R&S®M3SR Series4100

R&S®SK41xx
HF HIGH-POWER TRANSMITTERS

For advanced long-range BLOS communications

R&S®SK4105 HF high-power transmitter
with 5 kW output power

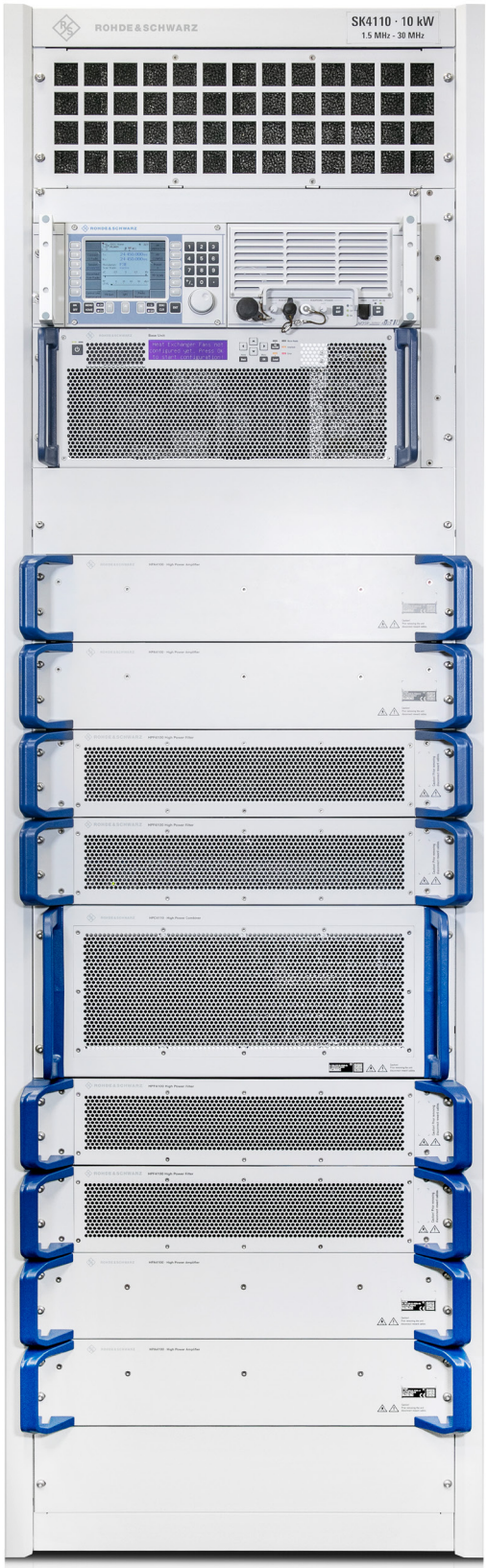
R&S®SK4110 HF high-power transmitter
with 10 kW output power

Product Brochure
Version 03.00

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®SK4105 and R&S®SK4110 HF high-power transmitters meet the requirements for advanced beyond-line-of-sight (BLOS) communications with very high data rates and maximum reliability. The innovative cooling concept minimizes operating costs.



The trend of ever higher frequencies to transmit more data with greater bandwidth continues. But isn't satellite communications always the best and most secure choice for every user?

Conventional shortwave transmitter systems are currently experiencing a renaissance. In particular, users who want to exchange messages securely and autonomously through their own communications infrastructure are looking for alternatives to supply their receiving ends with data, on land, at sea and in the air. As a result, high-power shortwave transmitters are increasingly being deployed.

The output power of 5 kW (R&S®SK4105) or 10 kW (R&S®SK4110) generated by the R&S®SK41xx HF high-power transmitters is sufficient to allow even advanced wideband HF waveforms to deliver the expected data rates with adequate spectral power density. The HF high-power transmitters are a future-proof investment. Thanks to an innovative liquid cooling concept, the R&S®SK41xx HF high-power transmitters are optimized for minimal total cost of ownership (TCO).

The systems consist of a software based exciter from the R&S®M3SR Series4100 HF radio family and liquid-cooled high-power amplifiers. The R&S®SK41xx transmit in the shortwave band in the frequency range from 1.5 MHz to 30 MHz. They are supplied complete with a heat exchanger and pump unit.

