5000 m above sea level in line with MIL-STD-810F method 500.4
Permissible altitude, transport	10000 m above sea level in line with MIL-STD-810F method 500.4
Sine vibration	in line with MIL-STD-167-1 type 1, 5 Hz to 55 Hz, 0.4 mm double amplitude, test period
Random vibration	30 min/axis, in line with EN 60068-2-6 in line with MIL-STD-810F, method 514.5, figure 514.5C-14, 6 grms, in line with EN 60068-2-64
Shock	in line with MIL-STD-810F, method 516.5, procedure I: SRS shock 45 Hz to 2000 Hz, 40 g, 6 shocks/axis, in line with EN 60068-2-27
EMI/EMC	in line with EN 301489-1/-22 and MIL-STD-461E: CE 101 figure CE101-4, curve 2 CE 102 figure CE102-1 CS 101 figures CS101-1 and CS102-2, curve 2 CS 114 ships (metallic, below decks), curve 2 RE 101 figure RE101-2 (for models 6105.6006.32, 6105.6006.33, 6105.6006.35, 6105.6006.36 only) RE 102 figure RE102-1, RE102-3 fixed wing > 25 m (nose to tail), RE102-4 navy fixed and air force RS 101 figure RS101-2 (max. field strength 160 dBpT) RS 103 ships (metallic, below decks) navy (2 MHz to 1 GHz, field strength 10 V/m)
Mechanical data	
Dimensions (H × W × D)	131.8 mm × 202 mm × 83.5 mm (19"/2) 5.19 in × 7.95 in × 3.29 in (19"/2)
Weight	max. 1.450 kg; 3.2 lb

R&S®IN4000A External Power Supply

The R&S®IN4000A is a compact, all-purpose AC/DC power supply designed for use with air traffic control, air defense and naval radiocommunications systems. The R&S®IN4000A supplies power to a variety of R&S®M3SR radios and system components.

The R&S®IN4000A features a wide AC input range that provides extremely 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. A well-engineered cooling concept keeps the power supply continuously cool, significantly increasing the life of the device. These features allow continuous operation. An integrated built-in test equipment (BITE) constantly checks the status of the power supply. In case of malfunctions, the device status is automatically transferred to a superordinate system. In addition, optical indicators show the status of the device. Temperature and input voltage are constantly checked.

The power supply complies with EN 61000-3-2 so that it does not inject harmonic currents into the public supply network. Integrated overvoltage protection and a very low DC output voltage tolerance make the R&S®IN4000A external power supply an extremely robust and reliable system component. Electromagnetic emissions fall within the limits defined in military specifications. Other characteristics such as high immunity to vibrations and a wide operating temperature range fulfill standard customer requirements.

The R&S®IN4000A external power supply is also available with a ruggedized front panel that conforms to protection class IP32. A dust filter protects the power supply against external substances that can impact the life of the device. The device comes with two different DC output voltages. Its housing is designed for installation in standard 19" rackmounts. The low weight and small height of the power supply as well as the utilization of standard connectors ensure a quick and permanently secure installation.

Specifications	
Input	
Input voltage	100 V to 240 V, 50/60 Hz 115 V at 50/60/400 Hz
Current drain	8.5 A to 3.4 A
Output (open-circuit- and short-circuit proof)	
Output voltage	28.4 V, (when delivered) via jumper 24 V
Output current	25 A
Cooling	built-in fans
Max. output power	700 W
Residual ripple	$V_{pp} \leq 1\,\%$, $V_{rms} \leq 5$ mV for f > 50 kHz
MTBF	23000 h GB at +21 °C in line with MIL-HDBK-217F
Protection	permanent short-circuit, overload
Electrical safety	in line with EN 60950-1, EN 60215
Environmental data	
Operating temperature range [1]	–20 °C in line with EN 60068-2-1 up to +55 °C in line with EN 60068-2-2
Storage temperature range	–40 °C to +70 °C
Humidity (+55 °C)	in line with MIL-STD-810F ed. 2000-01-01 method 507.4, ≤95 % humidity up to +55 °C

Specifications	
EMI/EMC	in line with MIL-STD-461C/part 4, RE02 fig. 4-14 narrowband (at 20 kHz to 1 GHz) RE02 figure 4-15 broadband (at 20 kHz to 1 GHz) CE03 figure 4-3 curve 1 narrowband (at 20 kHz up to 50 MHz) CE03 figure 4-4 curve 1 broadband (at 20 kHz up to 50 MHz)
Transients and spikes (AC supply)	STANAG 1008 edition 8
Vibration	5 Hz to 55 Hz, 0.15 mm amplitude, test duration: 12 min. in each of the three axes in line with EN 60068-2-6
Shock	45 Hz to 2000 Hz, ≤ 40 H g, shocks in each of the three axes in line with MIL-STD-810D method 516.4 and EN 60068-2-27
Permissible altitude	
Transport	10000 m above sea level
Operation	5000 m above sea level in line with MIL-STD-810F method 500.4
Mechanical data	
Dimensions	19" plug-in, 1 HU, depth 420 mm (16.54 in)
Weight	approx. 5.8 kg (12.77 lb)

[1] Device complies with specs after 5 min. warm-up time.

R&S®GT442D2 Timing System

Designed in line with STANAG and other applicable specifications, the timing systems of the R&S®GT400 family provide a precise operation time that is used together with SATURN/HAVE QUICK as well as R&S®SECOS systems. They contribute to the interoperability of EPM (ECCM) net members by receiving, maintaining, and transmitting the time of day (TOD).

Time reception: The TOD is derived from UTC using NAVSTAR GPS as the primary time source. Additional time sources can be SATURN/HAVE QUICK or R&S®SECOS radios or remote timing systems (transfer of HAVE QUICK TOD via line).

When synchronized to GPS the typical time accuracy of the R&S®GT400 is 10 ms. Time keeping of the R&S®GT400 is required when the above-mentioned time sources are down. When using the R&S®GT442D2 with a GPS-disciplined rubidium oscillator (with automatic frequency/time correction), the time is maintained with an accuracy of better than 1 ms/month in the worst case.

Time transmission/distribution can be performed in different ways, e.g. by air via a SATURN/HAVE QUICK/ R&S®SECOS radio, by line (SATURN/HAVE QUICK TOD), or by cable.

- Precise reference clock and time-of-day signal
- High time/frequency accuracy by use of GPS-disciplined rubidium oscillators
- No requirement for periodic realignments
- For EPM (ECCM) application in combination with R&S®M3SR Series4400

Ordering information

Designation	Type	Order No.
Timing System		
19" 3 HU; AC + DC (automatic switch-over) + battery (accumulator) set, all types complete with GPS receiver and GPS antenna	R&S®GT400xx	
With GPS-disciplined rubidium oscillator	R&S®GT442D2	6114.4002.02
Signal Distributor Option to the R&S®GT400 for distribution and amplification of 10 MHz rubidium oscillator reference signals to ten Rohde&Schwarz radios; for other applications, 5 MHz input signals can also be distributed; input level –0.5 dBm; output level +6 dBm (10×) and for special applications +13 dBm (1×); external module for rear mounting to the R&S®GT400	R&S®GV430	6073.2518.02
Software Software (EPROM) for time reference unit of R&S®GT400 timing systems for R&S®SECOS, HAVE QUICK, and SATURN operated radios	R&S®GT440-S	6109.9868.02

R&S®ZS4400 Service and Maintenance Tool

The R&S®ZS4400 offers the ability to determine and log all essential features and configurations of an R&S®M3SR Series4400 software defined radio as well as of the R&S®GB4000C remote control unit. The tool is used for the highly modular R&S®M3SR Series4400 software defined radio, which is deployed in air defense, navy and civil air traffic control missions.

The convenient GUI of the R&S®ZS4400 gives the user the identification of the addressed radio immediately after link setup. A standard Ethernet port connects the R&S®ZS4400 to the R&S®M3SR Series4400 or to a local area network (LAN). The tool allows uploaded radio configurations to be downloaded to other radios. This procedure is called cloning and makes it possible to log and distribute the radio configuration, for example at selected sites or after servicing has been performed.

In addition, the R&S®ZS4400 allows software updates or applications to be downloaded to R&S®M3SR Series4400 radios. A PIN is automatically queried in order to grant only authorized personnel access to the maintenance functions of the R&S®ZS4400. Entering the correct PIN authorizes the user to perform further operations.

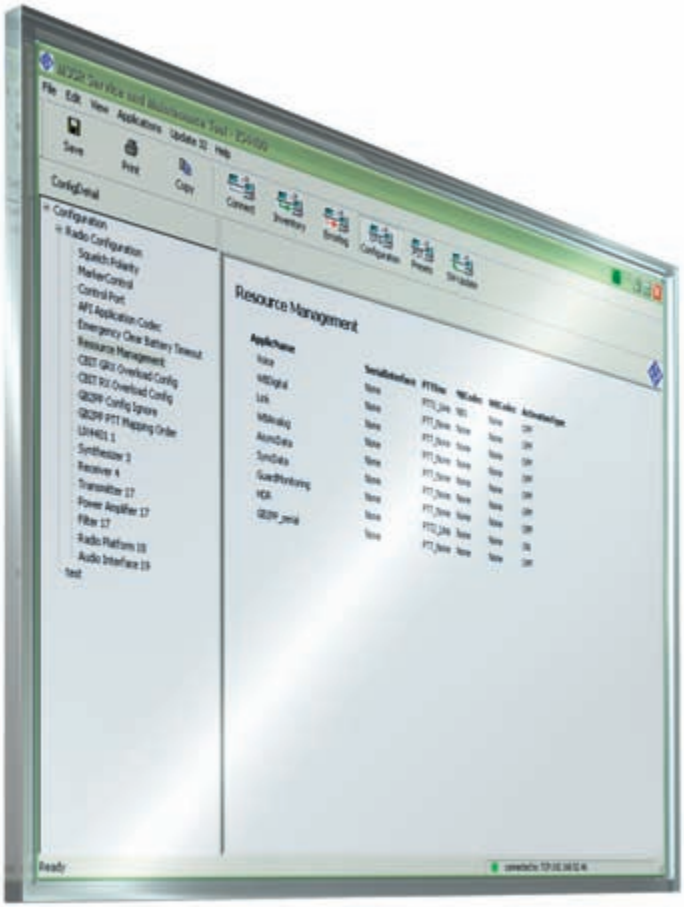
Moreover, the R&S®ZS4400 can be used to read out and log the activated device options.

Key facts

- Customized directories: for user-defined directory structure and management
- PIN entry request: to ensure authorized access only
- Radio configuration and cloning: for saving user-selected device configurations and loading this information onto other radio units to ensure identical configurations
- Error log, device inventory, radio options: device information that can be saved and printed for status freezes and system configuration
- Preset pages: download/upload of preset pages for distribution purposes
- Radio software update: automatic comparison of a software release already loaded and a CD-based one; performing software updates

System requirements

- Portable PC, min. 300 MHz processor, 64 Mbyte RAM, 40 Mbyte free space on hard disk drive, CD-ROM
- Standard Ethernet interface with 10 Mbit/s
- Windows XP operating system



Options

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

- 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 LINK11/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 interface for UHF data applications
Hardware option	R&S®GI4403-U	Antenna interface upgrade kit for separate receive and transmit antennas

Ordering information		
Designation	**Type**	**Order No.**
Transceiver with fixed frequency functionality (R&S®M3SR Series4400)		
VHF/UHF Transceiver (R&S®M3SR Series4400)		
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	6122.7059.03
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	6122.7059.52
VHF/UHF Transceiver 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; fixed frequency; with local control unit, OCXO, R&S®UX4401, separate main receiver antenna; ruggedized	R&S®XT4410A	6122.7059.70
VHF/UHF Transceiver 100 MHz to 512 MHz; 30 W AM/100 W FM; DC; fixed frequency; with local control unit, OCXO, R&S®UX4401; ruggedized	R&S®XT4410A	6122.7059.75
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	6122.7007.03
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; ruggedized	R&S® XT4460A	6122.7007.31
UHF Transceiver (R&S®M3SR Series4400)		
UHF Transceiver 225 MHz to 400 MHz; 30 W AM/100 W FM; DC; fixed frequency; with local control unit, OCXO; ruggedized	R&S®XD4410A	6122.7107.03
UHF Transceiver 225 MHz to 400 MHz; 30 W AM/100 W FM; DC; fixed frequency; with local control unit, OCXO, LINK; ruggedized	R&S®XD4410A	6122.7107.13
UHF Transceiver 225 MHz to 400 MHz; 30 W AM/100 W FM; DC; fixed frequency; without local control unit; with OCXO; ruggedized	R&S®XD4460A	6122.7120.03
UHF Transceiver 225 MHz to 400 MHz; 30 W AM/100 W FM; DC; fixed frequency; without local control unit; with OCXO, R&S®GI4403 var.02; ruggedized	R&S®XD4460A	6122.7120.05
UHF Transceiver 225 MHz to 400 MHz; 30 W AM/100 W FM; DC; fixed frequency; without local control unit; with OCXO, LINK; ruggedized	R&S®XD4460A	6122.7120.13
VHF Transceiver (R&S®M3SR Series4400)	on request	

Ordering information

Designation	Type	Order No.
Transceiver with HAVE QUICK I/II; R&S®SECOS 5/16 functionality (R&S®M3SR Series4400)		
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	6122.7259.03
UHF Transceiver (R&S®M3SR Series4400)	on request	
Transceiver with R&S®R&S®SECOS 5/16 functionality (R&S®M3SR Series4400) Available equipment as listed, other equipment on request.		
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	6122.7207.03
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	6122.7207.08
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, LINK; ruggedized	R&S®XT4410L	6122.7207.18
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	6122.7207.28
UHF Transceivers (R&S®M3SR Series 4400)	on request	
Transceiver with HAVE QUICK I/II functionality (R&S®M3SR Series 4400) Available equipment as listed, other equipment on request.		
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	6122.7159.03
UHF Transceiver (R&S®M3SR Series 4400)	on request	
Transceiver with SATURN/HAVE QUICK I/II functionality (R&S®M3SR Series 4400) Available equipment as listed, other equipment on request.		
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	6122.7307.03
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, LINK, R&S®ET4400G, UHF circulator and VHF bypass; ruggedized	R&S®XT4410M	6122.7307.51
Accessories		
Mating connector sets		
Mating Connector Set suitable for all R&S®M3SR Series4400 radios, with circular connector	R&S®ZF4410	6105.9011.02
Mating Connector Set suitable for all R&S®M3SR Series4400 radios, without circular connector	R&S®ZF4410	6105.9011.03
Power supplies		
Power Supply, AC/DC, front panel with dust filter and prepared for IP32, ruggedized, 19", 1 HU	R&S®IN4000A	6105.5500.04
Power Supply Cable, R&S®M3SR Series4400 <—> R&S®IN4000A, 0.5 m length	R&S®GK4103	6105.5639.05
Power Supply Cable, R&S®M3SR Series4400 <—> R&S®IN4000A, 1 m length	R&S®GK4103	6105.5639.10
Power Supply Cable, R&S®M3SR Series4400 <—> R&S®IN4000A, 2.5 m length	R&S®GK4103	6105.5639.25
Remote control units		
Remote Control Unit for R&S®M3SR, without audio, with software and LAN, DC, ruggedized	R&S®GB4000C	6105.6006.06/36
Mating Connector Set for R&S®GB4000C	R&S®ZF4410	6105.9011.04
Audio accessories		
Headset including microphone, ruggedized, with cable and NF-7 connector	R&S®GA012	0693.7664.02
Handset, ruggedized, with cable and NF-7 connector	R&S®GA013	0693.7712.02
Headset, dynamic, with cable and NF-7 connector	R&S®GA015	0583.6012.02
Headset, ultralight electret microphone, single earphone (dynamic), with cable and NF-7 connector	R&S®GA015L	6082.9663.02
Microphone, with cable and NF-7 connector, handheld type	R&S® GA016H1	0583.5568.02
Mechanical accessories		
Protective Plate for 19" front panel (for ruggedized R&S®M3SR Series4400 radios only)	R&S®KA4401	6122.3901.02
Portable Case for R&S®M3SR Series4400 and R&S®IN4000A power supply, RAL 1002, matt finish, 5 HU	R&S®KK4401	6123.4001.02
Service and maintenance tool		
Service and Maintenance Tool (for Windows XP/2000)	R&S®ZS4400	6102.2600.03
I-Level Special Test Equipment (I-STE) for R&S®M3AR, R&S®M3SR, R&S®M3TR	R&S®TS6030	on request

Ordering information

Designation	Type	Order No.
R&S®GT442D2 Timing System		
Timing System with GPS-disciplined rubidium oscillator, GPS antenna and R&S®GT400-S software, 19" rackmount, 3 HU	R&S®GT442D2	6114.4002.02
Signal Distributor for R&S®GT442D2 timing systems	R&S®GV430	6073.2518.02
R&S®VU220L and R&S®VD480L VHF/UHF Power Amplifiers		
VHF/UHF power amplifiers		
VHF Power Amplifier, 200 W, 118 MHz to 144 MHz, 200 W AM/300 W FM with RF bypass relay, 19" 4 HU rackmount, for export outside the European Union only	R&S®VU220L	6083.3517.02
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, without control cable	R&S®VD480L	6032.0504.23
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, 110 V, without control cable	R&S®VD480L	6032.0504.33
Programming Device for R&S®VD480L UHF power amplifier	R&S®ZT480L	6043.5948.02
Control cables		
Control Cable, R&S®M3SR <—> R&S®VD480L, length 2 m		6127.1007.02
Control Cable, R&S®M3SR <—> R&S®VD480L, length 1.2 m		6127.1007.12
R&S®Fx221 and R&S®Fx213 VHF/UHF filters and multicouplers		
VHF/UHF 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	0633.8012.02
UHF Automatic Multicoupler, 225 MHz to 400 MHz, 300 W FM		
Two-port with installation kit for 19" special rack, with two filters	R&S®FD221W2	0643.2517.02
Four-port with installation kit for 19" special rack, with four filters	R&S®FD221W4	0643.4510.02
Three-port with installation kit for 19" special rack, with three filters	R&S®FD221W4	0643.4510.04
VHF Automatic Filter, 100 MHz to 162 MHz, 300 W FM, 19" rackmount, 5 HU	R&S®FU221	0643.6012.02
VHF Automatic Multicoupler, 100 MHz to 162 MHz, 300 W FM		
Two-port with installation kit for 19" special rack, with two filters	R&S®FU221W2	0643.3513.02
Four-port with installation kit for 19" special rack, with four filters	R&S®FU221W4	0643.5516.02
Three-port with installation kit for 19" special rack, with three filters	R&S®FU221W4	0643.5516.04
Filter Control Cable for R&S®M3SR Series4400, length 2 m	R&S®ZT297-3	6115.4412.02
Filter Control Cable for R&S®M3SR Series4400, length 5 m	R&S®ZT297-3	6115.4412.05
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	0637.4311.05
UHF Automatic Filter, 225 MHz to 400 MHz, 19" rackmount, 3 HU, with two filters (2× UHF)	R&S®FD213A2	0652.5815.05
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	0637.4011.05
VHF Automatic Filter, 100 MHz to 162 MHz, 50 W AM/100 W FM, 19" rackmount, 3 HU	R&S®FU214A	0637.4611.05
Control Cable for R&S®Fx213A/Fx214A filters, for R&S®M3SR Series4400, length 2 m	R&S®FU214Z2	6115.4429.02

VHF/UHF System Components

AF accessories

R&S®GB208 AF Control Unit

Control of up to eight radio channels from a single operator position

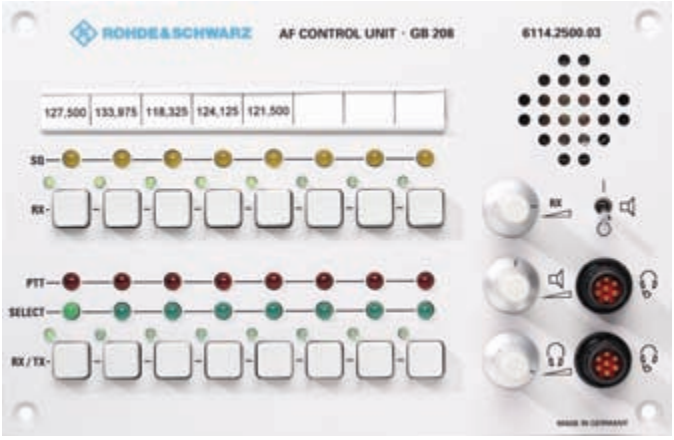
- Compact, flat design allowing integration into a desk or 19" rack
- Control of up to eight radio channels from a single operator position
- Capacity expandable to 16 or 24 channels by simple cascading of two or three units; all functions of the single unit remain available
- Random access of up to ten operator positions to the available radio channels; up to ten control units can be connected in parallel
- Internal loudspeaker (ON/OFF) and connector for external loudspeaker
- Three connectors for headset (two on front, one on rear)
- Either aural monitoring or aural monitoring and talking on one or more channels

Clear operation due to separate LED indicators

- Transmitter on air (PTT, red LED)
- Radio signal received (squelch, yellow LED)
- Radio channel selected by controller (green LED)

On selecting a channel (button), a control output can be activated (e.g. to mute the loudspeaker or as an alarm relay for the distress frequency).

Specifications	
Frequency range	0.3 kHz to 4 kHz
Number of inputs/outputs	8, expandable to 16 or 24 channels by cascading two or three units
Distance to transceivers	max. 500 m without intermediate amplifier
Operating temperature range	0 °C to +50 °C
Power supply	24 V DC with automatic switchover 230 V AC with external supply unit
Dimensions (W × H × D)	
R&S®GB208 model .02	202 mm × 137 mm × 105 mm (7.95 in × 5.40 in × 4.14 in) (with connectors)
R&S®GB208 model .03	202 mm × 132 mm × 120 mm (7.95 in × 5.20 in × 4.73 in) (with connectors)
Weight	approx. 0.5 kg (1.10 lb)
Color of front panel	telegray 2, RAL 7046



Ordering information

Designation	Type	Order No.
AF Control Unit		
Connectors on top, for desk mounting	R&S®GB208	6114.2500.02
Connectors on rear, for mounting in a desk or rack (with 19" frame)	R&S®GB208	6114.2500.03
Set of Accessories		
2 × control cable 50-wire, length 2.5 m 2 × connector block 50-pin (D-Sub ▷ screw-type terminals) 2 × cable connector (mating connector for AC and DC) 1 × cable connector (mating connector for speaker)	R&S®GB208-Z	6115.6715.02
2 × control cable 50-wire, length 8 m 2 × connector block 50-pin, (D-Sub ▷ screw-type terminals) 2 × cable connector (mating connector for AC and DC) 1 × cable connector (mating connector for speaker)	R&S®GB208-Z	6115.6715.08
AC Power Supply for rack integration, 24 V DC/1.25 A; profile rail mounting	R&S®NGRA24	6109.9868.02
Set of Cascading Cables		
2 × control cable 50-wire, length 2.5 m, for cascading of R&S®GB208 units	R&S®GB208-Z1	6148.0200.02
2 × control cable 50-wire, length 5 m, for cascading of R&S®GB208 units	R&S®GB208-Z1	6148.0200.05
2 × control cable 50-wire, length 8 m, for cascading of R&S®GB208 units	R&S®GB208-Z1	6148.0200.08

R&S®GA208 Speaker Control Unit

The R&S®GA208 comprises eight AF speaker amplifiers for external low-impedance passive speakers used in civil and military air traffic control applications. This allows the user to listen to eight different channels and control the volume of each speaker individually via one unit.

- Eight active AF line amplifiers support eight independent passive speakers
- Volume can be set individually for each speaker
- Select input for every speaker allows muting of individual speaker when using the R&S®GB208 AF control unit
- Redundant power supply supported

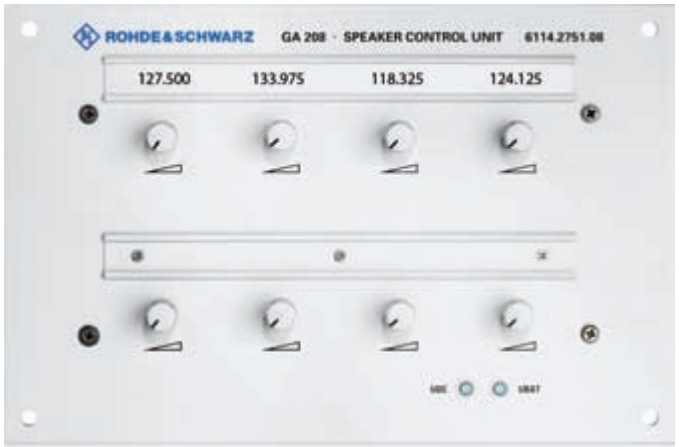
A special feature of the R&S®GA208 is the select line input, by which the associated speaker can be muted. In conjunction with the R&S®GB208 AF control unit, this allows the take-over of the channel to be processed via R&S®GB208 without causing audio feedback at the microphone input.

The R&S®GA208 can use two independent power sources:
- +24 V for the external R&S®NGRA24 AC power supply unit
- +24 V battery

An intelligent switchover circuit automatically switches over to the battery if the mains power supply fails.

Specifications

AF data	
Input impedance	> 20 kΩ
Input level	0 dBm
Output impedance	8 Ω
Output level	8 W
AF frequency range	0.3 kHz to 3.4 kHz
Control of select channel	using open-collector signal
Power supply	
Operating voltage	
Main power supply	18 V to 35 V, typ. 24 V
Backup battery	16 V to 35 V, typ. 24 V
Automatic switchover threshold	14 V, typ. 15 V
Operating current	60 mA, typ. 75 mA
Connectors	
AF in and Select	25-pin Cannon male
AF out	25-pin Cannon female
General data	
Rated temperature range	0 °C to +50 °C
Operating temperature range	–10 °C to +55 °C
Storage temperature range	–40 °C to +75 °C
Relative humidity (storage and operation)	<90 % at +40 °C, non-condensing
Shock	in line with IEC 68-2-6: 0.3 mm double amplitude, 2 g, 10 Hz to 55 Hz, 1 octave/min, test time 30 min
Vibration	in line with IEC 68-2-27: 30 g for 11 ms, 18 shocks in 3 directions
EMC	in line with EN 55022 class B
Electrical safety	in line with VDE 0804 and VDE 0805
Use	suitable for continuous operation
Color of front panel	gray
Dimensions (W × H × D)	202.2 mm × 131.8 mm × 90 mm (7.96 in × 5.19 in × 3.54 in)
Weight	0.5 kg (1.10 lb)



Ordering information

Designation	Type	Order No.
Speaker Control Unit	R&S®GA208	6114.2751.08
Power Supply	R&S®NGRA24	6109.9868.02
Accessories for R&S®GA208: DC mating connectors, control cable and connecting block		
Cable length 2.5 m	R&S®GA208-Z	6115.6767.02
Cable length 8 m	R&S®GA208-Z	6115.6767.08

VHF and UHF Amplifiers

R&S®VU220L VHF Power Amplifier

VHF 200 W AM/300 W FM

Ground-to-air and naval radiocommunications

In general, high-power amplifiers are used in ground-to-air radio stations for improving the communications link reliability.

- VHF 200 W AM output power, frequency range from 118 MHz to 144 MHz
- Excellent spectral purity
- Continuous operation (100 % duty cycle)
- Automatic AC/DC switchover
- Power management: normal/high power mode, selectable
- Use in 230 V or 110 V AC environment
- LED service indication, output power, VSWR, AC/DC
- Automatic bypass switchover at critical temperature and high VSWR

Applications

The R&S®VU220L VHF power amplifier is designed for the following system applications:

- Optimum efficiency in connection with R&S®M3SR Series4400 and R&S®Series200 communications systems
- Single and multichannel application
- Extension of the usable propagation range beyond LOS (making use of the physical bending effect)
- Extension of communications range under adverse technical conditions: compensation of RF power losses due to antenna filters, long antenna cables or unforeseen influences such as poor coaxial cable, connector or antenna matching (reflection losses) as they can occur under critical circumstances
- Increase of the antijam (AJ) margin, i.e. increased (EPM (ECCM) resistance in a jammed communications environment
- Models with RF bypass relays enabling operation in standard transceiver mode via a single TX/RX antenna path
- Use in radio systems with DC backup supply

Note:

For export outside the EU only.

Design – modularity – functions

The design of the R&S®VU220L is based on broadband and linear techniques. Integrated test facilities continuously monitor the key functions.

The R&S®VU220L is designed as a compact 19" plug-in (4 HU) for rack installation. It consists of the following:

- 19" adapter, 4 HU, with central cooling duct and heat sink
- VHF amplifier board 1: mounted on top of the heat sink
- VHF amplifier board 2: mounted on the lower side of the cooling duct and connected in parallel to the VHF amplifier board 1
- Output unit
- Control board
- Power supply 2: connected in parallel to power supply 1

Specifications

General data	
Frequency range	118 MHz to 144 MHz
RF input power	max. 20 W
RF output power	nominal, valid for the specified AC supply voltage and operating temperature ranges and for VSWR ≤ 2
AM carrier	200 W ± 1.5 dB
FM	200 W ± 1.5 dB
AM PEP (peak envelope power)	800 W
Continuous operation through e.g.	▌Sensor-controlled forced-air cooling ▌Automatic switching to RF bypass mode in case of e.g. extremely high or low supply voltage (AC or DC), VSWR typ. > 3 , heat sink temperature exceeding +80 °C or negative test result (NoGo)
Harmonics attenuation	> 80 dBc [1]
Spurious attenuation	> 80 dBc [1]
Backward intermodulation products	65 dB below wanted signal (with interfering signal 20 dB below wanted signal)
Classes of emission	AM, FM, other on request
S/N ratio (AM) with 1 kHz, m = 85 % and S/N > 50 dB of exciter	> 45 dB
AF distortion	< 10 % [2]
Modulation depth (m)	90 % AM
Power supply	
AC	110 V to 230 V, 50/60 Hz
DC	26 V to 31 V, operational down to 21.5 V, protected against wrong polarity and reverse feed
AC/DC switchover	automatic
Power consumption	
AC, TX mode	< 1.6 kW
EMC	IEC 801-2, -3 and -4, part 2
Electrical safety	EN 60215, EN 60950-1
Environmental data	
Operating temperature range	–10 °C to +55 °C [3]
Storage temperature range	–40 °C to +70 °C
Max. relative humidity, operation	93 % +2/–3 % at +40 °C (without condensation); EN 60068-2-30
Max. relative humidity, storage	93 % +2/–3 % at +40 °C; EN 60068-2-30
Permissible altitude, operation	3000 m above sea level
Permissible altitude, storage/transport	5000 m above sea level
Shock	EN 60068-2-27, 30 g for 11 ms, 18 shocks in 3 positions
Vibration	EN 60068-2-6, 0.3 mm double amplitude, 2 g, 10 Hz to 55 Hz, 1 octave/min, total test period 30 min
Mechanical data	
Dimensions (W × H × D)	483 mm × 220 mm × 471 mm (19 in × 8.66 in × 18.54 in)
Weight	approx. 27 kg (59.52 lb)

[1] In addition, the exciter values are applicable.
[2] Ref. to AM (m = 0.85; f_m = 1 kHz) and nominal supply voltage. In addition, the exciter values are applicable.
[3] 0 °C to +55 °C with full specifications.

Ordering information

Designation	Type	Order No.
VHF Power Amplifier (19" 4 HU plug-in, delivered with one set of accessories)	R&S®VU220L	6083.5317.02

R&S®VD480L UHF Power Amplifier

UHF 100 W AM/150 W FM

Ground-to-air and naval radiocommunications

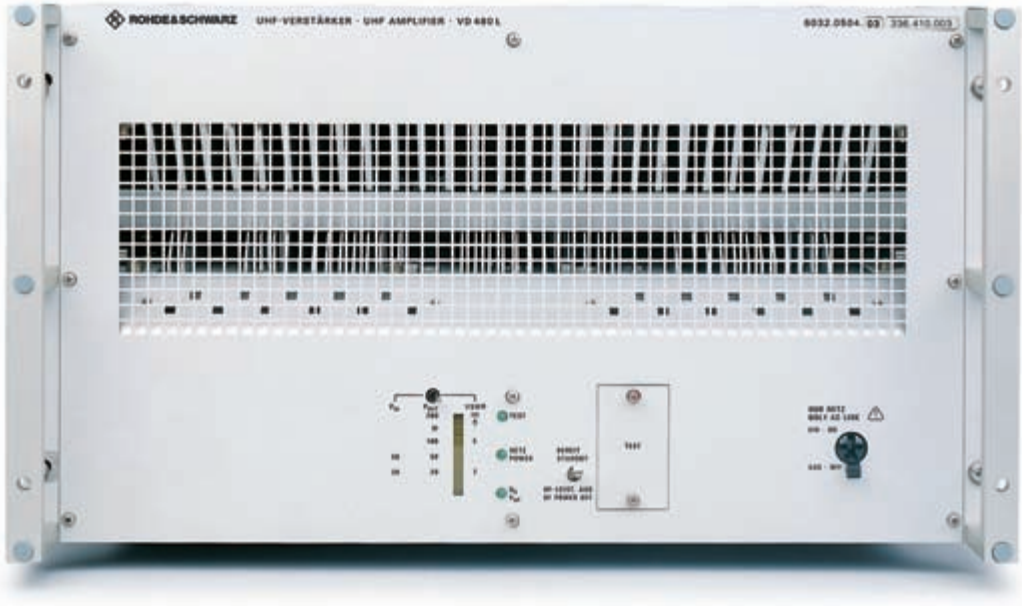
- UHF 100 W AM/150 W FM, frequency range from 225 MHz to 400 MHz
- Single and multichannel application
- High output power
- Continuous operation (100 % duty cycle)
- Automatic AC/DC switchover
- Support of fixed-frequency and EPM systems
- Data operation up to 16 kbit/s for wideband AM/FM
- Power management: normal/high power mode, selectable
- LED service indication
- Graceful power degradation in case of poor VSWR at output
- Automatic switchoff at critical temperature
- High reliability

In general, high-power amplifiers are used in ground-to-air radio stations for improving the communications link reliability under extreme natural or operational, planned or unforeseen conditions.

Applications

The R&S®VD480L UHF power amplifier is designed for the following system applications:

- Single and multichannel application
- Fixed-frequency systems
- Data operation: 16 kbit operable, e.g. for WB AM/FM baseband or diphase
- Models with RF bypass relays enabling the following:
  - Operation in standard transceiver mode via a single TX/RX antenna path (for all above applications)
  - Continued operation in case of amplifier failure
- EPM (HAVE QUICK/R&S®SECOS) systems (with R&S®M3SR Series4400 transceivers with separate TX and RX antennas)
- Use in 230 V or 110 V AC environment (different models available)
- Use in DC powered radio systems
- Use in collocated radio systems
- Optimum efficiency in connection with R&S®M3SR Series4400 communications systems
- Linear amplifier operation together with other (non-Rohde&Schwarz) exciters



Specifications

General data	
Frequency range	225 MHz to 400 MHz
RF gain	
Range	4 dB to 10 dB (factor 2.5 to 10)
Setting	factory-set via customized EEPROM, user-programmable with R&S®ZT480L
RF output power	
AM carrier	100 W
FM	nominal 150 W, max. 200 W [1]
AM peak envelope power (PEP)	nominal 400 W, max. 500 W [1]
Harmonics attenuation	> 80 dBc [2]
Spurious attenuation	> 80 dBc [2]
Backward intermodulation products	65 dB below wanted signal (with interfering signal 20 dB below wanted signal)
Classes of emission	AM, FM, other on request
AF bandwidth	depending on exciter
S/N ratio (AM)	> 45 dB [2]
AF distortion	< 10% [2]
Power supply	
AC I	100/110/120 V ± 10%, 50 Hz to 60 Hz
AC II	210/220/230 V ± 10%, 50 Hz to 60 Hz AC range depending on model, AC conversion kit: on request
DC	26.5 V ± 10%, operational down to 21.5 V [1]
AC/DC switchover	automatic
Power consumption	
AC, TX mode	< 1.6 kW/max. 2.2 kVA
DC, TX mode	typ. 27 A (AM)/34 A (FM) max. 40 A
Electrical safety	IP20, EN60215, EN60950-1
Environmental data	
Operating temperature range	–20°C to +55°C
Storage temperature range	–40°C to +70°C
Max. relative humidity, operation	95% at +40°C (without condensation)
Max. relative humidity, storage	95% at +40°C
Permissible altitude, operation	3000 m above sea level; +35°C
Permissible altitude, storage/transport	5000 m above sea level
Shock	30 g for 6 ms, 3 shocks in 3 positions
Vibration	0.3 mm double amplitude, 2 g, 10 Hz to 55 Hz, total test period 30 min
Mechanical data	
Dimensions (W × H × D)	483 mm × 265 mm × 471 mm (19 in × 10.43 in × 18.54 in)
Weight	approx. 55 kg (121.25 lb)

[1] With reduced specifications.
[2] Ref. to AM (m = 0.85; f_m = 1 kHz) and nominal supply voltage. In addition, the exciter values are applicable.

Ordering information

Designation	Type	Order No.
UHF Power Amplifier (19" 6 HU plug-in, delivered with AC mains cable, DC cable socket, fuses etc.) xx = 22 (230 V, without bypass relay) xx = 23 (230 V, RF bypass dual relay) xx = 32 (110 V, without bypass relay) xx = 33 (110 V, RF bypass dual relay)	R&S®VD480L	6032.0504.xx
Programmer STTE: special-type test equipment for reprogramming the EEPROM for optimum operation, e.g. after repair work or in connection with non-Rohde&Schwarz exciters	R&S®ZT480L	6043.5948.02

VHF/UHF Filters/ Multicouplers – Overview

For ground-to-air and naval radiocommunications

Filters/multicouplers have manifold functions and benefits. Because of the importance of the topic, the functions and benefits are described in the following in general and in detail:

In general

Highly selective filters and multicouplers:

- Protect and improve the operational quality of the customer's own VHF/UHF radio installations
- Protect the radio system from externally generated interfering signals from all kinds of civil or military in-band or out-of-band radio installations, including broadcasting, TV, microwave links, or radar
- Protect other electromagnetically sensitive radio, navigation, or radiomonitoring installations under the responsibility of one's own or other services
- Provide frequency economy in an environment with high frequency congestion – filters/combiners make it possible to use already or newly assigned and critically spaced frequencies
- Save space by installation of antennas on limited space – e.g. on the tower cabin roof, at the only available radio center, on board ships or in mobile or transportable systems (e.g. mobile towers)
- RF filters improve the characteristics of transmitting and receiving systems – depending on the RF path they are integrated into – as follows:

Transmit filter benefits – in detail

- Attenuation of broadband transmitter noise caused by the exciter oscillator or power amplifiers
- Suppression of spurious emissions, mainly occurring in the small-signal stages during frequency conditioning
- Suppression of harmonics, mainly generated in the power stages
- Attenuation of transmitter (backward) intermodulation products of the 3rd or higher order generated – within a simultaneously operating system with co-sited transmitters – by the radiation of transmitter signals via the antennas into the output of another transmitter. In this case, the attenuation of the filter at the transmission end is effectively doubled and adds to the antenna-decoupling factors

Receive filter benefits – in detail

- Suppression of out-of-band intermodulation products by additionally attenuating all signals and their harmonics which are outside of the receiving range and – due to nonlinearities and mixing – could cause intermodulation products to fall within the useful VHF or UHF band and disturb reception
- Suppression of third-order crossmodulation products by attenuating strong interfering signals which could transfer their modulation to the wanted – but possibly weak – signal
- Increase of image-frequency rejection by additionally attenuating signals defined as image frequency relative to the received frequency
- Increase of intermediate frequency (IF) rejection by additionally attenuating interfering signals on one of the intermediate frequencies
- Prevention of desensitization (reciprocal mixing) by attenuating strong interfering signals which could otherwise transfer the noise sidebands of the receiver oscillator, mixed onto the interfering signal, to the useful band, thus reducing sensitivity
- Prevention of blocking by attenuating strong interfering signals which could reduce the amplitude of the useful IF signal by overdriving the mixer stage

Practical effects of improvement

Optimized radio installations using filters help to achieve vital operational benefits.

