Project No. 24

TUBE SOUND FUZZ

Definition: Recreates the types of distortion normally associated with tubes, but with a solid-state design for low current consumption, compactness, and reliability.

Figure 5-137
The Tube Sound Fuzz mounted in a small box for onstage use.

Background

Musicians in general, and guitarists in particular, prefer the sound of tube amps to the sound of conventional transistor amps. However, tubes have certain disadvantages (fragility, sensitivity to mechanical vibration and shock, need for high-voltage power supplies, high current consumption, and change in sound as they age); therefore, transistor amps are often used where reliable operation is paramount.

Luckily, however, there is a member of the transistor family called the field effect transistor *(FET) that happens to distort in very much the same manner as a tube. This fuzz takes advantage of the FET's distortion characteristics to yield a tube-type distortion sound.*

Features

- Low-level or line-level operation
- Low noise compared with conventional fuzzes
- *Rhythm/lead* switch gives low levels of distortion for playing chords, and high levels of distortion for playing lead lines.
- *Fuzz* control varies intensity of fuzz in the rhythm mode
- Distortion increases smoothly as input level increases (soft clips over a wide range rather than hard clipping at a single overload point)
- "Warm" distortion sound accents even harmonics for a musical fuzz effect
- Only requires a single 9V battery (+15V operation is allowable, but not preferable)

Level of Difficulty: Beginner to intermediate

Contruction Tips

- This project uses CMOS ICs; *be sure to reread* the instructions on handing CMOS ICs included in the "Construction Tips" section of Project No. 15.
- Plug the IC into its socket *after* all wiring is complete but *before* you apply power to the unit.
- Separate input and output leads by at least 1 cm (1/2").

■ Shield the input lead. If the wires connecting to S1 and R5 exceed 7.2 cm (3"), use shielded cable for these also.

■ Even though sections IC1C-IC1F appear to have no influence on the operation of the circuit, be sure to wire them up exactly as shown. Leave the outputs of these sections unconnected.

■ Keep all wiring as short and direct as possible.

Using the Tube Sound Fuzz

This fuzz works best with line levels; however, it will also work very well with low-level inputs. With S1 in the *rhythm* position, R5 compensates for differences in input signal levels.

■ Plug your instrument into J1 and patch J2 to your amp. Although most people associate fuzzes with guitars, this unit also works well with electric pianos and other keyboards.

■ With S1 in the *rhythm* position, vary R5's position. You should obtain more intense fuzz effects as you turn this control clockwise. Try playing some "chunky," R&B types of riffs; adjust R5 until you get that old tube amp type of sound.

■ To increase the fuzz beyond the options offered by R5, change S1 to the *lead* position.

■ By turning R7 up full, you can probably overload the input of your amp and thereby create additional distortion.

■ To increase the intensity of the fuzz still further, patch a compressor (Project No. 8) between your instrument and the fuzz input.

Modifications

■ De-emphasized low-frequency response: Reduce the value of C4 to 0.05μF or even 0.02μF. This gives you nice, biting lead lines for guitar without having the bass strings muddy things up too much when you hit them.

■ De-emphasized high-frequency response: Increase the value of C2. A value of 50pF starts rolling off the high frequencies at approximately 4000Hz.

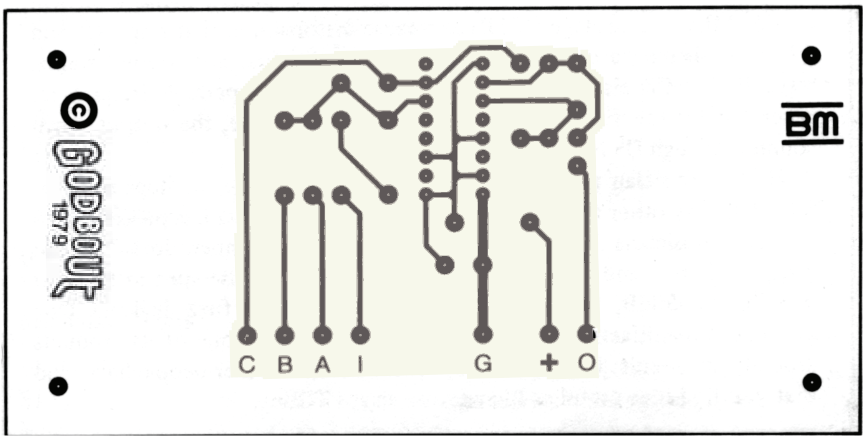
■ Less intense fuzz effect: Line-level signals may produce too fuzzy a sound for some tastes. In this case, increase R3 to 220k or even 470k.

In Case of Difficulty

■ Excessive current consumption (eats batteries): Some 4049s draw more current than others. If you have a couple fo 4049s around, try plugging in different chips (turn off power while changing chips!!) and reading the current consumption with a meter (see Project No. 19). Choose the chip with the lowest current consumption.

■ Oscillations or squeals: Check lead layout. Check that C6 is correctly polarized. Increase the value of C2 to 20 or 30pF.

Figure 5-138
Artwork for the foil side of the circuit board, shown 1 to 1.