R&S®SK4110 HF high-power transmitter

KEY FACTS

- HF wideband ready
- Full rated power up to VSWR 2:1
- Liquid-cooled amplifiers, unique worldwide
- High output power enables high data rates with channel aggregation
- Compact and quiet, even when operated 24/7
- Built-in redundancy for high reliability
- Outstanding HF performance, e.g. phase noise
- Requirements for linearity and robust operation, even with mismatch, surpass the expectations of common industry standards
- R&S®M3SR Series4100 radio as exciter
- ALE-3G and ALE-4G operation
- Frequency hopping capability (R&S®SECOM-H)
- Supports LINK 11/22 and LINK Y
- Operation with SELCAL
- Compliant with air traffic control standard ED-137C

BENEFITS

WIDEBAND OPERATION FOR HIGH DATA RATES

Up to now, a bandwidth of 3 kHz has been used for shortwave operation in single sideband mode. The R&S®SK41xx transmitters can aggregate up to 16 transmission channels to achieve higher data rates. This requires high linearity in the amplifiers and an exciter that will support these advanced methods well into the future.

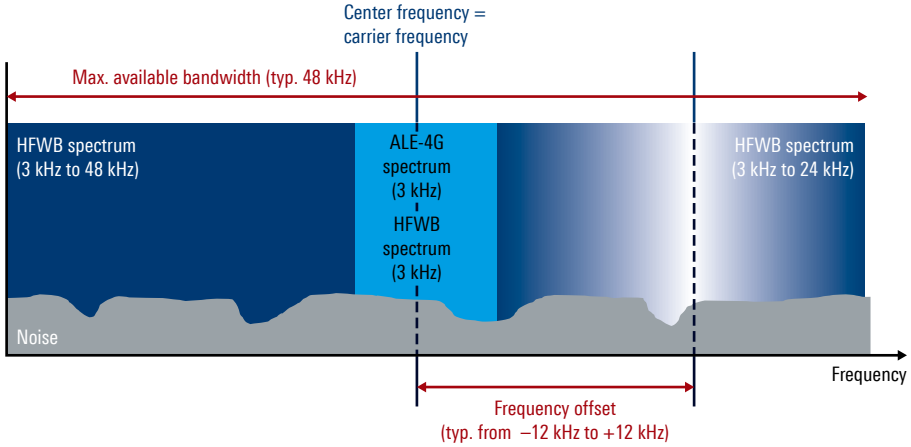
- Transmit bandwidths up to 48 kHz; prepared for up to 200 kHz
- Operation with built-in modulators or external modems via an external interface
- Prepared for ALE-4G and HF wideband
- Modulation methods up to 256QAM

The software based exciter from the R&S®M3SR Series4100 radio family supports the following transmission methods:

- HF wideband modem (MIL-STD-188-110D)
- ALE-4G (MIL-STD-188-141D, including ALE-2G and ALE-3G)
- Rohde&Schwarz proprietary IP over air (IPoA) wideband data modem (R&S®WBxDL)
- HF data modem (MIL-STD-188-110B/C, STANAG 4285, STANAG 4539)
- IP data over HF (STANAG 4538)
- Data link, in line with STANAG 5511, STANAG 5522
- EPM (R&S®SECOM-H, in line with STANAG 4444)
- Emission classes: A1A, A3E, H3E, R3E, B8E, B7D, F1D, F1B, F3E, J3E (LSB, USB), J2D (LSB, USB)

Bandwidth extensions up to 200 kHz will enable significant increases in date rates in the future. In addition, the R&S®SK41xx transmitters support established modulation methods such as 256QAM. This allows bit rates up to 240 kbit/s to be achieved even now in a bandwidth of 48 kHz. This enables relatively long messages to be transmitted over shortwave connections, such as emails with attachments.

HF wideband in the HF spectrum



LIQUID-COOLED AMPLIFIERS

Liquid-cooled amplifiers are a key component of the R&S®SK41xx transmitters. They ensure minimal operating costs and sustained information superiority.

- Extremely compact and very quiet
- Easy installation with no complex air cooling equipment
- Fully solid-state with built-in redundancy
- Fast swapping of individual amplifier rackmounts
- Pump unit flexibly detachable

Rohde&Schwarz has been building successful liquid-cooled amplifiers for many decades. They have been continually improved and today they are an essential part of terrestrial broadcasting. There are many thousands of installations worldwide and hundreds of satisfied broadcast customers rely on Rohde&Schwarz technology. The amplifiers of the R&S®SK4105 and R&S®SK4110 HF high-power transmitters are the product of this expertise. The high power is generated by amplifiers adapted to the frequency range.

