

# R&S® M3SR Series 4100 Software Defined Radios HF Radio Family for Stationary and Shipborne Communications



**75** Years of  
Driving  
Innovation



# R&S®M3SR Series 4100 Software Defined Radios At a glance

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 Series 4100 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 Series 4100 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 Series 4100 is a powerful radio platform that can be extended at any time. This helps to provide a safe and future-proof investment for customers.

Besides the existing waveforms from the "HF house", the R&S®M3SR Series 4100 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.

## Key facts

- Frequency range: 1.5 MHz to 30 MHz (transmission), 10 kHz to 30 MHz (reception)
- Power classes of 150 W, 500 W, 1000 W and standalone receiver
- Frequency hopping capability
- Wide operating temperature range from -20°C to +55°C
- Interoperability with the R&S®M3TR tactical radio family



# R&S®M3SR Series 4100 Software Defined Radios

## Key features and benefits

### Unrivaled radio parameters

- ▮ Collocation capability due to excellent receiver specifications
- ▮ Selective level control for optimum transmit power (option)
- ▮ Frequency-agile pre-/postselectors improve the large-signal characteristics (option)
- ▮ Digital IF and audio signal processing

### Flexible range of applications

- ▮ Three power classes and suitable line of accessories
- ▮ Local or remote operation
- ▮ Power supplies for all standard electrical networks
- ▮ Software defined radio system

### Secure communications

- ▮ EPM (ECCM) method for secure and jam-resistant voice and data links
- ▮ Powerful crypto algorithm
- ▮ Management of "black" keys offers additional security
- ▮ Data link capability in line with STANAG 5511 and STANAG 5522
- ▮ Centralized network, crypto, and frequency management capabilities for configuring Rohde&Schwarz radio networks

### Easy operation

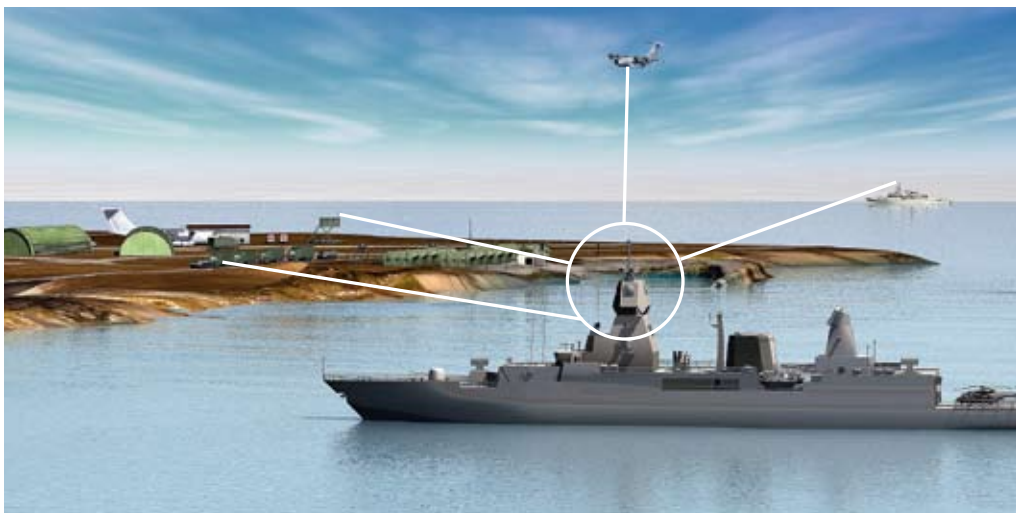
- ▮ Clear status display
- ▮ Preconfigured menus
- ▮ Remote control access with different levels of authorization

### Low maintenance effort

- ▮ Rugged design, suitable even for difficult environmental conditions
- ▮ Powerful built-in test (BIT)
- ▮ Excellent reliability

### Future-proof and safe investment

- ▮ Standards from the "HF house" can be upgraded as software option
- ▮ Future changes in standards can be taken into account in product and program planning
- ▮ Low life-cycle costs



State-of-the-art secure  
radiocommunications

# 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 Series 4100 (with the optional addition of digitally tuned HF filters), such challenges are easily surmounted. The R&S®M3SR Series 4100 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 Series 4100 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 band-pass 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/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 Series 4100 supports frequency hopping.

## Digital IF and audio signal processing

The R&S®M3SR Series 4100 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 Series 4100 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 Series 4100 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 Series 4100, 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.

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



# 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.

## **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 Series 4100 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 Series 4100 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: LINK-11
- STANAG 5522: LINK-22 (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:

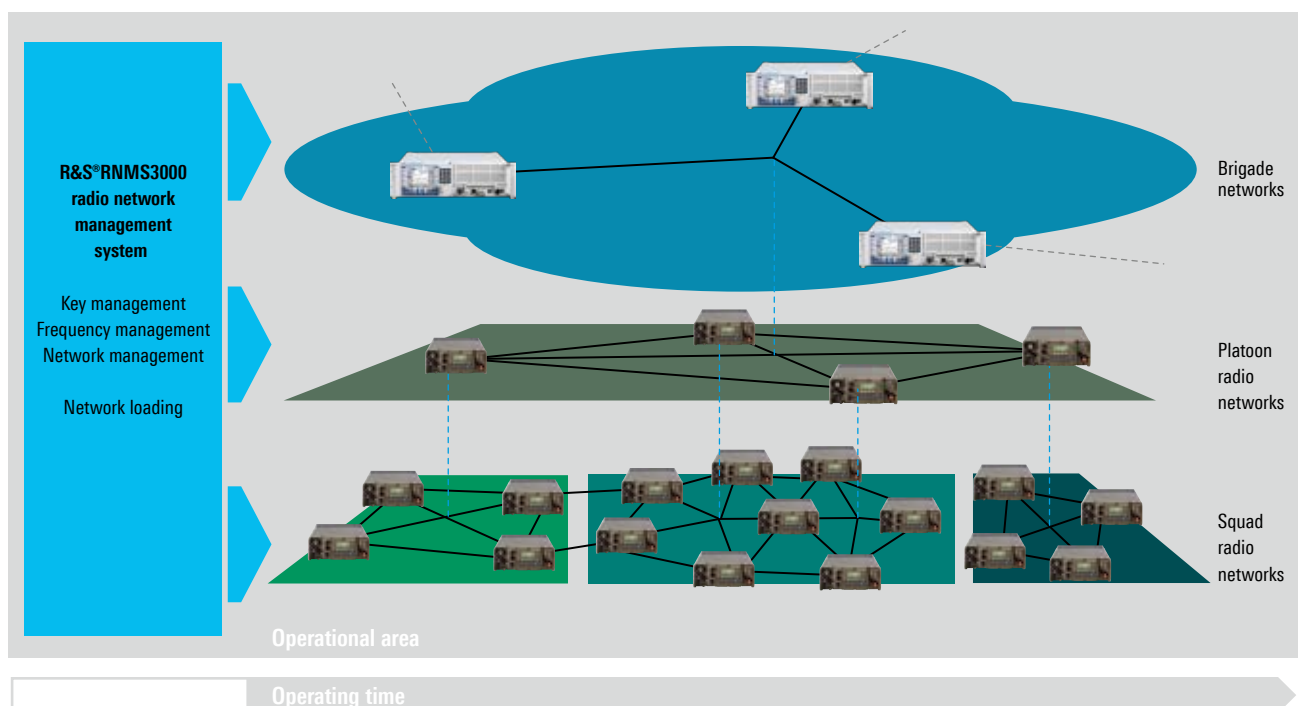
- Manages security keys
- Makes frequency assignments
- Establishes logical nets

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.

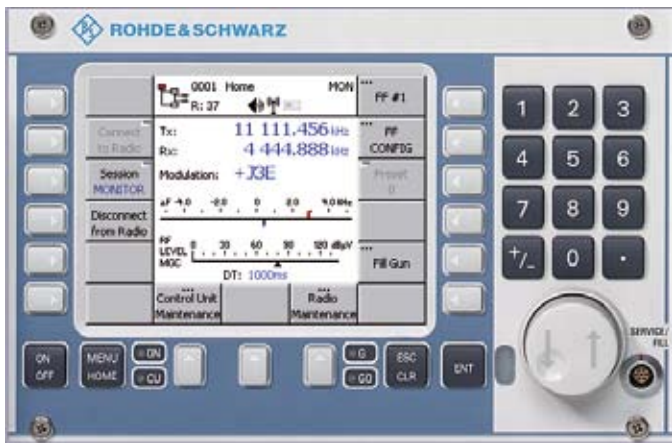
Moreover, the R&S®RNMS3000 software system provides a single data set that – when distributed to the required radios either via a fill device or a LAN connection – includes all parameters relevant to immediately using the radios within the defined logical network structure.

