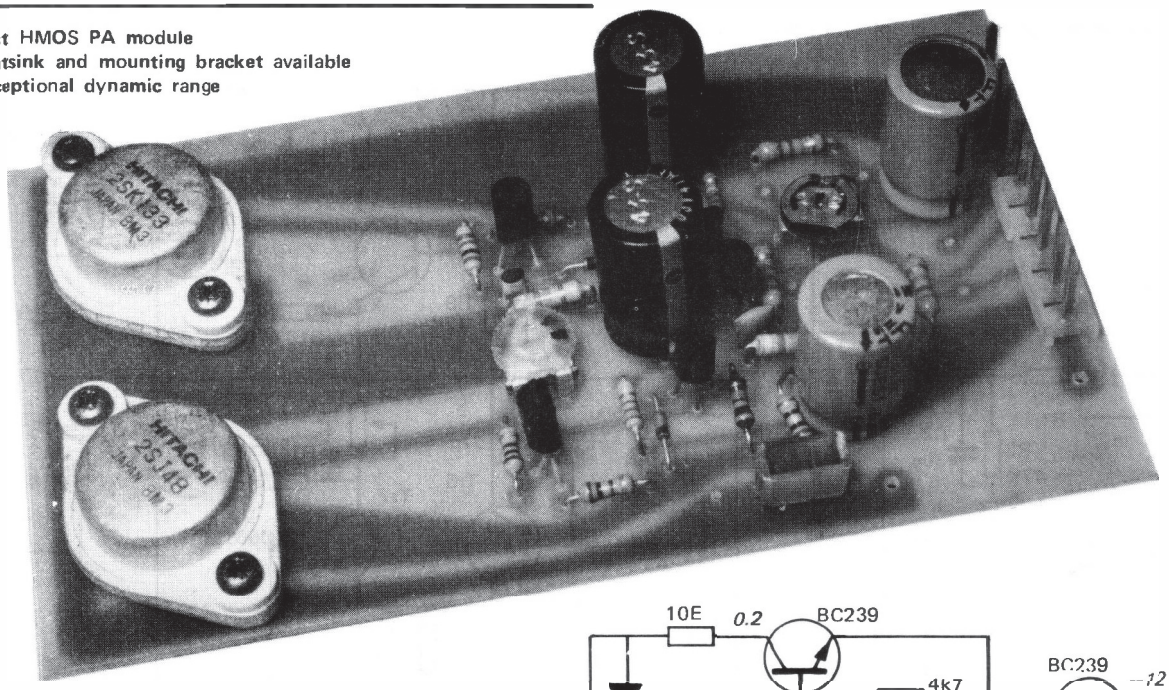
PA100

* First HMOS PA module
* Heatsink and mounting bracket available
* Exceptional dynamic range



General

There are, as you may have noticed, a lot of audio amplifier modules on the market. Moreover, there are approx. 'n' times as many different opinions on the subject of audio amplifier design. In the desperate search for a gimmick or two, some of the commercial companies engaged in the design and supply of audio equipment have been found searching the walls of certain palaeolithic caves in an attempt to revert to some long lost technology that might provide the answer for next year's sales feature.

Valves have been cited as the marvel of the age by some, but then again, if you read widely enough in the audio press, you are likely to come across some character advocating the application of HT across a watermelon to reduce TMKLD.

A well known manufacturer who doesn't in fact make what the name implies, produces a very excellent 100 watt amplifier that has been variously raved over, and raged over. It wouldn't be very surprising to learn that audio reviewers are really as bemused by the difference between A and B amplifiers as most mortals confess to being. But on the assumption that with 1% distortion from the disc/tape/microphone etc, and 3-5% from the loudspeakers - that the difference between 0.001% and 0.01% from the amplifier is really all that important, we offer you the new PA100, using some of the fastest and least obtrusive output devices known to man.

