Looking for an easy-to-build audio power amplifier with more power than the 25W module in the December 1993 issue? This single-chip power module will provide 50W RMS continuous into 8 ohms with extremely low distortion.

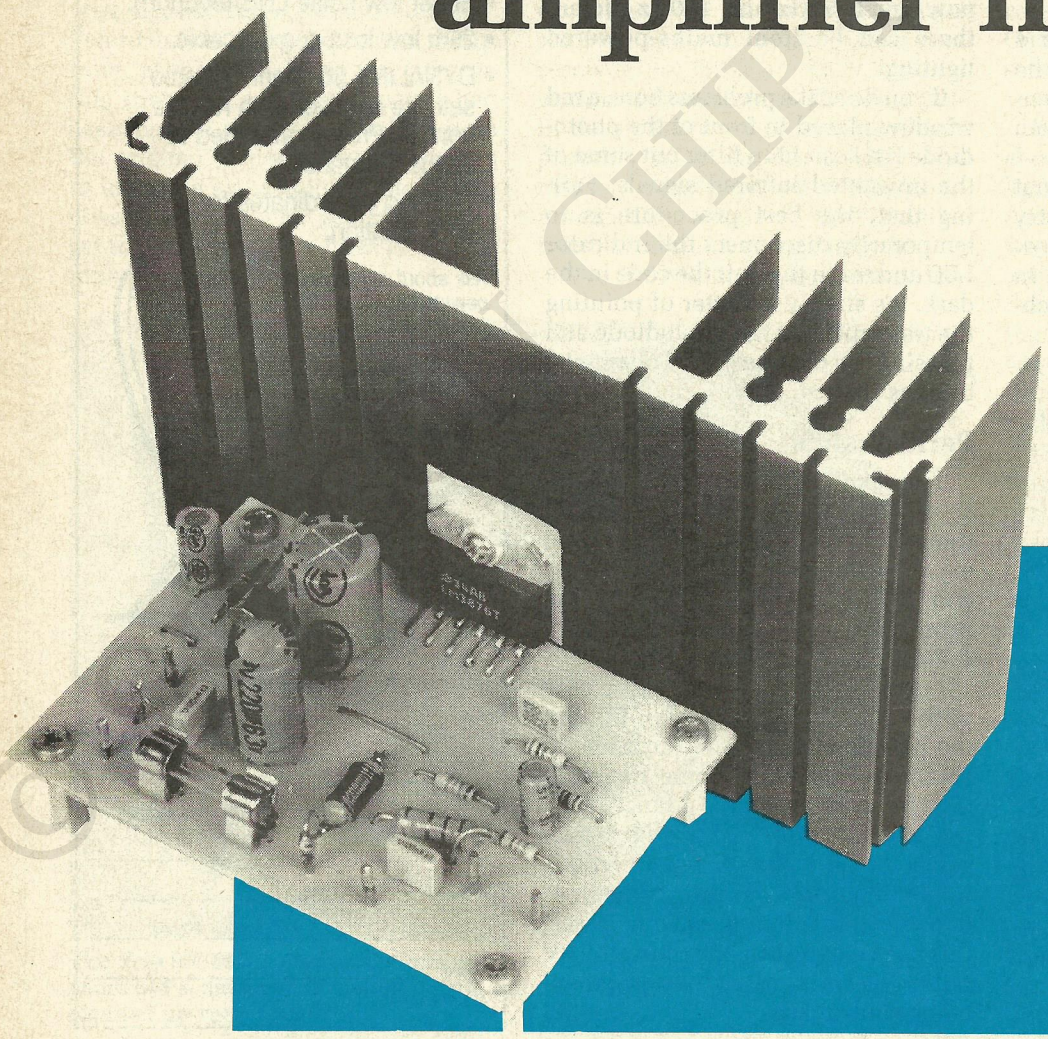
It's a sign of the times and how far electronics has come when you can buy a 50W audio power amplifier on a single chip which has better specifications than many of the discrete modules currently available.

This 50W amplifier module is based around the newly-released LM3876T from National Semiconductor. Not only can it deliver 50W RMS continuous into 8Ω loads but it has on-board protection and an input mute function. See the data article on this device elsewhere in this issue for the full details.