### Centralized network, crypto, and frequency management capabilities



# Easy operation

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



## Clear status display

All required settings on the radio can be made locally using the optional R&S®GB4000C (model 32/35) 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.

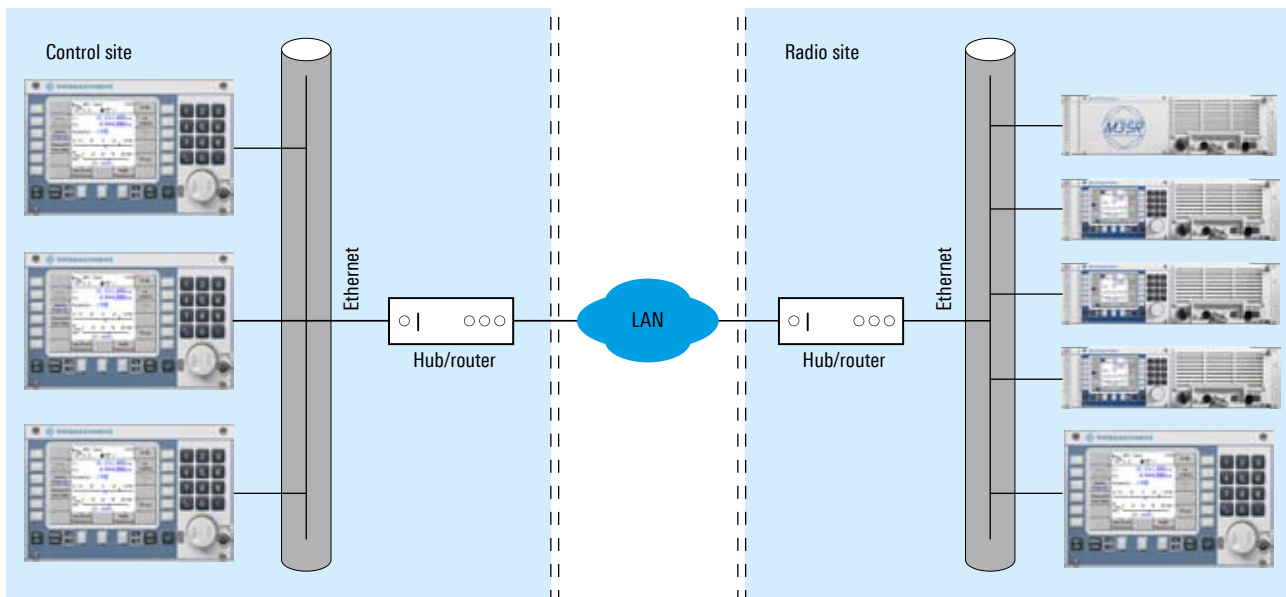
## Preconfigured menus

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.

## Remote control access with different levels of authorization

Using an R&S®GB4000C (model 33/36) 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





# 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-up 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 up. 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 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  $-20^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$  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.



View of the radio's interior

# Future-proof and safe investment

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

- HF modems STANAG 4285, STANAG 4415, STANAG 4539, Annex B, MIL-STD-188-110B
- 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 (without IP interface)

## 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 Series 4100 and provided to customers in the form of software updates.

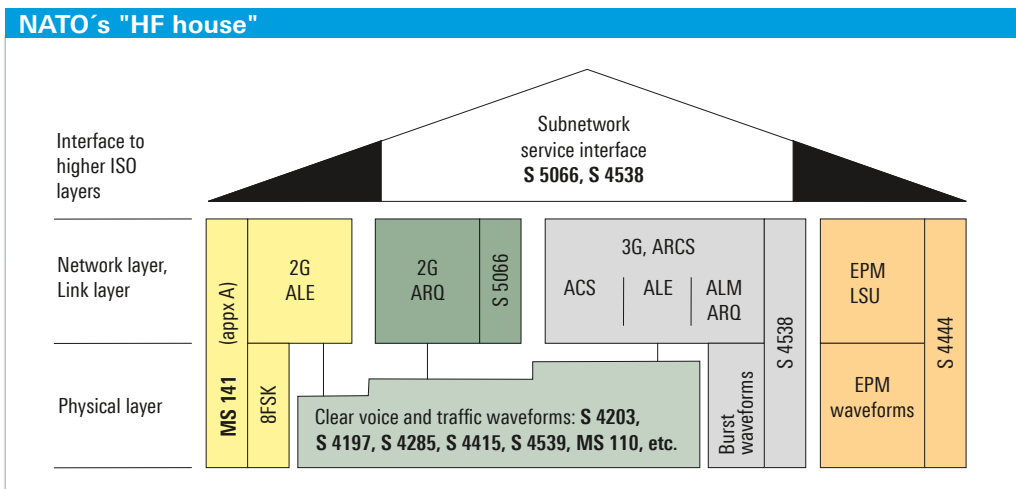
## Low life-cycle costs

- 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 Series 4100 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.

<b>STANAG 4203</b>	Technical standards for HF radio equipment
<b>STANAG 4415</b>	NATO robust waveform, 75 bit/s
<b>STANAG 4285</b>	Single tone modem, up to 3600 bit/s
<b>STANAG 4529</b>	Single tone modem, up to 1800 bit/s
<b>STANAG 4539</b>	Single tone modem, up to 12800 bit/s
<b>MIL-STD-188-110A/B</b>	Single tone modem, up to 12800 bit/s (≈ STANAG 4539)
<b>MIL-STD-188-141A/B</b>	Automatic link establishment
<b>STANAG 5066</b>	Profile for HF radio data communications
<b>STANAG 4538</b>	Automated radio control system (ARCS)
<b>STANAG 4444</b>	NATO HF slow hopping waveform

<b>ACS</b>	Automatic channel selection
<b>ALE</b>	Automatic link establishment
<b>ARCS</b>	Automatic radio control system
<b>ARQ</b>	Automatic repeat request
<b>ALM</b>	Automatic link maintenance
<b>EPM (ECCM)</b>	Electronic protective measures
<b>LSU</b>	Link setup
<b>2G/3G</b>	Second/third generation
<b>S xxxx</b>	STANAG xxxx
<b>MS xxxx</b>	MIL-STD xxxx



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

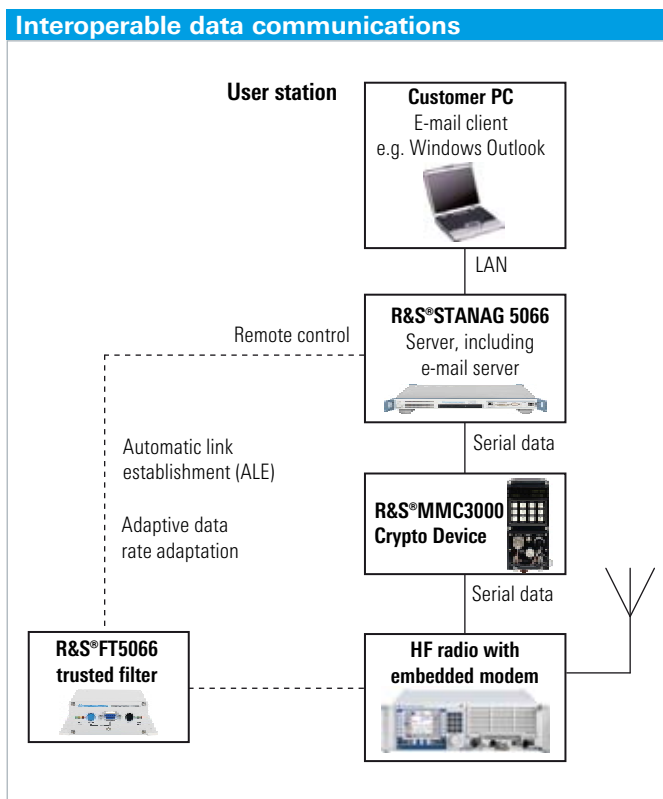
# Sample application

## Interoperable data communications with R&S®STANAG5066

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 communication 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 HF NATO protocol STANAG 5066 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.



