Its modest dimensions and battery operation make this amplifier eminently suitable for use out of doors: at garden parties, sporting events, boating galas, to name but a few. It might be classed as a good-quality PA (public address) amplifier in view of its better frequency response than usually found in run of the mill PA units.

MOBILE AF POWER AMPLIFIER

by
Arno Sevriens

In contrast to hi-fi power amplifiers, which are designed for low distortion, high slew rate, low noise, and good damping factor, public address amplifiers must meet different requirements. Among these are high output power, good reliability, and robustness.

Generally, low supply voltages result in relatively low power outputs. This is, however, not the case in the present amplifier, as shown in Table 1. The figures in this table become even more impressive if the modest dimensions of the amplifier are considered. Note that the supply voltages in the table are either asymmetrical or symmetrical. The difference between the two will be reverted to later.

Table 1. Correlation of input voltage, output power, and supply voltage.

Table 1.

Supply voltage	Supply current	Output power	Corresponding input voltage (rms)
12 V (±6 V)	1 A	5 W into 4 Ω	85 mV
12 V (±6 V)	2 A	10 W into 2 Ω	85 mV
24 V (±12 V)	3 A	40 W into 4 Ω	210 mV
24 V (±12 V)	6 A	80 W into 2 Ω	210 mV
36 V (±18 V)	5 A	100 W into 4 Ω	330 mV

Circuit description

Designing a power amplifier used to be a complicated and complex job. Nowadays, however, the complexity is contained entirely in proprietary ICs to which only a few external components need to be added to obtain a first-class amplifier. There used to be a lot of scepticism about these 'black boxes', but over the years they have more than proved themselves, so that any doubt as to their operational qualities is quite misplaced. The only drawback with them is that there is so little to explain about the final circuit.

Figure 1 shows that the proposed design is of the double push-pull type, which is about the only way that a large output power can be obtained from a low supply voltage. This arrangement ensures an available power output double that of a single push-pull amplifier. If then the output impedance is halved, the output power is doubled again, so that four times as much power becomes available. Note that the power developed by an output amplifier is determined by

$$P = u_{pp}^2/8R_L \text{ [W]} \qquad (1)$$

where P is het output power, u_{pp} is the maximum peak-to-peak voltage excursion across the load, and R_L is the load (i.e., loudspeaker) impedance.

A noteworthy aspect of the circuit is that, although the loudspeaker is direct-coupled to the amplifiers, an asymmetrical supply may be used. This is made possible by the virtual earth created by R_4 and R_5. It is, of course, true that this is high impedance, but this is of no consequence here because the output current does not return via earth. However, since it is permissible — and often preferable, as will be seen later — for a symmetrical supply to be used, the circuit makes provision

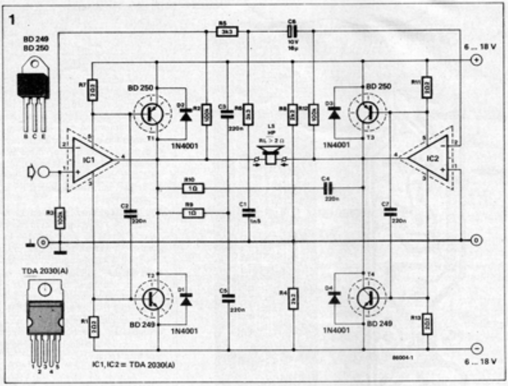

Fig. 1. The circuit diagram of the power amplifier is basically a double push-pull arrangement.

for both. Normally, therefore, an asymmetrical supply of 12 to 36 V is connected to the ⊕ and ⊖ terminals. Both push-pull amplifiers consist of a Type TDA2030(A) driver and complementary power stages Type BD249-BD250. The TDA2030(A) is a self-contained Class AB amplifier capable of delivering up to 18 W into a 4 Ω loudspeaker. It may, unfortunately, prove difficult in certain areas to get hold of a TDA2030A, in which case the TDA2030 may be used. This delivers a maximum power of about 14 W into 4 Ω. A further difference between the two types is that the (A) version may be used with supply voltages of up to ±22 V as against ±18 V for the basic version.

Whenever the load current rises above a level which the drivers cannot handle (and this almost entirely depends on the supply voltage), power stages T_1 to T_4 are switched on via resistors R_1, R_7, R_{11}, and R_{13}. Negative feedback provided by R_5-R_6-C_7-C_6 ensures fully stable operation.

Although there is no real protection against short-circuiting of the output, since this is difficult to realize in this type of amplifier, the thermal protection circuit in the driver ICs enable the unit to withstand quite a lot of rough treatment.