This amplifier module is quite robust and requires no setting up – all you do is build it then use it. It will also run on a lower supply voltage, with no changes to the circuit required.

Build this 50W audio amplifier module

By DARREN YATES



A glance at the specification panel in this article will show that this amplifier module has very respectable performance, better in fact than the Twin 50W power amplifier module published in the February 1992 issue of SILICON CHIP. In particular, note the very low distortion, excellent signal-to-noise ratio and very high damping factor.

Circuit details

Looking at the circuit diagram in Fig.1, you could be forgiven for thinking that the LM3876T is just a big power op amp – and that's really all it is, although it has a lot of enhancements in the way of internal protection circuitry. A handful of passive components and a power supply complete the circuit.

The input signal is connected to the non-inverting input at pin 10 via an RC network consisting of a series 1kΩ resistor and a 220pF shunt capacitor. This network is an RF attenuator to prevent pick-up of radio interference.

The voltage gain of the module is set to 19 by a negative feedback network consisting of an 18kΩ and 1kΩ resistive divider and a 22µF capacitor. The 1kΩ resistor and 22µF capacitor together set the low frequency -3dB point to about 7Hz.

Also connected to the output at pin 3 is a fairly savage Zobel network comprising a 2.7Ω resistor and 0.1µF capacitor. This RC network and the associated RL network consisting of a 10Ω resistor in parallel with a 0.7µH inductor ensure that variations in the load impedance at supersonic frequencies do not cause instability.

Muting

An optional feature of this module is the mute function at pin 8. We've shown pin 8 connected via switch S2 and a 27kΩ resistor to the negative supply rail. With the switch closed, the amplifier operates normally but with the switch open the audio signal is attenuated by 110dB (typical) which is near enough to completely off. The 22µF capacitor also connected to pin 8 provides a slow turn-on feature. If you don't want to use this feature, you can replace switch S2 with a wire link. The prototype board, shown in the photo, was wired this way.

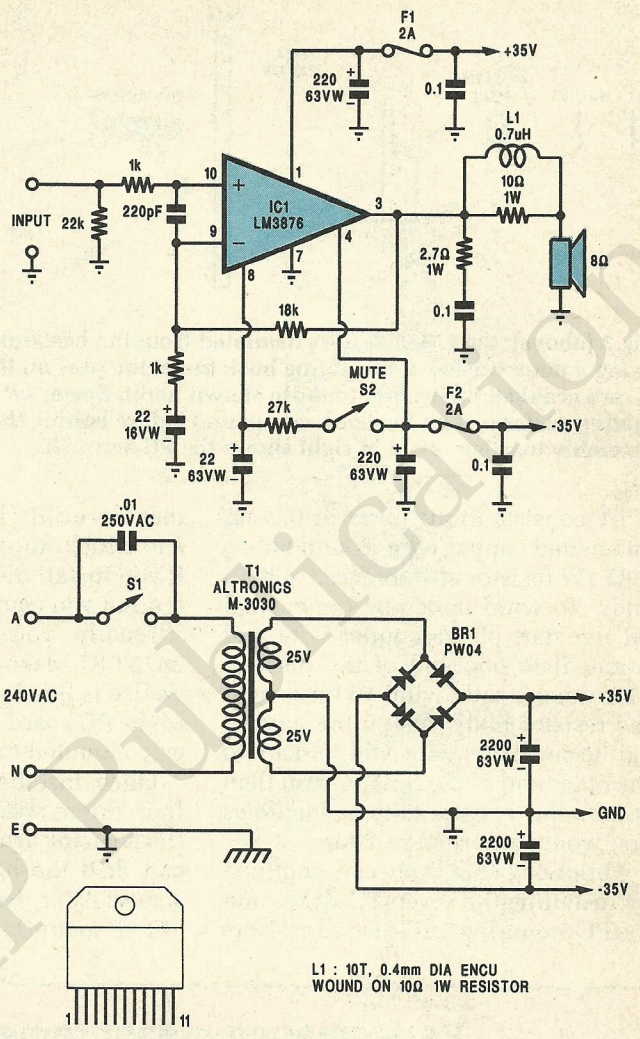
Power supply

The power supply uses a 50V centre-tapped transformer feeding a bridge rectifier and two 2200µF 63VW electrolytic capacitors. This results in balanced supply rails of around ±35V, although the exact voltage will depend on the mains voltage and transformer regulation.

