GUITAR NOTE EXPANDER

If you've ever built a conventional fuzz/sustain unit, you may have been disappointed by the harshness of the sound. If so, we present the answer to your problems — soft clipping. Design by Q.A. Rice. Development by Plamen Pazov.

A good number of fuzzbox circuits have appeared in the past which attempt to emulate the sound of an overdriven valve amp; the majority of these look great on a scope but still sound rough. The chief characteristic of valve amps is the way they overload; rounding off the peaks as opposed to transistor circuits which clip off the peaks, producing predominant odd harmonics. FET amps produce overload in a similar way to valve amps, and a cheaper and better (or worse) way to obtain this is to use CMOS gates in the linear mode. Figure 1 shows the overload for a triangular waveform. In the final circuit we have used a very versatile and much under-used CMOS IC, the CD4007 dual complementary pair and inverter. One complementary pair is wired as a second inverter — the two inverters are used as amplifiers and give a combined gain of 60 dB. One of the remaining CMOS FETs is used as a voltage-controlled resistor which can vary between from several megohms to a few hundred ohms. The output of the amplifier is passed to a detector which controls the resistance of the FET, and this is fed back to various parts of the circuit to give the expansion and compression effects. Figure 2 shows the input/output characteristics for the various functions. The compressor is effective over a 30 dB range.

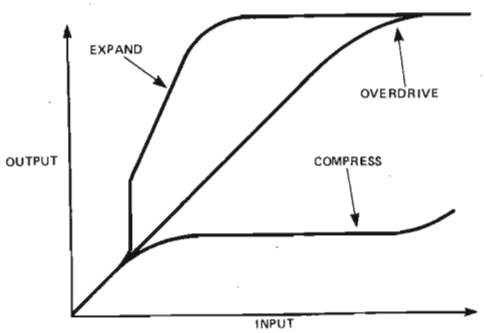


Fig.2 Input/output characteristics for various functions of the effects unit.

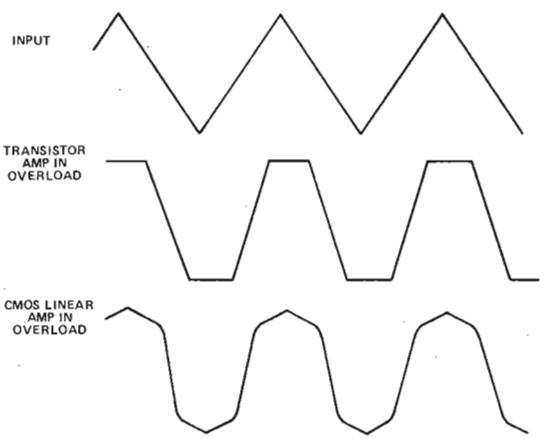


Fig.1 Clipping characteristics for two types of amplifier under overload conditions.

