No matter what anybody says, you can take it with you . . . here's the low-down on a small, inexpensive, portable headphone amp.

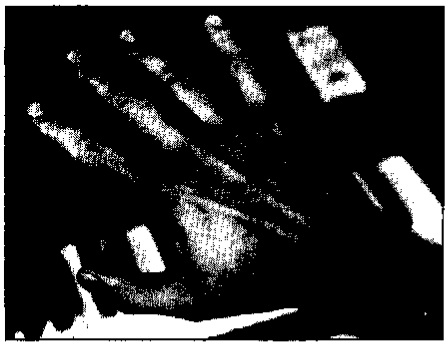
Pocket Rockit, A Personal Amplifier

Circuit

BY JIM FIORE

There I was, on the shore of a lovely Adirondack lake, bathed in the cool light of a mountain sunset . . . playing my bass guitar. Yes, thanks to a pocket-sized personal amplifier, designed to drive Walkman-style headphones from a single 9-volt battery, the full sound of my electric bass was right there with me in the sylvan mountain setting.

Since the "Pocket Rockit" (catchy name, eh?) seemed to work so well, I thought I'd share the design with other folks who like to play their instruments in odd surroundings, or practice, for example, at 3 a.m. but find that inconsiderate neighbors, policemen, or vigilante groups interrupt much too regularly. The Pocket Rockit is designed for guitar players, keyboardists, electronic drummers, and anyone who needs to monitor the output of an electronic instrument via headphones or through small loudspeakers. Functionally, the unit has volume and overdrive (distortion) controls, a "bright" switch, and bass, mid, and treble EQ controls.



*When not harassing his Electrical Engineering Tech. students at Mohawk Valley Community College in Utica, N.Y., **Mr. Fiore** spends vast amounts of time in his home studio communing with small pieces of silicon and lots of wire. Jim plays drums in deference to either Primal Scream therapy or Est. His hobbies include driving sideways down country roads, complaining about the high cost of yogurt, and Zelda.*

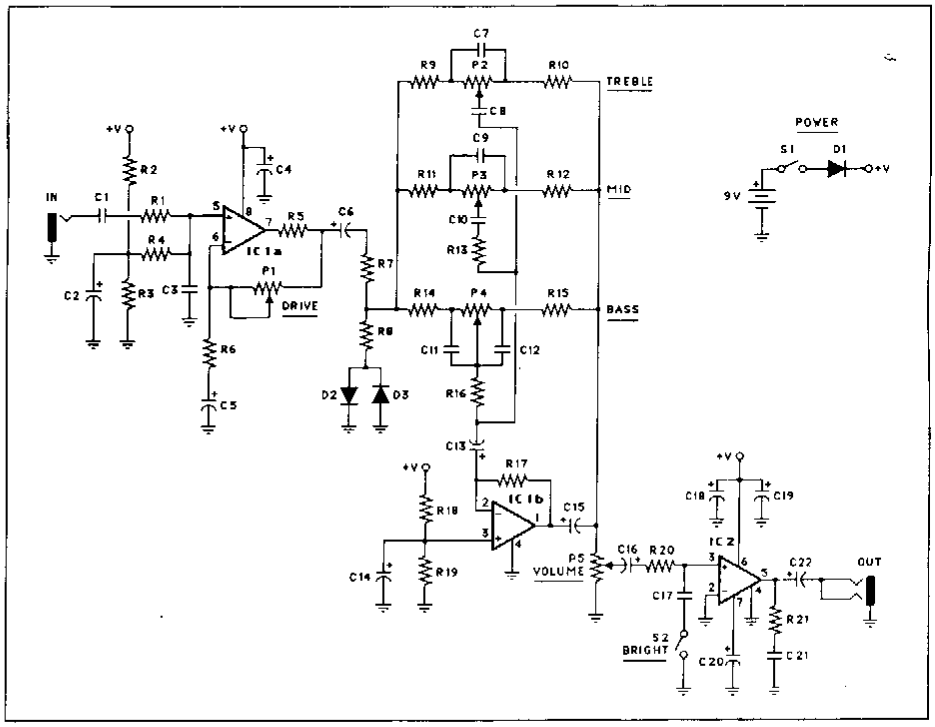


Fig. 1 *Schematic*

THE SCHEMATIC

Referring to the Rockit's schematic (**Fig. 1**), the first stage is a preamp/distortion block centered around op amp IC1a. An LF353 offers low battery drain, although an NE5532 could be used for lower noise. To eliminate the need for a bipolar power supply, R2, R3 and R4 bias the LF353 for single-ended operation. R4 and C2 decouple the input from the power supply noise while C1 and C6 are the input and output coupling capacitors, respectively. C5 restricts frequency response at subaudio frequencies. C3 and R1 minimize RFI (radio frequency interference). C4 bypasses the op amp power supply.