To obtain the quoted power output of 50 watts, you will need a transformer rated at 80VA or more. We suggest the 80VA toroidal type sold by Altronics (Cat. M-3030). A cheaper alternative would be the 44V centre-tapped 66VA transformer sold by Jaycar Electronics (Cat. MM-2010). This would reduce the module's maximum power output to about 40 watts.

Construction

All of the components for the 50W module except the heatsink are installed on a small PC board measuring 83 x 58mm and coded 01103941. Before you begin any soldering, check the board thoroughly for any shorts or



50W AUDIO AMPLIFIER MODULE

Fig.1: the module is based on IC1, an LM3876T audio amplifier IC with comprehensive internal protection circuitry. No setting-up adjustments are necessary.

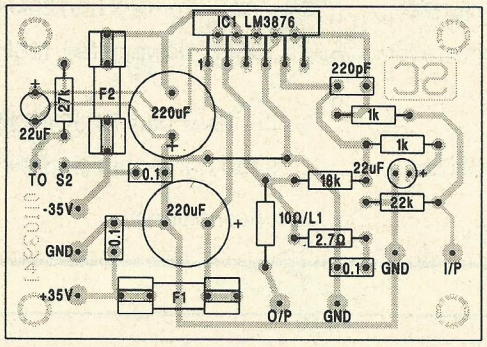
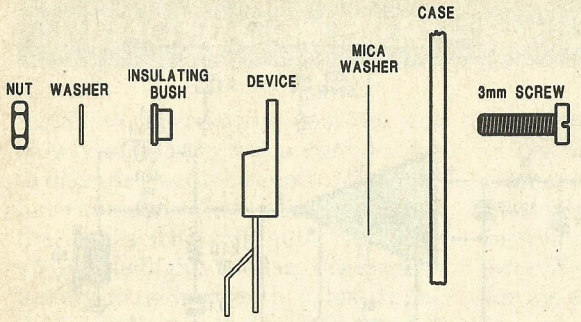


Fig.2: the parts layout on the PC board. Make sure that all polarised components are correctly oriented.

breaks in the copper tracks. These should be repaired with a small artwork knife or a touch of the soldering iron where appropriate.

When you're sure that everything is correct, you can install the wire links, followed by the resistors and capacitors. Make sure that you install the electrolytic capacitors correctly.



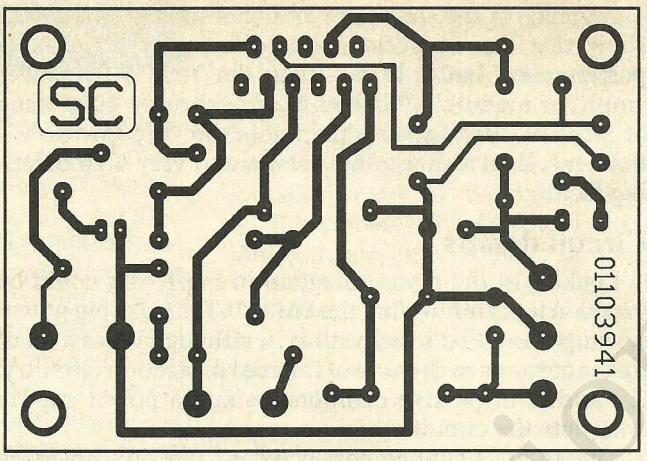


Fig.3 (above): the LM3876 IC is insulated from the heatsink using a mica washer & insulating bush (note: the pins on the IC are cranked differently to those shown here). Smear all mating surfaces with heatsink compound before bolting the assembly together. Fig.4 at right shows the PC artwork.

