# R&S®M3SR SERIES4100 RADIOS

## HF radio family for stationary and shipborne communications

**ROHDE & SCHWARZ**

Make ideas real

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# AT A GLANCE

Rohde & Schwarz has developed a state-of-the-art generation of communications systems designed to take HF radio to the next level. HF wideband functionality (in line with MIL-STD-188-110D and STANAG 5069) speeds up HF data transmission to achieve data rates comparable to those attained with SATCOM. Shortwave communications are a resource that can be set up easily, offers extreme reliability and is highly valued by security authorities and organizations as well as military users all over the world.

The R&S®M3SR Series 4100 HF radios are innovative, versatile software defined radios (SDR) that belong to the popular R&S®M3SR radio family. They support frequency hopping and provide interoperability with the R&S®M3TR family of tactical radios in all of the HF operating modes. Possible applications include typical navy applications on board ships and on shore, civil air traffic control, embassy radio systems and tactical applications.

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

The R&S®M3SR Series 4100 is a powerful radio platform that can be extended at any time. This helps to provide a safe, future-ready investment.

Besides the existing HF House waveforms, the R&S®M3SR Series 4100 will also support future waveforms that attain a suitable level of market acceptance and eventually become international standards. A software update is all that is required.

The radio already includes HF wideband functionality to establish long-range data links on a 48 kHz channel. The probability to obtain permanent high data rates can be increased thanks to a well-tuned and embedded radio HF wideband concept prepared for 48 kHz channels.

# KEY FACTS

► Frequency range: 1.5 MHz to 30 MHz (transmission),
  10 kHz to 30 MHz (reception)

► Different configurations available: Standalone receiver, standalone transceiver, standard and high-power transmitter systems, broadband systems, split-site configuration

► Standard power classes available: 150 W, 500 W, and 1000 W

► High-power classes available: 5000 W and 10 000 W

► Support of LINK11/22 and LINK Y data links

► Embedded secure voice and data capability

► Embedded HF wideband in line with MIL-STD-188-110D and STANAG 5069 for 48 kHz contiguous channels

► Embedded ALE4G (in line with MIL-STD-188-141D App. G and H)

► IP-over-air capability for up to 48 kHz contiguous channels

► SIP based remote voice operation

# IP FOR EASY INTEGRATION

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

### R&S®IPoA IP-over-air HF wideband radio transmission

The R&S®IPoA embedded radio protocol provides transparent IP functionality over the air in contiguous HF channels up to 48 kHz bandwidth. It can be used to set up communications systems that require transparent connection of IP networks over radio links. IP-based applications – such as situational awareness or message handling systems – are able to exchange their data over such radio links. The R&S®RNMS3000 network management system provides a wizard that creates an IPoA network structure automatically.

### R&S®IPoA protocol functionality

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

### R&S®IPoA embedded services

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

### Short data messages

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

### GPS reporting

GPS reporting allows the position of the own radio to be transmitted. The position of other radios can be shown on the HMI or transmitted to other applications. For example, the R&S®M3SR Series4100 radio in ALE-3G and ALE-G4 can receive the position from R&S®M3TR radios in the field (blue force tracking).

### IPoA with STANAG 4538 and WBxDL

Depending on the destination IP address, an advanced, highly robust link setup with ALE-3G or ALE-4G is used to establish a link to the appropriate radio. Once the link has been set up, the actual payload is transmitted with the xDL data link protocols from STANAG 4538 using error protection based on an integrated automatic repeat request (ARQ) procedure. In wideband mode, Rohde & Schwarz proprietary WBxDL waveforms with a bandwidth of up to 48 kHz are available for this purpose.

In the implementation developed by Rohde & Schwarz, the different xDL protocols are selected automatically. An intelligent choice is made based on the data size and current channel quality, due to a mechanism that ensures that the optimum waveform is always selected for maximum data throughput under a very wide range of channel conditions. Data transmission is still possible in very poor channels with a signal-to-noise (S/N) ratio as low as –6 dB.

### R&S®IPoA – transparent IP data transfer over air
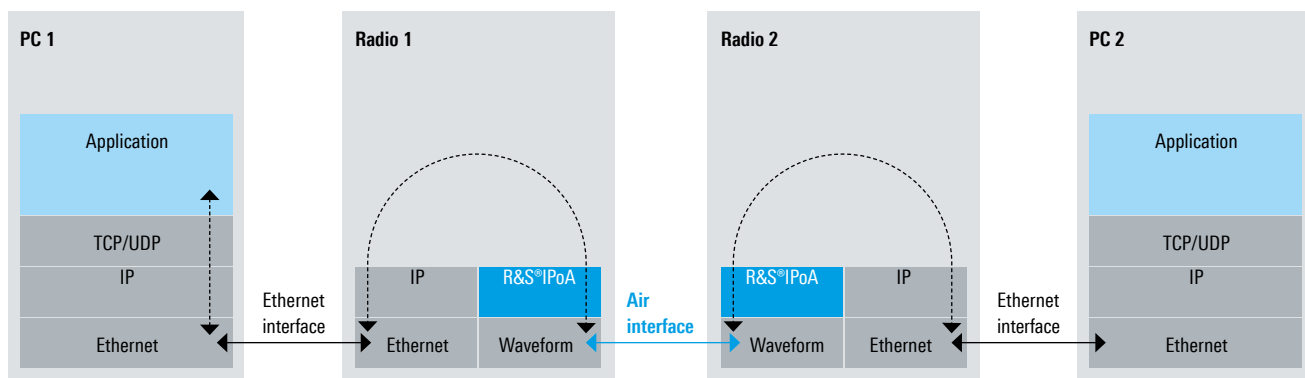
## Voice over IP, SIP and phone patch

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

## Audio and remote control via IP

Since all relevant information is transmitted via Ethernet, the operator does not have to be at the same location as the R&S®M3SR Series4100 radio, provided an IP connection is available.
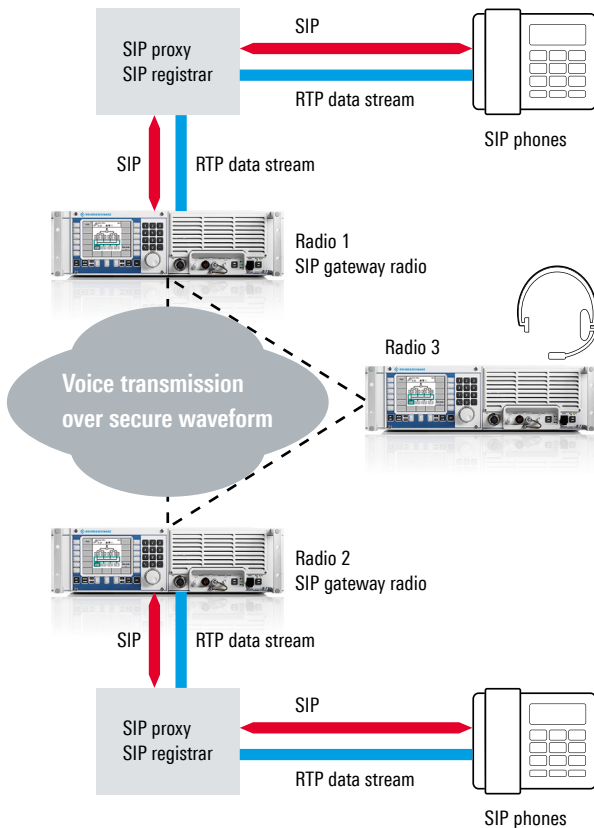
## Phone patch

The phone patch is used to integrate the R&S®M3SR Series4100 radio into an SIP phone system. With ALE-3G or ALE-4G, participants in the radio network can also be directly reached from a standard SIP phone. In addition, the radio network participants can directly communicate with other participants via the SIP phone system. If the secure digital voice (SDV) option is used, the connection is encrypted.

## Domain connect

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

## Easy integration into a VoIP network (phone patch)



SIP proxy
SIP registrar

SIP

RTP data stream

SIP phones

SIP    RTP data stream

Radio 1
SIP gateway radio

Radio 3

Voice transmission over secure waveform

Radio 2
SIP gateway radio

SIP    RTP data stream

SIP proxy
SIP registrar

SIP

RTP data stream

SIP phones

# INTEROPERABLE WAVEFORMS FOR MULTINATIONAL COOPERATION

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

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

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

## ALE-2G
ALE-2G is the automatic link establishment for second-generation systems. This software option provides support for the FED-STD-1045/1046/1049 and MIL-STD-188-141B App. A+B standards.

## ALE-3G, STANAG 4538, R&S®GS4155S, R&S®GS4165S
ALE-3G (third generation automatic link establishment) offers significant benefits compared to ALE-2G, including considerably faster and more robust link setup, improved automatic channel selection algorithms and embedded data link protocols. In addition, the automatic link maintenance (ALM) functionality is supported, allowing channels to be switched during a transmission without interrupting the link. The layer 2 protocols known as low-latency data link (LDL) and high-throughput data link (HDL) have the benefit of improved robustness at low S/N values compared to conventional protocols.

