

SUSTAIN FUZZ BOX

For that raunchy sound beloved of electric guitarists the world over, this simple little project is just the thing.

Fuzz-tone is to guitar what salt is to meat — it adds flavour and body. The ETI Fuzz Unit has an added bonus in an in-built sustain circuit, adding a bit of extra spice to the idea. The device offers three distinctive sounds, in addition to the 'straight through' option: sustain, fuzz with sustain or fuzz without sustain.

How We Did It

To explain how these sounds are realised, we have to consider the circuit diagram.

The input amplifier, IC1, gives the system some overall gain to boost the treble response and present the correct load impedance to the instrument. The mid-range gain is set to five, allowing 1 V peak-to-peak input signals before distortion and producing the largest possible dynamic range. The frequency response is flat from 20 Hz to about 2 kHz, after which an 8 dB step provides a gentle treble boost up to 20 kHz, where the response is rolled off.

Following the input stage is IC2a, one half of an NE571 compander IC configured as a conventional compressor with a fixed compression ratio of 2:1. This compression effectively halves the dynamic range of the incoming signal by attenuating high level signals and boosting low level ones; thus the signal hangs on — "sustains" — for much longer than it otherwise would. The compression also provides a constant level drive to the clipping stage, making the fuzz sound independent of the instrument output level.

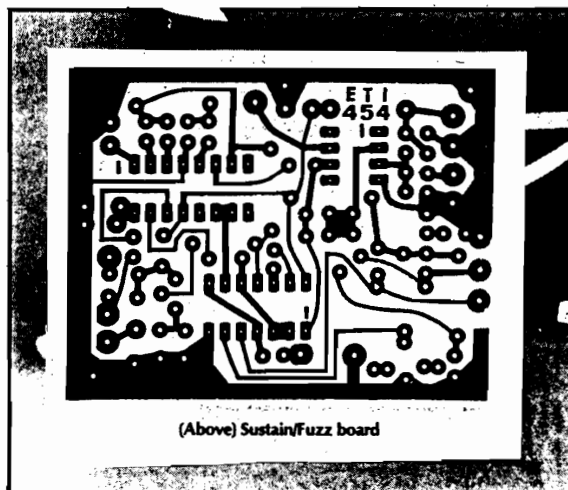
The fuzz stage, Q1, is a high gain amplifier stage. Because of the high, constant drive from the compressor it is always driven into hard clipping, resulting in an output which is substantially a squarewave. The output of the fuzz stage is fed through a tone control which varies the quality of the sound by rolling-off the high frequencies — one of the reasons for the treble boost at the input stage was to ensure that there would be some high frequencies to roll-off at this point!

Following Envelopes

The by now well-and-truly fuzzed signal is fed to the signal input of IC2b, the second half of the NE571 compander. This time the device is set-up as an envelope follower with a signal input and a control input; the output of IC2b is whatever frequencies are applied to the signal input but with the amplitude envelope of the signal fed to the control input. It is this envelope follower, plus some simple switching, which makes the Fuzz Unit so versatile — of which more shortly!

A deliberate modification to the envelope follower ensures that IC2b shuts-off completely when the signal on the control input falls below a certain level. This is a simple 'noise gate' function which prevents the amplification of low-level signals and noise, eliminating the hisses and buzzes of unwanted sounds and the squeals and howls of unexpected feedback! This function operates only when Fuzz function is selected.

The Fuzz Unit is capable of producing either sustain, fuzz with sustain, or fuzz without sustain. These variations are



achieved by selecting the appropriate output and the appropriate drive to the control input of the envelope follower.

The switching system is entirely electronic, so the guitar signal never leaves the box even if the footswitches themselves are a dozen yards away. The signal is not required to travel long lengths of cable and so is not attenuated or subject to interference. Also, single-pole non-audio type switches may be used, allowing a larger choice of switch types.

Two switch lines are used to control four electronic switches operating as two sets of change-over switches. One line controls A and B, (sustain on/off), the other controls C and D (fuzz on/off).

If neither fuzz nor sustain is selected, A and C are closed while B and D are open; the output of the unit is derived from the input pre-amplifier (so it will be a little louder and a little brighter than the guitar itself) via A and C.

If sustain is selected A and B change over and the output is from IC2a.

Selective Switching

Selecting fuzz closes D and opens C. Whether it is fuzz with sustain or fuzz without sustain now depends on the position of the sustain select switch. If sustain is selected the drive to the control input of the envelope follower is the compressed signal from IC2a; compression followed by expansion restores the amplitude envelope of the signal, so the output will have the dynamic characteristics of the original guitar sound, but will sustain for longer than usual. If sustain is not selected, the envelope follower control input is from the pre-amp. Therefore, the output of IC2b is the original signal expanded. Because of the value chosen for C7 and C16, the Fuzz Unit will produce a rather long 'delayed attack' effect when in



