Digital 10 W Stereo Audio Amplifier

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10 watts of audio per channel is available from this small and low-cost stereo audio amplifier. This capability was requested several times by young hams in the local amateur radio group, Deutschen Amateur-Radio-Club Fürstenfeldbruck.

No suitable kits were available, and prompted by an article [1] we decided to design it ourselves. This result (see Figure 1) was the winner of the DARC's Kit Contest at Ham Radio (Friedrichshafen) 2017. The amplifier can be used with a smartphone, tablet, PC, or radio needing more audio.

Figure 1: The completed 10W Stereo Audio Amplifier

Design

The amplifier uses a Class D IC, therefore a heatsink is not required. Figure 2 shows the schematic diagram. Advantages are the wide power supply range from 10 to 26V and you need only a few external components with the TPA3125D2 IC from Texas Instruments.

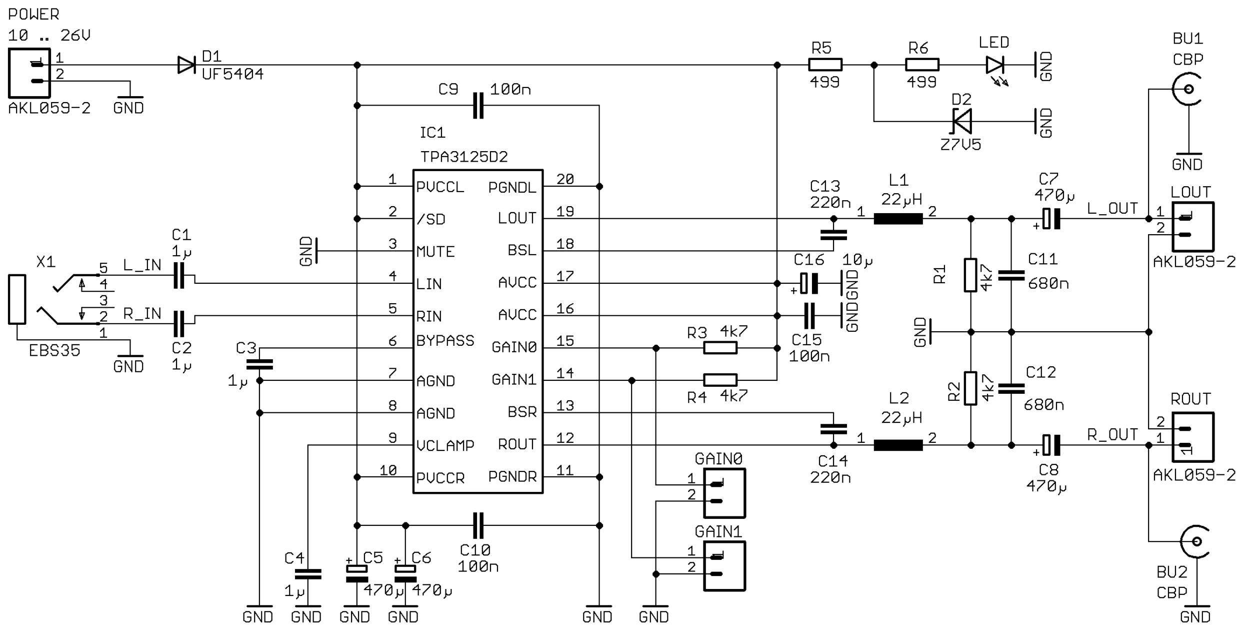

Figure 2: Schematic diagram of the amplifier

In Class D operation the power transistors operate digitally, which means they are either switched ON or OFF [3]. Compared to analog designs, power dissipation occurs only in the ON state, which can be handled by the IC with no heatsink required. The design mainly follows the datasheet recommendations [2]. LC networks L1/C11 and L2/C12 at the output result in a flat frequency response. These values are valid for 4 Ω loudspeakers. Gain can be adjusted with the jumpers from 20 to 36 dB in about 6 dB steps. The input resistance depends on the gain, as well. See Table 1 for details.

