50 W a.f. amplifier

uses only one IC

Although audio enthusiasts come in many sizes and colours, not many of them are prepared to spend a lot of money, time and effort to build an a.f. amplifier using up to 40 transistors to improve the distortion by a fraction of a per cent. Therefore, the amplifier described here should appeal to those enthusiasts. It is compact, presents no problems and yet has properties that make it fully suitable for all but the most demanding audio applications. In short, an amplifier that is geared to the practical audio buff.

Source: SGS Thomson

The Type TDA7294 IC from SGS-Thomson is an integrated a.f. amplifier intended for use in all sorts of hi-fi application. Its circuit diagram is shown in **Figure 1**. Its most prominent feature is the much higher power output than is usual with this kind of integrated amplifier. According to the manufacturer's data sheets, the special DMOS output stage of the 15-pin chip can deliver outputs of up to 100 watt. Considering other properties, such as low noise, low distortion and reliable short-circuit and thermal protection circuits as well, the chip is indeed an interesting one.

Having said that, power output specifications are often rather optimistic. In this instance, the 100 W appears to refer to the IEC norm for music power with 10 per cent distortion, which, as far as hi-fi applications are concerned, is not the correct way of specifying output power. Moreover, with peak supply voltages of ±40 V and a load impedance of 4 Ω, the maximum dissipation of the IC will easily be exceeded. For these reasons, the supply in the present amplifier has been kept down to a safe ±30 V. At these voltages, the chip delivers, without any difficulty, 50 W into an 8 Ω load and 80 W into a 4 Ω load. These are still very respectable figures, particularly in view of the reasonable price of the chip.

Specification

Input sensitivity:	1.3 V (50 W into 8 Ω)
Input impedance:	10 kΩ
Bandwidth:	16 Hz – 100 kHz
Slew rate:	10 V µs^{-1}
Output power:	50 W into 8 Ω (0.1% THD)
	82 W into 4 Ω (0.1% THD)
Signal-to-noise ratio:	105 dBa (1 W/8 Ω)
THD+N with 40 W into 8 Ω:	0.002% (1 kHz)
	< 0.04% (20 Hz – 20 kHz)

CIRCUIT DESCRIPTION

The circuit diagram of the amplifier in **Figure 2** shows that the IC needs only

a small number of external components. To keep the harmonic distortion low, the amplifier has a large feedback ratio and its closed-loop gain has been restricted to only 24 dB.

The input signal is applied to pin 3 via capacitor C_1 and low-pass filter R_6-C_{10}. The filter improves the pulse response and flattens the frequency response. For minimum output offset, the values of R_1 and R_3 should be equal, so that the input impedance is 10 kΩ. The roll-off frequencies of R_1-C_1 and R_2-C_2 determine the lower bandwidth limit of the amplifier: with values a specified, this is about 16 Hz. The upper –3 dB point is at about 100 kHz.

The amplifier is muted by a relevant input to pin 10 and placed in the stand-by mode by a relevant signal at pin 9. Muting should always take place before the stand-by mode is selected. Connecting the mute and standby pins permanently to the supply line ensures that the amplifier comes on immediately the power is switched on. Any switch-on clicks may be eliminated by increasing time constants R_3-C_4 and R_5-C_5.

If large-value electrolytic capacitors are used in the power supply, switching off will be rather slow. If that is considered a nuisance, an external mains detection network may be added. This can consist of, say, two diodes and two small smoothing capacitors for rectifying the secondary voltage of the mains transformer. The board has provision for this in the form of additional soldering pins adjacent to the mute and stand-by inputs: an earth pin in case use is made of an external protection circuit and a plus pin if such protection is not foreseen.

