

Sixties-style 40 W Audio Amplifier



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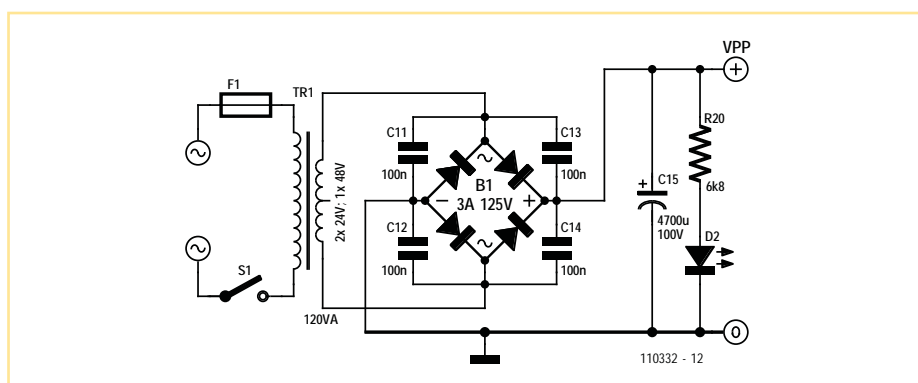
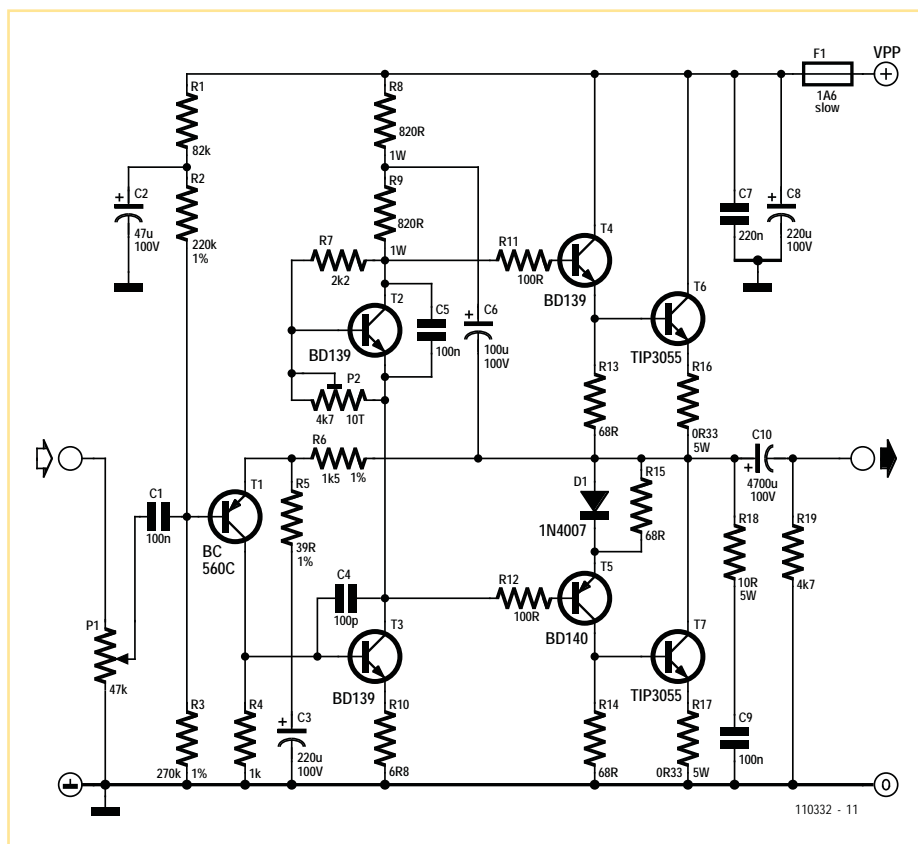
In the early 1960s RCA brought out a transistor that was to become truly legendary: the 2N3055. With a pair of these devices, you could put together an audio power amplifier that could deliver a healthy 40 W into 8 Ω . The circuit described here is fully in tune with the spirit of that era. For example, there are only seven active components in each channel, which reflects the design simplicity typical of that era (and actually a timeless quality). This 'retro' power amplifier pumps 45 W into 8 Ω with an input signal level of 0.5 V_{rms}.

It works as follows: the input signal is applied to the base of T1, while negative feedback from the output, attenuated by voltage divider R5/R6, is applied to the emitter of T1. The collector current of T1, which is proportional to the difference between the input and feedback signals, is fed to the base of T2. This transistor draws its operating current through R8 and R9 and provides voltage gain. Capacitor C6 is a bootstrap capacitor that hold the voltage across R9 nearly constant, so that the current through R9 is independent of the amplifier output signal level in the audio band.

Transistors T4–T7 form a quasi-complementary push-pull output stage. In the early 1960s, there simply wasn't any PNP transistor available that was truly complementary to the 2N3055. Designers came up with an ingenious way to get round this problem, which was to use a complementary Darlington pair consisting of a PNP driver transistor and an NPN power transistor. The schematic diagram clearly illustrates what is meant by a quasi-complementary push-pull output stage. Diode D1 provides balanced biasing for the output stage, which helps reduce distortion.

The operating point of the output stage is set and stabilized by transistor T3, which for this reason should be thermally coupled to the output transistors. The amplifier is powered from a single supply voltage at approximately 65 V, which is also 'typical sixties'. Capacitor C1, with a value of 4700 μ F, transfers the signal from the output stage to the load and provides a bit of protection for the speaker in case one of the transistors fails.

The amplifier does not have output current limiting. Although this is not a critical short-coming, a certain amount of caution is advisable. The only protection in this regard is provided by a slow-acting 1.6-A fuse in the supply



Performance figures with an 8.2 Ω resistive load (indicative values)

THD	0.08%; third harmonic at 1400 Hz; output level 3 V
Bandwidth	29 Hz (–3 dB) to over 100 kHz (–0.5 dB) at an output level of 3 V _{rms} –3 dB at 100 kHz referred to 18 V at 1.0 kHz
Maximum output voltage	19.5 V at the saturation threshold

line, which is intended to limit the damage if anything goes wrong.

The power supply consists of a transformer, a bridge rectifier, four small capacitors and a 4700 μ F electrolytic capacitor. This is enough to power a two-channel stereo amplifier. The LED is a power-on indicator and is intended to

be fitted on the front panel.

Assembling the circuit is very straightforward. Transistors T3, T4 and T5 should be fitted with heat sinks suitable for a TO126 package and with a thermal resistance less than 20 K/W. Transistors T2, T6 and T7 should all be fitted on a single heat sink with a thermal

resistance of 2 K/W or less, using insulating washers and thermal paste.

Before applying power to the circuit for the first time, set P2 to its maximum value, temporarily replace the fuse with a 47 Ω , 5 W resistor, and connect a voltmeter across R17. Then switch on the power.

The voltmeter should indicate 0 V. Now carefully adjust P2 until the voltmeter reads 15 mV, which corresponds to a quiescent current of 50 mA. Then switch off the power and

install the fuse in place of the power resistor. After this, check the voltage across R17 again (with the power on) and if necessary adjust it to 15 mV.

This is fun DIY project, cheap and unpretentious. Nevertheless, the sound quality of this amplifier is respectable. The distortion level gives no grounds for complaint. Of course, it's not a figure with an incredible number of zeros after the decimal point, but the idea here is to brush up on sixties technology.

The author has designed two PCB layouts: one for the amplifier and one for the power supply. The layouts can be downloaded from [1] in PDF, Gerber and/or Easy-PC CAD format.

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Internet Link

[1] www.elektor.com/l/110332