The gain of this stage equals (1+P1)/R6 and is adjustable from unity upwards toward 68 (about 36 dB). The load for this stage is non-linear and consists of R7, R8, D2 and D3. At low-signal levels, the signal is passed on with no change in waveshape, but at higher levels, the two diodes kick in and clip the signal. However, the clipping will tend to be somewhat softer than that produced by normal diode clippers thanks to R5, R7, and R8. These resistors tend to "buffer" the drastic change in diode impedance once conduction begins. Heavy Metal

users fear not, as high overdrive settings will still produce the classic, full bore "transistor distortion."

Stage two, built around op amp IC1b, provides the bass, mid, and treble EQ (equalization) functions. This circuit is a typical inverting configuration with a frequency selective feedback network. R9, R10, P2, C7 and C8 produce high frequency shelving. R11, R12, R13, P3, C9 and C10 comprise a 2 kHz midrange peak/dip function, and R14, R15, R16, P4, C11, and C12 produce low frequency shelving. R17-R19 and C13-C15 provide biasing and coupling. P5 is the volume control. Like P1, P5 must be a log (audio) taper device for proper "feel."

The final stage consists of the LM386 power op amp. It is bypassed with C18 and C19 while C20 maximizes the PSRR (power supply rejection ratio). The "bright" switch connects in a single pole lag network (low pass 6 dB/octave filter) hinged at 3 kHz. The normal position is with the switch closed. This will echo the response of typical 12- and 15-inch loudspeakers, which start to roll off once they reach their mass controlled region (this usually occurs between 2 and 4 kHz). Opening the switch will produce true flat response, which is subjectively bright when compared to a typical guitar or bass amplifier/loudspeaker setup. (Keyboardists, drummers and others who normally play through full range systems with a flat top end should consider this to be a "dull" switch instead—actually a more appropriate name, since it was designed with rock guitarists in mind. Har-de-har-har.)

Now that I've alienated several readers and the editor (just remember who signs your check, Jim—Ed.), let's continue. R21 and C21 stabilize the LM386 at high frequencies and C22 serves as the output coupling capacitor. Finally, at the output we connect the load. Normally this will be a pair of mini Walkman-style headphones. Note that a stereo output

