

# VOCAL ZAPPER

## MAKES YOU A "SUPERSTAR"

*Cancels the "phantomed" center channel of a stereo record  
and lets you substitute your own voice*

BY CRAIG ANDERTON AND DAVID KARR

**W**HETHER to practice singing, have fun at parties, or just feel like a rock star, the Vocal Zapper may be just what you want. This inexpensive device lets you remove a lead singer's voice during playback of most stereo records and substitute your own voice. The Zapper is effective only with stereo records and most effective with those in which the lead vocalist (and bass instruments, if used) occupy center-stage, with vocal and nonbass-instrumental accompaniment mixed more toward the left or right of the stereo spread. (This type of mix is common in popular music.)

To create the center-channel effect, the sound engineer generally mixes equal amounts of in-phase lead-vocal (and bass) signal with the directional left- and right-channel signals. When a stereo record mastered in this manner is played back, the mix psychoacoustically places the lead vocalist stage-center, with accompanying voices and instruments to the left and right of the stereo spread.

In the ZAP mode, the Zapper subtracts the left and right stereo signals fed to its inputs in a differential amplifier. The result is that all common-mode (equal-amplitude, in-phase) signals in both channels—in this case, the lead vocalist—are cancelled out. What emerges from the amplifier and is fed back into the stereo system is a single mono signal with all the original left- and right-of-center information, including any reverb that may have been added to the lead vocal, but no lead vocal. The residual reverb will generally be of a low enough level to be unobjectionable if you replace the lead vocal with your own voice. In fact, you may even find it desirable, since it adds depth to the sound.

To prevent complete cancellation of common-mode bass information, one channel has been modified to permit only those frequencies above about 160 Hz to be cancelled by the Zapper. Since unequal amounts of common-mode bass signal appear in the differential amplifier, little of it is eliminated from the mono signal at the output. Mono signals fed to the Zapper will be cancelled almost entirely.

**About the Circuit.** The heart of the Vocal Zapper, shown schematically in Fig. 1, is differential amplifier *IC1*. This IC and microphone preamplifier *IC2* can be an LM301, LM748, or any equivalent uncompensated operational-amplifier integrated circuit.

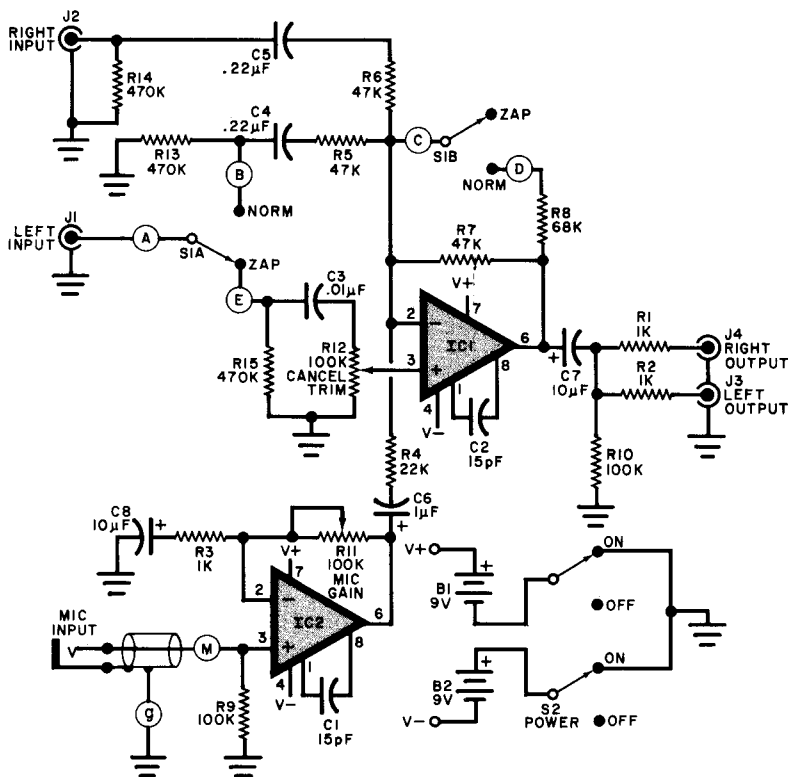
With *S1* set to NORM, both the left input at *J1* and the right input at *J2* are mixed together and fed to the negative, inverting input of *IC1*. Since in this mode only one input of *IC1* has a signal applied to it, no differential amplification occurs. In this event, *IC1* simply passes on *all* the signal information, including common-mode