L1 consists of 10 turns of 0.4mm enamelled copper wire wound onto a 10Ω 1W resistor and soldered at both ends. To wind it, scrape the enamel off the start of the copper wire and solder it to one end of the resistor. This done, neatly wind 10 turns onto the resistor body, scrape the enamel off the end of the wire, and solder it to the other end of the resistor. You then install the resistor-cum-inductor as you would a normal resistor.

Following that, you can continue by installing the seven PC stakes and the PC mounting 2AG fuse clips. Note that these clips have little lugs on one end which stop the fuse from moving. If you install the clips the wrong way around you cannot fit the fuses.

Finally, you can install the LM-3876T IC. Make sure that the tab of the device is lined up with the back edge of the PC board so that it can be properly mounted onto the heatsink.

Once installed, you can add the four 15mm spacers and then line up the heatsink against the IC so that you can drill the hole for the mounting screw. After drilling, use a standard TO-3P mounting kit to mount the device to the heatsink (see Fig.3) and make sure that the heatsink is electrically isolated from the device (use your multimeter switched to a high "Ohms" range).

The heatsink used needs to be substantial and should be rated at about 1.5°C/W or less. A suitable model is Altronics Cat. H-0580. If you use a smaller heatsink, the IC will run hotter and its internal protection circuitry will reduce the maximum available power output accordingly.

As presented in this article, the heatsink is attached to the PC board via the leads of the power IC. In practice, both the heatsink and the PC board should be attached to a suitable chassis, together with the power supply.

Performance measurements

Output power	50W into 8 ohms, 55W into 4 ohms
Frequency response	15Hz - 110kHz ±1dB
Input sensitivity	1V RMS (for clip point onto 8 ohms)
Harmonic distortion	< .06% from 20Hz to 20kHz; typically <.002%
Signal-to-noise ratio	106dB unweighted (20Hz-20kHz); -114dB A-weighted
Protection	2A fuses plus SPiKe (TM)
Damping factor	>150 (for 8-ohm loads)
Stability	unconditional

Testing

To test the unit, first connect up the power supply and apply power. The supply rails should be around ±37V (no load condition). Now check the quiescent current. This can be done in one of two ways. The first is to remove one fuse (while the power is off) and connect your multimeter, switched to an "Amps" range) across the fuse clips. With no input signal and no load, the quiescent current should typically be around 30mA but

RESISTOR COLOUR CODES

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	27kΩ	red violet orange brown	red violet black red brown
❑	1	22kΩ	red red orange brown	red red black red brown
❑	1	18kΩ	brown grey orange brown	brown grey black red brown
❑	1	1kΩ	brown black red brown	brown black black brown brown
❑	1	10Ω	brown black black brown	brown black black gold brown
❑	1	2.7Ω	red violet gold brown	red violet black silver brown

PARTS LIST

1 PC board, code 01103941, 84 x 58mm
4 10mm x 3mm machined screws
4 15mm x 3mm tapped spacers
1 125 x 75mm heatsink 1.5°C/W (Altronics Cat H-0580 or equivalent)
1 LM3876T 40W audio amplifier (IC1)
4 M205 PC-mounting fuse clips
2 2A M205 fuses
7 PC pins
1 30cm length of 0.4mm-dia. enamelled copper wire

Capacitors

2 220µF 63VW electrolytic
1 22µF 16VW electrolytic
1 22µF 63VW electrolytic
3 0.1µF 63VW MKT polyester

Resistors (0.25W, 1%)

1 27kΩ	1 1kΩ
1 22kΩ	1 10Ω 1W
1 18kΩ	1 2.7Ω 1W

Power supply

1 25V + 25V 80VA mains transformer (Altronics Cat. M-3030 or equivalent)
1 100V 6A bridge rectifier
2 2200µF 50VW or 63VW electrolytic capacitors

may range up to 70mA. Alternatively, you can connect a 100Ω 1W resistor across the fuse clips and measure the voltage across it. For a quiescent current of 30mA, the voltage across the 100Ω resistor should be 3V DC.

The DC voltage at the output should be within ±15mV of 0V DC.

Next, connect suitably rated speaker and check that you get an output. If you touch the input PC pin on the PC board you should get an "audible" blurt from the loudspeaker. If you don't, check that the mute circuit is disabled. To disable the mute facility, switch S2 must be closed or replaced with a wire link.

