

# R&S® BBL200

## Broadband Amplifier

### Liquid-cooled power amplifiers for high field strengths



# R&S®BBL200 Broadband Amplifier At a glance

The R&S®BBL200 broadband amplifiers are ideal for applications requiring high RF power. The R&S®BBL200 broadband amplifiers generate 3 kW, 5 kW and 10 kW of power in a frequency range from 9 kHz to 225 MHz. They are liquid-cooled, solid-state, highly rugged, quiet and efficient. Precise monitoring of all runtime parameters ensures maximum robustness and reliability.



The R&S®BBL200 broadband amplifiers from 9 kHz to 225 MHz open up applications requiring high field strengths and high amplifier power. Especially in EMC environments, they easily fulfill typical requirements as specified by relevant standards as well as those resulting from the physical characteristics of the antennas being used. This includes outstanding performance at 1 dB compression and high mismatch tolerance. The amplifiers are designed for continuous operation and deliver constant power even under mismatch conditions.

The advanced and robust, fully solid-state RF design offers many benefits. Sufficient power margins and efficient monitoring of all amplifier runtime parameters are the basis for smooth operation at high RF powers.

The R&S®BBL200 broadband amplifiers are liquid-cooled, which makes them compact and relatively quiet. The pump units, compression tanks and amplifier components are all located in the rack; only the compact heat exchanger needs to be located separately. This has the advantage that the bulk of the waste heat can be dissipated outside the amplifier room. All of the liquid cooling components are already in use in Rohde&Schwarz high-power TV transmitters. Thousands of these transmitters have been in operation worldwide for years, offering unparalleled reliability.

The R&S®BBL200 amplifier family's modular design makes it easy, for example, to remove amplifier plug-ins. The liquid cooling system does not pose any problems when amplifier modules are exchanged. Self-connecting and self-shutting valves reliably ensure perfect sealing, even during maintenance and service.

## Key facts

- Frequency range from 9 kHz to 225 MHz
- 3000 W, 5000 W and 10000 W output power
- 100 % mismatch tolerance
- Designed for continuous operation even under mismatch conditions
- Liquid-cooled, compact and quiet
- For amplitude, frequency, phase and pulse modulation
- Class A amplifier
- Three year warranty and flexible service level agreements

# R&S®BBL200

## Broadband Amplifier

### Benefits and key features

#### **The most advanced high-power amplifier on the market**

- ▮ Sophisticated RF design
- ▮ Compact and quiet thanks to liquid cooling
- ▮ Series production

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#### **Reliable with high availability**

- ▮ Outstanding expertise in amplifier development
- ▮ Cost benefit due to low downtime
- ▮ Rugged even under mismatch conditions

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#### **Flexible control and operation**

- ▮ Manual operation
- ▮ Local and remote operation via web browser and PC
- ▮ Ethernet or GPIB remote control
- ▮ Integration into the R&S®EMC32 EMC measurement software
- ▮ Safety thanks to two different interlocks

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#### **Excellent service and quick maintenance**

- ▮ Outstanding service concept
- ▮ Maximum investment protection through service level agreements
- ▮ From pre-sale to service – at your doorstep

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# The most advanced high-power amplifier on the market

Outstanding RF design plus high-quality series production in one of Europe's most progressive plants.

## Sophisticated RF design

The use of state-of-the-art design and simulation programs during development, the use of power semiconductors from internationally leading manufacturers and Rohde & Schwarz engineers' decades of experience in developing amplifiers produce the most advanced amplifier design currently available. Efficiency and ruggedness ensure smooth operation. Lean firmware with effective monitoring and protection mechanisms provides operational safety. Generous dimensioning of the RF amplifier stages provides sufficient margin and ensures compliance with warranted data sheet parameters.

