Headphone amplifier

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Solid State Amplifier with Transformer Output without Common OS

The presented amplifier circuitry is quite different from typical implementations.

such kind of devices. The amplifier is assembled on discrete components and has a very short sound

track, in fact it contains two stages (three active elements directly in the path). In the amplifier

there is no common OS, and good technical parameters are obtained by parametric linearization

tion and application of local operating systems. For optimal matching with different loads in the amplifier

an autotransformer is used. Sufficiently large output power - 0.8W, allows it to successfully

but work with almost any head phones. The presence of an 8 Ohm output makes it possible

work and sensitive broadband acoustics.

We can say that the approach itself when designing an amplifier and the applied solutions are more

characteristic of lamp circuitry, but transferred to a solid-state element base.

If we talk about a subjective assessment, then we can say with confidence that it sounds tangible

better than portable devices with class "D" amplifiers. Compared to good

tube amplifiers, then "better - worse" is probably not entirely applicable here, the sound is different, but

balance and resolution - it is not inferior to them. Yes, and the result of a subjective assessment

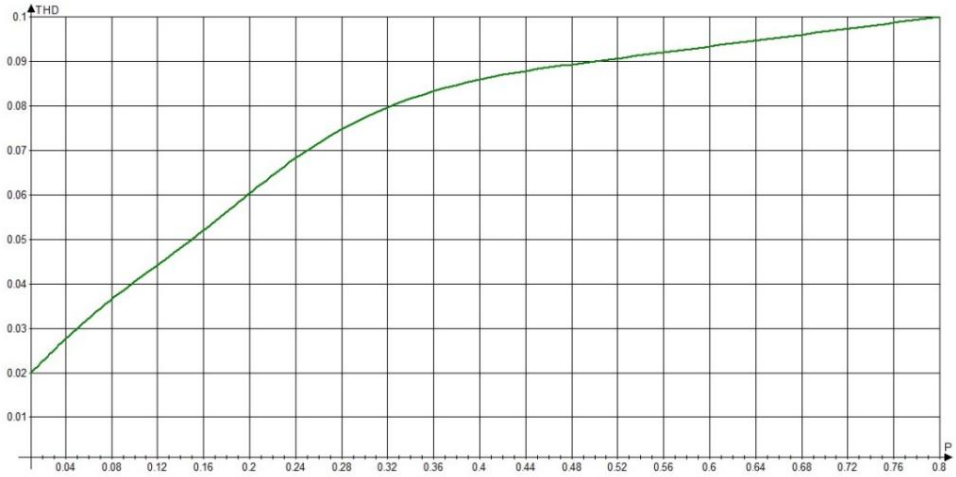
ki is highly dependent on headphones.

The amplifier has the following parameters:

Rated output power	0.8W
Sensitivity Load range Power band (depends on	0.7Vrms
selected rated load) Harmonic factor (max.) Output	8-600 (8,32,150,600) Ohm
noise level Inputs Power consumption Supply voltage	5Hz-80(40)kHz
	0.11%
	120µV
	RCA, mini-jack
	30W
	205÷250V 50, 60Hz

At the output of the amplifier, only the second and third harmonics are present, which quickly fall off with decreasing

output power (Fig. 1)



Picture 1

Amplifier circuit

Actually the amplifier itself has three main nodes: the driver, the output stage and the power system.

And in principle, they can be used together or separately.

Driver.

The rather small input capacitance of the output stage (ÿ50pF) allowed for an unusual solution (Fig. 2). A cascode amplifier with a deep local OS is used as a driver. The gain of the cascade without feedback reaches several thousand at medium frequencies, the introduction of local feedback through resistors R9, R14 (R12, R15) reduces the gain to 20. In fact, the gain of the cascade determines

by the ratio of the resistor in the collector of the upper transistor to the equivalent resistance of the resistor

OS. This made it possible to obtain high linearity and low sensitivity of the circuit to the parameters of the transit stores.

