

R&S® PKU100 Ku BAND SATELLITE UPLINK AMPLIFIER

Unique signal quality in a
compact, lightweight design



Product Brochure
Version 06.00

ROHDE & SCHWARZ

Make ideas real



AT A GLANCE

The R&S®PKU100 is a family of solid-state power amplifiers for the Ku band with RF peak power of 400 W and 750 W. It features outstanding efficiency in an extremely compact design. The powerful optional adaptive digital linearization improves the RF parameters to an extent previously not attainable. As a result, this amplifier family combines the advantages of solid-state and tube amplifiers.

Rohde & Schwarz has decades of experience in developing amplifiers for sound and TV broadcast transmitters and broadband applications. All of this expertise went into the development of the Ku band amplifier family. Amplifiers from Rohde & Schwarz are rugged and built for high availability. They are series produced at the Rohde & Schwarz Teisnach plant in Germany – one of Europe's most advanced production facilities.

The GaN based R&S®PKU100 amplifiers are available for the 12.75 GHz to 13.25 GHz and 13.75 GHz to 14.5 GHz frequency bands with RF peak power of 400 W and 750 W. Both the indoor and the outdoor models are extremely compact and easy to service. They offer efficiency otherwise only attained by tube amplifiers.

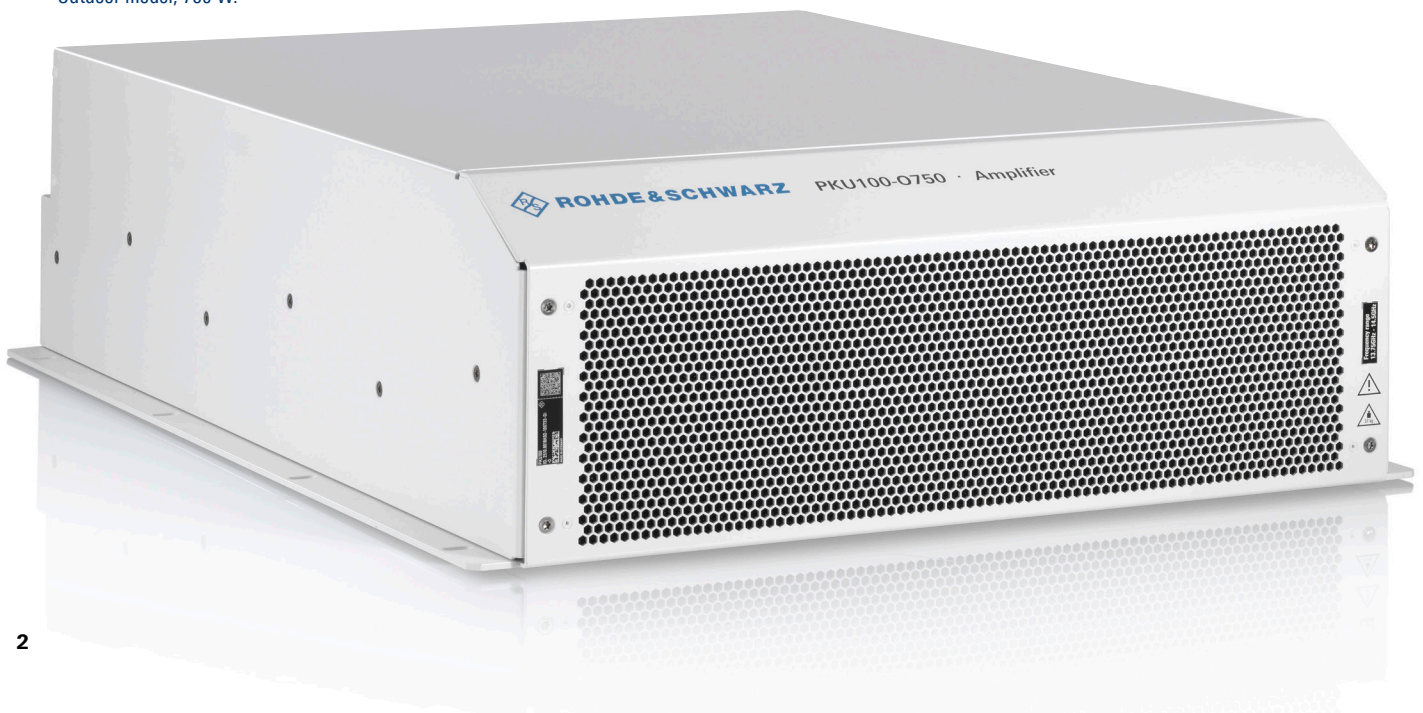
Featuring unique, optional adaptive digital linearization, the amplifiers achieve excellent signal quality. When fed with L band signals, an optional integrated upconverter converts these signals to the Ku band.

Optional power supply redundancy ensures high amplifier availability in case a power supply fails. If individual transistors fail, the amplifier will continue to operate. Even amplifier redundancy configurations can be implemented with a software control option.

The amplifiers are easy to integrate into network environments using SNMP. For manual control, the amplifier operating parameters and settings can be conveniently accessed via the amplifier's operating panel or a web based GUI.

An optional air ducting kit is available for indoor models. The kit is connected to an existing ventilation system at the customer's site and allows the amplifier to be operated in rooms without dedicated air conditioning. This enables the use of gaseous fire extinguishing agents, since the air ducting kit is firmly attached to the amplifier and cannot be removed.

