High-to-low impedance 'interface' to suit the ETI-470 60 watt amp

The popularity of our 60 watt low distortion amplifier module (May '79) has exceeded all expectations. To achieve the amplification 'accuracy' these power amps are capable of, the drive impedance must be very low — in the order of five to ten ohms. Our previous preamps, the 422 and 482, and many preamps available, generally have a medium to high output impedance and will not properly mate with the 470. This interface provides the necessary impedance conversion, allowing these amps to be used with many existing preamp designs.

Phil Wait

DESIGNED primarily for use with our Series 4000 stereo amplifier, the 470 low TID 60 watt amplifier module has found its way into the most surprising applications – from a dc motor drive to discos in central Africa. Thousands of the modules have been built, occasional output transistor shortages not withstanding, in Australia, New Zealand, Europe, Africa, Canada and the UK.

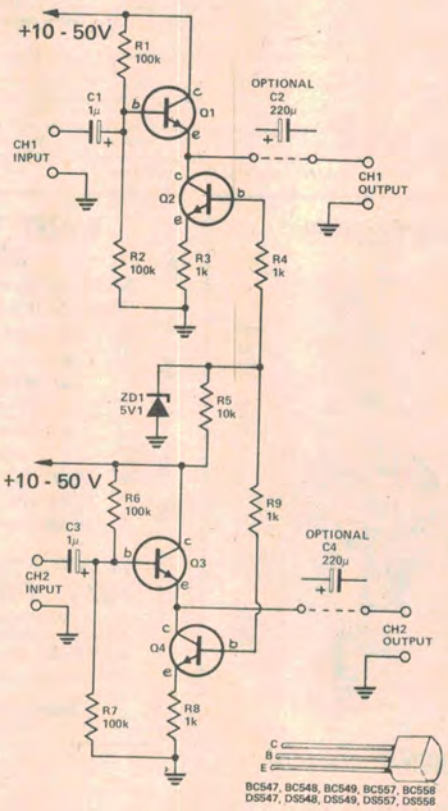
Although the 470 module was designed to be driven from a low impedance source, it is obvious from readers' letters that there are many who want to use it with existing equipment having a preamp with a high output impedance.

This project describes a two-channel (stereo) interface for driving up to two 470 modules (per channel) from a high impedance source, and can in fact be used in any application requiring a very low impedance drive at audio frequencies.

The input stage of the 470 consists of an emitter – coupled darlington pair with the input signal fed to the non-inverting input and the feedback connected to the inverting input. To reduce high frequency intermodulation the slew rate of this stage is limited by placing a 470n (0.47μ) capacitor between the two bases.

The input impedance varies with frequency, from a few thousand ohms at quite low frequencies to hundreds of ohms at the high frequencies, where the effect of the slew limiting capacitor becomes apparent.

If the stage is driven from a high impedance source, the output of the driving current will be loaded down at high frequencies by the reduced input impedance of the amplifier, causing high frequency distortion. This is why we specified a low impedance driving source for the 470, and designed our preamplifier accordingly.



Interface design

The circuit for our interface uses two emitter followers (one per channel) with constant-current generators in the emitters referenced from a zener-regulated supply voltage.

The easiest way to convert from a high impedance to a low impedance with little attenuation is with an emitter follower. The input signal is fed into the base of a transistor and the output taken from the emitter, the collector being tied to the supply. Emitter followers have a high input impedance and very low output impedance. The output impedance is roughly the value of the emitter resistor divided by the beta of the transistor.

To allow the circuit to be used with the power amplifier or with the driving source the circuit must be able to operate over a very wide range of dc supply voltages as found in graphic equalisers, organs, preamplifiers and such.

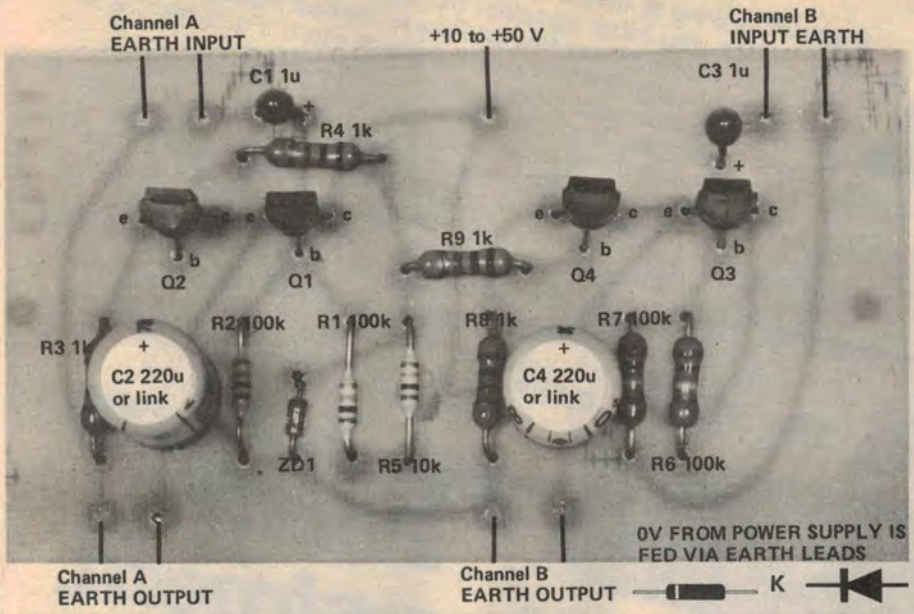
To limit the supply current and dissipation of the emitter follower when

HOW IT WORKS – ETI 474

The circuit consists of two emitter followers, Q1 and Q3, with constant current generators in their emitters. The constant current generators share the same voltage reference, ZD1.