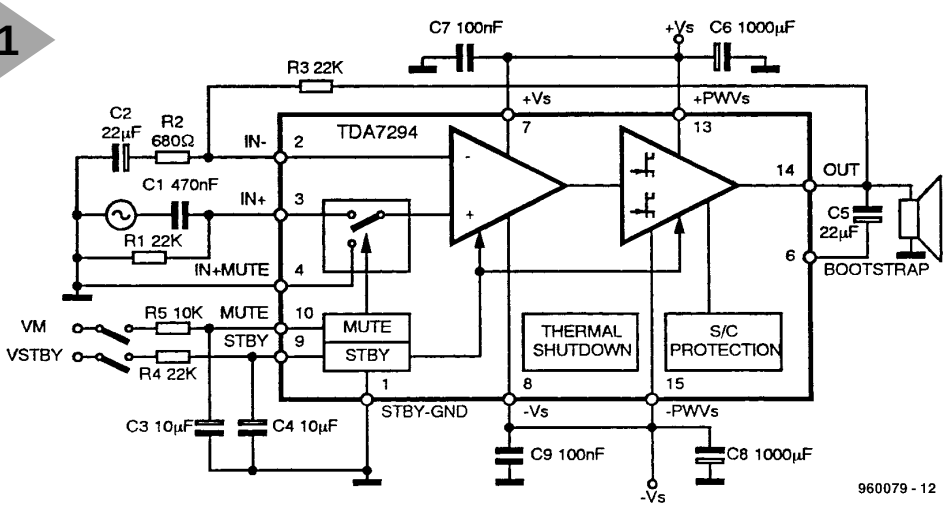
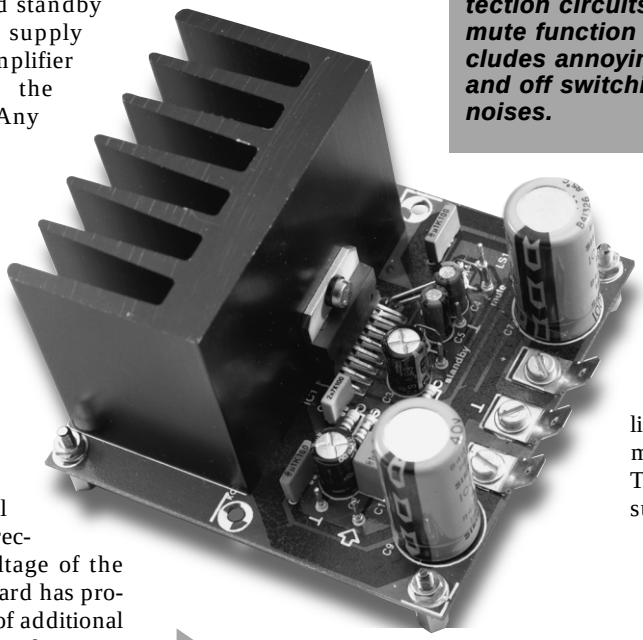


Figure 1. The TDA7294 has standard thermal and short-circuit protection circuits. The mute function precludes annoying on and off switching noises.



CONSTRUCTION

It is best to build the amplifier on the printed-circuit board shown in **Figure 3**. The illustration proves what a compact unit this amplifier is. In view of the scarcity of components, populating the board is very simple.

The back surface of the IC is linked internally to the negative supply rail. Consequently, to preclude electrical contact between the heat sink and the enclosure, the heat sink is mounted on the board. Insulating material between the heat sink and the IC is, therefore, not needed, although the use of some heat conducting paste is advisable.

In the selection of a suitable heat sink, a continuous output of 50 W into 8 Ω was assumed. The selected heat sink is also all right for music outputs of 80 W into 4 Ω. Problems caused by high temperatures are very unlikely, since the IC has internal thermal protection that causes the mute to come into operation at 145 °C and switches the amplifier to stand by at 150 °C.

Provision for connecting the power lines to the board is by three PCB terminal blocks (clamping-screw type). These ensure loss-free passage of the supply current.

The symmetrical power supply is

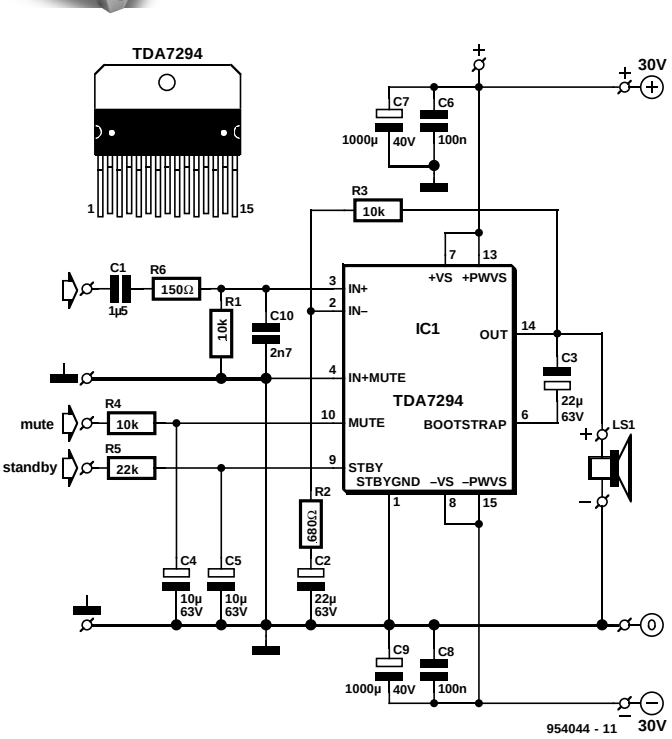


Figure 2. In the final design of the amplifier, supply voltages of ±30 V were decided upon; these are more than sufficient for a power output of 50 W into 8 Ω.