Benefits	Background
No irritation of the operator	By unwanted response of the receiver carrier squelch
No degradation of the receive sensitivity	Also with weak wanted receive signals
No irritation of the operator by spurious reception (phantom signals)	Such interference may be generated by signals identical to the image frequencies or the intermediate frequency
No RF output power reduction of the transmitter	Interfering signals entering via the antenna socket influence the VSWR-dependent gain control loop
No radiation of unwanted and interfering signals	Radiated TX intermodulation products can result in self-jamming of one's own receive system or irritations of the aircraft pilot

Quick type guide and basic specifications

The following guide helps to identify the correct filter or multicoupler for the system requirement by comparison. For additional specifications and ordering information, please refer to the type-specific additional specifications.

Type	Frequency range in MHz	Tuning	RF input power AMc = AM carrier	3 dB BW (in % of f_o or in MHz)	Selectivity [1]	Insertion loss (filter)	Remarks, multicoupler capability: S = starpoint N = no, filter only
Manually tuned							
Filters with 1 × R&S®HS9043/9 per port	100 to 156.000	manual	50 W AMc	≥ 0.2 % (k3)	≥ 14 dB: 1 % (k3)	≤ 2.0 dB (k3) ≤ 0.5 dB (k10)	
Filters with 1 × R&S®HS9043/0 per port	225 to 399.975	manual	50 W AMc 100 W FM	≥ 0.2 % (k3)	≥ 17 dB: 1 % (k3)	≤ 2.0 dB (k3) ≤ 0.5 dB (k10)	
Automatically tuned; for the R&S®M3SR Series4400							
R&S®FU214A	100 to 162.025 [2]	automatic ≤ 4 s typ. 2 s	50 W AMc 100 W FM	≥ 0.5 MHz	20 dB: ≤ ±2 MHz 35 dB: ≤ ±5 MHz 40 dB: ≤ ±7 MHz	≤ 1.5 dB (+10 °C to +40 °C) ≤ 2.0 dB (–30 °C to +55 °C)	N: filter with integrated bypass for distress channel
R&S®FD213A	225 to 399.975	automatic ≤ 4 s typ. 2 s	50 W AMc 100 W FM	≥ 1 MHz	20 dB: ≤ ±3 MHz 35 dB: ≤ ±7 MHz 40 dB: ≤ ±11 MHz	≤ 1.5 dB (+10 °C to +40 °C) ≤ 2.0 dB (–30 °C to +55 °C)	N: filter with integrated bypass for distress channel
R&S®FD213A2	225 to 399.975 (2 ×)	automatic ≤ 4 s typ. 2 s	50 W AMc 100 W FM (per radio)	≥ 1 MHz	20 dB: ≤ ±3 MHz 35 dB: ≤ ±7 MHz 40 dB: ≤ ±11 MHz	≤ 1.5 dB (+10 °C to +40 °C) ≤ 2.0 dB (–30 °C to +55 °C)	N: dual filter for two independently operating UHF radios; with integrated bypass for UHF distress channel
R&S®FT213A	100 to 162.025 and 225 to 399.975	automatic ≤ 4 s typ. 2 s	50 W AMc 100 W FM	VHF: ≥ 0.5 MHz UHF: ≥ 1 MHz	VHF: 20 dB: ≤ ±2 MHz 35 dB: ≤ ±5 MHz 40 dB: ≤ ±7 MHz UHF: 20 dB: ≤ ±3 MHz 35 dB: ≤ ±7 MHz 40 dB: ≤ ±11 MHz	≤ 1.5 dB (+10 °C to +40 °C) ≤ 2.0 dB (–30 °C to +55 °C)	N: combined VHF/UHF filter with integrated bypass for VHF and UHF distress channels
R&S®FU221, R&S®FU221Wx	100 to 162.025 [2]	automatic ≤ 10 s typ. 6 s	200 W AMc 800 W PEP 300 W FM	≥ 0.05 %	20 dB: ≤ ±0.4 % 40 dB: ≤ ±1.0 % 60 dB: ≤ ±4.0 %	≤ 2.0 dB (0 °C to +40 °C) ≤ 2.5 dB (–20 °C to +55 °C) additionally 0.5 dB at ≤ 108 MHz	S: up to 4 radios can be connected to one antenna (R&S®FU221W4)
R&S®FD221, R&S®FD221Wx	225 to 399.975	automatic ≤ 10 s typ. 6 s	200 W AMc 800 W PEP 300 W FM	≥ 0.05 %	20 dB: ≤ ±0.4 % 40 dB: ≤ ±1.0 % 60 dB: ≤ ±4.0 %	≤ 2.0 dB	S: up to 4 radios can be connected to 1 antenna (R&S®FD221W4)

[1] Attenuation at x % frequency offset from center frequency f_o.
[2] Nominal value is 162.025 MHz, but operation is possible up to 162.975 MHz.

Related products

R&S®HS9043/0 Cavity Filter
UHF range 225 MHz to 400 MHz
- Manually tuned
- Excellent mechanical precision
- Versatility in use for multiport filters or multicouplers
- Reasonable size
- Good price/performance ratio

R&S®HS9043/9 Cavity Filter
VHF range 100 MHz to 156 MHz
- Manually tuned
- Excellent mechanical precision
- Versatility in use for multiport filters or multicouplers
- Reasonable size
- Good price/performance ratio

Related products

R&S®FU221 VHF Filters, R&S®FD221 UHF Filters R&S®FU221W(.) VHF Multicouplers, R&S®FD221W(.) UHF Multicouplers
- Automatically tuned
- High RF power
- High selectivity
- Four ports or less

R&S®FU214A VHF Filters, R&S®FD213A UHF Filters R&S®FD213A2 UHF Filter (dual type), R&S®FT213A VHF/UHF Filter
- Automatically tuned
- Medium RF power
- Medium selectivity
- Bypass for distress frequencies
- Stationary and mobile use

R&S®HS9043 Cavity Filters

The R&S®HS9043/0 and R&S®HS9043/9 cavity filters are proven "workhorses" that have been used successfully for decades. They are applied to single-channel systems where medium power-handling and medium selectivity are sufficient.

There are two basic types: the R&S®HS9043/9 VHF cavity filter and the R&S®HS9043/0 UHF cavity filter. They are equal in design and function, but differ in their specifications and dimensions.

The R&S®HS9043 are cylinder-shaped and designed as coaxial resonant-line circuits with an inner and outer conductor. The input and output coupling is made with variable coupling loops that can be rotated separately to vary the coupling degree (K) and the selectivity of the filter.

Special filter and multicoupler capability
The R&S®HS9043 can be configured to the following:

- Special filter types, e.g.
  - with three ports for three radios and three antennas
  - with two filters per port (double-section filter) to increase selectivity
- Starpoint multicouplers

The appropriate number of R&S®HS9043 cavity filters is assembled together with a mechanical slide-in unit, special coaxial two- or four-way starpoints, RF cables, transformation stages, etc. to form a compact 19" plug-in for rack integration.

R&S®HS9043/0
cavity filter.

R&S®HS9043/9
cavity filter.

R&S®FU221 VHF Filters
R&S®FD221 UHF Filters
R&S®FU221W(.) VHF Multicouplers
R&S®FD221W(.) UHF Multicouplers

- Automatically tuned
- High RF power
- High selectivity
- Four ports or less

The R&S®FU221 and R&S®FD221 filters consist of two coaxial resonators, fixed-coupled to form a compact two-section filter plug-in. Tuning is performed manually by altering the length of the longitudinally adjustable inner conductors via a gearing common to both resonators.

The gear is driven by a microprocessor-controlled stepping motor. Following a frequency change input from the radio, the inner conductors of the cavity resonators are first driven to their start (HOME) position in mechanical mid-position. Subsequently, automatic tuning is continued by counting the frequency-specific definite angle of rotation of the stepping motor which is supported by a sophisticated and optically assisted motor control, an electronically stored frequency characteristic, and built-in tests. Two light barriers prevent the filters from moving against the two stops. From the gear unit, an additional axle is routed outward on which a manual tuning knob can be fixed in the event of automatic tuning failure.

The robust and mechanically stiff layout and the use of temperature-stable material for filter bodies, spindles, and coupling in connection with silver-coating ensure the specifications throughout the entire temperature range and under 100% duty-cycle high-power operation

The control cable between filter and radio unit provides the operating DC voltage as well as necessary frequency and other control information.

R&S®FU221 VHF filter.

Multicoupler capability

To form a multicoupler (combining filter) to operate a number of transmitters or receivers via a single antenna, up to four filters can be combined via a VHF or UHF two- or four-way combining array for rack integration. This array consists of a starpoint and a multistage quarter-wave transformation line toward the common antenna ensuring good matching of the filter inputs to the input impedance of the antenna over the entire VHF or UHF band. The multicouplers are suitable for operation at any frequency in the band.

Please note:

- Two differing filter models for standalone (screw-type RF sockets) or multicoupler use (plug-in RF sockets)
- Different filter arrangement in multicouplers for VHF (filters in horizontal position) or UHF (filters in vertical position: two upper and two lower units) due to the necessary short connection to the two- or four-way combining array
- Extension models of multicouplers available, 100% prepared for upgrading to a maximum of four ports; please refer to the ordering information for details

For basic specifications, e.g.

- Frequency range
- RF power handling
- Bandwidth
- Selectivity
- Insertion loss

see "VHF/UHF Filters/Multicouplers – Overview"

Additional specifications	
Circuit design characteristics	fixed-coupled 2-circuit (resonator) type
Input impedance (radio port)	50 Ω, VSWR: ≤ 1.6:1 (0 °C to +40 °C) ≤ 2.0:1 (–20 °C to +55 °C) valid for filters; multicouplers see below
Output impedance (antenna port)	50 Ω
RF connectors (radio or antenna port)	N female
Tuning control	
Interface	control from radio
Code	BCD, TTL positive logic
Start	automatic start by change of BCD information
Power supply	
Interface	DC supply from radio
Voltage	28 (+2/–6) V DC, negative to ground
Current (filter)	
During tuning	≤ 2.0 A
Quiescent current	≤ 0.25 A

Additional specifications

Different specifications for multicouplers	
Number of inputs (radio ports)	2 to 4, depending on type and model
Maximum total RF input power	2 to 4 × 200 W AM carrier, 100% mod. 2 to 4 × 300 W FM
Maximum total RF output power (antenna port)	800 W AM carrier, 100% mod., 1200 W FM
Insertion loss	
R&S®FD221W2/W4	≤ 2.5 dB (–20 °C to +55 °C)
R&S®FU221W2/W4	≤ 2.5 dB (0 °C to +40 °C) ≤ 3.0 dB (–20 °C to +55 °C) additionally 0.5 dB at f ≤ 108 MHz
Input impedance (radio port)	50 Ω VSWR ≤ 2.0:1 (0 °C to +40 °C) VSWR ≤ 2.5:1 (–20 °C to +55 °C)
General data	
Dimensions (W × H × D)	
R&S®FU221	483 mm × 220 mm × 560 mm (19 in × 8.66 in × 22.05 in) (seated depth)
R&S®FD221	483 mm × 220 mm × 500 mm (19 in × 8.66 in × 19.69 in) (seated depth)
R&S®FU/FD221W2 (.02)	550 mm × 445 mm × 592 mm (21.65 in × 17.52 in × 23.31 in) (rack requirement)
R&S®FU/FD221W4 (.02)	550 mm × 890 mm × 592 mm (21.65 in × 35.04 in × 23.31 in) (rack requirement)
Weight	
R&S®FU/FD221	approx. 30 kg (66.14 lb)
R&S®FU/FD221W2 (.02)	approx. 65 kg (143.30 lb)
R&S®FU/FD221W4 (.02)	approx. 130 kg (286.60 lb)

Note: Specifications refer to filters and multicouplers, if not stated otherwise, and to nominal RF terminations (50 Ω).

Ordering information

Designation	Type	Order No.
UHF Filter Standard filter [1]	R&S®FD221	0633.8012.02
Spare model for multicoupler W2 Spare/extension model for upper two filters of W4 (.02/.03/.04) Spare model for W4 (.12) [2] [3]	R&S®FD221	0633.8012.03
Spare/extension model for lower two filters of W4 (.02/.03/.04) [2] [3]	R&S®FD221	0633.8012.04
UHF Two-Port Multicoupler Standard type, 19", 10 HU [3]	R&S®FD221W2	0643.2517.02
UHF Four-Port Multicoupler Standard type, 19", 20 HU [4]	R&S®FD221W4	0643.4510.02
Special model [5]	R&S®FD221W4	0643.4510.12
UHF Two-Port Multicoupler Special model, 19", 20 HU, extendible to 4 ports by R&S®FD220 (.04) [6]	R&S®FD221W4	0643.4510.03
UHF Three-Port Multicoupler Special model, 19", 20 HU, extendible to 4 ports by R&S®FD 220 (.04) [6]	R&S®FD221W4	0643.4510.04
VHF Filter Standard filter [1]	R&S®FU221	0643.6012.02
Spare model for W2 or W4 Extension model for W4 [7]	R&S®FU221	0643.6012.03
VHF Two-Port Multicoupler Standard type, 19", 10 HU	R&S®FU221W2	0643.3513.02
VHF Four-Port Multicoupler Standard type, 19", 20 HU [7]	R&S®FU221W4	0643.5516.02
VHF Two-Port Multicoupler Special model, 19", 20 HU, extendible to 4 ports [6]	R&S®FU221W4	0643.5516.03
VHF Three-Port Multicoupler Special model, 19", 20 HU, extendible to 4 ports [6]	R&S®FU221W4	0643.5516.04
Accessories		
Filter Control Cable for R&S®M3SR Series4400; 2 m length	R&S®ZT297-3	6115.4412.02
Filter Control Cable for R&S®M3SR Series4400; 5 m length	R&S®ZT297-3	6115.4412.05

1) Horizontal 19" rack plug-in, 5 HU, with standard (screw-connected) RF connectors, for standalone filter (not multicoupler) use.
2) Vertical ½ 19" plug-in, 10 HU, with plug-in RF connectors for automatic connection with the multicoupler combining array.
3) The R&S®FD221W2 (.02) consists of two R&S®FD221 (.03) UHF filters and one UHF two-way combining array.
4) The R&S®FD221W4 (.02) consists of two R&S®FD221 (.03) upper filter plug-ins side by side, two R&S®FD221 (.04) lower filter plug-ins side by side, and one UHF four-way combining array. For logistics advantage: see note 5.
5) The R&S®FD221W4 (.12) can be used as a special alternative to model .02: It includes four identical R&S®FD221 (.03) filters.
6) Delivered with 50 Ω terminations for open extension port(s).
7) The R&S®FU221W4 (.02) consists of four R&S®FU221 (.03) VHF filters and one VHF four-way combining array.

R&S®FU214A VHF Filters
R&S®FD213A UHF Filters
R&S®FD213A2 UHF Filter (dual type)
R&S®FT213A VHF/UHF Filter

- Automatically tuned
- Medium RF power
- Medium selectivity
- Bypass for distress frequencies
- Stationary and mobile use

Design and features

This filter series has outstanding features such as:
- Compact 19" design, 3 HU
- Combined VHF/UHF type available
- Integrated bypass for receiving VHF, UHF, or VHF/UHF distress frequencies

A combined R&S®FT213A VHF/UHF filter includes two capacitively tuned coaxial resonators per frequency range to form a two-section filter for the operating frequency. Tuning is carried out by means of a common [1] axle which is driven and controlled by a microprocessor-controlled stepping motor by way of a gearing. Following a frequency change input from the radio, the filter tuning axle is first driven to the normal start (HOME) position. It is then moved to an angular position corresponding to the new frequency.

Tuning is supported by a sophisticated and optically assisted motor control. If the frequency change is less than 100 kHz, retuning does not take place. The emission of RF power during automatic tuning is prohibited.

From the gear unit, an additional axle is routed outward on which a manual tuning knob can be fixed in the event of automatic tuning failure, supported by the integrated scales and the tuning control meter.

The robust design and the use of selected temperature-stable materials and low-loss (silver-coated) surfaces ensure the specifications throughout the entire temperature range and under 100 % duty-cycle operation.

The control cable between filter and radio unit provides the operating DC voltage as well as necessary frequency and other control information.

Bypass benefits

The 121.5 MHz bypass or 243 MHz bypass (VHF or UHF guard receiver bypasses) bridges the guard frequency across the receiver by active extraction. During transmit operation the bypass is disabled electronically by means of control information from the radio. Thus, distress channel reception is possible automatically without any manipulations.

[1] Common for the two resonators per frequency band and for VHF and UHF.

For basic specifications, e.g.
- Frequency range
- RF power handling
- Bandwidth
- Selectivity
- Insertion loss

see "VHF/UHF Filters/Multicouplers – Overview"

R&S®FT213A VHF/UHF automatic filter: The standard model .05 is fitted with 19" rackmount devices (instead of cabinet).

Additional specifications

Circuit design characteristics	fixed-coupled 2-circuit (resonator) type
Input impedance (radio port)	50 Ω, VSWR ≤ 1.6:1 (+10 °C to +40 °C) ≤ 2.0:1 (–30 °C to +55 °C) valid for filters
Output impedance (antenna port)	50 Ω
RF connectors (radio or antenna port)	N female
Tuning control	
Interface	control from radio
Code	BCD, TTL positive logic
Start	automatic start by change of BCD information
Power supply	
Interface	DC supply from radio
Voltage	28 (+2/–6) V DC, negative to ground
Current (filter)	
During tuning	≤ 2.0 A
Quiescent current	≤ 0.25 A
Bypass filter characteristics and mutual influences	
Insertion loss	±1 dB
Additional attenuation of bypass filter by main filter (with frequencies close together)	≤ 10 dB for worst case (details on request)
Additional attenuation of main filter by bypass filter (with frequencies close together)	≤ 10 dB for worst case (details on request)
Attenuation in stopband	
At ≥ ±8 MHz from 243.0 MHz	> 30 dB
At ≥ ±4 MHz from 121.5 MHz	> 30 dB
Isolation	> 50 dB
General data	
Dimensions (W × H × D)	
Standard models	485 mm × 132 mm × 450 mm (19.08 in × 5.20 in × 17.72 in) (seated depth)
Shockmount models	485 mm × 200 mm × 450 mm (19.08 in × 7.87 in × 17.72 in)
Weight of standard models .05	
R&S®FT213A	approx. 18 kg (39.68 lb)
R&S®FD213A	approx. 11 kg (24.25 lb)
R&S®FD213A2	approx. 18 kg (39.68 lb)
R&S®FU214A	approx. 15 kg (33.07 lb)
Additional weight of shockmount models	approx. 4.5 kg (9.92 lb)

Note: Specifications refer to filters and multicouplers, if not stated otherwise, and to nominal RF terminations (50 Ω).

Ordering information

Designation	Type	Order No.
Standard models for 19" rack installation		
UHF Filter	R&S®FD213A	0633.8012.03
UHF Filter (2 × UHF)	R&S®FD213A2	0633.8012.04
VHF Filter	R&S®FU214A	0643.2517.02
VHF/UHF Filter	R&S®FT213A	0643.4510.02
Control Cable with 37-pin D-Sub and MIL connectors Length 2 m Length 5 m	R&S®ZT297-3	6115.4429.xx xx = 02 xx = 05

R&S®ATCMC Air Traffic Control Multicouplers

Active VHF/UHF multicouplers for ATC signal distribution
The R&S®ATCMC8 multicoupler saves space while optimally supporting conventional ATC system installations by means of eight receivers operated in parallel on one antenna. The R&S®ATCMC16 multicoupler features simultaneous signal distribution to up to 16 receivers. The multicouplers' integrated, steep-sided filters reliably suppress interference from high-power VHF FM and TV signals.

To maximize the operational reliability of the ATC receiving system, a single point of failure is avoided in the amplifiers owing to the intelligent switching concept of the R&S®ATCMC multicouplers. To handle any interruptions in the AC supply voltage, the R&S®ATCMC feature automatic switchover to the DC input provided for an emergency power supply. The internal operating state of the R&S®ATCMC can be monitored and evaluated by R&S®Series4200 radios via an alarm contact.

- Suppression of adjacent signals from high-power transmitters
- Band-selective in the VHF or UHF ATC frequency range
- 1-to-8/1-to-16 distribution
- Automatic emergency power switchover
- Overvoltage protection
- Floating alarm contact
- Customized filter frequencies on request

Suppression of adjacent high-power signals
The R&S®ATCMC's integrated bandpass filtering considerably improves the reception conditions for the connected receivers. Adjacent signals such as high-power FM signals in the VHF band or TV signals in the UHF band are suppressed. To offer optimized filtering for any application, the R&S®ATCMC is available as either a VHF or a UHF model. The R&S®ATCMC-B1 option is offered for cases where customized filter frequencies are needed.

Available as 1-to-8 or 1-to-16 model
In ATC, the parallel operation of eight or 16 receivers on one antenna each is very common. The R&S®ATCMC multicoupler family can easily handle this challenge and is therefore available as either an 8- or 16-port model. To prevent the connected receivers from affecting each other (e.g. due to local oscillators and synthesizers), both models feature high port-to-port isolation.

Integrated automatic emergency power switchover
The R&S®ATCMC is ideal for operation with either AC or DC power. The integrated electronic switchover mechanism automatically detects interruptions in the AC power supply and immediately switches to the DC supply without any signal interruption. Thus, the emergency power supply systems with 24 V DC voltage that are common in ATC can be used.

Reliable protection against large signals
The integrated protective circuits at the RF input protect the R&S®ATCMC against large signals and reliably prevent damage to the connected receivers.

Remote monitoring through floating alarm contact
Featuring an integrated alarm contact as standard, the R&S®ATCMC multicoupler family offers impressive capabilities for the remote monitoring of the internal operating state. If a malfunction occurs, the R&S®ATCMC immediately switches the floating contacts of a relay in order to indicate the modified operating state. All internal supply voltages of the amplifiers are monitored. In conjunction with R&S®Series4200 radios, this alarm contact offers the capability to automatically report the operating state of the R&S®ATCMC to the user.

R&S®ATCMC8: 1-to-8 model.

R&S®ATCMC16: 1-to-16 model.

Specifications of the R&S®ATCMC8

R&S®ATCMC8 VHF		
Standard frequency range [1]		112 MHz to 144 MHz
Impedance	input/output	50 Ω
RF input	1 ×	N female
VSWR	input	< 1.5:1, typ. 1.2:1
VHF FM band suppression	7-pole elliptical highpass filter referenced to 127 MHz	< –25 dBr for f < 103 MHz
UHF TV band suppression	3-pole Chebyshev lowpass filter referenced to 127 MHz	< –30 dBr for 470 MHz < f < 1 GHz
Max. input power		+15 dBm
RF outputs	8 ×	N female
VSWR	output	< 1.5:1, typ. 1.2:1
1 dB compression		> +15 dBm, typ. +19 dBm
Decoupling between two outputs		> 27 dB, typ. 34 dB
Intermodulation suppression IP3	output	> +33 dBm, typ. +36 dBm
Gain		2 dB ± 1.5 dB
Noise figure		< 7 dB, typ. 4.5 dB
Reverse decoupling		> 34 dB, typ. 38 dB
R&S®ATCMC8 UHF		
Standard frequency range [1]		225 MHz to 400 MHz
Impedance	input/output	50 Ω
RF input	1 ×	N female
VSWR	input	< 1.5:1, typ. 1.2:1
VHF band suppression	5-pole Chebyshev highpass filter referenced to 310 MHz	< –17 dBr for f < 100 MHz
UHF band V suppression	5-pole Chebyshev lowpass filter referenced to 310 MHz	< –17 dBr for 650 MHz < f < 1 GHz
Max. input power		+15 dBm
RF outputs	8 ×	N female
VSWR	output	< 1.5:1, typ. 1.2:1
1 dB compression		> +15 dBm, typ. +18 dBm
Decoupling between two outputs	directly adjacent	> 23 dB, typ. 26 dB
	not directly adjacent	> 23 dB, typ. 30 dB
Intermodulation suppression IP3	output	> +32 dBm, typ. +35 dBm
Gain		2 dB +2 dB/–1.5 dB
Noise figure		< 7 dB, typ. 5 dB
Reverse decoupling		> 33 dB, typ. 38 dB
General data		
Dimensions	W × H × D	482.6 mm × 43.8 mm × 145 mm (19 in × 1.72 in × 5.71 in), 19", 1 HU
Temperature	operating temperature range	–20 °C to +55 °C
	storage temperature range	–40 °C to +70 °C
Weight		approx. 2.6 kg (approx. 5.73 lb)
Primary power supply	AC	90 V to 250 V/50 Hz to 60 Hz; IEC connector
Energy consumption		≤ 8 W
Emergency power supply	DC (fully automatic switchover)	19 V to 32 V, typ. 0.3 A
Alarm contact	maximum switching current	≤ 1 A
	maximum switching voltage	≤ 42 V
Connector type	emergency power supply, alarm contacts	CA 6 GS (6+PE)
Electromagnetic compatibility		EN 55011 class B and EN 61326

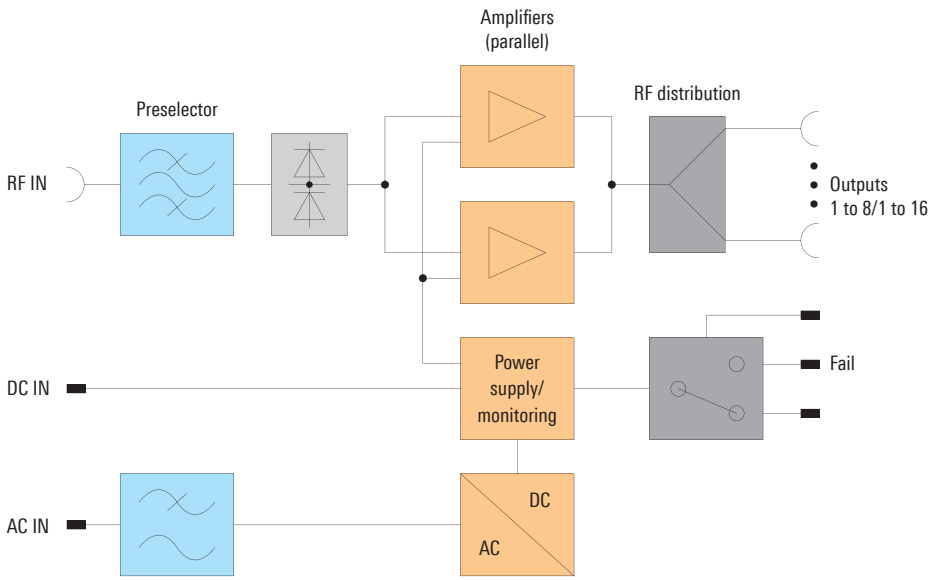
[1] Other frequency ranges on request.

Specifications of the R&S®ATCMC16

R&S®ATCMC16 VHF		
Standard frequency range [1]		112 MHz to 144 MHz
Impedance	input/output	50 Ω
RF input	1 ×	N female
VSWR	input	< 1.5:1, typ. 1.3:1
VHF FM band suppression	7-pole elliptical highpass filter referenced to 127 MHz	< –25 dBr for f < 103 MHz
UHF TV band suppression	3-pole Chebyshev lowpass filter referenced to 127 MHz	< –30 dBr for 470 MHz < f < 1 GHz
Max. input power		+15 dBm
RF outputs	16 ×	N female
VSWR	output	< 1.5:1, typ. 1.2:1
1 dB compression		> +15 dBm, typ. +18 dBm
Decoupling between two outputs		> 27 dB, typ. 34 dB
Intermodulation suppression IP3	output	> +32 dBm, typ. +35 dBm
Gain		2 dB ± 2 dB
Noise figure		< 7 dB, typ. 5 dB
Reverse decoupling		> 34 dB, typ. 42 dB
R&S®ATCMC16 UHF		
Standard frequency range [1]		225 MHz to 400 MHz
Impedance	input/output	50 Ω
RF input	1 ×	N female
VSWR	input	< 1.5:1, typ. 1.3:1
VHF band suppression	5-pole Chebyshev highpass filter referenced to 310 MHz	< –17 dBr for f < 100 MHz
UHF band V suppression	5-pole Chebyshev lowpass filter referenced to 310 MHz	< –17 dBr for 650 MHz < f < 1 GHz
Max. input power		+15 dBm
RF outputs	16 ×	N female
VSWR	output	< 1.5:1, typ. 1.3:1
1 dB compression		> +15 dBm, typ. +18 dBm
Decoupling between two outputs	directly adjacent	> 23 dB, typ. 26 dB
	not directly adjacent	> 23 dB, typ. 30 dB
Intermodulation suppression IP3	output	> +32 dBm, typ. +35 dBm
Gain		2 dB ± 2 dB
Noise figure		< 7 dB, typ. 5 dB
Reverse decoupling		> 34 dB, typ. 42 dB
General data		
Dimensions	W × H × D	482.6 mm × 43.8 mm × 145 mm (19 in × 1.72 in × 5.71 in), 19", 1 HU
Temperature	operating temperature range	–20 °C to +55 °C
	storage temperature range	–40 °C to +70 °C
Weight		approx. 2.6 kg (approx. 5.73 lb)
Primary power supply	AC	90 V to 250 V/50 Hz to 60 Hz; IEC connector
Energy consumption		≤ 8 W
Emergency power supply	DC (fully automatic switchover)	19 V to 32 V, typ. 0.3 A
Alarm contact	maximum switching current	≤ 1 A
	maximum switching voltage	≤ 42 V
Connector type	emergency power supply, alarm contacts	CA 6 GS (6+PE)
Electromagnetic compatibility		EN 55011 class B and EN 61326

[1] Other frequency ranges on request.

Block diagram of the R&S®ATCMC VHF/UHF



Ordering information

Designation	Type	Order No.
VHF frequency range		
Air Traffic Control Multicoupler VHF, 8 outputs	R&S®ATCMC8 VHF	5201.7960.10
Air Traffic Control Multicoupler VHF, 16 outputs	R&S®ATCMC16 VHF	5201.7960.20
UHF frequency range		
Air Traffic Control Multicoupler UHF, 8 outputs	R&S®ATCMC8 UHF	5201.7990.10
Air Traffic Control Multicoupler UHF, 16 outputs	R&S®ATCMC16 UHF	5201.7990.20
Option		
Customized Filter Frequencies	R&S®ATCMC-B1	5201.7954.02

R&S®MX400 Mobile Tower

For air traffic control and air defense

The R&S®MX400 is a completely self-contained system designed for quick installation and for long-term deployment under adverse weather conditions. It provides all ATC equipment needed for rapid, safe and reliable operation.

The system consists of a two-axle trailer with an integrated lifting mechanism and a detachable ATC cabin. A separate one-axle trailer with a diesel generator provides power for airfield operation wherever and whenever required. The entire system can be towed by any suitable truck.

The cabin, built as a full-featured ATC system, is equipped in line with the operational requirements of ICAO.

The basic equipment consists of the following:

- Up to three controller positions equipped with control and indicating instruments
- VHF or VHF/UHF communications sets in the frequency ranges 100 MHz to 512 MHz, 100 MHz to 163 MHz (225 MHz to 400 MHz)
- VHF/UHF guard receiver for the international distress frequencies 121.5 MHz/243.0 MHz (integrated in R&S®M3SR)
- HF communications set in the frequency range 1.5 MHz to 30 MHz, voice and data
- Digital multichannel voice recorder for all radio transmission and intercom conversations
- Voice communications system (VCS)
- Telephone equipment
- One set of meteorological sensors and indicators
- Accurate positioning and time through GPS
- Complete accessory package (signal projector, fire extinguisher, binoculars, obstruction lights, crash alarm, etc.)
- Split air-conditioning system

- Filing cabinets for supplies and equipment
- DC power supply system with backup batteries for emergency operation

System layout

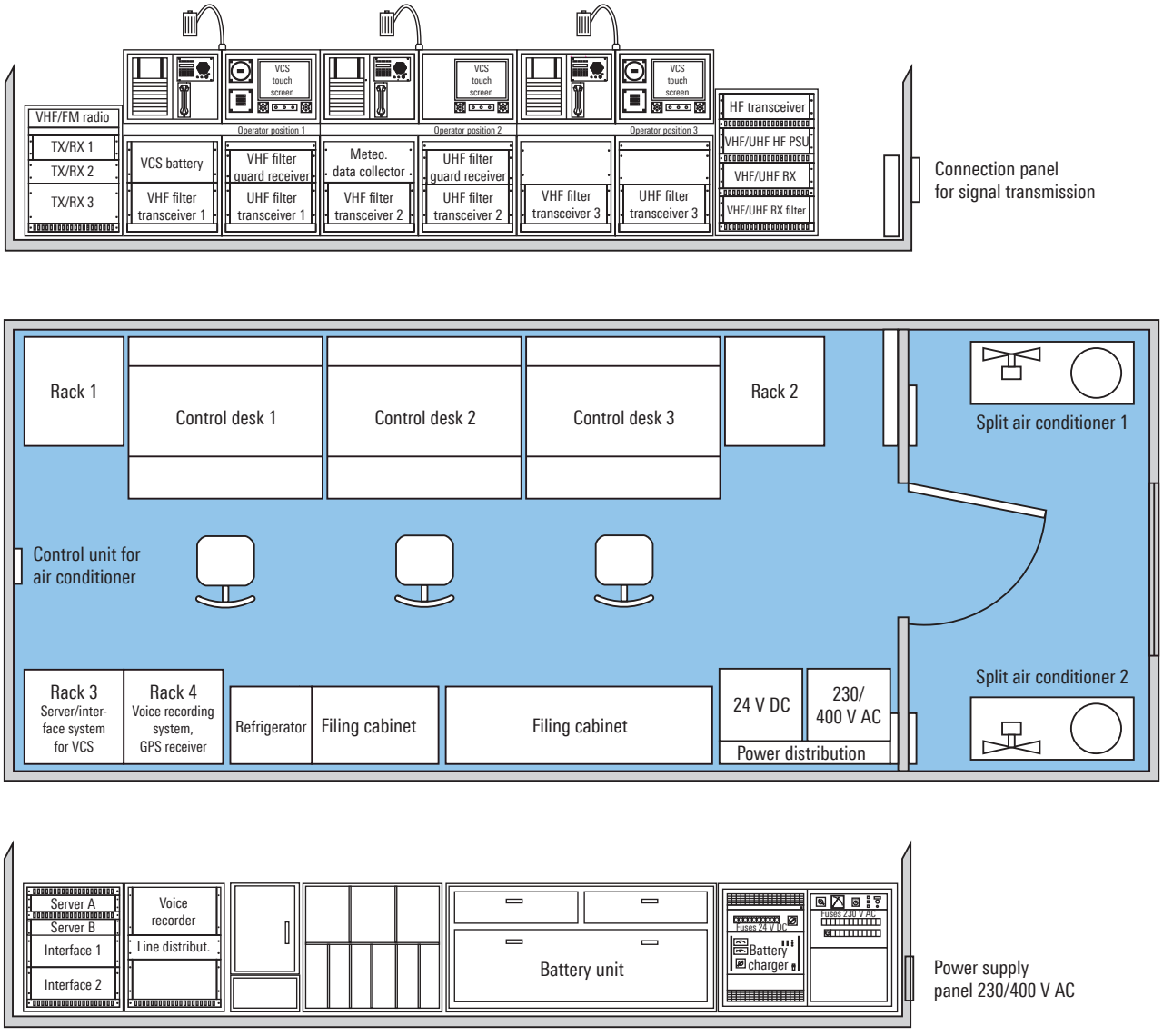
A special lifting mechanism on the two-axle trailer is designed to lift the cabin to the operational height of 6.5 m above ground (working position). An automatic levelling system ensures that the entire mobile tower can be set up in balance easily. The R&S®MX400 can be operated worldwide in all climatic zones.

The dimensions of the detachable cabin comply with the ISO international standard for 20-foot containers, which allows problem-free transport by ship, truck, aircraft, helicopter or rail.

The power supply of the entire mobile tower can be either a landline AC source or a diesel generator. The generator is designed to operate on standby, i.e. it will be started automatically when the local power supply fails.

All system components are integrated in the tower cabin so that the system can be put in operation immediately after arriving at the new site. The R&S®MX400 mobile tower has a modular system design. The final system design will be tailored to meet the needs of the individual customers.

System layout (example) of the R&S®MX400 mobile tower



Chapter 3
Tactical Radiocommunications

Rohde&Schwarz products span all short-range communications including HF/VHF/UHF radios in all power classes and a wide range of ancillary equipment and components to establish communications networks and systems for military scenarios.

In addition to stationary, vehicular and portable transceivers, Rohde&Schwarz provides the hardware and software for EPM (ECCM) and automatic link establishment (ALE), fast data modems, tactical antennas, couplers and filters for integration on all military platforms.

Interfaces and gateways to LAN and tactical Internet are the key components to implement tactical area networks including voice, data and video transmission. Highly effective protocols (e.g. TCP/UDP) and waveforms provide powerful and secure information transfer.

R&S®M3TR Software Defined Radios

A new generation of high-performance digital radios

- Multiband capability
- Multiwaveform capability
- High data rate of up to 72 kbit/s
- Software-configurable and upgradeable (P³I)
- Selective links in one net
- Low volume/weight
- Power-saving mode
- Removable front panel for flexible use and integration
- User-friendly HMI (single-knob control for basic operation)

The challenge

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 solution

The R&S®M3TR software defined radio family is a new generation of high-performance digital radios. It represents a revolutionary change, both technically and economically, in the tactical communications sector. The heart of the new integrated communications system is the lightweight R&S®MR300xH/U manpack transceiver (1.5 MHz to 108 MHz or 25 MHz to 512 MHz), 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 advanced multiband tactical radio
- R&S®MR300xU advanced multiband tactical radio
- R&S®MR3000P VHF tactical handheld radio

Logistics and readiness

- Minimum volume and weight for drop-in replacement programs
- Maximum autonomy by strict power-saving management
- Built-in test down to module level
- Common logistics concept for reduced costs throughout life cycle
- Common human-machine interface (R&S®MR300xH/U)
- Less training required
- Excellent flexibility
- High MTBF

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, thus allowing interoperability as well as uniform and reduced interservice logistics. The frequency flexibility of the R&S®M3TR meets various national and international regulations, thus providing global operation in fast-changing missions and environments.