## Compact and quiet thanks to liquid cooling

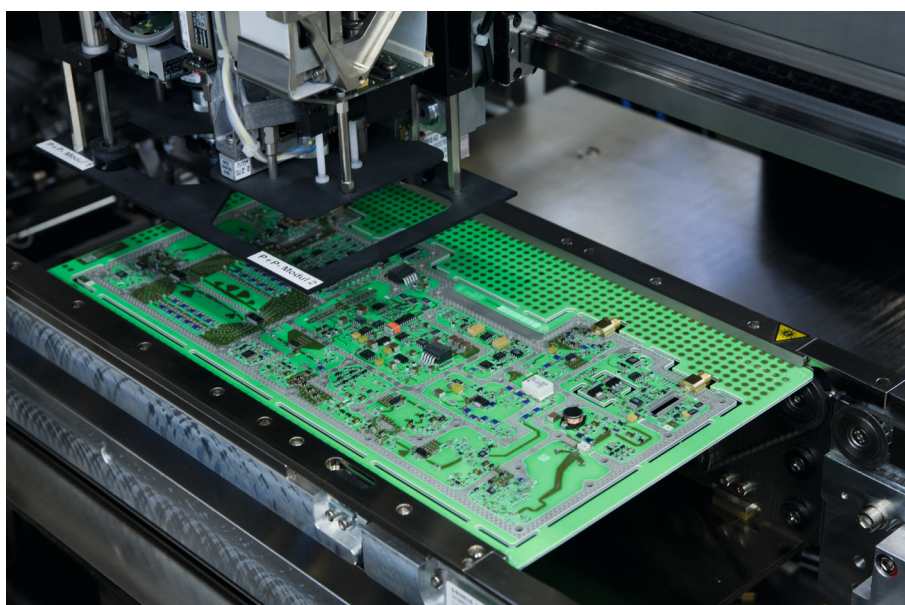
The mechanical concept of the R&S®BBL200 sets new standards. Liquid cooling of the amplifier modules makes the R&S®BBL200 amplifiers very quiet in comparison with completely air-cooled amplifiers. The combination of high-performance modules and efficient liquid cooling results in a compact design that is unparalleled in this power class. Despite the high power density, efficient module cooling ensures suitable temperatures in the amplifier rack. Waste heat is dissipated by a heat exchanger that can be located some distance from the amplifier. As a result, even with high amplifier output power only a relatively small air conditioning system is needed in the amplifier room. If a liquid cooling system is already available on site, a liquid-liquid heat exchanger can be used as an alternative. This allows operation regardless of the cooling medium in use.

## Series production in one of Europe's most advanced plants

The R&S®BBL200 broadband amplifiers are series-produced in one of Europe's most advanced plants. The multiple award-winning<sup>1)</sup> Rohde & Schwarz plant in Teisnach, Germany, offers superior manufacturing depth. From precision mechanical engineering and machining to printed board production and final assembly, all manufacturing steps are united under the same roof. Automated final test setups ensure that the Rohde & Schwarz plant delivers only specification-compliant products to its customers.

<sup>1)</sup> Awards received by the Rohde & Schwarz plant in Teisnach include:

- 2010 and 2014 Factory of the Year, Germany
- 2013 Best Factory, award winner of European industrial excellence competition
- 2014 Bavarian Quality Award
- 2016 Global Excellence in Operations (GEO) overall award winner, Germany



Automatic insertion of components into printed boards at Rohde & Schwarz.

# Reliable with high availability

Broadband amplifiers as reliable as the sound and TV broadcast transmitters from Rohde & Schwarz.



Europe's first VHF FM transmitter (built by Rohde & Schwarz in 1949) and the company's latest R&S®THR9 VHF FM transmitter.

## Outstanding expertise in amplifier development

The expertise gained over many years in the development of power amplifiers is based on the R&D work for Rohde & Schwarz sound and TV broadcast transmitters. All of the liquid cooling components were taken unmodified from Rohde & Schwarz high-power transmitters. Their reliability is well-known and a major reason for the company's global market leadership in digital terrestrial transmitter technology.

## Cost benefit due to low downtime

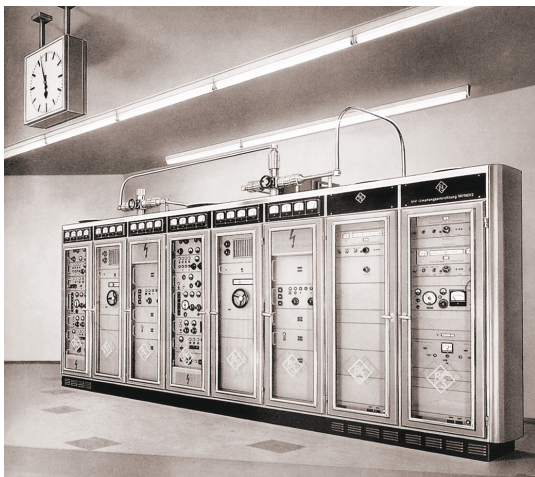
The market launches of the R&S®BBA100 broadband amplifier family in 2010 and the R&S®BBA150 family for the microwave range in 2013 underscore the Rohde & Schwarz claim to offer stable, reliable amplifiers for maximum customer benefit. Low downtime is an important economic factor. The new R&S®BBL200 broadband amplifiers with liquid cooling for high power now enhance the portfolio.