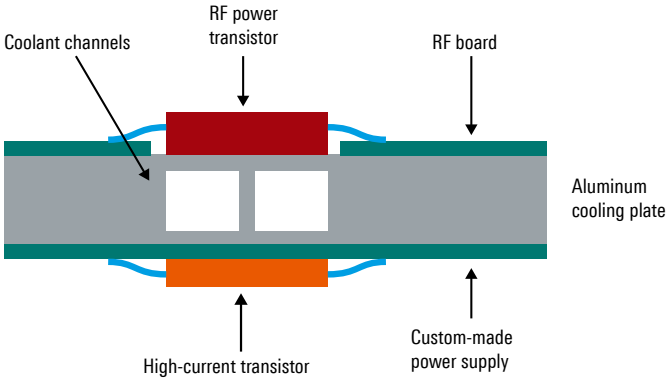
There are many benefits: the amplifiers are very quiet because they have no internal fans. They are very compact. For both transmitter models, a single 19" rack provides enough space to install all the components. For the 5 kW transmitter, the rack even holds the pump unit, which is separate for the 10 kW transmitter.

Conventional high-power amplifiers require expensive air supply systems and the process of routing large air ducts through the building is complicated. Filter units and air drying systems consume additional power, need constant maintenance and require regular cleaning. None of this is necessary with a liquid-cooled system. The hoses, heat exchangers and pump unit can be set up and put into service quickly and economically. The heat exchangers are usually installed outside the building, with the pump unit placed near the transmitter. The heat exchangers are suitable for deployment in every environment, whether on the coast with sea air or in frosty regions with snow and ice.

The cooling system is filled with Antifrogen® N coolant for protection against frost and corrosion, similar to car cooling systems. The system is fully solid-state, so the amplifiers in this system continue operating if a power amplifier transistor fails, unlike tube amplifiers. Complete 19-inch power amplifier modules can easily be exchanged on site without opening the cooling circuit.

Schematic depiction of liquid-cooled amplifier

Heat is absorbed and carried away directly where it is generated. This considerably reduces the stress on other modules, increases the reliability of the transmitter and extends its life.



HIGH POWER AND OUTSTANDING LINEARITY

Derived from the R&S®BBL200 broadband amplifiers, the HF high-power transmitters are available in two power classes with transmit power of 5 kW or 10 kW. The power rating refers to the average HF power output and peak envelope power (PEP). The power consumption of the 5 kW system is approximately 13 kW, corresponding to an efficiency of more than 30 %.

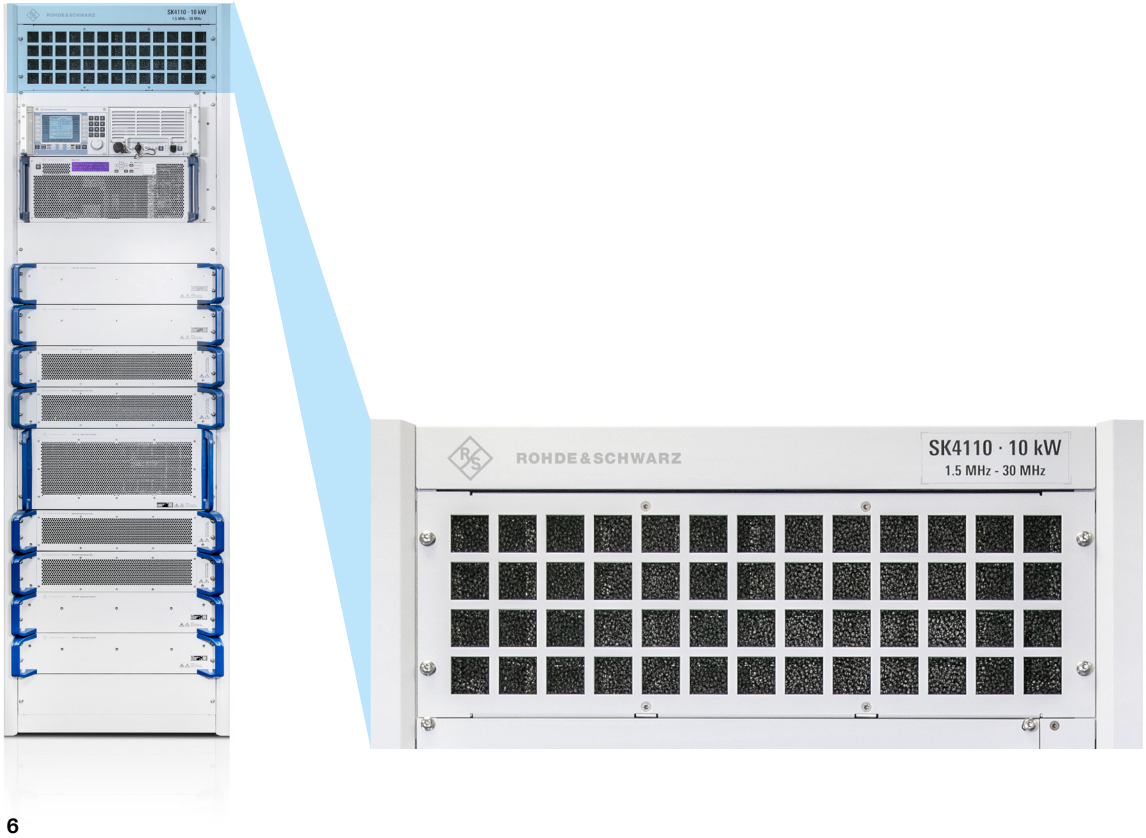
- Choice of output power: 5 kW or 10 kW PEP/AVG
- Full power even with mismatch up to a voltage standing wave ratio of 2:1
- Emergency operation possible in the event of output stage failure or failure of individual power supplies
- Complies with required limits on spurious emissions and harmonics, in line with ICAO Annex 10 Vol III, Part 1 and Part 2
- Two-tone intermodulation, better than –30 dBc with reference to the single tone

