therefore, not made low by one of the ICs. The gate and source are both at 3.3 V so that the transistor is cut off. The I²C bus at the right section is not affected and this line is also high, but here the high level is 5 V (in the left section, it is 3.3 V).

2. An IC in the left section makes the bus low. The level at the source of the transistor is 0 V and that at the gate, 3.3 V.

The transistor conducts, so that the 5 V section is pulled low by the transistor and the relevant IC. This means that the low level at the left section is transferred to the right section.

3. An IC in the right section makes the bus low. The left section is pulled low via the diode in the transistor, not necessarily to zero but to a level a diode voltage above zero. This level is, however, low enough to switch on

the transistor, since the potential at the source is a few volts below that at the gate. Since FETs can conduct in two directions, the left section is made low via the transistor and the relevant IC in the right section. So, again the low level is transferred.

It is obvious that the FETs used must have some specific properties. One of the most important of these is that the transistor must conduct when
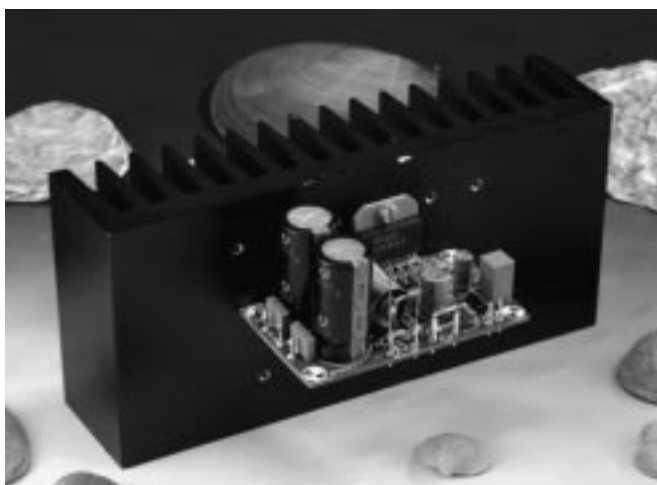
the gate-source potential is less than 2 V. Also, its channel resistance must be lower than 100 Ω, and it must be able to carry a current of at least 10 mA. Its input capacitance should not exceed 100 pF and it should be capable of switching within 5 ms. Suitable Philips types are the BSN10, BSN20, BSS83, and BSS88.

[984019]

003 100-watt single-IC amplifier

Specifications *(8 Ω/1 kHz unless otherwise noted)*

Input sensitivity:	1 V$_{rms}$ (63 W into 8 Ω)
Output power, 8 Ω:	63 W (THD <1%)
Output power, 4 Ω:	108 W (THD <1%)
Damping factor (8 Ω)	>450 at 1 kHz
	>170 at 20 kHz
Slew rate:	>10 V/μs (rise time = 5 μs)
Power bandwidth:	8 Hz to 90 kHz
Signal/noise ratio:	94 dBA (1 W into 8 Ω)

Design: T. Giesberts

According to National Semiconductor, the LM3886 is a high-performance 150W Audio Power Amplifier with Mute. The performance of the LM3886, say NS, utilising its Self Peak Instantaneous Temperature (°Ke) (SPIKe) protection circuitry, puts in a class above discrete and hybrid amplifiers by providing an inherently, dynamically protected Safe Operating Area (SOA). The LM3886T

comes in an 11 (staggered-) lead non-isolated TO220 package. We put the LM3886T through its paces, using two earlier publications (Ref. 1, 2) and an existing printed circuit board as a basis. For test purposes, the prototype of the amplifier was powered by a stabilised ± 35-V supply. A maximum undistorted output power of about 63 watts into 8 ohms was obtained at a drive level of 1 Vrms. Dropping the load impedance to 4 ohms

pushed the output power to no less then 108 watts. In practice, these power levels can be taken to mean 'music power', but do remember that the amplifier will not normally be powered from a regulated supply!