# Sample application

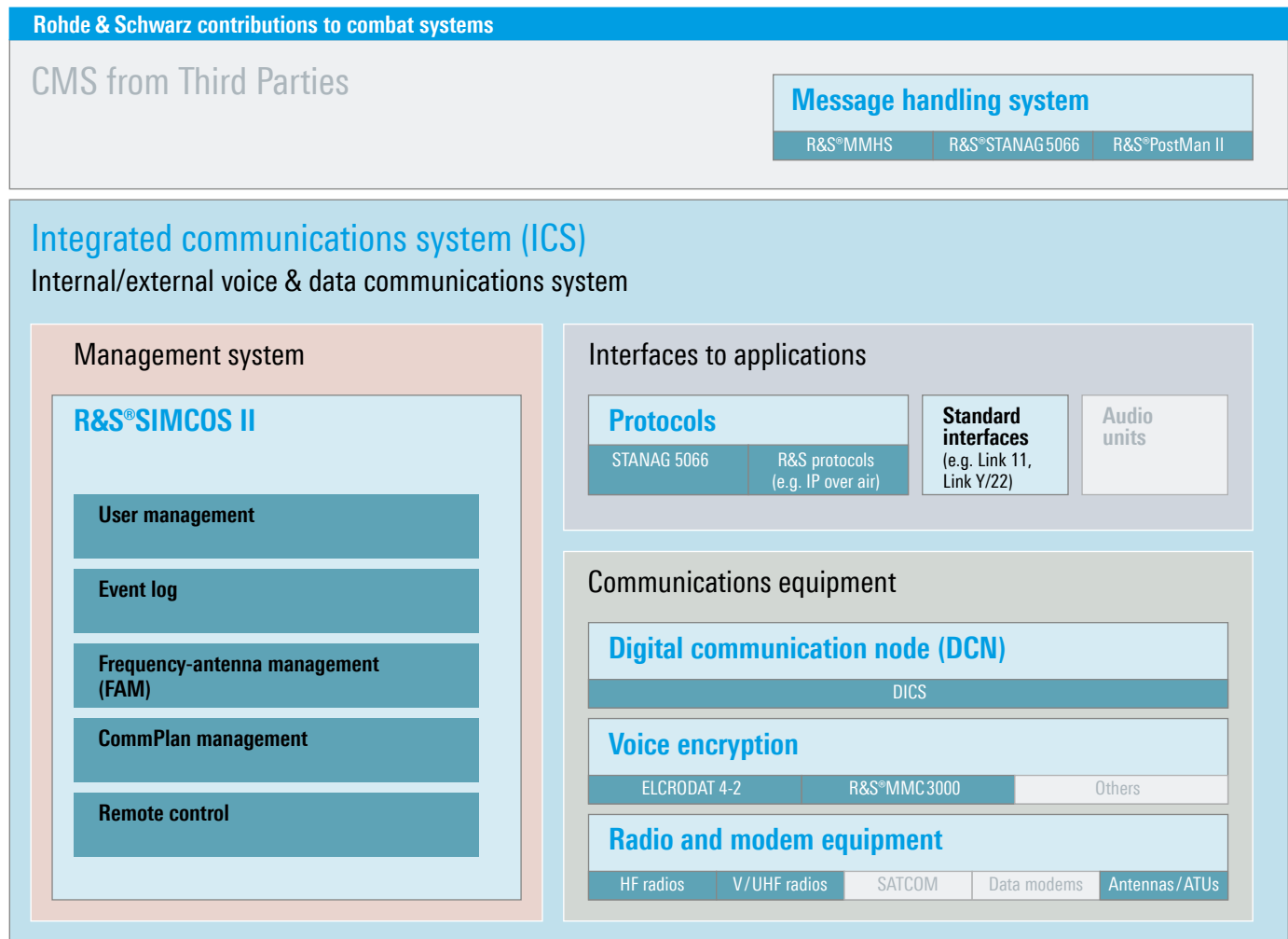
## Integrated naval communications systems

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 also 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®STANAG5066 and R&S®MMHS message handling systems can be seamlessly integrated into R&S®SIMCOS II.



# System configuration

## 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 Series 4100 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-proof investment

The system is based on the principle of combining ship-board 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.

Example: 16-line HF broadband system



# System configuration HF transmit/receive broadband system

The ADCF frigate "HMS De Zeven  
Provinciën" of the Royal Netherlands  
Navy is equipped with a Rohde & Schwarz  
HF broadband system with 16 radio  
channels



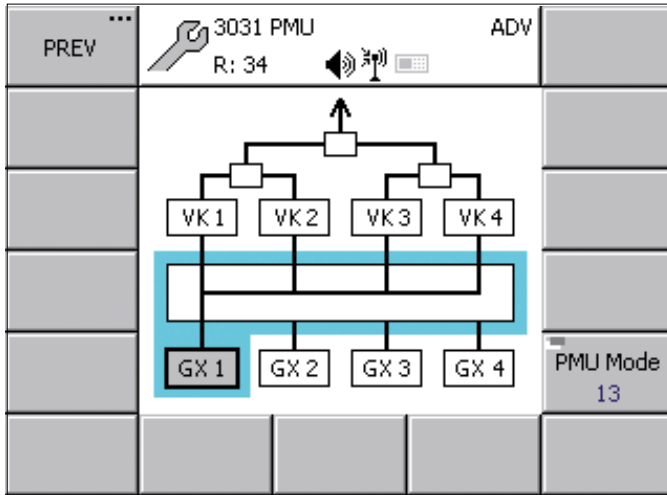
## R&S®GV4190D power management unit – a modular component of the HF broadband system

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/exciter 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 Series 4100 including:

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

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.



### 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/exciter and the power amplifiers. These modes are especially suitable for locally controlling 4 kW transmitter/receiver systems such as those deployed at shore stations.

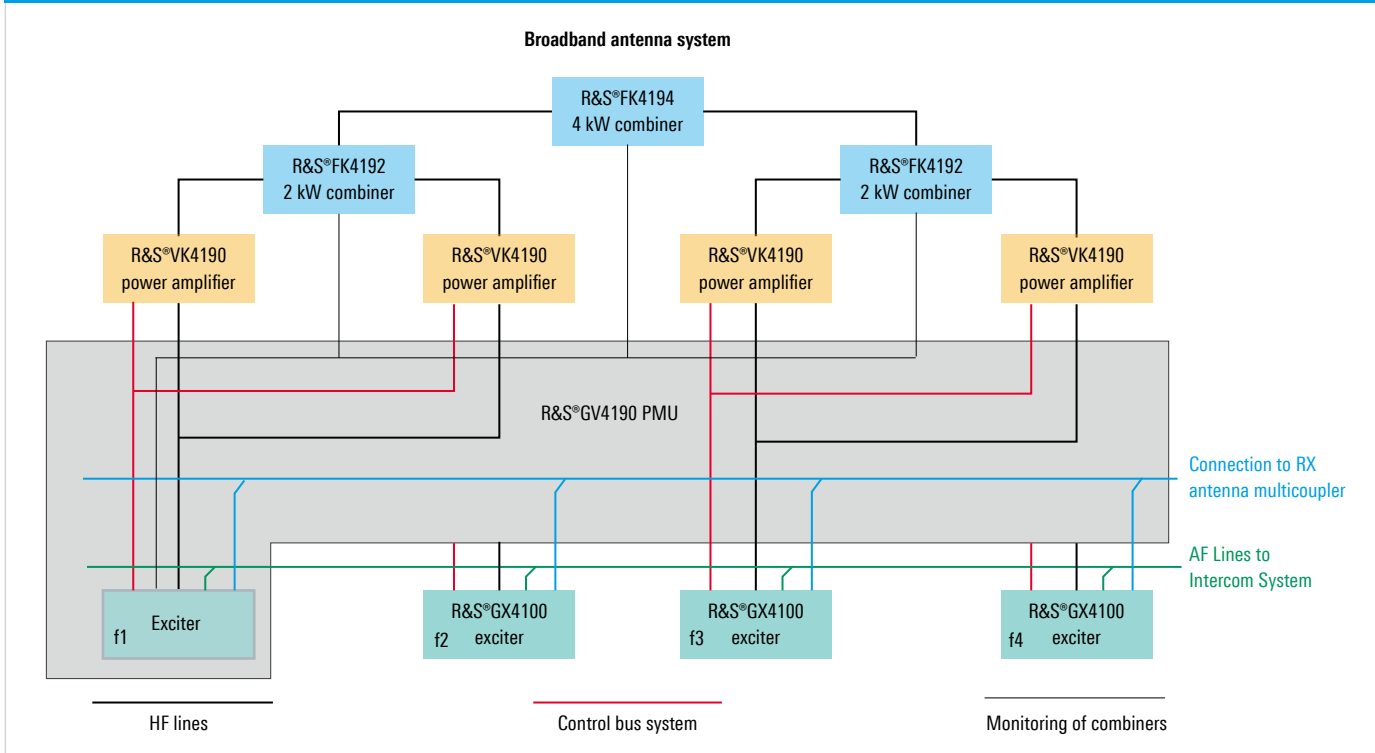
### Flexible, logical allocation of the connected receivers/exciter and power amplifiers

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).