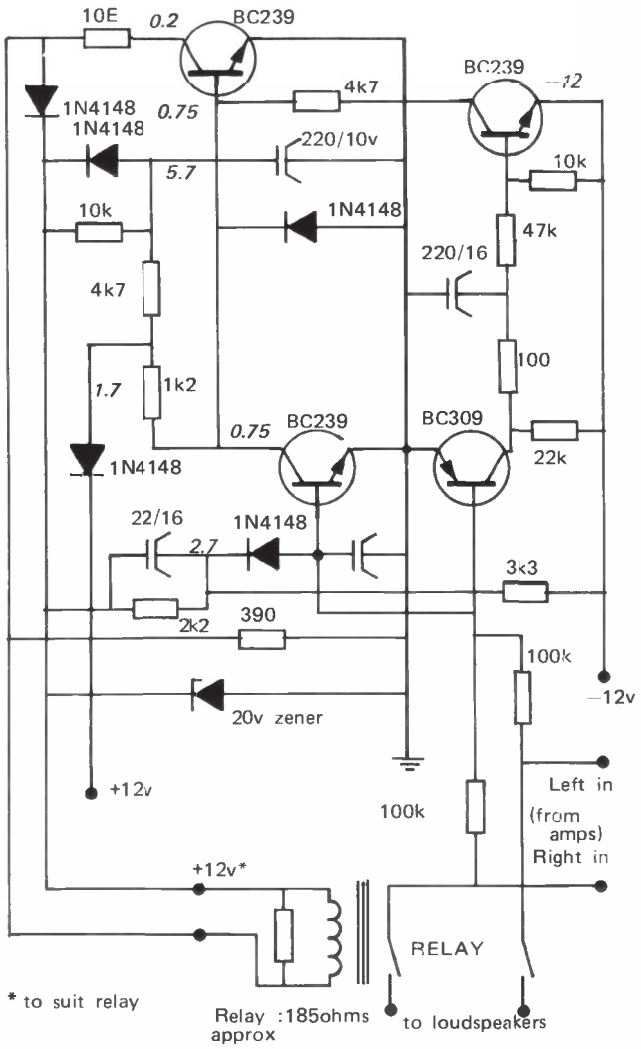
When you compare the frequency response of a good loudspeaker with that of a good amplifier, you are forgiven for wondering what all the fuss is about. Still, to make the best of the situation, the obvious answer is for the loudspeaker to be designed totally around the characteristics of a specific amplifier. Philips motional feedback seems like such an obvious concept, that it is a mystery why the practise is not far more widespread.

Notwithstanding all this cynicism, as long as you are determined to have a go at HiFi, then you might as well start with an amplifier that is as inobtrusive as possible. Ambit's PA100 is designed with the output transistors on the board, thus giving known and repeatable results – the heatsink bracket is predrilled to fit between the output devices and the PCB.

The dynamic range of the unit is in fact over 100dB, using Hitachi low noise input stages. The low drive requirement of the HMOS output stage reduces the number of active devices to a bare minimum - making the amplifier both simple to build and simple to set up.

Since we advocate the use of DC amplification (direct coupled) - alongside here is a design for a relay operated offset sensor. It is not guaranteed to switch off in time to save every amp/speaker combination from nanosecond destruction, but it will preserve the vast majority of voice coils from accidental damage. The relay contacts are paralleled to reduce contact resistance to a minimum.

The unit provides a slow switch on build up time delay, thus providing a welcome respite from the usual 'thump' that rattles the flight of plaster ducks on the living room wall.