## HF4G house
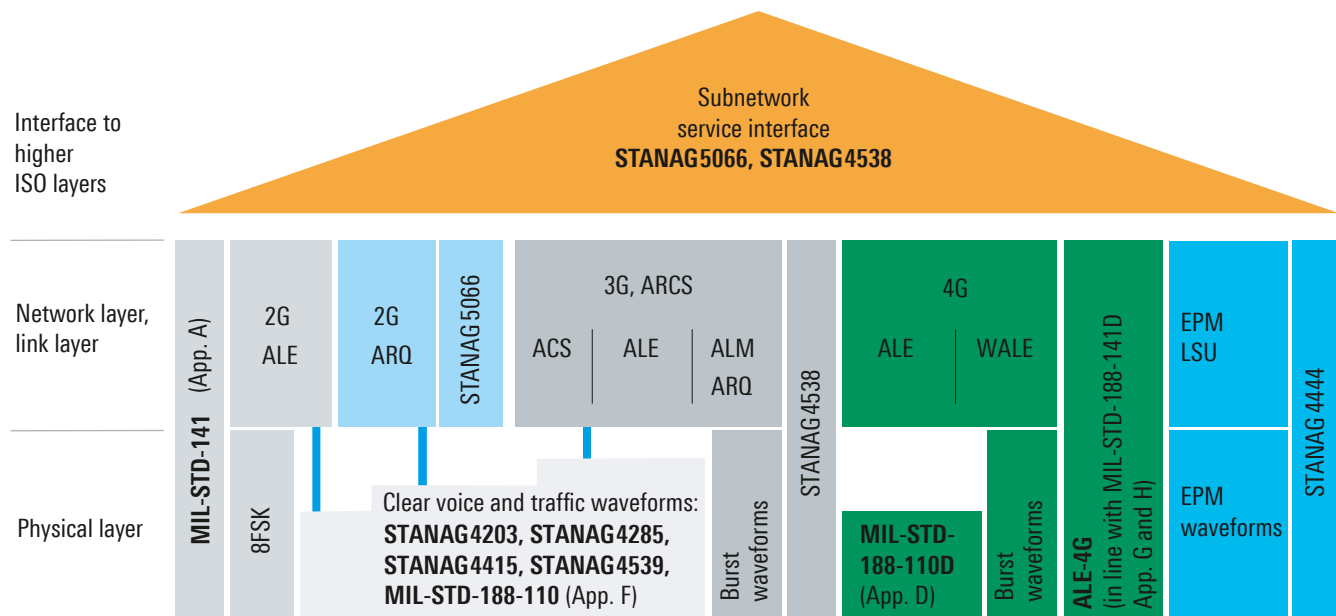


**Abbreviations**

| | | | | | |
|---|---|---|---|---|---|
| ACS | automatic channel selection | ALM | automatic link maintenance | 2G/3G/4G | second/third/fourth generation |
| ALE | automatic link establishment | EPM (ECCM) | electronic protective measures | | |
| ARCS | automatic radio control system | LSU | link setup | | |
| ARQ | automatic repeat request | WALE | wideband automatic link establishment | | |

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

## ALE-4G (in line with MIL-STD-188-141D App. G and H)

ALE-4G (fourth generation automatic link establishment) enables link establishment for HF wideband channels with a bandwidth of up to 48 kHz. The link is set up in two steps.

First step: automatic selection of the available channel (next free channel or free channel with the best transmission properties) via standard 3 kHz HF channels.
Second step: automatic expansion of the bandwidth and selection of the suitable modulation scheme depending on the channel conditions with the aim of maximum data throughput.

ALE-4G has two modes:
▶ Fast ALE: for the fastest connection setup under good channel conditions
▶ Deep ALE: for secure connection establishment under unfavorable to poor channel conditions.
Selection of the appropriate ALE mode is fully automatic. ALE-4G is backwards compatible with ALE-2G and ALE-3G.



## HF modem

The STANAG 4539 HF modem provides transmission data rates from 75 bit/s to 12 800 bit/s. It is the recommended modem for new NATO projects. It automatically adapts the receiving data rate and is used preferably with the 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 performs significantly better than that of the competition and is robust in case of multipath propagation. STANAG 4539 includes the STANAG 4415 modem standard.

The STANAG 4285 HF modem is used primarily for broadcasting operation and for ARQ-secured data transmission, typically in conjunction with an external R&S®STANAG5066 application.

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

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

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

## HF wideband modem

The embedded MIL-STD-188-110D App. D HF wideband modem provides data rates of up to 240 kbit/s in 48 kHz channels. This corresponds to an increase in data throughput of up to 25 times compared to traditional single side band (SSB) waveforms. The increase in data throughput is not the only benefit of the new HF wideband waveform. By expanding the channel bandwidth, the usual HF data throughput rates can also be achieved under unfavorable to poor channel conditions. The increase in the channel bandwidth compensates for the reduced data throughput of "lower" modulation schemes. For a data throughput of 6.4 kbit/s, 64 QAM modulation in the 3 kHz channel is required, whereas BPSK modulation is sufficient in a 12 kHz channel. This corresponds to a reduction of approx. 10 dB in the SNR requirement in the channel.

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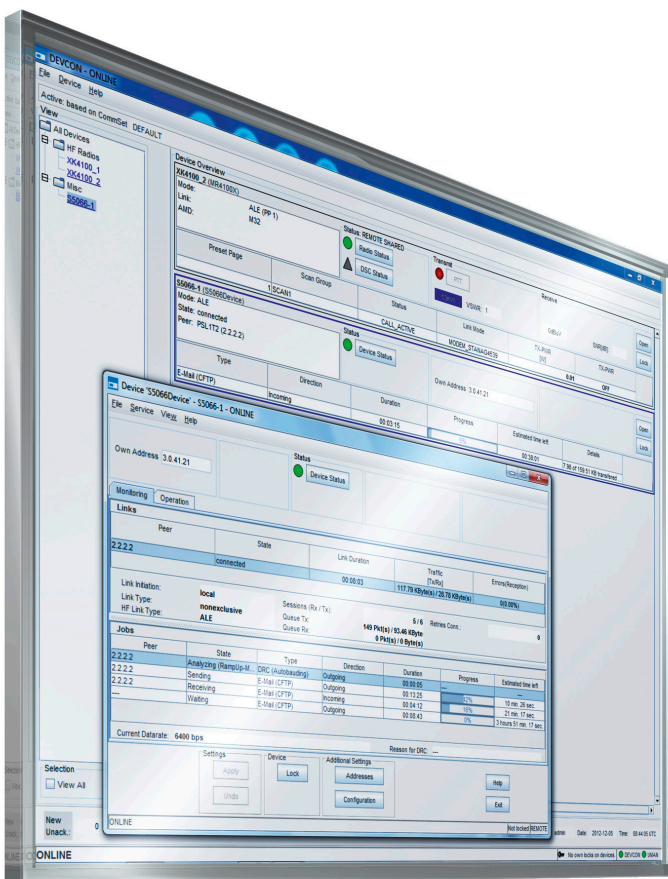
# SECURE AND RELIABLE COMMUNICATIONS

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

## Secure digital voice/data (SDV)

SDV provides easy-to-use, versatile embedded encryption for fixed frequency connections as well as for connections established with ALE-3G and ALE-4G.

When using ALE-3G's synchronous link or ALE-4G establishment process, users profit from the combination of information security (SDV) and modern ALE inherent mechanisms for improving transmission security (linking security). In modern ALE mode, the replay protection protects against spoofing attacks.

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

## Last ditch voice

In order to ensure reliable connections in heavily disturbed channels, the radio must employ extremely robust transmission methods: A very good choice is the last ditch voice (LDV) technique from Rohde & Schwarz available for the R&S®M3SR Series 4100 radio family.