The antennas used in this frequency range often do not provide optimal impedance matching, so it is important that the system can output maximum power even with a high voltage standing wave ratio (VSWR). The R&S®SK41xx HF high-power transmitters meet this requirement up to a VSWR of 2:1. At higher values, the transmitter automatically reduces the output power to prevent damage to the transmitter system.

Particularly for complex signals and multi-carrier transmission with large bandwidths, requirements are increasing for amplifier linearity. The R&S®SK41xx transmitters comply with the required limits for harmonics and spurious emissions, in line with ICAO Annex 10 Vol III.

This also applies to intermodulation products, where the R&S®SK41xx transmitters achieve excellent values of better than –30 dBc with reference to the single tone in a two-tone measurement.

R&S®SK4110 with 10 kW output power



INNOVATIVE INTEGRATED REDUNDANCY CONCEPTS

In addition to a compact design and high performance, the R&S®SK41xx HF high-power transmitters stand out with their unique mechanisms for continued operation in the event of faults.

These mechanisms ensure high availability and interruption-free operation, resulting in substantial time savings, a considerable advantage for unmanned remote stations in particular.

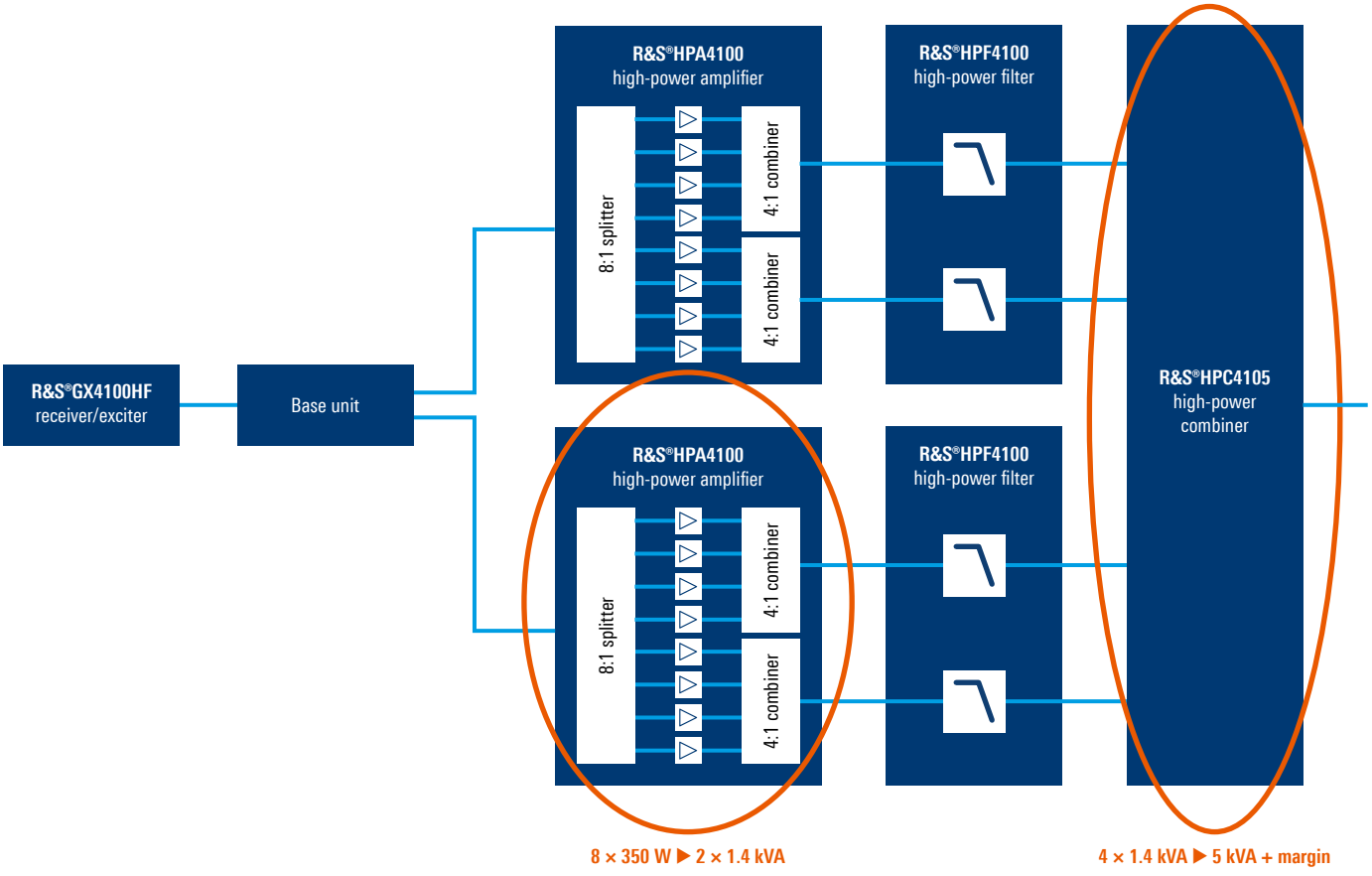
Each 19-inch power amplifier module has three power supplies. If one of these power supplies fails, the system can continue operation at up to 80 % of the nominal RF power. This gives the user time to calmly prepare for and carry out the replacement of the defective module.

If an output stage transistor fails, the maximum achievable output power is reduced, but the HF high-power transmitter can continue operating reliably. The amount of power reduction depends on how many transistors have failed and whether the transmitter is a 5 kW or a 10 kW system.

The R&S®SK41xx transmitters can optionally be equipped with an uninterruptible power supply (UPS) to ensure a continued supply of power to the controller and the exciter in the event of a power failure. This avoids the need to restart these components, minimizing the wait time until the system is fully available again.