Multimode

A software radio not only offers flexible network solutions but also integrates existing national or company standards into a single unit. Due to optimized protocols and waveforms, the R&S®M3TR attains maximum throughput rates for digital voice, data, video and position location. Available waveforms are:

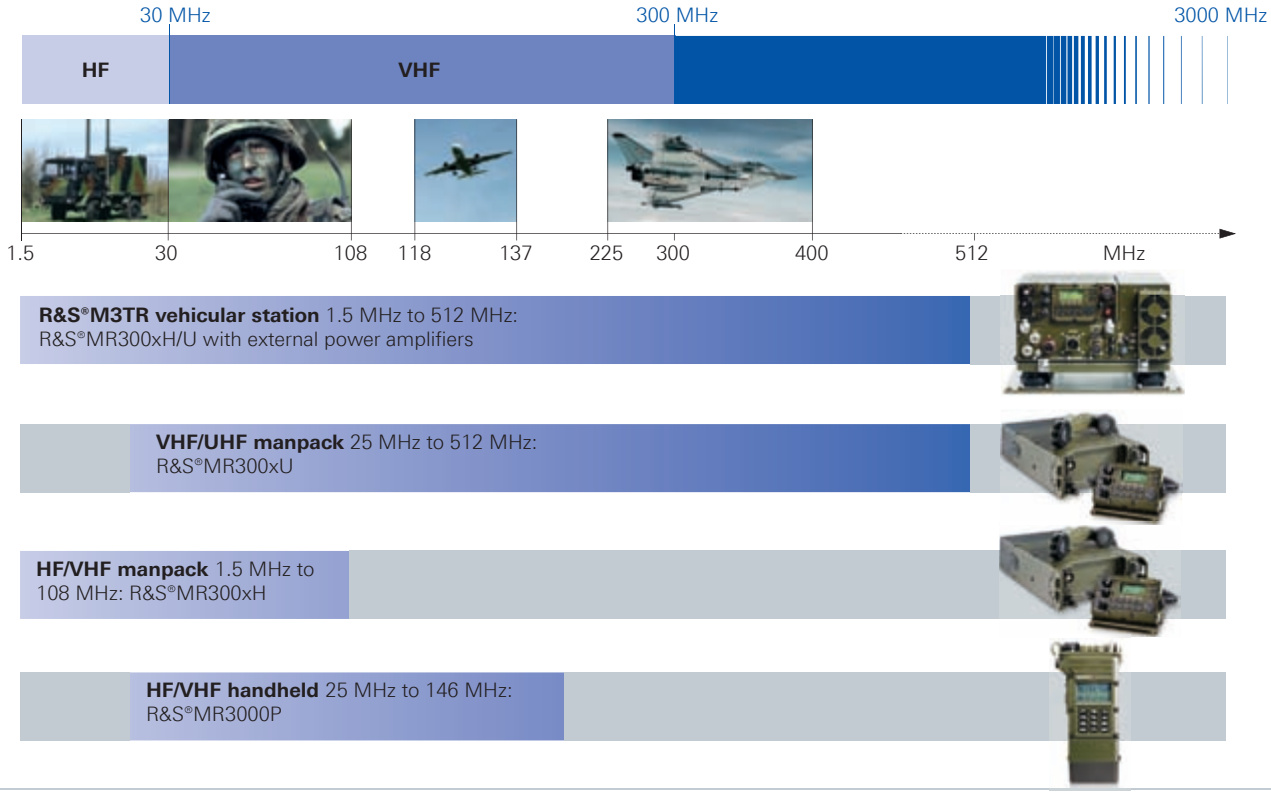
BLOS

- 2nd generation (2G) ALE in line with FED-STD-1045/46/49
- 3rd 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 4539
  - STANAG 4285
- FF modulation in line with AM, FM, SSB

LOS

- EPM (ECCM) in line with
  - R&S®SECOM-V
  - R&S®SECOM-P
  - R&S®SECOS 5/16 TDMA
  - HAVE QUICK I, II
- Modem waveforms
  - R&S®SECOM-V data, up to 16 kbit/s
  - VHF/UHF FF modem, up to 72 kbit/s

Multiband tactical radio family



Security
- Embedded COMSEC, 256-bit key
- Compatible with 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.

Ease of operation
The R&S®M3TR radios offer many diverse functions that help ensure straightforward, secure and error-free operation. The functions are available via hierarchically structured menus and context-sensitive softkeys. The well-thought-out concept and the arrangement of the control elements allow the intuitive control of the radio even under difficult conditions from outside and without having the removable front panel in view.

Menu-oriented user interface and PC-based tools
The R&S®MR300xH/U 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
The 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.

R&S®MR300xH/U
Advanced Multiband Tactical Radios

The R&S®MR300x transceivers form a family of high-performance digital radios covering the HF, VHF/FM and VHF/UHF bands. Owing to different high-speed data modes and protocols as well as different antijam modes for HF, VHF/FM and VHF/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).

- Multiband capability
  (1.5 MHz to 512 MHz with external devices)
- Multiwaveform capability
- Embedded EPM (ECCM) in line with R&S®SECOM-V/H/P
- High data rate of up to 72 kbit/s
- Software-configurable and upgradeable (P³I)
- Selective links in one net
- Low volume/weight
- Power-saving mode
- Integrated GPS and position report
- Removable front panel for flexible use and integration
- User-friendly HMI

R&S®MR3000P VHF Tactical Handheld Radio

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

Due to its jam-resistant digital waveform (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 R&S®M3TR tools such as R&S®RNMS3000 can be used. Seamless integration into tactical networks with R&S®M3TR fixed and vehicle stations as well as highly mobile forces is thus possible without any problem. The R&S®MR3000P features an integrated crypto module of the highest security level which provides protection for confidential messages.

- Multiband capability
- Embedded EPM (ECCM) in line with R&S®SECOM-P (frequency hopping and digital encryption)
- 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

Configuration examples

Configuration with external power amplifiers
The R&S®M3TR is designed to provide exceptional flexibility for networking services via RF networks on air. The transceivers can be used in portable, vehicular and stationary applications including installations in movable containers and shelters. Their rugged hardware complies with the individual MIL-STDs dealing with environmental conditions. Shockmounts are provided for mobile use.

A wide range of antennas adapted to the various applications (portable, mobile, base station) is available. Radio functions can be remote-controlled by means of an RC unit.

Covered frequency ranges and RF power for different configurations

Configuration			RF frequency in MHz/max. power		
			HF	Tactical VHF	ATC Air defense
TX/RX	HF external PA	VHF/UHF external PA	1.5 MHz to 29.9 MHz	30 MHz to 107.9 MHz	108 MHz to 511.9 MHz
R&S®MR300xH			20 W [1]	10 W	[2]
R&S®MR300xH	•		150 W	10 W	[2]
R&S®MR300xH		•	20 W [1]	50 W	50 W
R&S®MR300xH	•	•	150 W	50 W	50 W
R&S®MR300xU			[2]	10 W	10 W
R&S®MR300xU	•		150 W	10 W	10 W
R&S®MR300xU		•	[2] [3]	50 W	50 W
R&S®MR300xU	•	•	150 W	50 W	50 W

[1] At 50 Ω.
[2] RX; TX: max. 1 mW.
[3] 10 W at 25 MHz to 30 MHz.

Configuration overview of vehicle/command post station

This example of a radio station consists of the manpack transceiver with audio and data accessories and two power amplifiers. Amplifiers are available as compact versions or as standalone units. A compact amplifier (R&S®VT3050C) also includes the frame for mechanically fastening a radio in a vehicular installation and can be equipped with options for connecting external audio distribution systems or field telephones. Standalone amplifiers are connected to a compact amplifier to further increase the usable frequency range of the system. Amplifiers increase output power up to 50 W in the VHF and UHF bands and up to 150 W or 500 W in the HF band.

If these power amplifiers are used, a single R&S®M3TR radio (R&S®MR300xH or R&S®MR300xU) spans the entire frequency range from 1.5 MHz to 512 MHz without any gaps.

Audio/data accessories

- Handsets/headsets
- Speakers
- Vehicle intercom
- Radio wire integration

VHF/UHF antennas

- VHF
- UHF
- Multiband

HF antennas

- Whip
- Wire
- NVIS

R&S®VT3050C VHF/UHF compact amplifier

R&S®VK3150 HF amplifier

R&S®FK3150 antenna coupler

Remote control

- RC units
- RC software

Data transmission/networking

- Tactical PC/PDA
- Message handling software
- Blue force tracking

Mission planning

- Fillguns
- Mission planner software
- Remote device loader software

Configuration overview of manpack radio

Audio accessories

- R&S®GA3001 handset
- R&S®GA3002 headset
- R&S®GA3003 microphone/speaker
- R&S®GA3005 loudspeaker

Chargers and batteries

- R&S®IC3001 vehicle charger
- R&S®IC3000 workshop charger
- R&S®IB3001/IB3002 battery pack

Data communications

- Tactical notepad, R&S®T@cMan software
- Cables, e.g. R&S®GK3024 data/remote cable

R&S®MR300xH/U manpack radio + software options

Other accessories

- R&S®MZ3088 manpack bag
- R&S®GK3005 front-panel extension
- R&S®GK3009 power/LAN adapter

Radio configuration

- R&S®GP3000 fillgun

Manpack antennas

- R&S®HV3003 GPS antenna
- R&S®HV3004 VHF manpack antenna
- R&S®HV3007 HF whip antenna
- R&S®HV3009 VHF/UHF manpack antenna

Configuration overview of handheld radio

Mission planning

- R&S®GP3021 fillgun
- Mission planner software
- Data loader software

R&S®MR3000P handheld radio

Chargers and batteries

- R&S®IB3022 battery pack
- R&S®IC3023 vehicle charger
- R&S®IC3022 universal charger

Audio accessories

- R&S®GA3023 microphone/loudspeaker

Other accessories

- R&S®MZ3021 bag
- R&S®MZ3023 set bag
- R&S®IV3021 vehicle support

Handheld antennas

- R&S®HV3031 GPS receiver
- R&S®HD3088 VHF hang-up antenna
- R&S®HV3022 short whip antenna
- R&S®HV3021 long whip antenna
- R&S®HD3001 VHF directional manpack antenna

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 waveforms

Type	Designation	Runs in frequency range (in MHz)	Support of waveform by			
			R&S®MR3000H/U	R&S®MR3001H/U	R&S®MR3002H/U	R&S®MR3003H/U
R&S®GS3001S	R&S®SECOM-H	1.5 to 29.9	•	•	•	•
R&S®GS3030S	R&S®SECOM-V	30 to 107.9 / 121 to 511.9	•	•	•	•
	R&S®SECOM-P	30 to 87.9	•	•	•	•
R&S®GS3006S	HAVE QUICK I/II	225 to 399.9		•		•
R&S®GS3007S	HAVE QUICK I	225 to 399.9		•		•
R&S®GS3516S	R&S®SECOS 5/16 TDMA	225 to 399.9		•		•

ALE – automatic link establishment

Type	Designation	Runs in frequency range (in MHz)	Support of waveform by			
			R&S®MR3000H/U	R&S®MR3001H/U	R&S®MR3002H/U	R&S®MR3003H/U
R&S®GS4101S	ALE 2G, FED-STD-1045/46/49	1.5 to 29.9			•	•
R&S®GS4155S	ALE 2G, FED-STD-1045/46/49 ALE 3G, STANAG 4538, (FLSU, LP, HDL, LDL)	1.5 to 29.9			•	•

Modem waveforms

Type	Designation	Runs in frequency range (in MHz)	Support of waveform by			
			R&S®MR3000H/U	R&S®MR3001H/U	R&S®MR3002H/U	R&S®MR3003H/U
R&S®GM4120S	HF modem STANAG 4285, STANAG 4529, STANAG 4539, STANAG 4415	1.5 to 29.9			•	•
R&S®GS3030S	VHF/UHF Modem 72 kbit/s	30 to 511.9	•	•	•	•

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 processor. Crypto units complying with NATO standards or from other manufacturers may be used as an external option.

R&S®SECOM-V (R&S®GS3030S, op-code)
R&S®SECOM-V is optimized for the tactical VHF band. It is implemented as a software option running on all R&S®MR300xH/U tactical transceivers.

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 for up to a few hundred users 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-H (R&S®GS3001S, op-code)
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 1200 bit/s or 2400 bit/s, adjustable) and data services (up to 2400 bit/s). User data (including digital voice) is always transmitted in encrypted form (COMSEC, R&S®RSCA crypto algorithm). To plan communications networks and links, a PC-based radio network management system is available. The 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 respective radios by means of a fillgun or directly by using one of the digital interfaces of the radio (e.g. LAN, serial interface).

Note: To run R&S®SECOM-H on an R&S®MR300xU transceiver, the R&S®VK3150(C) HF power amplifier and other system components are required.

R&S®SECOM-P (R&S®GS3030S, op-code)
R&S®SECOM-P is the standard EPM 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/U equipment as a software option, R&S®SECOM-P provides full interoperability between all R&S®MR300x transceivers in mixed networks.

R&S®SECOS 5/16 TDMA (R&S®GS3516S, op-code)
The R&S®SECOS air-ground-air waveform provides interoperability in the EPM mode between the R&S®M3TR and the R&S®M3AR and R&S®M3SR transceivers. Besides digital voice mode, data transmission with data rates of up to 16 kbit/s is supported. Both TDMA and non-TDMA modes are implemented. For details on R&S®SECOS implementation in the R&S®M3TR, refer to the related Technical Information (R&S®M3TR SECOS).

Note: To run R&S®SECOS on an R&S®MR3001H or R&S®MR3003H transceiver, the R&S®VT3050 or R&S®VT3050C VHF/UHF power amplifier is required.

The R&S®SECOS 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/GS3007S, op-code)
The NATO ground-air-ground (GAG) waveform HAVE QUICK provides interoperability in the EPM mode between the R&S®M3TR and various types of legacy equipment. In particular, it allows the integration of R&S®M3TR transceivers into networks based on the R&S®M3AR and R&S®M3SR transceivers.

Note: To run HAVE QUICK on an R&S®MR3001H or R&S®MR3003H transceiver, the R&S®VT3050 or R&S®VT3050C VHF/UHF power amplifier is required.

R&S®MR300xH/U supported services

Voice communications

Analog voice
Depending on the software configuration, the radio is able to transmit and receive the following signal modulations in the VHF/UHF band:
- J3E (USB, LSB)
- A3E (AM)
- F3E (FM)
- F1B/F1D (FSK)
- J2D (USB)

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

Digital voice (optional)
For communications under the EPM 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
- AMBE vocoder 2.4/4.8/9.6/16 kbit/s
- CVSD vocoder 16 kbit/s

AMBE is the standard vocoder for voice transmission under R&S®SECOM-V. It makes use of the R&S®SECOM-V 16 kbit/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.

R&S®SECOM-H
- 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 (1.5 MHz to 30 MHz). As an integral component of the R&S®SECOM-H HF EPM 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
- CVSD vocoder 16 kbit/s

R&S®SECOS digital voice
- CVSD vocoder 16 kbit/s
- AMBE vocoder 16 kbit/s

In the R&S®SECOS mode, the CVSD and AMBE vocoder types are supported. The vocoder type is to be preconfigured by the R&S®RNMS3000 net management tool.

Data communications

The R&S®M3TR provides the following optional data transmission modes:
- STANAG 4285 single tone waveform (HF: 1.5 MHz to 29.999999 MHz)
- R&S®SECOM-H data mode, up to 2400 bit/s (HF: 1.5 MHz to 29.999999 MHz)
- FSK modulation
- R&S®SECOM-V data mode (VHF: 30 MHz to 107.975 MHz, UHF: 121 MHz to 511.975 MHz)
- 72 kbit/s high-speed modem (VHF/UHF: 30 MHz to 511.975 MHz)
- R&S®SECOS 5/16 TDMA (TDMA and non-TDMA data modes)
- IP over air data mode

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

STANAG 4285 data mode (R&S®GM4120S)
The STANAG 4285 HF modem is a transparent modem for narrowband (3 kHz) data communications in the HF band with a user data rate of up to 3600 bit/s. The following user data rates can be selected via radio HMI:
- 75 bit/s
- 150 bit/s
- 300 bit/s
- 600 bit/s
- 1200 bit/s
- 2400 bit/s
- 3600 bit/s

STANAG 4539 data mode (R&S®GM4120S)

The STANAG 4539 HF modem enables self-identifying (auto-baud) data communications (up to 12800 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 12800 bit/s)

For backward interoperability, a STANAG 4539 modem is compatible with the following non-self-identifying NATO standards:

- STANAG 4285 (low and medium rate HF waveform from 75 bit/s to 3600 bit/s)
- STANAG 4529 (low and medium rate maritime HF waveform with 1240 Hz bandwidth from 75 bit/s to 1800 bit/s)

R&S®SECOM-H data mode

The R&S®SECOM-H high-frequency (HF) electronic protection measures (EPM) system is a frequency-hopping HF radiocommunications system.

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.

R&S®SECOM-H provides the following user data rates:

- 300 bit/s
- 600 bit/s
- 1200 bit/s
- 2400 bit/s

The data rates are selectable by HMI.

R&S®SECOM-V data mode

In R&S®SECOM-V, data rates up to 16 kbit/s are possible. User data rates span from 600 bit/s up to 9.6 kbit/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. R&S®SECOM-V hopping works in the frequency range from 30 MHz to 107.975 MHz and 121 MHz to 511.975 MHz. For detailed information, refer to the related technical information (R&S®SECOM-V).

72 kbit/s VHF/UHF modem (optional)

For mobile radiocommunications, military users often employ terminal equipment of narrow bandwidth and with 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 kbit/s
- Bandwidth efficiency up to 3 bit/s/Hz
- Auto-baud capability
- Embedded solution for R&S®MR300xH/U transceiver
- For complete VHF/UHF range from 30 MHz to 512 MHz

Depending on the data rate and the selected bandwidth, there may be different signal-code constructs. Their main differences are:

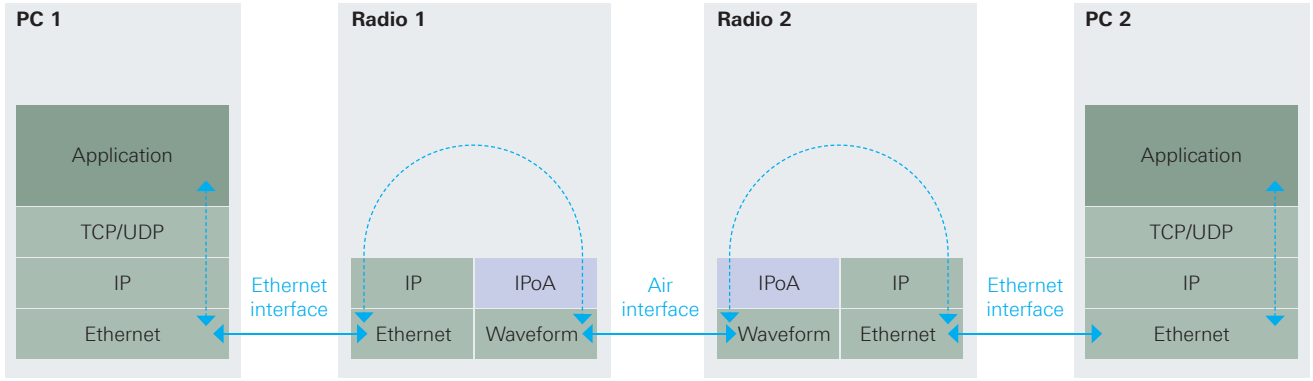
- Number of carriers
- Type and distribution of individual carrier modulation
- Number of pilot tones

These parameters ensure optimal matching to the data rate and the required bandwidth. The modem provides a transparent channel without integrated protocol. It can be operated under the control of a higher layer protocol outside the radio. 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 modem supports ten different waveforms with allocated bandwidths which can be selected by the user.

Waveform	Data rate	Bandwidth
72/36	72 kbit/s	36 kHz
72/24	72 kbit/s	24 kHz
64/36	64 kbit/s	36 kHz
64/24	64 kbit/s	24 kHz
56/24	56 kbit/s	24 kHz
48/24	48 kbit/s	24 kHz
36/36	36 kbit/s	36 kHz
32/24	32 kbit/s	24 kHz
24/24	24 kbit/s	24 kHz
16/12	16 kbit/s	12 kHz

The data rates as well as the subsciber data rates are selectable by HMI or can be preconfigured (R&S®RNMS3000).

IPoA – transparent IP data transfer over air



IPoA – IP radio transmission

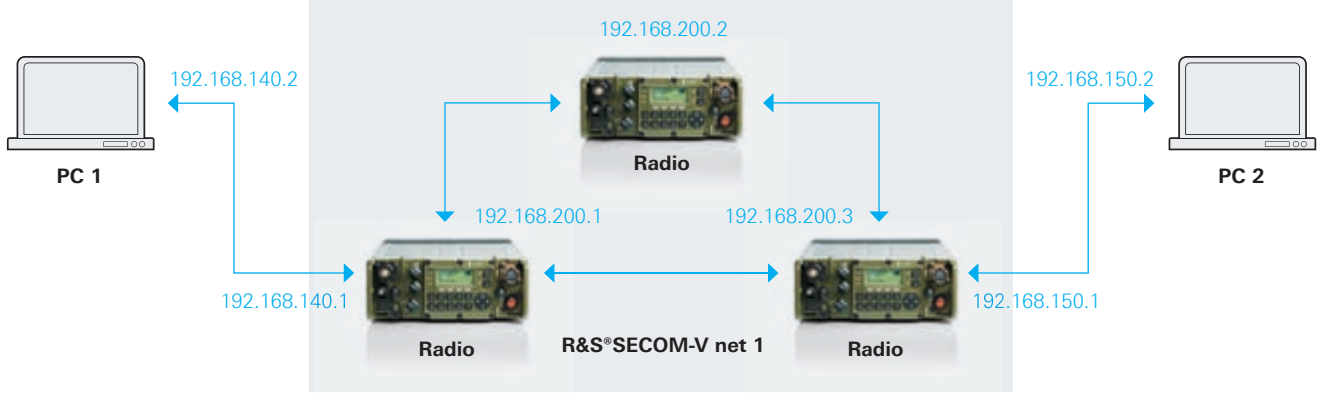
The IPoA embedded radio protocol provides transparent IP functionality over the air. It can be used to set up communications systems that require a transparent connection of IP networks over radio links. IP-based applications – such as situational awareness or message handling systems – are enabled to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

An R&S®M3TR radio equipped with IPoA includes standard 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. Besides the standard IP address of the physical Ethernet interface (which is used, for example, for remote control), a second IP address represents the air interface of the radio. The radio can be connected via an Ethernet connector (RJ-45) to 10BaseT and 100BaseT network equipment (such as hubs, switches, routers) provided by the R&S®KG3031, R&S®KG3032 docking station and the R&S®VT3050C compact amplifier. If IPoA functionality is to be used with manpack radios, the RS-232-C interface (R&S®M3TR data connector at the front panel) is to be used. A PPP connection will be established between the radio and the external system for this application.

IPoA protocol functionality

The embedded IPoA protocol currently supports IPv4 (Internet protocol version 4). An internal address mapping function ensures that data is delivered to the correct recipient. The IP packets are transmitted transparently over the radio channel. Performance of the data link 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.

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



ALE (R&S®GS4101S, R&S®GS4155S, op-code)

Automatic link establishment (ALE)
The common basic protocol standard for ALE is FED-STD-1045/46, known as 2nd generation or 2G ALE. 2G ALE uses non-synchronized 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.

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 3rd generation or 3G ALE. Through synchronization, the calling time to achieve a link may be reduced to less than 10 seconds. Although 3G ALE is better and more reliable, the existence of a large, installed base of 2G ALE radio systems and the wide availability of the equipment have made 2G the baseline standard for global interoperability.

The R&S®MR3002H/U and R&S®MR3003H/U transceivers support both the 2nd and 3rd generation of ALE in accordance with FED-STD-1045/46 and STANAG 4538.

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

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 initiated BIT is executed after manual activation by the operator. The continuous BIT 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.

R&S®M3TR supported services

GPS services

GPS reporting

Operators can send their own position in a waveform-specific net (R&S®SECOM-V or R&S®SECOM-P). 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 thus be stopped. Collisions between individual transmissions of GPS information are prevented.

GPS controller

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

GPS position information

The latest GPS information of each radio is stored in an internal table by the GPS controller. This table is updated each time when a GPS information is received by the GPS controller.

The GPS information is not stored in the GPS controller when the radio is switched off. 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 receiver module on the R&S®MR300xH and R&S®MR300xU

The GPS receiver module is built into the R&S®M3TR (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 radio. External audio equipment can still be used with the GPS module installed.

R&S®HV3003 GPS antenna

The R&S®HV3003 is an L1-band GPS antenna with high gain and low noise amplifier for tactical applications. It can be connected directly to the GPS antenna input of R&S®MR3000 transceivers. The R&S®HV3003 features both a magnetic holder and a belt for attaching the antenna to the carrying bag for the radio, for example the R&S®HV3003 includes a high-performance GPS patch antenna and a low noise amplifier. The antenna is of low profile design, and it is compact and fully waterproof.

- Compact design
- Fully weatherproof
- Low weight

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

R&S®HV3003 GPS antenna.

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/U) presets can be defined and stored in the radio.

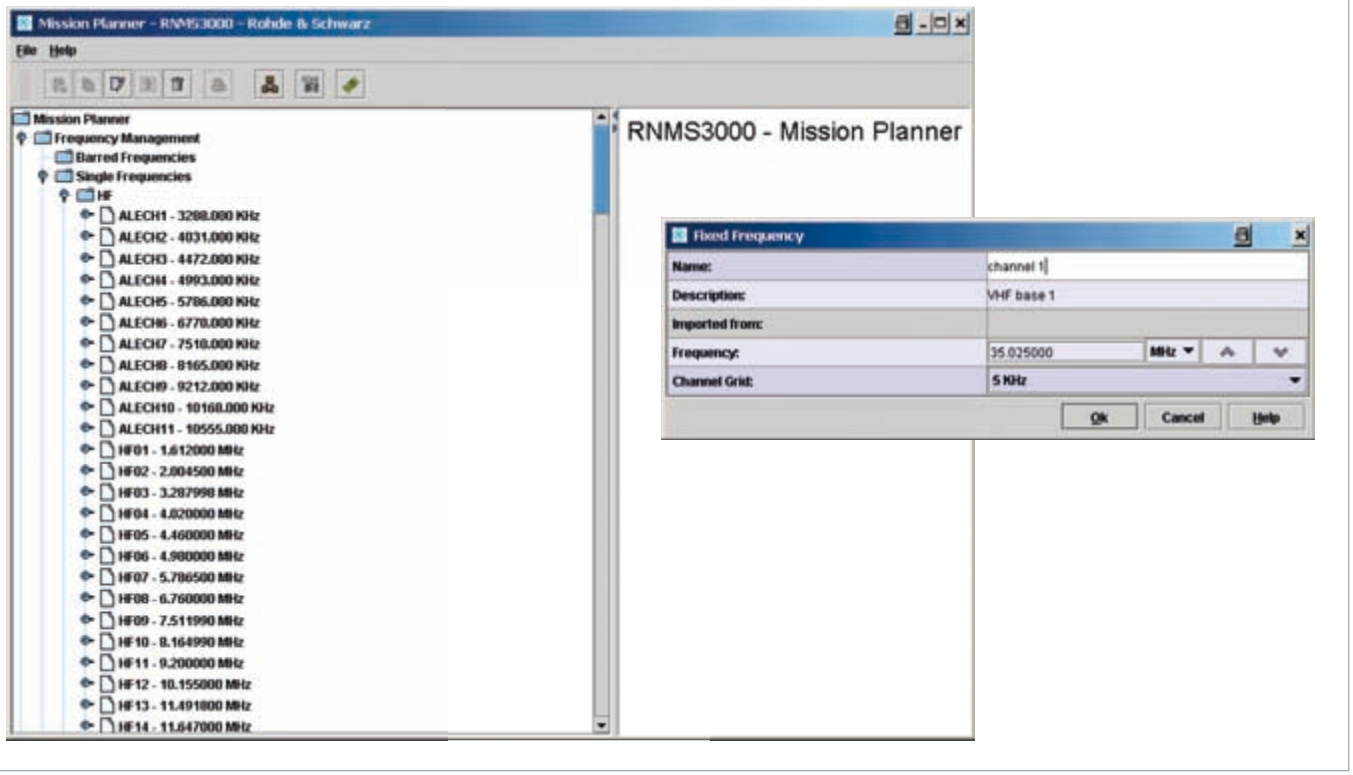
Channels (R&S®MR300xH/U)
A channel is a set of parameters specifying an FF channel (e.g. TX and RX frequency, modulation, RF power). Channel data can be stored in both the manual preset or on one of the remaining 99 presets. In total, 450 channels are available:

First 400 channels:
- Can be generated during R&S®RNMS3000 configuration
- Can be entered directly at radio HMI
- Available on PP 0 (manual PP)

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

Mission planner – FF channel management



Accessories for the R&S®MR300xH/U

	Type, designation	Description
Audio accessories		
	**R&S®GA3001** **Handset** Rugged handset for R&S®MR3000 transceivers	The R&S®GA3001 handset can be connected to the audio connector of the R&S®MR300xH and R&S®MR300xU transceivers, as well as to the switching unit, the remote control unit and other system components of the R&S®M3TR transceiver family. ❙ High microphone sensitivity ❙ High efficiency ❙ Whisper mode capability ❙ Rugged moulded housing ❙ Non-reflecting matt finish
	**R&S®GA3002** **Headset with PTT** Lightweight headset with active microphone	The R&S®GA3002 is is available as a single-ear and as a double-ear version. A flexible cut-out polymer ear pad makes for user convenience without masking outside noise. The microphone is fitted to an adjustable flexible support. An adjustable headband allows the user to wear the headset according to personal preferences and without requiring any tools. ❙ Improved intelligibility ❙ High microphone sensitivity ❙ PTT unit or optional VOX operation ❙ For use with and without combat helmets
	**R&S®GA3003** **Microphone/Speaker** Loudspeaker box with built-in audio amplifier and microphone	The R&S®GA3003 consists of a loudspeaker box with built-in audio amplifier and microphone. The active loudspeaker/microphone can be connected directly to the audio interface of R&S®MR3000 transceivers. Other than with handsets, the received signal is audible over several meters. The unit features a PTT switch and a quick-fastening device to fix it to clothing or bags. The R&S®GA3003 needs no external power supply.
	**R&S®GA3005** **Loudspeaker** Loudspeaker with connector for R&S®GA3001 handset/ R&S®GA3002 headset	The active loudspeaker box is used for loud monitoring of the received signal and can be connected directly to the audio interface of R&S®MR3000 transceivers or the audio connector of the switching unit. The R&S®GA3005 consists of a loudspeaker box with built-in audio amplifier and a box holder, which allows the position of the box to be changed when necessary. Additionally, it features an output for the R&S®GA3001 handset or R&S®GA3002 headset. This makes it possible to operate the loudspeaker together with a handset/headset at the same time. ❙ No separate power supply required ❙ Built-in audio amplifier ❙ Output for handset or headset ❙ Volume control

	Type, designation	Description
Batteries and battery chargers		
	**R&S®IB3001** **Li-Ion Battery Pack** **R&S®IB3002** **Combat Battery Pack** Power supply for portable use of R&S®MR3000 transceivers	The R&S®IB3001/IB3002 are sealed power packs with a watertight connector to the radio. They provide highest energy density, low weight and high autonomy. Two versions are available: a rechargeable Li-Ion battery (R&S®IB3001) and a non-rechargeable LiSO2 combat battery (R&S®IB3002). The R&S®IB3001 achieves maximum energy density due to Li-Ion technology. The battery pack's interface supports charge control functions such as battery state-of-charge, remaining capacity, remaining time, and chemical composition, which are available over the serial link. The battery pack does not require any maintenance. The battery pack is equipped with quickrelease fasteners, and single-hand operation is provided. The battery pack is protected against: ❙ Short circuit (all cases) ❙ Overdischarging (rechargeable batteries only) ❙ Overcharging (rechargeable batteries only) ❙ Polarity inversion during charging (rechargeable batteries only) The rechargeable battery packs withstand as much as 1000 charge/discharge cycles with no less than 60% of the initial capacity. ❙ Rechargeable, up to 1000 cycles ❙ Li-Ion technology, no memory effect ❙ Smart bus control for continuous monitoring of battery parameters ❙ High capacity for higher autonomy ❙ Low volume and weight
	**R&S®IC3000** **Stationary Battery Charger** Charger for the R&S®IB3001 Li-Ion battery packs	The R&S®IC3000 is a charger for the R&S®IB3001 Li-Ion battery packs. It can charge up to 8 batteries simultaneously. The battery charger is intended for indoor use, e.g. workshops or shelters. Mains power supply allows input voltages from 100 V to 240 V AC at 50 Hz to 60 Hz. The R&S®IC3000 provides comprehensive battery maintenance functionality. This includes capacity measurement, battery status read-out, charging to C/2 for storage, or controlled discharging. After a battery has been charged to the desired level, the charger automatically stops charging. Batteries can therefore remain in the charger without any risk of overcharging. If a non-rechargeable battery (e.g. R&S®IC3002 Li-S battery) is accidentally connected to the charger, the type of battery is detected automatically, and no charging takes place. Because R&S®M3TR batteries store their operating parameters in their own memory, it is possible to read out battery data such as available battery capacity, state of charge, temperature, battery chemistry, etc. The charger provides four main functions. These functions can be selected for each battery slot independently: ❙ CH: charging to full capacity ❙ C/2: charging or discharging to 60 % capacity (recommended for battery storage) ❙ CAP: discharging with capacity measurement, subsequently charging to full capacity ❙ READ: read-out of battery data
	**R&S®IC3001** **Mobile Battery Charger** Vehicular charger for the R&S®IB3001 Li-Ion battery packs **R&S®GK3020** Power supply cable for the R&S®IC3001 battery charger	The R&S®IC3001 is a vehicular charger for the R&S®IB3001 Li-Ion battery pack. One battery can be charged at a time. The charger is a rugged and waterproof unit for use mainly in military vehicles. The input voltage range is 10 V to 33 V DC. The R&S®IC3001 can be installed in vehicles with its mounting plate in horizontal or vertical position. Charging of the battery starts automatically after the battery has been connected to the charger. As soon as a battery is fully charged, the charger automatically stops charging. Batteries can therefore remain in the charger without any risk of overcharging. If a non-rechargeable battery (e.g. R&S®IB3002 Li-S battery) is accidentally connected to the charger, the type of battery is detected automatically, and no charging takes place. A red LED lights up to inform the user that the wrong battery is connected.

	Type, designation	Description
Antenna tuning unit and other equipment		
	**R&S®FK3150** **Antenna Tuning Unit** Automatic matching of HF antennas, in particular of electrically short antennas **R&S®KS3150F** **Shockmount** Recommended extra	The R&S®FK3150 HF antenna tuning unit is part of the R&S®M3TR tactical transceiver family. It allows automatic matching of HF antennas in the range from 1.5 MHz to 30 MHz, in particular of electrically short antennas, as are usually found in vehicular applications. The sturdy and water-proof casing of the R&S®FK3150 is shock- and UV-resistant and thus ideal for mobile applications. The ATU is arc-protected against lightning strokes. It is also protected against over-temperature and static charges on antennas. Fault detection and reporting to the R&S®MR3000 transceiver is provided by an automatic BIT (built-in test). The microprocessor-controlled tuning allows the self-learning of more than 1500 tuning settings which are retained in a non-volatile memory. The stored channels can be called up quickly, which allows frequency-agile operation (ALE, slow frequency hopping). The channel information can be easily loaded from the transceiver to the ATU's internal memory. The R&S®FK3150 is intended for use with an HF power amplifier. The amplifier also supplies power to the ATU, which means that the R&S®FK3150 does not require a power supply of its own. The tuner is controlled via two coaxial lines (R&S®M3TR external control bus).
	**R&S®GB3031R** **Single Remote Control Unit** Remote control and remote operation of one R&S®MR3000 radio	The R&S®GB3031R is intended for remote control and remote operation of one R&S®MR300xH/U radio. Besides a built-in loudspeaker, the unit features a serial interface for connecting a data terminal or a PC, as well as an audio connector for R&S®M3TR handsets or headsets. Moreover, the unit is equipped with a line interface (600 Ω, 0 dBm) for connecting vehicle intercom systems, for example. Power is supplied by the connected radio so that no additional power supply is required. Connection to the radio is provided by two cables, one exchanging remote control signals, the other carrying user data, audio signals, and power supply. The remote control unit uses the radio's removable front panel. The panel must therefore be removed from the radio and installed in the remote control unit. The control cable fits directly into the front-panel port of the radio. The maximum distance between radio and remote control unit is 12 m. ❙ Remote control of all functions accessible from the radio's front panel ❙ Monitoring of audio signals from and to the radio, via the built-in loudspeaker or external handset/headset ❙ Volume control and muting of the built-in loudspeaker ❙ Remote voice communications by handset or headset ❙ Remote data communications via serial data interface for data terminals or PC ❙ Audio interface (600 Ω) for external audio equipment
	**R&S®GK3005** **Fixture Cable for Detachable Front Panel**	The R&S®GK3005 is an accessory and allows detached operation of an R&S®M3TR radio via its detachable frontpanel. It consists of a plastic cover with a flexible cable supporting operation of the radio up to a distance of approx. 2 m. The R&S®GK3005 is delivered without radio frontpanel, which is part of the R&S®MR3000U or R&S®MR3000H radio. The R&S®GK3005 makes it possible to operate the radio in portable applications where the radio is carried on the user's back in the manpack bag. By means of straps (included) the unit can be worn on the arm, in front of the user's chest, or can be fixed at the belt. It can also be installed in vehicles as a simple remote control unit. The detached frontpanel supports control of all radio functions, but does not include any radio interfaces. Audio/data accessories, antennas, etc. therefore be connected directly to the radio.

R&S®KG3031 Single Docking Station for R&S®M3TR Manpack Radios

R&S®KG3032 Dual Docking Station for R&S®M3TR Manpack Radios

The R&S®KG3031/KG3032 docking stations are a core accessory for R&S®M3TR radio systems. Like a docking station for a laptop computer, the R&S®KG3031 connects R&S®MR3000 manpack radios to external system components, such as:

- RF power amplifiers
- Antennas
- Audio equipment (handsets/headsets, loudspeakers, vehicle intercom systems, etc.)
- Power supply
- Field telephones
- Data interfaces (including Ethernet)
- External cipher units

Unlike legacy solutions based on mere mechanical mounting frames with all wiring directly at the manpack radio, the R&S®KG3031 follows a different approach: Because each R&S®MR3000 manpack radio features a rear system connector, the radio can be mounted and dismounted in no time.

The rear connector provides the most important interfaces such as RF, audio, power supply lines, a digital bus to control external equipment, etc. For standard applications, it is not necessary to fit cables to the radio's front panel. This provides "jerk and run" capability in an emergency, or convenient handling if the radio is temporarily used as a manpack. Front clips with knurled screws allow the radio to be inserted and removed without using any tools. The fixation elements are secured against loosening caused by vibration.

The R&S®KG3031 docking station (DS) is intended for installation of one R&S®MR3000H or R&S®MR3000U manpack radio. For applications requiring simultaneous operation of two radio stations, the R&S®KG3032 dual docking station is available. It enables, for example, parallel use of an HF and an VHF link at the same time. Other applications cover full duplex links as well as relay and rebroadcast stations that require simultaneous RX and TX operation.

Installed manpack radios operate with external power amplifiers or their internal (manpack) power amplifier if an output power of up to 10 W (VHF/UHF) or 20 W (HF) is sufficient for the distance to be covered. For this application, docking stations are equipped with a fan unit to dissipate the heat from the manpack.