Outdoor model, 750 W.



KEY FACTS

- ▶ Frequency ranges from 12.75 GHz to 13.25 GHz and 13.75 GHz to 14.5 GHz
- ▶ Indoor and outdoor models with RF peak power of 400 W or 750 W
- ▶ GaN technology
- ▶ Adaptive linearization
- ▶ Upconverter for L band signal feeding
- ▶ Convenient power supply redundancy

BENEFITS

Combined benefits of solid-state and tube technologies

- ▶ Continued operation even if individual power transistors fail
- ▶ High efficiency
- ▶ Compact and lightweight
- ▶ [page 4](#)

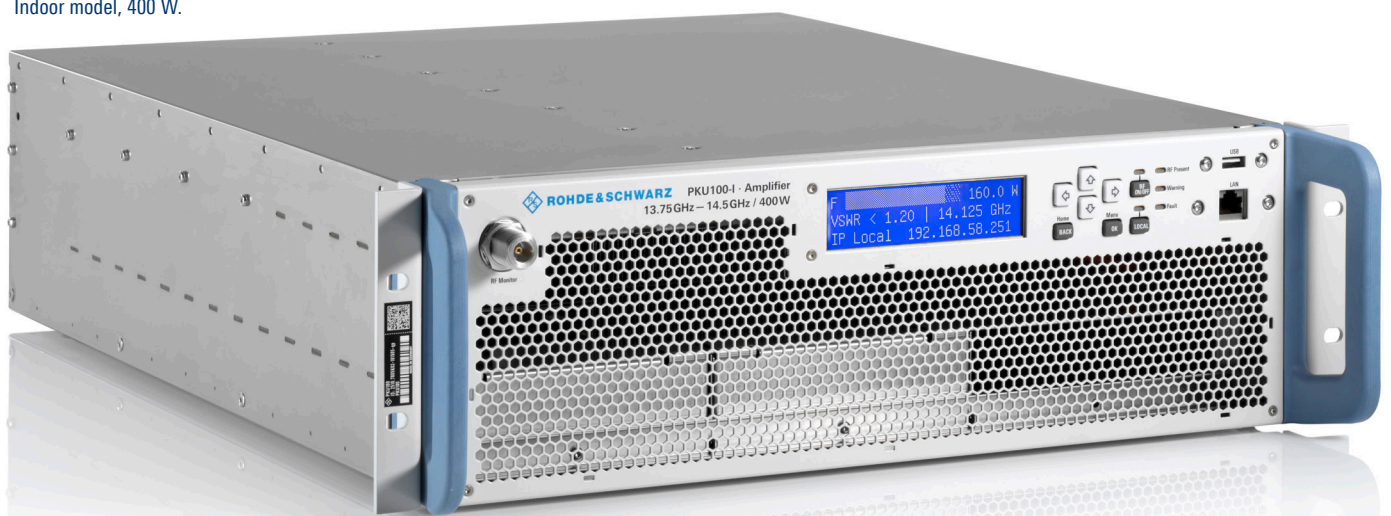
Flexible options for diverse applications

- ▶ Adaptive linearization for excellent signal quality
- ▶ Upconverter for L band signal feeding
- ▶ Extremely high output frequency accuracy
- ▶ Air ducting kit for R&S®PKU100 indoor models
- ▶ Convenient power supply redundancy and optional DC power supply
- ▶ Innovative amplifier redundancy configurations
- ▶ [page 6](#)

Versatile control options

- ▶ Operation via web GUI over Ethernet
- ▶ Remote control over Ethernet using SNMP
- ▶ Configurable parallel remote interface
- ▶ RS-232 and RS-485 serial interfaces
- ▶ [page 9](#)

Indoor model, 400 W.



COMBINED BENEFITS OF SOLID-STATE AND TUBE TECHNOLOGIES

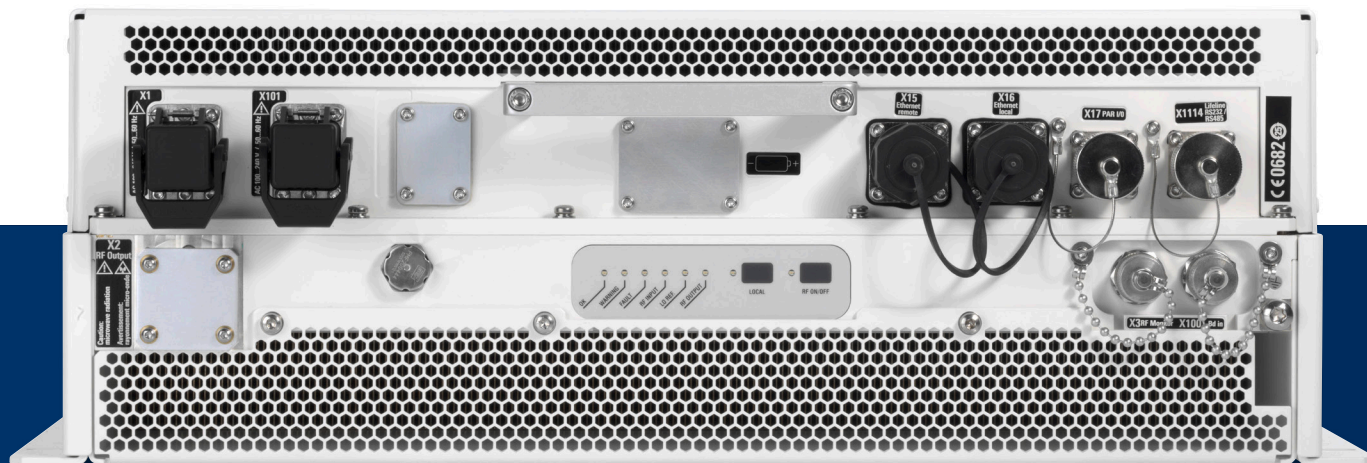
Thanks to their solid-state design, R&S®PKU100 amplifiers offer all of the well-known advantages of transistor over tube technology:

- ▶ Ready for use within a minimum of time
- ▶ Energy-efficient amplifier redundancy since the standby amplifier need not be operated in hot-standby mode
- ▶ Stable despite temperature fluctuations, long lifetime
- ▶ Reliable and easy to put into operation

Continued operation even if individual power transistors fail

R&S®PKU100 amplifiers will continue operating even if individual transistors fail – a distinct advantage over tube amplifiers. If individual transistors fail, the amplifier will continue operating at reduced output power. For example, if one fourth of its power transistors fail, the R&S®PKU100 will still deliver more than 50% of its maximum output power. The output power is automatically adjusted to the maximum possible output power. If the required output power is less than the maximum possible output power after a transistor failure, the amplifier's performance will not be affected.

Outdoor model, 750 W, rear view.



High efficiency

The R&S®PKU100 amplifiers deliver outstanding efficiency – even compared to tube amplifiers. Peak efficiency is higher than 20%. QPSK efficiency is typically > 14% at nominal output power. These values refer to the efficiency of the amplifier as a whole. They are calculated as the ratio of the RF output power present at the flange to the AC power consumed (including the power required for the fans and control unit). For conventional amplifiers, efficiency is commonly specified as the efficiency of a single transistor or tube stage – without taking into account the losses incurred in the power combiners, power supplies, fans and control unit.

Compact and lightweight

The R&S®PKU100 amplifiers are just as compact and lightweight as tube amplifiers. The 400 W and 750 W indoor models for installation in 19" racks are only three rack units high. Weighing just 18.3 kg and 25 kg, respectively, they are considerably lighter and more compact than comparable solid-state amplifiers.

The compact 400 W and 750 W outdoor models, weighing 23 kg and 35 kg, respectively, can be mounted directly on the antenna. They are rugged and weatherproof in line with IP65. They offer the same advantages as the indoor models over tube amplifiers and conventional solid-state amplifiers.

Both models contain redundant, hot-swappable fans. If a fan fails, the amplifier can continue operating within a limited temperature range. Depending on the ambient temperature and the required output power, the output power may be momentarily reduced when a fan is replaced.

Indoor model, 400 W, rear view.



FLEXIBLE OPTIONS FOR DIVERSE APPLICATIONS

Adaptive linearization for excellent signal quality

The R&S®PKU100 amplifiers are the first of their kind to offer adaptive linearization at the RF level. This option makes it possible to achieve previously unattained spectral purity, allowing full exploitation of the amplifier's potential.

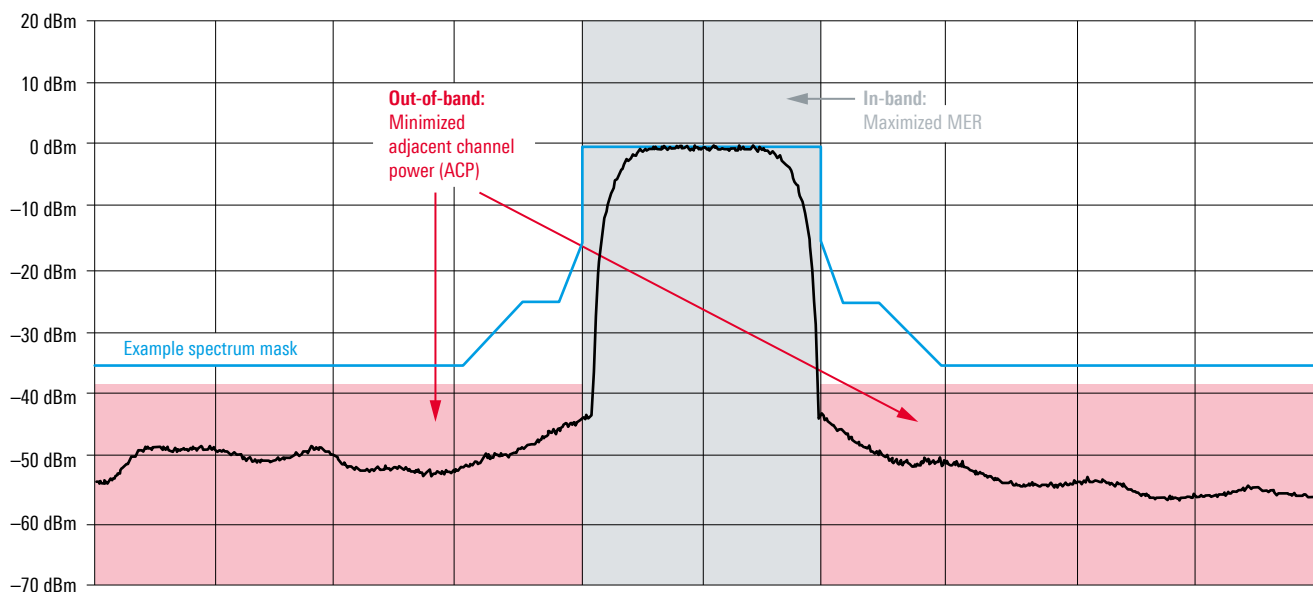
Adaptive linearization modifies the input signal to optimally compensate for nonlinearities in the amplifier. This significantly increases signal quality in the uplink both inside and outside the wanted signal's bandwidth. Inside the signal bandwidth, the error vector magnitude (EVM) and the modulation error ratio (MER) are substantially improved. Outside the signal bandwidth, the shoulder attenuation is increased, which improves the adjacent channel leakage ratio (ACLR).