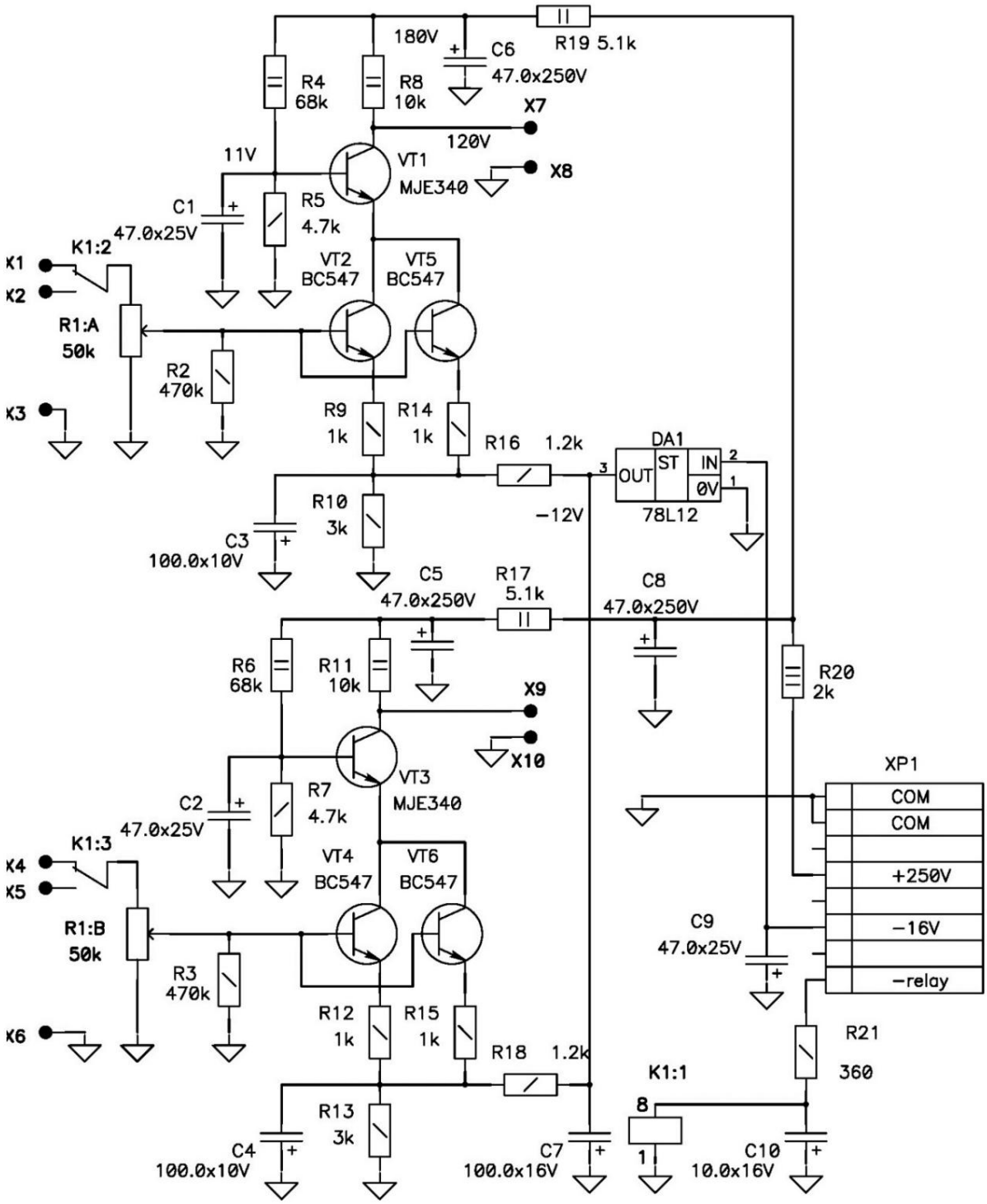


Figure 2 Although the load capacitance of the driver

is not large, the quiescent current of the driver must be large enough

(ÿ6mA), which conflicts with the desire to minimize the noise level. This problem is partially solved by parallel connection of input transistors. The inherent noise level of the cascade does not exceed

raises 30μV. The amplifier bandwidth starts from a few hertz and ends at 200 kilohertz with a capacitive load of about 60pF. In order to obtain a

large output signal swing with low distortion and provide the desired

DC modes, the driver is powered by high voltage. The direct current mode itself is set by a negative bias on the resistor R10 (R13) from the auxiliary source (DA1). Stabilizer noise is effectively suppressed by a filter formed by elements R16 (R18), C3 (C4). To some, this solution may seem overly complicated, but it allows you to get rid of one

capacitance in the signal circuit.

output stage.