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







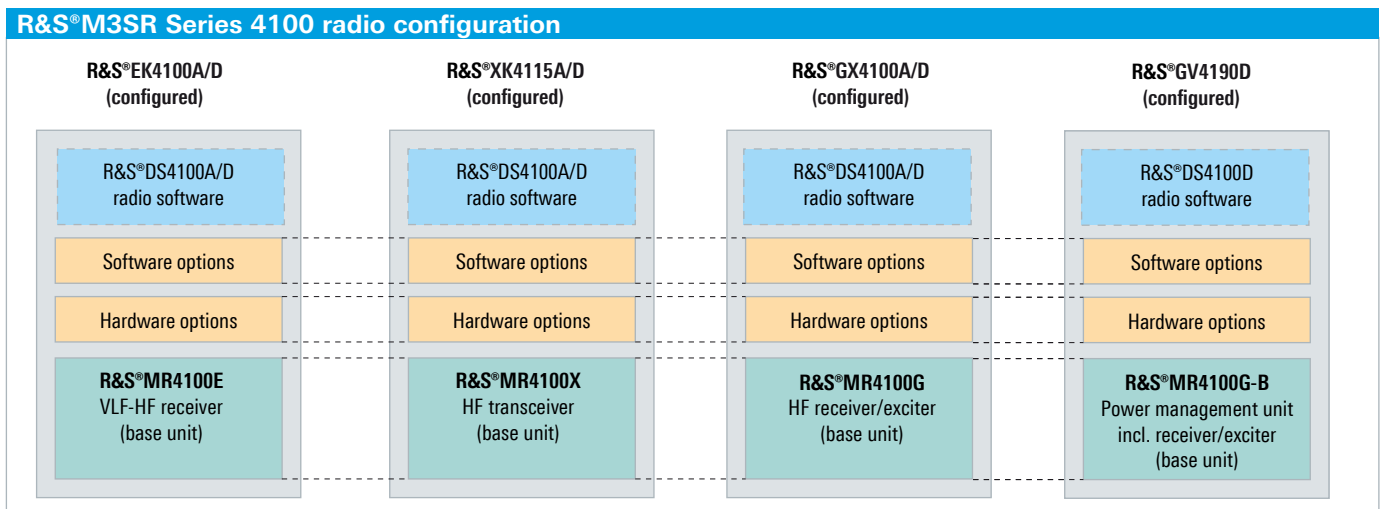
# R&S®M3SR Series 4100 Software Defined Radios Logistical structure

## Base radio models

The logistical structure of the R&S®M3SR Series 4100 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 base radio models are also available in ruggedized versions (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 next chapter from page 24 onward.



# VLF-HF receiver

## R&S®EK4100A/D

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

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®DS4100A/D  
radio software

Software options

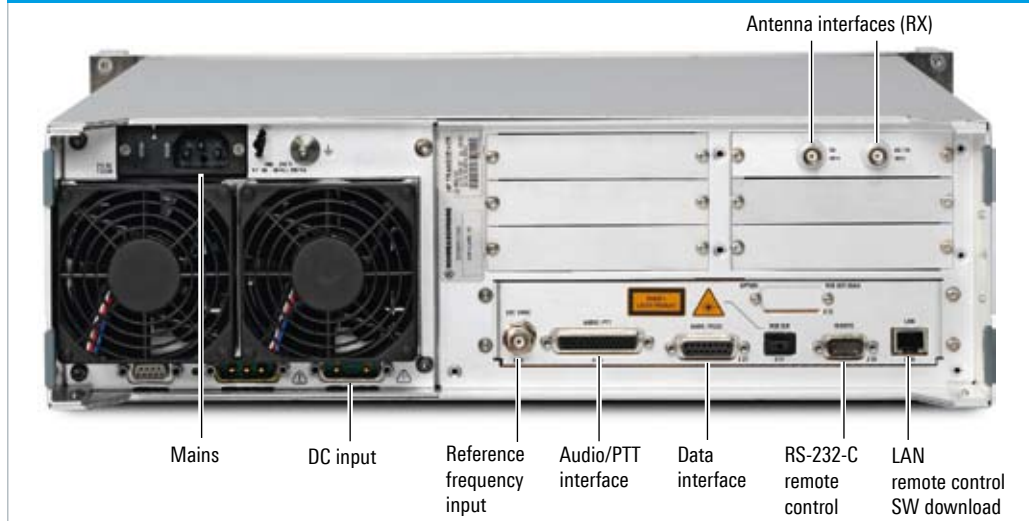
Hardware options

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

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



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

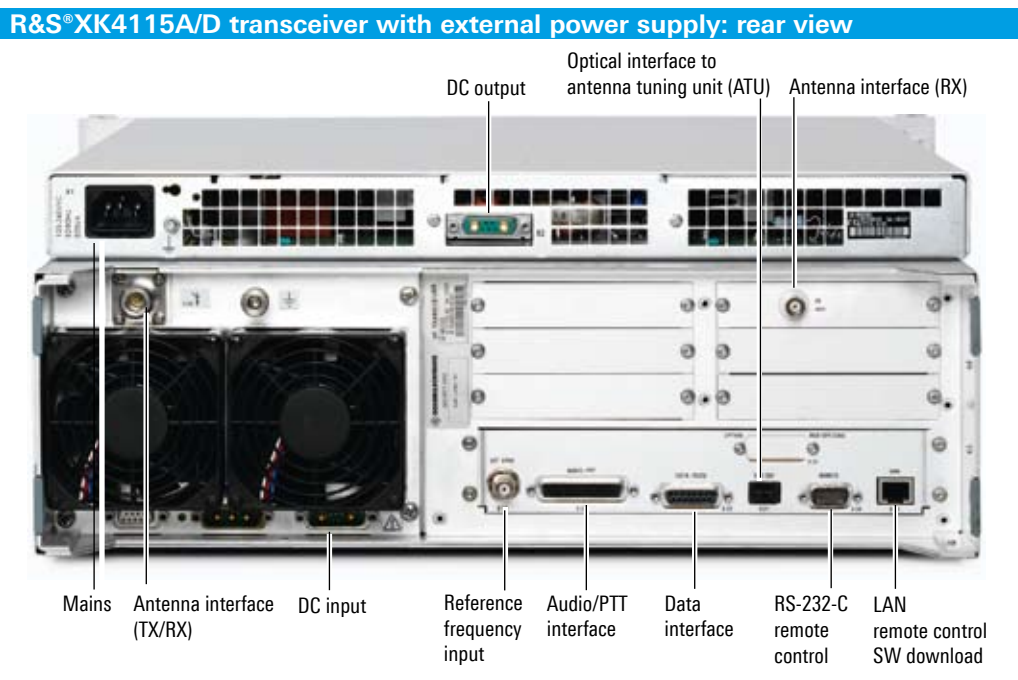
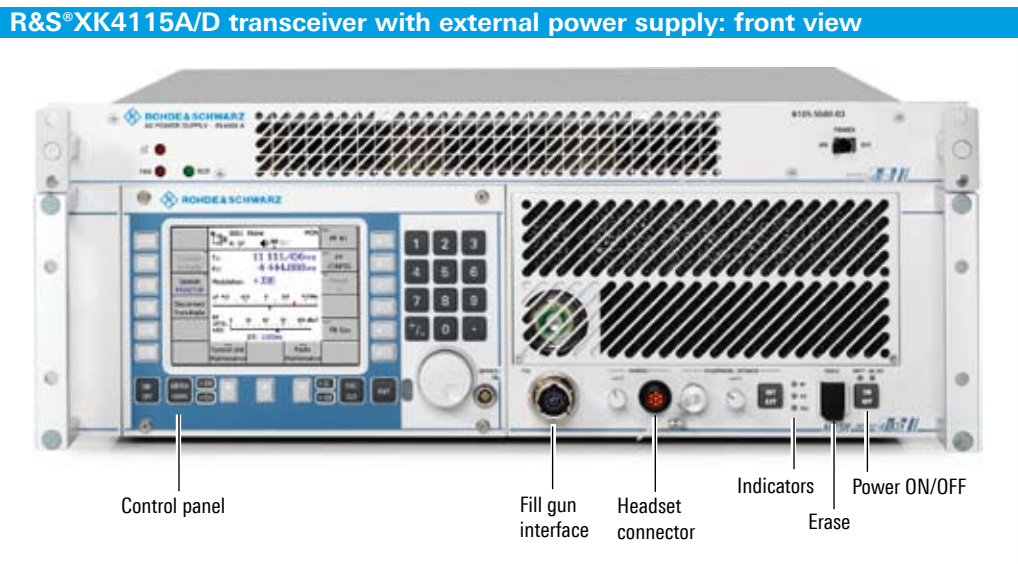
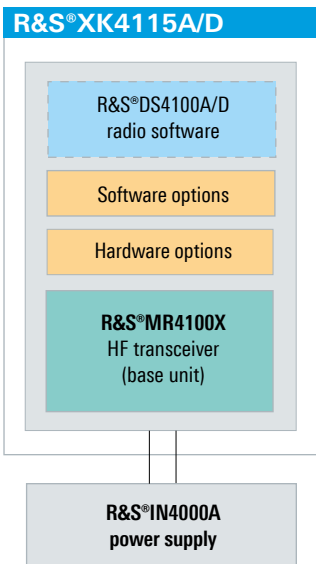


# 150 W transceiver

## R&S®XK4115A/D

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

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).