## Rugged even under mismatch conditions

The R&S®BBL200 broadband amplifiers have high mismatch tolerance and are rugged enough to handle an RF short circuit or open RF output. They are designed to constantly generate the specified power, even under mismatch conditions.

## Transfer of know-how

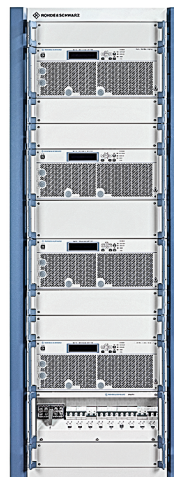
All the Rohde & Schwarz sound and TV broadcast transmitter manufacturing know-how has gone into the development of the broadband amplifiers.



1963:  
VHF radio transmitter with mit 2 × 5 kW



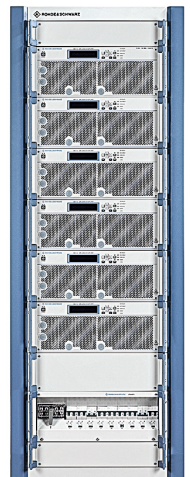
2010:  
R&S®BBA100  
broadband amplifier



2013:  
R&S®BBA150  
broadband amplifier



2014:  
R&S®BBL200  
broadband amplifier



2016:  
R&S®BBA130  
broadband amplifier

# Flexible control and operation

Operation of the R&S®BBL200 is always efficient, including local and remote control and operation via web GUI.

## Manual operation

The R&S®BBL200 is manually operated via the display and buttons directly on the instrument. This is ideal for use in an amplifier room, for example, to easily change settings. A clever menu structure provides straightforward access to all essential information and settings. During operation, RF output power, reflected power and VSWR are displayed.

## Local and remote operation via web browser and PC

The web GUI integrated into the R&S®BBL200 is called up via LAN and web browser. The R&S®BBL200 can be conveniently operated via its graphical user interface using a laptop near the instrument or a control workstation PC. A common web browser (e.g. Google Chrome, Mozilla Firefox, Microsoft Internet Explorer) is all that is needed.

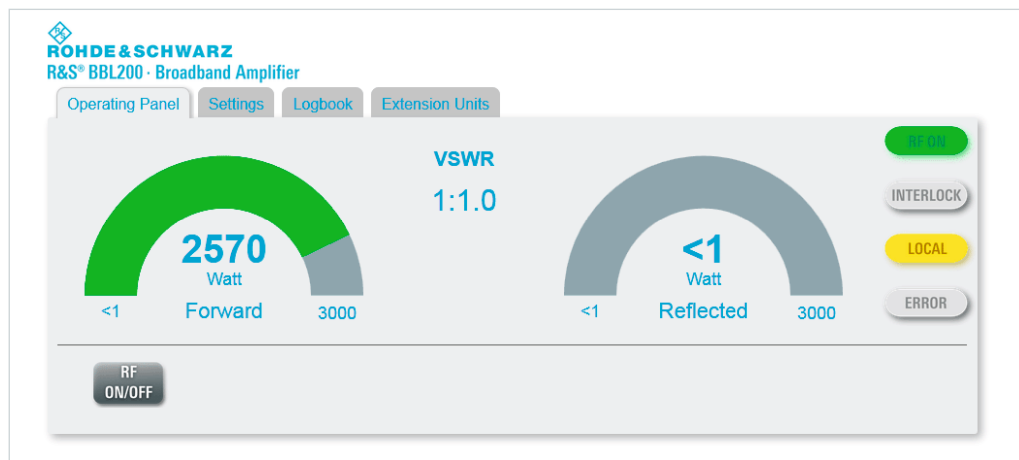
## Ethernet or GPIB remote control

The Ethernet interface makes it possible to automate test sequences with remote control commands in line with the SCPI nomenclature. TCP/IP networks are now standard for equipment networking and control; a separate infrastructure is no longer needed. To make integration especially easy, the R&S®BBL200 allows an IP network address to be set manually or assigned automatically via DHCP.