The reference voltage, 5.1V, is derived from ZD1, and fed to the bases of Q2 and Q4. The voltage on their emitters is then set at 4.4V. The transistors will always pass the exact amount of current required to maintain this voltage on the emitters, regardless of supply voltage.

The input signal is fed to the bases through dc blocking capacitors C1 and C3, and the output is taken from the emitters directly or via the optional blocking capacitors C2 and C4. The gain of the circuit is a little less than unity.



PARTS LIST - ETI 474

Resistors all ½W, 5%
R1, R2 . . . . . 100k
R3, R4 . . . . . 1k
R5 . . . . . 10k
R6, R7 . . . . . 100k
R8, R9 . . . . . 1k

Capacitors
C1. . . . . 1μ 35V tantalum
C2. . . . . 220μ 35V electro (optional)
C3. . . . . 1μ 35V tantalum
C4. . . . . 220μ 35V electro (optional)

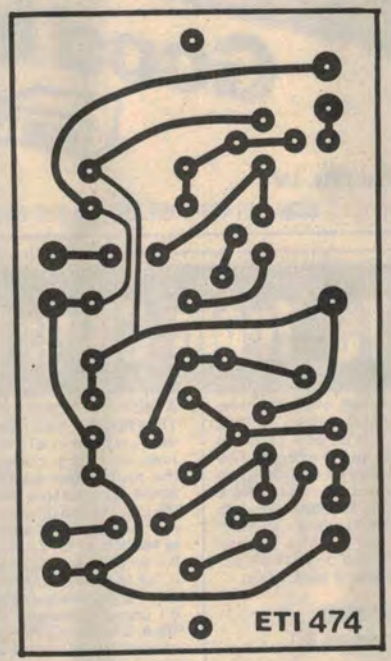
Semiconductors
ZD1. . . . . 5V1 400mW zener diode
Q1–Q4. . . . . BC107, BC547, DS547 or similar

Miscellaneous
ETI 474 pc board.

used with a high supply voltage we used a constant current generator (Q2, Q4) in each of the emitters in place of the normal emitter resistor. The use of a constant current generator also increases the input resistance and decreases the output resistance. A current of about four milliamps flows through the transistors for all supply voltages above five volts.

The output capacitors (C2, C4) provide dc isolation for the output, but since the 470 modules already have an isolation capacitor (C1), they can be left out and the pc board bridged with a length of tinned copper wire. If any other connection is made from the output, for auxilliary equipment, the capacitors should be left in.

If the capacitors are removed it will be necessary to replace the input capacitor on the 470 power amplifier



(C1) with a 220μ, 35 volt electrolytic **oriented it with its positive lead towards the input terminal.**

Construction

Construction is straightforward, the only thing to watch is the orientation of the transistors and the zener diode. The unit can be mounted with the power modules and run from their supply or mounted with the driving circuit. Input and output connections should be via shielded cables which also carry the power supply earth on the braid to avoid earth loops.

If only one power module is to be driven, as with an electronic organ, the pc board can be cut in half and only one channel assembled. ●

Hints and tips for the ETI-470 60W Module

MOST PEOPLE haven't had problems with their 470 module, but inevitably there are some who do. From calls and letters to our reader enquiry service we have identified five areas of trouble.

1) The earth rail on the amplifier must be returned to the 0V rail on the power supply. If this is not done the input transistors and their current source (Q1-Q5) will be destroyed. This is probably our failing as, although it is obvious to most people, it was not indicated on the circuit given in the May '79 issue but was indicated in the wiring diagram of the Series 4000 amplifier in the July '79 issue.

2) It can be seen from the overlay that the base lead of Q5 must be slightly bent to fit the pc board. The transistor can easily be inserted the wrong way round. Watch this.

3) The darlington output transistors **must** have a good heatsink. Always make sure the thermal contact between the transistor and the heat-sink is good. Use a thermal compound (such as Bevaloid GS13), but not too much – just a smear on either side of the mica washer. Use a metal, rather than a nylon screw with an insulating bush, to fasten the transistor – a nylon one will stretch under tension. Make sure the heatsink is smooth and flat, curved or sandblasted heatsinks will not make good thermal contact with the transistor body.

4) Make sure that the transistor Q8 has a good thermal contact to the heatsink. It must be the same heatsink as the output transistors.

5) Never, never run the amp without a heatsink, even if only to set the bias.

Overheating of the output devices due to poor heatsinking will result in thermal run away which will blow the fuses but will probably not damage the output transistors provided the two amp fuses are in circuit. Faults where the amplifier operates correctly for a while then blows fuses, will probably be due to poor heatsinking.

Most transistors in the amplifier are designed to run quite warm in normal operation.

No problems have become apparent with the preamplifier (ETI-471).