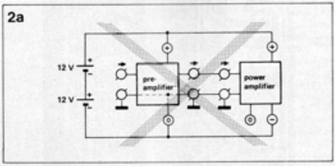

Fig. 2a. Incorrect way of using the same supply for a pre-amplifier and the power amplifier, because the earth return lines in the two units are at a different potential.

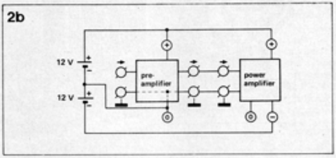

Fig. 2b. A pre-amplifier intended for operation from an asymmetrical supply should be connected as shown here.

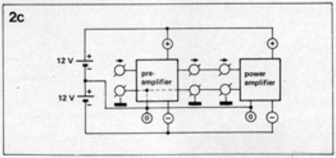

Fig. 2c. If the pre-amplifier is designed for a symmetrical power supply, it should be connected as shown here.

Construction

It is advisable to build the amplifier

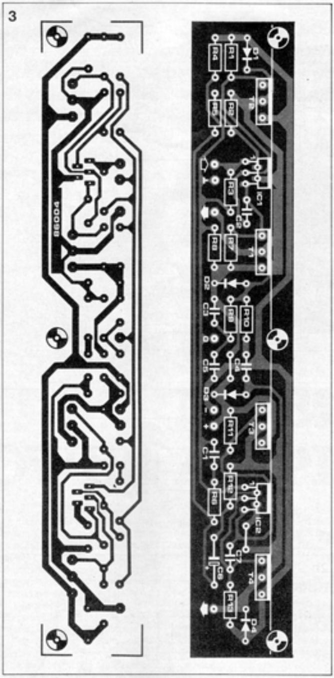

Fig. 3. The printed-circuit board for the power amplifier can conveniently be combined with a 200 mm long heat sink for the power stages.

on the printed-circuit board shown in Fig. 3. This has been designed to mate with a 200 mm long heat sink for the ICs and power transistors, which obviates any long connecting wires between these components and the board.

The driver ICs and power transistors should be mounted onto the heat sink with the aid of insulating washers (provided with these components) and ample silicone grease. It is recommended to tap three M3 threaded holes in the flange of the heat sink to facilitate mounting the PCB. The completed assembly is shown in Fig. 4.

The amplifier may be fitted in a suitable case of its own, but in many cases it would be more sensible to combine it with an appropriate pre-amplifier. Whatever housing is used, however, it is important that there is adequate cooling of the heat sink.

Screened cable should be used for connecting the pre-amplifier to the power amplifier. Power lines and loudspeaker connections should have a cross-sectional area of not less than 2.5 mm².

Use of a pre-amplifier

As stated earlier, the power amplifier may be powered by an asymmetrical 12 to 36 V supply or a symmetrical ±6 to ±18 V one. The supply may consist of a 12 V car battery, or two or more of such batteries in series, or it may be a simple mains supply. In the latter case, a symmetrical version is obtained by the use of a centre-tapped mains transformer.

If the supply is used to power the pre-amplifier also, care should be taken to ensure that the signal earths in the two amplifiers are at the same potential. If, for instance, the pre-amplifier is intended to be powered by an asymmetrical supply and is then connected to the power amplifier supply, the ⊖ line in the power amplifier will be shorted to earth as shown in Fig. 2a. The only solution to this problem is to use a symmetrical supply and power the pre-amplifier from one half of this as shown in Fig. 2b. If the pre-amplifier is intended to be powered symmetrically, there are, of course, no problems — see Fig. 2c. ⧓

SGS application

Parts list

Resistors:
$R_1;R_7;R_{11};R_{13}$ = 2Ω2
$R_2;R_3;R_{12}$ = 100k
$R_4;R_8$ = 2k2
$R_5;R_6$ = 3k3
$R_9;R_{10}$ = 1 Ω

Capacitors:
C_1 = 1n5
$C_2 \ldots C_5;C_7$ = 220n
C_6 = 10µ;16V

Semiconductors:
$T_1;T_3$ = BD250
$T_2;T_4$ = BD249
$D_1 \ldots D_4$ = 1N4001
$IC_1;IC_2$ = TDA2030(A) (see text)

Miscellaneous:
heat sink 100 × 200 × 25 mm, e.g. Fischer SK42 type

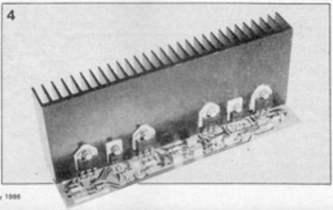

Fig. 4. Completed assembly of PCB and heat sink.