The tried and tested GPIB interface is another available option. This interface makes it easier to integrate the amplifier into existing GPIB laboratory networks. The remote control commands for all Rohde & Schwarz broadband amplifiers are identical, which simplifies control and integration.



Display and buttons on the R&S®BBL200 front panel.



Operating panel on the R&S®BBL200 web GUI.

## Integration into the R&S®EMC32 EMC measurement software

Complex EMC measurement scenarios almost always require the use of higher-level measurement and control software such as R&S®EMC32. The complete integration of the R&S®BBL200 into the EMC measurement software offers many different options for setting and controlling the amplifier for immunity measurements in line with common standards such as CISPR, IEC, ISO, EN, ETSI, VDE, FCC and ANSI.

## Safety thanks to two different interlocks

Two different interlocks are available. You can choose the one that best suits your application. The automatic device interlock is supplemented by a second, interactive interlock. The automatic device interlock restarts the amplifier without user interaction as soon as the interlock circuit is closed again. The interactive interlock requires user confirmation before RF power can be output again.



R&S®EMC32 EMC measurement software.

The screenshot shows the R&S BBL200 web GUI settings panel:

- Operating Panel:** Settings, Logbook, Extension Units
- Model:** A3000 - Base Unit (9k-225MHz, 3000W)
- Firmware Version:** SW:01.50,FPGA:01.03
- Serial Number:** 100225
- Gain:** 00.0 dB (Set Gain)
- Power unit:** Watt (selected), dBm
- Ethernet:** 1Gbit/s FD
- IP Address:** 192.168.002.229
- Subnet Mask:** 255.255.255.000
- DHCP:** On (selected), Off
- Buttons:** Set Network Configuration

Settings panel on the R&S®BBL200 web GUI.

# Excellent service and quick maintenance

Minimal downtime due to modular design and worldwide service.

## Outstanding service concept

Like the tried and tested R&S®BBA150 family, the R&S®BBL200 broadband amplifiers feature a modular design. Downtime is minimized when problems arise since components can be replaced faster. For example, amplifier plug-ins and power couplers can be replaced on site with little effort. The liquid cooling is also straightforward. Self-shutting valves reliably ensure perfect sealing even when components are temporarily removed.

Spare parts are available worldwide. Parts are usually exchanged at the local Rohde&Schwarz office or the nearest service center. If the problem cannot be eliminated at the local service center, the instrument will be repaired at the plant.

## Maximum investment protection through service level agreements

Service level agreements and options ensure the operational readiness and availability of the R&S®BBL200 broadband amplifier at a reasonable, plannable cost of ownership even beyond the three-year warranty period.

## From pre-sale to service – at your doorstep

Rohde & Schwarz is a technology group of companies with a global presence. More than 9000 employees maintain direct customer contact in over 70 countries. The Rohde & Schwarz service network ensures optimum on-site support by highly qualified experts. User risks are reduced to a minimum at all stages of the project:

- Solution finding/purchase
- Technical startup/application development/integration
- Training
- Operation/calibration
- Service, support and maintenance

Rohde&Schwarz can offer all customers a customized solution tailored to their requirements.