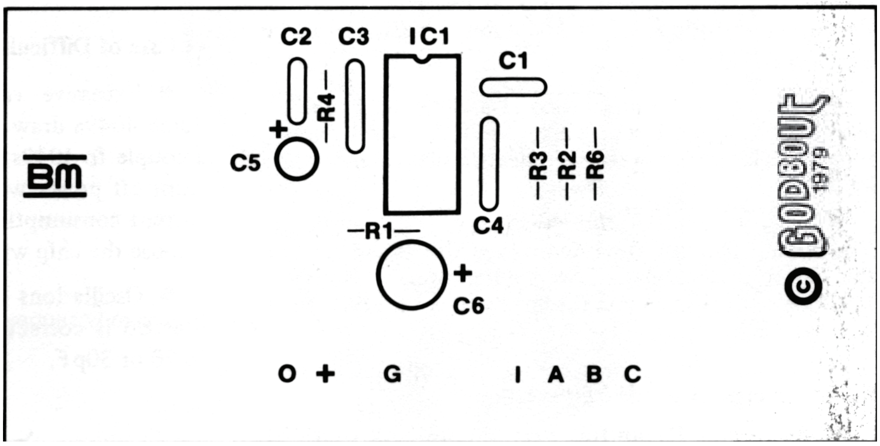


Specifications

Current consumption: ±7mA (depends on the individual 4049)
Maximum input before clipping, S1 in *lead* position*: 15mV
Maximum input before clipping, S1 in *rhythm* position, R5=0*: 150mV

*Since this unit doesn't hard clip, these figures represent where distortion starts increasing rapidly. If you observe a sine wave going through the fuzz and slowly turn up the level of the sine wave, it will become increasingly distorted. With very large input levels, the output waveform is a square wave with gently rounded corners.

Figure 5-139
Component layout for the tube sound fuzz.



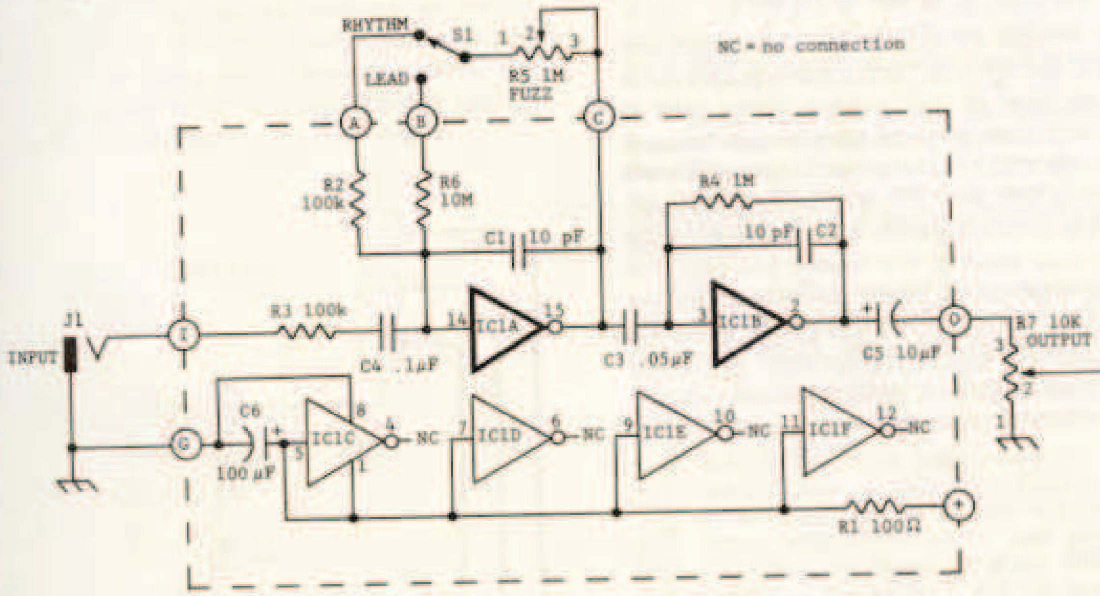
How it Works

IC1 is a 4049 hex CMOS inverter/buffer that was never really intended for audio use. It's a *digital* IC (the type used in computers), and is generally grouped with lots of other digital ICs to implement some type of digital function (microcomputer, industrial control, and so on). But as it so happens, each inverter of the IC may be modified to run as a *linear* (audio) IC, and because these inverters are based on FET circuitry, distorting them gives a tube-type distortion sound.

The input couples through R3 and C4 into the first stage of the fuzz, IC1A. This basically amplifies the input signal a lot, and may or may not add some distortion, depending on the setting of S1/R5. However, even if this stage doesn't add distortion, the greatly amplified signal level will overload the second stage (IC1B) and cause distortion in that stage. C1 and C2 are designed to discourage oscillation in the first and second stages, respectively; C2 also helps cut out some of the superhigh frequencies generated by the fuzz. After leaving the second stage, the output signal couples through C5 into output control R7.

How a musician reacts to a fuzz is highly subjective, perhaps more so than with any other type of effect. Nonetheless, this fuzz has pleased hard-to-please musicians . . . it distorts in a very smooth manner, doesn't sound gritty or harsh, and is very quiet (I measured the noise spec in the *lead* position as -58dB, which is pretty remarkable for a fuzz device!). One prominent manufacturer has even based the design of one of its products around this circuit; I hope you enjoy it as much as other people have, and that you find it as useful as I have.

Figure 5-140
Tube sound fuzz schematic.



Project No. 24 PARTS LIST

Resistors (all are 1/4W, 10% tolerance, except as noted)

R1	100Ω
R2, R3	100k
R4	1M
R5	1M linear taper pot—controls *fuzz intensity* when S1 is in the *rhythm* position
R6	10M
R7	10k audio taper pot—controls *output level*

Capacitors (rated at more than 10V for +9V operation)

C1, C2	10pF, disc ceramic
C3	0.05µF (mylar preferred, disc acceptable)
C4	0.1µF (mylar preferred, disc acceptable)
C5	10µF, electrolytic or tantalum
C6	100µF, electrolytic

Semiconductor

IC1	CD4049 CMOS hex inverter

Mechanical Parts

J1, J2	Open circuit 1/4" mono phone jack
S1	SPDT toggle switch—selects *rhythm/lead*
Misc.	Case, knob, 16-pin IC socket, wire, solder, etc.