3

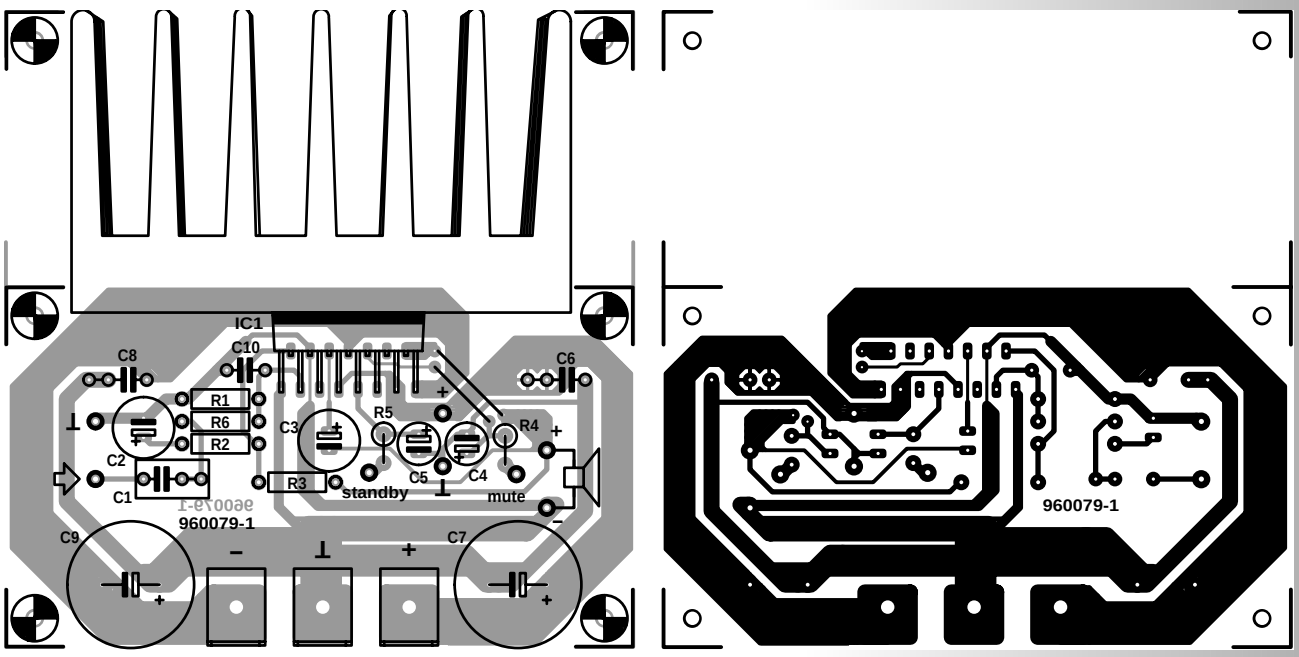


Figure 3. The printed-circuit board is very compact and even houses the requisite heat sink.

best constructed from a toroidal mains transformer, a 25 A bridge rectifier and two 10,000 µF, 50 V electrolytic capacitors.

FINALLY

As mentioned before, thanks to its good performance and high power output, the amplifier is in principle usable in virtually any hi-fi set-up. Owing to its compactness, it is particularly suitable for use in combination with a preamplifier as an integrated amplifier or as part of an active loudspeaker system where space is almost always at a premium.

For those who would like some proof of the figures given in the specification table, **Figure 4** shows the distortion characteristic of the amplifier obtained with a spectrum analyser. The measurements were carried out at an output power of 40 W into 8 Ω and a bandwidth of 80 kHz. As usual, the characteristic slopes upward at higher frequencies, but the distortion does not exceed 0.04 per cent. In a large part of the a.f. range (up to about 1 kHz), the total-harmonic-distortion-plus-noise (THD+N) does not even rise above 0.02 per cent. This sort of performance is excellent for all but the most demanding applications. [960079]

Parts list

Resistors:
R_1, R_3, R_4 = 10 kΩ
R_2 = 680 Ω
R_5 = 22 kΩ
R_6 = 150 Ω

Capacitors:
C_1 = 1.5 µF, 63 V*
C_2, C_3 = 22 µF, 63 V, radial
C_4, C_5 = 10 µF, 63 V, radial
C_6, C_8 = 100 nF
C_7, C_9 = 1000 µF, 40 V, radial
C_{10} = 2.7 nF*, pitch 5 mm
* metallized polyester

Integrated circuits:
IC_1 = TDA7294V

Miscellaneous:
3 off PCB terminal block with clamping screws
1 off heat sink, 2.5 K W^{-1} (e.g. Fischer Type SK100, available from Dau – telephone 01243 553031))
for power supply:
1 off mains transformer, 2×22 V, 80 VA
2 off electrolytic capacitor, 10,000 µF, 50 V
1 off 25 A bridge rectifier
PCB Order no 960079-1 (see Readers' Services towards the end of this issue)

Figure 4. The distortion characteristic, measured with an output power of 40 W into 8 Ω, is excellent for this type of amplifier.

4