Interface options allow connection to external devices such as power amplifiers, vehicle intercom systems, or field telephone systems. A built-in power supply /filter unit allows the system to be fed directly from the vehicle board supply.

R&S®KG3032 dual docking station for R&S®M3TR manpack radios.

R&S®KG3031 single docking station for R&S®M3TR manpack radios.

R&S®GP3000 Fillgun for R&S®MR3000 Tactical Radios

R&S®GP3100 Fillgun for R&S®MR3000 Tactical Radios (Have Quick I/II mode)

Transfer of configuration data to one or more R&S®MR3000 tactical radios

The fillgun (data load device) is used to transfer configuration data to one or more R&S®MR3000 radios. Its particular advantage is that data can be distributed to radios without requiring additional hardware such as PCs and power supplies.

Configuration can include the following, for example (depending on loaded software options):

- Transceiver operating modes (FF, FH, ALE, voice/data modes)
- Assignment of nets and channels to preset pages (up to 99)
- Frequencies and hop sets of presets
- Configuration of data modems
- Simplex or semiduplex operation
- Channel parameters (modulation, squelch type, power, voice compression etc.)
- Address management, SECOM/ALE addresses, point-to-point, point-to-multipoint link management
- Modem configuration, modem support
- Security keys for TRANSEC and COMSEC

The fillgun needs no power supply since it is supplied by either the connected PC or the radio. The fillgun status is indicated by LEDs (power on, reading, writing, connected, error).

Use

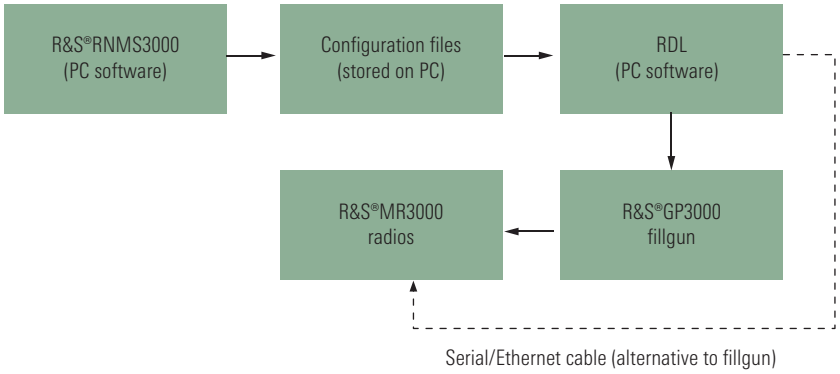
Operation is simple and straightforward. After setting up a net configuration with R&S®RNMS3000, the generated configuration files are stored in the fillgun via the serial interface (R&S®GK3021 USB cable) of the PC running the R&S®RNMS3000 remote device loader (RDL). The fillgun now contains the necessary preset information for all radios of the addressed network(s). Configuration data may differ between the subscribers (radios) of a net; therefore, each radio will download the information that was specifically generated for it during the network management process.

At the radio site, operator action is limited to choosing the appropriate RGA (radio global address) in the radio MMI to assign a radio to its preconfigured configuration. After finishing the download process, the radio will reboot and be fully operational.

Security

All files transferred from and to the fillgun are encrypted before loading. Sensitive data such as keys is therefore stored in the fillgun in black form only.

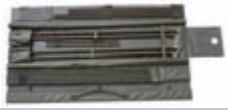
Data transfer using the R&S®GP3000 fillgun



Antennas for the R&S®MR300xH/U

Type	Frequency range	Power	Design	Application	Mast	Antenna coupler
Antenna selection chart – HF						
R&S®HV3007 (see also page 33) 	1.5 MHz to 30 MHz	20 W	Whip	Manpack	N/A	R&S®MR3000H
R&S®AK3001 [1] 	1.5 MHz to 30 MHz	150 W	Wire	Manpack	R&S®KM3032	R&S®MR3000H
R&S®AK3031 [2] 	2 MHz to 90 MHz	20 W	Wire dipole	Manpack	R&S®KM3032	Not required
R&S®HV3011	1.5 MHz to 30 MHz	150 W	Rod	Vehicle	N/A	R&S®MR3000H/ R&S®FK3150
R&S®HA104 	1.5 MHz to 30 MHz	150 W	Rod	Vehicle	N/A	R&S®MR3000H/ R&S®FK3150
R&S®AK503 [3] 	1.5 MHz to 30 MHz	150 W	Wire	Vehicle Semi-stationary	R&S®KM011	R&S®MR3000H/ R&S®FK3150

[1] R&S®GK3019 model .04 long wire adapter required.
[2] R&S®GK3019 model .02 BNC adapter required.
[3] R&S®HZ3503 model .02 long wire adapter required.

Type	Frequency range	Power	Design	Application	Mast
Antenna selection chart – VHF tactical					
R&S®HV3004 (see also page 33) 	30 MHz to 88 MHz	10 W	Whip	Manpack standard whip antenna	N/A
R&S®HV3021 (see also page 38) 	30 MHz to 88 MHz	5 W	Whip	Handheld whip antenna	N/A
R&S®HV3022 (see also page 39) 	30 MHz to 88 MHz	5 W	Whip	Handheld whip antenna	N/A
R&S®HD3088[1] **(see also page 40)** 	30 MHz to 88 MHz	10 W	Wire	Manpack/handheld hang-up antenna	R&S®KM3032
R&S®HD3001[1] **(see also page 39)** 	30 MHz to 88 (108) MHz	25 W	Wire	Manpack handheld high-gain directional antenna	R&S®KM3032
R&S®HV3015 (see also page 37) 	30 MHz to 108 MHz	50 W	Rod	Vehicle/semi-stationary, no ground plane needed due to dipole design, with lightning protection	R&S®KM3031
R&S®HV3012 (see also page 35)	30 MHz to 108 MHz	50 W	Rod	Vehicle, optimized for low profile	N/A
R&S®HL3031 (see also page 40) 	30 MHz to 108 MHz	100 W	Log-periodic dipole	(Semi-)stationary, high-gain antenna	R&S®KM3031

[1] R&S®GK3019 model .02 BNC adapter required.

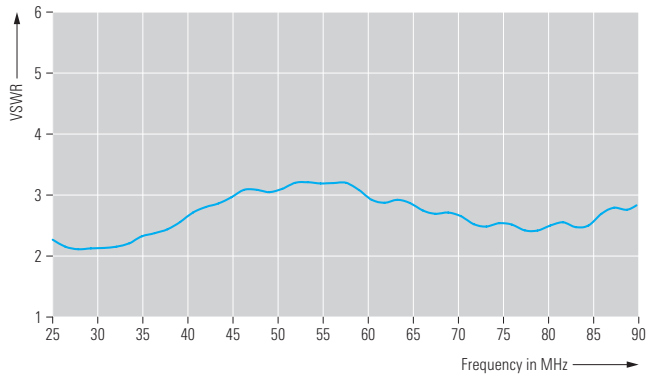
Type	Frequency range	Power	Design	Application	Mast
Antenna selection chart – VHF/UHF and multiband					
R&S®HV3009 (see also page 34) 	118 MHz to 400 MHz	10 W	Whip	Manpack	N/A
R&S®HV3013 (see also page 36) 	225 MHz to 512 MHz	50 W	Rod	Vehicle/semi-stationary, no ground plane needed due to dipole design, with lightning protection	R&S®KM3031
R&S®HV3018 	108 MHz to185 MHz	50 W	Rod	Vehicle/semi-stationary	R&S®KM3031
R&S®HV3019 (see also page 38) 	118 MHz to 400 MHz	50 W	Rod	Vehicle/semi-stationary, no ground plane needed due to dipole design, with lightning protection	R&S®KM3031
R&S®HL3032 (see also page 40) 	220 MHz to 405 MHz	50 W	Log-periodic dipole	(Semi-)stationary, high-gain antenna	R&S®KM3031
R&S®HL3033	30 MHz to 512 MHz	50 W	Log-periodic dipole	(Semi-)stationary, high-gain antenna	R&S®KM3031
R&S®HK055L1 	30 MHz to 512 MHz	50 W	Rod	Vehicle/stationary	N/A

R&S®HV3004 Whip Antenna

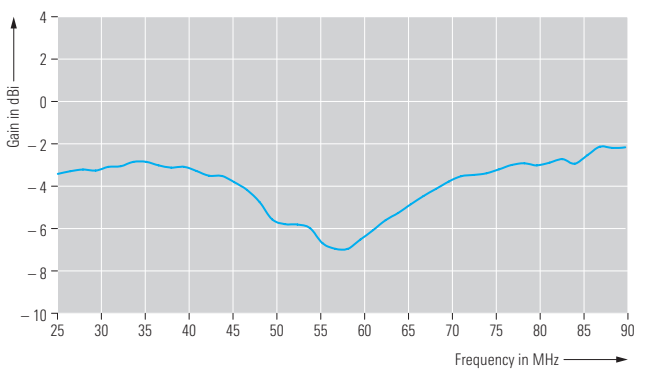
Flexible VHF manpack antenna with gooseneck
The R&S®HV3004 is a steel tape antenna sealed with a rubber cover. It can be folded at any point and has a flexible base to be operated with the radio in any position. The antenna will unfold automatically and can be bent to provide low profile if required.

- Frequency range 25 MHz to 88 MHz
- Low profile
- Folding tape antenna
- Low volume
- Low weight
- High gain

Typical standing wave ratio



Typical gain



R&S®HV3007 Whip Antenna

Whip antenna for portable use in the HF range from 1.5 MHz to 30 MHz
The R&S®HV3007 is a folding whip for R&S®MR3000H manpack radio sets. The antenna is made of copper-coated epoxy fiberglass elements that ensure optimum flexibility and reduced weight. The antenna is matched automatically by the internal antenna tuning unit of the R&S®MR3000H manpack radio.

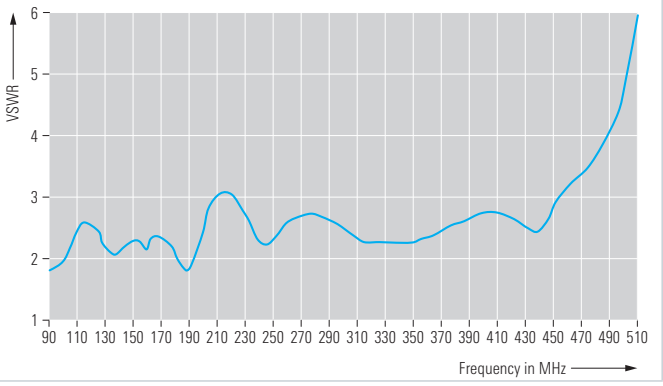
- Frequency range 1.5 MHz to 30 MHz
- End-fed whip for reliable links over short to medium distances
- Radiating elements made of composite fiber for low weight
- Flexible antenna base with spring
- Antenna tuned by built-in ATU of R&S®MR3000H transceiver

R&S®HV3009 Whip Antenna

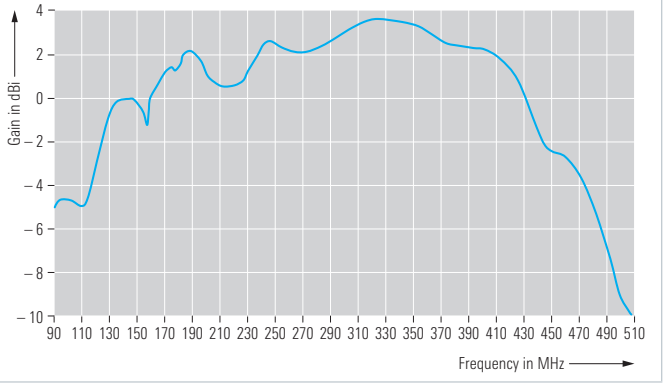
VHF/UHF manpack antenna for R&S®MR3000 radios
The R&S®HV3009 is a broadband manpack antenna. It consists of a sealed metal tube with matt black finish. A matching unit at the base of the antenna ensures proper matching over a wide frequency range. The antenna can be used together with any R&S®MR3000U manpack transceiver.

- Frequency range 118 MHz to 400 MHz
- Manpack antenna
- Broadband characteristics
- Low volume, low weight
- Completely sealed unit
- High gain

Typical standing wave ratio



Typical gain



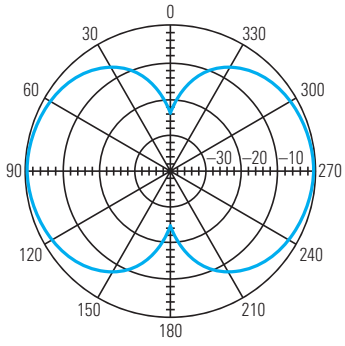
R&S®HV3012 Whip Antenna

Low-profile monopole antenna with radiating element made of stainless steel

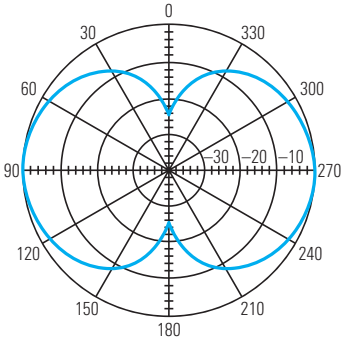
The R&S®HV3012 is a low-profile monopole antenna. Its radiating element is made of stainless steel. The antenna is also available with a GPS antenna integrated in the antenna base.

- Frequency range 30 MHz to 108 MHz
- Designed for operation on all kinds of vehicles including jeeps, trucks, and other armored vehicles
- Suitable for operation on shelters and on masts or in other permanent installations
- Low-profile, stainless steel whip
- GPS base available

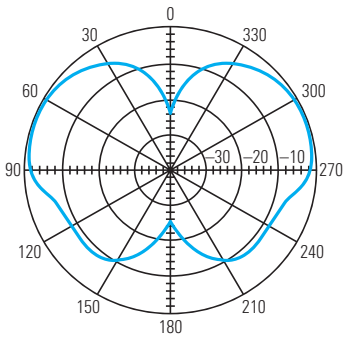
Radiation pattern: elevation



30 MHz

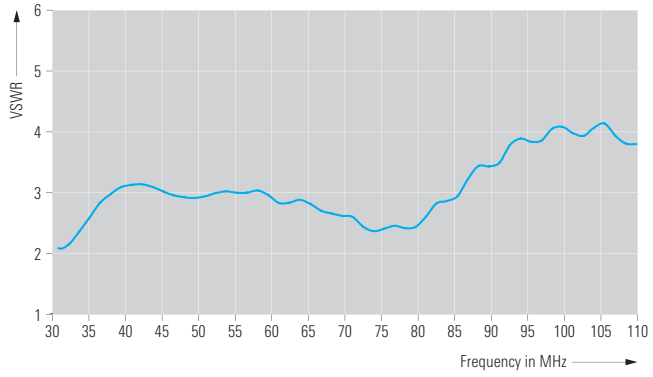


60 MHz

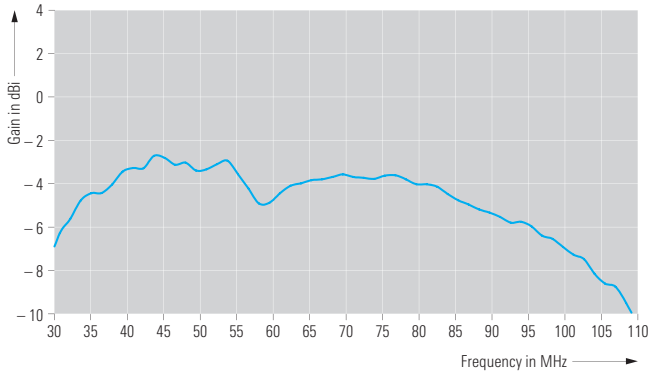


90 MHz

Typical standing wave ratio



Typical gain



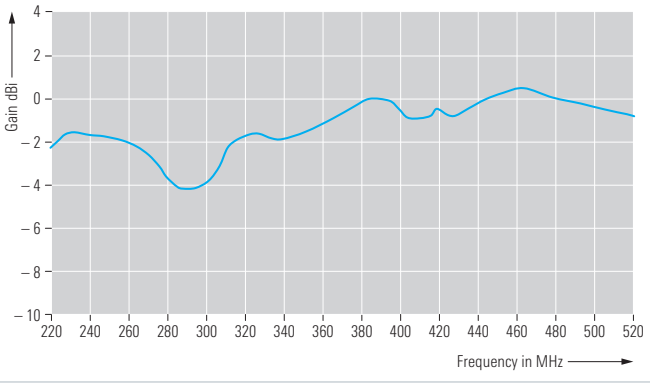
R&S®HV3013 Whip Antenna

Center-fed dipole antenna with radiating element completely enclosed in epoxy/fiberglass laminate

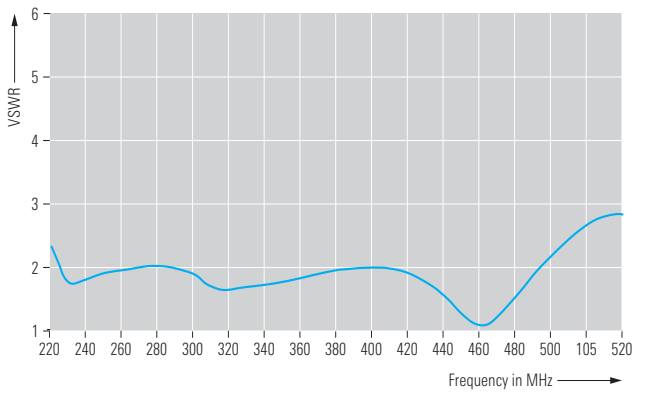
The R&S®HV3013 is a center-fed dipole antenna. Its radiating element is completely enclosed in epoxy/fiberglass laminate. Metal parts are made of brass and stainless steel. Rods can be exchanged without tools.

- Frequency range 225 MHz to 512 MHz
- Designed for operation on all kinds of vehicles including jeeps, trucks, and other armored vehicles
- Suitable for operation on shelters and on masts or in other permanent installations
- Different kinds of bases available, with or without spring for flexible or rigid installation (on request)
- No groundplane needed (center-fed)
- GPS base available

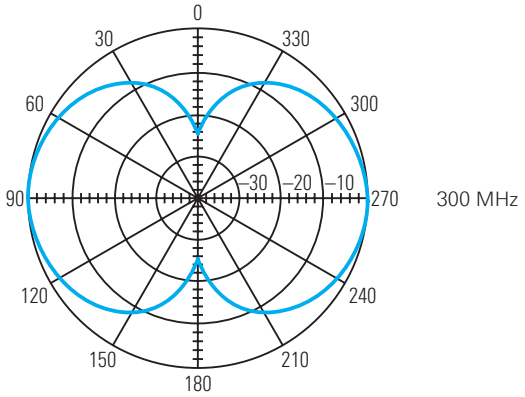
Typical gain



Typical standing wave ratio



Radiation pattern: elevation



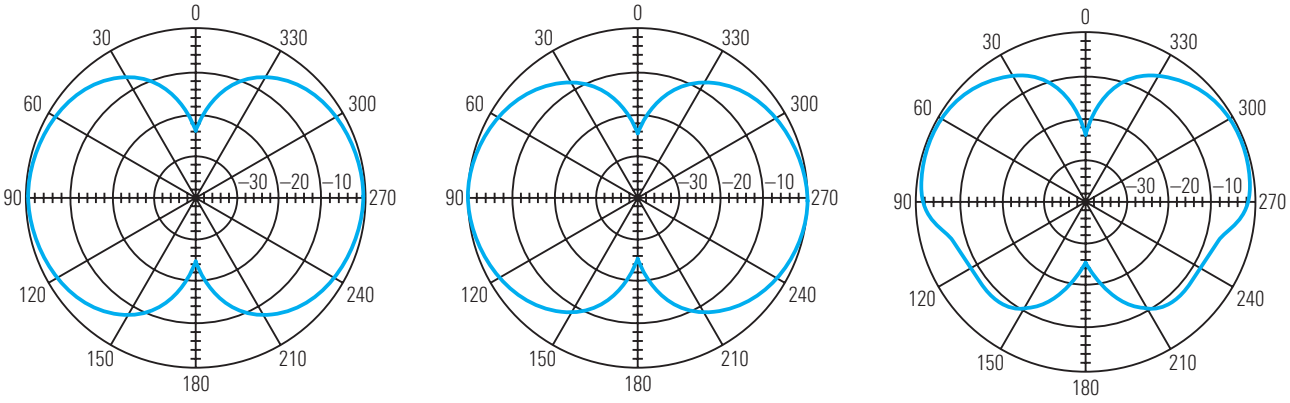
R&S®HV3015 Whip Antenna

Center-fed dipole antenna with radiating element completely enclosed in epoxy/fiberglass laminate

The R&S®HV3015 is a center-fed dipole antenna. Its radiating element is completely enclosed in epoxy/fiberglass laminate. Metal parts are made of brass and stainless steel. Because it uses the same base as the R&S®HV3013 antenna, rods can be exchanged without tools.

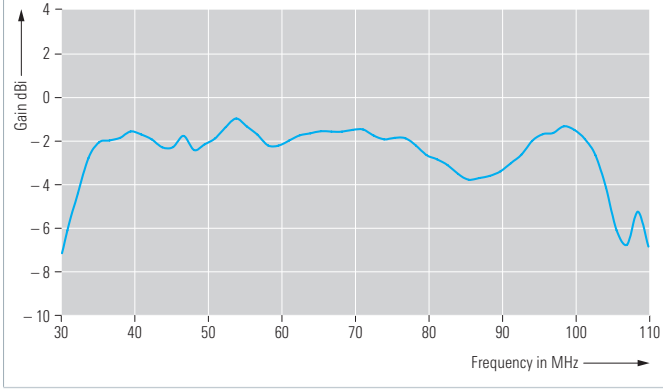
- Frequency range 30 MHz to 108 MHz
- Designed for operation on all kinds of vehicles including jeeps, trucks, and other armored vehicles
- Suitable for operation on shelters and on masts or in other permanent installations
- Different kinds of bases available, with or without spring for flexible or rigid installation (on request)
- No groundplane needed (center-fed)
- GPS base available

Radiation pattern: elevation

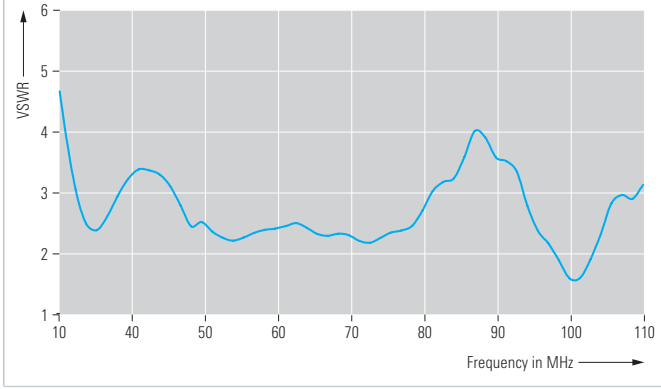


30 MHz | 60 MHz | 90 MHz

Typical gain



Typical standing wave ratio

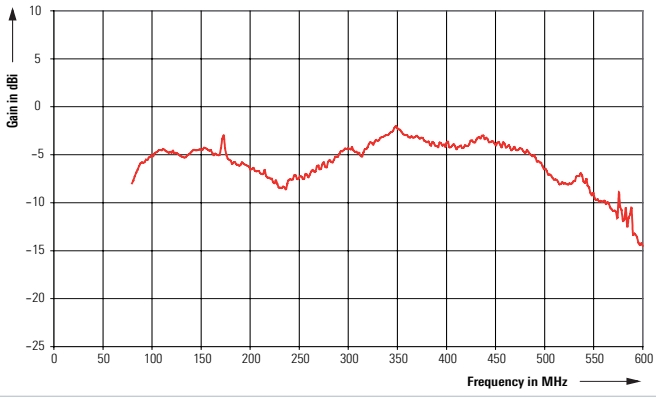


R&S®HV3019 Whip Antenna

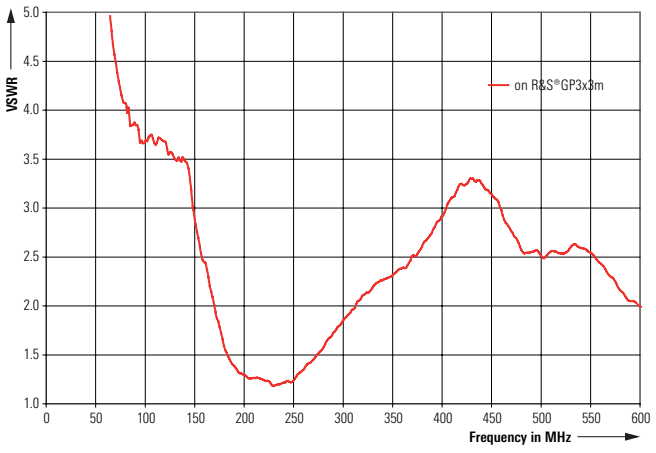
Center-fed dipole antenna with radiating element completely enclosed in epoxy/fiberglass laminate
The R&S®HV3019 is a center-fed dipole broadband antenna and covers the 100 MHz to 400 MHz range. Its radiating element is completely enclosed in epoxy/fiberglass laminate. Metal parts are made of brass and stainless steel. Rods can be exchanged without tools. Because the antenna has dipole characteristics, it can be used with and without a counterweight for both vehicle and mast installations.

- Frequency range 100 MHz to 400 MHz
- Designed for operation on all kinds of vehicles including jeeps, trucks, and other armored vehicles
- Suitable for operation on shelters and on masts or in other permanent installations
- Different kinds of bases available, with or without spring for flexible or rigid installation
- No groundplane needed (center-fed)
- Four-hole NATO flange with spring
- GPS base available

Gain of the R&S®HV3019



VSWR of the R&S®HV3019



R&S®HV3021 Whip Antenna

Basic type of antenna for R&S®MR3000P transceivers
The R&S®HV3021 is the basic type of antenna for R&S®MR3000P transceivers. The antenna consists of a flexible steel tape, covered by a plastic sleeve. The steel tape makes it possible to bend the antenna at any point, the minimum bending radius being 1 cm. The antenna is electrically connected to the transceiver via a BNC connector. The design of the antenna ensures high mechanical resistance. For storage, the antenna can be folded up to a length of only 0.25 m.

- Frequency range 25 MHz to 146 MHz

R&S®HV3019 Whip Antenna.

R&S®HV3021 Whip Antenna.

R&S®HV3022 Whip Antenna

Particularly suited for short-range communications – for R&S®MR3000P transceivers

The R&S®HV3022 is an antenna for R&S®MR3000P transceivers. It is particularly suited for short-range communications. The antenna consists of a flexible steel tape, covered by a plastic sleeve.

The steel tape makes it possible to bend the antenna at any point, the minimum bending radius being 1 cm. The antenna is electrically connected to the transceiver via a BNC connector. For storage, the antenna can be folded up to a length of only 0.25 m.

- Frequency range 25 MHz to 146 MHz

R&S®HD3001 Long-Wire Antenna

Designed for quick setup of mobile VHF communications sites

The R&S®HD3001 is a wide-range directional VHF antenna with a frequency range from 30 MHz to 88 MHz. The nominal antenna load is 50 Ω. The direction of maximum radiation is in the direction of the terminal resistor.

This antenna is suitable for stationary operation at longer distances (up to 25 km) also in undulated terrain. For optimal range, the antenna can be directed using a compass and a map.

- High gain
- Easy setup and disassembly
- Compact package for transportation
- Low weight
- Frequency range 30 MHz to 88 MHz

Radiating element

The long-wire directional antenna consists of an insulated 30 m long line with a loop in the middle. Both ends of the line are terminated with threaded pegs. The long-wire antenna set also contains the impedance transformer and the terminating resistor with counterweights, consisting of three 1.5 m long lines. Both ends of the antenna radiator are equipped with a couple of anchoring ropes with a maximum adjustable length of 2 m. All antenna elements are stored in a bag.

R&S®HD3088 Hang-Up Antenna

For operating R&S®M3TR/R&S®XV3088 transceivers from manholes, forests, or buildings
This antenna is used for operating R&S®M3TR/ R&S®XV3088 transceivers from manholes, forests, or buildings. The antenna consists of a halyard for raising the antenna, an antenna element, an impedance matching unit in the bottom part of the antenna element, two 2.5 m counterpoises, and a 5 m coaxial cable terminated with a BNC connector. The antenna is reeled on an aluminum alloy winch. Its main advantage is that it allows a higher position to be attained than with the manpack whip antenna. In this way, the range of the R&S®M3TR/R&S®XV3088 can be increased remarkably.

- Compact antenna
- Fully weatherproof
- Low weight
- Frequency range 30 MHz to 88 MHz

R&S®HL3031/3032 Log-Periodic Antenna

High-gain directional antennas
The R&S®HL3031/R&S®HL3032 series of VHF and VHF/UHF log-periodic antennas has been designed for a wide range of applications, including tactical surveillance, monitoring, electronic countermeasures, and point-to-point communications.

The high-gain directional antennas are of rugged design. Since they can quickly and easily be assembled, they are ideal for tactical use under difficult environmental conditions. Vertical or horizontal modes of operation can be chosen and very similar radiation patterns are generated in both orientations. The antennas are painted in olive drab. A carrying bag is provided for antenna storage and transportation. Both antennas are also available with lightweight tactical masts such as the 8.5 m R&S®KM3031. This mast system consists of tubular fiberglass sections to reduce pattern distortion when the array is vertically polarized.

- R&S®HL3031: 30 MHz to 108 MHz, 100 W
- R&S®HL3032: 220 MHz to 405 MHz, 100 W

Accessories for the R&S®MR3000P

	Type, designation	Description
	**R&S®GA3023** **Microphone/Speaker** Loudspeaker box with built-in audio amplifier and microphone for R&S®MR3000P transceivers	The R&S®GA3023 consists of a loudspeaker box with built-in audio amplifier and microphone. The active loudspeaker/microphone can be connected directly to the audio interface of R&S®MR3000P transceivers. Other than with handsets, the received signal is audible over several meters. The unit features a PTT switch and a quick-fastening device to fix it to clothing or bags. The R&S®GA3023 needs no external power supply.
	**R&S®IB3022** **Li-Ion Battery Pack** Li-Ion battery pack for R&S®MR3000P	The R&S®IB3022 is a battery pack for the R&S®MR3000P handheld radio. Due to Li-Ion technology it provides particularly high capacity. The battery pack consists of a serial-parallel set of four Li-Ion cells with protective diagnostics circuits. A display on the battery informs about current battery capacity. Built-in diagnostics circuits use two-wire bus communications between the battery pack and the charger to display the battery pack charging parameters on the charger display.
	**R&S®IC3022** **Universal Charger** Universal charger for R&S®MR3000P batteries	The R&S®IC3022 is a charger for R&S®IB3022 battery packs used for the R&S®MR3000P. It can charge up to eight batteries simultaneously. The battery charger is intended for indoor use, e.g. workshops or shelters. Mains power supply allows input voltages from 100 V to 240 V AC at 50 Hz to 60 Hz. The R&S®IC 3022 provides comprehensive battery maintenance functionality. This includes capacity measurement, battery status read-out, or controlled discharging. After a battery has been charged to the desired level, the charger automatically stops charging. Batteries can therefore remain in the charger without any risk of overcharging. Because R&S®MR3000P batteries store their operating parameters in their own memory, it is possible to read out battery data such as available battery capacity or state of charge.
	**R&S®IV3021** **Vehicle Support** Vehicle mount with charger for the R&S®MR3000P	The R&S®IV3021 vehicle support makes it possible to supply power to the R&S®MR3000P and to charge its battery pack in vehicles with board mains voltage of 12 V or 24 V. The R&S®IV3021 vehicle support is to be fixed to the vehicle dashboard using four screws on its base. The support can accommodate both the transceiver and one battery pack. When inserted, the transceiver can be secured by a lever lock. The R&S®IV3021 is turned on by turning on the transceiver or by putting the battery pack in the charging position. The ON status and charging status are indicated by LEDs. Transceiver and battery pack are not supplied with the support.

R&S®GP3021 Fillgun for R&S®MR3000P Transceivers

For transmitting all relevant preset information, as well as COMSEC/TRANSEC keys

The R&S®GP3021 fillgun (data load device) is used to transfer configuration data to one or more R&S®MR3000P VHF tactical handheld radios. Its particular advantage is that data can be distributed to radios without requiring additional hardware such as on-site PCs and power supplies.

Configuration can include the following:

- Transceiver operating modes (FF, FH, voice/data modes)
- Assignment of nets and channels to preset pages (up to 9)
- Frequencies and hop sets of presets
- Simplex or semiduplex operation
- Channel parameters (squelch type, RF power, etc)
- Address management, R&S®SECOM-P addresses, link management
- Security keys for TRANSEC and COMSEC

The fillgun needs no power supply since it is supplied by either the connected PC or the radio. An erase button is available to erase stored configuration data. Moreover, a display shows the ID of the fillgun. The equipment supplied includes the fillgun, a fabric case, and a USB cable for connecting the device to a PC.

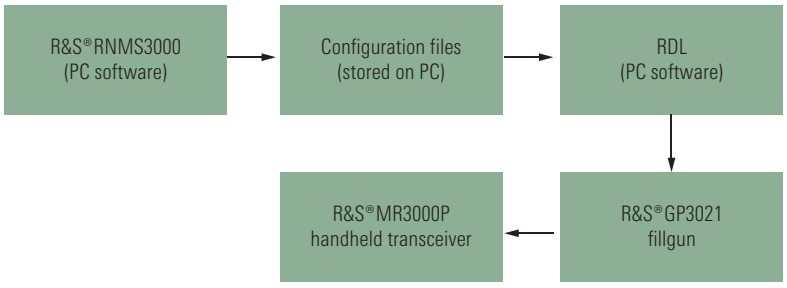
Use

Operation is simple and straightforward. After setting up a net configuration with the R&S®RNMS3000 mission planner, the generated configuration files are stored in the fillgun via the serial interface (USB) of the PC running the R&S®RNMS3000 remote device loader (RDL). The fillgun now contains the necessary preset information for all radios of the addressed network(s). At the radio site, operator action is limited by connecting the fillgun to the AF connector and loading the configuration into the radio. After finishing the download process, the radio is fully operational.

Security

All files transferred from and to the fillgun are encrypted before loading. Sensitive data such as keys is therefore stored in the fillgun in black form only.

Data transfer using the R&S®GP3021 fillgun



External Amplifiers

Configuration overview with docking station and power amplifiers

External amplifiers – overview

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

VHF/UHF antennas

- VHF
- UHF
- Multiband

HF antennas

- Whip
- Wire
- NVIS

R&S®KG3031A docking station

R&S®VT3050 50 W VHF/UHF power amplifier

R&S®VK3150 HF amplifier

R&S®FK3150 antenna coupler

Power supply

R&S®VT3050 50 W VHF/UHF Power Amplifier

The R&S®VT3050 50 W VHF/UHF power amplifier supports continuous operation across the 30 MHz to 512 MHz frequency range with 50 W transmit power.

The R&S®VT3050 is a member of the R&S®M3TR family of multiband tactical radio systems. This power amplifier meets the need for military voice and data communications in all analog and digital fixed-frequency and frequency-hopping modes supported by the R&S®MR300xH/U tactical radio. The amplifier is especially designed for high linearity to satisfy the requirements of the R&S®M3TR's high-speed radio modem for 72 kbit/s. Furthermore, it supports medium to fast frequency hopping. Collocation options are available for VHF Low (30 MHz to 88 MHz). The co-site filter is factory-installed. Fully automatic operation (controlled from the host transceiver) and rapid tuning capability make pre-/postselector operation transparent to the user.

Operational configuration and BITE/fault status reporting are performed via the transceivers. The R&S®VT3050 uses rugged tactical packaging and meets the same environmental specifications for temperature, shock, vibration and submersibility as the rest of the R&S®M3TR family. Operation is fully automatic. Built-in test equipment (BITE) and diagnostic testing are fully integrated into the transceiver system. The VHF/UHF amplifier is mounted separately with an independent shockmount. This provides additional flexibility when installing tactical radio systems into vehicles.

An R&S®M3TR VHF/UHF system can be easily upgraded to multiband operation. The R&S®M3TR's serial control bus allows combinations of transceivers with up to two external amplifiers. By adding an R&S®VK3150 HF amplifier and an R&S®FK3150 antenna tuning unit, the system can be expanded to a frequency range of 1.5 MHz to 512 MHz.

For use with standard VHF and UHF antennas, the amplifier features two configurable RF outputs. The frequency that splits the available frequency range of 30 MHz to 512 MHz is user-selectable. Possible settings could be, for instance, 30 MHz to 108 MHz for the RF_{Low} output leaving 108.025 MHz to 512 MHz for the RF_{High} output. If a multiband antenna such as the R&S®HK055L1 is used, the entire range of 30 MHz to 512 MHz can be routed to one of the outputs.

R&S®VT3050C 50 W VHF/UHF Compact Power Amplifier

The R&S®VT3050C 50 W VHF/UHF compact power amplifier accommodates an R&S®MR300xU or R&S®MR300xH manpack radio.

The R&S®VT3050C is a member of the R&S®M3TR family of multiband tactical radio systems. The power amplifier supports continuous operation across the 30 MHz to 512 MHz band with 50 W transmit power. The R&S®VT3050C accepts an R&S®MR300xU or R&S®MR300xH manpack radio (not included in the equipment supplied) as a plug-in exciter. Because each R&S®MR300xH/U manpack radio features a rear system connector, the radio can be mounted and dismounted quickly. Connectors at the front panel provide the most important interfaces such as RF, audio, power supply lines and a digital bus to control external equipment. For standard applications, it is not necessary to plug cables to the radio's front panel. This provides "jerk and run" capability in an emergency, or convenient handling if the radio is temporarily used as a manpack. The R&S®VT3050C operates on 12 V or 24 V vehicle power supply.

The R&S®VT3050C with all options, including R&S®KS3001V and R&S®MR300xH/U (radio not supplied with amplifier).

- Frequency range from 30 MHz to 512 MHz
- Very compact size, easy to install
- Output power 50 W CW and PEP
- Frequency-hopping capability (NATO HAVE QUICK I/II, R&S®SECOM-V, R&S®SECOM-P, R&S®SECOS)
- Protected against antenna mismatch, overload, overvoltage
- High MTBF
- Scalable for multiband operation (1.5 MHz to 512 MHz)

Options for the R&S®VT3050C

Co-site filter:
A collocation option is available for VHF Low (30 MHz to 88 MHz). The co-site filter is factory-installed. Fully automatic operation (controlled from the host transceiver) and rapid tuning capability make pre-/postselector operation transparent to the user.

Field telephone interface:
This option provides a two-wire interface to connect the amplifier to a field telephone. The operator can select four modes for routing telephone calls from and to the radio:

- Audio-Radio: audio interface connected to radio
- Radio-Phone: field telephone connected to radio
- Audio-Phone: field telephone connected to audio interface
- Audio-Radio-Phone: field telephone connected to radio and audio interface

Audio/data interface:
This option provides a versatile audio/data interface including power lines, audio, data and control signals. It is used to connect external devices such as an R&S®MMC3000 or KY57 cipher unit.

R&S®VK3150 150 W HF Power Amplifier

The R&S®VK3150 150 W HF power amplifier increases the HF output power of the R&S®MR300xH/U manpack radios to 150 W PEP or 100 W average.