Thanks to adaptive linearization, R&S®PKU100 amplifiers are well suited for use with the higher-order modulation schemes defined in the DVB-S2X standard.

If adaptive linearization is active, linearization automatically adapts in the event of an output power or frequency change. The adaptive linearization option can be used for signal bandwidths up to 100 MHz and is available for and L band signal feeding.

Excellent signal quality

The R&S®PKU100 is well suited for use with higher-order modulation schemes. The adaptive linearization feature from Rohde & Schwarz seamlessly improves the purity of the RF output signal.



Upconverter for L band signal feeding

Line losses are relatively high in the Ku band owing to the high frequencies. Consequently, signals are typically fed to the amplifier in the L band, which involves lower losses. An optional upconverter, which is available for all amplifier models, converts the frequency to the Ku band.

Extremely high output frequency accuracy

When signals are fed in the L band, a reference frequency is required for upconversion to the Ku band. An external 10 MHz reference signal can be supplied, or an optional oven-controlled crystal oscillator (OCXO) can be used. The OCXO can be synchronized to the external 10 MHz reference signal to ensure continued high stability of the output frequency in the Ku band in the event the external reference fails.

Air ducting kit for R&S®PKU100 indoor models

The R&S®PKx-B100 air ducting kit provides the amplifier with a controlled air supply from an independent air intake system at the customer's site. It also enables the controlled discharge of heated exhaust air into an independent exhaust air system. Further elements such as auxiliary fans and cooled intake air must be provided on site.

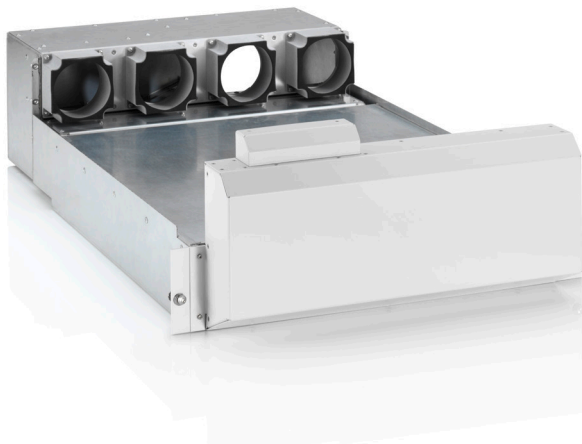
The air ducting kit is designed for installation in commercial 19" racks and intended for stationary use only. It is supplied as a separate item and is attached on site to the R&S®PKU100 and connected to the customer's ventilation system.

Convenient power supply redundancy and optional DC power supply

Power supply redundancy is offered as an option. The power supplies can be fed individually from different power networks. If a power network or power supply fails, the R&S®PKU100 continues to run at full power without interruption. Thanks to the quick-release connections, defective power supplies in the indoor models can be replaced quickly and easily without interrupting amplifier operation.

The R&S®PKU100 can also be operated from a 48 V DC source. This is important for mobile applications or when the amplifier needs to be temporarily powered from a battery.

Air ducting kit for installation in 19" racks.



The air ducting kit is firmly attached to the R&S®PKU100.



Innovative amplifier redundancy configurations

The R&S®PKU100 offers two different redundancy configurations:

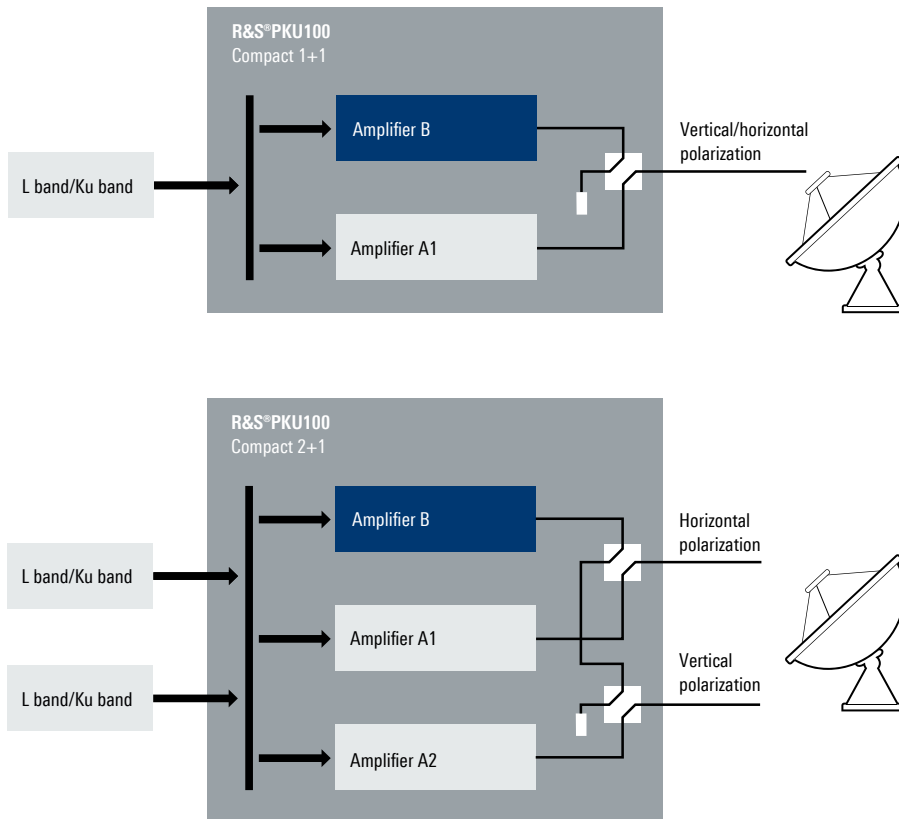
- ▶ Compact 1+1
- ▶ Compact 2+1

In a Compact 1+1 system, two R&S®PKU100 operate in a fully symmetrical 1+1 configuration. The two units monitor each other, making extra hardware for system monitoring and control unnecessary. Doing away with a separate, governing control unit eliminates the risk of a single point of failure. Compact 1+1 systems require considerably less space than conventional 1+1 configurations, which deploy an external control unit.

Compact 2+1 is an enhanced version of the well-known 1+1 configuration. It requires no extra hardware for system monitoring and control. These functions are performed by the standby amplifier. The standby amplifier in a Compact 2+1 configuration is automatically adjusted to the settings of the active amplifiers. If an active amplifier fails, the standby amplifier takes over with virtually no interruption of transmission. Likewise, in the event a standby amplifier needs to be replaced, the new standby amplifier reads the settings from the active amplifiers, which continue operating.

Both the Compact 1+1 and the Compact 2+1 configuration support control of 12 V, 24 V and 48 V waveguide switches. This is enabled by a software feature that also allows control of additional switches that may be located very close to the antenna.

R&S®PKU100 amplifier redundancy configurations



VERSATILE CONTROL OPTIONS

Operation via web GUI over Ethernet

The integrated web GUI is accessed via LAN using a web browser (Chrome recommended). The graphical user interface allows convenient operation from a laptop connected directly to the amplifier or from a PC at a remote workstation.

Remote control over Ethernet using SNMP

The amplifiers can be integrated into a network management system using SNMP. The IP network address can be set manually or assigned via DHCP.