It is implemented on the basis of a source follower with parametric stabilization of the operating point (Fig. 3). I want to draw the attention of readers that the local OS inherent in the source follower is one entity, and the stabilization of the operating point is the second entity, and it is not a classical OS, where the input and output signals directly interact [1]. The main difference between the cascade and the previous versions described is the ability to work on a grounded load.

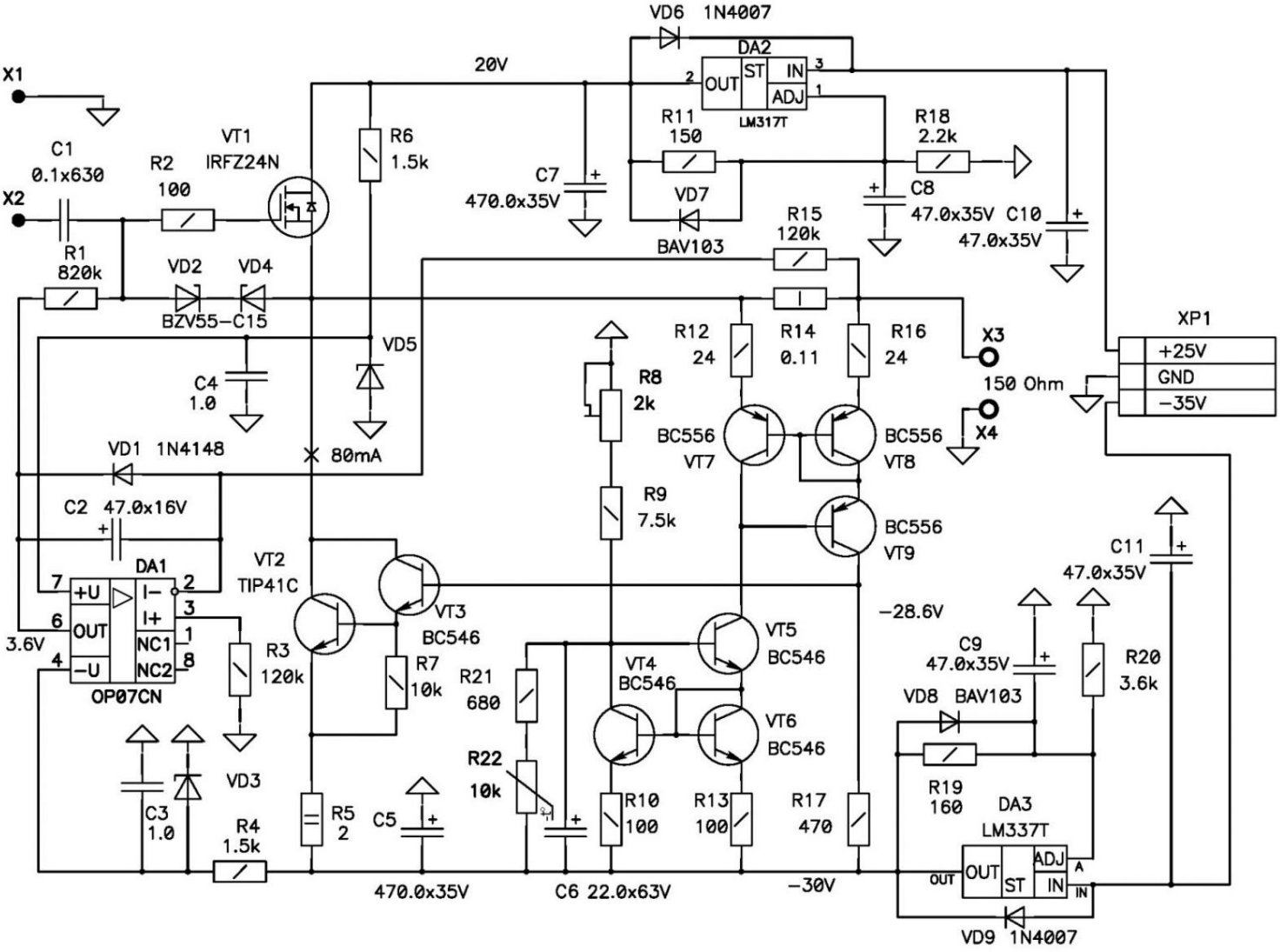


Figure 3 A very low-frequency OS on the op-

amp DA1 ensures that zero is held at the output of the stage. Information

about the load current is taken from the current sensor R14 and amplified by a transconductance amplifier on transistors VT2÷VT9. NTC thermistor R22 stabilizes the quiescent current of the stage when the temperature of the output transistor changes. The quiescent current of the output stage is set by resistor R8.

To reduce the mutual influence of the channels, each output stage has its own stabilizers.
lysers - DA2, DA3.

The rated load of the cascade is 150 Ohm. The cascade is directly loaded on a matching auto-transformer, which determines its frequency response. Matching autotransformer of Ukrainian production type TVZ TU8-600 (with very good parameters). The cascade works fine even without an output transformer and scales well in terms of output power.

Structurally, the output stage is implemented as a functionally complete module. transistors
VT1, VT2 must be on the same heatsink, and with this heatsink it is necessary to ensure good thermal contact of the thermistor. Connecting powerful transistors and stabilizer microcircuits with wires is highly undesirable.

Supply system

The amplifier used a centralized linear stabilizer with a control element