The R&S®VK3150 provides medium-power/medium-range communications links. Typical applications include mobile or base station installations for general-purpose HF SSB voice and data communications.

Continuous coverage is provided over the 1.5 MHz to 30 MHz frequency range. The power amplifier section is of broadband design and fully supports frequency-agile operating modes (automatic link establishment, slow frequency hopping). When used with the automatic R&S®FK3150 HF antenna tuning unit, the output of the R&S®VK3150 is automatically matched to most rod and whip antennas.

Built-in self-test features permit operators or maintenance personnel to fully check the transceiver and the power amplifier down to module level. Fault conditions are displayed on the transceiver's front-panel display.

The R&S®MR300xH/U manpack acts as an exciter for the power amplifier, avoiding the disadvantages of transceiver/booster solutions with respect to unwanted emissions. The HF power amplifier is mounted separately on an independent shockmount with room for proper air flow. This provides additional flexibility when installing tactical radio systems into vehicles.

The R&S®VK3150 uses rugged tactical packaging and meets the same environmental specifications for temperature, shock, vibration and submersibility as the rest of the R&S®M3TR family.

R&S®VK3150 150 W HF Power Amplifier.

R&S®MG3500 500 W HF Power Amplifier

The R&S®MG3500 power amplifier increases the HF output power of an R&S®MR300xH/U transceiver in the HF range up to max. 500 W. Thus, it makes reliable medium- and long-range connections via ground wave and sky wave possible. Typical applications include stationary and semi-mobile installations for tactical radio networks.

- Frequency range from 1.5 MHz to 30 MHz
- Output power 500 W CW and PEP
- Frequency-hopping capability (R&S®SECOM-H)
- Protected against mismatch and short-circuit
- High MTBF

Operating modes
The amplifier operates in the entire HF range from 1.5 MHz to 30 MHz. In addition to the analog modes (AM, FM, SSB), frequency-agile radio techniques such as ALE and the R&S®SECOM-H EPM method offered in the R&S®M3TR are also supported.

Broadband antennas (VSWR < 2) can be directly connected to the amplifier. If the R&S®FK4190M antenna tuning unit is added, standard rod, whip or wire antennas can also be operated. In this case, the R&S®FK4190 is automatically controlled and tuned by the receiver. Furthermore, hop sets and scan groups for the frequency-agile modes are learned for the connected antenna, and the associated data records are stored in the tuning unit. The tuning processes are largely performed automatically and do not require the operator to take any special steps.

Reliability
The R&S®MG3500 is fully integrated into the built-in test (power-on test and continuous test) of the transceiver. Error messages from the amplifier are output on the transceiver HMI for the operator. To make service easier, error messages down to the module level can be called up.

Power supply
The R&S®MG3500 can operate in either the single-phase or three-phase mode. In addition, emergency operation from a 24 V DC power supply is possible (max. HF output power is then 100 W).

Environmental and EMC properties
Like all system components of the R&S®M3TR family, the R&S®MG3500 has also been subjected to rigorous quality testing. It meets the requirements of the MIL-STD-810F and MIL-STD-461E standards.

Multiband extension
All R&S®MR300xH/U transceivers support multiband operation. The frequency range of an R&S®M3TR HF system equipped with the R&S®MG3500 can also be extended to cover the VHF/UHF range. This is done by connecting the R&S®MG3500 to the extension port of an R&S®VT3050C amplifier. This combination then permits continuous operation at all frequencies between 1.5 MHz and 512 MHz. Moreover, this configuration supports all R&S®M3TR EPM and modem options in the VHF and UHF range.

Design
The R&S®MG3500 HF power amplifier is modular with 19" rackmount design. Any R&S®MR300xH/U transceiver can be operated as an exciter for controlling the R&S®MG3500 power amplifier. It can be replaced without requiring tools, or it may be used temporarily as a manpack transceiver.

The interfaces on the manpack transceiver (audio, serial data/control, GPS antenna connector, etc.) of course remain accessible even after the transceiver has been installed in the R&S®MG3500.

R&S®MG3500 500 W power amplifier with the R&S®MR300xH/U transceiver in shock-mounted frame (option); the transceiver is not part of the equipment supplied.

Ordering information

Designation	Type	Order No.
HF/VHF tactical radio, 0.5 W to 10 W (HF up to 20 W)		
Int. GPS receiver, ATU, RS-232-C and IP interface	R&S®MR3000H	6118.3000.04
Int. GPS receiver, ATU, RS-232-C and IP interface; prepared for HAVE QUICK I/II and R&S®SECOS 5/16	R&S®MR3001H	6137.9300.04
Int. GPS receiver, ATU, RS-232-C and IP interface; prepared for STANAG 4538/4539	R&S®MR3002H	6137.9400.04
Int. GPS receiver, ATU, RS-232-C and IP interface; prepared for HAVE QUICK I/II, R&S®SECOS 5/16 and STANAG 4538/4539	R&S®MR3003H	6137.9500.04
VHF/UHF tactical radio, 0.5 W to 10 W		
Int. GPS receiver, RS-232-C and IP interface	R&S®MR3000U	6118.3500.04
Int. GPS receiver, RS-232-C and IP interface; prepared for HAVE QUICK I/II and R&S®SECOS 5/16	R&S®MR3001U	6137.9600.04
Int. GPS receiver, RS-232-C and IP interface; prepared for STANAG 4538/4539	R&S®MR3002U	6137.9700.04
Int. GPS receiver, RS-232-C and IP interface; prepared for HAVE QUICK I/II, R&S®SECOS 5/16 and STANAG 4538/4539	R&S®MR3003U	6137.9800.04
Tactical handheld transceiver up to 5 W		
Handheld Transceiver	R&S®MR3000P	6131.4307.10
Mating connector set (R&S®MR300xH/U)		
Connector Kit for R&S®M3TR transceiver	R&S®GK3004	6098.3253.02
R&S®SECOM support equipment (R&S®MR300xH/U)		
Key Generation Equipment for R&S®SECOM incl. R&S®KGE3000 key generation module and software for data communications and remote control	R&S®CP3000	6130.7983.xx
Fillgun for transmitting all relevant preset information, as well as COMSEC/TRANSEC keys	R&S®GP3000	6099.3805.02
Fillgun HAVE QUICK I/II for transmitting all relevant preset information	R&S®GP3100	6131.6039.02
Key Distribution Device for R&S®SECOS 5/16 TDMA	R&S®KDD3750	6131.2010.02
Remote control units		
Single Remote Control Unit with 3.5 m connecting cable	R&S®GB3031R	6131.7106.03
Single Remote Control Unit with 8 m connecting cable	R&S®GB3031R	6131.7106.10
Single Remote Control Unit with 12 m connecting cable	R&S®GB3031R	6131.7106.15
Docking stations and accessories (R&S®MR300xH/U)		
Single Docking Station with blower; frame only; not operational without additional components	R&S®KG3031	6121.9006.13
Dual Docking Station with blower; frame only; not operational without additional components	R&S®KG3032	6123.1002.13
Ground Plate without shockmounts; standard; for R&S®KG3031/KG3032	R&S®KG3030G	6123.1502.02
Ground Plate without shockmounts; with slides; for R&S®KG3031/KG3032	R&S®KG3030G	6123.1502.12
Ground Plate with shockmounts; standard; for R&S®KG3031/KG3032	R&S®KG3032G	6123.1854.02
Ground Plate with shockmounts and slides; for R&S®KG3031/KG3032	R&S®KG3032G	6123.1854.12
Auxiliary Box; standard; incl. audio line, Ethernet, audio wideband and multipurpose I/O interface; for R&S®KG3031/KG3032	R&S®GB3130A	6131.5984.02
Auxiliary Box; field telephone; incl. audio line, Ethernet, audio wideband and multipurpose I/O interface; for R&S®KG3031/KG3032	R&S®GB3130A	6131.5984.03
RF Interface Option; rear connector for 2 × N output	R&S®GV3130B	6131.6900.02
RF Interface Option; rear connector for R&S®VT3050 and R&S®VK3150	R&S®GV3130B	6131.6900.03
RF Interface Option; rear connector for R&S®VK3150 and 1 × N output	R&S®GV3130B	6131.6900.04
Power Filter; max. 20 A; for R&S®KG3031	R&S®IZ3030F	6125.9600.02
Power Filter; max. 40 A; for R&S®KG3032	R&S®IZ3030F	6125.9600.03
Audio accessories (R&S®MR300xH/U)		
Handset with PTT, microphone and earpiece	R&S®GA3001	6098.2505.02
Headset with PTT, microphone and two earpieces	R&S®GA3002	6098.2605.02
Headset with PTT, microphone and one earpiece	R&S®GA3002	6098.2605.03
Active Loudspeaker/Microphone	R&S®GA3003	6098.3001.02
Active Loudspeaker/Microphone	R&S®GA3023	6131.4707.02
Loudspeaker for connection to R&S®MR300xH/U audio socket with through-connection to R&S®GA3001/GA3002	R&S®GA3005	6137.7537.xx
Length of cable: 2 m		6137.7537.02
Length of cable: 5 m		6137.7537.05
Length of cable: 10 m		6137.7537.10
Batteries and chargers (R&S®MR300xH/U)		
Standard Battery Pack, Li-Ion, rechargeable; 28.8 V/5.5 Ah	R&S®IB3001	6118.0201.03
Combat Battery Pack, LiS02, non-rechargeable; 28 V/7.5 Ah	R&S®IB3002	6118.0253.03
Battery Charger, AC, stationary automatic charging of up to eight R&S®IB3001 Li-Ion batteries	R&S®IC3000	6098.2257.02

Ordering information

Designation	Type	Order No.
Battery Charger, DC, mobile automatic charging of one R&S®IB3001 Li-Ion battery	R&S®IC3001	6095.5755.02
Power supply cables for chargers are to be ordered separately.		
Power amplifiers (R&S®MR300xH/U)		
150 W HF Power Amplifier for R&S®MR300xH/U transceivers; 1.5 MHz to 30 MHz	R&S®VK3150	6118.0301.02
50 W VHF/UHF Power Amplifier for R&S®MR300xH/U transceivers; 30 MHz to 512 MHz; with co-site filter	R&S®VT3050	6118.5503.02
50 W VHF/UHF Power Amplifier for R&S®MR300xH/U transceivers; 30 MHz to 512 MHz; without co-site filter	R&S®VT3050	6118.5503.03
50 W VHF/UHF Compact Power Amplifier for R&S®MR300xH/U transceivers	R&S®VT3050C	6140.9250.xx
30 MHz to 512 MHz; with co-site filter		6140.9250.02
30 MHz to 512 MHz		6140.9250.03
30 MHz to 512 MHz; with field telephone and audio/data		6140.9250.07
30 MHz to 512 MHz; with co-site filter, field telephone and audio/data		6140.9250.17
Vehicular mounts (R&S®MR300xH/U): mounting frame with shockmounts		
For R&S®VT3050 or R&S®VK3150 Power Amplifier	R&S®KS3000V	6099.6104.02
For R&S®VT3050C Power Amplifier	R&S®KS3001V	6140.9350.02
For R&S®FK3150 Antenna Tuning Unit	R&S®KS3150F	6099.6004.02
Blower Unit for R&S®VK3150 or R&S®VT3050 power amplifiers	R&S®KL3000V	6118.0101.02
Control cables (R&S®MR300xH/U)		
Cable for connection of an R&S®VT3050 and an R&S®VK3150 power amplifier; 0.28 m length	R&S®GK3011	6130.2500.02
Cable for connection of an R&S®VT3050 and an R&S®VK3150 power amplifier; 0.5 m length	R&S®GK3011	6130.2500.03
Control Cable for connection of an R&S®VK3150 power amplifier and an R&S®FK3150 ATU	R&S®GK3012	6123.2909.xx
0.6 m length		6123.2909.02
0.8 m length		6123.2909.12
3 m length		6123.2909.03
20 m length		6123.2909.20
25 m length		6123.2909.25
50 m length		6123.2909.50
Please note that always two R&S®GK3012 control cables are required.		
Cable for connection of an R&S®VT3050 power amplifier and an R&S®KG3031/KG3032 docking station		
R&S®VT3050/R&S®VT3050C right-hand side; 1 m length	R&S®GK3030U	6130.2300.02
R&S®VT3050/R&S®VT3050C left-hand side; 1 m length	R&S®GK3030U	6130.2300.03
R&S®VK3150 right-hand side; 1 m length	R&S®GK3030H	6130.2400.02
R&S®VK3150 left-hand side; 1 m length	R&S®GK3030H	6130.2400.03
Data cables (R&S®MR300xH/U)		
RS-232-C Data Cable for connecting an R&S®MR300xH/U to a PC; 2 m length	R&S®GK3003	6135.2109.02
RS-232-C Data Cable for connecting an R&S®MR300xH/U to a PC; 3 m length	R&S®GK3003	6135.2109.03
Cable for connecting the R&S®KG3031/KG3032 Ethernet interface to a PC; 2 m length	R&S®GK3018	6125.9200.02
USB Cable for connecting the R&S®GP3000 to a PC; 2 m length	R&S®GK3021	6118.1750.02
Cable for RS-232-C remote control and data; for connecting an R&S®MR300xH/U to a PC; 3 m length	R&S®GK3024	6135.2209.03
Cable for RS-232-C remote control; for connecting an R&S®MR300xH/U to a PC; 1 m length	R&S®GK3025	6135.2250.02
Cable for RS-232-C remote control; for connecting an R&S®MR300xH/U to a PC; 3 m length	R&S®GK3025	6135.2250.03
Data Download Cable R&S®KDD373/3750 <--> R&S®MR300xH/U; 3 m length	R&S®GK3026	6133.8380.03
Cable for remote control, RS-232-C data and audio line; for connecting an R&S®MR300xH/U to external systems; 3 m length	R&S®GK3027	6137.7472.03
RF cables (R&S®MR300xH/U)		
RF Cable N – N for connection of an R&S®VK3150 power amplifier and an R&S®FK3150 ATU	R&S®GK3013	6123.3005.xx
0.6 m length		6123.3005.02
0.9 m length		6123.3005.12
3 m length		6123.3005.03
5 m length		6123.3005.05
20 m length		6123.3005.20
25 m length		6123.3005.25
50 m length		6123.3005.50

Ordering information

Designation	Type	Order No.
RF Cable N – BNC for connection of an R&S®VK3150/VT3050/VT3050C power amplifier and an antenna	R&S®GK3014	6123.3105.xx
2 m length		6123.3105.02
5 m length		6123.3105.05
10 m length		6123.3105.10
20 m length		6123.3105.20
50 m length		6123.3105.50
GPS Cable TNC – SMA	R&S®GK3016	6125.8904.xx
2 m length		6125.8904.02
5 m length		6125.8904.05
10 m length		6125.8904.10
Power supply cables (R&S®MR300xH/U)		
Power Supply Cable for R&S®KG3031 and R&S®KG3032; 90° plug; 5 m length	R&S®GK3002	6125.8704.02
Power Supply Cable for R&S®KG3031 and R&S®KG3032; straight plug; 5 m length	R&S®GK3002	6099.3705.02
Power Supply and Ethernet Cable (RJ-45 plug) for R&S®MR300xH/U manpack transceivers (rear connector)	R&S®GK3009	6118.1608.02
Power Supply Cable for R&S®VK3150/VT3050/VT3050C power amplifiers; 5 m length	R&S®GK3015	6143.7155.05
Power Supply Cable for R&S®IC3001 charger; 3 m length	R&S®GK3020	6118.1508.03
Power Supply Cable for R&S®IC3001 charger; plug 90°; 3 m length	R&S®GK3020	6118.1508.13
Further cables (R&S®MR300xH/U)		
Cable Rebroadcast for connection of two R&S®MR300xH/U transceivers	R&S®GK3001	6099.3605.xx
2 m length		6099.3605.02
6 m length		6099.3605.06
10 m length		6099.3605.10
Cable for detachable front panel; max. 1.5 m length	R&S®GK3005	6118.1008.02
Manpack antennas (R&S®MR300xH/U)		
Wire Antenna for manpack or stationary use; 1.5 MHz to 30 MHz; 150 W	R&S®AK3001	6118.1850.02
Wire Dipole Antenna for manpack use; 2 MHz to 90 MHz; 25 W; broadband antenna	R&S®AK3031	6099.8007.02
Wire Dipole Antenna for manpack use; 2 MHz to 90 MHz; 25 W; broadband antenna; with mast	R&S®AK3031	6099.8007.04
Mast for R&S®AK3031 wire dipole antenna; 7 m height	R&S®KM3032	6131.7306.02
Long Wire Antenna; 30 MHz to 88 (108) MHz; 30 W high-gain directional antenna	R&S®HD3001	6131.7406.02
Hang-up Antenna; terminated with BNC connector; 30 MHz to 88 MHz; power rating 12.5 W into 50 Ω	R&S®HD3088	6092.1859.02
GPS Antenna for manpack and vehicle applications; active; magnetic holder; L1 band	R&S®HV3003	6118.2004.02
Whip Antenna for manpack; 25 MHz to 88 (108) MHz; 20 W	R&S®HV3004	6128.1400.02
Long Whip Antenna for manpack; 1.5 MHz to 30 MHz; 25 W	R&S®HV3007	6118.0853.02
Whip Antenna for manpack; 118 MHz to 400 MHz (88 MHz to 450 MHz); 15 W	R&S®HV3009	6126.5967.02
Vehicular antennas (R&S®MR300xH/U)		
Whip Antenna for vehicle use; 1.5 MHz to 30 MHz; 400 W	R&S®HV3011	6099.7600.02
Whip Antenna for vehicle use; 30 MHz to 108 MHz; 75 W; low profile	R&S®HV3012	6099.7700.02
Whip Antenna for vehicle use; 30 MHz to 108 MHz; 75 W; low profile; with GPS base	R&S®HV3012	6099.7700.03
Whip Antenna for vehicle or stationary use; 225 MHz to 512 MHz; 50 W; center-fed	R&S®HV3013	6099.7800.02
Whip Antenna for vehicle use; 225 MHz to 512 MHz; 50 W; center-fed; with GPS base	R&S®HV3013	6099.7800.03
Whip Antenna for vehicle or stationary use; 30 MHz to 108 MHz; 50 W; center-fed	R&S®HV3015	6098.8803.02
Whip Antenna for vehicle use; 30 MHz to 108 MHz; 50 W; center-fed; with GPS base	R&S®HV3015	6098.8803.03
Whip Antenna for vehicle or stationary use; 108 MHz to 185 MHz; 50 W; center-fed	R&S®HV3018	6131.7506.02
Whip Antenna for vehicle use; 108 MHz to 185 MHz; 50 W; center-fed; with GPS base	R&S®HV3018	6131.7506.03
Whip Antenna for vehicle or stationary use; 100 MHz to 400 (512) MHz; 50 W; center-fed	R&S®HV3019	6131.7606.02
Whip Antenna for vehicle use; 100 MHz to 400 (512) MHz; 50 W; center-fed; with GPS base	R&S®HV3019	6131.7606.03

Ordering information

Designation	Type	Order No.
Stationary antennas (R&S®MR300xH/U)		
Log-Periodic Dipole Antennas (high-gain directional antennas)		
30 MHz to 108 MHz; 100 W	R&S®HL3031	6099.9803.02
30 MHz to 108 MHz; 100 W; with mast	R&S®HL3031	6099.9803.04
220 MHz to 405 MHz; 100 W	R&S®HL3032	6099.9903.02
220 MHz to 405 MHz; 100 W; with mast	R&S®HL3032	6099.9903.04
30 MHz to 512 MHz; 100 W	R&S®HL3033	6118.0901.02
30 MHz to 512 MHz; 100 W; with mast	R&S®HL3033	6118.0901.04
Mast for R&S®HL3031, R&S®HL3032 and R&S®HL3033 log-periodic antennas; 8.5 m height	R&S®KM3031	6098.8903.02
Whip Antenna for stationary use; 225 MHz to 512 MHz; 50 W; center-fed; with mast	R&S®HV3013	6099.7800.04
Whip Antenna for stationary use; 30 MHz to 108 MHz; 50 W; center-fed; with mast	R&S®HV3015	6098.8803.04
Coaxial Dipole Antenna for vehicle or stationary use; 115 MHz to 1500 MHz; 250 W	R&S®HV3017	6118.0753.02
Coaxial Dipole Antenna for stationary use; 115 MHz to 1500 MHz; 250 W; with mast	R&S®HV3017	6118.0753.04
Whip Antenna for stationary use; 108 MHz to 185 MHz; 50 W; center-fed; with mast	R&S®HV3018	6131.7506.04
Whip Antenna for stationary use; 100 MHz to 400 (512) MHz; 50 W; center-fed; with mast	R&S®HV3019	6131.7606.04
GPS Antenna Supplement for R&S®HK055L1	R&S®KM055	6135.1825.02
For further antennas, see the "Antennas HF-VHF/UHF-SF" catalog; PD 0758.0368.52.		
Antenna adapters (R&S®MR300xH/U)		
Long Wire Adapter for use of R&S®AK503 with R&S®FK3150	R&S®HZ3503	6118.2256.02
Long Wire Adapter for use of R&S®AK503 with R&S®MR300xH	R&S®HZ3503	6118.2256.03
Adapter, BNC, R&S®M3TR antenna connector to BNC	R&S®GK3019	6125.9300.02
Adapter, N, R&S®M3TR antenna connector to N	R&S®GK3019	6125.9300.03
Long Wire Adapter for use of wire antennas on R&S®M3TR manpack radios	R&S®GK3019	6125.9300.04
Antenna tuning unit (R&S®MR300xH/U)		
Antenna Tuning Unit for R&S®M3TR; 1.5 MHz to 30 MHz; 150 W	R&S®FK3150	6095.5855.02
Rucksacks and manpack bags (R&S®MR300xH/U)		
Transport Bag for R&S®KM011 mast; color: olive drab	R&S®MZ3011	6126.5680.03
Rucksack for R&S®AK3031 antenna; color: camouflage	R&S®MZ3031	6126.5580.02
Rucksack for R&S®AK3031 antenna; color: olive drab	R&S®MZ3031	6126.5580.03
Rucksack for R&S®MR300xH/U and accessories; color: camouflage	R&S®MZ3060	6098.2857.02
Rucksack for R&S®MR300xH/U and accessories; color: olive drab	R&S®MZ3060	6098.2857.03
Rucksack for R&S®MR300xH/U, R&S®XV3088 and accessories; color: camouflage	R&S®MZ3088	6092.2603.02
Transport Bag for R&S®AK503 antenna, antenna head, radiators and ropes; color: olive drab	R&S®MZ3503	6126.5780.03
Test system for radio equipment of the R&S®M3xR family		
I-Level Special Test Equipment (I-STE for R&S®M3AR, R&S®M3SR, R&S®M3TR, R&S®Series2000, R&S®Series4200)	R&S®TS6030	5200.7050.02
Other types on request.		
Handheld transceiver and accessories (R&S®MR3000P)		
VHF Tactical Handheld Radio, 25 MHz to 145 MHz; 0.2/5 W; including R&S®SECOM-P EPM (ECCM) waveform (VHF/FM)	R&S®MR3000P	6131.4307.10
Fillgun for handheld transceiver; for transmitting all relevant preset information, as well as COMSEC/TRANSEC keys	R&S®GP3021	6131.4607.03
Handheld Microphone/Speaker	R&S®GA3023	6131.4707.02
Serial Data Cable	R&S®GK3028	6140.4606.02
Power Supply Cable for R&S®IV3021	R&S®GK3029	6131.5255.08
Battery Pack, Li-Ion, for R&S®MR3000P transceiver	R&S®IB3022	6131.4907.02
Battery Charger, AC, stationary, for R&S®MR3000P transceiver; automatic charging of up to eight R&S®IB3022 Li-Ion batteries	R&S®IC3022	6131.4959.02
Vehicle Support; vehicle mount with charger for R&S®MR3000P transceiver	R&S®IV3021	6131.5103.02
Long Tape Antenna for R&S®MR3000P transceiver; 1.1 m length	R&S®HV3021	6131.4407.02
Short Tape Antenna for R&S®MR3000P transceiver; 0.5 m length	R&S®HV3022	6131.4559.02
Bag for R&S®MR3000P transceiver	R&S®MZ3021	6131.4359.02
Set Bag for R&S®MR3000P transceiver and accessories	R&S®MZ3022	6131.4807.02
Battery Pack Bag for R&S®MR3000P transceiver	R&S®MZ3023	6131.4859.02

R&S®XV3088 VHF Transceiver System

High-performance multirole combat radio system

- Built-in voice scrambler
- Instantaneous erasure of preprogrammed data in case of imminent danger
- Keypad control from handset or transceiver control panel
- Compatibility with most transceivers in use around the world
- Fillgun programming
- Scanning
- Semiduplex operation

The R&S®XV3088 VHF transceiver is a high-performance pouch radio that can be instantly redeployed as a long-duration patrol backpack and that offers logistic, tactical, and cost advantages. The heart of the integrated communications system is the high-performance lightweight R&S®XV3088 VHF transceiver that offers a solution to all aspects of tactical communications. Up to 2320 channels (9 programmable), full data facility, and an unparalleled simplicity of operation demonstrate state-of-the-art technology. Its multirole characteristics are further enhanced by a carefully designed range of ancillaries producing an exceedingly cost-effective and logistically desirable system.

Characteristics

- Preselection for up to 9 channels and their storage in memory
- Data transmission using data modem
- Detached operation by means of the R&S®GB3088 remote control unit for a range of at least 500 m using ordinary two-wire field cable
- Standard or 150 Hz subtone squelch
- POST (power-on self-test)

Mobile operation
The R&S®XV3088 is upgraded to a complete vehicle communications system by means of the R&S®KS3088 vehicle mounting frame and the R&S®VV3088M/R&S®VV3088V power amplifier with output power of 25 W or 50 W. The complete communications system can be built into practically any military vehicle.

R&S®XV3088 VHF transceiver.

Secure transmission
The built-in voice scrambler provides digital voice encryption by sampling with 32-bit code, scrambling, and transmission via the radio channel. The 10000 possible code combinations are entered by means of a fillgun.

Selective calling of up to 99 subscribers
Selective dialing to desired subscriber and fast transmission of message by means of three-digit numeric code.

R&S®XV3088 manpack receiver with R&S®GM3088 radio data modem for data transmission via the R&S®XV3088 transceiver.

Three power stages
High, moderate, and low (high only available with 25/50 W RF amplifier).

Two multifunction connectors
Providing both secure and fast data transmission with 2400 bit/s as well as remote-control capabilities and an audio interface, the transceivers can be enhanced with accessories such as handset, headset etc.

Simplified operation
Clearly arranged keypad for point and shoot operation and clear override mode.

Whisper mode
Increased microphone sensitivity for discreet operation in silent environment.

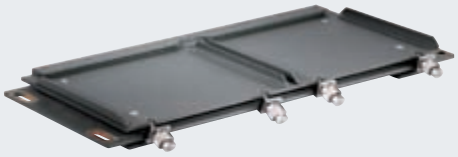
Compact size
One of the smallest and lightest manpack radios of just 83 mm × 205 mm × 252 mm with battery pack attached. The rugged package is submersible and withstands harshest environmental and EMC conditions.

Antennas
The range of antennas available includes a low-profile antenna that allows discreet operation, a 1.5 m tape antenna to increase range, as well as long-wire antennas and antennas for mobile use. In case of considerable mismatch, e.g. antenna damage, the TX LED signals the error by flashing in red.

R&S®XV3088 (R&S®XV3088C) mobile system: The base unit is formed by the R&S®XV3088 transceiver, built-in into various frames together with the R&S®VV3088M (R&S®VV3088V) 25 W (50 W) power amplifier.

Accessories for the R&S®XV3088

	Type, designation	Description
	**R&S®IB3088** **Rechargeable Battery Pack** 4 Ah power supply for R&S®XV3088 or R&S®XV3088C VHF transceiver	The R&S®IB3088 is a compact quick-charge NiCd battery pack, VARTA 10/RSQ4 type. The box contains an electronic battery test circuit. The battery voltage is tested by pressing the button and is then indicated. The box is mechanically connected to the device feed with one quick-release joint. Automatic electric interconnection is ensured by rugged spring contacts. The box is made of cast aluminum and is waterproof.
	**R&S®IC3088R** **Quick Battery Charger** Quick charging of one or two R&S®IB3088 battery packs	The R&S®IC3088R is used for quick charging of one or two R&S®IB3088 battery packs in any combination. Simultaneously, it can control and test other battery packs. The charging characteristic is automatically changed according to the type of battery pack. Charged battery packs are fixed to the charger by means of quick-release fasteners. The charger can be carried with the charged batteries.
	**R&S®IC3088S** **Standard Battery Charger** Simultaneous charging of one to six R&S®IB3088 rechargeable battery packs	The charger is used for simultaneous charging of one to six R&S®IB3088 rechargeable battery packs at 0.1 C standard current. Charged battery packs are fixed to the charger by means of quick-release fasteners. The charger can be carried with the charged battery packs.

	Type, designation	Description
	**R&S®VV3088M** **25 W Power Amplifier** Amplifies the output power of the R&S®XV3088 or R&S®XV3088C transceiver to 25 W	If the amplifier is turned off, the transceiver's HF output power (5 W or 0.2 W) is connected directly to the antenna. The amplifier also features an AF amplifier, a power supply unit, and a modem for radio data transmission (RS-232-C). Optionally a modem variant featuring IP packet transmission and a network mode is available. The Communication protocol used in the network variant complies with the US MIL-STD-188-220B (Interoperability Standard for Digital Message Transfer Device Subsystems) The amplifier is installed with the R&S®XV3088 or R&S®XV3088C transceiver. Together they form the mobile set. The unit is installed in a mounting frame.
	**R&S®VV3088V** **50 W Power Amplifier** Amplifies the output power of the R&S®XV3088 or R&S®XV3088 transceiver to 50 W	If the amplifier is turned off, the transceiver's HF output power (5 W or 0.2 W) is connected directly to the antenna. The amplifier also features an AF amplifier, a power supply unit, and a modem for radio data transmission (RS-232-C). Optionally a modem variant featuring IP packet transmission and a network mode is available. The Communication protocol used in the network variant complies with the US MIL-STD-188-220B (Interoperability Standard for Digital Message Transfer Device Subsystems) The amplifier is installed with the R&S®XV3088 or R&S®XV3088C transceiver. Together they form the mobile set. The unit is installed in a mounting frame.
	**R&S®KS3088H** **Vehicle Mounting Frame** **for Horizontal Installation** Joint installation of the transceiver and the 25 W/50 W amplifier; with quick-release fasteners	The frame is used for joint installation of the R&S®XV3088 or R&S®XV3088C transceiver and the R&S®VV3088M or R&S®VV3088V amplifier. The frame's design allows the transceiver to be released from the set quickly and easily. The frame is used for fixed installation into a mobile conveyor by means of four M8 screws. The R&S®XV3088 or R&S®XV3088C transceiver and the R&S®VV3088M or R&S®VV3088V amplifier are placed next to each other.
	**R&S®KS3088V** **Vehicle Mounting Frame** **for Vertical Installation** Joint installation of the transceiver and the 25 W/50 W amplifier; with quick-release fasteners	The frame is used for joint installation of the R&S®XV3088 or R&S®XV3088C transceiver and the R&S®VV3088M or R&S®VV3088V amplifier. The frame's design allows the transceiver to be released from the set quickly and easily. The frame is used for fixed installation into a mobile conveyor by means of six M6 screws. The R&S®XV3088 or R&S®XV3088C transceiver and the R&S®VV3088M or R&S®VV3088V amplifier are placed on top of each other.

	Type, designation	Description
	**R&S®GP3088** **Fillgun** Automatic programming of the RF transceiver's operating parameters	The R&S®GP3088 fillgun is used for automatic programming of the RF transceiver's operating parameters. The device also allows the stored data to be deleted quickly and makes it possible to create a two-letter address of the transceiver. The fillgun includes a case and a floppy disk containing necessary software.
	**R&S®GB3088** **Remote Control and Rebroadcast Accessory** Manual or automatic rebroadcast and remote control of the transceiver's basic functions	The R&S®GB3088 provides manual or automatic rebroadcast of radio signals in both transmission directions, or remote control of the transceiver's basic functions. With a field telephone connected, it can be used for communications with operators in the radio transmission direction or for operator communications via a service line. The unit automatically adjusts correct polarity to the two-wire field cable. The accessory also includes a connecting cable, a holding strap, and a bag.
	**R&S®GM3088** **Radio Modem** Data transmission with the R&S®XV3088 transceiver	The R&S®GM3088 radio modem is used for data transmission with the R&S®XV3088 transceiver or with transceivers featuring the standard 0.3 kHz to 3.4 kHz channel or a wider radio channel. The same type of modem is used in the R&S®VV3088M and R&S®VV3088V amplifiers. Optionally a modem variant featuring IP packet transmission and a network mode is available. The Communication protocol used in the network variant complies with the US MIL-STD-188-220B (Interoperability Standard for Digital Message Transfer Device Subsystems) The radio modem set includes a connecting cable, a PC interconnecting cable, a holding strap, and a bag.

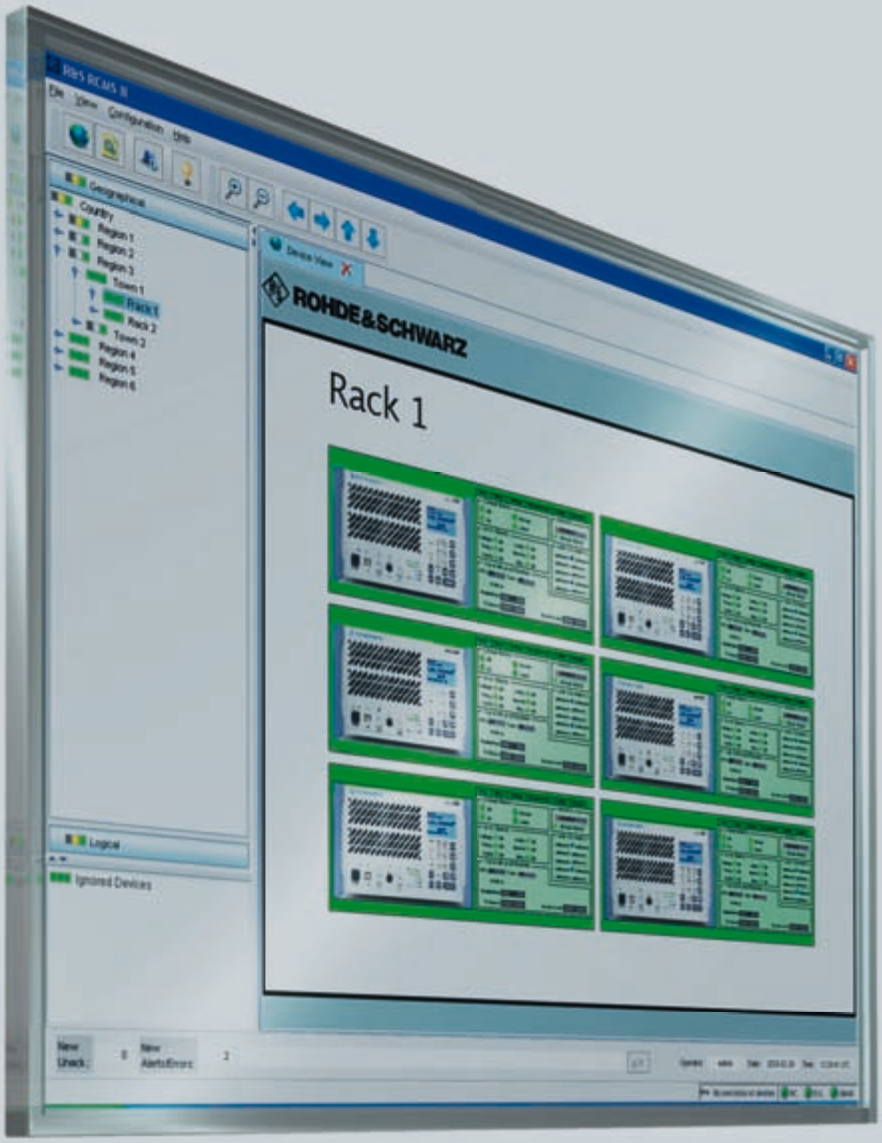
	Type, designation	Description
	**R&S®GA3088** **Handset** Mechanical resistance, watertightness, and stiffness	The R&S®GA3088 handset can be connected to any of the two audio connectors on the R&S®XV3088 or R&S®XV3088C transceiver or to any transceiver accessory featuring an audio connector. Its design ensures mechanical resistance, watertightness, and stiffness. Control functions ❙ Two-step volume controls ❙ PTT switch ❙ Audio tone signaling ❙ Handset Handset When connected to the audio connectors of the transceiver, the R&S®GA3088 handset enables radiocommunications and transmission of tone signals. Handset with control Along with handset functions, the R&S®GA3088 handset with control also features transceiver remote control and operating mode display. Control functions ❙ Two-step volume control, channel selection, start and stop of scanning ❙ Clear override ❙ Selection of displayed information type: channel/frequency Handset display information ❙ Selective communications ❙ Symbolic channel number or frequency displayed in reception and transmission mode ❙ Scanning ❙ Clear override ❙ Two-digit code displayed in short-coded messages mode ❙ Address and signal code of transmitting stations ❙ Voice encryption mode
	**R&S®MZ3088** **Manpack Bag** Storage and transport of all components	The bag is used for storage and transport of all components of the R&S®XV3088 or R&S®XV3088C portable transceiver set for field use. The bag's design provides easy access to all components. The bag can be carried in one hand as well as on the shoulders. Other features include: easy access to panel connectors, wide adjustability of straps, protection against falling. The pack is resistant to sunshine, moisture, mold, oil, petrol, and warfare chemicals. The bag can be washed, and is damage-proof against falls from up to one meter.

