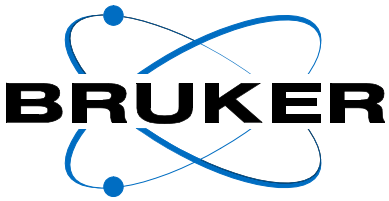

BLAH300

Amplifier 700-900MHz
Operating & Service Manual

Version 001

The information in this manual may be altered without notice.

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This manual describes the units as they are at the date of printing. On request, the manufacturer shall supply circuit diagrams, lists of components, descriptions, calibrating instructions and any other information for use by qualified personnel of the user, in charge of repairing the parts of the unit which have been stated by the manufacturer to be "repairable". Such supply shall in no event constitute permission to modify or repair the units or approval of the same.

This unit is not designed for any type of use which is not specifically described in this manual. Such use may be hazardous.

This manual was written by

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General information 1

Introduction 1.1

The BLAH300 700-900MHz Amplifier is a pulse broadband linear power amplifier, specially designed for High Field Nuclear Magnetic Resonance (NMR) applications.

The class AB linear amplifier provides 300W peak power over the frequency range 650-900MHz on the H300 output for Solid applications and 50W peak power on the H50 output for the High Resolution applications.

The amplifier is realised with N-CHANNEL RF POWER MOSFET transistors.

The unit support pulse width of 100ms and duty cycle of 10% at full power.
Its built-in control and protection circuitry allows continues wave at lower power (30W/10W for H300/H50).

Protection is done against:

- Excessive power output level (overdrive)
- Excessive pulse repetition rate (duty-cycle)
- Excessive pulse length (pulse- width)
- Excessive reflected RF power (mismatch)
- Overheat protection

The amplifier is housed in a 19" rack cabinet 3U and has an inside power supply.

Initial Turn On Procedure 1.2

The AC input voltage for the power supply unit must be in the range 188 to 264VAC 50/60Hz. At turn on, the amplifier unit has following display:

- The +32V, +15V, -15V and +5V are ON (GREEN).
- The RF power outputs H300 and H50 must be connected to the probe or 50 Ohms load.
- The BLNK in is a TTL pulse signal with correct polarity: low (0V) = RF pulse out allowed (standard configuration).
- The H in is the RF signal of +8dBm max. at frequencies between 650 and 900MHz.
- The SEL H50/H300 is the TTL switch signal with level low (0V) for SOLID (H300) and level high (5V) for HIGH RESOLUTION (H50).
- The RS485 connectors set the interface between amplifier and spectrometer.

Package *1.3*

The amplifier unit BLAH300 700-900MHz has the BRUKER P/N: W1345066.

Safety 2

Labels 2.1

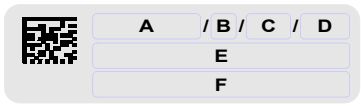
Labels are provided to alert operating and service personnel to conditions that may cause personal injury or damage to the equipment from misuse or abuse. Please read the labels and understand their meaning.

Dangerous area 2.1.1

WARNING ! High Voltage.

Name plate 2.1.2

The Amplifier 700-900MHz can be identified by a name plate at the front panel of the unit which has following information:

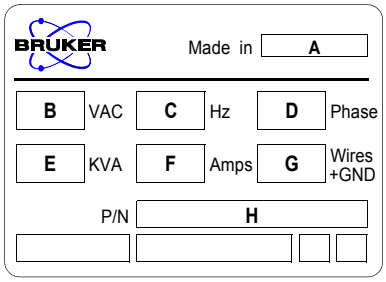


- **(A) Part Number**
  This field indicates the assembly number which identifies the part number of the product.
- **(B) Variant**
  This field indicates the variant number which identifies the production category of the product. The default variant is 00.
- **(C) ECL**
  This field indicates the revision number which identifies the product configuration. The initial revision is 0.00.
- **(D) Serial Number**
  This field indicates the manufacturing number which identifies the serial number of the product.
- **(E) Type**
  This field contains the designation of the product.

- **(F) Information**
  This field contains information about the mains input requirement of the product.