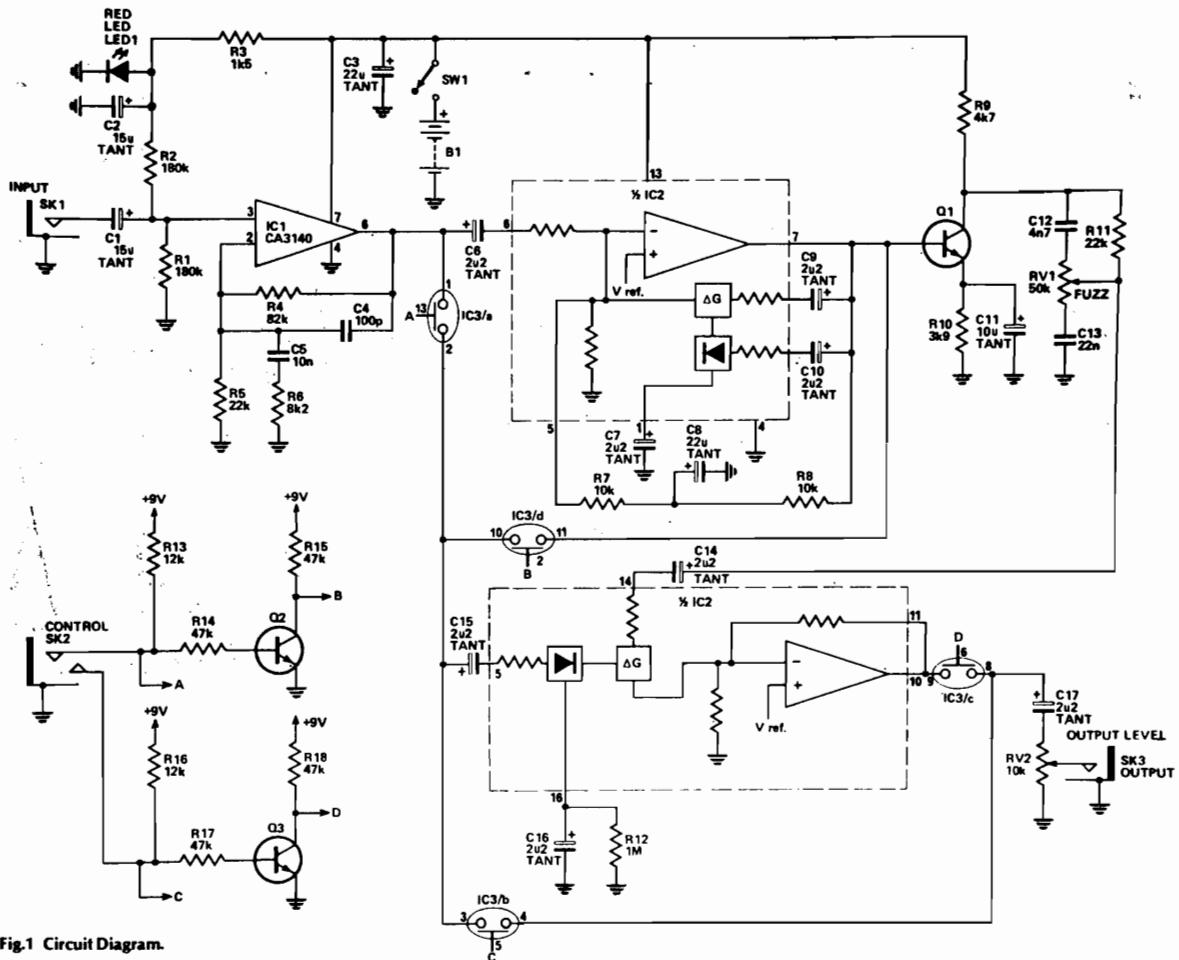


Fig.1 Circuit Diagram.

this mode. If a shorter attack is wanted, C7 and C16 should be reduced; this will give a faster attack in 'fuzz without sustain', and enhanced attack in 'fuzz with sustain'.

Once the box has been drilled, the PCB should be assembled according to the circuit and component overlay. Be sure that polarised components are correctly installed. The ICs should be put in last. Finally, make the control interconnections using the shortest possible lengths of wire.

Use insulated wire, and make sure that nothing is shorting to the box; the battery is best restrained by using a piece of double-sided tape.

After carefully checking that all connections are as they should be, apply power and you've got 'The Fuzz'.

Best results are obtained with the guitar output as high as it will go without causing distortion on loud notes when The Fuzz is switched to sustain only.

HOW IT WORKS

The input amplifier (IC1) is a CA3140, chosen for its low noise. The input impedance of the device is quite high, so the effective value is determined by the parallel combination of R1, R2; the values used give an end impedance of 90k. R1 and R2 can be as low as 10k or as high as 1M, as long as they are the same and within this range.

The bias for the CA3140 is filtered and regulated by R3, C2 and LED1; the LED also acts as a 'power on' indicator! The LED must be red as other colours have a different forward voltage. The stage gain of five is set by the ratio of R4 and R5, while C4, C5 and R6 tailor the frequency response.

IC2 is a dual gain control IC, NE571, which may be set-up to implement a number of signal processing functions. Each half of the IC consists of a full wave rectifier acting on the control input, a variable gain cell (signal input), an operational amplifier and a bias system. The blocks may be set-up as, for example, a compressor, an expander, a limiter or an envelope follower. The compression/expansion ratio is internally set at 2:1 while the attack and release times are determined by an external timing capacitor and an internal resistor, the attack-to-decay time ratio is internally set at 1:5.