Jumper			
Gain1	Gain0	Gain	Input Resistance
closed	closed	20 dB	60 kΩ
closed	open	26 dB	30 kΩ
open	closed	32 dB	15 kΩ
open	open	36 dB	9 kΩ

Table 1: Jumper settings vs gain and input resistance

Input resistance and the lower frequency limit of the input depend on the chosen gain and on the values of capacitors C1 and C2. The lower frequency limit of the output is defined by the impedance of the loudspeakers and the output capacitors C7 and C8. As shown, the lower frequency limit is about 85 Hz.

Diode D1 protects the amplifier in case of reverse polarity. The LED acts as a power indicator, while resistors R5, R6 and Zener diode D2 limit the LED current to 8 to 10mA.

Construction

The component scheme in Figure 3 shows all required info where to place the components.

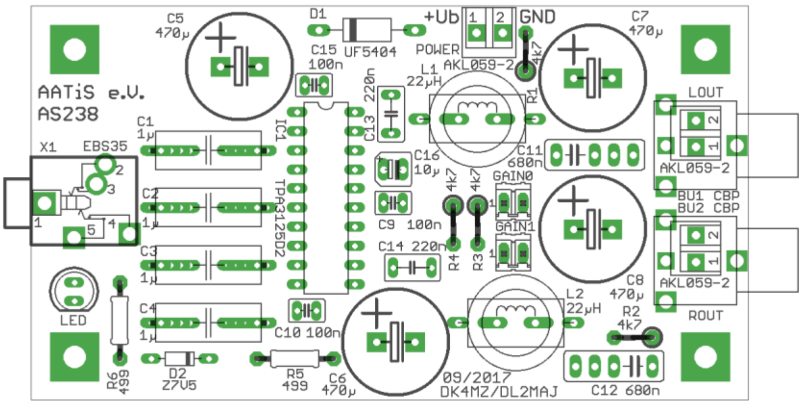

Figure 3: Components Scheme

Building the kit starts by installing components with the lowest height: Diode D2 and the resistors R5 and R6. Insert only a few components, turn over the PCB, and solder them. This offers a fast and easy way where you need no more than two hands for holding the component, the soldering iron, and the solder. In the next step, install the diode D1 and the IC socket. (A socket is used for IC1 to have an easy exchange job in case of problems.) Proceed with the rest of the components.

Decide on the type of output connectors before soldering them to the board: The PCB can accept Cinch sockets OR terminal screws, BUT not both!

After completion and a careful inspection of all solder joints the amplifier should work. Volume control is provided by the signal source, e.g. the smartphone or radio.

Output Spectrum

The datasheet [2] specifies the switching frequency at 300 kHz ± 50 kHz. Figures 4 through 6 show the spectrum of the output signal of one channel at different operating conditions.

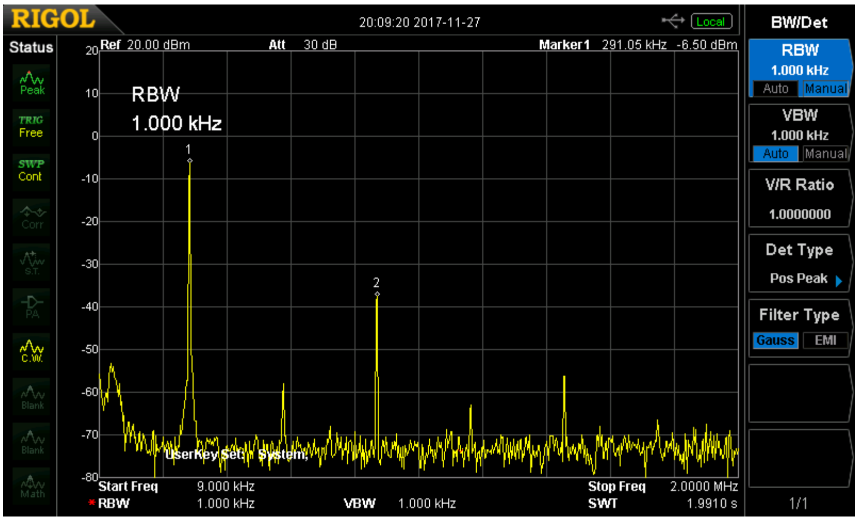

Figure 4: Output signal without input signal (9 kHz to 2 MHz)

Marker1 in Figure 4 (under the "RBW 1.000 kHz" label) indicates the switching frequency of 291.05 kHz. This value is visible in the upper right part of Figure 4.