Identifying plate *2.1.3*

The Amplifier 700-900MHz can be identified by an identifying plate at the back panel of the unit which has following information:



- **(A) Made in**
  This field indicates the country where the product was manufactured.
- **(B) Voltage**
  This field indicates the input mains voltage of the product.
- **(C) Frequency**
  This field indicates the input mains fréquency of the product.
- **(D) Phases**
  This field indicates the number of phases of the mains.
- **(E) Power**
  This field indicates the absorbed power of the product.
- **(F) Current**
  This field indicates the absorbed current of the product.
- **(G) Wires**
  This field indicates number of wires with the ground in the mains cord.
- **(H) Part Number**
  This field indicates the assembly number which identifies the part number of the product.

Operation 3

Front Panel 3.1

The BLAH300 front panel is provided with 12 status displays, 5 RF connectors, and 2 RS485 connectors.

Displays 3.1.1

Table 3.1. Display

Green LED ON means correct operating:	
+32V ON	Indicates +32V DC supplies on the amplifiers.
+15V, -15V, +5V ON	Indicates DC supplies on control board.
H300 ON	When pulsing RF Power is present at the Solid output.
H50 ON	When pulsing RF Power is present at the High Resolution output.
Red LED ON means default in the amplifier:	
Overdrive	Indicates when the power limit is reached.
Duty Cycle	Indicates when the duty cycle limit is reached.
Pulse Width	Indicates when the pulse width limit is reached.
Mismatch	Indicates when the power reflection limit is reached.
RF Power FLT is ON	In case an above default occurred. These defaults disable ''Blanking'' of the amplifier in a loop timing.
Overheat is ON	When the temperature on the heat sink is too high or in case of a default with the ventilation: the ''blanking'' of the different amplifier is disabled until the temperature decreases.

Connectors *3.1.2*

Table 3.2. Connectors

H IN	RF IN max +4dBm	SMA type connector (female).
H300 OUT	RF OUT H300 (Solid output)	N type connector (female).
H50 OUT	RF OUT H50 (High Resolution)	N type connector (female).
BLANKING	TTL Pulse 5V = RF Pulse OFF, Pusle 0V = RF Pulse ON.	BNC type connector (female).
SELH50/H300	TTL SEL = 5V = H50, SEL= 0V =H300, Not connected = H50.	BNC type connector (female).

Interface RS485 connectors *3.1.3*

The Control I/O interface connections are 15 pins, D shape sub-miniature type connectors mounted on the SBS BUS Controller.

SBS BUS = Serial BRUKER SPECTROSPIN Bus

The next table shows the pin out of the parallel connectors.

Table 3.3. RS485 Pin out assignment

Pin 1	Shield
Pin 2	Transmit data line +
Pin 3	Wake up line /WUP
Pin 4	Receive data line +
Pin 5	NC
Pin 6	GND
Pin 7	GND
Pin 8	GND
Pin 9	Transmit data line -
Pin 10	NC
Pin 11	Receive data line -
Pin 12	NC
Pin 13	VRS (+12 V)
Pin 14	VRS (+12 V)
Pin 15	VRS (+12 V)

Design and view *3.1.4*

Figure 3.1. BLAH300 Front Panel Design

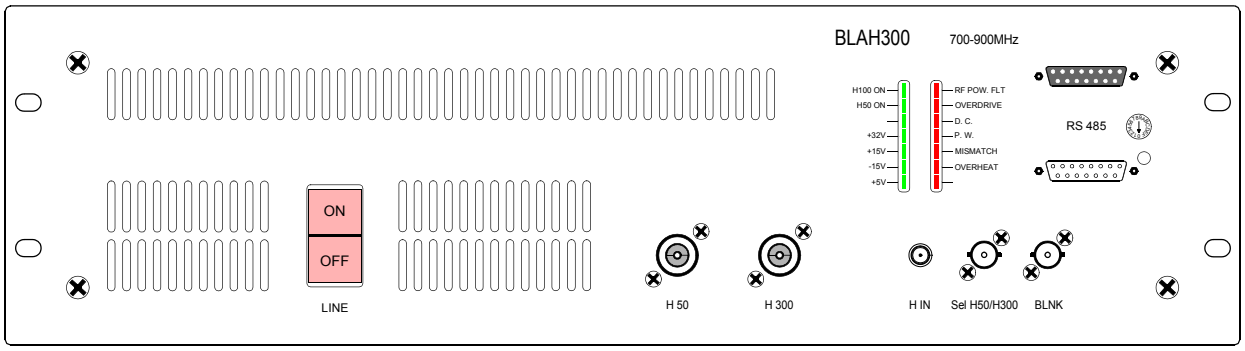


Figure 3.2. BLAH300 Front Panel View

Rear Panel *3.2*

The rear panel of the Amplifier is free of elements in exception of the three pole (2P + E) line filter socket.