# 500 W/1000 W transceiver systems

To cover large distances, flexible system solutions with an output power of 500 W and 100 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 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/D exciter/receiver
- R&S®VK4150/4190 power amplifier
- R&S®IN4150/4190 power supply

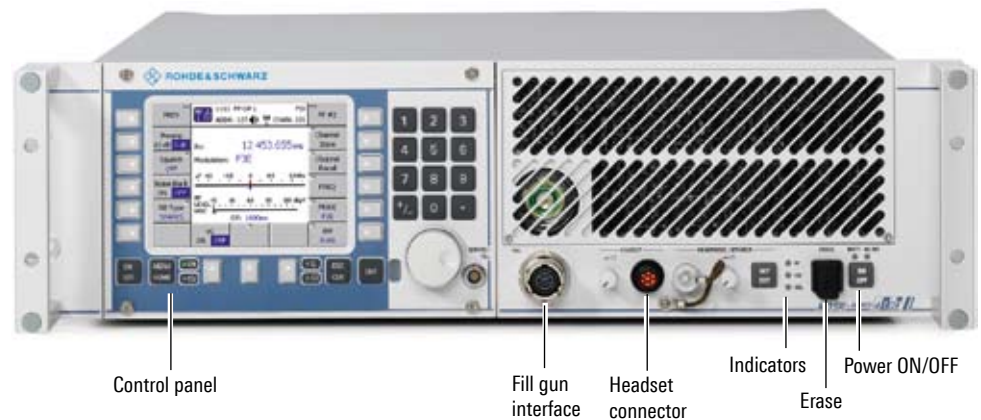
## Transceiver system

R&S®GX4100A/D  
receiver/exciter  
(base unit)

R&S®VK4150/4190  
power amplifier

R&S®IN4150/4190  
power supply

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



## R&S®GX4100A/D

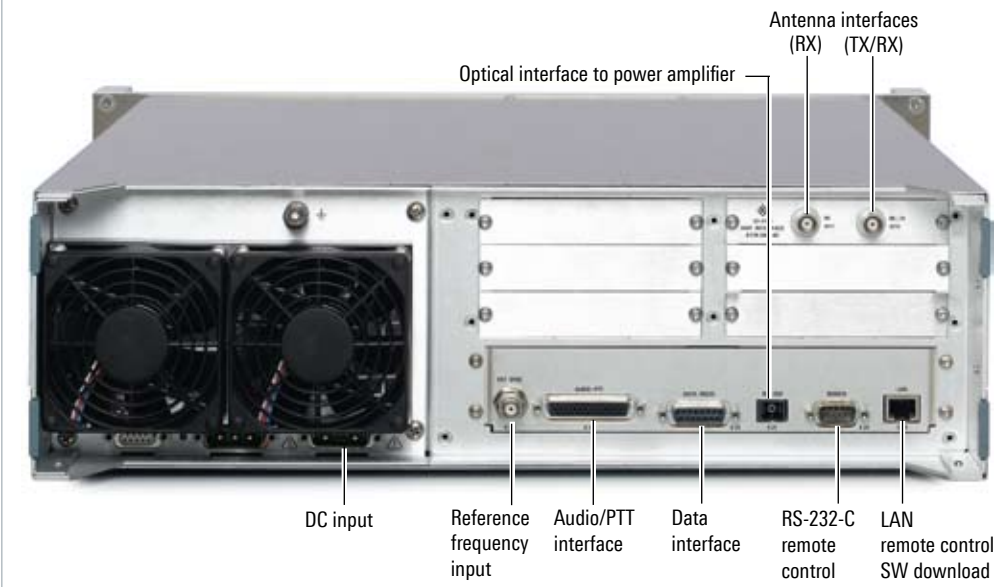
R&S®DS4100A/D  
radio software

Software options

Hardware options

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

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



## 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 amplifiers

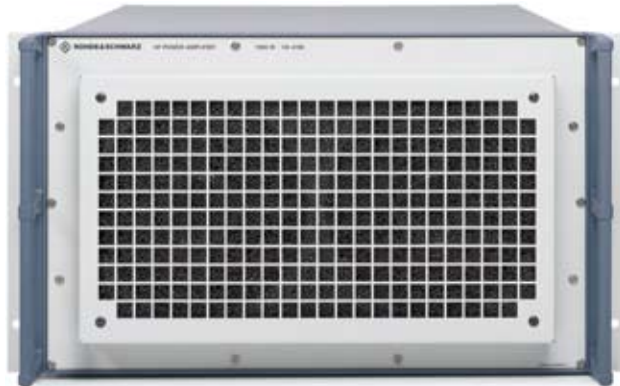
The digitally controlled R&S®VK4150/VK4190 power amplifiers are available in a standard version or a special version with built-in receiver input protection. This option reliably protects the receiver input from destruction in the presence of HF interference on the antenna (caused by nearby transmitters)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

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

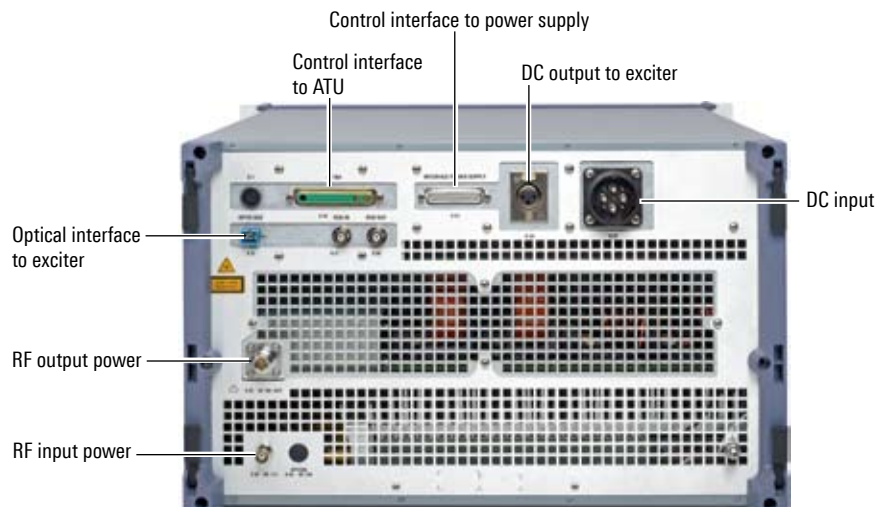
## Characteristics

- ▮ 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

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



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



## Transceiver system

**R&S®GX4100A/D**  
receiver/exciter  
(base unit)

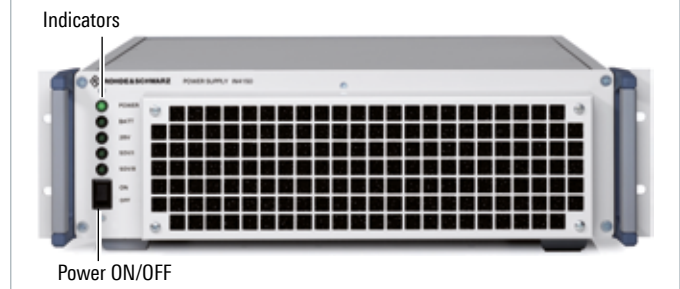
**R&S®VK4150/4190**  
power amplifier

**R&S®IN4150/4190**  
power supply

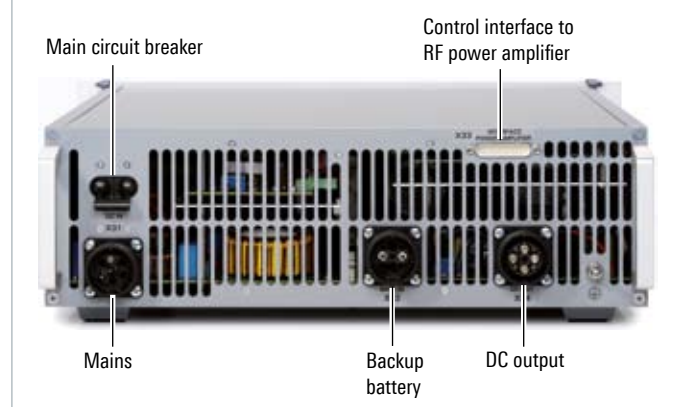
## Standard power supplies for the 500 W/1000 W transceiver systems