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

## Structure of the stack

Structure of the stack for secure digital voice with and without ALE-3G and ALE-4G link establishment and for last ditch voice.
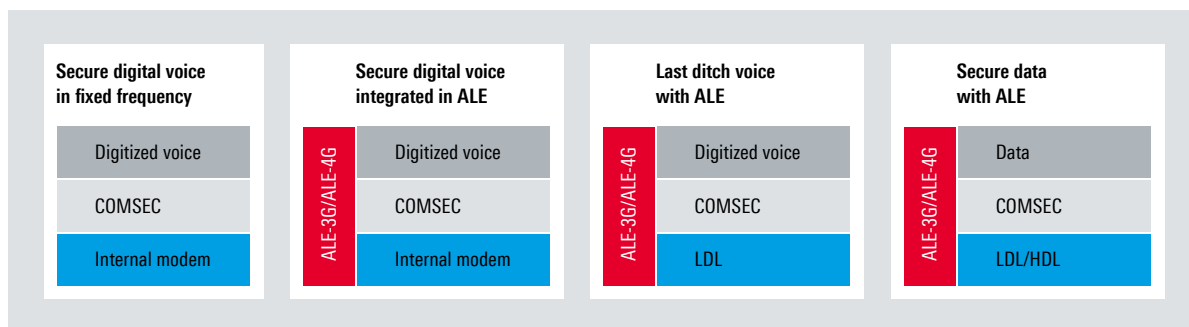
## R&S®SECOM-H EPM (ECCM), R&S®GS3001S

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

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

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

## Management of black keys for additional security

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

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



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

# UNRIVALED RADIO PARAMETERS

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

**Collocation capability due to excellent receiver specifications**
Simultaneous operation of multiple radio lines on board ships is extremely challenging for the collocation capability of the radios due to the spatial proximity of the radios that results in low antenna decoupling values. However, due to the outstanding specifications of the radios of the R&S®M3SR Series4100, such challenges are easily surmounted. For HF parameters such as second and third-order intercept, desensitization and crossmodulation immunity, the R&S®M3SR Series4100 sets new standards. For example, even without preselection the receiver provides third-order intercept (IP3) of 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 (software option)**
Mutual influences between adjacent transmitter lines would cause a traditional transmitter to reduce its output power since the external power is taken into account as reflected power during VSWR calculation. The optional selective directional coupler available in the power amplifiers makes it possible to perform narrowband weighting of the transmit signal and the reflected antenna power. This means that the transmitter power control of the transmitter lines is not influenced during normal operation.

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

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



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

# SUITABLE FOR A WIDE RANGE OF SITUATIONS

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

**Three standard 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 fourth generation of HF communication (HF wideband) places significantly higher demands on the output power. By expanding the channel bandwidth up to 48 kHz, the "power in the channel" is also spread across the bandwidth. This must be compensated for by increasing the transmission power in order to keep the spectral power density constant The radios of the R&S®M3SR Series4100 are available in standard power classes of 150 W, 500 W, 1000 W. The R&S®M3SR Series4100 also includes a separate, standalone receiver. Without additional hardware, the R&S®M3SR Series4100 components can also be used to set up IP-based split-site systems. The product portfolio is rounded out by system components such as antenna tuning units (ATU) and dipole antennas from Rohde&Schwarz. For radio applications on ship and shore, broadband radio systems are also available. All components are designed to operate 24/7 within the rated temperature ranges at full output power.

**HF broadband system**

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

**See separate product brochures: R&S®M3SR Series4100 HF broadband system (PD 5214.1243.12) and R&S®SK41xx HF high-power transmitters (PD 3683.4155.12).**



R&S®M3SR Series4100 radios.

# EASY OPERATION

Rohde & Schwarz has extensive experience in stationary radio systems, which is reflected in the operating concept of the R&S®M3SR Series 4100 radios. The displays and control elements are arranged in a user-friendly manner and are easy to understand.

## Clear status display

All required settings on the radio can be made using the R&S®GB4000C control unit. The R&S®GB4000C can be integrated into the radio or it can control the radio remotely. It can also be used to operate several R&S®M3SR Series 4100 radio systems (only one at a time) in an IP network.

## Preconfigured menus

The user interface for the R&S®M3SR radio family has clearly structured menus that are organized by function. Each operating mode is set using preconfigured menus (preset pages). The R&S®M3SR Series 4100 can manage up to 100 preconfigured menus. The configuration is generated using the R&S®RNMS3000 network management system. The preset pages can then be loaded into the radio via LAN, RS-232 or a fill device.

## Radio configuration only by authorized personnel

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



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

# LOW MAINTENANCE

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

### Rugged design, suitable even for difficult environmental conditions

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

### Powerful built-in test (BIT)

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

The following built-in tests are supported:
▶ Power-on BIT (PBIT)
▶ Continuous BIT (CBIT)
▶ Initiated BIT (IBIT)

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

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

### Excellent reliability

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

### Easy module exchange

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



Internal view of the 150W standalone transceiver.

# SPLIT-SITE SYSTEM

The R&S®M3SR Series4100 radio family supports IP-based split-site operation; no additional hardware is required.

Operation of high-power transmitters close to receivers at the same site, as occurs in broadcast and ship-to-shore (BRASS) applications, can cause interference to the receivers. In such cases, the transmitters and receivers are located at separate sites ("split-site operation"). In military environments too, it is common to install the transmitter and receiver systems as far as possible from the operational centers to help prevent precise position fixing of the operational centers and attacks against them.

### Split-site operation with the R&S®M3SR Series4100

In the R&S®M3SR Series4100 family of HF radios, the split-site controller functionality is entirely implemented in software and no special hardware is required. Standard radios from the R&S®M3SR Series4100 are used as the split-site transmitter and receiver. For data transfer between the split-site controller and the transmitter and receiver, the IP interface included in the radios is used. The figure shows a typical split-site system with these radios.

Split-site operation also supports complex waveforms such as automatic link establishment (ALE-2G/ALE-3G/ALE-4G in line with STANAG 4538, MIL-STD-188-141D) as well as modem waveforms (e.g. MIL-STD-188-110D STANAG 4285 and STANAG 4539). Of course, classic HF modes such as SSB (J3E) or AM (A3E) can also be used.

### Support also for secure links

The interfaces in the R&S®M3SR Series4100 radios for data and remote control data are unchanged. Crypto devices and – if red/black separation of the control signals is required – a trusted filter (firewall functionality) can be used. Encryption is possible using external, commercially available IP security solutions.

### Split-site system with R&S®M3SR Series4100 radios
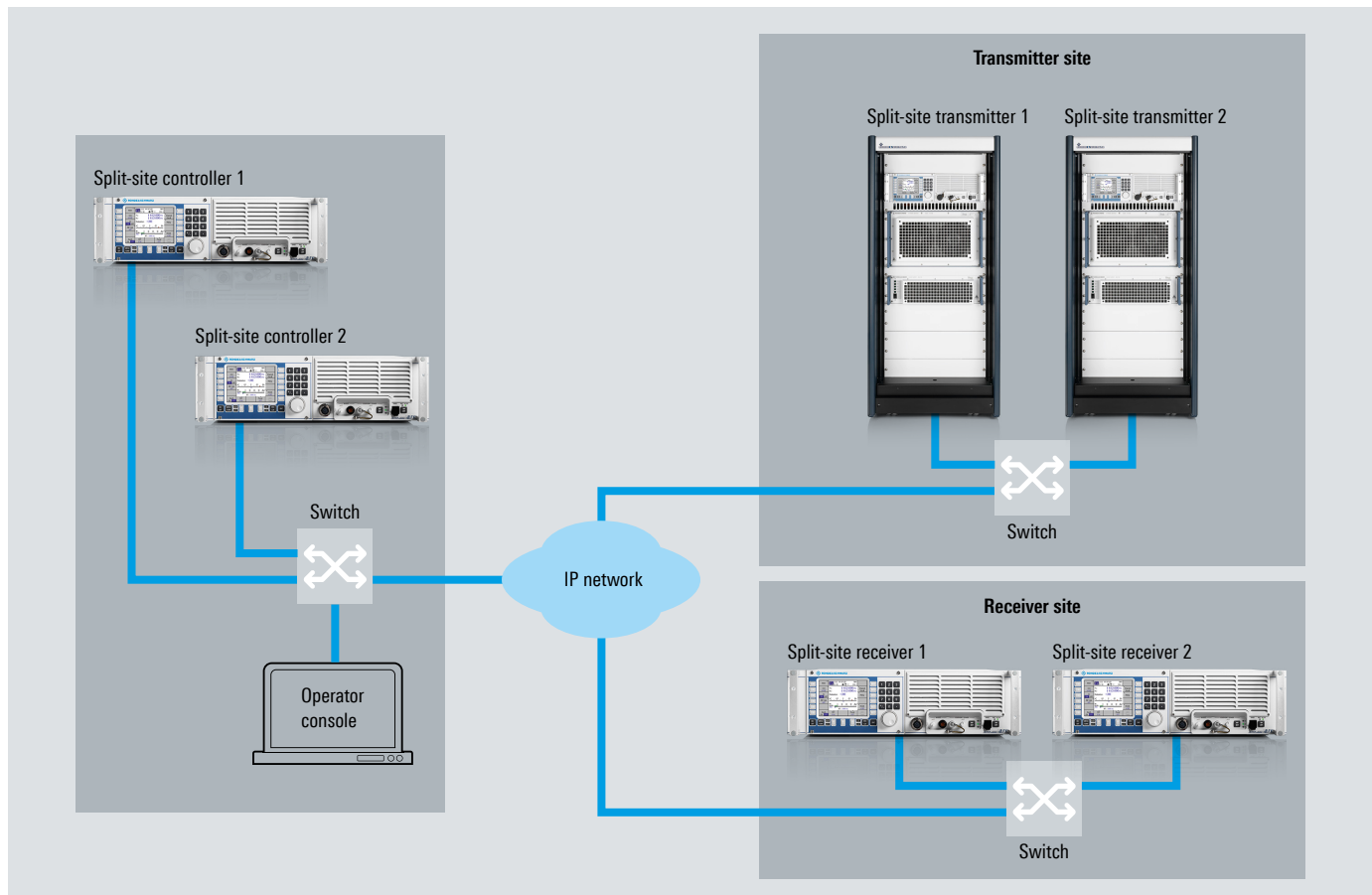
## High availability and flexibility

Communications links today are increasingly based on the internet protocol, which is progressively replacing the classic analog and digital telecommunications links. One of the objectives in the development of IP was to enable the transport of data packets via alternative routes in case connections fail. With appropriate network planning, high availability can be ensured for the entire system.