Great attention should be paid to the cooling of the amplifier IC. The cooling capacity offered by a heatsink as specified in the parts list is really only sufficient for load impedances of 6 ohms or more. Even if a heatsink with a thermal resistance lower than 1 K/W is employed, the amplifier IC will cause a 'hot spot' on the heatsink surface where the actual thermal resistance is much higher locally than the specification! With this in mind, it is recommended to drop the supply voltage to about ± 30 V if the amplifier is used to drive a 4-ohm load. Also, bear in mind that heatsink isolating materials like mica and even ceramics tend to raise the thermal resistance by 0.2 K/W to 0.4 K/W. The metal tab at the back of the IC is at the negative supply potential.

Boucherot network C6-R6 is not normally required in this application, and should be omitted unless the amplifier is found to be unstable as a result of an application which is widely different from the one shown here. Populating the amplifier board itself will be a piece of cake, and most of the time required to build the amplifier will go into drilling, cutting, mounting and isolating the heatsink. The printed circuit board shown here is available ready-made through the Publishers' Readers Ser-

vices. Note that the radial electrolytic capacitors are rated at 40 volts, so you have to make sure that the supply voltage can never exceed that level. The performance of the prototype amplifier built and tested in our design lab is expressed by the Specifications box.

(984062-1)

COMPONENTS LIST

Resistors:
R1,R3 = 1kΩ
R2,R4,R5,R8,R9 = 22kΩ
R6 = not fitted, see text
R7 = 10Ω, 5W

Capacitors:
C1 = 2μF2, MKT (Siemens), pitch 5mm or 7.5mm
C2 = 220pF, 160V, axial, polystyrene (Siemens)
C3 = 22μF, 40V, radial
C4 = 47pF, 160V, axial, polystyrene (Siemens)
C5 = 100μF, 40V, radial
C6 = not fitted, see text
C7,C8 = 100nF
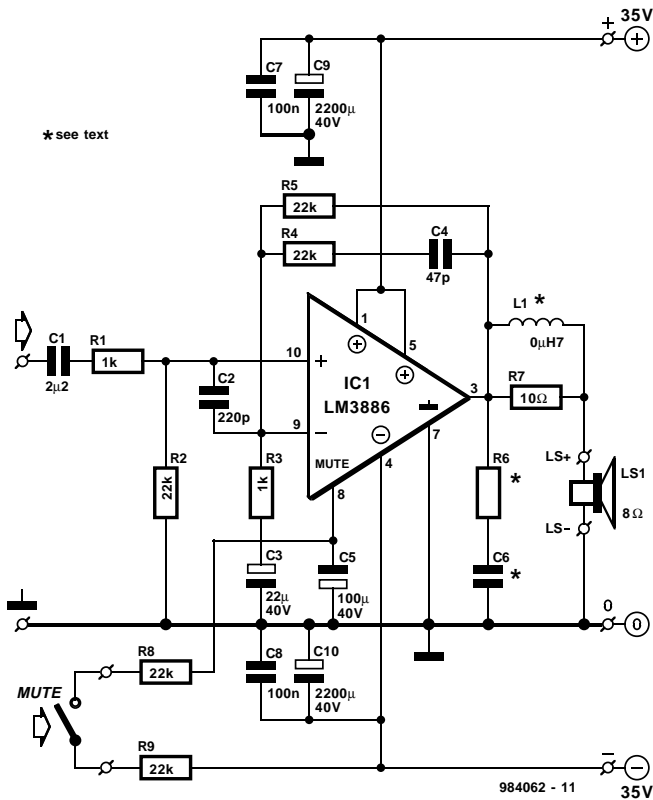C9,C10 = 2200μF, 40V, radial, max. diameter 16mm