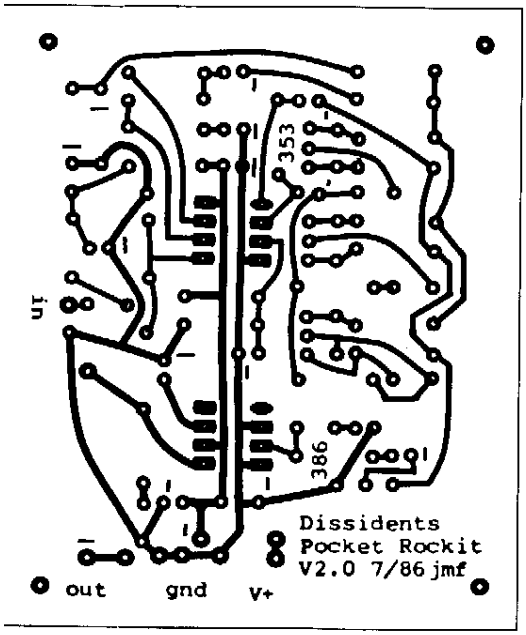


Fig. 2 *Foil side of PC board*

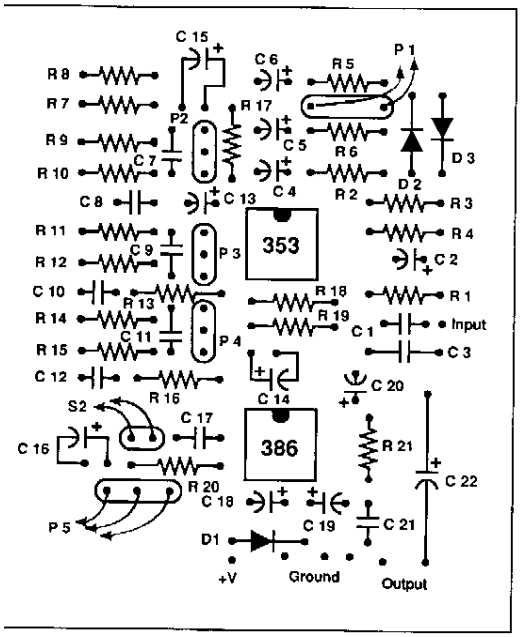


Fig. 3 *Stuffing Guide*

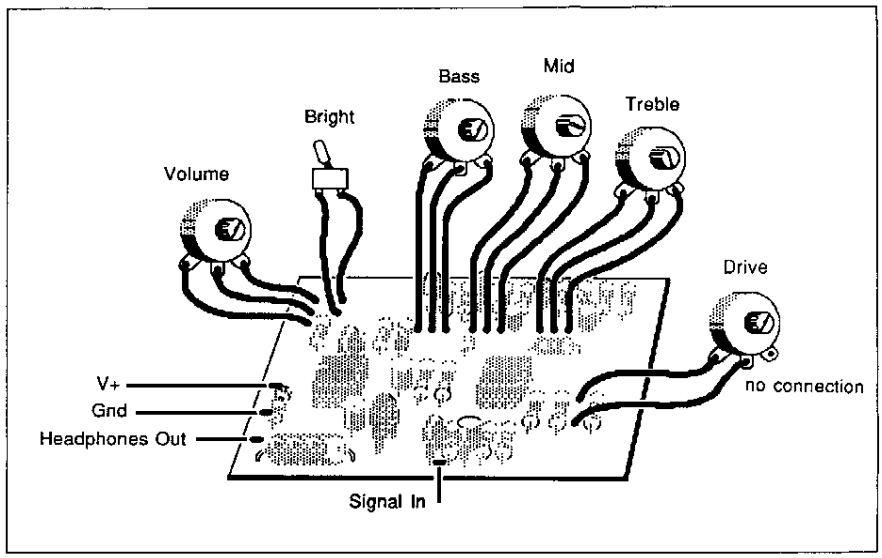


Fig. 4 *Wiring: How to avoid the counter clockwise blues*

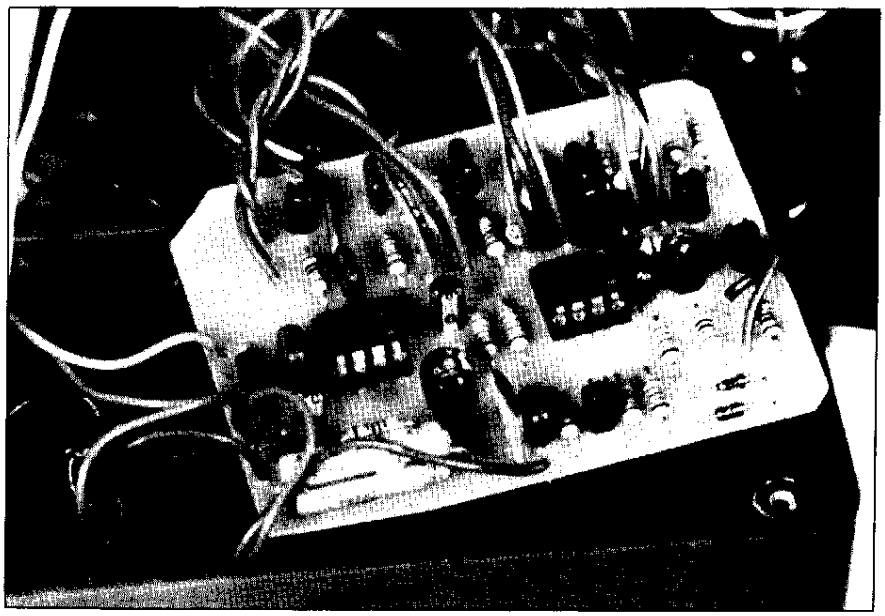


Fig. 5 *Completed PC Board*

plug is required to send the instrument signal (in mono, of course) to both ears. (It's also possible to connect a small loudspeaker here instead; for best performance make sure that the load does not drop below 8 ohms.) A pair of mini headphones connected in mono will usually produce around 25 ohms. (The load impedance is usually listed in the specifications for a particular loudspeaker; otherwise, those who have access to sophisticated electronics devices can measure load impedances with an impedance meter.)

The maximum output power is about ½ watt, which won't make a loudspeaker scream but can produce *very high* levels with headphones—so **be careful**. You can maximize battery life by keeping the volume low and using high impedance headphones (like the Sennheiser HD 414). Alternately, you can power the circuit from a 9-volt battery eliminator. If batteries are really important, you can get longer life by using six 1.5-volt AA batteries instead of the single 9-volt unit. The AA's will come out cheaper in the long run, particularly if you opt for the rechargeable Ni-Cad variety. They do, however, take up more space.