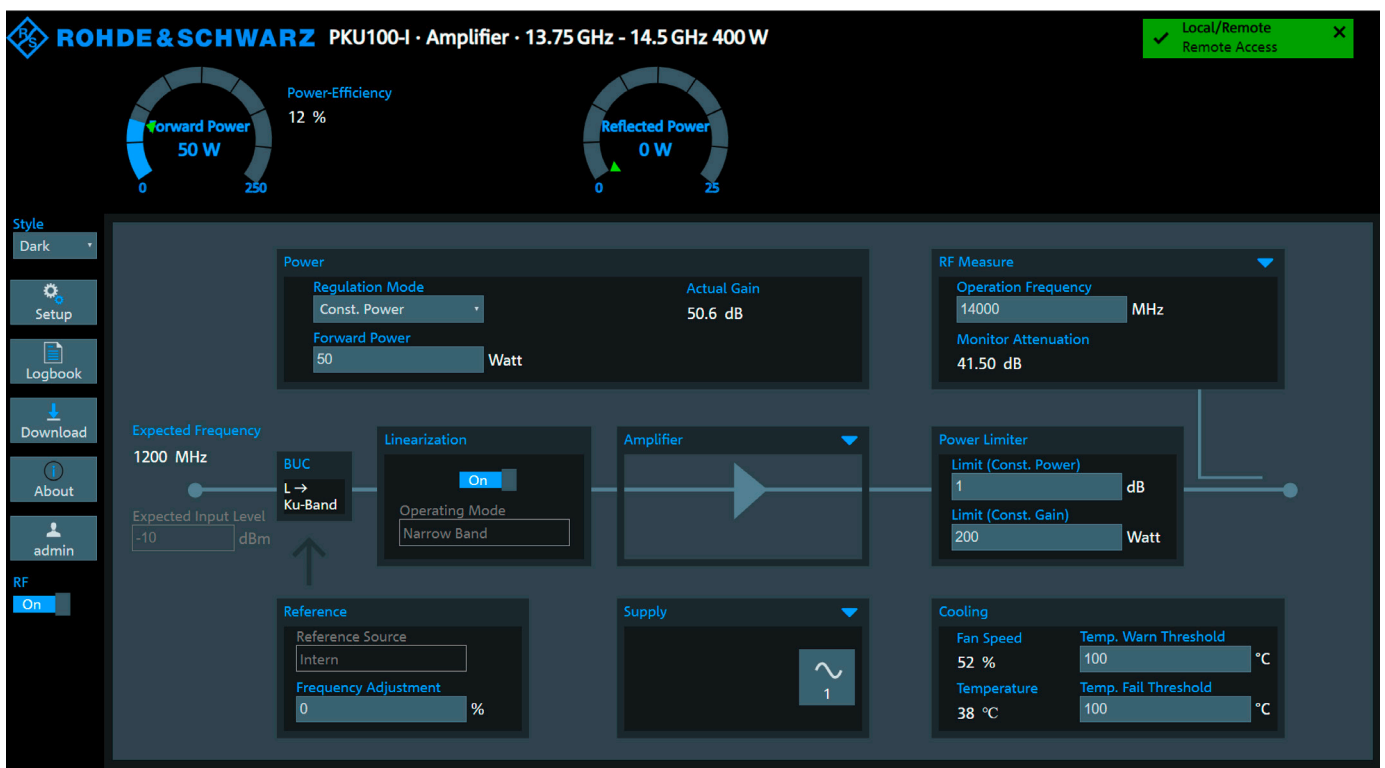
Configurable parallel remote interface

The parallel remote interface enables communications with the amplifiers using three messages and six commands. The messages and commands available on the interface can be individually configured.

RS-232 and RS-485 serial interfaces

The amplifiers come with RS-232 and RS-485 serial interfaces for data communications.

Amplifier status display in web based GUI.



SPECIFICATIONS

	400 W models	750 W models
RF specifications		
Output frequency		
Frequency range 1	12.75 GHz to 13.25 GHz	
Frequency range 2	13.75 GHz to 14.5 GHz	
Input frequency, SSPB (BUC)		
Frequency range 1	950 MHz to 1450 MHz (local oscillator frequency: 11.8 GHz)	
Frequency range 2	950 MHz to 1700 MHz (local oscillator frequency: 12.8 GHz)	
Output power at RF output		
P_{sat} (max.)	≥ 400 W	≥ 750 W
P_{avg} (max.)	≥ 180 W	≥ 350 W
QPSK P_{avg} (max.)	≥ 180 W ¹⁾	≥ 350 W ¹⁾
64APSK P_{avg} (max.)	≥ 180 W ¹⁾	≥ 350 W ¹⁾
Adaptive linearization	for signals with bandwidth < 100 MHz	
Adjacent channel power		
Without adaptive linearization	< -25 dBc	
With adaptive linearization	< -35 dBc, typ. -40 dBc	
Shoulder attenuation with P_{avg}		
Without adaptive linearization	nom. ≥ 22 dB, typ. ≥ 25 dB	
With adaptive linearization	nom. ≥ 33 dB, typ. ≥ 40 dB	
MER with adaptive linearization for a QPSK signal	> +30 dB	
Constant output power mode		
Two-tone intermodulation without adaptive linearization	at P_{avg} (max.), $\Delta f < 50$ MHz: typ. < -25 dBc, nom. < -23 dBc	
Output power setting range referred to P_{avg} (nom.)	-13 dB to +0.5 dB	
Power stability		
Within indoor temperature range	±0.5 dB	
Within outdoor temperature range	±1 dB	
Control range	0 dB ± 3 dB (default setting), nominal value configurable from ±2 dB to ±6 dB	
Constant gain mode		
Maximum gain	73 dB	76 dB
Gain adjustment range	25 dB ±0.5 dB	
Gain stability at constant temperature over 24 h	<ul style="list-style-type: none"> ▶ SSPA: ±0.3 dB ▶ SSPB or SSPA with adaptive linearization: ±0.4 dB 	
Gain stability in specified temperature range	<ul style="list-style-type: none"> ▶ SSPA, indoor model: ±1.5 dB ▶ SSPA, outdoor model: ±2.5 dB ▶ SSPB or SSPA with adaptive linearization, indoor model: ±2.0 dB ▶ SSPB or SSPA with adaptive linearization, outdoor model: ±3.0 dB 	
Frequency response over full frequency band	±3 dB	
Frequency response in RF channel	±0.3 dB	up to ±0.75 dB
Input power, QPSK P_{avg}	-20 dBm to 0 dBm	
Maximum input power, P_{avg}	≤ +13 dBm	
VSWR at L band input, $Z_0 = 50 \Omega$	< 1.5:1	
VSWR at Ku band input, $Z_0 = 50 \Omega$	< 2:1	
VSWR at RF output	≤ 1.3:1; power reduction starting at (1.6 ± 0.3):1	
AM/PM conversion	< 2°/dB	
Harmonics at P_{avg} (max.)	< -50 dBc	< -55 dBc
Coupling factor for RF monitor output at center of band referred to RF output power, exact value stored in amplifier	-43 dB	-46 dB
Noise power density		
In transmit band	< -65 dBm (1 Hz)	
In receive band (10.7 GHz to 11.7 GHz)		
Frequency range 1	< -150 dBm (1 Hz)	
Frequency range 2	< -160 dBm (1 Hz)	