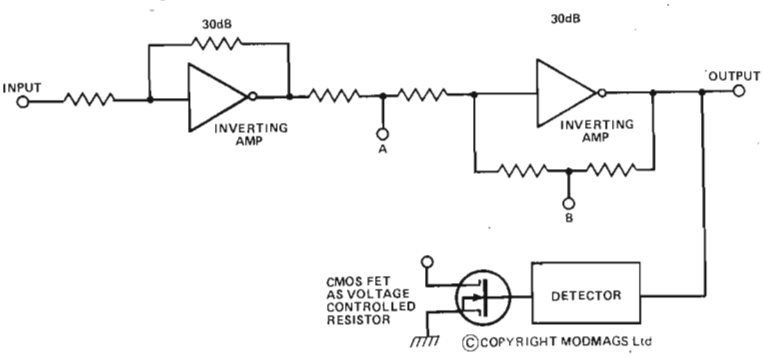
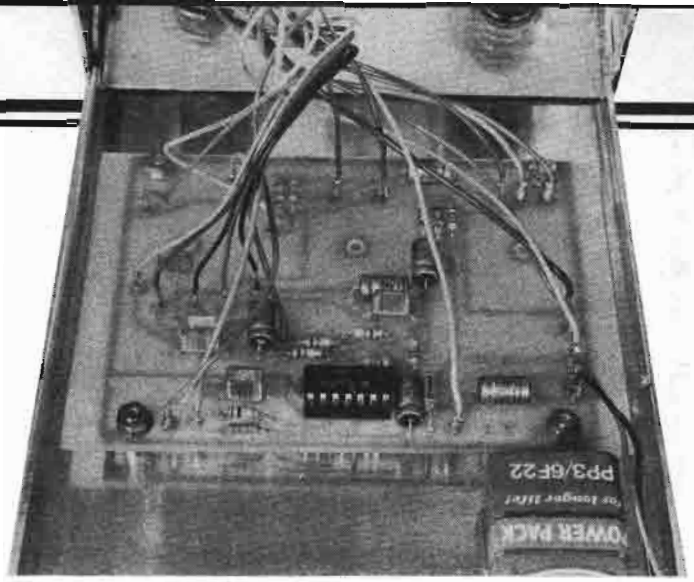


Fig.3 This diagram shows the basic principle of the unit.



The unit has six functions, as follows:

1. Overall overdrive
2. Overall compression, for sustaining
3. High frequency compression, for bass overdrive
4. Overall expansion, for sustained overdrive
5. Mid expansion, for mid to high accentuation
6. High frequency expansion, for high accentuation

The effect of all these functions is variable, with the exception of overdrive.

Construction

The PCB is designed to accept the control components (SW2 and pots) if PCB-mounting of these components is preferred, to give a very compact construction. For the prototype this was not necessary as we used a custom-built housing (see Buylines). The box comes unpunched so if you want to arrange the controls and sockets differently you can get a drill and do your own thing. If you use a different housing remember that a metal case should be used to maintain proper screening.

We used a volume control with a built-in on/off switch instead of the standard method of using the input jack, as the latter approach produces a 9 V peak back into the source circuit and can cause damage if this circuit is active.

If the guitar has a low sensitivity pickup, it may be necessary to increase the value of R2 accordingly. The unit only consumes 3 mA so the batteries should last quite a while.

HOW IT WORKS

CMOS inverters may be used in the same manner as op-amps in the inverting mode, with the added bonus that they are self-biasing. The input is fed into IC1a, configured as a high gain, high impedance amplifier to give a gain of around 30 dB. This is decoupled and passed through a resistor pair to a second amplifier stage, which has a resistor pair in its feedback (see Fig. 3). If point A is now taken to ground via a resistance, gain is reduced; if this is done to point B, gain is increased. The final output is passed through a detector to give a voltage proportional to the signal level; this voltage is used to control the CMOS FET. If the FET is taken to point A or point B, then the overall gain is proportional to the final output signal. Thus if the output reduces the signal, it is self compressing. If it increases it, the signal is expanded. By making these gain variations frequency-dependant, we can accentuate or subdue the high frequency as required, at various break points to give the effects required. The output signal has to be attenuated to return it to its original level.

PARTS LIST

Resistors (all ¼ W, 5%)	
R1, 10	**100k**
R2	**3M3**
R3, 4, 7	**4k7**
R5, 6	**150k**
R8	**1M0**
R9	**470k**
Potentiometers	
RV1	**10k logarithmic**
RV2	**100k logarithmic with integral switch**
Capacitors	
C1	**220n polyester**
C2, 3, 4, 6, 10, 11	**2u2 16 V axial electrolytic**
C5	**22n polyester**
C7	**3n3 ceramic or polycarbonate**
C8	**1n0 ceramic or polycarbonate**
C9	**10n polyester**
Semiconductors	
IC1	**CD4007**
D1, 2	**OA91**
Miscellaneous	
SW1	**DPDT latching footswitch**
SW2	**2-pole 6-way rotary switch**
SK1, 2	**mono jack sockets**

Battery clip (PP3), metal box (see Buylines).