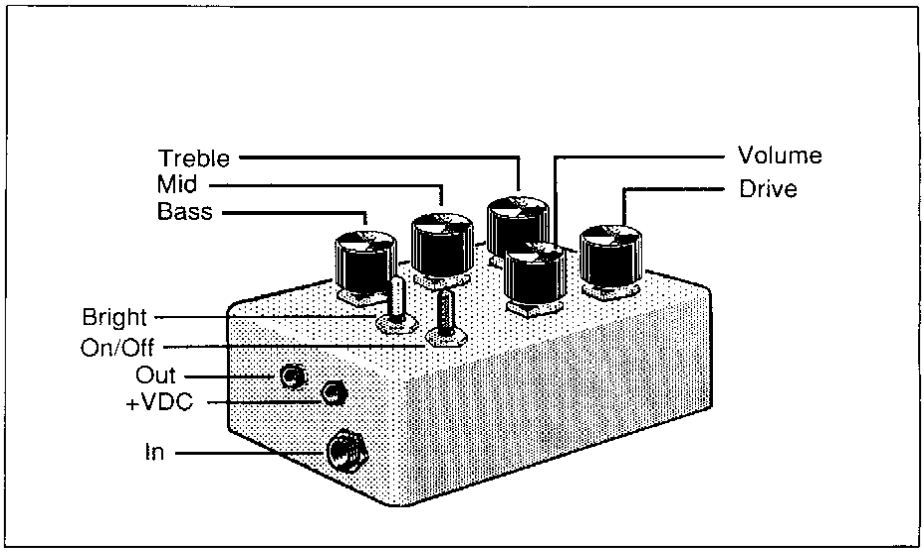


Fig. 6 *Suggested layout for complete project*

Fig. 2 shows the PC board (foil side) artwork; **Fig. 3** shows the component layout. When assembling, make sure that you obey the polarity markings for the caps and diodes. Also make sure that the ICs are oriented correctly. Miswiring the pots can produce some strange results; for all pots requiring three leads, the wiper arm should connect to the center pad on the PC board. The other wires are connected as shown in **Fig. 4**. Connecting them backwards will make your vol-

ume, drive, and other controls *decrease* when you rotate the pot clockwise, so pay attention. **Fig. 5** shows a completed board and pot assembly, and **Fig. 6** is a drawing of the completed unit.

FINDING PARTS

If you can't find parts locally, there are several good mail order sources including Digi-Key Electronics, PO Box 677, Thief River Falls, MN 56701; Jameco Electronics, 1355 Shoreway Rd., Belmont, CA 94002; and JDR Micro Devices, 1224 S. Bascom Ave., San Jose, CA 95128. If you use good, standard soldering techniques, IC sockets and the like, your Pocket Rockit should give you no trouble during assembly and test. I hope you find this circuit useful, and that it gives you a lifetime of service. CM

Parts List

Resistors *(All resistors ⅛ W, 5% carbon film)*

R1, R11, R12	4k7 (4.7K)
R2, R3, R18, R19	220k
R4	470k
R5	220
R6	1k
R7, R8	68 (68Ω)
R9, R10	3k3 (3.3K)
R13	6k8 (6.8K)
R14, R15	5k6 (5.6K)
R16	27k
R17	1 M
R20	10k
R21	10 (10μ)
P1	100k log potentiometer
P2, P3, P4	100k linear potentiometer
P5	1k log potentiometer

Capacitors *(15 working volts DC or greater)*

C1	100n mylar (0.1)
C2, C13-C16, C19	10μ electrolytic
C3	68p disc
C4	1μ5 tantalum
C5	22μ electrolytic
C6	33μ electrolytic
C7	560p disc
C8	1n5 mylar (0.0015)
C9	2n2 mylar (0.0022)
C10	4n7 mylar (0.0047)
C11, C12	22n mylar (0.022)
C17	6n8 mylar (0.0068)
C18	100n mylar (0.1)
C20	47μ electrolytic
C21	47n 50V mylar (0.047)
C22	470μ electrolytic

Semiconductors

IC1	LF353 dual op amp (National Semi)
IC2	LM386 power amp (National Semi)
D1	1N4001 rectifier
D2, D3	1N914 or equiv. diode

Mechanical Parts

S1, S2	SPST switch
Misc.	Knobs, case, hookup wire, IC sockets, ¼" and ⅛" jacks (mono and stereo), battery clip, etc.