It is possible to vary both the compression ratio and the attack/decay ratio by the use of complex external circuitry. However, the internally set values are adequate for the purpose of this gadget.

PARTS LIST

Resistors all 1/2 W, 5%

R1,R2	180k
R3	1k5
R4	82k
R5	22k
R6	8k2
R7,R8	10k
R9	4k7
R10	3k9
R11	22k
R12	1M0
R13	12k
R14,15	47k
R16	12k
R17,18	47k

Potentiometers

RV1	50k linear
RV2	10k logarithmic

Capacitors

C1,C2	15u tantalum
C3	22u tantalum
C4	100p disc ceramic
C5	10n ceramic
C6,C7	2u2 tantalum
C8	22u tantalum
C9,C10	2u2 tantalum
C11	10u tantalum
C12	4n7 ceramic
C13	22n ceramic
C14-17	2u2 tantalum

Semiconductors

Q1-3	BC548
LED1	TIL220 red or similar
IC1	CA3140
IC2	NE571
IC3	CD4016

Miscellaneous

Metal box, PCB, 9 V battery, DPST miniature switch, two jack sockets (mono), one jack socket (stereo).

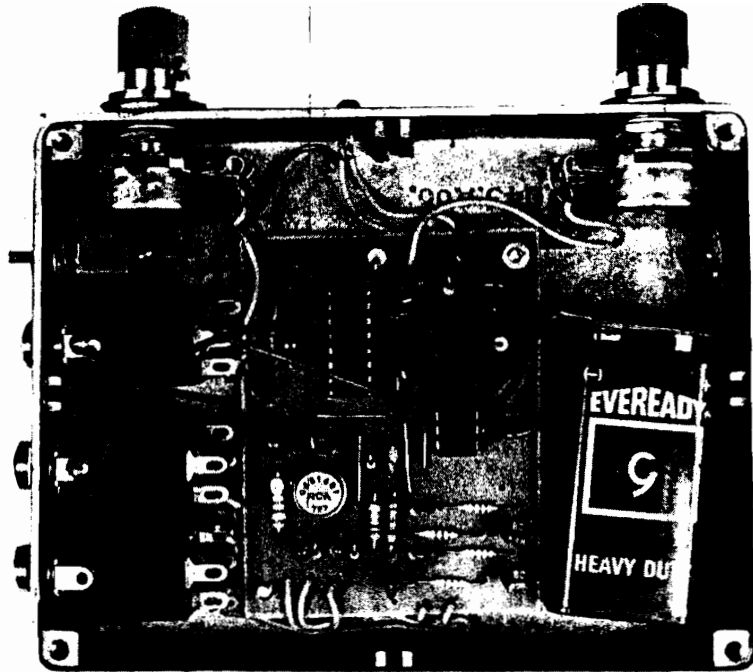
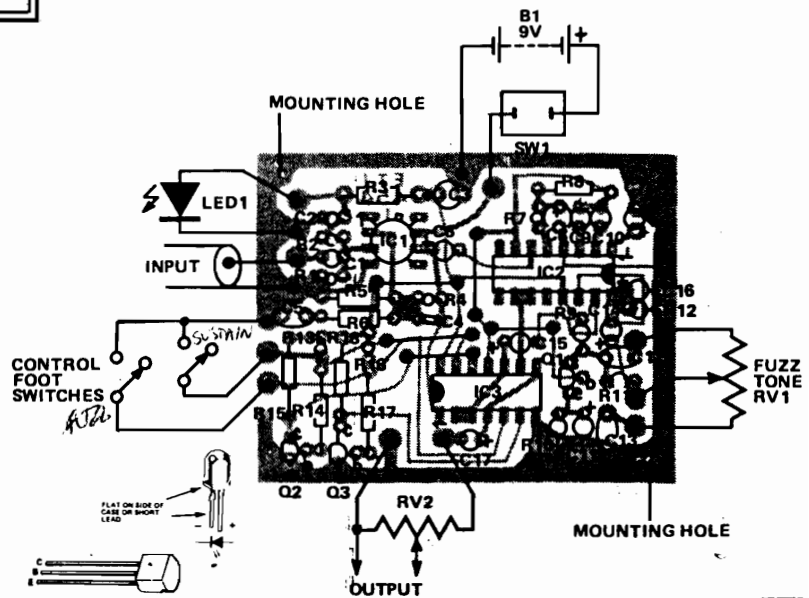


Fig. 2 An internal view shows the relative positions of controls, PCB, sockets and battery. The battery can be held in place with a piece of double-sided tape. The unit can be installed in its own case as shown, or incorporated into an existing effects unit.

Fig. 3 Component overlay. Note the orientation of IC1 and IC2; they are not mounted in the same direction. LED 1, in the bias network of IC1, is also used as a power on indicator. As the signal is switched electronically on the board, the control footswitches need not be expensive audio types.



BC547, BC548, BC549, BC557, BC558.

ETI