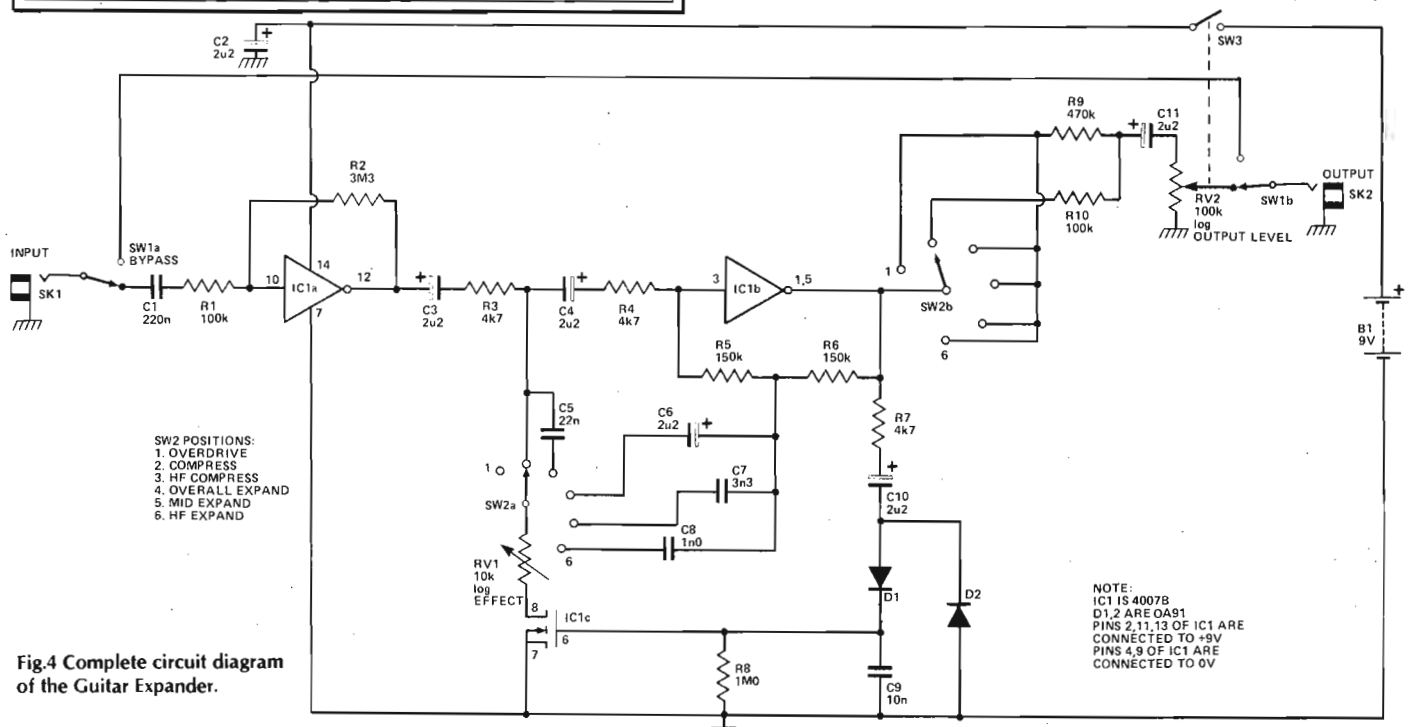
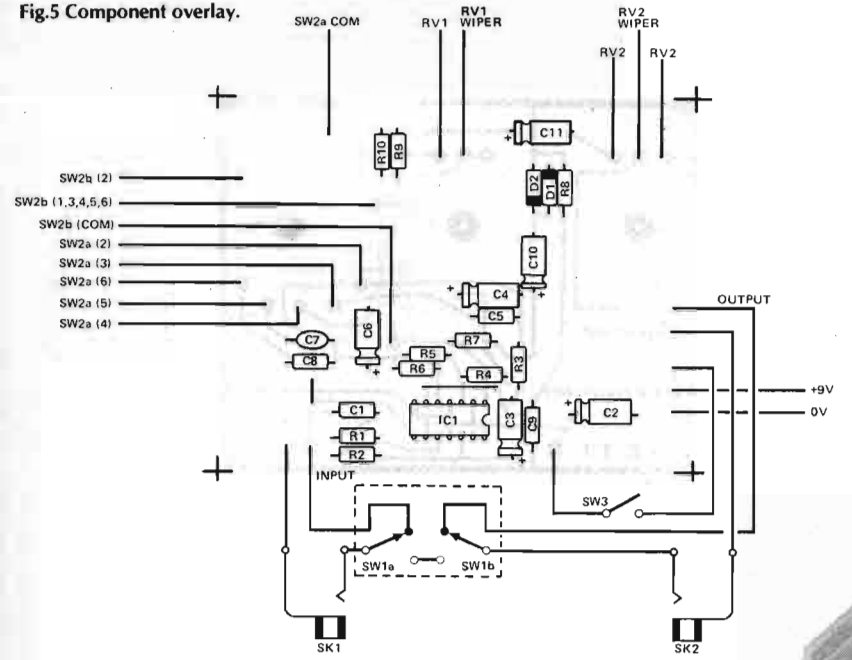