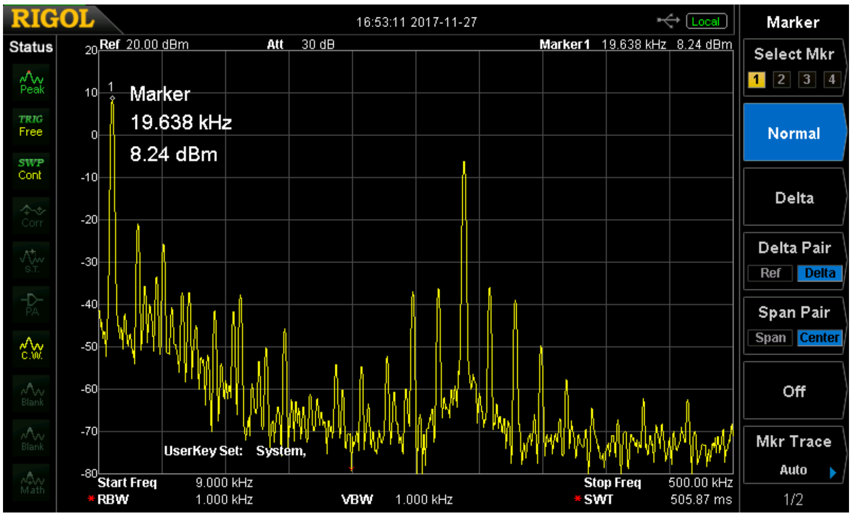

Figure 5: Output signal with 20 kHz input signal (9 kHz to 500 kHz, Marker1 at 19.638 kHz)

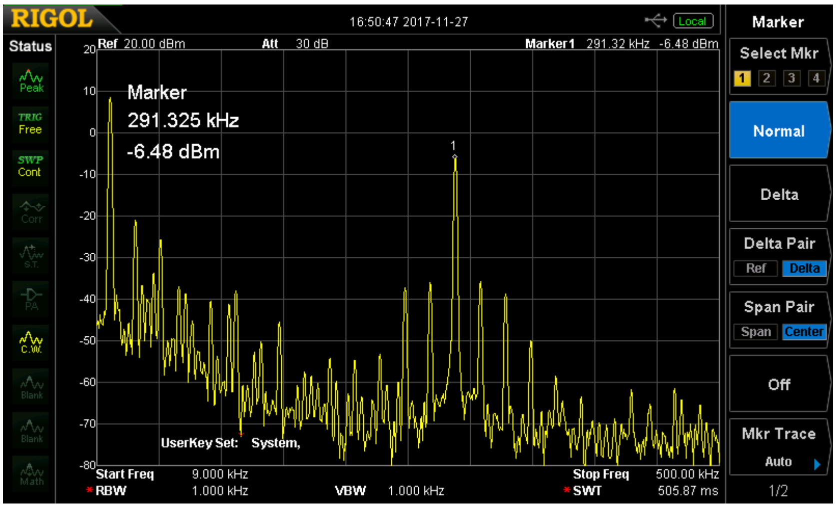

Figure 6: Output signal with 20 kHz input signal (9 kHz to 500 kHz, Marker1 at switching frequency)

A component at the switching frequency of 291 kHz is clearly visible. With modulation a lot of spurious signals occur, but at lower audio frequencies these are close to the switching frequency and out of the audio band.

Building the Amplifier

A kit (part number AS238 at a cost of 12€) for this project is offered by “Arbeitskreis Amateurfunk und Telekommunikation in der Schule” (AATIS, www.aatis.de) and can be ordered by email via bestellung@aatis.de.

References

[1] Andreas Köhler, *Klasse-D-NF-Verstärker mit S/PDIF-Eingang*, FUNKAMATEUR June 2017, page 532-534
[2] Datasheet TPA3125D2, www.ti.com
[3] https://de.wikipedia.org/wiki/Klasse-D-Verstärker

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