ment on the primary side of the power transformer [2]. The advantage of this approach is good suppression of network noise and the ability to minimize losses in the stabilizers of the output stages. The downside is the rather high complexity and the need to use a non-standard power transformer. In principle, just such a solution is not at all necessary, everything can be implemented more simply without significant losses in quality. Therefore, I will not give diagrams, but will dwell on the necessary voltage parameters at the channel outputs.

The voltage at the output of the channel that feeds the output stages is selected based on the inherent
network instability and, in the worst case, should exceed the output voltage of the stabilizers by 2-3 volts. Permissible ripple level - 200÷300mV. The total current consumption of the output stages is about 200mA. Naturally, in this case, it will be necessary to increase the area of the heatsinks of the stabilizer chips.
congestion.

The high supply voltage of the driver needs to be stabilized. Since the current consumption of the driver is small (about 17mA) and constant, you can get by with a conventional parametric stabilizer on a zener diode. The main requirement: the minimum level of noise and ripple at the level of 200÷300μV. The amplifier used a multi-section RC filter, the second and third filter sections are placed directly on the driver board.

There are no special requirements for the auxiliary voltage parameters. It is also necessary to take into account the instability of the network for the normal operation of the 12-volt stabilizer and provide a ripple level of about 50mV. On this channel, the maximum current consumption is about 30mA.

Prototype

For a more thorough check of the sound properties and the identification of hidden "devils", a re-
the amplifier prototype was lysed (Fig. 4). This case design is not mandatory, but there are a few important points to consider when making or selecting a case.