- ▮ CE conformity in line with EN 60945 and ETSI EN 300373-1/-2/-3
- ▮ Compliant to 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

### R&S®IN4150/4190 power supply: front view

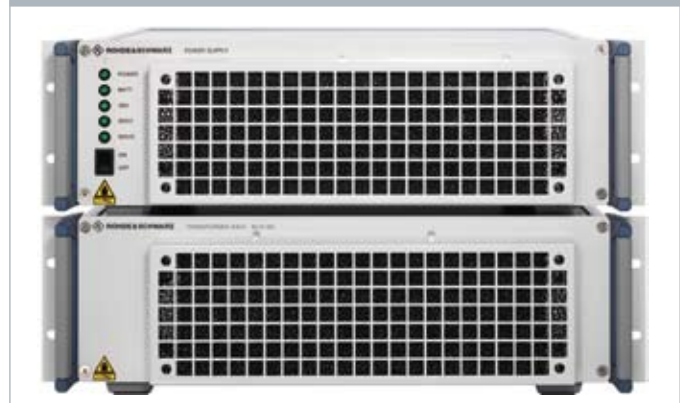


### R&S®IN4150/4190 power supply: rear view



### R&S®IN41x0/BV4190 power supply

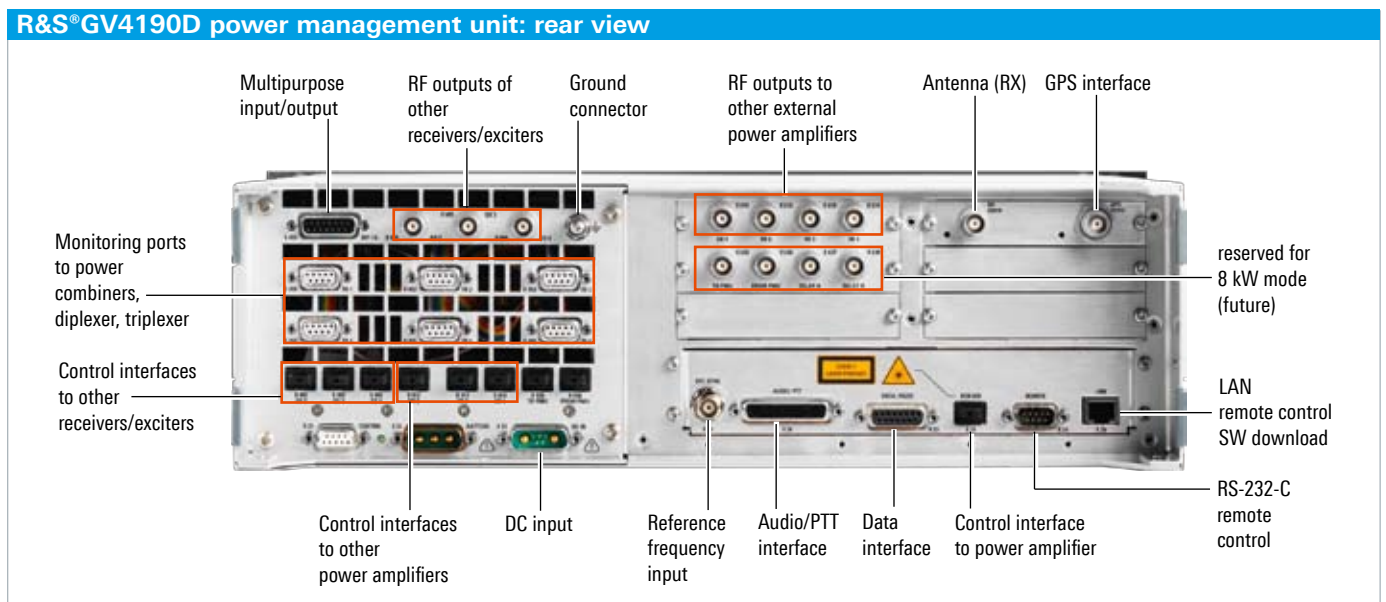
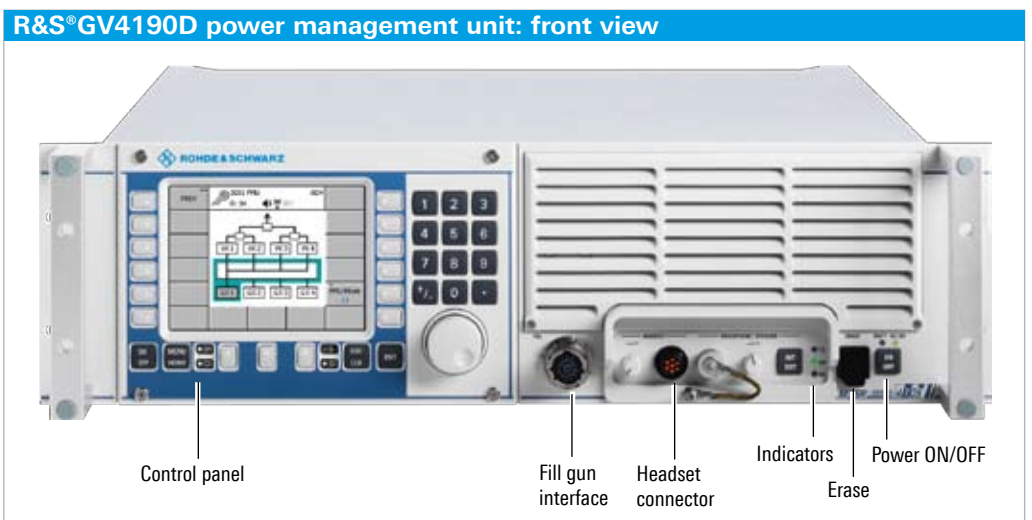
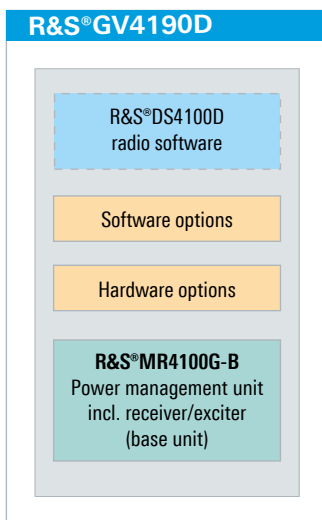
R&S®IN4150/4190 power supply (above) in 3-phase operation at 440 V with external R&S®BV4190 transformer (bottom)



# Power management unit

## R&S®GV4190D

The type designation and the associated order number for an R&S®GV4190D base unit that is custom-configured are order-specific. This makes it possible to clearly identify any customized power management unit with all of its options using a unique order number.



# Hardware options for receiver, exciter and transceiver

## R&S®GB4000C local control panel

- Compact dimensions
- Rugged design
- Graphical color LCD
- Internal built-in test (BIT)

The R&S®GB4000C local control panel (model 32/35) is used to operate and monitor the radio. The 5" LC display provides good readability even under poor lighting conditions. Hardkeys and softkeys as well as a clearly designed user interface ensure ease of use when controlling the radio.

## R&S®FK4120/4140 digitally tuned HF selectors

- 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 ( $V_{rms}$ )
- Frequency hopping capability in line with R&S®SECOM-H

The R&S®FK4120/FK4140 digitally tuned HF selectors are optional plug-in modules for the radios of the R&S®M3SR Series 4100. 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/Hz.

These digitally tuned HF selectors 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.

