

R&S® BBL200 BROADBAND AMPLIFIER

Liquid-cooled power amplifiers
for high field strengths



Product Brochure
Version 05.00

ROHDE & SCHWARZ

Make ideas real



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 series' 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.

R&S®BBL200

KEY FACTS

- ▶ Frequency range from 9 kHz to 225 MHz
- ▶ 3 kW, 5 kW and 10 kW output power
- ▶ 100 % mismatch protection
- ▶ 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

BENEFITS

One of the most advanced high-power amplifiers

▶ [page 4](#)

Reliable with high availability

▶ [page 5](#)

Flexible control and operation

▶ [page 6](#)

Excellent service and quick maintenance

▶ [page 8](#)

ONE OF THE MOST ADVANCED HIGH-POWER AMPLIFIERS

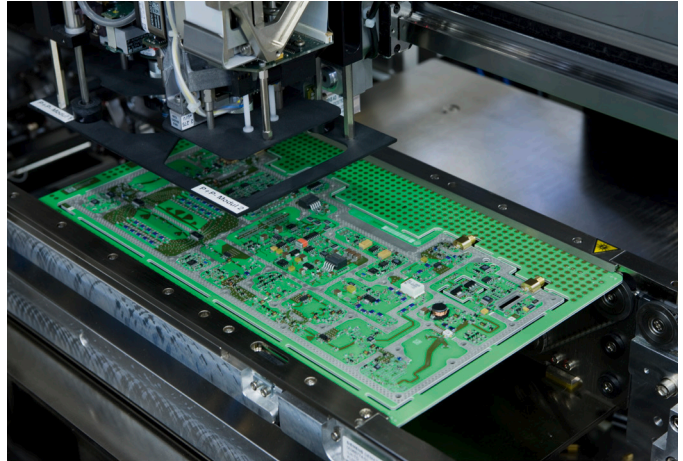
Outstanding RF design meets high-quality series production in one of Europe's most advanced plants

Sophisticated RF design

State-of-the-art design and simulation software used during development, the use of power semiconductors from internationally leading manufacturers and Rohde&Schwarz engineers' decades of experience in developing amplifiers produce one of the most advanced amplifiers 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 specified parameters.

Compact and quiet thanks to liquid cooling

The mechanical design of the R&S®BBL200 sets 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 the right 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.



Automatic insertion of components into printed boards at Rohde & Schwarz

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 Rohde&Schwarz plant in Teisnach, Germany offers excellent manufacturing depth. From precision mechanical engineering and machining to printed board production and final assembly, all manufacturing steps are brought together under one roof. Automated final test setups ensure that all products that the Rohde&Schwarz plant delivers to its customers comply with specifications.

Awards received by the Rohde & Schwarz Teisnach plant include

- ▶ 2010: Factory of the Year, Germany
- ▶ 2013: Best German Factory Finalist, European Industrial Excellence Award
- ▶ 2014: Bavarian Quality Award
- ▶ 2014: Factory of the Year, Germany
- ▶ 2015: TOP Innovation Award
- ▶ 2016: Global Excellence in Operations (GEO) overall award winner, Germany
- ▶ 2017: Best Business Award
- ▶ 2020: Manufacturing Excellence Award
- ▶ 2023: Factory of the Year, Germany, Excellence in Small Series Production category

RELIABLE WITH HIGH AVAILABILITY

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

Outstanding expertise in amplifier development founded on decades of experience

The expertise gained over many years in the development of power amplifiers is based on R&D for Rohde & Schwarz radio 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 series in 2010 and the R&S®BBA150 series for the microwave range in 2013 fulfill the Rohde & Schwarz promise to offer stable, reliable amplifiers that maximize user effectiveness. Low downtime is an important economic factor. The 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.

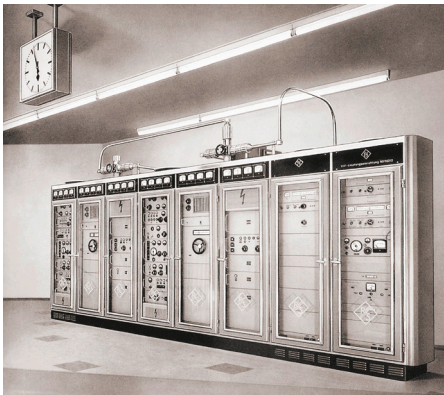
Knowledge transfer

All of the Rohde & Schwarz radio and TV transmitter manufacturing expertise has gone into the development of the broadband amplifiers.