R&S®SK4105 system architecture

Simplified RF path: The margin at the amplifier output is of central importance to achieve a VSWR of 2:1.



FLEXIBLE R&S®M3SR Series4100 RADIO AS EXCITER

The R&S®GX4100A exciter is a key component of the R&S®SK41xx HF high-power transmitters.

- ► Tried and tested R&S®M3SR Series4100 radio
- ► Includes commonly used waveforms
- ► Prepared for future waveforms via software upgrades

Rohde&Schwarz uses a radio of the R&S®M3SR Series4100 family as an exciter. This radio is deployed worldwide and has sold thousands of units.

The architecture of the R&S®M3SR Series4100 radio supports commonly used transmission methods. New waveforms can be integrated as needed via software upgrade. This ensures that future requirements for this system component can be met easily.

R&S®M3SR Series4100 radio

OPTIMAL DEPLOYMENT IN SHIP-SHORE AND AIR TRAFFIC CONTROL APPLICATIONS

The R&S®SK41xx HF high-power transmitters are especially suitable for deployment in naval communications, particular at coastal radio stations. The transmitters are also suitable for air traffic control radio stations, where reliable systems are needed for long-range communications.

Shortwave propagation conditions (BLOS) make it theoretically possible to reach all parts of the world with a single high-power transmitter. This technical advantage allows the user to operate independently of the commonly used satellite communications channels if necessary.

Common communications applications:

- BRASS, BRE1TA, SSSB
- HF backbone as a substitute for satellite communications or wireline communications in emergences
- Border defense and coastal defense
- Long-range radio link coverage for pilot-controller voice communications (ATC)

The following services, among others, are provided or transmitted by these radio stations:

- Military messaging such as ACP 127, STANAG 4406, STANAG 5066
- Transmission of videos or photos
- Supports LINK 11/22 and LINK Y data links
- IP based applications such as email and voice over IP

Typical coastal radio station.