Inductor:
L1 = 0.7μH, 13 turns of 1.2-mm diameter (#18 SWG) enamelled copper wire, 10mm internal diameter, wound around R7.
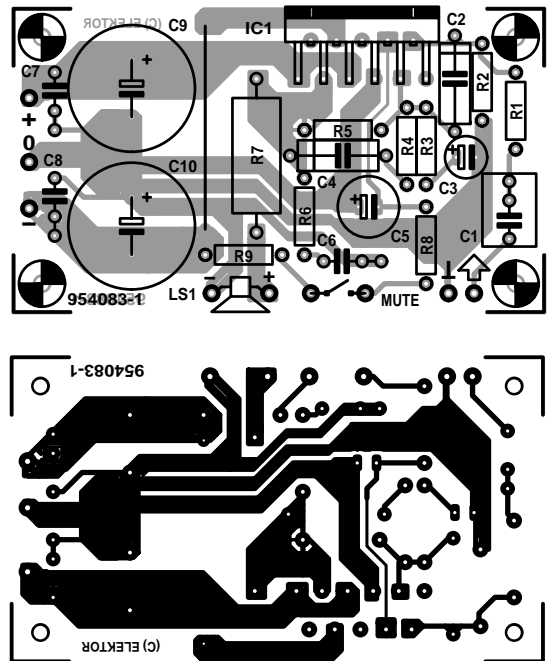
Semiconductor:
IC1 = LM3886T (National Semiconductor)

Miscellaneous:
Heatsink for IC1: specification R$_{th}$ < 1K/W
Printed circuit board, order code 954083-1.

References:
1. LM3886 150W Audio Power Amplifier with Mute (Application Note), *Elektor Electronics* May 1995.

2. Single-chip 50 W AF Amplifier, *Elektor Electronics* December 1995.

★ see text

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954083-1

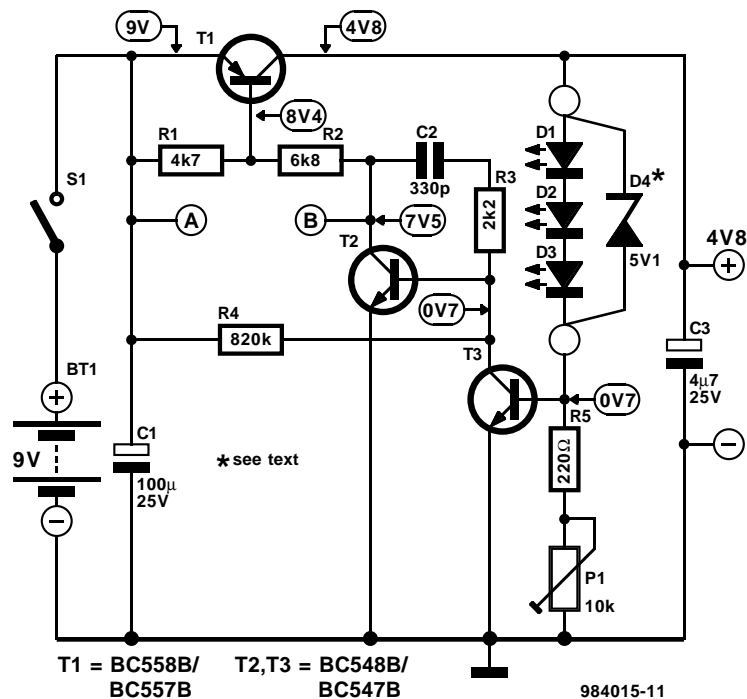# 004   thrifty voltage regulator

Design: F. Hueber

One of the drawbacks of a three-pin voltage regulator is that the input voltage needs to be 2.5–3 V higher than the output voltage. This makes these integrated regulators unsuitable for battery power supplies. If, for instance, the output voltage is 5 V, a 9 V battery could be discharged to 7.5 V or thereabouts only. On top of this, most of these regulators draw a current of about 2 mA. Special low-drop versions sometimes offer a solution, but they are not ideal either.

The regulator described here is rather thriftier: it draws a current of only 300 µA and the difference between its input and output is only 100–200 mV

In the circuit diagram, T_1 is arranged as a series regulator, which means that the difference between input voltage and output voltage is limited to the transistor's saturation potential. Therefore, a 9 V battery can be discharged to about 5 V, which is quite an improvement on the situation with an integrated reg-

ulator.

Diodes D_1-D_2-D_3, or a suitable zener diode (D_4), in conjunction with R_5 and P_1, form a

variable reference voltage source, which is used as the (output-dependent) base potential of T_3. If the output voltage

drops below a desired level, the base potential of T_3 also drops. The transistor then conducts less hard and its collector volt-

T1 = BC558B/BC557B   T2,T3 = BC548B/BC547B

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