Europe's first VHF FM transmitter (built by Rohde & Schwarz in 1949) and the company's state-of-the-art R&S®THR9 VHF FM transmitter

Radio transmitters



VHF radio transmitter with 2 x 5 kW

Broadband amplifiers



R&S®BBA100



R&S®BBA150



R&S®BBL200



R&S®BBA130



R&S®BBA300

1963

2010

2013

2014

2016

2022

FLEXIBLE CONTROL AND OPERATION

Operation of the R&S®BBL200 is always efficient – whether local or via remote control or web GUI

Manual operation

The R&S®BBL200 can be operated manually via the display and buttons on its front panel. 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, the 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 can be accessed via LAN and web browser. The broadband amplifier 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 Edge) is all that is needed.

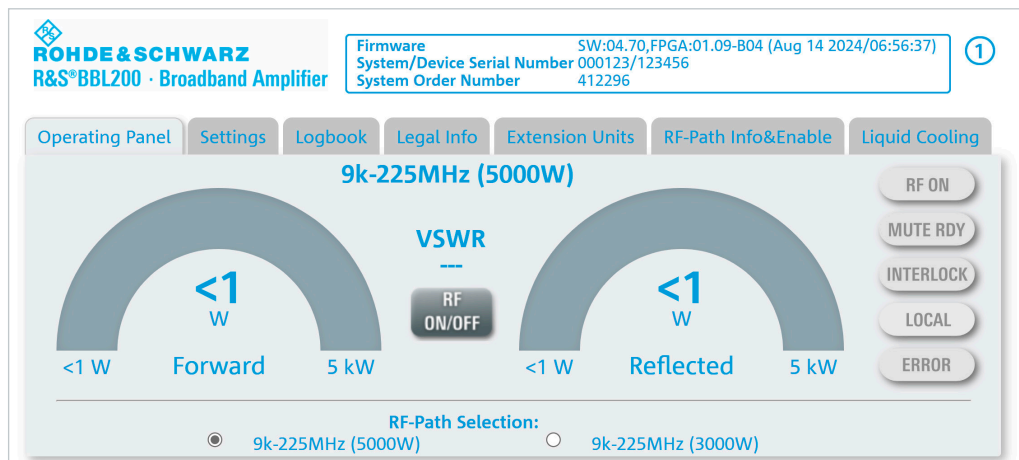
Ethernet or GPIB remote control

The standard Ethernet interface enables the automation of test sequences using remote control SCPI commands. TCP/IP networks are now standard for equipment networking and control; a separate infrastructure is no longer needed. To make integration especially easy, the IP network address can be set manually or assigned automatically via DHCP.

The 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 in the R&S®BBL200 web GUI

Integration into the R&S®ELEKTRA EMC test software

Complex EMC measurement scenarios almost always require the use of higher-level measurement and control software such as R&S®ELEKTRA. The complete integration of the R&S®BBL200 into the EMC test software offers many different options for controlling the amplifier and adjusting settings 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 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.

**ROHDE & SCHWARZ**
R&S®BBL200 · Broadband Amplifier

FirmwareSW:04.70,FPGA:01.09-B04 (Aug 14 2024/06:56:37)
System/Device Serial Number000123/123456
System Order Number412296

1

Operating PanelSettingsLogbookLegal InfoExtension UnitsRF-Path Info&EnableLiquid Cooling

- Gain Adjustment

Gain Adjustment-00.00 dBSet Gain

- Misc. Settings

Power Unit☒ Watt☐ dBm
Automatic Standby☐ Yes☒ No
Automatic RF-ON☒ Off☐ On☐ Last
Fan Control☐ Mode 1☒ Mode 2