SPECIFICATIONS IN BRIEF

Specifications in brief		
Frequency range	TX	1.5 MHz to 29.999999 MHz
Waveforms		
EPM (ECCM) software	powerful proprietary HF slow hopping waveform with embedded COMSEC, optional	R&S®SECOM-H
ALE-2G	second generation automatic link establishment, optional	in line with: ► FED-STD-1045/1046/1049 ► MIL-STD-188-141B, App. A and B
ALE-3G	third generation automatic link establishment, optional	in line with STANAG 4538 (fast link setup (FLSU), circuit link control (CLC))
ALE-4G	fourth generation automatic link establishment, optional	in line with MIL-STD-188-141D WALE, App. G and H
HF modem, embedded	optional	in line with: ► STANAG 4285 ► STANAG 4539 (including STANAG 4415) ► MIL-STD-188-110B, Section 5.3 and App. C ► STANAG 4529 ► STANAG 4481 ► STANAG 5065 ► MIL-STD-188-110B, App. F
HF wideband modem, embedded	optional	in line with MIL-STD-188-110D, App. D, block 4
Data link protocols	ARQ (optional)	in line with: ► STANAG 4538 (LDL, HDL) ► Rohde&Schwarz propriety protocol R&S®WBxDL
Data link capability	optional	in line with: ► STANAG 5511 ► MIL-STD-188-203-1A ► STANAG 5522 (fixed frequency only)
HF output power		
R&S®SK4105 (5 kW) transmitter system	all modes	5 kW (67 dBm) ± 0.5 dB PEP and AVG
R&S®SK4110 (10 kW) transmitter system	all modes	10 kW (70 dBm) ± 0.5 dB PEP and AVG
Electrical specifications		
Rated power		
R&S®SK4105 (5 kW) transmitter system	HFCW = 5 kW (RMS), VSWR = 1	< 16 kVA (typ.)
R&S®SK4110 (10 kW) transmitter system	HFCW = 10 kW (RMS), VSWR = 1	< 27 kVA (typ.)
General data		
Environmental data		
Operating ambient temperature range	valid for indoor equipment, transmitter including pump unit	0 °C to +40 °C, in line with EN 60068-2-1, EN 60068-2-2 (equipment class B tailored)
Storage temperature range	valid for indoor equipment, transmitter including pump unit	–20 °C to +70 °C
Permissible outdoor temperature range	valid for heat exchanger and cooling liquid	–20 °C to +45 °C
Dimensions	rack setup, W × H × D, including handles, stands and crane lugs, one rack, 42 HU, pump unit integrated in the rack	
	R&S®SK4105 (5 kW) transmitter system (without external heat exchanger)	600 mm × 2050 mm × 1100 mm (23.62 in × 80.71 in × 43.31 in)
	R&S®SK4110 (10 kW) transmitter system (without external pump unit and external heat exchanger)	600 mm × 2050 mm × 1100 mm (23.62 in × 80.71 in × 43.31 in)

PRODUCT INFORMATION

Designation	Type
High-power amplifier system (including liquid cooling equipment)	
5 kW high-power transmitter	R&S®SK4105
10 kW high-power transmitter	R&S®SK4110
Base radio	
HF receiver/exciter, DC, without local control panel and radio software	R&S®MR4100G
Mating connector set, for R&S®MR4100G	R&S®ZF4101
Radio software	
Radio software, without export restriction	R&S®GS4100A
Radio software, with export restriction	R&S®GS4100D
Hardware options	
48 kHz line interface	R&S®GI4104
Digital line interface	R&S®GI4107
NMEA (DSC) interface	R&S®GS4102

Your local Rohde&Schwarz expert will help find the best solution for you.
Contact your local Rohde&Schwarz sales office for more information, www.sales.rohde-schwarz.com.

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Service at Rohde&Schwarz
You're in great hands

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

Rohde&Schwarz

The Rohde&Schwarz technology group is among the trailblazers when it comes to paving the way for a safer and connected world with its leading solutions in test&measurement, technology systems and networks&cybersecurity. Founded 90 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

Sustainable product design

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

Certified Quality Management ISO 9001

Certified Environmental Management ISO 14001

Certified Quality Management AQAP-2110

Certified Information Security Management ISO 27001

Rohde&Schwarz training
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Rohde&Schwarz customer support
www.rohde-schwarz.com/support

PD 3683.4155.12 | Version 03.00 | August 2024 (st)
R&S®SK41xx HF High-Power Transmitters
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