The ability to assign a split-site controller dynamically to a certain transmitter and receiver offers great flexibility in configuring the overall system. This makes it possible to select the transmitters and receivers with the sites and antennas that are the best match for the current task. Usage of costly transmit antenna switches can be kept to a minimum by appropriate system design. Even if individual split-site components fail, the remaining components can be reallocated dynamically, which helps to improve overall availability.

## Lower maintenance and logistics costs

Generally, each base unit in the R&S®M3SR Series4100 radio family (R&S®GX4100, R&S®EK4100 or R&S®XK4115) can be configured as a split-site controller by activating the corresponding software option. The R&S®M3SR Series4100 radios used in the transmitter and receiver systems do not require any special hardware extensions for split-site operation. The table shows an example illustrating the benefits of configuration for split-site operation: A split-site radio line can be implemented using three identical R&S®GX4100 receivers/exciters. This is a significant benefit for users, simplifies logistics and saves on spare units.

User interface for split-site configuration
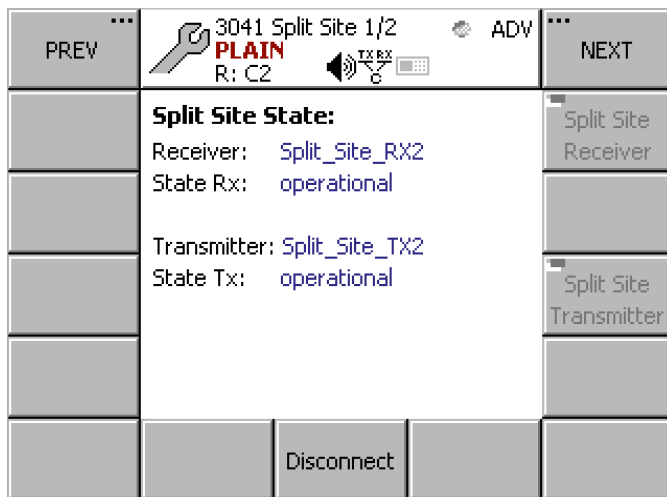


**Possible hardware configuration for split-site operation with the R&S®M3SR Series4100 HF radios**

| Components | Hardware |
|---|---|
| Split-site transmitter | R&S®GX4100 (receiver/exciter), R&S®VK4190 (1000 W power amplifier), R&S®IN4190 (1000 W power supply) |
| Split-site receiver | R&S®GX4100 (receiver/exciter), R&S®IN4000A (power supply) |
| Split-site controller | R&S®GX4100 (receiver/exciter), R&S®IN4000A (power supply) |

# R&S®RNMS3000 RADIO NETWORK MANAGEMENT SYSTEM

Utilization planning, radio network configuration and data distribution

## Increased significance for a radio network management system

In today's world, information exchange via voice and data is indispensable for military forces to fulfill their increasing mission requirements. Handling all these communications demands with their complex waveforms requires an extended network management system. By offering R&S®RNMS3000, Rohde & Schwarz provides such a radio network management system. It enables military leaders to turn their Rohde & Schwarz combat radio equipment into a robustly networked communications system based on mission demand and on complex hierarchical structures, especially in joint or combined missions. In the past, many parameters had to be adjusted on the radios, which required highly skilled users. In future, the configuration complexity will be done during the preparative configuration of a management system.

## R&S®RNMS3000 – the convenient way to empower the capabilities of Rohde & Schwarz radios in networks

The R&S®RNMS3000 software supports centralized network management, where one central organizational unit performs the complete mission planning, as well as decentralized management, where the various configuration steps are accomplished on different military hierarchical levels. The R&S®RNMS3000 software suite, consisting of the mission planner, the remote device loader and the remote distributor, offers the following functions:
► Management of security keys
► Frequency assignments
► Establishment of logical nets
► Distribution of mission files

The objective is to provide mission-tailored and secured radiocommunications networks. Especially the R&S®RNMS3000 capability to manage NATO-specific waveforms, as well as general HF House waveforms and Rohde & Schwarz proprietary waveforms, underlines its broad range of applications.

### Comprehensive waveform support
► NATO waveforms
► HF House waveforms
► R&S®SECOM waveform
► R&S®SECOS waveform

## Process sequence
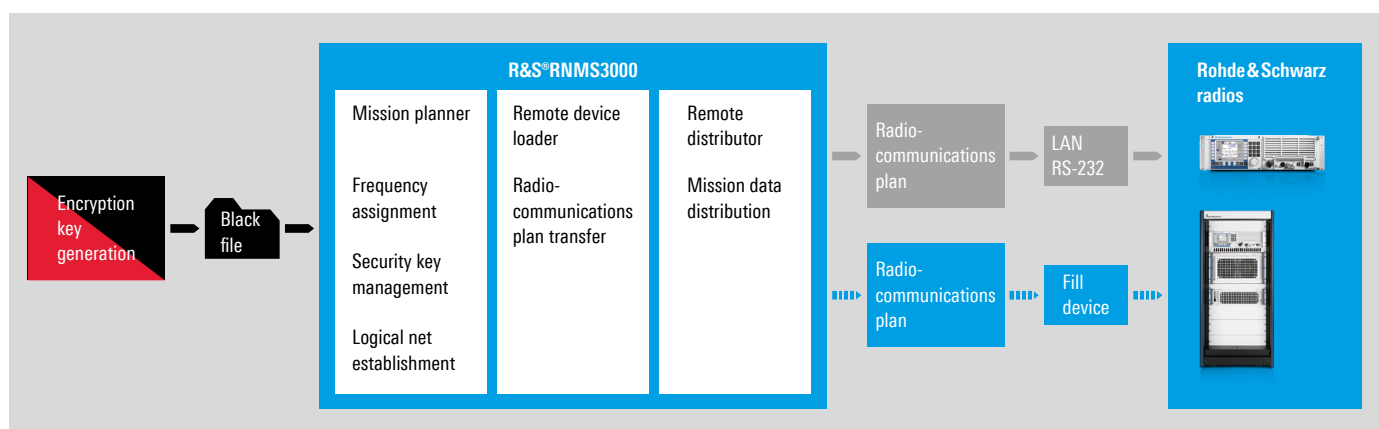
## Highlights
▶ Support of all Rohde & Schwarz radios and all frequencies
▶ Support of voice and data services
▶ Network planning, mission file generation and distribution with one software suite
▶ Target-oriented software guidance with wizards

## Key features
### Mission planner – mission-tailored network planning
▶ Frequency assignment
▶ Hop set generation and management
▶ Security key management
▶ Efficient mission planning

### Remote device loader – mission-optimized radiocommunications plan transfer
▶ Secure file transfer
▶ Effective hardware programming

### Remote distributor – extended mission data distribution
▶ File distribution over existing IP networks
▶ Event log and status control

## Effective mission planning
The mission planner software allows mission-optimized and time-critical software use. The program provides target-oriented software navigation via wizards to allow operator mission planning with a focus on the essential parameters. In case of a configuration error, R&S®RNMS3000 displays a fault message including advice to support the error search process. The created mission file and configuration progress are saved automatically in a database to avoid losing critical mission data due to a hardware failure.

## R&S®GP4100A fill device
The R&S®GP4100A fill device needs no power supply since it is supplied by either the connected PC or the radio. The fill device status is indicated by LEDs (power on, reading, writing, connected, error). After setting up a network configuration with R&S®RNMS3000, the generated configuration files are stored in the fill device via the USB interface of the PC running R&S®RNMS3000 and the remote data loader (RDL).

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. All files transferred from and to the fill device are encrypted before loading. Sensitive data such as keys is therefore stored in the fill device in black form only.



R&S®GP4100A fill device for R&S®M3SR Series 4100 radios.