- Ethernet

IP Address172.26.69.15
Subnet Mask255.255.255.0
Gateway172.26.69.1
DHCP Client☒ On☐ Off
Host NameBBL200-A5000-000123
SCPI Timeout☒ 30 Minutes (recommended def.)☐ 1 Day (not recommended)
RF-OFF on lost Remote Ctrl.☐ Yes☒ No
Set Network Configuration

- Maintenance

Run Self-Test
Run Self-Test at Start☐ Yes☒ No
Run Bias-Current-Calibration

- System Info

General

Current Timestamp000d 01h 56min 42s
System TypeBBL200 A5000
System/Dev. Serial No.000123/123456
System Order Number412296
Device Types of UnitsA5000 - Base Unit
A5000 - Ext. Unit 001
A5000 - Ext. Unit 002

FirmwareSW:04.70,FPGA:01.09-B04 (Aug 14 2024/06:56:37)

Ethernet

Connection100Mbit/s FD
MAC Address00:90:B8:1F:15:8F

Settings panel in 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 series, 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 (SLA) and options ensure the operational readiness and availability of the R&S®BBL200 broadband amplifiers at a reasonable, plannable cost of ownership even beyond the three-year warranty period.

From presales to service – at your doorstep

Rohde&Schwarz is a technology group with a global presence. The Rohde&Schwarz network ensures optimum on-site support by highly qualified experts. User risks are reduced to a minimum at all project stages:

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

Rohde&Schwarz offers customers customized solution tailored to their requirements.



SPECIFICATIONS IN BRIEF

Specifications in brief

RF specifications

Frequency range		9 kHz to 225 MHz, instantaneously
Nominal output load		50 Ω
Nominal power		3 kW (64.8 dBm), 5 kW (67 dBm), 10 kW (70 dBm)
Modulation capability		AM, FM, ϕ M, PM
Nominal power gain	3 kW model	68.2 dB
	5 kW model	70.4 dB
	10 kW model	73.4 dB
Gain flatness		± 3.0 dB
Gain adjustment range		> 15 dB
Harmonics		
3 kW model	9 kHz to 110 MHz, at 3 kW; 110 MHz to 225 MHz, at 2.8 kW	< -20 dBc
5 kW model	9 kHz to 110 MHz, at 5 kW; 110 MHz to 225 MHz, at 3.5 kW	< -20 dBc
10 kW model	9 kHz to 110 MHz, at 10 kW; 110 MHz to 225 MHz, at 8 kW	< -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 (nom.)
Input VSWR	into 50 Ω	max. 2:1
Maximum input level	RF	+5 dBm
	DC	0 V
Nominal output impedance		50 Ω
Output mismatch tolerance	at VSWR \leq 6:1	without foldback
	at VSWR > 6:1	with gradual foldback to approx. 50% of nominal output power, depending on load impedance
Output mismatch protection, VSWR		100%, without damage

RF sample and detected RF sample signals

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)

Connectors

Connecting plate on rack top cover or on 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 \times WAGO X-COM, 7-pin, female
RF output port	rear panel, bottom	1 5/8" EIA female
Mains power	rear panel, bottom	
	3 kW model	5 \times 4 mm ² power cord
	5 kW model	5 \times 10 mm ² power cord
	10 kW model	5 \times 16 mm ² power cord
Coolant supply		rack top cover, rear panel or rack shelf

Electrical specifications of amplifier system

Nominal operating voltage ranges	3 kW model, 5 kW model, 10 kW model	380 V to 415 V AC \pm 10%, three-phase with N, 47 Hz to 63 Hz
	3 kW model, 5 kW model	208 V to 240 V AC \pm 10%, three-phase, 47 Hz to 63 Hz