DC offset protection

Correct operation causes the relay to close

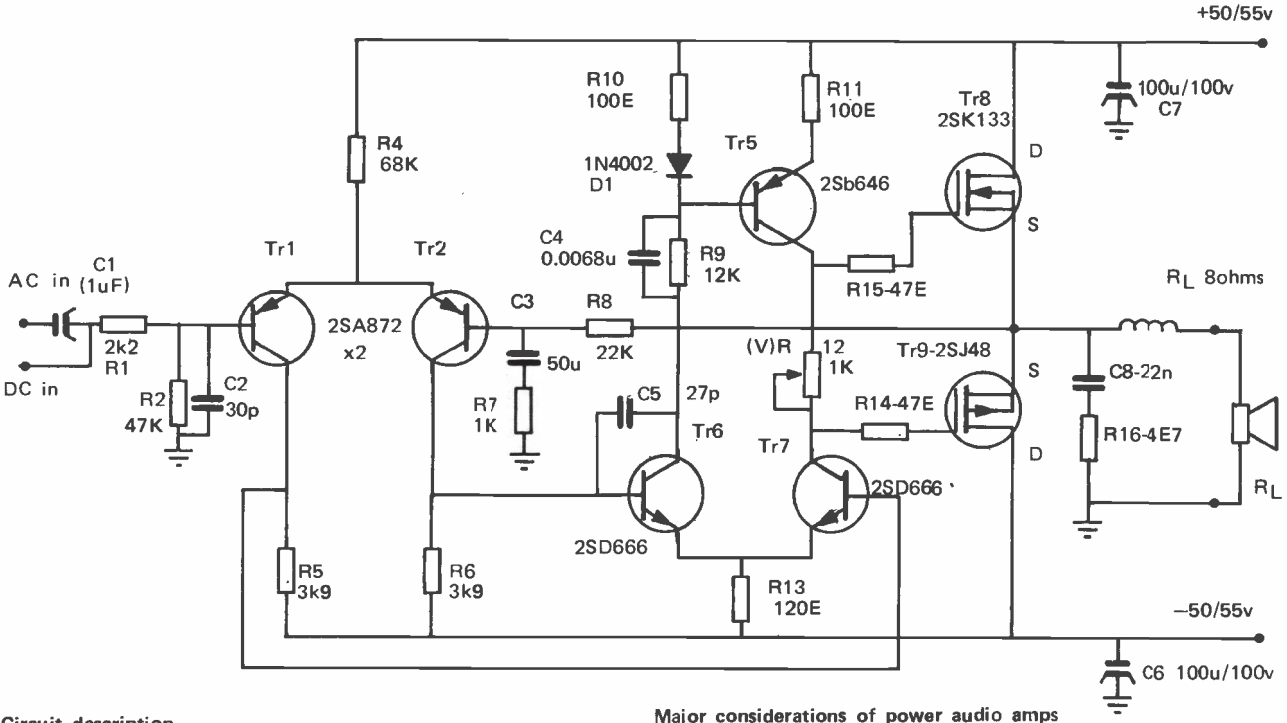
The circuit may be driven from any number channels (via the 100K resistors on the base of the BC309) - since if an offset condition occurs in any output, the circuit will cause the relay to drop out. The relay contacts are not shown paralleled in the diagram, but for best results, as many gold plated contacts as possible should be connected in parallel for minimum resistance.

Figures in italics indicate test voltages

100W MOSFET PA unit - PA101

The circuit below is a development from the original PA100 - and it is relatively easy to adapt existing boards to the new suggested configuration. The major advantages being the improved stability of the bias arrangements - enabling the offset adjustments to be disposed of. The net result produces virtually no switch on/off transient - although we still recommend the use of an offset sensing circuit with relay control for the remote eventuality of a breakdown.

Facilities for AC and DC coupling are provided.



Circuit description

Although we have been offering power MOSFETs for some time, they seem to have suffered from the usual British electronic engineers' malaise of not having appeared in Wireless World. If a product is described in Wireless world, be it a heap of old bean cans, or the most sophisticated audio amplifier in the world, then engineers believe in its existance.

At the moment, audio engineers seem to treat power MOSFETs on a par with the Yeti - they've just about heard of them, but until one is caught and displayed in public (in this case, some noble tome like WW), then they might as well not exist.

Those intrepid explorers who have dared to cross this uncharted territory, and found their first experience to be anything less than shattering have been overheard to take an uncharitable view of the devices. Thus have complementary HMOSFETs been dismissed as transient figments of some crazed designer's imagination in some quarters.