If the circuit isn't working, check all audio paths from the input through to the output for continuity. You should also make sure that the PC stakes are well soldered into position. Some brands don't take solder easily and can cause dry joints. **SC**

NOTES & ERRATA FOR PROJECTS PUBLISHED IN SILICON CHIP (1994)

40V/3A Adjustable Power Supply, January & February 1994: Some readers have experienced difficulty with the wiring of switch S4 and potentiometer VR1. Unfortunately, with multi-turn pots, the pinouts are not necessarily the same for all brands. Usually, the pin arrangement is shown on the body and the correct wiring can be worked out from this.

Basically, you only need to find the wiper and connect it to the PC board on terminal 21 as shown on the wiring diagram. Terminal 22 goes to one end of the pot. If the output voltage from the power supply is a maximum when the pot is turned fully anticlockwise & a minimum when rotated fully clockwise, connect the wire from terminal 22 to the other end of the pot.

For S4, the switch specified in the parts list is an Altronics S-1394 momentary pushbutton type which has the wipers of the double pole switch at one end rather than the centre as is customary with toggle switches.

If a momentary pushbutton switch with the wipers in the centre of the switch is used, the wiring will have to be changed as mentioned on page 71 of the February 1994 issue.

Finally, the orientation required for S4 on the wiring diagram is with the common terminals facing the mains switch S1.

12-240VAC 200W Inverter, February 1994: (1) Transistor Q16 on the circuit diagram (Fig.4) is incorrectly labelled as a BC338; it should be a BC328. In addition, the transistor marked Q12 near Q13 (Fig.4) should be designated Q14. On the overlay diagram (Fig.5), transistors Q13 and Q14 are transposed, while the .047µF capacitor near T2 should be a .0047µF capacitor to agree with the circuit. The parts list should also show a .0047µF MKT capacitor instead of a .047µF capacitor.

(2) the 1kΩ resistor which connects to pin 6 of IC3 on the overlay diagram should be 10kΩ as shown on the circuit. Use of a 1kΩ resistor will cause the inverter to shut down prematurely.

Champ Audio Amplifier, February 1994: The text on page 47 regarding the "blurt" test should read, "You do this by winding the trimpot **anticlockwise** and then putting your finger on the input".

90-Second Message Recorder, February 1994: The distributor for the ISD audio recorder chip is Adilam Electronics, which has branches in most Australian states as well as New Zealand.

50W Audio Amplifier Module, March 1994: (1) The 22µF capacitor connected to pin 8 on the LM3876 is shown reverse-biased on both the circuit and the wiring diagram. The 220µF capacitor connected to the negative supply rail is also connected the wrong way on the circuit but is correctly shown on the wiring diagram. Modules that have been running for more than a few hours should have the 22µF capacitor replaced.

(2) The LM3876 used in this design has been changed to severely limit its power output into 4-ohm loads. If you want to use a 4-ohm load, the solution is to use the LM3886 which can deliver over 60W. However the supply rails should be reduced to ±28V, as recommended in the article for the LM3876 when using 4-ohm loads. (08/03)

Remote Control Extender for VCRs, April 1994: The panel mount DC socket for the plugpack should be an insulating type to prevent the negative pin shorting to the case. This is shown in the photograph on page 21 of the article in the April issue.

Discrete Dual Supply Voltage Regulator, April 1994: The PC board pattern and the overlay pattern on page 31 has an error in that pin 3 of IC1b is not grounded. The board can be corrected by connecting a short link across to the adjacent GND track.

Induction Balance Metal Locator, May 1994: The parts list should indicate 5 rather than 4 0.1µF MKT capacitors. The extra capacitor is shown on the overlay but not on the circuit. It is used as a bypass to ground for the +7V supply near VR1. The .001µF capacitor shown on the overlay next to VR1 should be .01µF.

Fast Charger for Nicad Batteries, May 1994: The circuit (Fig.2) shows a 680Ω current limiting resistor for LED 1. This should be changed to 470Ω to agree with the parts layout diagram (Fig.3). The parts list should also be altered.