Specifications in brief

Nominal current at 230 V, per phase	3 kW model	< 20.5 A
	5 kW model	< 35 A
	10 kW model	< 72 A
Nominal power		
3 kW model	$RF_{cw} = 3 \text{ kW (RMS)}, VSWR = 1$	< 14.2 kVA
5 kW model	$RF_{cw} = 5 \text{ kW (RMS)}, VSWR = 1$	< 24 kVA
10 kW model	$RF_{cw} = 10 \text{ kW (RMS)}, VSWR = 1$	< 50 kVA
Electrical specifications of heat exchanger		
Nominal operating voltage range		230 V AC $\pm 10\%$, single-phase, 50 Hz to 60 Hz $\pm 6\%$
Current at 230 V	3 kW model	< 1.5 A
	5 kW model	< 3.5 A
	10 kW model	< 13 A
Power consumption	3 kW model	< 350 VA
	5 kW model	< 810 VA
	10 kW model	< 3 kVA
Cooling specifications		
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	
	3 kW model	max. 9.5 kW
	5 kW model	max. 15.7 kW
	10 kW model	max. 41 kW
	air volume flow	
	3 kW model	6200 m ³ /h
	5 kW model	5145 m ³ /h
	10 kW model	20 100 m ³ /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	
	3 kW model, 5 kW model	2 × 40 mm (2 × 1.6 in)
	10 kW model	2 × 51 mm (2 × 2.0 in)
	bending radius	280 mm (11 in)
Graphical user interface		
Local graphical display		200 × 48 pixel, monochrome
Web GUI	via Ethernet	RJ-45, 10/100 Mbit/s, autonegotiation, half/full duplex
Remote control		
Ethernet		RJ-45, 10/100 Mbit/s, autonegotiation, half/full duplex
Environmental conditions		
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% relative humidity, without condensation
Altitude	operating altitude	up to 2000 m
	storage altitude	up to 4600 m
Protection		
Load VSWR		unlimited
Interlock		1 automatic interlock, 1 interactive interlock
Input protection against bias voltage	optional	DC block level $\leq 50 \text{ V DC}$
Transient voltage compatibility		category II, in line with IEC 60364-4-443
Switching capacity of internal fuses		< 10 kA

Specifications in brief		
Thermal overload		shutdown at thermal overload (+50 °C ambient temperature)
Pressure overload		pressure relief valve, 5 bar
Module exchange		self-shutting valves
Dimensions (W × H × D)		
Dimensions of amplifier system	rack setup, including handles, stands and crane lugs	
3 kW model		600 mm × 1570 mm × 1100 mm (23.6 in × 61.8 in × 43.3 in)
5 kW model		600 mm × 2050 mm × 1100 mm (23.6 in × 80.7 in × 43.3 in)
10 kW model		1200 mm × 2050 mm × 1100 mm (47.2 in × 80.7 in × 43.3 in)
Dimensions of heat exchanger	including handles and stands	
3 kW model		1241 mm × 558 mm × 400 mm (48.9 in × 22.0 in × 15.8 in)
5 kW model		1125 mm × 925 mm × 600 mm (44.3 in × 36.4 in × 23.6 in)
10 kW model		2400 mm × 1150 mm × 600 mm (94.5 in × 45.3 in × 23.6 in)

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

ORDERING INFORMATION

Designation	Type	Configuration No.
R&S®BBL200 single-band power amplifiers		
Frequency band from 9 kHz to 225 MHz		
3 kW, liquid-cooled, 31 HU rack model	R&S®BBL200	BBL200-A3000
5 kW, liquid-cooled, 42 HU rack model	R&S®BBL200	BBL200-A5000
10 kW, liquid-cooled, 2 × 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 × 20 m cooling hose and filling pump		

Service options		
Frequency range/output power upgrade		on request
Calibration		on request
Service level agreements (SLA)		
BASIC Coverage of repair costs (material and performance), access to the Rohde&Schwarz Support Center and basic support		Contact your local Rohde&Schwarz sales office
CUSTOMIZED The BASIC SLA plus additional modules to achieve the required coverage, e.g. on-site service, technical support or regular product maintenance		
PREMIUM On-site service within two working days (for rack systems) or prioritized repair within nine working days at the plant/service center (for benchtop models), provision of spare parts and components, software/firmware updates, fast technical support during business hours, regular product maintenance, annual review meeting and access to the Rohde&Schwarz Support Center		

For more information on the individual services and their availability, see "Service Levels Description for Rohde&Schwarz Broadband Amplifiers" (PD 3607.6467.92).

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

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

Rohde & Schwarz training

www.training.rohde-schwarz.com

Rohde & Schwarz customer support

www.rohde-schwarz.com/support