Specifications

R&S®XV3088	
Frequency range	30.000 MHz to 87.975 MHz
Channel spacing	25 kHz
Number of working channels	2320
Effective audio frequency range, F3 mode	300 Hz to 3.4 kHz
Effective audio frequency range, data transmission	150 Hz to 9 kHz
Channel selection	from handset or control-panel keypad
Transmission modes	simplex or semiduplex telephony, data transmission of 1.2 kbps or 16 kbps
Voice scrambling	internal digital scrambler
Transmitter	
Power output	nominal 5 W (+1.5 dB/–1 dB), reduced 0.2 W (± 2 dB)
Modulation	F3E, max. shift 5.6 kHz
Harmonics suppression	–60 dB
Receiver	
Sensitivity	> 0.5 µV at 12 dB SINAD
AF output power	adjustable, min. 200 mW into 4 Ω load
Squelch	standard or 150 Hz subtone
Power supply	
Nominal supply voltage	12 V/4 A NiCd battery pack
Supply voltage range	10 V to 15 V
Period between charging	min. 14 h at transmit/receive/standby ratio of 1:1:10 and nominal output power of transmitter
General data	
Operating temperature range	–30 °C to +60 °C
Transceiver weight	max. 2.7 kg (5.95 lb) (without batteries and accessories)
Battery pack weight	max. 2.5 kg (5.51 lb)
Transceiver dimensions with battery pack attached	83 mm × 205 mm × 252 mm (3.27 in × 8.07 in × 9.92 in)
Weight of complete set in carrying bag with spare battery pack	< 10.9 kg (24.03 lb)
Dimensions of complete set in carrying bag	250 mm × 380 mm × 450 mm (9.84 in × 14.96 in × 17.72 in)
Waterproof	up to 1 m (3.28 ft) depth

Ordering information

Designation	Type	Order No.
Transceiver 30 MHz to 88 MHz; 0.2/5 W; 2320 channels; simplex/semiduplex operation; voice/data: 1.2 kbit/s to 16 kbit/s; code transmission; color: olive green		
Standard	R&S®XV3088	6092.1507.02
With encryption card	R&S®XV3088C	6092.1559.02
Power Amplifier With integrated data modem, audio amplifier, and power supply for other components of the system; with RS-232-C interface		
25 W; max. current consumption: 10 A, 12/27 V DC	R&S®VV3088M	6092.2103.xx
50 W; max. current consumption: 6 A, 18 V to 30 V DC	R&S®VV3088V	6092.2155.xx
Recommended extras		
Handset with control function, transceiver remote control, and backlit LC display	R&S®GA3088	6092.1707.02
Remote Control Unit and Intercom with interface for field telephones and automatic rebroadcast functionality	R&S®GB3088	6092.2503.02
Radio Modem; FSK modulation with adjustable bit rate of 300/600/1200/2400 bps; RS-232-C interface and PC interconnecting cable	R&S®GM3088	6092.2255.xx
Fillgun, PC-programmable; for loading all relevant channel parameters, as well as cloning	R&S®GP3088	6092.2303.02
Hang-Up Antenna, terminated by BNC connector; 30 MHz to 88 MHz; power rating 12.5 W into 50 Ω	R&S®HD3088	6092.1859.02
1.5 m Tape Antenna, foldable, power rating 5 W into 50 Ω	R&S®HV3088L	6092.1759.xx
0.5 m Tape Antenna, foldable, power rating 5 W into 50 Ω	R&S®HV3088S	6092.1807.xx
Battery Pack, NiCd; autonomy: 14 h at transmit/receive/standby ratio of 1:1:10	R&S®IB3088	6092.1659.02
Fast Charger for simultaneous charging of up to two R&S®IB3088 battery packs; charging time 60 min	R&S®IC3088R	6092.2003.02
Standard Battery Charger for simultaneous charging of up to six R&S®IB3088 battery packs; charging time 14 h to 16 h	R&S®IC3088S	6092.1959.02
Vehicle Mounting Frame, horizontal, for joint installation of transceiver and 25/50 W amplifier; with quick-release fastener	R&S®KS3088H	6092.2355.02
Vehicle Mounting Frame, vertical, for joint installation of transceiver and 25/50 W amplifier; with quick-release fastener	R&S®KS3088V	6092.2403.02
Manpack Bag for R&S®M3TR/XV3088 and accessories; color: camouflage	R&S®MZ3088	6092.2603.02


ROHDE&SCHWARZ
Rack 1

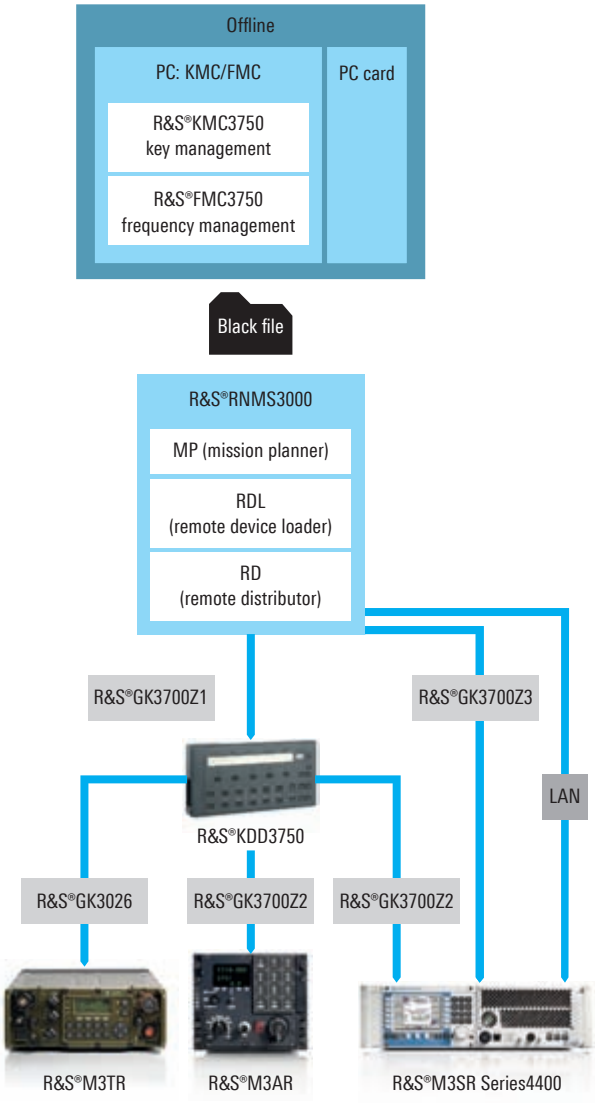
Chapter 4
Software Solutions for Radiocommunications

R&S®RNMS3000 Radio Network Management System

The convenient way to empower the capabilities of the Rohde&Schwarz radios in networks

R&S®RNMS3000

System architecture example for R&S®SECOS



R&S®RNMS3000 is a family of software products for radio network management. R&S®RNMS3000 covers crypto management, frequency assignment, and network configuration. A specific combination of the R&S®RNMS3000 products is available for the demands of the radiocommunications market. These R&S®RNMS3000 systems are described in separate articles. A complete overview of all applications of the radio network management system from Rohde&Schwarz is provided here.

Application fields

The R&S®RNMS3000 solutions address every major radiocommunications scenario in today's military and civil radio market.

The R&S®RNMS3000 solution for tactical applications covers the planning and configuration of radio networks including R&S®M3TR. Voice and data services are offered within the network. These services can be transmitted either with plain or EPM (ECCM) waveforms. Four different waveform groups can be selected depending on the customer's needs:

- R&S®SECOM waveforms
- R&S®SECOS waveforms
- NATO waveforms
- HF house waveforms

Frequency and key management is also included with the distribution of the configuration data, either by courier or network.

Moreover, R&S®RNMS3000 enables users to set up jamming-resistant and secure communications between ground stations and airborne radios. The generation of high-quality encryption keys and EPM (ECCM) parameters for R&S®SECOS, NATO, R&S®SECOM and HF House waveforms is provided by the application. All EPM (ECCM) relevant data can be transported via secure loading media or networks.

R&S®DS3100M Mission Planner (MP)
R&S®DS3321D Remote Distributor (RD)
R&S®DS3300D Remote Device Loader (RDL)
R&S®CP3000 Key Generation Equipment (KGE)
R&S®KMC3750 Key Management Center
R&S®FMC3750 Frequency Management Center

R&S®RNMS3000 is a family of software products that covers the planning and security of radio networks. A specific combination of the R&S®RNMS3000 products is available for the demands of the radiocommunications market.

Setting up a reliable and secure radio network includes several steps. First, it is necessary to generate keys and hop sets. Then the radios that form a radio network have to be set up and configured with the appropriate data for the network. This configuration data must be consistent and must be available at the various – even scattered – radio locations. R&S®RNMS3000 enables the user to do all this by simply using its software application tools. R&S®RNMS3000 is a highly scalable system and can easily be adapted to different radiocommunications and network scenarios.

The R&S®RNMS3000 solution

The R&S®RNMS3000 family consists of the following products:

- R&S®CP3000 – key generation equipment (KGE) – is an integrated solution for generating COMSEC and TRANSEC keys, e.g. for use in the R&S®SECOM-H or R&S®SECOM-V waveform. This suite consists of the R&S®KGE3000 hardware and a software application that enables the user to create and store the generated keys. R&S®CP3000 provides the secure keys for further applications in operation and mission planning.
- The R&S®FMC3750 frequency management center is a software application for defining the hop sets for the R&S®SECOS waveform. Self-jamming can be excluded due to frequency and time orthogonality. The calculation algorithm of the R&S®FMC3750 generates frequency- and time-orthogonal parameters.
- These hop sets are combined with an encryption key for COMSEC of R&S®SECOS. This key is provided by the R&S®KMC3750 key management center software. The operative encryption keys and hop sets are encrypted for transport. This is called black key loading. After black key loading the data cannot be read out. Only the radio device is able to decrypt the hop set and COMSEC – TRANSEC key.
- R&S®DS3100M – the mission planner (MP) – is the operation and mission planning software in the R&S®RNMS3000 family. All mission planning steps are provided by a single software application.
- R&S®DS3321D – the remote distributor (RD) – allows the configuration of the network members to be distributed via an IP network such as a LAN or WAN.
- R&S®DS3300D – the remote device loader (RDL) – makes it possible to load the radio configuration of the network members into the target radio devices via fillgun, via serial interface, or via Ethernet (LAN).

Main features and capabilities

- State-of-the-art graphical user interface
- Graphical map display of networks, link types, and stations
- Security management with support of TRANSEC and COMSEC keys for R&S®SECOM waveforms from R&S®CP3000 as well as user-defined keys
- Security management with support of TRANSEC and COMSEC keys for R&S®SECOS waveforms
- One application suite for several different radios, i.e. R&S®M3AR, R&S®M3SR, and R&S®M3TR
- Standalone solutions or network-distributed system configurations available
- Network management for plain and EPM (ECCM) waveforms
- Network configuration (address management)
- Frequency assignment for overall networks and subnetworks
- Frequency assignment module with coverage calculation and interference calculation (on request)
- Configuration management of radio capabilities and radio equipment (radio option and external equipment)
- Supported waveforms: plain, ALE (2G and 3G) R&S®SECOM-H, R&S®SECOM-V, STANAG 4285, HAVE QUICK I/II, VHF/UHF modem, R&S®SECOS 5/16 TDMA
- Radio options and system equipment can be specified and considered for radio network setup
- Available on Windows 2000/XP

Planning networks and operations

The MP software application performs all network configuration tasks. For all operations, configurations can be created and reused for each operation and mission. R&S®DS3100M, the mission planning software, has the advantage that mission-critical settings must be defined only once and can be exported and even shared with other MP installations.

When the network is configured, the complete settings for the network members can be transported on a fillgun or sent via a network (LAN or WAN). Therefore, R&S®RNMS3000 can be used even in complex distributed networks.

The R&S®DS3100M MP mission planner software is primarily used to configure and manage radio networks and their services and allows the full extent of each radio's capabilities to be utilized. Alternatively, a network can be set up quickly and easily by using the wizards provided. Each step in the process is saved automatically. In addition, exports can be used to make a copy of the mission. With one step a configuration run is started which sets the configuration data for all network members. Specific settings such as sequence of the services and/or waveforms can be applied.

The configuration data for all network members can now be loaded on the fillgun via USB, or it can be distributed via LAN or WAN.

Empower your radio network

In the field of tactical applications, R&S®RNMS3000 offers a comprehensive solution that is easy to adapt and understand. The complex task of setting up radio networks and managing them with the various configurations needed by the operator can be accomplished using modern, reliable, efficient, and ergonomic software tools. R&S®RNMS3000 is the convenient way to empower the Rohde&Schwarz radios in your networks to utilize the full extent of their capabilities.

Ordering information

Designation	Type	Order No.
Mission Planner Basic software for creating and configuring radio networks and missions using radio devices from Rohde&Schwarz	R&S®DS3100M	6130.4003.xx
Remote Distributor Distribution of mission data and configuration data via network	R&S®DS3321D	6133.1905.02
Remote Device Loader Basic software for distributing and loading configuration data to various radio devices	R&S®DS3300D	6130.3007.xx
Option for R&S®SECOM		
Key Generation Equipment For R&S®SECOM incl. R&S®KGE3000 key generation module and software	R&S®CP3000	6130.7983.xx
Mandatory for R&S®SECOS		
Frequency Management Center For R&S®SECOS5/16 TDMA	R&S®FMC3750	6131.2040.02
Key Management Center For R&S®SECOS5/16 TDMA; incl. security coprocessor card	R&S®KMC3750	6131.2004.02
xx = depends on configuration Please note that required fill devices and associated cabling depend on selected waveforms and radio types		

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.

- No additional hardware required for monitoring and controlling radios at the individual sites
- Support for Rohde&Schwarz radios with EPM (ECCM) capabilities for military applications
- Redundant system for continuous monitoring and control
- Overall status report sent to higher-level monitoring system via SNMP

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.

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.

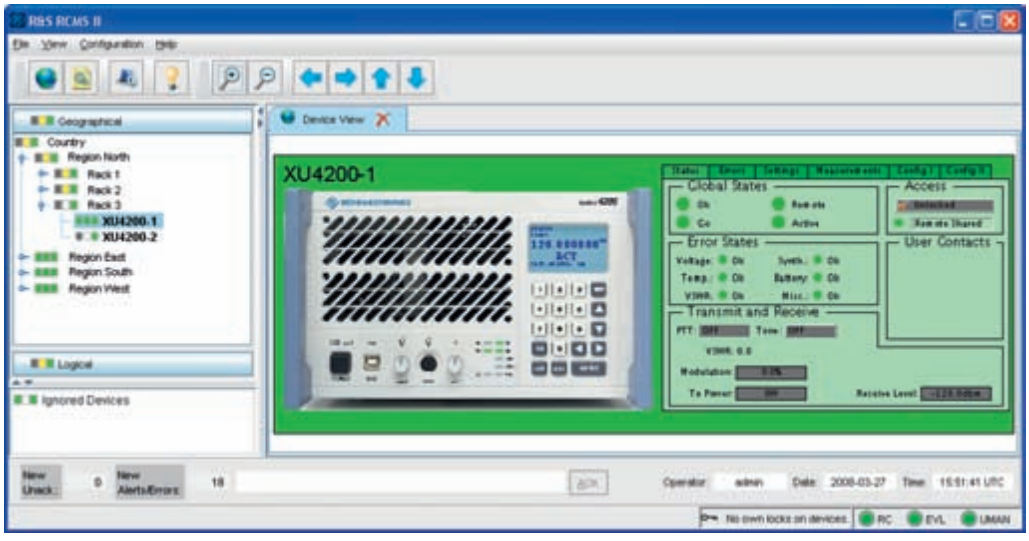
Wide range of analysis features

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. This allows tracking the history of an individual radio or the entire system at any time.

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.



Standard R&S®RCMS II configuration for the R&S®Series4200.

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 and R&S®M3SR Series4400 radios can be connected directly to existing IP infrastructure without requiring additional hardware.

State-of-the-art technology with off-the-shelf hardware

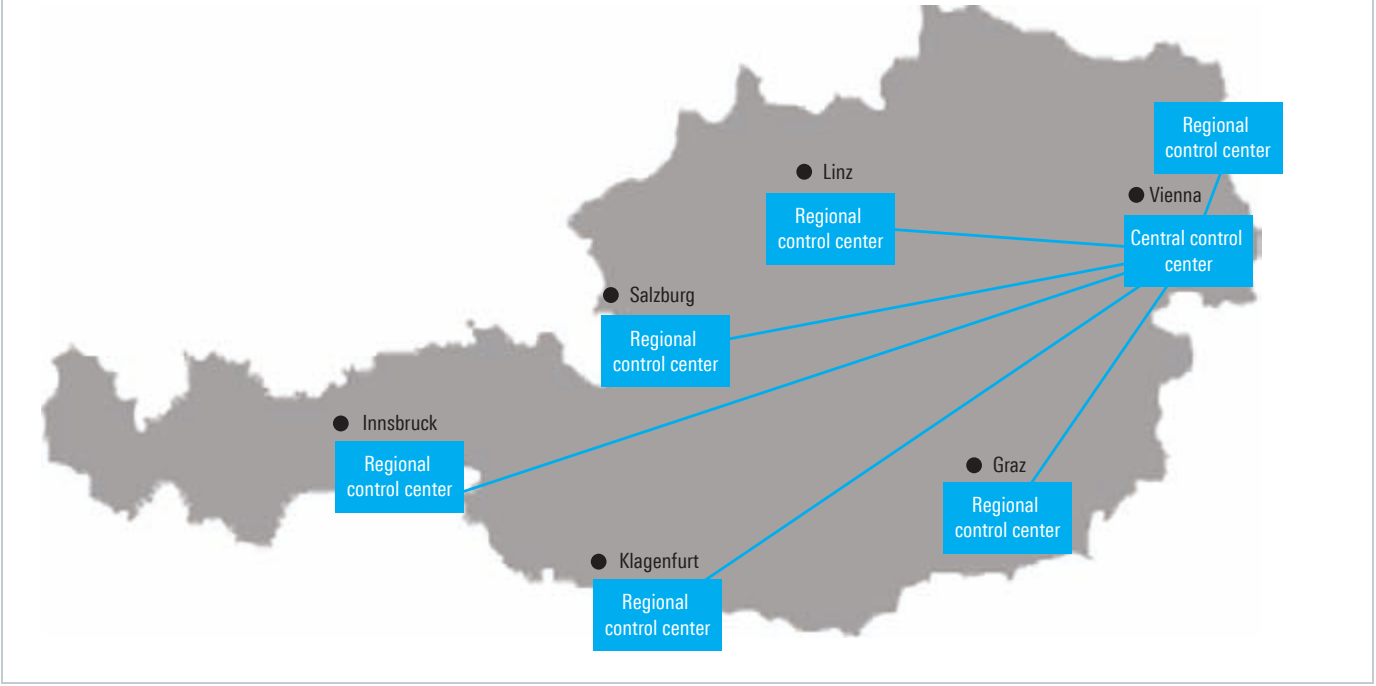
Windows platform

R&S®RCMS II uses off-the-shelf computer hardware running Windows XP Professional.

IP technology

R&S®RCMS II uses IP technology. The communications between R&S®RCMS II workstations, servers and radios is handled via IPv4. Existing LAN/WAN infrastructure can be used if it meets the requirements of R&S®RCMS II.

Country-wide R&S®RCMS II in Austria (AustroControl)



Secure and reliable operation

Flexible user management

The user management features facilitate the assignment 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

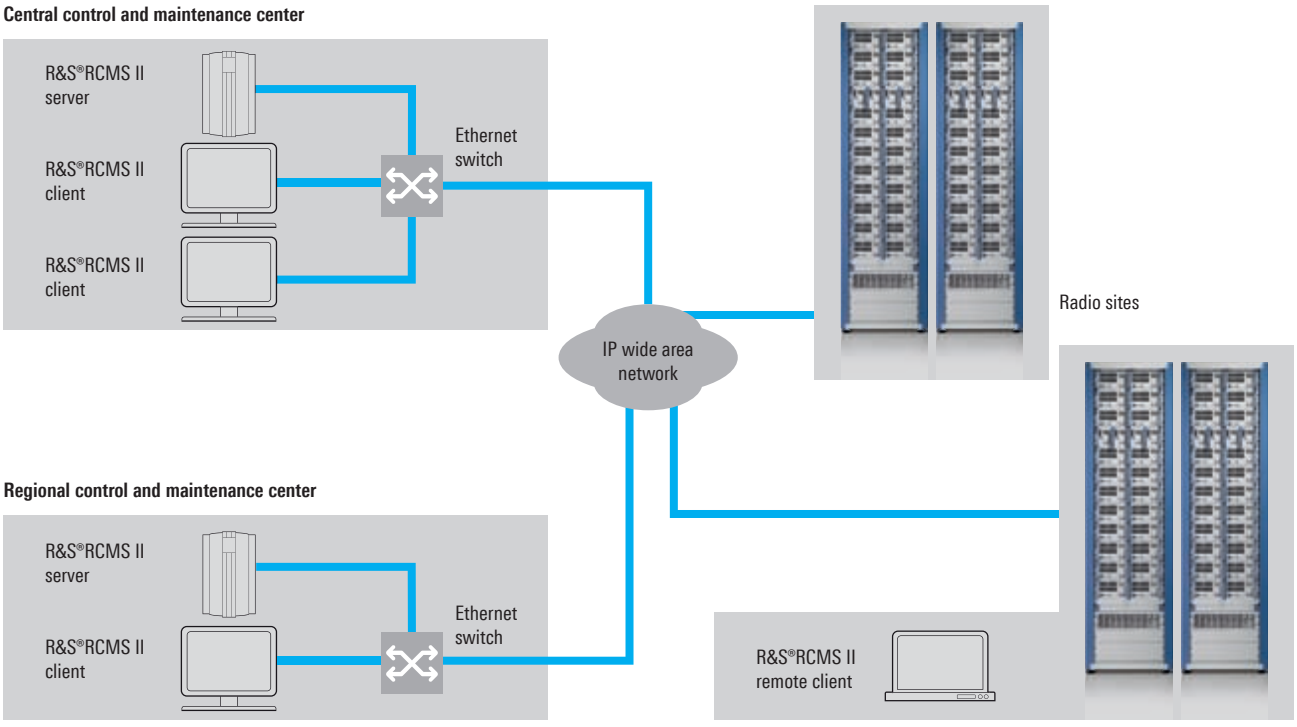
Radio voice and data transmission remains unaffected in the event that the R&S®RCMS II system is not available. It is possible to increase system availability for monitoring and controlling R&S®Series4200 and R&S®M3SR Series4400 radios by expanding R&S®RCMS II with a secondary server. The secondary server can be used for monitoring and control activities in the case that the primary server fails.

Interoperation with other ATC systems

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.

Connecting the radio sites using IP technology



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
- Multiple server solution for large-scale radio systems

Single server solution for small and mid-sized radio systems

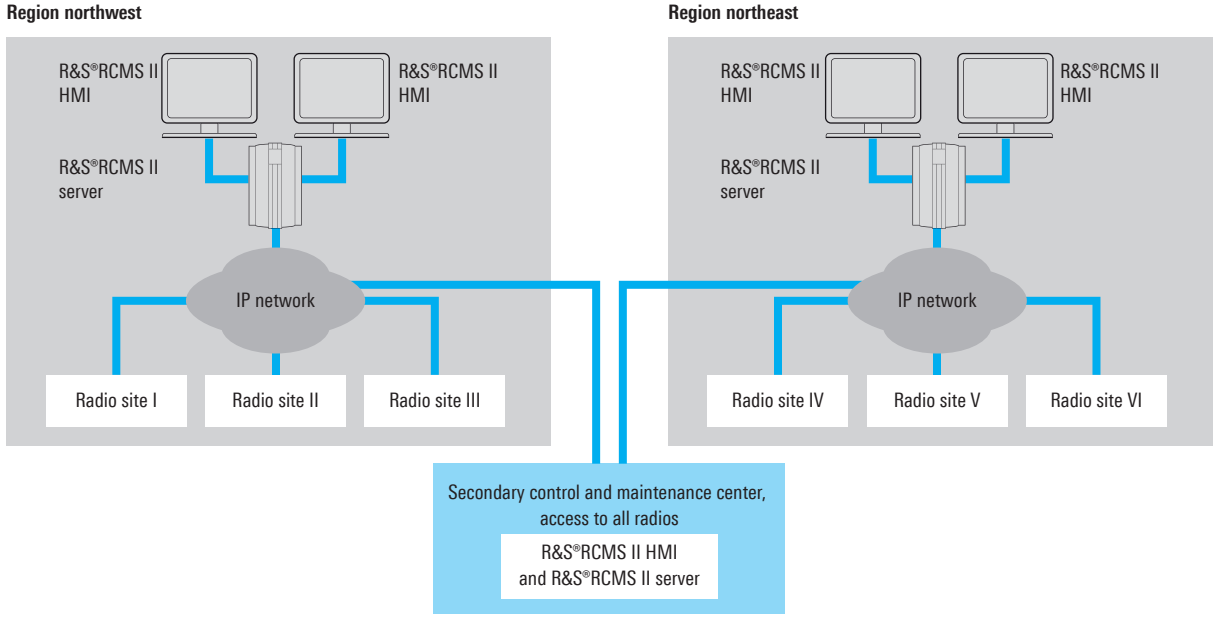
The R&S®RCMS II single server solution operates on a single desktop or laptop on which the server applications and the graphical user interface are installed. In this way, a small radio system for a single airport can be implemented cost-effectively using just one off-the-shelf desktop or laptop.

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.

Multiple server solution for large-scale radio systems

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. Alternatively, the radios in the regions can be monitored from a central location. In this case, the control activities are handled by means of an additional R&S®RCMS II server in the secondary control and maintenance center.

Example of multiple server solution



Supported radios

R&S®RCMS II supports R&S®Series2000 [1], R&S®Series4200 and R&S®M3SR Series4400 radios. R&S®Series200 [1], R&S®Series400U [1] and R&S®M3SR Series4100 radios can be integrated into the R&S®RCMS II system upon request.

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.

[1] 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-C interface can only be monitored and controlled from a single system.

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

- 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 XP Professional

Workstation

- 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 XP Professional

The hardware would be scaled according to the size of the radio system to be monitored.

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, flight 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 in the ground radios at the remote sites.

Ordering information

Designation	Type	Order No.
Mandatory articles		
Standard RCMS Server Software with one client license ❙ Fault management and remote control ❙ For R&S®Series4200, R&S®M3SR Series4400 and R&S®Series2000 ❙ For up to 200 RX/TX radios or 100 TRX radios	R&S®DS3800	6146.2405.02
Optional articles		
Software options		
Extended RCMS Server Software for one Standard RCMS server ❙ Enhanced remote control for fixed frequency ❙ For R&S®M3SR Series4400 and R&S®Series2000	R&S®DS3801	6146.2834.02
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	6146.2840.02
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	6146.2857.02
Extended RCMS Server Software for one Standard RCMS server ❙ Enhanced remote control for fixed frequency and SATURN with HAVE QUICK I/II waveform ❙ For R&S®M3SR Series4400	R&S®DS3804	6146.2970.02
One Client License ❙ For operational access to one RCMS server (Standard or Extended)	R&S®DS3820	6146.2863.02
Licenses for radios		
RCMS License for one R&S®Series4200 transmitter or receiver	R&S®DS3830	6146.2870.02
RCMS License for one R&S®Series4200 transmitter	R&S®DS3831	6146.2886.02
RCMS License for one R&S®M3SR Series4400 or R&S®Series2000 radio	R&S®DS3833	6146.2905.02
SNMP support		
License to provide R&S®RCMS II summary status information via SNMP v2c to a third-party monitoring system	R&S®DS3841	6146.2928.02

R&S®SIMCOS II Signal Management and Control System

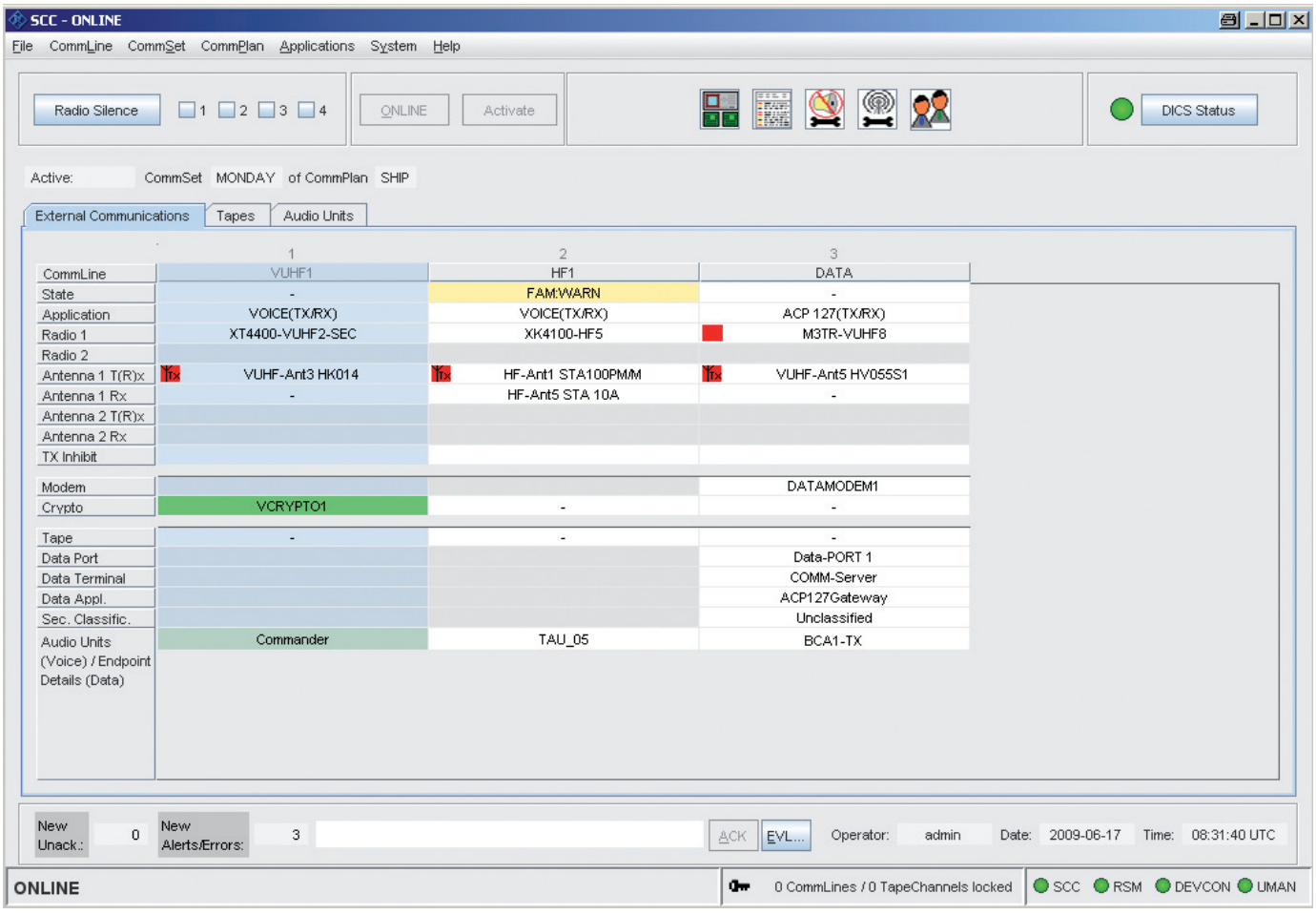
Signal management and control system for naval applications

Integrated communications systems (ICS) are a vital tool for commanding and controlling naval assets. Their main job involves handling ship-internal communications as well as ensuring the reliable exchange of strategic, tactical and administrative information between ships in a fleet or between ships and shore command radio stations. In addition, this information must be distributed quickly and effectively and archived as needed.

System overview

R&S®SIMCOS II is a comprehensive integrated client/server software suite for the management and control of complex communications systems in both ship and shore environments. R&S®SIMCOS II is suitable for all classes of ships from patrol boats to light aircraft carriers as well as for shore stations. It is particularly suitable for naval communications systems and especially takes into account the requirements of fully integrated shipborne communications systems.

In an ICS scenario, R&S®SIMCOS II manages, controls, and monitors external and internal communications subsystems, i.e. radio systems, switching matrix, and peripheral equipment such as modems and antenna switching units. R&S®SIMCOS II caters for all typical scenarios needed to set up and operate a naval ICS, designed and supplied by Rohde&Schwarz and implementing Rohde&Schwarz radio equipment from and the digital communications network (DCN). R&S®SIMCOS II ensures a high degree of scalability and provides different variants depending on the customer's environment. If NATO interoperability in HF communications is requested, R&S®STANAG 5066 with its e-mail, IP and character-oriented serial stream adapters can be fully integrated. Furthermore, a frequency and antenna management facility is made available by the R&S®SIMCOS II FAM option.



CommPlan definition: preparing a CommLine in R&S®SIMCOS II.

Main features and capabilities

- Remote-controls the parameter settings of connected communications equipment (devices), radios, modems, etc.
- Controls the digital communications switch of the DCN to establish local functional chains (called CommLines) for various applications between radios, modems, crypto devices, and communications endpoints (user audio units, data sources, and sinks)
- Controls the antenna distributor to assign antenna devices to radio devices
- Provides monitoring functions for:
  - Operational status of the system (e.g. error messages from remote-controlled devices)
  - Effective utilization of system resources (radios and antennas) (using optional FAM)
- Uses state-of-the-art technologies and standards: client/server architecture, CORBA), relational databases for secure storage of all user data and central software deployment

Planning operations

CommPlans and CommSets for particular mission scenarios, e.g. ASW (anti-submarine warfare), ASuW (anti-surface ship warfare), AAW (anti-air warfare), can be configured and prepared without any interference to the settings of the active CommPlan, i.e. the current operational status of the DCN is not altered. For this purpose, the following has to be defined/redefined:

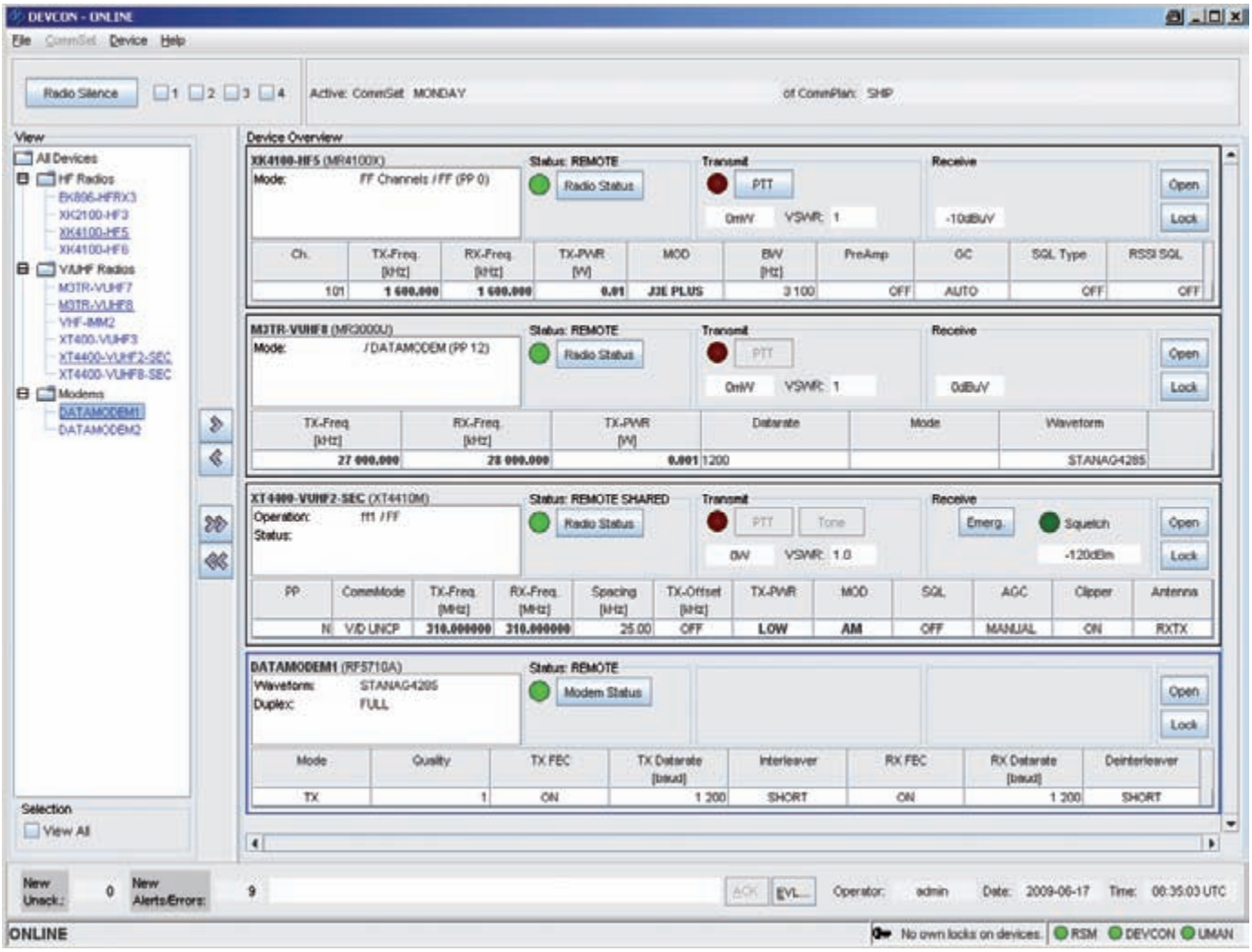
- CommLines incl. AU (audio units) allocations
- Tape record channel allocations for audio units and other devices
- Relay configuration

Operation

The following main operator functions are available:

- Activation of a preplanned CommPlan and CommSet
- Modification of current CommLines, tape allocations or relay configurations
- Access to
  - Device control application for changing device parameters; remote control of equipment
  - Frequency antenna management (FAM) for decision aid computation for radio links (optional)

Remote control: extended capability for remote control and monitoring of device parameters.



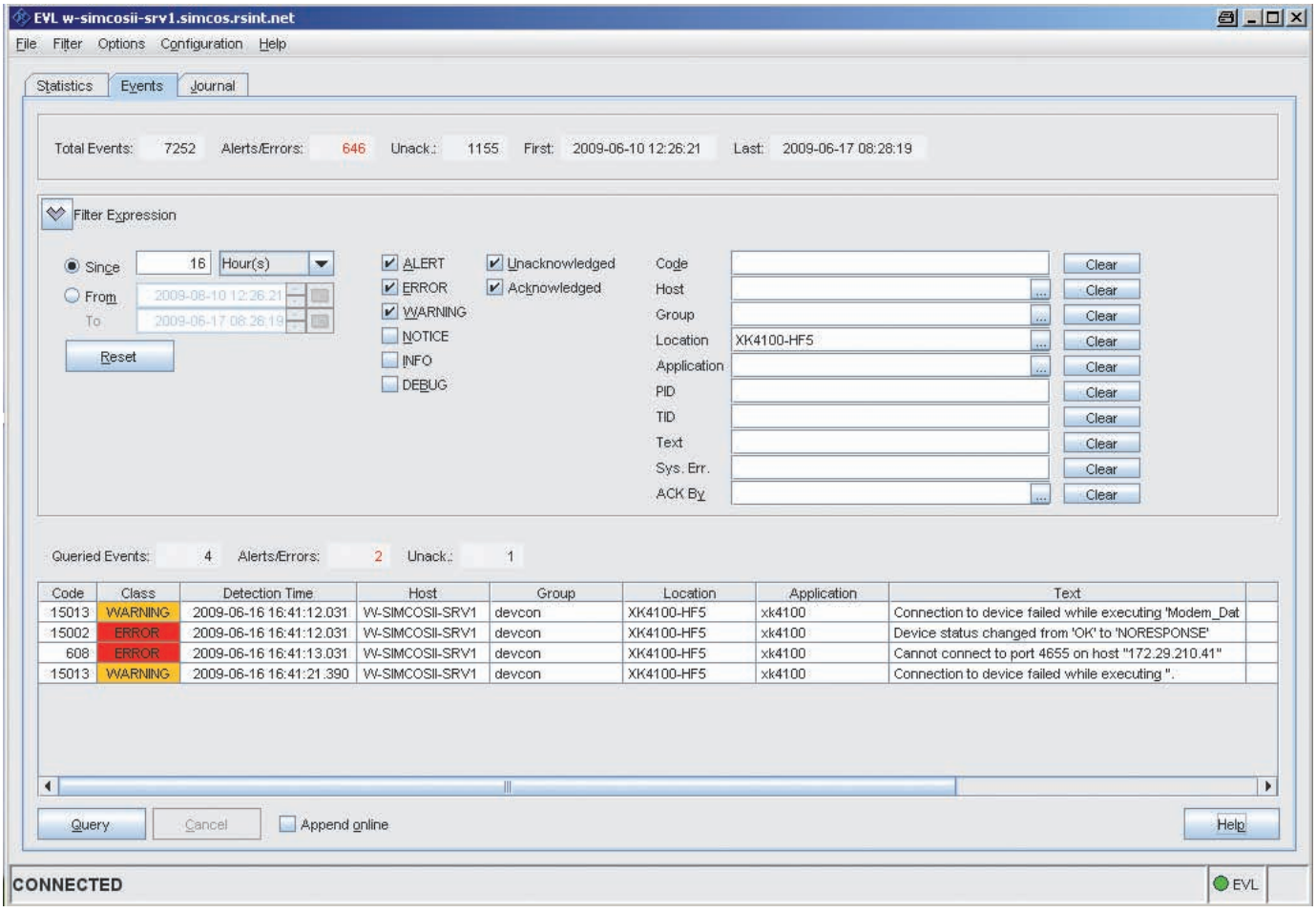
System monitoring

A continuous monitoring function monitors and displays:

- Operational state of the DCN (failures in nodes, slots, and interfaces of the DCN)
- Operational state of communications devices and modem devices
- Squelch and carrier state for radio devices
- Plain/Cipher state for external crypto devices used in CommLines depending on hardware configuration

All events are recorded in a central log and archived by the R&S®SIMCOS II server for later analysis.