# SYSTEM OVERVIEW

## Logistical structure

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

Each radio model consists of:
► Hardware base unit
► Radio software
► Software and hardware options

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

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

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

## R&S®M3SR Series4100 standard power classes
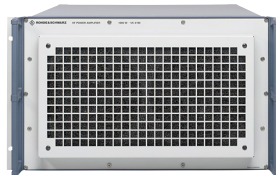
| R&S®EK4100A/D receiver | R&S®XK4115A/D 150 W transceiver | 500 W transceiver systems | 1000 W transceiver systems |
|---|---|---|---|







R&S®GX4100A/D
HF receiver/exciter



R&S®GX4100A/D
HF receiver/exciter



R&S®VK4150
500 W HF power amplifier



R&S®VK4190
1000 W HF power amplifier
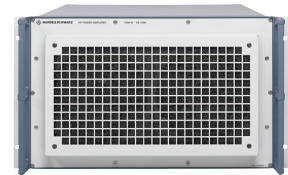


R&S®IN4000A power supply



R&S®IN4150 power supply



R&S®IN4190 power supply

# R&S®EK4100A/R&S®EK4100D VLF-HF RECEIVER

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

## Key features
► Frequency and channel scanning
► IP3 > 40 dBm
► Latest DSP technology
► 10 kHz to 30 MHz reception
► High sensitivity
► Full remote control via IP or RS-232
► Audio via IP or analog
► Modular concept

## R&S®EK4100A/D



R&S®GS4100A/D
radio software

Software options

Hardware options

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

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



Control panel | Fill device interface | Headset connector | Indicators | Erase | Power on/off

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



Mains | Reference frequency | Antenna interfaces (RX and RX/TX) | GPS antenna

DC input | Audio/PTT interface | Data interface | RS-232 remote control | LAN
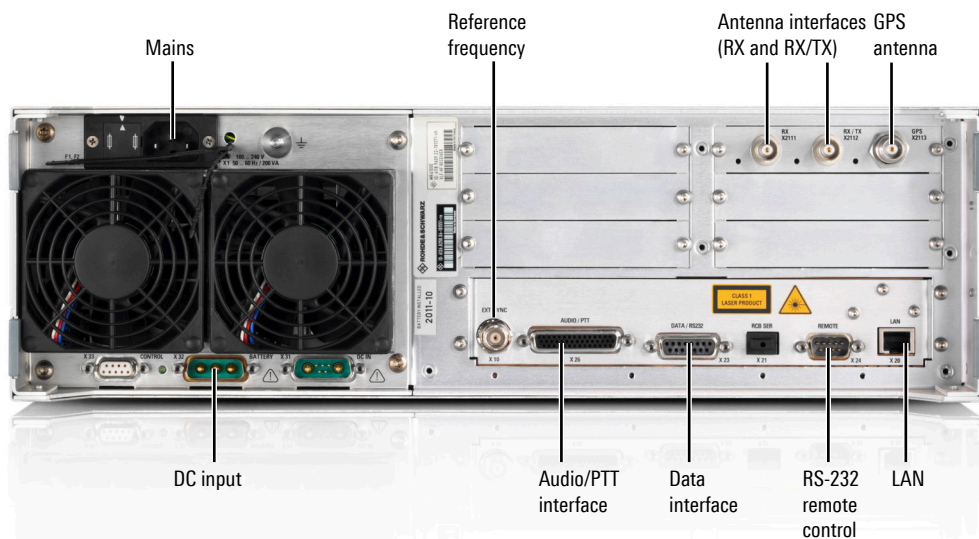
# R&S®XK4115A/R&S®XK4115D 150 W TRANSCEIVER

The R&S®XK4115 has a built-in 150 W power amplifier. The transceiver can be operated on 28 V DC voltage or, with an external R&S®IN4000A power supply, on 230 V AC voltage. In addition to the receive characteristics it shares with the R&S®EK4100A/R&S®EK4100D, the transceiver offers the following noteworthy features:
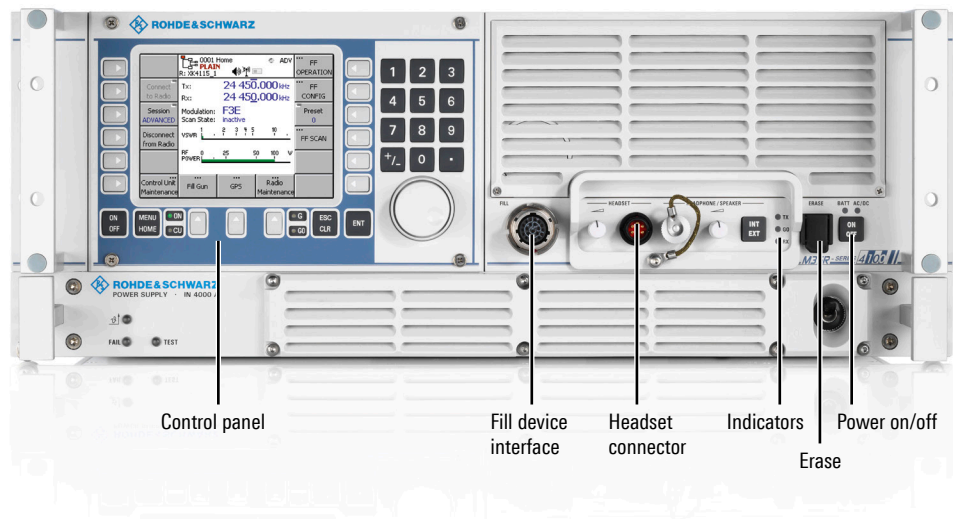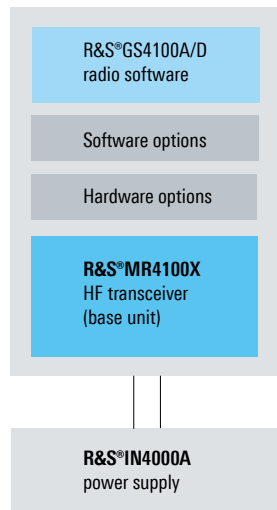
► 24/7 operation (TX at +55°C)
► Link operation ready
► Frequency hopping capability

## R&S®IN4000A external power supply

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

### R&S®XK4115A/D



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



Control panel — Fill device interface — Headset connector — Indicators — Power on/off — Erase

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



HF output — Optical interface to antenna tuning unit (ATU) — Antenna interface (RX) — GPS antenna — DC input — Audio/PTT interface — DC output — Mains — Reference frequency input — Data interface — RS-232 remote control — LAN
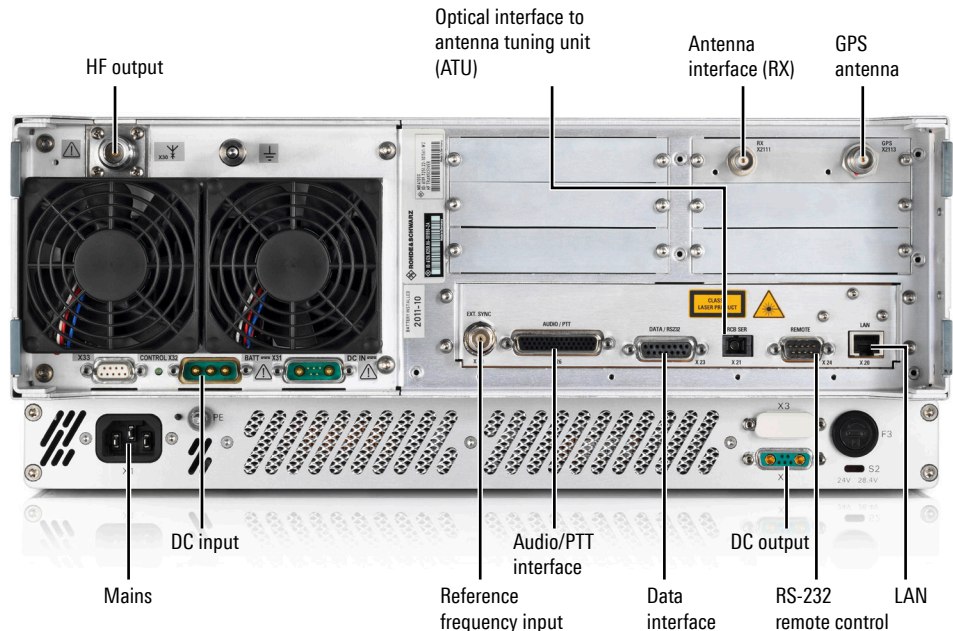
# 500 W/1000 W TRANSCEIVER SYSTEMS

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

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

A 500 W or 1000 W transceiver system consists of the following components:
▶ R&S®GX4100A/R&S®GX4100D receiver/exciter
▶ R&S®VK4150/R&S®VK4190 power amplifier
▶ R&S®IN4150/R&S®IN4190 power supply

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

### R&S®GX4100A/D

| R&S®GS4100A/D radio software |
| Software options |
| Hardware options |
| **R&S®MR4100G** HF receiver/exciter (base unit) |