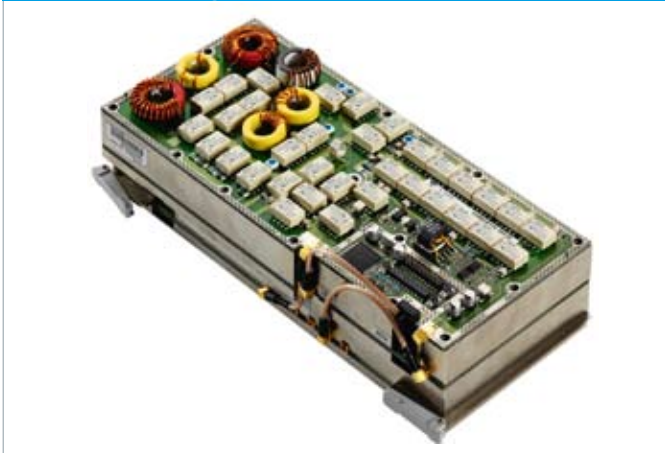
## R&S®GS4102 NMEA (DSC) interface

The NMEA (DSC) interface is necessary when the R&S®M3SR Series 4100 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®GB4000C local control panel



R&S®FK4120 digitally tuned HF selector



R&S®GS4102 NMEA (DSC) interface





# Software options for receiver, exciter and transceiver

The most noteworthy feature of the R&S®M3SR Series 4100 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 basic 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.

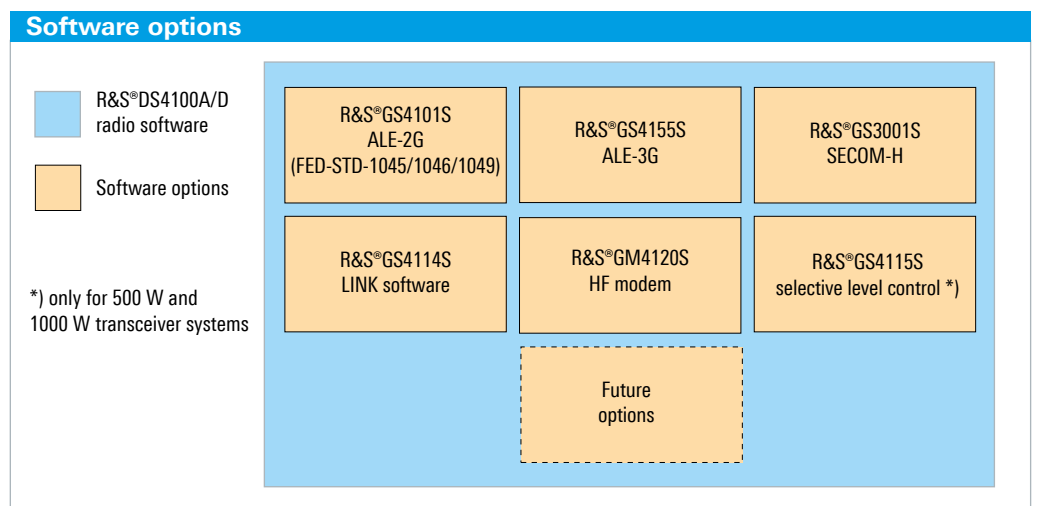
## R&S®GS3001S SECOM-H EPM (ECCM) waveform

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 the best-possible 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 LINK-11 as well as LINK-Y or LINK-22 modems (fixed frequency) can be connected directly to the radio. The R&S®GS4114S LINK software can only be enabled in R&S®DS4100D.

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



# Software options for receiver, exciter and transceiver

## **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. The R&S®GS4115S selective level control can be enabled in R&S®DS4100A and R&S®DS4100D.

## **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 Annex B HF modem provides transmission data rates from 75 bits/s to 9600 bits/s. It is the recommended modem for new projects within NATO. It automatically sets the transmission data rate and is used preferably with the R&S®STANAG5066 data protection protocol. STANAG 4539 Annex B includes the following modem standards:

- STANAG 4415
- MIL-STD-188-110A, Part 5.3
- STANAG 4539, Annex B, Part 4

R&S®GM4120S 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. 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 data link protocols can be controlled using serial data.

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

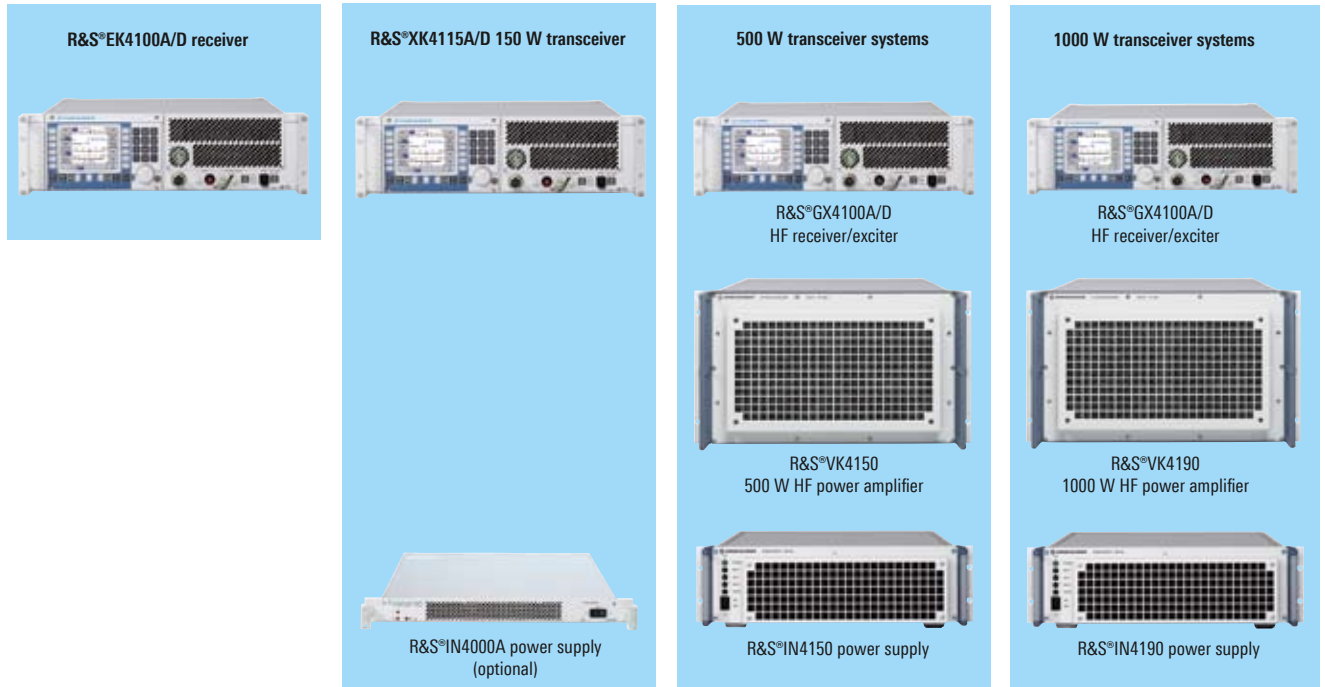
- ALE-2G (FED-STD 1045/1046/1049)
- ALE-3G (STANAG 4538, fast link setup)
  - LDL (low latency data link protocol)
  - HDL (high rate data link protocol)

The R&S®GS4155S option can be activated in the R&S®DS4100D radio software only.

# Ordering information

## R&S® M3SR Series 4100 power classes

Please note: all base units are also in ruggedized version available



R&S®EK4100A/D receiver	Type	Order no.
<b>Base units</b>		
VLF-HF Receiver; AC/DC; without local control panel and radio software	R&S®MR4100E	6118.9609.02
VLF-HF Receiver; AC/DC; without local control panel and radio software; ruggedized version	R&S®MR4100E	6118.9609.12
<b>Radio software</b>		
Software CD without export restriction	R&S®DS4100A	6119.7800.xx
Software CD with export restriction	R&S®DS4100D	6119.7900.xx
<b>Hardware options</b>		
Local Control Panel (without audio; including software and LAN)	R&S®GB4000C	6105.6006.32
Local Control Panel (without audio; including software and LAN), ruggedized version	R&S®GB4000C	6105.6006.35
Digitally Tuned HF Selector, 20 dB, operates in transmitting and receiving section	R&S®FK4120	6119.5007.02
Digitally Tuned HF Selector, 40 dB, operates in transmitting and receiving section	R&S®FK4140	6119.6003.02
NMEA (DSC) Interface, for connection to an external DSC controller (GMDSS)	R&S®GS4102	6119.3504.02
DSP Board, hardware platform for embedded HF modem (R&S®MR4100E, model 02 only)	R&S®GS4105	6119.2108.02
<b>Software options (option keys)</b>		
ALE-2G (FED-STD-1045/1046/1049)	R&S®GS4101S	6120.6003.02
ALE-2G (FED-STD-1045/1046/1049), STANAG 4538 (ALE-3G, 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
HF Modem, single tone modems in line with STANAG 4285, STANAG 4539 annex B, MIL-STD-188-110B	R&S®GM4120S	6142.7519.02
<b>Mating connector set</b>		
Mating Connector Set for R&S®MR4100E	R&S®ZF4101	6120.5007.05