Event log: detailed system monitoring.



Ordering information

Designation	Type	Order No.
R&S®SIMCOS II (1 server + 1 client) incl. extended remote control for FF operation	R&S®DS3400	6145.9406.02
Options		
Site Control Center	R&S®DS3401	6145.9835.02
Automatic Replacement of Radios in CommLines	R&S®DS3402	6145.9841.02
Frequency Antenna Management	R&S®DS3403	6145.9858.02
Extended Remote Control for radios with HAVE QUICK I/II	R&S®DS3404	6145.9987.02
Extended Remote Control for radios with SATURN + HAVE QUICK I/II	R&S®DS3405	6145.9993.02
Extended Remote Control for radios with SECOS, SECOM-H or SECOM-V	R&S®DS3406	6146.0002.02
Client License for one client workstation (software only)	R&S®DS34220	6145.9870.02
License for one controlled radio	R&S®DS3430	6145.9893.02
License for one controlled modem	R&S®DS3440	6145.9912.02
License for one controlled auxiliary device (R&S®MMC3000, PSHH2, AAD, voice recorder)	R&S®DS3450	6145.9929.02

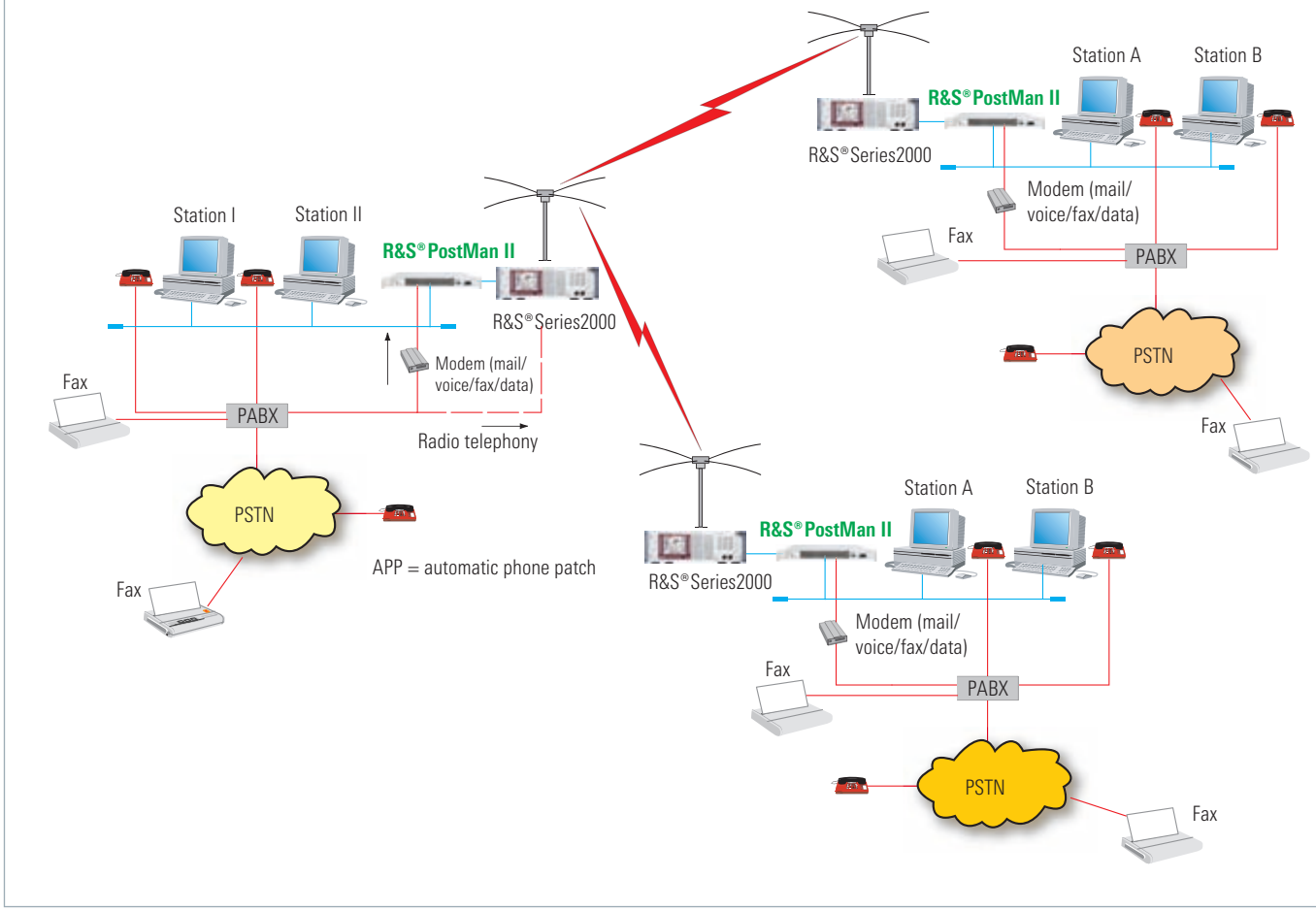
R&S®PostMan II Information and Communications System

Advanced information exchange in strategic radio networks

R&S®PostMan II is a combined hardware/software product with client-server architecture for advanced Internet/intranet communications via radio. It offers e-mail, fax, file transfer, voice, and data services by radio from almost any point on earth. R&S®PostMan II allows information to be exchanged between individual workstation terminals as well as throughout entire computer networks via a LAN. An R&S®PostMan II server with an optional interface expansion can simultaneously exchange information across several links and in both directions (receive and transmit). For example, an e-mail can be transmitted over one link while a fax is being sent over another.

The primary transmission media are HF/VHF/UHF radios. The transmission protocol that is used was specially developed by Rohde&Schwarz. It is particularly well suited for secure data transmissions via half-duplex radio links. In radio transmissions, R&S®PostMan II controls the connected transceiver or modem via a serial interface. This feature is implemented as standard for the R&S®Series2000 transceivers.

Application scenario: voice, data, fax, mail communications



Applications

- E-mail (with attachment), POP3/SMTP-based
- Fax service
- Voice mail
- Chat
- Transparent TCP/IP
- Radio telephony
- GPS tracking
- Broadcast telegram mode
- Cyclic exchange of data

E-mail

Any standard e-mail client such as Outlook can be used for e-mail transmission. To reduce transmission time, both the text body and the attached files undergo data compression. If the radio link is interrupted, R&S®PostMan II automatically attempts to contact the addressee even through alternative routes or media, depending on the chosen settings. All exchanged information can of course be protected against unauthorized access with the aid of external encryption units. For e-mail encryption, the SafeIT software encryption tool from Rohde&Schwarz SIT GmbH can be used as an e-mail client plug-in.

Fax

Faxes to be sent can either be generated electronically on a PC or placed in the fax machine as hardcopy. The destination address entered on a workstation terminal or the number dialed on a fax machine may be another computer or fax machine. If access to public telephone networks is available, worldwide fax service is possible.

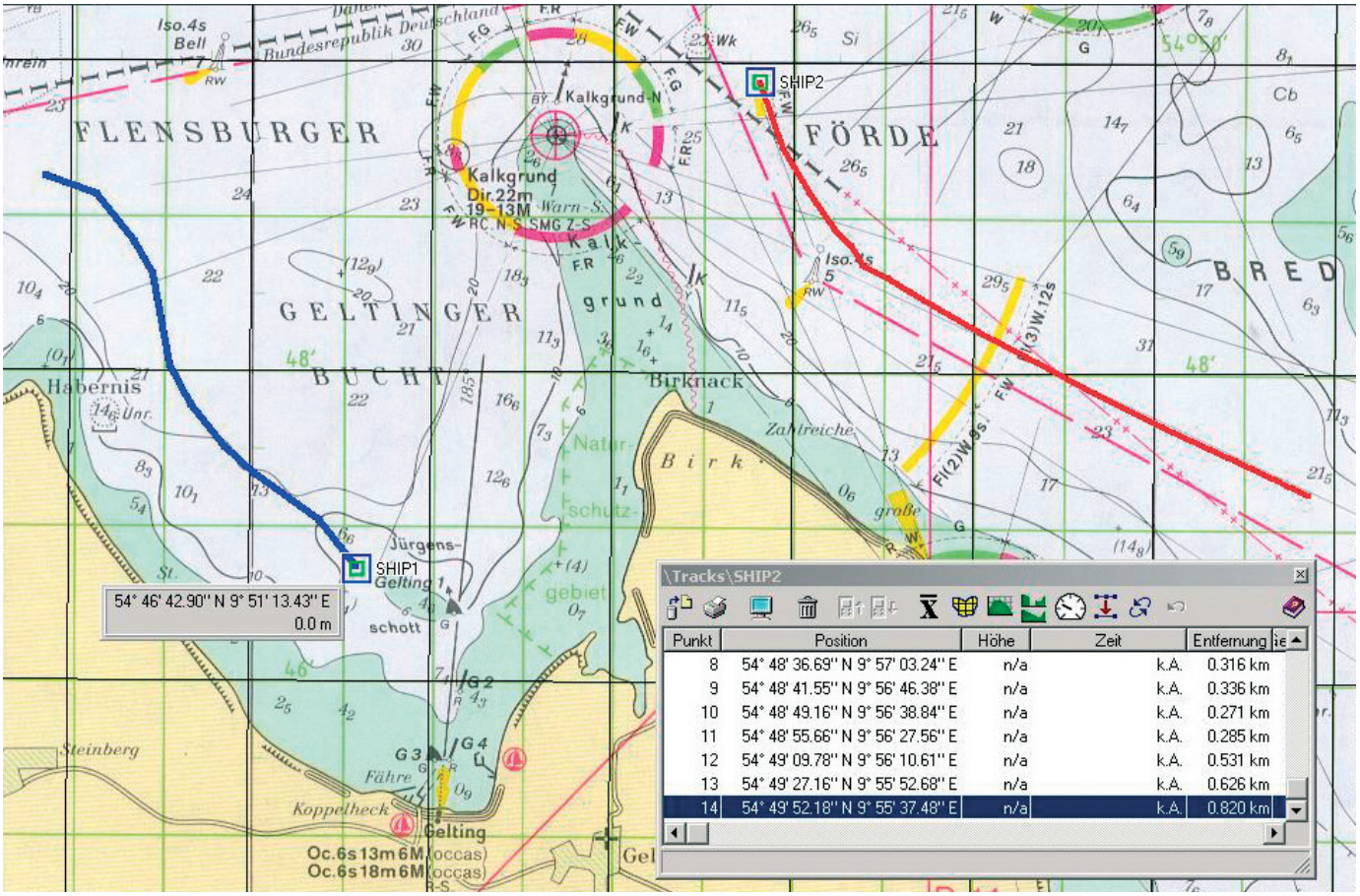
Voice mail

Voice mail is used to send a voice message directly from a telephone. After the R&S®PostMan II telephone number and the recipient's number have been dialed, a voice message can be left on the R&S®PostMan II server. R&S®PostMan II then automatically delivers the voice message as an e-mail attachment to the other party.

Chat

The chat service is used for almost realtime interactive e-mail communications between multiple parties. R&S®PostMan II uses the transparent TCP/IP mode to exchange the data, which makes it possible to expand this service to existing networks.

GPS tracking of mobile stations.



Radio telephony

Radio telephony is provided by using the automatic phone patch (APP) option for the R&S®Series2000 HF transceiver family. This makes shortwave telephone calls possible.

GPS tracking

Another R&S®PostMan II feature is the capability to track mobile stations by using the global positioning system (GPS). If a station is equipped with a GPS receiver, position data (in line with the NMEA standard protocol) can be transmitted in addition to the actual data (e.g. e-mail). The current position of and the route covered by each mobile station can thus be tracked from a command center. The standard package includes a tool with which scanned maps can be calibrated.

Broadcast telegram mode

In the broadcast telegram mode, messages in ASCII text format are transmitted within fixed timeslots without the peer station issuing an acknowledgement. This application ensures maximum security against hostile radiomonitoring. Several network subscribers can be reached in one transmit operation without having to set up multiple connections.

DataLinkCycle

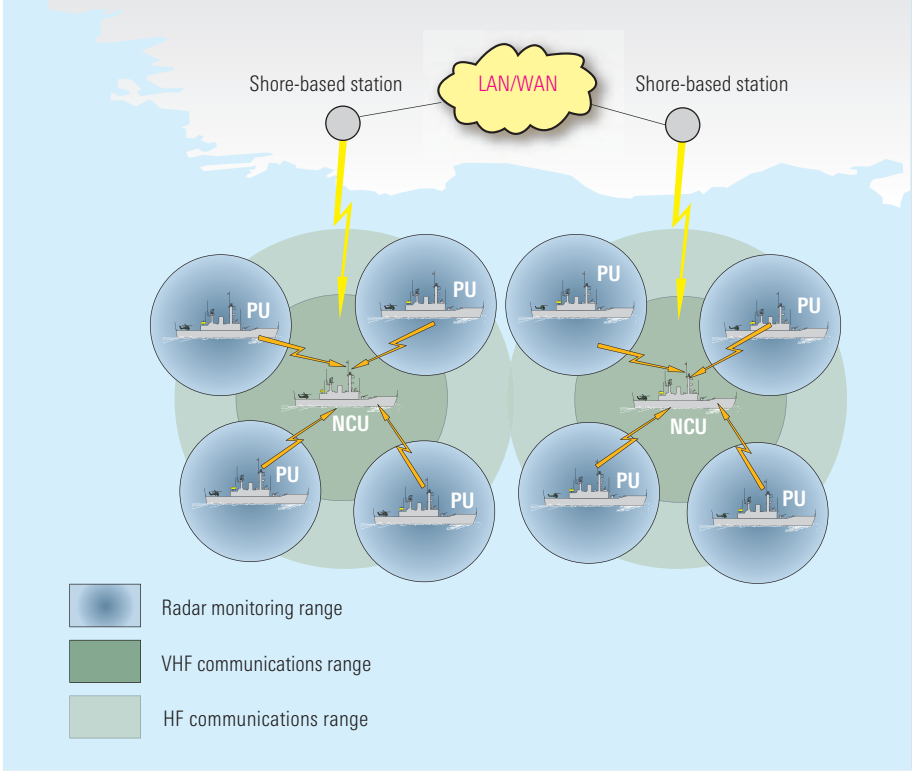
DataLinkCycle with its integrated radio protocol is a solution for cyclic exchange of any customer-defined data. To provide reliable data transmission, DataLinkCycle includes the following:

- ALE-similar link establishment process
- TDMA process for management of channel access of all network participants

One operation scenario is the cyclic exchange of radar data when monitoring coastline borders.

The cyclic received radar information of single radar sensors (PU = participating units) are transmitted to a net control unit (NCU) which consolidates this information to form one global radar picture and then distributes the global radar information back to the PUs and defined coastal stations. This is possible in HF and VHF networks using the R&S®Series2000, R&S®M3SR Series4400, and R&S®Series400 radios.

Coastline border monitoring scenario



Encrypted transmission

All exchanged information can of course be protected against unauthorized access with the aid of customized encryption procedures. A large number of encryption options are available, ranging from software-only or combined hardware/software solutions up to the integration of customized encryption units into the information flow.

Configuration and network management

System management and network planning are prerequisites for reliable and smooth operation in radio-based communications networks. A convenient graphical user interface is provided for managing all required network data and available resources. The preconfigured instrument settings are automatically activated on the transceivers. Network management is provided as a service on the R&S®PostMan II server and is started from a workstation terminal in the network. The generated network management data is stored in an SQL database on the R&S®PostMan II server.

Over-the-air configuration

Product updates as well as new configuration data can be sent to any station in a radiocommunications network. The station will be updated automatically either immediately after receiving the data or at a defined date and time. This allows the coordinated updating of dedicated or all stations even if they are unattended.

Ordering information

Designation	Type	Order No.
R&S®PostMan II Information and Communications System, incl. R&S®PSL1 and voice/fax/data modem, basic system and services, network services	R&S®DS102	6131.7664K02
Options		
Fax Service Software	R&S®DS102B1	6124.2502.02
Voice Mail Software	R&S®DS102B2	6124.2554.03
GPS Tracking Software, incl. standard map (without GPS receiver, antenna, and special custom-tailored map)	R&S®DS102B3	6124.2602.02
R&S®SITMinisafe2-PM2 Encryption Module	R&S®DS102B5	6124.2702.02
Broadcast/Telegram Mode	R&S®DS102B6	6124.2754.03
Proprietary Data Link Protocol (PRP) providing e-mail, chat, TCP/IP (mandatory for R&S®DS102B1/B2/B3/B5)	R&S®DS102B8	6131.7906.02
DataLinkCycle, proprietary data link protocol (RS.ARP), proprietary link establishment (ALE) and dynamic TDMA functionality	R&S®DS102B10	6124.2954.02
TTY Emulation Application	R&S®DS102B19	6124.2960.02
Remote Control for R&S®Series2000 Fixed Frequency	R&S®DS102B20	6124.2977.02

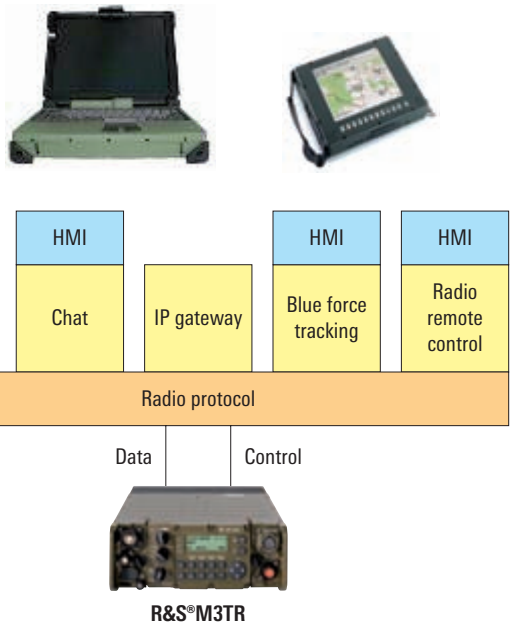
R&S®T@cMan for R&S®M3TR Software Defined Radios

The ideal solution for data communications in the electronic battlefield, optimized for use with the R&S®M3TR software defined radio

Tomorrow's tactical communications systems

Communications requirements have significantly changed in military operation scenarios from the users' point of view and even more so from the point of view of the operations centers. Voice communications in the past used to have higher priority than data transfer. Now, the secure and fast exchange of information via different data transfer methods – especially via radio – plays a key role in modern armed forces and nonmilitary organizations such as special task forces of the police or border patrol. Information needs to be quickly distributed in the electronic battlefield of the future. Modern communications systems that are equipped with radios optimally meet these requirements.

Applications of R&S®T@cMan



R&S®T@cMan – the tactical communications system solution

Rohde&Schwarz provides professional solutions for voice communications as well as for a wide range of data communications. The security that is required during voice and data operation is ensured by means of EPM (ECCM) methods that are integrated in radio systems.

R&S®T@cMan is a tactical communications system whose various applications have been optimized for data transfer in tactical radio networks with radios of the R&S®M3TR family. To allow communications with stationary operations centers outside the VHF/UHF ranges, R&S®T@cMan also supports the stationary R&S®M3SR Series4100 radio. By optimally employing the different operating modes (VHF/UHF and HF waveforms) of the R&S®M3TR, the requirements of heterogeneous mission conditions (communications distance and data rate) can be met. Users can thus handle their tasks much more conveniently.

It goes without saying that a system must be easy to operate during missions. All R&S®T@cMan applications have a human-machine interface (HMI) that allows information to be conveniently entered or read, especially on a touch screen tablet PC.

By using the R&S®T@cMan e-mail application, which is optionally available, messages can be quickly created and transmitted. In addition, standard interfaces such as SMTP and POP3 can be used with the R&S®T@cMan mail server, allowing existing standard e-mail clients to be connected, e.g. Outlook Express.

When tactical information needs to be exchanged in near-realtime, R&S®T@cMan provides a chat application, which can be used to quickly create short text messages, prioritize them, and transmit them immediately.

The need for data access and distribution was one of the reasons why numerous organizations have set up intranet systems. Today, also mobile operational forces considerably benefit from accessing such IP-based and LAN/WAN-connected networks. R&S®T@cMan provides an IP gateway that allows IP-based applications to be operated via a radio network. Data that was previously only accessible via LAN/WAN connections (e.g. in C⁴I systems) can now be accessed via radio links using standard IP methods.

Task force members and their leaders must have an up-to-the-minute overview of their positions at all times. R&S®T@cMan blue force tracking allows the GPS positions of the group's own members to be automatically exchanged and graphically displayed on a map.

R&S®T@cMan also permits the radio to be remote-controlled and monitored from a PC by using the radio remote control function.

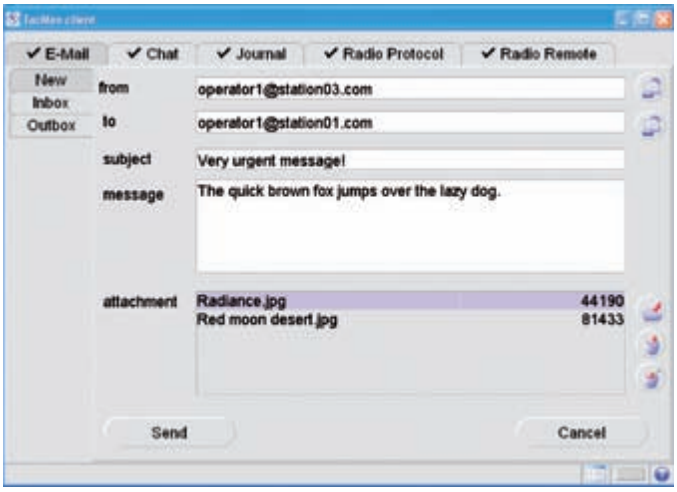
The radio protocol integrated in R&S®T@cMan is the ideal prerequisite for fast and secure data transfer of the R&S®T@cMan applications in VHF/UHF and HF networks.

E-mail

The R&S®T@cMan e-mail option includes all functions required for conveniently managing and efficiently exchanging e-mail messages, including e-mail attachments.

This e-mail application allows new messages to be generated and e-mail traffic, including a preconfigured address book, to be managed. The user can also monitor the progress of message exchange in realtime and, if necessary, interrupt an in-progress transmission. Data transfer that is interrupted manually, or because of the quality or occupation of the radio channel, is automatically resumed by the system without retransmitting data that has already been successfully transferred. If this function is not required, an external e-mail client such as Outlook Express can be connected to the SMTP/POP3 mail server integrated in R&S®T@cMan.

HMI of the e-mail application.



Chat

The R&S®T@cMan chat option allows short text messages to be efficiently exchanged within a radio network almost without delay (as often occurs with e-mails). The text messages are transferred within the radio network either in broadcast mode, i.e. all radio network participants receive the same message at the same time, or in point-to-point (PTP) addressing mode. In PTP addressing mode, the messages are exchanged and displayed exclusively between the two radio stations that are directly addressed.

HMI of the chat application.

Blue force tracking

By using the R&S®T@cMan blue force tracking option, GPS position information is automatically read from the connected R&S®M3TR radio and efficiently forwarded to all other radio network participants. These automatic position messages are visualized on a digital map. Various map formats can be integrated. If the map format provides altitude information, altitude profiles between two positions can be displayed.

Graphical display of blue force tracking.

Radio remote monitoring and control

The R&S®T@cMan radio remote control application allows the transfer activities and parameters of a connected R&S®M3TR (and R&S®M3SR Series4100) radio to be monitored on a PC. The scope of functions provided by this remote control application includes general status information as well as a wide variety of waveform-specific parameters.

IP gateway

To integrate existing applications that are based on the IP standard, the R&S®T@cMan IP gateway option supports the transparent transfer of the TCP/IP, UDP/IP, and ICMP/IP IP services. In combination with the R&S®M3TR radio, this option can act as an IP gateway between radio networks and wireline networks (LAN/WAN). Mobile units can thus be optimally connected to the networks of operations centers and the data they store, for example in C^4I systems.

Radio protocols

RS-IRP: To support the narrowband waveforms of the R&S®M3TR (and R&S®M3SR Series4100) radio, R&S®T@cMan includes as standard an RS-IRP radio protocol stack (RS-IRP, Rohde&Schwarz interactive radio protocol). The stack, which was specifically developed for this purpose, covers the ISO/OSI layers 2 and 3 and plays a key role in the efficient data transfer capabilities provided by R&S®T@cMan. Major protocol characteristics such as network routing, quality of service, as well as the automatic request for repetition (ARQ) method to prevent incorrect useful data are part of the radio protocol, as are channel access methods minimizing collisions in the air.

For efficient and interoperable data exchange in the HF frequency range, R&S®T@cMan supports the optional HF NATO radio protocol STANAG 5066 for the R&S®M3TR radio and for R&S®M3SR Series4100. The STANAG 5066 radio protocol provides interoperable HF data communications among joint forces and allied partners.

The following types of connection are supported:
- Point-to-point
- Broadcasting

R&S®M3TR supports the following VHF/UHF waveforms:
- R&S®SECOM-V
- VHF/UHF modem

R&S®M3TR and R&S®M3SR Series4100 support the following HF waveforms:
- R&S®SECOM-H
- STANAG 4285
- STANAG 4539

Extensive monitoring capabilities of the radio links complement the scope of functions provided by the R&S®T@cMan radio protocols.

R&S®T@cMan offers a comprehensive portfolio of data transfer applications together with high-performance radio protocols for VHF/UHF and HF networks, as well as sophisticated blue force tracking characteristics, thus providing a unique solution for state-of-the-art tactical communications.

Benefits

- Ideally complements secured data transfer to the tactical R&S®M3TR radio and its waveforms (R&S®SECOM-V, VHF/UHF modem, R&S®SECOM-H) and to the stationary R&S®M3SR Series4100 radio
- Optionally scalable from IP gateway, e-mail, chat, radio remote control to complete application portfolios, including blue force tracking – in line with customer requirements
- HMI optimized for touch screen, ideal for tactical operation
- Allows integration of the optimized RS-IRP radio protocol for efficiently transmitting data in radio networks
- Supports communications in PTP and broadcast radio networks

Ordering information

Designation	Type	Order No.
Mandatory article		
R&S®T@cMan Software Packet for one radio, including RS-IRP for R&S®SECOM-V and VHF/UHF modem, remote control, IP gateway, e-mail and chat	R&S®DS3500	6146.0402.02
Options		
Blue Force Tracking Function	R&S®DS3502	6146.0848.02
License for STANAG 5066 for STANAG 4285 and STANAG 4539 waveforms, including CFTP and HMTP e-mail clients	R&S®DS3504	6146.0919.02

R&S®STANAG 5066 HF Radio Data Communications System

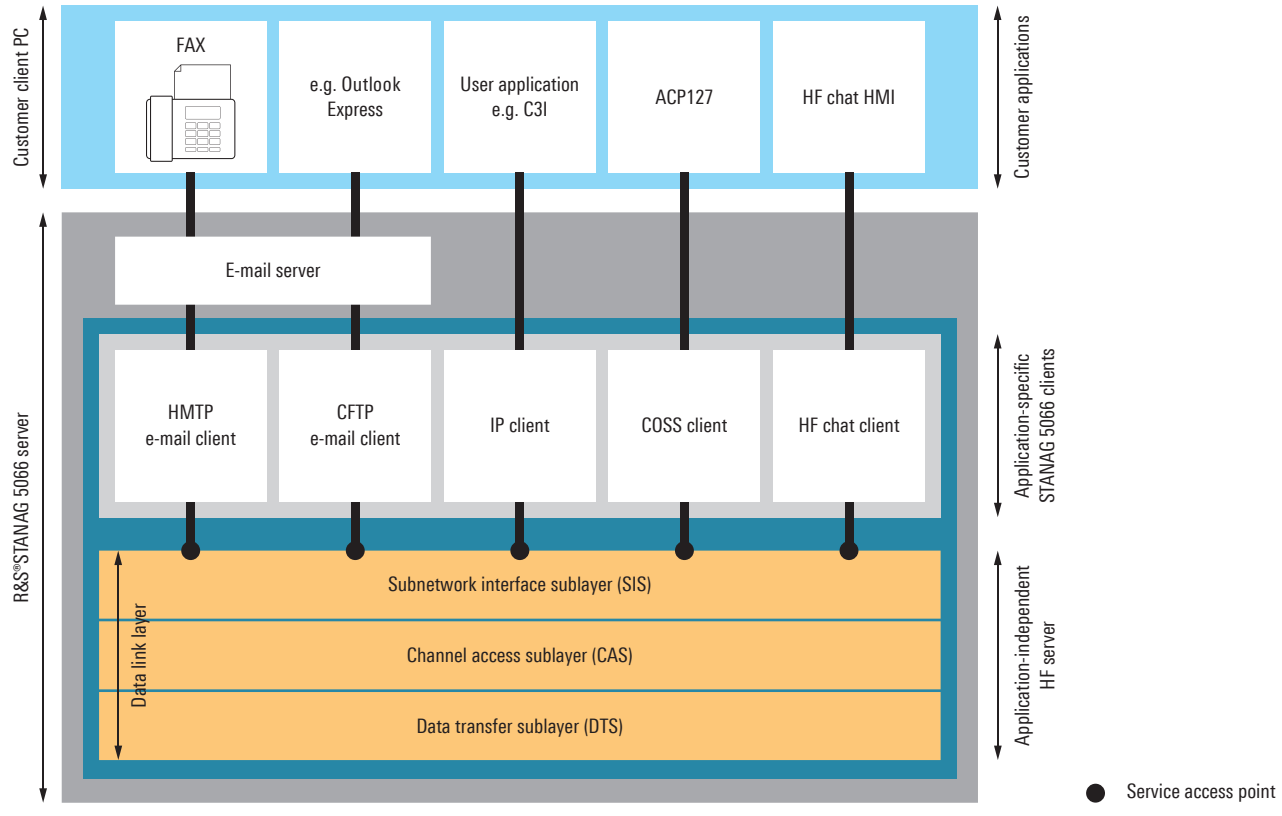
Complete communications solution for secure and robust data exchange in HF radio networks

Interoperable data communications

The exchange of information for command and control is vital for the successful planning and execution of military operations. Interoperable data exchange within joint and allied forces is essential in these scenarios. STANAG 5066 is the HF communications radio protocol which is very widely accepted and used not only in maritime but also in tactical environments. STANAG 5066, edition 1.2, amendment 1 is currently being ratified by NATO member countries.

- Compliance with STANAG 5066, edition 1.2, amendment 1
- Interoperable HF data communications with joint and allied forces
- Interface with ALE (in line with MIL-STD-188-141B, App. A + B)
- Adapters to e-mail, IP, and serial communications systems
- Controllable quality of service
- Automatic adaptation of data rate
- Easy adaptation to HF propagation conditions
- Integrated radio remote control
- Integrated communications system in conjunction with R&S®SIMCOS II

STANAG 5066 layer architechture



R&S®STANAG 5066 data communications system
R&S®STANAG 5066 is the latest generation of the STANAG 5066 compliant data communications solution. R&S®STANAG 5066 is an open, modular, multiuser system consisting of a data link protocol and various application adapters (called clients in STANAG 5066). The adapters connect with a variety of applications using standard interfaces such as e-mail interfaces, IP interfaces, and serial interfaces. A standard e-mail program that does not belong to R&S®STANAG 5066 can be used as an application connecting to the HMTP/CFTP client.

Supported radios and modems
R&S®STANAG 5066 supports the following radio and modem equipment:

Radios
- R&S®Series2000
- R&S®M3SR Series4100
- R&S®M3TR

HF modems
- GA123A
- RM6

Characteristics

R&S®STANAG 5066 layer model
The data link layer supports point-to-point, point-to-multipoint (no elimination of collisions due to the nonexisting definition of a media access layer in edition 1.2), and broadcast communications. Depending on the application requirements R&S®STANAG 5066 offers different transmission strategies with quality of service (QoS) aspects considered. If the focus is on reliability, the automatic repeat request (ARQ) mode provides recovery from communications errors by repeating erroneous data packets.
With time-critical services, non-ARQ mode speeds up delivery of the data. Both modes may be used with a data packet processing procedure based on adapter priorities. For secure communications R&S®STANAG 5066 supports external crypto devices.

Adaptation to the environment
As HF transmission mostly aims at long-range communications, a wide variety of propagation conditions may be encountered during transmission. R&S®STANAG 5066 provides easy adaptation to the expected HF conditions, even if the operators are not HF radio experts. Various predefined timing and configuration parameters are selected by a single mouse click.

For reliable HF radiocommunications, R&S®STANAG 5066 supports automatic link establishment (MIL-STD-188-141B, App. A + B), modem waveforms (STANAG 4285, STANAG 4539/Annex B, MIL-STD-188-110A, MIL-STD-188-110B, App. C) and automatic adaptation of the data rate to obtain the most suitable data rate for the current HF conditions. R&S®STANAG 5066's adaptive data rate change (ADRC) uses an intelligent-rule-based adaptation algorithm to select the optimal data rate to ensure reliable and efficient data communications. Optimized support for autobaud waveforms may be optionally selected to speed up data rate change.

Sending or receiving messages …
R&S®STANAG 5066 is able to transport plain text and data attachments (e.g. facsimiles) using the HMTP (HF e-mail transfer protocol) or CFTP (compressed file transfer protocol) protocol clients . Thus, the requirements of modern battle force e-mail systems are met.

R&S®STANAG 5066 provides standard interfaces for e-mail transfer, i.e. SMTP/POP3/IMAP, by using custom-off-the-shelf e-mail services. The customer's preferred e-mail client can be used to send e-mails via R&S®STANAG 5066.

… connecting to the IP world …
R&S®STANAG 5066 adds interoperable and transparent IP-based HF communications to existing customer communications systems. TCP and UDP based operation is provided to open up a wide range of user-defined IP applications. R&S®STANAG 5066 considers IP QoS demands and transparently maps them to its transmission strategies.

… or integrate legacy equipment …
Many current communications systems are based on serial line communications such as ACP127. R&S®STANAG 5066 provides a character-oriented serial stream (COSS) adapter to integrate such communications systems in an interoperable way. This opens up smooth migration paths for communications systems, enabling the concurrent and cooperative operation of modern and legacy systems.

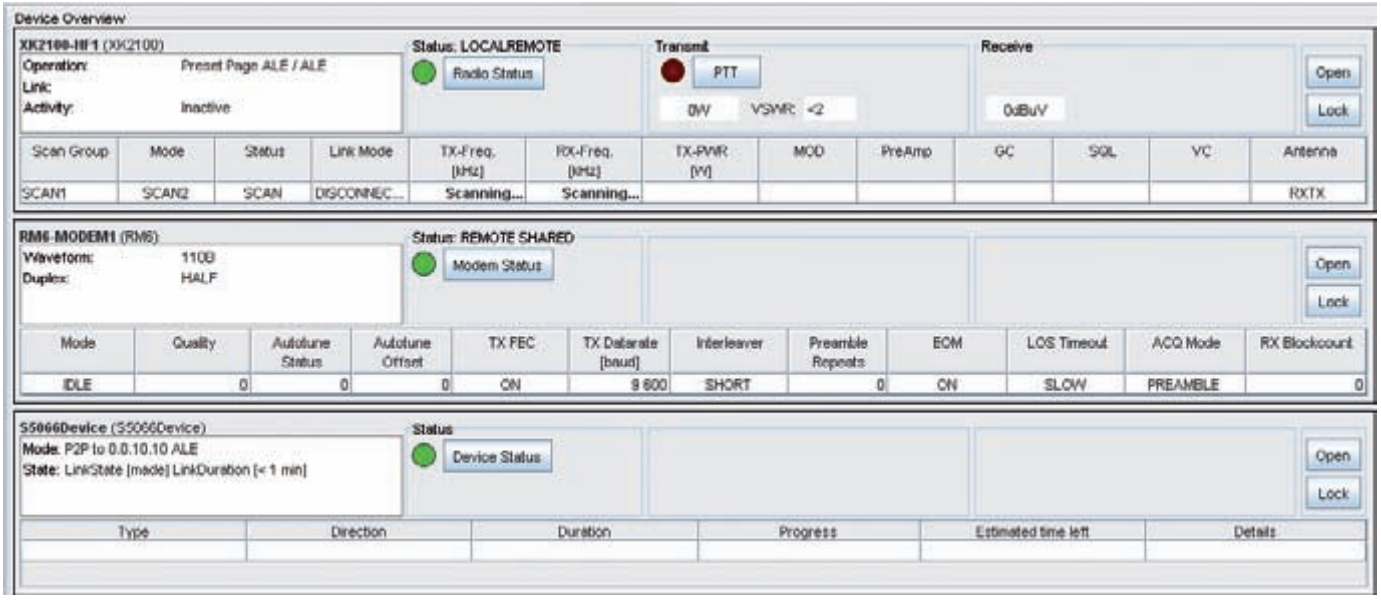
… by providing high data security
R&S®STANAG 5066 system operates with various external online crypto devices. Trusted filters provide full red/black separation for the remote control of modem and radio.

Integrated control and monitoring

Configuration and monitoring HMI of R&S®STANAG 5066

R&S®STANAG 5066 seamlessly integrates into R&S®SIMCOS II. Consequently, R&S®STANAG 5066 is remotely controllable from any operator workstation. An easy-to-use graphical user interface provides the means to monitor, control, and configure R&S®STANAG 5066 at different levels depending on operator skills.

Extensive remote control capabilities.