Technical description

4

System Overview 4.1

The BLAH300 can provide an output of 300W and more on the Solid Output H300, over the full frequency range of 650 to 900MHz, or 50W on the High Resolution output, over the same frequency range.

The RF section of the system consists of a linear module BLMH300 mounted on a single heat sink with 2 fans as ventilation.

The linear class A/AB driver uses the Bias voltage for gating the MOSFET transistors and will be switched to H50 output and the power amplifier H300. The switch is a power RF relay driven by the control Sel H50/H300.

Each output pass through a Bi-directional coupler to end at the front panel connectors.

When the High Resolution channel H50 is in use, the Blanking signal is present only on the driver and the Blanking of the power amplifier is disabled. When working on SOLID channel H300, the Blanking signal is used on all stages of the amplifier (driver and power amplifier).

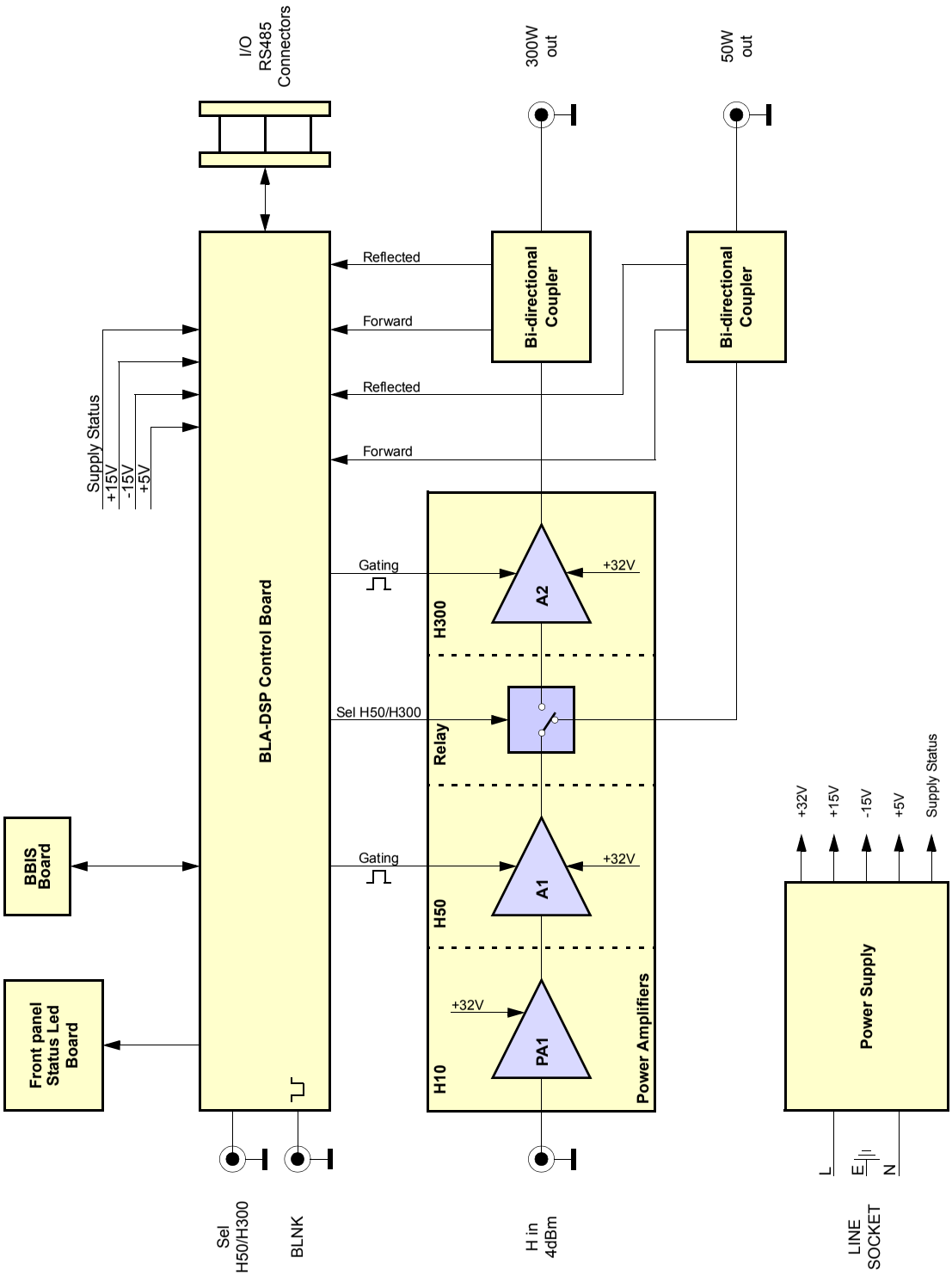
For the rest of the document, blanking means:

- low level @ 0V = amplifier disable (i.e. no RF).
- high level @ 5V = amplifier ON (RF pulse allowed).

The entire system is controlled by a Digital Signal Processing control board:

- To get information of type of amplifier and defaults, and to display power level or reflected power.
- To set protection on amplifiers and display defaults in case of excessive power, duty cycle, pulse width, reflected power, and overheat.

Figure 4.1. BLAH300 System Block Diagram



Theory of Operation 4.2

RF Section 4.2.1

RF Preamplifier

The first section of the driver is an hybrid amplifier to get a good noise factor (7dB), followed by two switched Thermal-PAD and basic attenuators, one for the channel H50 and one for the channel H300, followed by a second hybrid amplifier, Thermal-PAD attenuator and finally two push-pull MOSFET transistors in class AB to built a 37dB gain block.

The switched attenuator is needed to minimize gain when operating in Solid mode H300 and full gain in mode H50. These attenuators are in fact tiled in a variable attenuator to adjust output power, and a Thermal-PAD for compensation of the output power drift with temperature of the amplifier.

The two transistors are blanked with the Blanking signal to achieve good isolation of the amplifier.

RF driver

The second section of the driver includes a MOSFET transistor to get output power. This stage achieves a gain of 10dB and is also blanked.

The total linear gain is about 47dB for the driver. The direct output power is 65W at the module, and it is operating at +32V supply.

RF Relay H50/H300

The coaxial RF relay switch the RF power from the driver via a bi-directional coupler to the High Resolution output H50 at the front panel, when the Sel H50/H300 signal is controlled to TTL level high or not connected. When the level is low, the relay switches the output of the driver to the input of power amplifier to get high power on the H300 output.

RF Coupler H50

The H50 bi-directional coupler provides a forward signal of about 1V for full 50W (envelope of RF pulse signal) for monitoring of the output power. It also gives an image of the reflected power to the load (probe).

Both signals, forward and reflected, are linked to the BLA-DSP Control Board for monitoring and protection setting of the H50 output.

RF Power Amplifier

The amplifier is built with 4 MOSFET transistors coupled with -6db 4 ways splitter/combiner. The amplifier is blanked to minimize noise at output, and it delivers a direct power of about 320W. The gain of the stage is about 9dB. The power amplifier is operating at +32V DC supply.

RF Coupler H300

The H300 bi-directional coupler provides a forward signal of about 1V for full 300W (envelope of RF pulse signal) for monitoring of the output power. It also gives an image of the reflected power to the load (probe).

Both signals, forward and reflected, are linked to the BLA-DSP Control Board for monitoring and protection setting of the H300 output.

Control Board and SBS Bus *4.2.2*

The BLA-DSP Control Board has 3 principal functions:

- To distribute the blanking signals to the amplifiers. In case of default, the protection disables the Blanking with a certain time delay loop, this may cut up the RF signal and display the status of the default with the same time loop. When the default is corrected the RF output is allowed again.