	400 W models	750 W models
Group delay		
Linear		0.025 ns/MHz
Parabolic		0.015 ns/MHz
Ripple within 72 MHz		1 ns (peak-to-peak)
Ripple over full frequency band		2 ns (peak-to-peak)
SSPB (BUC)		
Spurious		< -65 dBc
Phase noise (internal reference)		
10 Hz		< -50 dBc, typ. < -60 dBc
100 Hz		< -65 dBc, typ. < -70 dBc
1 kHz		< -75 dBc, typ. < -78 dBc
10 kHz		< -85 dBc, typ. < -90 dBc
100 kHz		< -95 dBc, typ. < -100 dBc
1 MHz		< -105 dBc, typ. < -115 dBc
Required reference frequency	10 MHz with external bias tee, alternatively internal reference OCXO	
RF and monitor ports		
RF output	waveguide, WR75	
RF input	N	
RF monitor ports	N	
Operation		
Local operating panel		
Web GUI over Ethernet	RJ-45, 10/100 Mbit/s, autosense, half/full duplex	
Network management via SNMP and Ethernet	RJ-45, 10/100 Mbit/s, autosense, half/full duplex	
Parallel remote interface (optional)	floating contacts for 6 commands and 3 messages, configurable	
Serial interfaces	RS-232, RS-485, full duplex	
General data		
Operating voltage	100 V to 240 V AC + 10%, single phase; 50 Hz to 60 Hz + 6%; optional: -48 V DC, -40 V to -57 V	
Power consumption		
At 230 V AC, MER max. 30 dB, QPSK, including fans	nom. < 1500 VA, typ. 1300 VA	nom. < 2800 VA, typ. 2500 VA
QPSK efficiency at nominal power	nom. > 13%, typ. > 14%	nom. > 12.5%, typ. > 13.5%
Peak efficiency at P_{sat}	> 20%	
Dimensions (W × H × D)		
Indoor models	19" × 3 RU × 550 mm (19" × 3 RU × 21.7 in)	
Outdoor models	355 mm × 171 mm × 638 mm (14.0 in × 6.7 in × 25.1 in)	515 mm × 171 mm × 638 mm (20.3 in × 6.7 in × 25.1 in)
Weight (without backup power supply)		
Indoor models	18.3 kg (40.3 lb)	25 kg (55 lb)
Outdoor models	23 kg (51 lb)	35 kg (82 lb)

	Indoor models	Outdoor models
Ambient conditions		
Temperature range		
Operating temperature	+1 °C to +45 °C (at 2000 m above sea level) +1 °C to +40 °C (at 3000 m above sea level)	-40 °C to +55 °C (at 2000 m above sea level) -40 °C to +50 °C (at 3000 m above sea level)
Storage temperature	-40 °C to +85 °C	
Humidity	max. +40 °C at 95% rel. humidity, noncondensing: 100%	
Height above sea level	up to 3000 m	up to 3000 m
Protection class	IP40	IP65
Shock	40 g/11 ms, in line with MIL-STD-810E method 516.4	
Vibration, random	10 Hz to 300 Hz, acceleration 1.2 g (RMS)	
Vibration, sinewave	5 Hz to 150 Hz, max. 1.8 g at 55 Hz, max. 0.5 g at 55 Hz to 150 Hz, in line with EN60068-2-6, EN61010-1	

¹⁾ Predistorted (MER and channel dependent).

ORDERING INFORMATION

Designation	Type	Order No.
Indoor base unit, 400 W, 3 RU rack model	R&S®PKU-I400	2510.7005.41
Outdoor base unit, 400 W, outdoor housing	R&S®PKU-O400	2510.8001.41
Indoor base unit, 750 W, 3 RU rack model	R&S®PKU-I750	2510.7005.81
Outdoor base unit, 750 W, outdoor housing	R&S®PKU-O750	2511.6002.81
Hardware options		
Adaptive linearization for amplifier with Ku band input, indoor model, 400 W	R&S®PKU-B040	2510.9420.40
Adaptive linearization for amplifier with Ku band input, outdoor model, 400 W	R&S®PKU-B040	2511.6925.40
Adaptive linearization for amplifier with Ku band input, indoor model, 750 W	R&S®PKU-B075	2510.9420.75
Adaptive linearization for amplifier with Ku band input, outdoor model, 750 W	R&S®PKU-B075	2511.6925.75
Upconverter for amplifier with L band input, indoor models	R&S®PKU-B200	2510.9420.02
Upconverter for amplifier with L band input, outdoor model, 400 W	R&S®PKU-B200	2511.6925.02
Upconverter for amplifier with L band input, outdoor model, 750 W	R&S®PKU-B250	2511.6925.50
RF monitor ports, rear	R&S®ZRK-SR	2510.9466.00
RF monitor ports, front	R&S®ZRK-SF	2510.9437.00
Air filter for indoor model	R&S®PKx-B110	2510.9495.02
Air ducting kit, intake and exhaust air, indoor model, 400 W	R&S®PKx-B100	2513.1008.02
Air ducting kit, intake and exhaust air, indoor model, 750 W	R&S®PKx-B100	2513.1008.03
Air ducting kit, exhaust air, indoor model, 400 W	R&S®PKx-B100	2513.1008.04
Air ducting kit, exhaust air, indoor model, 750 W	R&S®PKx-B100	2513.1008.05
Air filter for air ducting kit	R&S®PKx-B111	2513.1708.02
Hardware option for control of waveguide relays up to 48 V DC	R&S®PKx-B50	2514.8935.02
Software options		
OCXO	R&S®PKU-K01	2510.9772.02
Adaptive linearization for amplifiers with L band input, 400 W	R&S®PKU-K40	2510.9789.02
Adaptive linearization for amplifiers with L band input, 750 W	R&S®PKU-K75	2510.9795.02
Software option for amplifier redundancy switching, required per R&S®PKU100	R&S®PKx-K10	2514.8941.02
Service options		
Service level agreement BASIC during warranty period for R&S®PKU100, incl. factory repairs, technical support, software updates and access to Rohde&Schwarz Support Desk	R&S®SBWPKU	2510.7486.76
Service level agreement BASIC, 1 year, for R&S®PKU100, incl. factory repairs, technical support, software updates and access to Rohde&Schwarz Support Desk	R&S®SB1PKU	2510.7486.02
Service level agreement BASIC, 2 years, for R&S®PKU100, incl. factory repairs, technical support, software updates and access to Rohde&Schwarz Support Desk	R&S®SB2PKU	2510.7486.03
Service level agreement BASIC, 3 years, for R&S®PKU100, incl. factory repairs, technical support, software updates and access to Rohde&Schwarz Support Desk	R&S®SB3PKU	2510.7486.04
Service level agreement BASIC, 4 years, for R&S®PKU100, incl. factory repairs, technical support, software updates and access to Rohde&Schwarz Support Desk	R&S®SB4PKU	2510.7486.05