The first time an engineer tried to get to grips with a bipolar output system, no doubt he went scurrying back to the 807s.

Enough of this - on the positive side, we have been developing with these devices for over a year, the results of which are shown above. The circuit isn't much changed, but various PC layouts have been tried to achieve optimum results.

C1/R1 are used in AC coupled applications, whereas C1 is bypassed for DC operation, when the whole amplifier may be treated as a large DC opamp, with Tr2 being the inverting 'input'. Thus the gain is set by the ratio of the two resistors in the negative feedback path - R7 and R8.

The input and driver stage transistors are all characterized for high voltage, low noise audio amplification. The ratings of the devices are generous, enabling the whole circuit to tolerate a high degree of mal treatment before irrepairable damage is done.

The bulk of the driver circuitry is devoted to classical voltage gain configurations, since the output FETs require little power for operation - merely enough to cope with the charging of the input capacities.

VR12 sets the output quiescent current of the FETs in a class AB configuration - without the need for considerations of secondary breakdown and thermal runaway, encountered in bipolar design techniques. 80mA is a typical value, selected by checking for minimum distortion.

The speed of operation of the MOSFET, coupled with the very low drive requirements, makes the calculation of phase correction components simple. For the most, part, they are not needed. Some very fine tuning can be achieved in some circuits by placing a small capacitor (2p2 -22p) across R8.

C5 is not intended for phase correction, but for stability in the drive circuits. This component is layout sensitive, and thus also depends on the types of components used, together with their lead lengths.

Major considerations of power audio amps

The first concern is usually good signal to noise+distortion. 100dB S/N should be easily achieved with most modern semi-conductor technology - and in the case of the PA101, this can be extended to 120dB + (input shorted).

Most of this is dependant on good earthing practise, and avoiding taking the input earths across the output and power earths. The currents flowing in high power amplifiers are substantial - and even an apparently low impedance piece of copper track (or connection wire) can possess the few fractions of an ohm necessary for a substantial potential to be set up along a single earth track.

If a wire of resistance 0.05 ohm carries 4 amps, then the PD is (4x.05) V = 0.2V. If this PD happens to lie across the path of a feedback loop - then the result is distorion, since the feedback loop is no longer referred to the earth. It is thus necessary to run all earths to a centra earthing system via low impedance connections.

If the earth loop current happens to be in phase with the amplified signal, then positive feedback results, and the circuit oscillates at the 'resonant' frequency.

Capacitors C7 and C6 may seem superfluous if you are using 10,000uF smoothing at the power supply, but if they are left out, the effects are the same as with earth loops, since for example, the input stage emitter resistor is now R4, plus the impedance of the +ve rail supply to the reservoir capacitor. R4 is thus on the end of a 'modulated' HT rail, and must be decoupled at the board end of the supply.

If two or more amplifiers are used with a single supply, then the supply leads - as well as the earth leads, must be taken to a single point source. Otherwise, simply providing a ring main enables one amplifier to modulate the other(s), resulting in cross talk.

Stability and varying load conditions is one point that frequently gets overlooked. The fact that an amplifier works immaculately into an 8 ohm resistive load may be very misleading. Most people have heard apparently similarly specified amplifiers making entirely different sounds on the same speakers - and an amplifier that completely changes its characteristics when fed into different speaker loads.

Capacitive loading changes the voltage/current phase at the output by drastic amounts. Sometimes, sufficiently for the amplifier feedback to be driven into a positive condition resulting in instability. Loudspeaker crossovers are usually full of capacitors - so a check on the stability is essential.

Although there are many detailed differences with a power MOSFET v Bipolar, most of the basic criteria for sound amplifier design apply to both types. We invite the daring to advise us of their exploits, and we will provide a £100 credit note prize for the first design we examine that exceeds -70dB for both THD/TID from 30Hz to 20kHz at 75W RMS into 8 ohms.. (Using our MOSFETs, of course!)