# Specifications in brief

Specifications in brief		
<b>RF data</b>		
Frequency range		9 kHz to 225 MHz instantaneously
Nominal output load		50 Ω
Nominal power		3000 W (64.8 dBm), 5000 W (67 dBm), 10000 W (70 dBm)
Modulation capability		AM, FM, φM, PM
Nominal power gain	3000 W model	68.2 dB
	5000 W model	70.4 dB
	10000 W model	73.4 dB
Gain flatness		±3.0 dB
Gain adjustment range		> 15 dB
Harmonics	3000 W model 9 kHz to 110 MHz                      at 3000 W 110 MHz to 225 MHz                    at 2800 W	< -20 dBc
	5000 W model 9 kHz to 110 MHz                      at 5000 W 110 MHz to 225 MHz                    at 3500 W	< -20 dBc
	10000 W model 9 kHz to 110 MHz                      at 10000 W 110 MHz to 225 MHz                    at 8000 W	< -20 dBc
Spurious	carrier offset > 100 kHz, starting at 1 MHz	-80 dBc (nom.), max. -70 dBc
Noise figure	at maximum gain	
	5 kHz to 50 MHz	< 16.0 dB (nom.)
	50 MHz to 225 MHz	< 9.0 dB (nom.)
Nominal input impedance		50 Ω
Input level for nominal output power		-3.4 dBm
Input VSWR	into 50 Ω	max. 2:1
Maximum input level	RF	+5 dBm
	DC	0 V
Nominal output impedance		50 Ω
Nominal forward output power	at VSWR < 6:1	continuous, without foldback
	at VSWR > 6:1	continuous, with gradual foldback to approx. 50 % of output power depending on load impedance
Output mismatch protection, VSWR		100%, without damage
<b>RF sample and detected RF sample signals</b>		
RF sample signal coupling factor	RF forward and reflected sample ports, optional	approx. 70 dB (see test report for details)
Detected sample signal level	detected forward and reflected sample ports, optional	to 3.0 V DC (see test report for details)
<b>Mechanical specifications of amplifier system</b>		
Dimensions	rack setup, W × H × D, incl. handles, stands and crane lugs	
	3000 W model	600 mm × 1570 mm × 1100 mm (23.62 in × 61.81 in × 43.31 in)
	5000 W model	600 mm × 2050 mm × 1100 mm (23.62 in × 80.71 in × 43.31 in)
	10000 W model	1200 mm × 2050 mm × 1100 mm (47.24 in × 80.71 in × 43.31 in)
<b>Mechanical specifications of heat exchanger</b>		
Dimensions	W × H × D, incl. handles and stands	
	3000 W model	1241 mm × 558 mm × 400 mm (48.86 in × 21.97 in × 15.75 in)
	5000 W model	1125 mm × 925 mm × 600 mm (44.29 in × 36.42 in × 23.62 in)
	10000 W model	2400 mm × 1150 mm × 600 mm (94.49 in × 45.27 in × 23.62 in)
<b>Connectors</b>		
Connecting plate at rack top cover or at bottom of rear panel	RF input port	N female
	sample ports, for RF or detected RF	N female
	Ethernet	RJ-45
	interlock	WAGO X-COM®, 7-pin, female
	amplifier state	WAGO X-COM®, 7-pin, female
	transparent I/O, optional	2 × WAGO X-COM®, 7-pin, female

Specifications in brief		
RF output port	rear panel, bottom	1 5/8" EIA female
Mains power	rear panel, bottom	
	3000 W model	5 × 4 mm <sup>2</sup> power cord
	5000 W model	5 × 10 mm <sup>2</sup> power cord
	10000 W model	5 × 16 mm <sup>2</sup> power cord
Coolant supply		rack top cover, rear panel or rack shelf
<b>Electrical specifications of amplifier system</b>		
Nominal operating voltage ranges	3000 W model, 5000 W model, 10000 W model	380 V to 415 V AC ± 10%, three-phase with N, 50 Hz to 60 Hz ± 6%
	3000 W model, 5000 W model	208 V to 240 V AC ± 10%, three-phase, 50 Hz to 60 Hz ± 6%
Nominal current	3000 W model, at 230 V, per phase	< 20.5 A
	5000 W model, at 230 V, per phase	< 35 A
	10000 W model, at 230 V, per phase	< 72 A
Nominal power	3000 W model, $RF_{cw} = 3000$ W (RMS), VSWR = 1	< 14.2 kVA
	5000 W model, $RF_{cw} = 5000$ W (RMS), VSWR = 1	< 24 kVA
	10000 W model, $RF_{cw} = 10000$ W (RMS), VSWR = 1	< 50 kVA
<b>Electrical specifications of heat exchanger</b>		
Nominal operating voltage range		230 V AC ± 10%, single-phase, 50 Hz to 60 Hz ± 6%
Current at 230 V	3000 W model	< 1.5 A
	5000 W model	< 3.5 A
	10000 W model	< 13 A
Power consumption	3000 W model	< 350 VA
	5000 W model	< 810 VA
	10000 W model	< 3000 VA
<b>Cooling specifications</b>		
Cooling circuit		closed cooling system, automatic pressure balancing
Coolant		39% v/v Antifrogen® N (based on monoethylene glycol, water and anticorrosion additives)
Heat exchanger	capacity	
	3000 W model	max. 9.5 kW
	5000 W model	max. 15.7 kW
	10000 W model	max. 41 kW
	air volume flow	
	3000 W model	6200 m <sup>3</sup> /h
	5000 W model	5145 m <sup>3</sup> /h
	10000 W model	20100 m <sup>3</sup> /h
	mounting type	indoor or outdoor, floor installation
Recommended distance between amplifier system and heat exchanger	pipe length	max. 2 × 20 m
	difference in altitude	max. 20 m
Cooling hose	outside diameter	
	3000 W model, 5000 W model	2 × 40 mm (2 × 1.57 in)
	10000 W model	2 × 51 mm (2 × 2.0 in)
	bending radius	280 mm (11 in)
<b>Graphical user interface</b>		
Local display		200 × 48 pixel, monochrome
Web GUI	via Ethernet	RJ-45, 10/100 Mbit/s, autonegotiation, half/full duplex
<b>Remote control</b>		
Ethernet		RJ-45, 10/100 Mbit/s, autonegotiation, half/full duplex
<b>Environmental conditions</b>		
Temperature loading	operating temperature range	0 °C to +40 °C
	storage temperature range	-20 °C to +70 °C
Damp heat		max. +40 °C at 95 % rel. humidity, without condensation
Altitude	operating altitude	up to 2000 m
	storage altitude	up to 4600 m

