Широкополосный усилитель BBL200

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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 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

▷ page 4

Reliable with high availability

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

▷ page 5

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

▷ page 6

Excellent service and quick maintenance

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

▷ page 8

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 engineers' decades of experience in de-veloping amplifiers produce the most advanced amplifier design currently available. Efficiency and ruggedness en-sure 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.

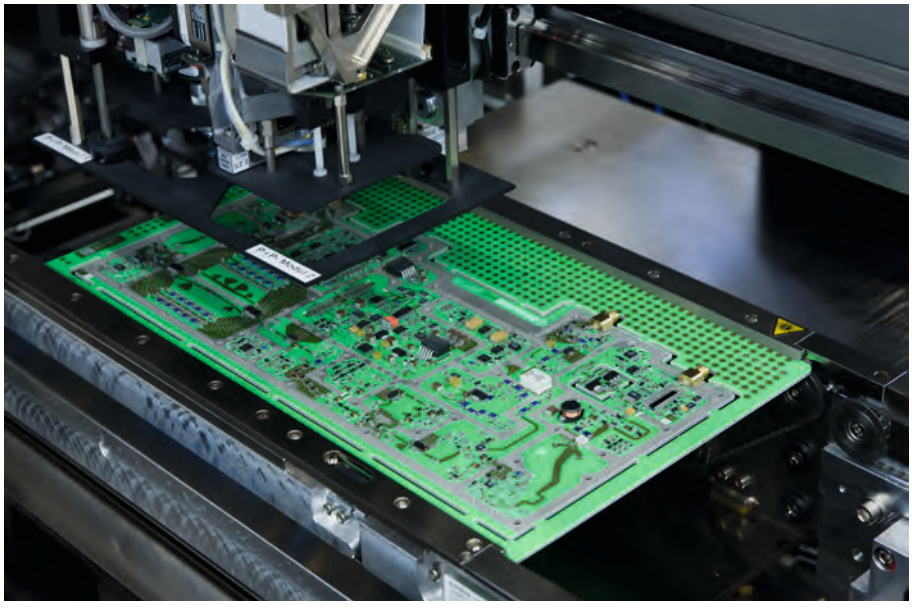
Compact and quiet thanks to liquid cooling

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[1)] plant in Teisnach, Germany, offers superior manufacturing depth. From pre-cision 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 plant delivers only specification-compliant products to its customers.

1) Awards received by the 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 .

Reliable with high availability

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

Europe's first VHF FM transmitter (built by 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 develop-ment of power amplifiers is based on the R&D work for sound and TV broadcast transmitters. All of the liquid cooling components were taken unmodified from high-power transmitters. Their reli-ability 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 claim to offer stable, reliable amplifiers for maximum cus-tomer 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 mis-match 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 mis-match conditions.

Transfer of know-how

All the 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 broadband amplifiers are identical, which simplifies control and integration.

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

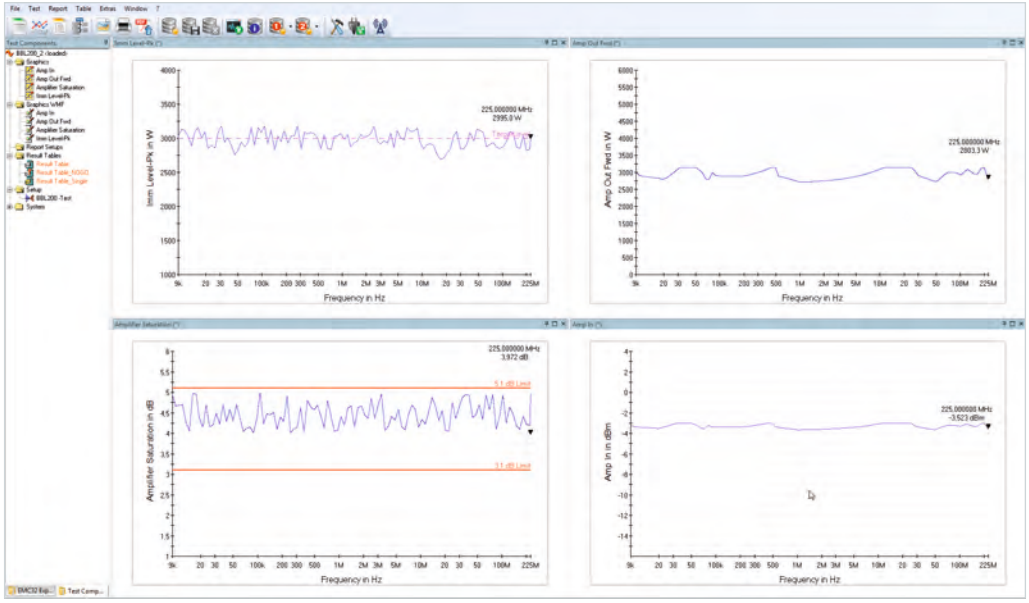
Operating panel on the R&S®BBL200 web GUI.

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.

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

Specifications in brief

Specifications in brief		
RF data		
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 110 MHz to 225 MHz	 at 3000 W at 2800 W	< –20 dBc
	5000 W model 9 kHz to 110 MHz 110 MHz to 225 MHz	 at 5000 W at 3500 W	< –20 dBc
	10000 W model 9 kHz to 110 MHz 110 MHz to 225 MHz	 at 10000 W 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
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)
Mechanical specifications of amplifier system			
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)
Mechanical specifications of heat exchanger			
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)
Connectors			
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 mm² power cord
	5000 W model	5 × 10 mm² power cord
	10000 W model	5 × 16 mm² power cord
Coolant supply		rack top cover, rear panel or rack shelf
Electrical specifications of amplifier system		
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
Electrical specifications of heat exchanger		
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
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	
	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 m³/h
	5000 W model	5145 m³/h
	10000 W model	20100 m³/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)
Graphical user interface		
Local 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 % 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

Ordering information

Designation	Type	Configuration No./ Order No.
R&S®BBL200 single-band power amplifiers		
Frequency band from 9 kHz to 225 MHz		
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 × 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.		
Options		
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

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