1. When working on High resolution channel, only the Blanking signal on the driver H50 is needed, so Blanking on PA is disabled.
2. When working on Solid channel H300 the Blanking signal is needed on all amplifiers (driver and PA).

- To send information of power, defaults and status to the console. The SBS Bus Controller, via the RS485 connector, reads also information for identification of the amplifier (Bruker Board Identification System = BBIS).
- To set limitations and protections to the amplifier when a default condition occurs (overdrive, pulse width, duty cycle, reflected power, overheat, supplies default, fans default).

Status Led Board *4.2.3*

The Status Led Board displays all information or defaults in the amplifier unit and status or pulse.

Specifications 5

BLAH300 Common Characteristics 5.1

Table 5.1. BLAH300 Common Specifications

Constant Internal Protection	Supplies faults & Over heat
Forward Power	Peak & CW Power Pulse Width Duty Cycle
Reflected Power	Peak & CW Power
Front Panel Indicators	Amplifier Status Led Board
Front Panel Interfaces	2 x I/O 15-pin sub miniature type D connectors
Front Panel controls	1 x Sel H50/H300 control signal
Front Panel connectors	1 x RF input, 2 x RF output, 1 x blanking input
Rear Panel Interface	15 - pin DIN 41612-H ERNI female connector (power supply connection)
Cooling System	Forced-air cooling (front to rear)
Size	5.2" H x 19" rack cabinet x 23" D (132.5 x 48,3 x 58 cm)
Weight	19 kg
Supply	188-264 VAC single phase 50-60Hz

General specifications Solid output H300 5.2

Table 5.2. Solid Output H300 Specifications

Frequency range	650 to 900MHz
Linear Gain	56dB ±1.5 typ.
Gain Flatness	±1.5dB max.
Minimum Pulsed Output Power (at nominal input +4dBm)	300W min. full range
CW Output Power	30W max. (internal limitation)
Linear Output Power	200W typ. at 1dB compression
Amplifier Biasing	Class AB Operation
Blanking Delay	< 1µs typ.
RF Rise Time	< 100ns
RF Fall Time	< 50ns
DC Ringing	±200mV typ. (due to blanking signal)
Input Noise Figure	7dB max.
Output Noise Power (Unblanked)	< -111dBm @ 1Hz
Output Noise Power (Blanked)	Thermal noise +7dB
IN/OUT Impedance	50Ω
Input V.S.W.R.	1.5 max.
Output Harmonics	30dBc max. at 300 W
Pulse Width (int. limitation)	100ms @ 300W (up to CW at 30W)
Duty Cycle (int. limitation)	10% @ 300W (up to 100% at 30W)
Amplitude Droop	< 8% @ 300W for 100ms Pulse Width < 5% @ 300W for 10ms Pulse Width
Amplitude stability / Temperature	< 0.2% / °C

General specifications High Resolution output H50 *5.3*

Table 5.3. High Resolution Output H50 Specifications

Frequency range	650 to 900MHz
Linear Gain	47dB ±1.5 typ.
Gain Flatness	±1.5dB max.
Minimum Pulsed Output Power (at nominal input + 4 dBm)	50W min. full range
CW Output Power	10W max. (internal limitation)
Linear Output Power	30W typ. at 1dB compression
Amplifier Biasing	Class AB Operation
Blanking Delay	< 1µs typ.
RF Rise Time	< 100ns
RF Fall Time	< 50ns
DC Ringing	±200mV typ. (due to blanking signal)
Input Noise Figure	7dB max.
Output Noise Power (Unblanked)	< -120dBm @ 1Hz
Output Noise Power (Blanked)	Thermal noise +7dB
IN/OUT Impedance	50Ω
Input V.S.W.R.	1.5 max.
Output Harmonics	30dBc max. at 300 W
Pulse Width (int. limitation)	100ms @ 50W (up to CW at 10W)
Duty Cycle (int. limitation)	20% @ 50W (up to 100% at 10W)
Amplitude Droop	< 8% @ 50W for 100 ms Pulse Width < 5% @ 50W for 10 ms Pulse Width
Amplitude stability / Temperature	< 0.2% / °C

Specifications

Figures

Figures

Tables

Tables