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



Control panel
Fill device interface
Headset connector
Indicators
Erase
Power on/off

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



Antenna interface (RX)
Interface (TX) to power amplifier
GPS antenna

DC input
Reference frequency input
Audio/PTT interface
Data interface
Optical interface to power amplifier
RS-232 remote control
LAN
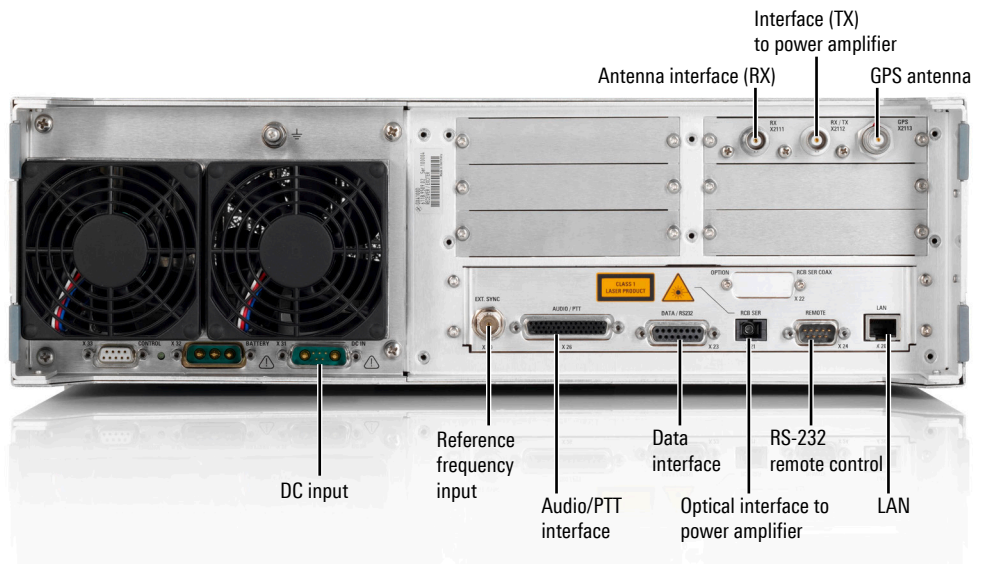
## R&S®VK4150/R&S®VK4190 power amplifier

The digitally controlled R&S®VK4150/R&S®VK4190 power amplifier is available as a standard model and a special model with built-in receiver input protection. The receiver input protection protects the receiver input from destruction through HF interference on the antenna The built-in receiver input protection should be selected whenever undisturbed reception of wanted signals is required under extreme conditions.
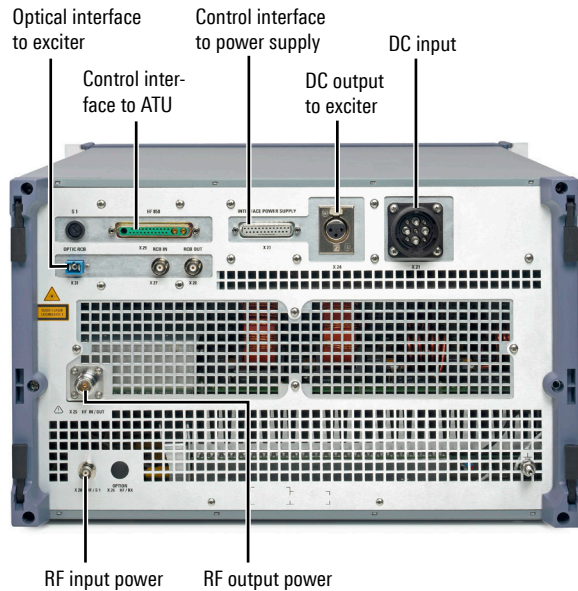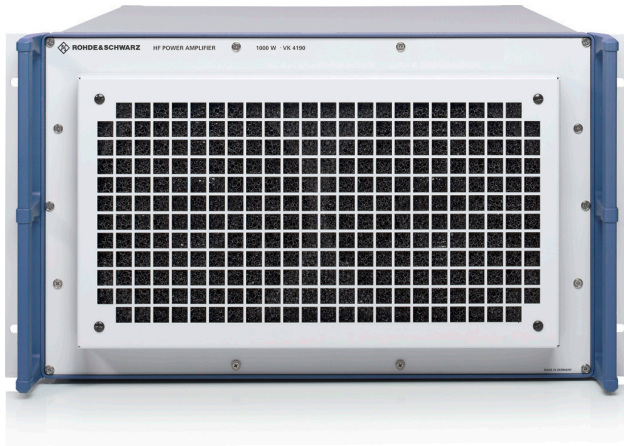
▶ 24/7 operation at full output power (100% duty cycle) even at +55 °C
▶ Rugged design, high MTBF
▶ Software option for selective level control available

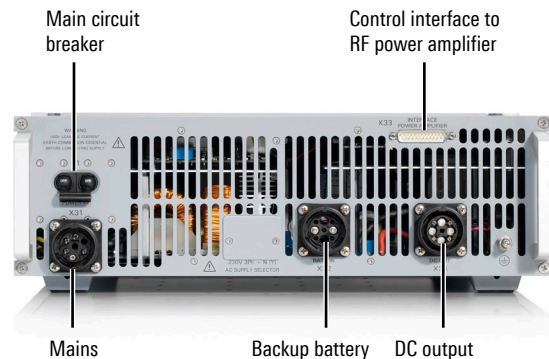## R&S®IN4150/R&S®IN4190 standard power supply

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

▶ Different models available for all conventional electrical networks
▶ High efficiency (up to 90%)
▶ State-of-the-art power factor correction (> 95%)
▶ Automatic switchover between AC and battery supply in case of power failure

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



Optical interface to exciter
Control interface to ATU
Control interface to power supply
DC output to exciter
DC input
RF input power
RF output power

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



Indicators
Power on/off
Main circuit breaker
Control interface to RF power amplifier
Mains
Backup battery
DC output
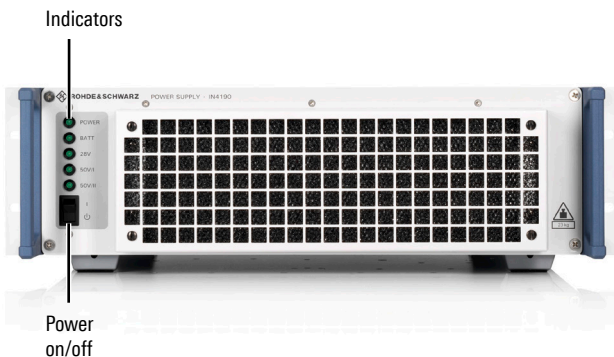
# ANTENNA TUNING UNITS

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

## Key features

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

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

### Maintenance-free, rugged design
The rugged design of the Rohde & Schwarz ATUs allows them to be operated 24 hours a day.

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

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

## R&S®M3SR Series4100 overview

| 150 W transceiver | 500 W transceiver systems | 1000 W transceiver systems |
|---|---|---|
| R&S®FK4115M ATU | R&S®FK4190M ATU | R&S®FK4190M ATU |
| R&S®HX002H1 dipole antenna | R&S®FK4150U ATU | R&S®FK2900M ATU |
| R&S®HX002H2 dipole antenna | R&S®FK2900M ATU | R&S®FK4190X HF postselection |
| R&S®FK4115X HF postselection | R&S®FK4190X HF postselection | R&S®FK002H0 dipole antenna |
| | | R&S®HX002H0 dipole antenna |

Frequency hopping capability (in line with R&S®SECOM-H)