R&S®XK4115A/D transceiver	Type	Order no.
<b>Base units</b>		
HF Transceiver, 150 W; DC; without local control panel and radio software	R&S®MR4100X	6119.7251.02
HF Transceiver, 150 W; DC; without local control panel and radio software; ruggedized version	R&S®MR4100X	6119.7251.12
<b>Radio software</b>		
Software CD without export restriction	R&S®DS4100A	6119.7800.xx
Software CD with export restriction	R&S®DS4100D	6119.7900.xx
<b>Hardware options</b>		
Local Control Panel (without audio; including software and LAN)	R&S®GB4000C	6105.6006.32
Local Control Panel (without audio; including software and LAN), ruggedized version	R&S®GB4000C	6105.6006.35
Digitally Tuned HF Selector, 20 dB, operates in transmitting and receiving section	R&S®FK4120	6119.5007.02
Digitally Tuned HF selector, 40 dB, operates in transmitting and receiving section	R&S®FK4140	6119.6003.02
NMEA (DSC) Interface, for connection to an external DSC controller (GMDSS)	R&S®GS4102	6119.3504.02
DSP Board, hardware platform for embedded HF modem (R&S®MR4100X, model 02 only)	R&S®GS4105	6119.2108.02
<b>Software options (option keys)</b>		
EPM (ECCM) Software R&S®SECOM-H	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, 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
HF Modem, single tone modems in line with STANAG 4285, STANAG 4539 annex B, MIL-STD-188-110B	R&S®GM4120S	6142.7519.02
<b>Power supply units</b>		
Power Supply, 230 V AC, 1 phase	R&S®IN4000A	6105.5500.03
Power Supply, 230 V AC, 1 phase, ruggedized version	R&S®IN4000A	6105.5500.04
<b>Mating connector sets</b>		
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
<b>Power supply cables</b>		
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

500 W and 1000 W transceiver systems	Type	Order no.
<b>Base units</b>		
HF Receiver/Exciter, DC; without local control panel and radio software	R&S®MR4100G	6118.9750.02
HF Receiver/Exciter, DC; without local control panel and radio software; ruggedized version	R&S®MR4100G	6118.9750.12
<b>Radio software</b>		
Software CD without export restriction	R&S®DS4100A	6119.7800.xx
Software CD with export restriction	R&S®DS4100D	6119.7900.xx
<b>Hardware options</b>		
Local Control Panel (without audio; including software and LAN)	R&S®GB4000C	6105.6006.32
Local Control Panel (without audio; including software and LAN); ruggedized version	R&S®GB4000C	6105.6006.35
Digitally Tuned HF Selector, 20 dB, operates in transmitting and receiving section	R&S®FK4120	6119.5007.02
Digitally Tuned HF Selector, 40 dB, operates in transmitting and receiving section	R&S®FK4140	6119.6003.02
NMEA (DSC) Interface, for connection to an external DSC controller (GMDSS)	R&S®GS4102	6119.3504.02
DSP Board, hardware platform for embedded HF modem (R&S®MR4100G, model 02 only)	R&S®GS4105	6119.2108.02
<b>Software options (option keys)</b>		
EPM (ECCM) Software R&S®SECOM-H	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, 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 (PA)	R&S®GS4115S	6120.6703.02
HF Modem, single tone modems in line with STANAG 4285, STANAG 4539 annex B, MIL-STD-188-110B	R&S®GM4120S	6142.7519.02
<b>HF power amplifiers</b>		
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
<b>Power supply units for 500 W transceiver system</b>		
Power Supply 230 V AC; 1 or 3 phases + N	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
Transformer 440 V AC	R&S®BV4190	6120.2908.02
<b>Power supply units for 1000 W transceiver system</b>		
Power Supply 230 V AC; 1 or 3 phases + N	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	R&S®BV4190	6120.2908.02
<b>Mating connector sets</b>		
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
<b>Connecting cables</b>		
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
DC Cable; R&S®GX ↔ R&S®VK; 2.5 m length	R&S®GK4104	6120.5907.25
HF 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 Supply Cable; R&S®BV ↔ R&S®IN; 3 m length	R&S®GK4108	6120.3756.03

HF transmit/receive broadband system	Type	Order No.
<b>Basic units</b>		
Power Management Unit incl. HF receiver/exciter functionality; basic unit; DC, without local control panel and radio software; ruggedized	R&S®MR4100G-B	6119.6255.12
HF Receiver/Exciter basic unit, DC; without local control panel and radio software, ruggedized	R&S®MR4100G	6118.9750.12
<b>Radio software</b>		
Software CD without export restriction	R&S®DS4100A	6119.7800.xx
Software CD with export restriction	R&S®DS4100D	6119.7900.xx
<b>Hardware options</b>		
Local Control Panel (without audio; incl. software and LAN), ruggedized	R&S®GB4000C	6105.6006.35
Digitally Tuned RF Selector, 40 dB, functional for transmitting and receiving section (mandatory option)	R&S®FK4140	6119.6003.02
NMEA (DSC) Interface, for connection of 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
<b>Software options</b>		
EPM (ECCM) Software R&S®SECOM-H	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, 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 annex B, MIL-STD-188-110B	R&S®GM4120S	6142.7519.02
<b>Power amplifier</b>		
1000 W HF Power Amplifier	R&S®VK4190	6120.1501.03
<b>Power supply units</b>		
Power Supply 230 V AC; 1 or 3 phases + N	R&S®IN4190	6120.2708.02
Power Supply 440 V AC; 3 phases (used together with transformer R&S®BV4190)	R&S®IN4190	6120.2708.03
Transformer 440 V AC	R&S®BV4190	6120.2908.02
<b>Mating connector sets</b>		
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
<b>Cables</b>		
Fibre Optic Connecting Cable; VK to GX; 1 m length	R&S®GK4101	6120.5620.10
Fibre Optic Connecting Cable; VK to GX; 3.5 m length	R&S®GK4101	6120.5620.35
DC cable GX to VK; 2.5 m length	R&S®GK4104	6120.5907.25
RF cable GX to VK; 3 m length	R&S®GK4105	6120.3604.03
Control cable VK to IN; 3 m length	R&S®GK4106	6120.3656.03
DC cable VK to IN; 3 m length	R&S®GK4107	6120.3704.03
Power cable BV to IN; 3 m length	R&S®GK4108	6120.3756.03
<b>System components</b>		
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

Auxiliary equipment	Type	Order no.
Remote Control Unit	R&S®GB4000C	6105.6006.33
Remote Control Unit, ruggedized version	R&S®GB4000C	6105.6006.36
Headset including microphone, ruggedized version, with cable and NF-7 connector	R&S®GA012	0693.7664.02
Headset including microphone, ruggedized version, 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.xx
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	Type	Order no.
<b>HF antenna tuning units (150 W transceiver)</b>		
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
<b>HF antenna tuning units (500 W/1000 W transceiver systems)</b>		
HF Antenna Tuning Unit for land-based and shipborne applications	R&S®FK2900M	6097.1005.02
HF Antenna Tuning Unit for land-based and shipborne applications, mast antennas >12 m	R&S®FK2900M	6097.1005.05
HF Antenna Tuning Unit for land-based and shipborne applications, frequency hopping capable	R&S®FK4190M	6120.9002.02
HF Antenna Tuning Unit for submarine applications, frequency hopping capable	R&S®FK4150U	6120.9254.07
<b>Mating connector sets</b>		
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
<b>Control cables for antenna tuning units</b>		
Optical Control Cable for connecting R&S®FK4115M/R&S®HX002H1/R&S®HX002H2	R&S®GK4102	6120.5720.xx
xx = 10 → 10 m length, xx = 25 → 25 m length, xx = 50 → 50 m length		
Control Cable for connecting R&S®FK4150U	R&S®GK2903	6117.9505.xx
xx = 10 → 10 m length, xx = 20 → 20 m length, xx = 30 → 30 m length, xx = 40 → 40 m length, xx = 50 → 50 m length		
Control Cable for connecting R&S®FK4190M, R&S®FK2900M	R&S®GK2903M	6117.9757.xx
xx = 10 → 10 m length, xx = 20 → 20 m length, xx = 30 → 30 m length, xx = 40 → 40 m length, xx = 50 → 50 m length		

Test System for radio equipment of the R&S®M3xR family	Type	Order no.
I-Level Special Test Equipment (I-STE for R&S®M3AR, R&S®M3SR, R&S®M3TR)	R&S®TS6030	on request
Other types on request.		

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For data sheet, see  
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