First of all, you need to take care of the maximum separation in space between the power and output transformers or think about their good magnetic shielding. Sufficient cooling of the output stages must also be ensured. In total, the power dissipation on the power transistors of the output stage is about 5W. If the power supply system is implemented without a primary stabilizer, then it is necessary to take into account the power dissipated on the stabilizers of the output stage at the maximum mains voltage (the current consumption of each output stage is about 90mA). In the prototype coolers

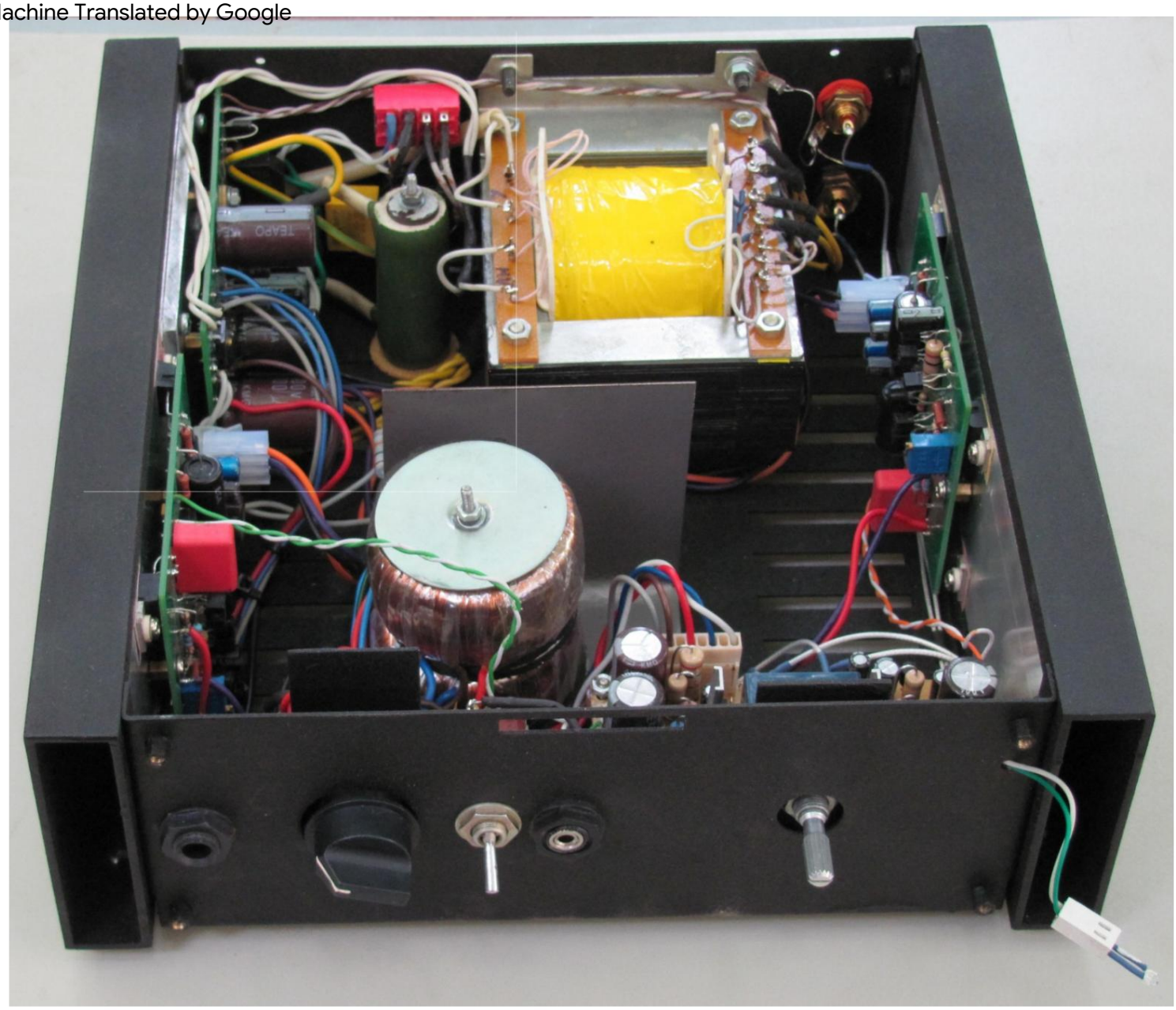


Figure 4

serve as the side walls of the housing, made of thick-walled rectangular aluminum tube. Case dimensions - 240x240x80 mm.

Literature

1. E.V. Karpov, Hybrid World (p. 12); 2003 2. E.V. Karpov, Stabilized power supply of a tube amplifier; 2006

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