Fixed frequency applications

## ATU selection guide



Frequency hopping possible

Fixed frequency application
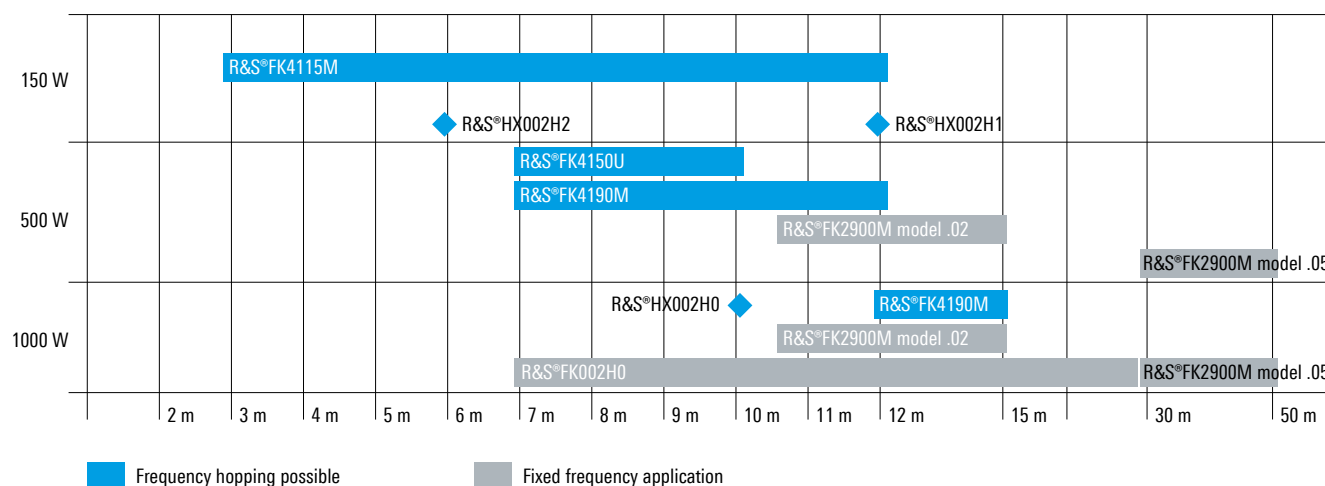
# ANTENNA TUNING UNITS

| Type | Designation, description |
|---|---|
| **R&S®FK4115M HF antenna tuning unit** | The R&S®FK4115M matches rod, whip and wire antennas (as used in naval and stationary applications) to the RF output of the 150 W transceiver of the R&S®M3SR Series 4100. The antenna tuning unit (ATU) can handle up to 150 W PEP or 100 W CW at a 100 % duty cycle. The R&S®FK4115M has an extremely fast setting time for silent channels and allows frequency hopping operation in line with R&S®SECOM-H. <br><br> ▶ Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz <br> ▶ Tuning of rod, whip and wire antennas <br> ▶ 150 W PEP, 100 W CW at 100 % duty cycle <br> ▶ Frequency hopping capability (R&S®SECOM-H) <br> ▶ Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is < 5 ms <br> ▶ If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (nonsilent mode) in < 100 ms (typ.) |
| **R&S®FK4150U HF antenna tuning unit** | The R&S®FK4150U matches rod, whip and wire antennas (as used in submarine applications) to the RF output of the 500 W transceiver systems of the R&S®M3SR Series 4100. The antenna tuning unit (ATU) can handle up to 500 W PEP and CW with rod/whip antennas of 7 m to 10 m in length. The R&S®FK4150U has an extremely fast setting time for silent channels and allows frequency hopping operation in line with R&S®SECOM-H. <br><br> ▶ Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz <br> ▶ Tuning of rod, whip and wire antennas <br> ▶ 500 W CW and PEP with 7 m to 10 m rod/whip antennas <br> ▶ Frequency hopping capability (R&S®SECOM-H) <br> ▶ Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is < 5 ms <br> ▶ If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (nonsilent mode) in < 100 ms (typ.) |
| **R&S®FK4190M HF antenna tuning unit** | The R&S®FK4190M matches rod/whip and wire antennas (as used in naval applications) to the RF output of the 500 W and 1000 W transceiver systems of the R&S®M3SR Series 4100. The antenna tuning unit (ATU) can handle up to 500 W CW and PEP with rod/whip antennas of 7 m to 11 m in length and up to 1000 W with 12 m rod antennas. Additionally, it provides preselection in the receive mode. The R&S®FK4190M has an extremely fast setting time for silent channels and allows frequency hopping operation in line with R&S®SECOM-H. <br><br> ▶ Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz <br> ▶ Tuning of rod/whip antennas of 7 m to 11 m in length <br> ▶ 500 W CW and PEP at 100 % duty cycle <br> ▶ 1000 W CW and PEP (12 m rod antennas only) <br> ▶ Frequency hopping capability (R&S®SECOM-H) <br> ▶ Once the tuning data for these frequencies is known and stored, the silent setting time of the ATU is < 5 ms <br> ▶ If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned (nonsilent mode) in < 100 ms (typ.) |
| **R&S®FK2900M 1 kW HF antenna tuning unit** | The R&S®FK2900M matches the amplifier outputs of the transceivers to rod and wire antennas. It is designed for stationary or shipboard applications. <br><br> ▶ Silent tuning over the entire frequency range from 1.5 MHz to 30 MHz <br> ▶ Tuning of all rod antennas from 10.5 m to 12 m <br> ▶ Tuning of long-wire antennas <br> ▶ 1000 W CW and PEP at 100 % duty cycle <br> ▶ Once the tuning data for these frequencies is known and stored, the ATU setting time is < 40 ms <br> ▶ If the required VSWR (< 1.5:1) is not attained, the ATU can be retuned in < 200 ms |
| **R&S®FK002H0 1 kW HF antenna tuning unit** | The R&S®FK002H0 is a standalone antenna tuning unit (ATU). It can match the impedance of a radiator to 50 Ω for every frequency from 1.5 MHz and 30 MHz. The R&S®FK002H0 is powered and controlled by the R&S®GX002 junction unit. <br><br> ▶ High RF power at small antennas (1 kW RF power at rod antennas starting at 7 m) <br> ▶ High efficiency (no resistance loading) <br> ▶ HF-cable-only interface <br> ▶ Co-site robust, fast tuning with low RF power (active power) or zero RF power (silent tuning) |

# DIPOLES AND POSTSELECTOR



R&S®HX002H1 150 W HF dipole.

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

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

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

## Typical three-dimensional radiation patterns



1.5 MHz          5 MHz

15 MHz          20 MHz
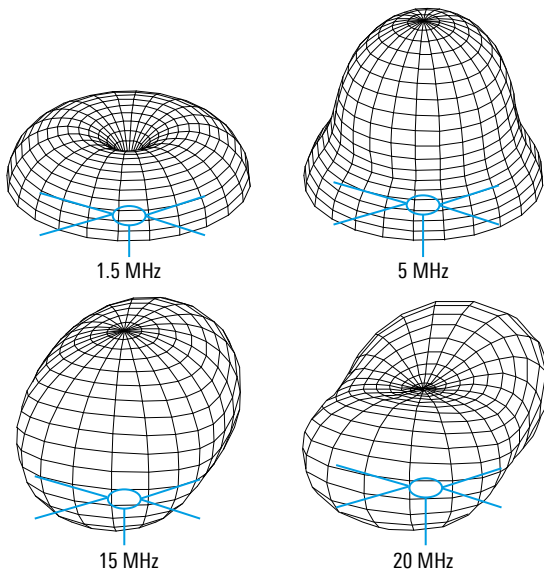
Typical three-dimensional radiation patterns above perfectly conducting ground.

## R&S®FK4115X 150 W HF postselector

This filter is used together with the 150 W transceiver systems for suppressing mutual interference that may occur with co-sited transmit and receive antennas. It is mainly used for shipborne applications in order to meet collocation requirements if space for antennas is limited.

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

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

R&S®HX002H0 1 kW HF dipole with ATU.
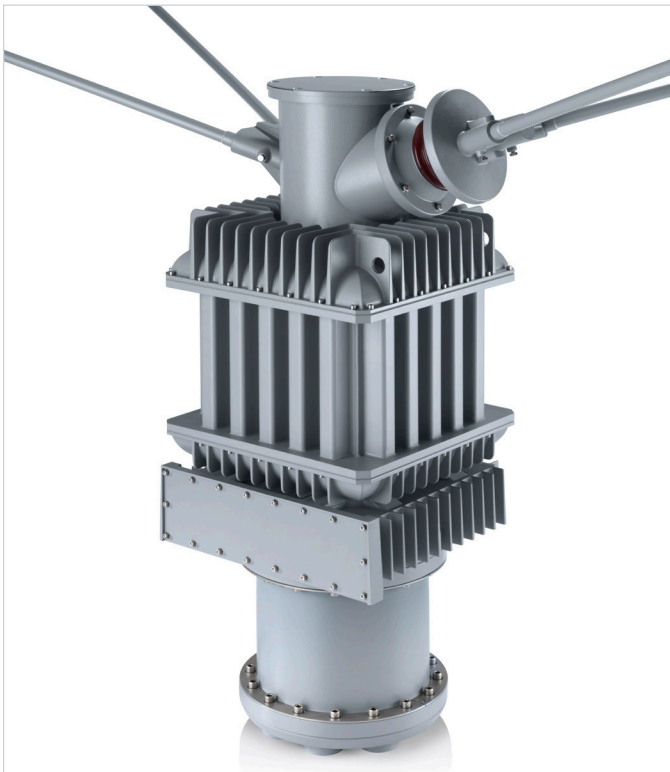
## R&S®HX002H0 1kW HF dipole with ATU

The R&S®HX002H0 HF dipole with ATU permits optimum coverage of all distance ranges. It is particularly useful for HF communications over short and medium distances because below 1000 km, vertical road antennas do not ensure sufficient transmission reliability on account of the skip zone. Lightning protection circuitry is provided in the antenna head, at multiple locations inside the ATU and the balun section.