## Specifications in brief

Protection		
Load VSWR		unlimited
Interlock		1 device interlock, 1 configurable interlock
Input protection against bias voltage	optional	DC block level ≤ 50 V DC
Transient voltage compatibility		category II, in line with IEC 60364-4-443
Switching capacity of internal fuses		< 10 kA
Thermal overload		shutdown at thermal overload (+50 °C ambient temperature)
Pressure overload		pressure relief valve, 5 bar
Module exchange		self-shutting valves

All specified parameters are valid for an ambient temperature of +25 °C, input impedance of 50 Ω and output impedance of 50 Ω.

For data sheet, see PD 3606.9456.22 and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

# Ordering information

Designation	Type	Configuration No./ Order No.
<b>R&amp;S®BBL200 single-band power amplifiers</b>		
<b>Frequency band from 9 kHz to 225 MHz</b>		
3000 W, liquid-cooled, 31 HU rack model	R&S®BBL200	BBL200-A3000
5000 W, liquid-cooled, 42 HU rack model	R&S®BBL200	BBL200-A5000
10000 W, liquid-cooled, 2 x 42 HU rack model	R&S®BBL200	BBL200-A10000
Accessories supplied: rack power cord, user manual (printed and on CD), test report, indoor heat exchanger, 2 x 20 m cooling hose and filling pump.		
<b>Options</b>		
GPIB Remote Control	R&S®BBA-B101	5355.8250.05
Fast Muting, only for applications above 3 MHz	R&S®BBL-B130	5356.9914.02
DC Block Input Protection (N)	R&S®BBA-B132	5353.9236.03
RF Forward/RF Reflected Sample Ports (N), connector at bottom of rear panel for 3000 W and 5000 W models	R&S®BBL-B140	5356.9937.02
RF Forward/RF Reflected Sample Ports (N), connector at bottom of rear panel for 10000 W model, connector at rack top for all models	R&S®BBL-B140	5356.9937.03
Detected Forward and Reflected RF Sample Ports (N)	R&S®BBL-B141	5356.9908.02
Transparent I/O	R&S®BBL-B160	5356.9920.02
Rack Rollers	R&S®ZR1-RW01	5354.4309.02

Service options		
Service Level Agreement BASIC 1, 2 or 3 years	Includes repairs in factory, technical support, software updates, access to Rohde&Schwarz Support Desk	R&S®SB1/2/3AMP
Service Level Agreement ADVANCED 1, 2 or 3 years depending on regional availability	Includes repairs in factory or in service center within 9 working days, technical support, remote error analysis, software updates with installation support, access to Rohde&Schwarz Support Desk	R&S®SA1/2/3AMP
Service Level Agreement PREMIUM 1, 2 or 3 years depending on regional availability	Includes provision of spare parts and components for quick repair on site, technical support with very short reaction times, remote error analysis, software updates with installation support, access to Rohde&Schwarz Support Desk	R&S®SP1/2/3AMP
REGULAR PRODUCT MAINTENANCE 1 year	Periodical inspection and maintenance	R&S®SV1AMP

For more information, see Service Levels Description for R&S®AMP Amplifier Systems PD 3607.6467.22.

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](http://www.sales.rohde-schwarz.com)

## 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.

## 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**

## Rohde & Schwarz GmbH & Co. KG

[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## Rohde & Schwarz training

[www.training.rohde-schwarz.com](http://www.training.rohde-schwarz.com)

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PD 3606.9456.12 | Version 04.00 | October 2017 (fi)

R&S®BBL200 Broadband Amplifier

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3606945612