Ordering information

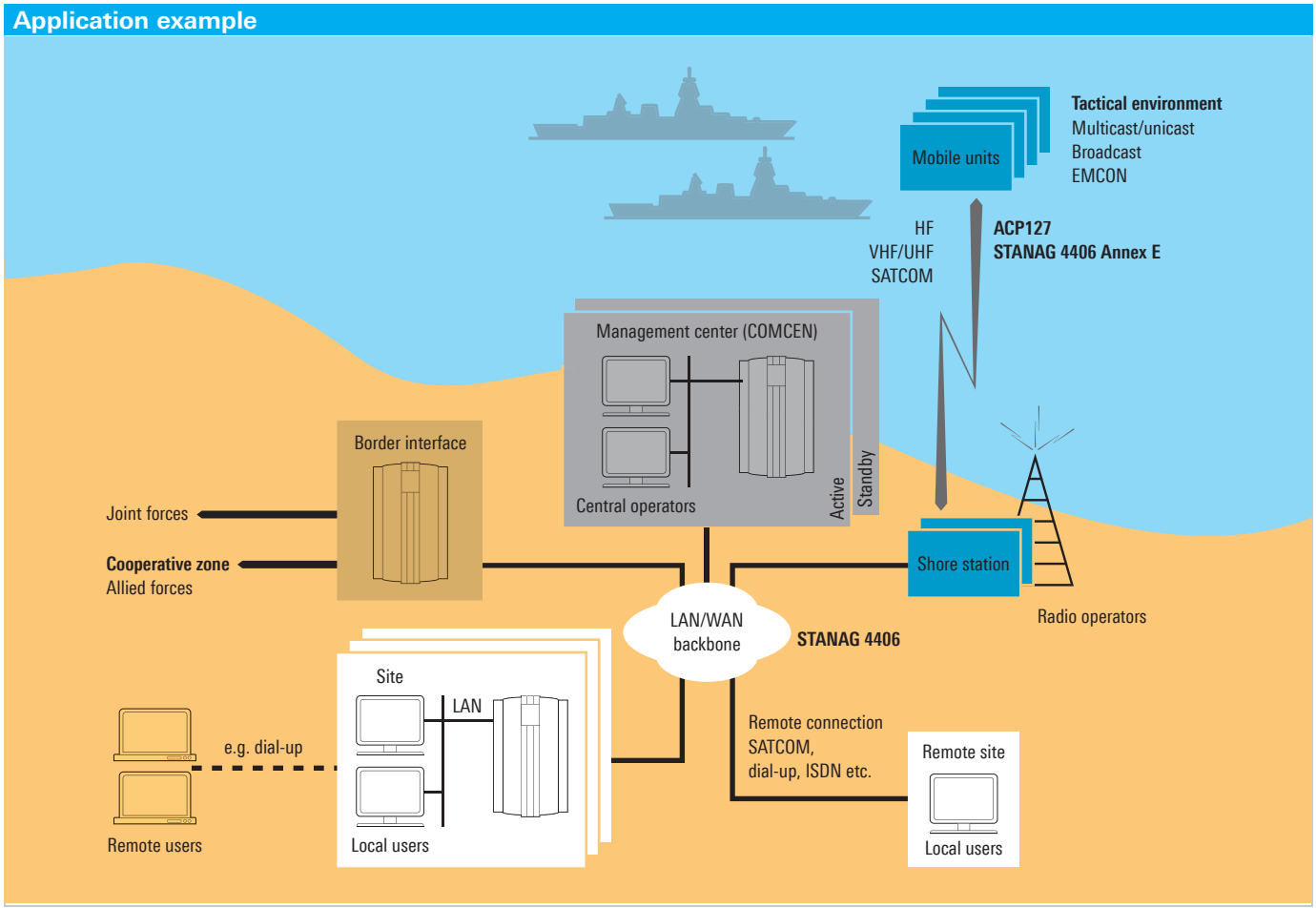
Designation	Type	Order No.
R&S®STANAG 5066 Server Software for one radio line including IP client and remote control capability	R&S®DS3600	6164.1409.02
Options		
E-mail (HMTP + CFTP)	R&S®DS3602	6146.1838.02
Chat (HF chat)	R&S®DS3603	6146.1844.02
COSS Client	R&S®DS3604	6146.1850.02
License for one additional radio line (up to 4 lines)	R&S®DS3670	6146.1867.02

R&S®MMHS STANAG 4406-Based Military Message Handling System

The exchange of information for command and control – both within and between armed forces at sea, on the ground and in the air – must be reliable, automatic and secure. These requirements are met by state-of-the-art information management systems such as R&S®MMHS.

The R&S®MMHS military message handling system is a STANAG 4406-compatible, all-in-one solution that combines easy and convenient operation with efficient administration. Communications over leased lines are increasingly giving way to TCP/IP based state-of-the-art wide area networks (WANs). The STANAG 4406 NATO standard describes the exchange of military messages in strategic IP-based local and wide area networks (LAN/WAN). Annex E furthermore defines an ultra-sophisticated interface to radiocommunications networks. The support of future IP radios is already covered. Although communications in radio networks are still dominated by ACP 127 radio systems, current plans call for the replacement of ACP 127 with STANAG 4406 within NATO by 2012.

Application example



- Compliant with STANAG 4406 Ed. 2, the latest NATO standard for military message handling
- Comprehensive role-based military messaging functions
- Outstanding radio network capabilities by means of STANAG 4406 Annex E
- Central configuration and management capability
- Seamless system interoperation with the R&S®SIMCOS II signal management and control system
- Interoperability with legacy ACP 127 systems
- Gateway to SMTP-based e-mail networks

Comprehensive role-based military messaging functions

The R&S®MMHS enables military organizations to exchange information automatically, securely and reliably in compliance with strictly predefined guidelines. As a military message handling system, the R&S®MMHS excels owing to role-based addressing. Moreover, it supports all required military message attributes and allows the use of electronic ADat-P3 forms. Even large volumes of messages can be handled by using the R&S®MMHS automatic message distribution function. A "Fire & Forget" mechanism ensures delivery and processing. For example, non-processed messages can automatically be sent to deputies if necessary. Configurable workflows help to ensure that messages can be created, checked and ultimately released by authorized users in the sequence wanted. The security of military communications is based on the encryption of the communications links, often by means of hardware encryption devices. R&S®MMHS also offers both end-to-end encryption and the capability to digitally sign messages in order to safeguard the internal integrity of the messages. All validated messages are stored in an archiving system.

Outstanding radio network capabilities by means of STANAG 4406 annex E

The R&S®MMHS implements annex E of STANAG 4406 and thus provides outstanding capabilities in radio networks, particularly when compared to conventional ACP 127 systems:

- Support of attachments
- Automatic error correction
- Multicast, i.e. a message can be transmitted to multiple parties simultaneously. Especially in the case of large attachments, this feature allows optimum utilization of radio channel capacity
- Automatic rebroadcasting for recipients operating in the EMCON mode in order to increase the probability of correct reception
- Transport of signed and end-to-end encrypted messages

Central configuration and management capability

The R&S®MMHS provides unique management functions with which roles, authorizations, security certificates, routing configuration and system configuration can be managed from a central location. All configuration data is transmitted to all units by means of automatic replication mechanisms. This also makes it very easy to manage a nationwide message handling network with the R&S®MMHS with a minimum of personnel.

Seamless system interoperation with the R&S®SIMCOS II signal management and control system

The system's interoperation with the R&S®SIMCOS II signal management and control system allows remote control and monitoring of all radios from any workstation. In addition, the R&S®MMHS is fully integrated into the planning and administration of radio links.

Interoperability with legacy ACP 127 systems

The integrated ACP 127 gateway of the R&S®MMHS enables parallel operation of ACP 127-based communications and thus paves the way for the step-by-step migration to a state-of-the-art, homogeneous STANAG 4406 communications network.

Gateway to SMTP-based e-mail networks

An integrated SMTP gateway makes communicating with STANAG 5066 e-mail networks and with non-military e-mail networks an easy task.

Ordering information

Designation	Type	Order No.
Mandatory articles		
R&S®MMHS Basic Software Package	R&S®DS3700	6147.1754.02
Software options		
Central Message Archive	R&S®DS3701	6147.2180.02
ACP 127 Gateway	R&S®DS3702	6147.2196.02
STANAG 4406 Annex E Gateway	R&S®DS3703	6147.2209.02
E-Mail Gateway	R&S®DS3704	6147.2215.02
Border Gateway	R&S®DS3705	6147.2221.02
Additional licenses		
License for one Workstation	R&S®DS3720	6147.2267.02
License for one STANAG 4406 annex E radio line	R&S®DS3710	6147.2250.02
Country-Wide License for the management console	R&S®DS3706	6147.2238.02
Accessories		
USB Token	R&S®DS3770	6070.8544.00
Systematic IRIS Software Package for one Workstation	R&S®DS3770	6147.2244.02


ROHDE&SCHWARZ I-STE TS6030 · BASIC RACK 5200.7050.02
SELECT
RADIOCOMMUNICATION
SERVICE MONITOR

Chapter 5
Service and Maintenance

As a supplier of highly secure radiocommunications systems as well as versatile test and measurement equipment for all aspects of radiocommunications, Rohde&Schwarz possesses the comprehensive expertise to meet any test requirement, from conventional analog communications systems to state-of-the-art software defined radios.

The R&S®TS6030 test system is specifically designed for performing service and maintenance on radios and accessory equipment of the R&S®M3xR family and the R&S®Series4200. In conjunction with the test routines built into the radio equipment, the R&S®TS6030 enables the user to identify errors down to the module level (I-level).

Type	Designation	Description	Page
R&S®TS6030	I-Level Special Test Equipment	Fast and easy on-site maintenance of radios, amplifiers and control units	260

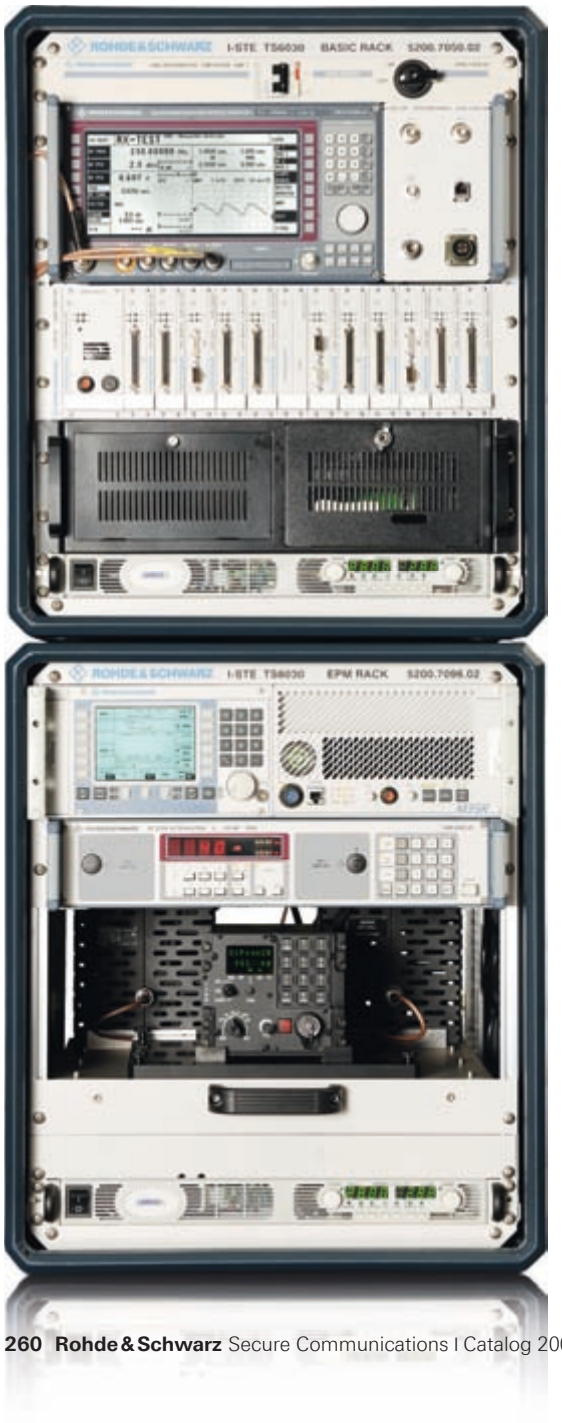
R&S®TS6030 I-Level Special Test Equipment

Fast and easy on-site maintenance of radios, amplifiers and control units

The R&S®TS6030 test system is specifically designed for performing service and maintenance on radios and accessory equipment of the R&S®M3xR family and the R&S®Series4200. In conjunction with the test routines built into the radio equipment, the R&S®TS6030 enables the user to identify errors down to the module level (I-level).

The radio being tested can be quickly connected to the R&S®TS6030. Testing itself is then performed fully automatically. The R&S®TS6030 is a highly reliable and accurate test system that can be operated without requiring extensive training. Since the R&S®TS6030 test system is housed in rugged, splashproof 19" boxes, it can be transported safely, set up quickly, and utilized at a variety of locations.

- Fast and automatic functional test
- Testing across the radio equipment's entire frequency range
- Precise error identification
- Verification after module replacement
- Easily adaptable to a variety of radio types
- Transportable and robust 19" aluminum racks



Upper case: basic system
lower case: EPM (ECCM) mode extension.

Reliable functional test of radio equipment

Fast and automatic functional test
The user can now run automatic tests of radio equipment by means of the R&S®TS6030 software. The test system's software controls the entire test sequence and features a straightforward, interactive graphical user interface (GUI) based on Windows. In its default configuration, the software performs a full test of the unit under test (UUT). There is no need to switch any cable connections during the test, which makes system operation a lot easier.

Performance test covering radio equipment's entire frequency range

Plain mode
Plain mode (unencrypted) communications is a standard functionality in all R&S®M3xR radios. To carry out a functional test in this mode, only the basic system (on top in picture) is needed.

The system analyzes the following UUT functions and characteristics in this mode:

- RF parameters of the RX/TX antenna interface
- Audio and data transmission
- Level and performance of all interfaces
- Evaluation of results output by the UUT's internal test routines (via the remote interface)
- Initiated built-in test (IBIT)
- Continuous built-in test (CBIT)
- Analysis of the UUT's power consumption

EPM (ECCM) mode

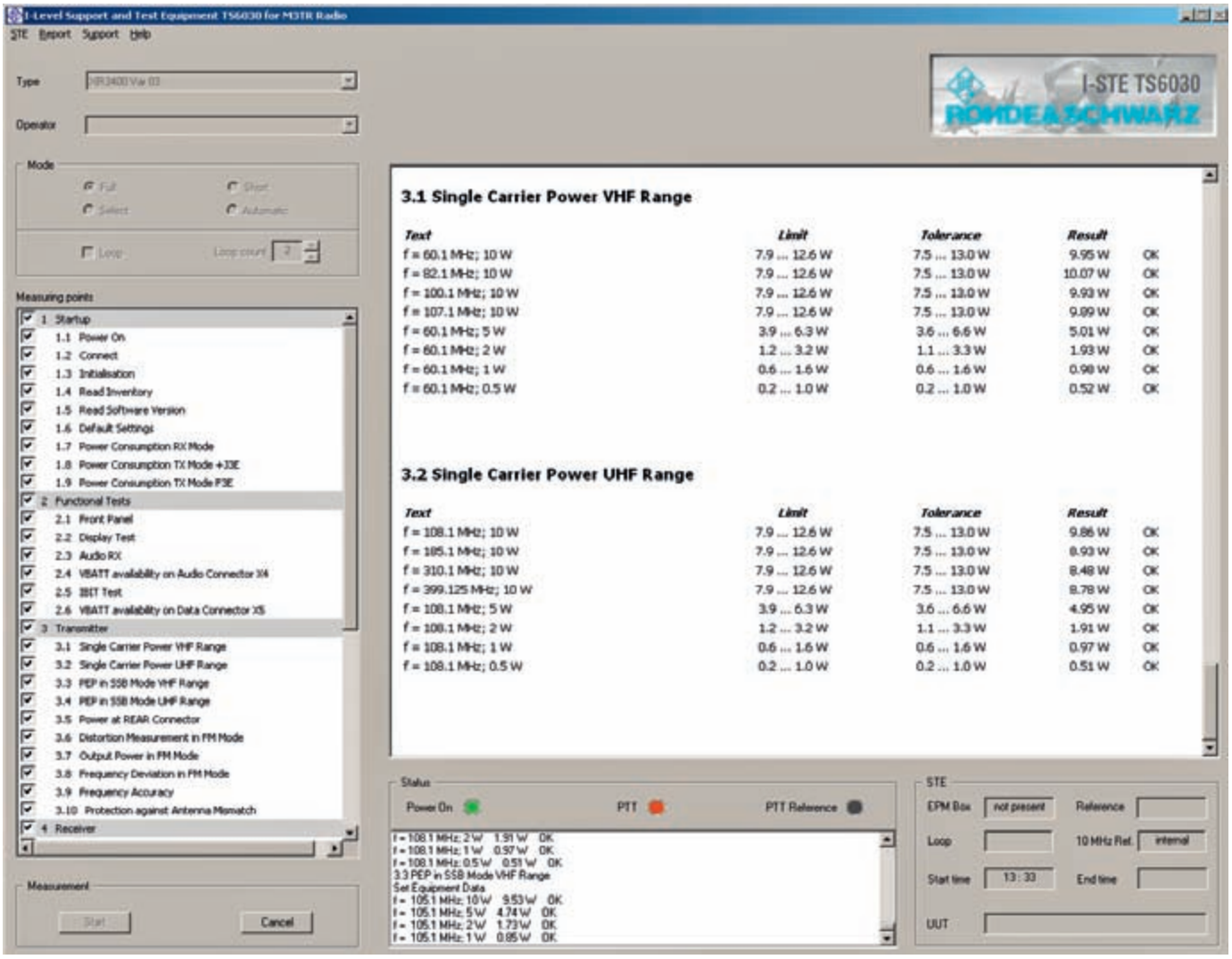
R&S®M3xR radios may include electronic protective measures EPM (ECCM) capabilities such as R&S®SECOS, R&S®SECOM, HAVE QUICK and SATURN. To test the EPM (ECCM) functionality of a UUT, a second radio is needed that operates with the same keys of the same encryption standard as the UUT. The second radio is implemented as a reference radio, which is also often referred to as a golden device.

The EPM (ECCM) mode extension (R&S®TS6030-B100 option) consists of a second rack (at bottom in picture) and enables the user to perform the following tests for encrypted communications:

- Key and data handling
- Time synchronization
- Voice transmission between UUT and reference radio
- Test of radio traffic with high losses on radio link

The radio link is simulated in the EPM (ECCM) mode by the R&S®RSG step attenuator. Any of the following radios may be used as a reference receiver as long as it offers the same encryption method as the UUT: R&S®M3AR, R&S®M3SR or R&S®M3TR. For example, it is possible to test an R&S®M3AR radio by means of an R&S®M3SR that is used as a golden device. This ensures maximum system flexibility.

Graphical user interface of the R&S®TS6030 software.



User-selectable scope of testing
The R&S®TS6030 allows the user to select individual test groups to cover specific UUT functionalities. Each test group consists of a specific set of test steps for performing and evaluating the required measurements. To detect sporadic errors, the R&S®TS6030 software can automatically repeat the selected test sequence (loop).

Display of the current system status
The system status as well as measurement and analysis results are displayed in the status panel even while the functional test is in progress.

Automatic generation of test reports
As each test step is completed, the R&S®TS6030 software generates a detailed test report that records the results of the test step. Test reports can be stored and printed. The test sum can be used to check the integrity of the stored test report.

Maximum flexibility, minimum training

Do-it-yourself on-site repair
Sending radios to external service centers for testing not only takes a lot of time: It also takes a big bite out of the budget. The R&S®TS6030 helps to avoid this entire process.

Precise error identification
Based on the results of the individual test steps, the R&S®TS6030 assesses overall UUT functionality. Defects within a UUT can be precisely localized through the intelligent correlation of all results.

Recommended replacement unit for defective modules
After precisely identifying an error in the UUT, the R&S®TS6030 recommends the smallest replaceable unit (SRU). This minimizes costs and effort in the repair of defective radios.

Functionality verification after module replacement
The R&S®TS6030 can also be used to verify whether a repair (e.g. a module replacement) was successful. The user merely needs to subject the repaired radio to the test again. This type of the verification proves that the UUT functions properly and is an essential component of maintenance measures, for example in aviation electronics.

Mobile use of the R&S®TS6030.

Mobile and adaptable to customer requirements

Easily adaptable to a variety of radio types

The R&S®M3AR, R&S®M3SR, R&S®M3TR, R&S®Series4200 and the R&S®Series2000 radios have different interfaces and power supply requirements because they are intended for different applications. The R&S®TS6030 offers special-to-type interfaces for each type of radio. They can be used as required without any modification to the test system. The R&S®TS6030-B10/-B110, -B20/-B120, -B30/-B130 and -B60/-B65 options include as standard the plug-in cards required in each case. This plug-and-play functionality makes system upgrading an easy task.

It is not necessary to switch any cable connections during the test, which makes system operation a lot easier. Support for additional types of radios is available on request.

Testing of power amplifiers and antenna tuners also possible

For testing R&S®VT3050C, R&S®VK3150 and R&S®VD480L power amplifiers, test options can be added specifically for this purpose. These options contain all required cables plus an extension for the test software. Moreover, the R&S®TS6030 also offers optional support for testing the R&S®FK3150 HF antenna tuner.

Transportable and robust 19" box

The R&S®TS6030 is housed in a rugged 19" box (12 HU). Its front and rear sides can be protected during transport by means of the covers supplied with the unit. The R&S®TS6030-B100 (EPM (ECCM) mode) option comes in a second box with identical characteristics and of identical size. The cable connections between the two boxes are dimensioned such that the boxes can be set up one on top of the other or next to each other.

The protective covers include convenient pouches for storing all cables during transport. If the equipment is to be used solely in a stationary lab setup, all components of the R&S®TS6030 including the EPM (ECCM) mode expansions can be installed in just one 19" rack (27 HU).

Advantages of the R&S®TS6030 compared with built-in test equipment of the radios

R&S®TS6030	R&S®M3xR and R&S®Series4200 built-in test equipment
Test over the same interfaces via which the UUT is also connected	Measurements are performed at the main test points inside the UUT
Selectable test groups across the entire frequency range of the radios	No selection possible
Recommendation for the replacement of a defective module owing to the intelligent linking of all test results	Results of the built-in test must be interpreted by the user with the help of the manual
Loop function for detecting sporadic errors in the real operation environment	The measurements at the main test points are repeated
Test of encrypted communications	Testing not possible
Test of EPM (ECCM) modes with different types of radios	Testing not possible
Measurement of the operating temperature inside the UUT not possible	The temperature inside the UUT is measured
Generation of a complete test report in line with Rohde&Schwarz test instructions	Output on the UUT display
Verification after a module replacement under the same test conditions	

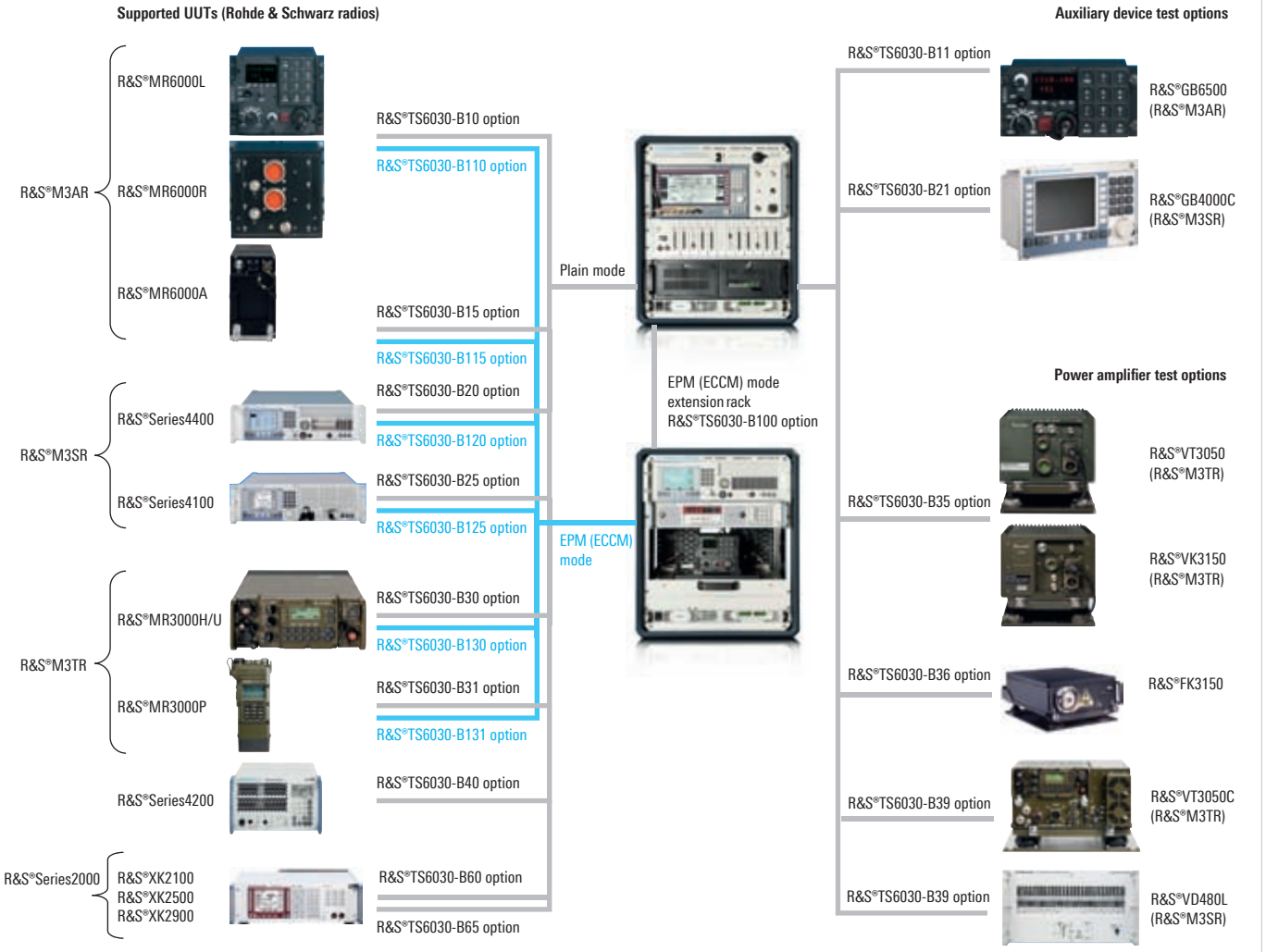
System interface of the R&S®TS6030.

Water-resistant rugged transit case (IP65).

Specifications

Dimensions		
Basic system rack/EPM (ECCM) mode extension	with cover (W × H × D)	534 mm × 618 mm × 710 mm (21 in × 24.33 in × 28 in)
	without cover (W × H × D)	534 mm × 618 mm × 580 mm (21 in × 24.33 in × 22.83 in)
Weight	basic system rack	75 kg (165.35 lb)
	EPM (ECCM) mode extension	50 kg (110.23 lb)
Temperature range	operating	+5 °C to +40 °C
	storage	–20 °C to +60 °C
	best test accuracy	+20 °C to +23 °C
	damp heat	+40 °C at 95 % relative humidity
Power supply		100 V to 240 V AC, 50/60 Hz
Time required		
Connecting a UUT		<5 min
Complete test	R&S®M3SR	<30 min (depending on type and equipment)
	R&S®M3TR	<30 min (depending on type and equipment)
	R&S®M3AR	approx. 40 min (depending on type and equipment)
Test system setup		<30 min
Test system dismantling		<30 min
Recommended calibration cycle	R&S®CMS54, R&S®NRT-Z14	1 year

Overview of R&S®TS6030 options



Ordering information

Designation	Type	Order No.
Basic system [1]		
I-Level Special Test Equipment, incl. system rack, measurement equipment, 19" industrial PC and laser printer	R&S®TS6030	5200.7050.02
Included measurement equipment		
Radiocommunication Service Monitor	R&S®CMS54	0840.0009.54
OCXO Reference Oscillator	R&S®CMS-B2	1001.6809.02
Centronics Interface and ITU-T Filter	R&S®CMS-B55	1032.0790.02
10 MHz Reference Frequency IN/OUT	R&S®CMS-B22	1001.6750.02
19" Adapter, 4 HU 3/4 for design 90 cabinets	R&S®ZZA-99	0839.5775.00
Attenuator 30 dB, 100 W	R&S®RBU100	1073.8495.30
Directional Power Sensor 25 MHz to 1 GHz	R&S®NRT-Z14	1120.5505.02
RS-232-C Interface Adapter for R&S®NRT-Z sensors	R&S®NRT-Z3	1081.2705.02
System interface options (plain mode) [1]		
Including interface modules, cabling and plain mode test software suite		
System Interface for R&S®M3AR, radio types R&S®MR6000R, R&S®MR6000L	R&S®TS6030-B10	5200.7067.02
System Interface for R&S®M3AR, radio type R&S®MR6000A	R&S®TS6030-B15	5201.6229.02
System Interface for 611H	R&S®TS6030-B18	5201.6241.02
System Interface for R&S®M3SR Series4400	R&S TS6030-B20	5200.7073.02
System Interface for R&S®M3SR Series4100	R&S®TS6030-B25	5201.6458.02
System Interface for R&S®Series400U	R&S®TS6030-B28	5201.6258.02
System Interface for R&S®M3TR	R&S®TS6030-B30	5200.7080.02
System Interface for R&S®Series4200	R&S®TS6030-B40	5201.6441.02
System Interface for R&S®SeriesARRS	R&S®TS6030-B50	5201.6535.02
System Interface for R&S®Series2000	R&S®TS6030-B60	5201.8921.02
EPM (ECCM) mode extension options [2] [5]		
EPM (ECCM) Mode Extension, including system rack and measurement equipment	R&S®TS6030-B100	5200.7096.02
Included measurement equipment		
RF Step Attenuator, DC to 5.2 GHz	R&S®RSG	1009.4505.02
19" Adapter, 2 HU 1/1 for design 90 cabinets	R&S®ZZA 92	0396.4886.00
Attenuator 30 dB 100 W, 2 units	R&S®RBU100	1073.8495.30
System interfaces (EPM (ECCM) mode extension), including interface modules, cabling and EPM (ECCM) mode test software suite		
System Interface for R&S®M3AR, radio types R&S®MR6000R, R&S®MR6000L	R&S®TS6030-B110	5200.7109.02
System Interface for R&S®M3AR, radio type R&S®MR6000A	R&S®TS6030-B115	5201.6235.02
System Interface for 611H	R&S®TS6030-B118	5201.6270.02
System Interface for R&S®M3SR Series4400	R&S®TS6030-B120	5200.7115.02
System Interface for R&S®M3SR Series4100	R&S®TS6030-B125	5201.6464.02
System Interface for R&S®Series400U	R&S®TS6030-B128	5201.6264.02
System Interface for R&S®M3TR	R&S®TS6030-B130	5200.7121.02
Auxiliary device test options		
Control unit tests, including cabling and control unit test software suite		
Control Unit Test for R&S®M3AR (R&S®GB6500); requires R&S®TS6030-B10 option	R&S®TS6030-B11	5200.7138.02
Control Unit Test for R&S®M3SR Series4400 (R&S®GB4000C); requires R&S®TS6030-B20 option	R&S®TS6030-B21	5200.7144.02
Control Unit Test for R&S®GB406S1; requires R&S®S6030-B20 option	R&S®TS6030-B22	5201.6529.02
Extension for R&S®MR3000P Plain Mode, including cabling for R&S®MR3000P and test software suite extension; requires R&S®TS6030-B30 option	R&S®TS6030-B31	5201.7931.02
Extension for R&S®MR3000P EPM (ECCM) Mode, including cabling for R&S®MR3000P and EPM (ECCM) test software suite extension; requires R&S®TS6030-B130 option	R&S®TS6030-B131	5201.7948.02
Power amplifier test options (including test software suite extension) [4] [5]		
R&S®VT3050/VK3150 Power Amplifier Test, including cabling for R&S®VT3050, R&S®VK3150	R&S®TS6030-B35 [3]	5201.6206.02
R&S®FK3150 HF Antenna Tuning Unit Test, including antenna simulation unit and cabling	R&S®TS6030-B36 [3]	5201.6212.02
R&S®VT3050C Power Amplifier Test, including cabling for R&S®VT3050C	R&S®TS6030-B38 [3]	5201.7860.02
R&S®VD480L Power Amplifier Test, including cabling for R&S®VD480; requires R&S®TS6030-B20 option	R&S®TS6030-B39	5201.6512.02
R&S®Series2000 Power Amplifier Test, including cabling for R&S®XK2500/2900; requires R&S®TS6030-B60 option	R&S®TS6030-B65	5201.8938.02

[1] The basic system can only be ordered together with an R&S®TS6030-B10/-B15/-B18/-B20/-B25/-B28/-B30/-B40/-B50 or R&S®TS6030-B60 system interface option.

[2] The EPM (ECCM) mode extension can only be ordered together with an R&S®TS6030-B110/-B115/-B118/-B120/-B125/-B128 or R&S®TS6030-B130 system interface option. For the EPM (ECCM) tests, a reference radio is required (not included in the items supplied).

[3] Requires the R&S®TS6030-B30 option. A docking station is not included in the items supplied (docking station not required for the R&S®VT3050C).

[4] For testing antennas an antenna tuning unit and an antenna simulator are required (not included in the items supplied).

[5] For the EPM (ECCM) tests and power amplifier test option, a reference radio is required (not included in the items supplied).

Chapter 6
Appendix

Technologies come and go – good service is of lasting value

From products to solutions

Productivity = advanced technology + excellent service

Customers that choose Rohde&Schwarz show a special esteem for high productivity and profitability of an investment. And they rightly expect these qualities to be maintained throughout the product's entire lifetime. From the time it leaves the factory, a Rohde&Schwarz instrument or system has everything that serves this purpose: cutting-edge, future-ready technology, easy operation and maintenance, ruggedness and perfect quality. But experience has shown that good support is what makes a good product a good solution. For this reason, Rohde&Schwarz has built up a worldwide service and support network that assists you quickly and competently with all your needs so that you can exploit the full potential of your Rohde&Schwarz products.

Your desire – our commitment

Full-range service at your command

There is one goal common to all service operations, no matter how different they may be in detail: to protect your investment and maximize the added value. The right mix from our service and support package ensures that your Rohde&Schwarz products will perform to their full capacity and that your investments will pay dividends to the end of their lifetime:

- Availability through quick maintenance and repair
- State-of-the-art operation through hardware and software updates
- Deployment possibilities through application support
- Productivity from day one through turnkey installation and commissioning of systems
- Build-up of know-how by training your staff

Worldwide Service

High-quality service safeguards your investment

Equipment and systems from Rohde&Schwarz offer the utmost in precision and accuracy. To make sure that customers can rely on this accuracy at all times, we have built a service network that ensures global access to expert calibration and maintenance, as well as any repair needs.

Globally local

The Rohde&Schwarz service network is designed to be multilevel and decentralized. This means that all of our equipment and systems can be fully serviced by area support and local service centers and do not have to be sent elsewhere except in only the most exceptional circumstances. For customers, this means minimum downtime and maximum availability.

The local service center – your partner close by

Each local service center provides a wide range of services tailored to local requirements. All local service centers are equipped to provide the services typically required by the customers in their area.

The area support center – expert technical knowledge and logistical backup

Located in the key industrial regions of the globe, these facilities have the resources to assist customers at virtually any level. Engineers are on call and generous stocks of parts are on hand, as is all the equipment needed for advanced diagnostics, repair and calibration.

The Cologne and Munich service centers

Our service centers in Cologne and Munich, Germany, are at the core of our worldwide service system. They back up our area support and local service centers with wide-ranging support, training, documentation and other services. They also function as area support centers for Europe, providing logistical support, high-level troubleshooting, maintenance, repair and calibration.

Maximum availability

Working together, this network assures our customers of minimum downtimes and maximum availability. Whether for safety-critical applications or in cost-intensive production, Rohde&Schwarz customers know they can rely on our service network to keep their equipment at the highest level of precision.

Consistently high standards

All of our service centers are internally audited to stringent quality standards. Our staff undergoes continuous and extensive training on the latest product developments, technologies and procedures. This ensures that Rohde&Schwarz customers the world over have local access to the same consistently high level of expertise.

Fast spare parts supply

Even the best equipment can fail sometime. And then you are thankful if faulty parts can be replaced fast. More than 30000 different spare parts are stored by Rohde&Schwarz.

For the customer, this modern warehousing and logistics hub means extremely fast spare parts availability virtually anywhere in the world. Rohde&Schwarz equipment is highly modular, which saves time and cuts costs if repair is needed. Rohde&Schwarz ensures long-term spare parts availability also for older modules and systems.

Service addresses

You will find current addresses on our homepage:

www.rohde-schwarz.com

Global Service Network

ROHDE&SCHWARZ

Home

Information Resources

We back up our technology solutions with exhaustive information in many forms, so that you always have access to what you need

Support line help

We offer expert support line help. That means when you call us with a question, you talk to a qualified engineer who can give you real answers.

24 h reachability

Customer support

Our regional support centers will be glad to answer any questions regarding our products and service:

Europe, Africa, Middle East
Phone +49 1805 12 42 42 or +49 89 4129 137 74
customersupport@rohde-schwarz.com

North America
Phone 1 888 837 87 72 (1 888 TEST RSA)
customer.support@rsa.rohde-schwarz.com

Latin America
Phone +1 410 910 79 88
customersupport.la@rohde-schwarz.com

Asia/Pacific
Phone +65 65 13 04 88
customersupport.asia@rohde-schwarz.com

Our promise

Whatever questions customers have about Rohde&Schwarz products or services, we will try to provide the answers! If an immediate answer is not possible, we won't waste your time with unnecessary calls or holding patterns. Instead, we'll record your problem, work on it and get back to you.

If you are already a customer, your local service center will often be the fastest source of information – they already know your requirements and applications in more detail.

Catalogs

In addition to this catalog, we offer:

- Test and Measurement Products
- Broadcasting
- Radiomonitoring and Radiolocation
- HF–VHF/UHF–SHF Antennas

Product brochures/data sheets

The product brochures/data sheets provide a detailed description of each device, with features, applications and specifications. All product brochures/data sheets are also available as pdf files on our website.

News/MIL-News from Rohde&Schwarz

These journals inform subscribers on new product developments and feature articles from the development lab. Back issues of News are available on the Web. If you'd like to subscribe, contact your local Rohde&Schwarz sales engineer.

Application notes

They give you valuable information on specific applications. All our application notes are free of charge and can be downloaded from our website.

Special publications

Additional technical literature from Rohde&Schwarz is available in the form of special publications on current items, refresher topics, books, compendia, etc.

Website

Our website **www.rohde-schwarz.com** contains a vast amount of material, including detailed product information, much of which is downloadable as pdf files. You can also get a personal newsletter sent to you automatically, with information on your topics of interest.

Ownership Options, Demo Units, Trademarks, Specifications

Rohde&Schwarz offers a variety of ways to acquire our equipment when you need it, without placing undue strain on your liquidity

Rental with purchase option

Do you need a device only temporarily? Are you unsure as to your future plans? Or do you have to bridge a momentary financial bottleneck? Business is not always predictable, so we offer a rental with purchase option. For details and terms, please contact your local Rohde&Schwarz representative.

Demo units

To allow our customers to convince themselves of the technical performance and quality of our radios, Rohde&Schwarz will make available free-of-charge demo units on request. In individual cases, demo units can be purchased at favorable prices.

For details and terms, please contact your local Rohde&Schwarz representative.

Trademarks

Trade names are trademarks of the owners

- R&S® is a registered trademark of Rohde&Schwarz GmbH & Co.KG
  Example: R&S®EK2000 VLF-HF Receiver
- Windows is a registered trademark of Microsoft Corp., USA
- CORBA is a registered trademark of the Object Management Group, Inc.

Specifications

Specifications are given in this catalog partly in condensed form. For full and binding specifications please refer to the relevant data sheet.

Catalog Contents

Index