▶ High RF power at small antenna (1 kW, 5 m radiator radius)
▶ Omnidirectional coverage with high-angle radiation (NVIS), no skip zone
▶ Very compact dimensions, setup close to neighboring antennas possible
▶ Highly efficient (no resistive loading)
▶ RF-cable-only interface
▶ Co-site robust, fast tuning with low or zero RF power



R&S®FK4190X 1 kW HF postselector.

## R&S®FK4190X 1 kW HF postselector

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

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

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

# SOFTWARE AND HARDWARE OPTIONS

## DESCRIPTION OF SOFTWARE OPTIONS
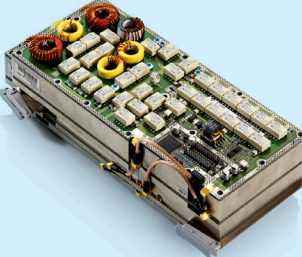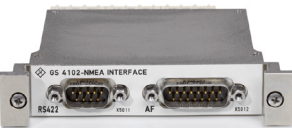
| Type | Designation, description | Available for software | |
|---|---|---|---|
| | | R&S®GS4100D [1] | R&S®GS4100A [2] |
| R&S®GM4120S | **HF narrowband modem**<br>Single-tone HF modem, in line with STANAG 4285, STANAG 4529, STANAG 4539 (including STANAG 4415, MIL-STD-188-110B, section 5.3 and App. C), STANAG 4481 (single-channel modes), STANAG 5065, MIL-STD-188-110B, App. F | • | |
| R&S®GM4151S | **HF narrowband modem**<br>Single-tone HF modem, in line with STANAG 4285, STANAG 4539, MIL-STD-188-110B section 5.3 and App. C, multitone support, for external multitone HF modems | | • |
| R&S®GM4152S | **HF narrowband modem incl. ALE3G**<br>ALE3G (MIL.STD-188-141 App. A,B,C), single-tone HF modem, in line with STANAG 4285, STANAG 4529, STANAG 4539 (including STANAG 4415, MIL-STD-188-110B, section 5.3 and App. C), STANAG 4481 (single-channel modes), STANAG 5065, MIL-STD-188-110B, App. F | • | |
| R&S®GM4153S | **HF narrowband modem incl. ALE3G**<br>ALE3G (MIL.STD-188-141 App. A,B,C), single-tone HF modem, in line with STANAG 4285, STANAG 4539, MIL-STD-188-110B section 5.3 and App. C, multitone support, for external multitone HF modems | | • |
| R&S®GM4154S | **Secure digital voice/data incl. ALE3G**<br>ALE-3G/STANAG 4538 (FLSU, LP, LDL, HDL, HDL+, OD, ALM), including ALE-2G; secure digital voice (supported in STANAG 4538 and FF), secure digital data (supported in STANAG 4538), last ditch voice (supported in STANAG 4538) | • | |
| R&S®GM4155S | **Secure digital voice/data incl. ALE3G**<br>ALE-3G/STANAG 4538 (FLSU, LP, LDL, HDL, OD, ALM), including ALE-2G; secure digital voice (supported in STANAG 4538 and FF), secure digital data (supported in STANAG 4538), last ditch voice (supported in STANAG 4538) | | • |
| R&S®GM4156S | **HF narrowband modem incl. secure digital voice/data and ALE3G**<br>ALE-3G/STANAG 4538 (FLSU, LP, LDL, HDL, HDL+, OD, ALM), including ALE-2G; secure digital voice (supported in STANAG 4538 and FF), secure digital data (supported in STANAG 4538), last ditch voice (supported in STANAG 4538); single-tone HF modem, in line with STANAG 4285, STANAG 4529, STANAG 4539 (including STANAG 4415, MIL-STD-188-110B, section 5.3 and App. C), STANAG 4481 (single-channel modes), STANAG 5065, MIL-STD-188-110B, App. F | • | |
| R&S®GM4157S | **HF narrowband modem incl. secure digital voice/data and ALE3G**<br>ALE-3G/STANAG 4538 (FLSU, LP, LDL, HDL, OD, ALM), including ALE-2G; secure digital voice (supported in STANAG 4538 and FF), secure digital data (supported in STANAG 4538), last ditch voice (supported in STANAG 4538), single-tone HF modem, in line with STANAG 4285, STANAG 4539, MIL-STD-188-110B section 5.3 and App. C, multitone support, for external multitone HF modems | | • |
| R&S®GM4170S | **HF wideband modem**<br>HF MOD 48KHZ MIL-188-110D App. D, single-tone HF modem, in line with STANAG 4285, STANAG 4529, STANAG 4539 (including STANAG 4415, MIL-STD-188-110B, section 5.3 and App. C), STANAG 4481 (single-channel modes), STANAG 5065, MIL-STD-188-110B, App. F | • | |
| R&S®GM4171S | **HF wideband modem**<br>HF MOD 48KHZ MIL-188-110D App. D, single-tone HF modem, in line with STANAG 4285, STANAG 4539, MIL-STD-188-110B section 5.3 and App. C, multitone support, for external multitone HF modems | | • |
| R&S®GM4172S | **HF wideband modem incl. ALE4G**<br>ALE-4G (MIL-STD-188-141D App. A,B,C,G,H) HF MOD 48KHZ MIL-188-110D App. D, single-tone HF modem, in line with STANAG 4285, STANAG 4529, STANAG 4539 (including STANAG 4415, MIL-STD-188-110B, section 5.3 and App. C), STANAG 4481 (single-channel modes), STANAG 5065, MIL-STD-188-110B, App. F | • | |
| R&S®GM4173S | **HF wideband modem incl. ALE4G**<br>ALE-4G (MIL-STD-188-141D App. A,B,C,G,H), HF MOD 48KHZ MIL-188-110D App. D, single-tone HF modem, in line with STANAG 4285, STANAG 4539, MIL-STD-188-110B section 5.3 and App. C, multitone support, for external multitone HF modems | | • |

| Type | Designation, description | Available for software | |
|---|---|---|---|
| | | R&S®GS4100D [1] | R&S®GS4100A [2] |
| R&S®GM4174S | **Wideband secure digital voice/data incl. ALE4G**<br>ALE-4G (MIL-STD-188-141D App. A,B,C,G,H), Rohde & Schwarz proprietary IPoA HF wideband (≤ 48kHz) waveform incl. secure digital voice (supported in STANAG 4538 and FF), secure digital data (supported in STANAG 4538), last ditch voice (supported in STANAG 4538) | ● | ● |
| R&S®GM4176S | **HF wideband modem incl. wideband secure digital voice/data and ALE4G**<br>ALE-4G (MIL-STD-188-141D App. A,B,C,G,H), Rohde & Schwarz proprietary IPoA HF wideband (≤ 48 kHz) waveform incl. secure digital voice (supported in STANAG 4538 and FF), secure digital data (supported in STANAG 4538), last ditch voice (supported in STANAG 4538); HF MOD 48KHZ MIL-188-110D App. D, single-tone HF modem, in line with STANAG 4285, STANAG 4529, STANAG 4539 (including STANAG 4415, MIL-STD-188-110B, section 5.3 and App. C), STANAG 4481 (single-channel modes), STANAG 5065, MIL-STD-188-110B, App. F | ● | |
| R&S®GM4177S | **HF wideband modem incl. wideband secure digital voice/data and ALE4G**<br>ALE-4G (MIL-STD-188-141D App. A,B,C,G,H), Rohde & Schwarz proprietary IPoA HF wideband (≤ 48kHz) waveform incl. secure digital voice (supported in STANAG 4538 and FF), secure digital data (supported in STANAG 4538), last ditch voice (supported in STANAG 4538), HF MOD 48KHZ MIL-188-110D App. D, single-tone HF modem, in line with STANAG 4285, STANAG 4539, MIL-STD-188-110B section 5.3 and App. C, multitone support, for external multitone HF modems | | ● |
| R&S®GS4156S | **Split-site**<br>Split-site controller software option, for separate receive and transmit setup | ● | ● |
| R&S®GS4114S | **LINK software**<br>Tactical data link capability in line with STANAG 5511, STANAG 5522 (fixed frequency), LINK Y | ● | |
| R&S®GS3001S | **EPM (ECCM) software: R&S®SECOM-H** | ● | |

[1] D version of radio software: export license required.

[2] A version of radio software: without export restrictions.

# DESCRIPTION OF HARDWARE OPTIONS

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

# PRODUCT OVERVIEW

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

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

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

Your local Rohde & Schwarz expert will help you find the best solution for your requirements.
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## Service that adds value

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

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## Sustainable product design

► Environmental compatibility and eco-footprint
► Energy efficiency and low emissions
► Longevity and optimized total cost of ownership

| Certified Quality Management | Certified Environmental Management |
|---|---|
| ISO 9001 | ISO 14001 |

| Certified Quality Management | Certified Information Security Management |
|---|---|
| AQAP-2110 | ISO 27001 |

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