Fig.4 Complete circuit diagram of the Guitar Expander.

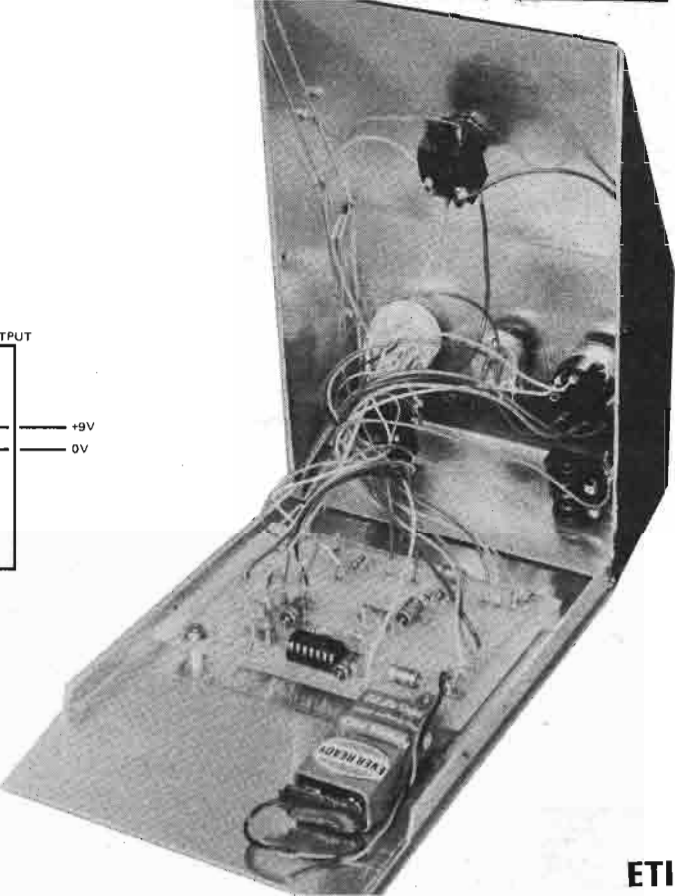
Fig.5 Component overlay.