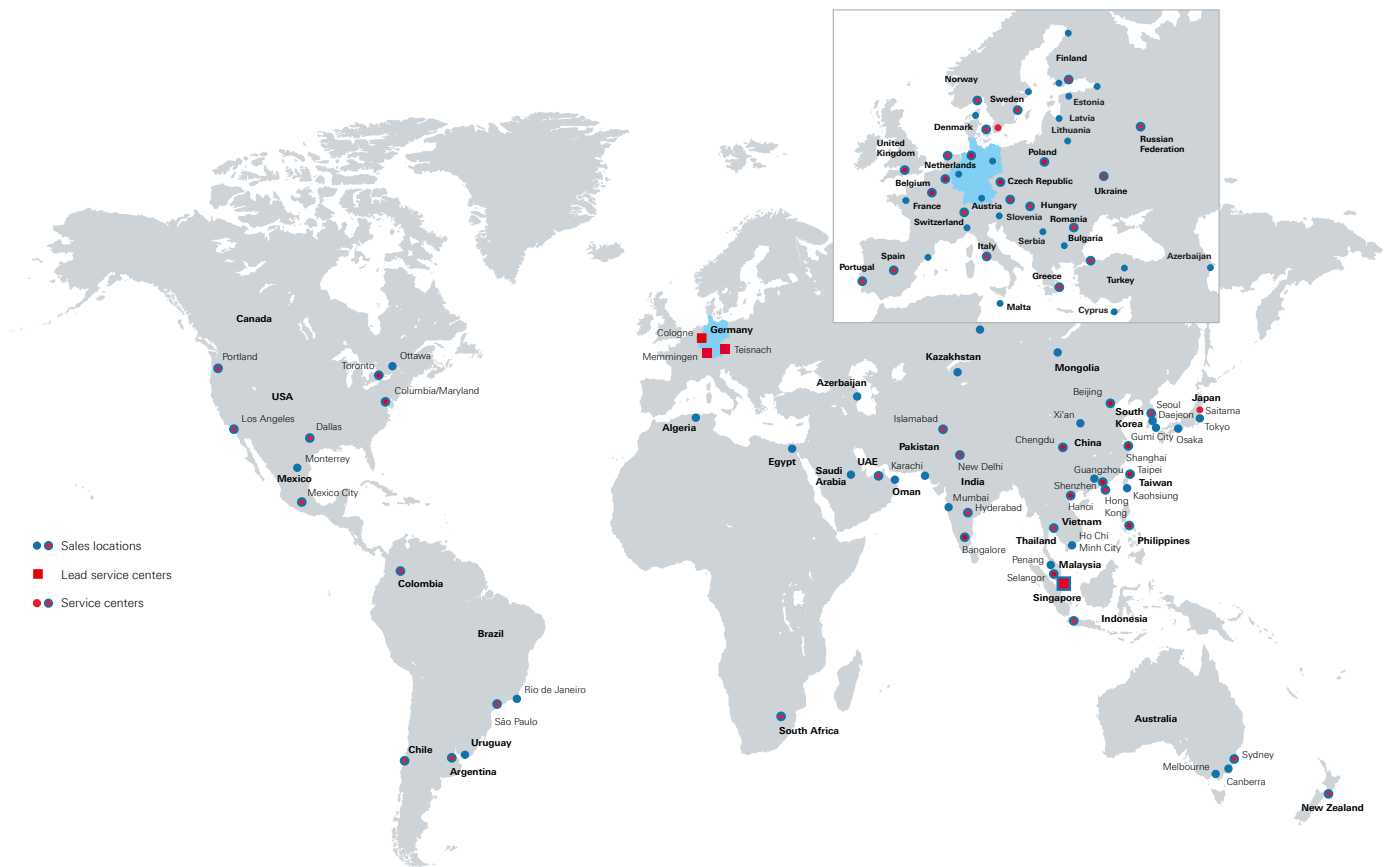
Your local Rohde & Schwarz expert will help you determine the optimum solution for your requirements. To find your nearest Rohde & Schwarz representative, visit www.sales.rohde-schwarz.com

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- ▶ Technical startup/application development/integration
- ▶ Training
- ▶ Operation/calibration/repair



Service that adds value

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

Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, 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

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