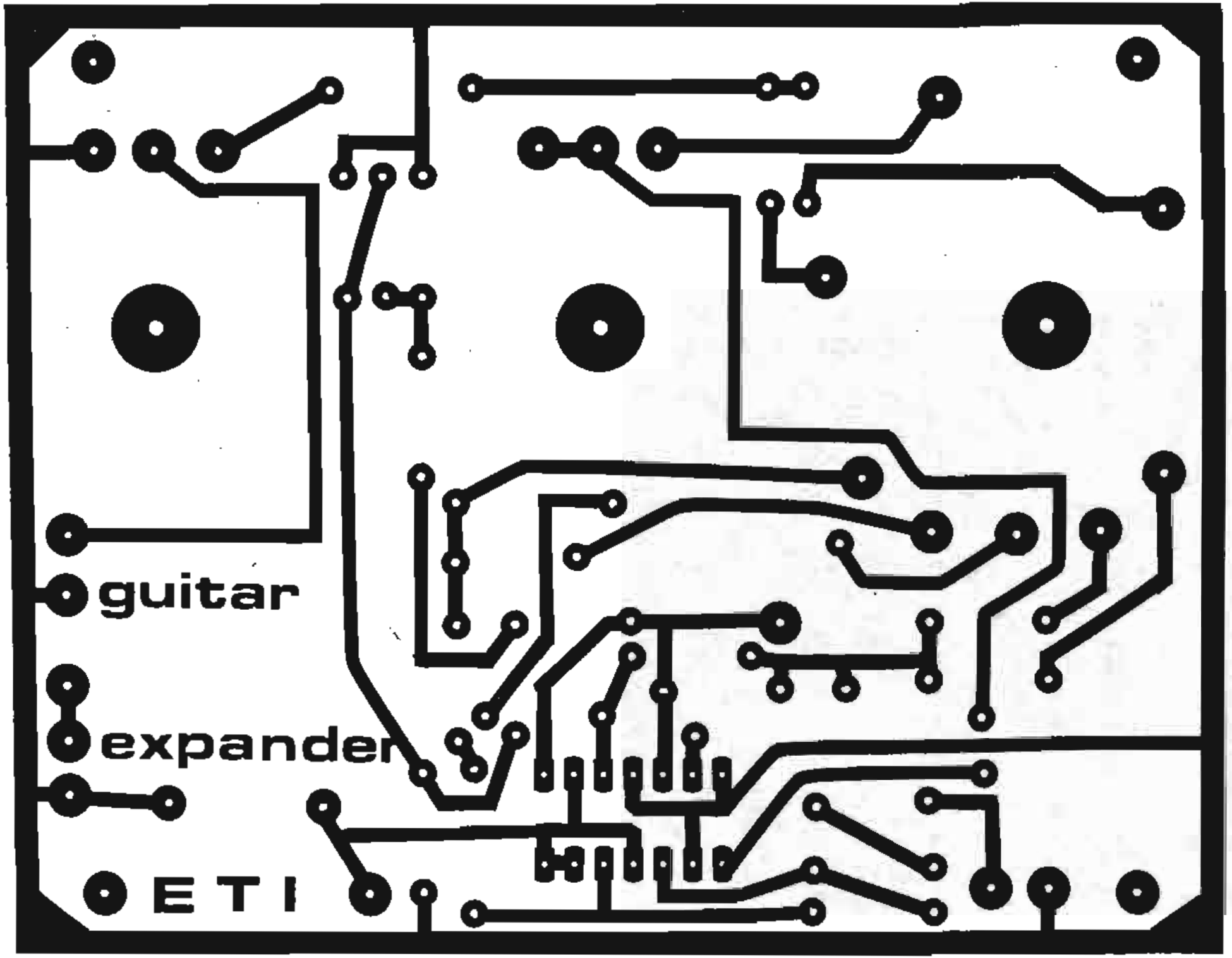


BUYLINES

As mentioned in the text, we have arranged for the construction of a custom case for this project, or indeed any other of your musical projects. H.L. Smith & Co Ltd, 287 Edgware Road, London W2 1BE will supply the box, ref. ETI-1 for the modest sum of £2.00.

All the other components should be readily available from most of the distributors advertising in this issue.

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