vocal in mono form, to both *J3* and *J4*, the left and right outputs, respectively. If a microphone is plugged into *J5* in the NORM mode, its signal would be amplified by microphone preamplifier *IC2* and mixed with the left and right input signals to provide a "duet" signal capability. (Microphone gain is set as desired with potentiometer *R11*.)

Setting *S1* to ZAP (common-mode cancel) causes the left-channel input signal to feed the positive, noninverting input of *IC1*, while the right-channel signal continues to feed the negative input. Once the two signals enter *IC1*, one of them is inverted (phase shifted by 180°) so that common-mode information cancels. The music at this point would be lower in volume than in the NORMAL mode.

The value of *C3* has been selected to prevent complete cancellation of bass information in the common-mode signals. Frequencies below about 160 Hz pass through the differential amplifier from *J1* with considerably lower amplitude than those





### PARTS LIST

- B1, B2—9-volt transistor battery
- C1, C2—15-pF disc capacitor
- C3—0.01- $\mu$ F, 15-V disc or Mylar capacitor
- C4, C5—0.22- $\mu$ F, 15-V disc or Mylar capacitor
- C6—1- $\mu$ F, 15-volt electrolytic or tantalum capacitor
- C7, C8—10- $\mu$ F, 15-volt electrolytic or tantalum
- IC1, IC2—LM301, LM748 or equivalent op amp (see text)
- J1 through J4—Phono jack (see text)
- J5—Microphone jack (see text)
- Unless otherwise specified the following are 1/4-watt, 10% tolerance fixed resistors
- R1, R2, R3—1 k $\Omega$
- R4—22 k $\Omega$
- R5, R6, R7—47 k $\Omega$
- R8—68 k $\Omega$
- R9, R10—100 k $\Omega$
- R11, R12—100-k $\Omega$  upright pc-type trimmer potentiometer
- R13, R14, R15—470 k $\Omega$
- S1, S2—Dpdt switch
- Misc.—Printed-circuit or perforated board; IC sockets (optional); sheet aluminum for front and rear panels; L brackets; No. 6 machine hardware; dry-transfer lettering kit; hookup wire; solder; etc.

Fig. 1. Schematic diagram of the Zapper. IC1 and IC2 can be any uncompensated op amp ICs similar to the LM301.

from J2. Although these two bass signals are common-mode, they are of unequal amplitudes and, therefore, don't cancel completely. During zap-

ping, you can add your own voice in place of the vocal being cancelled simply by singing into a microphone plugged into MIC input J5.

Power for the circuit is supplied by a pair of 9-volt transistor batteries, B1 and B2. Since the circuit requires a bipolar source, B1 and B2 are ar-

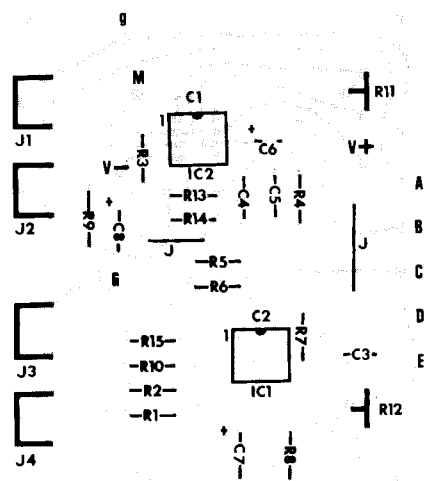
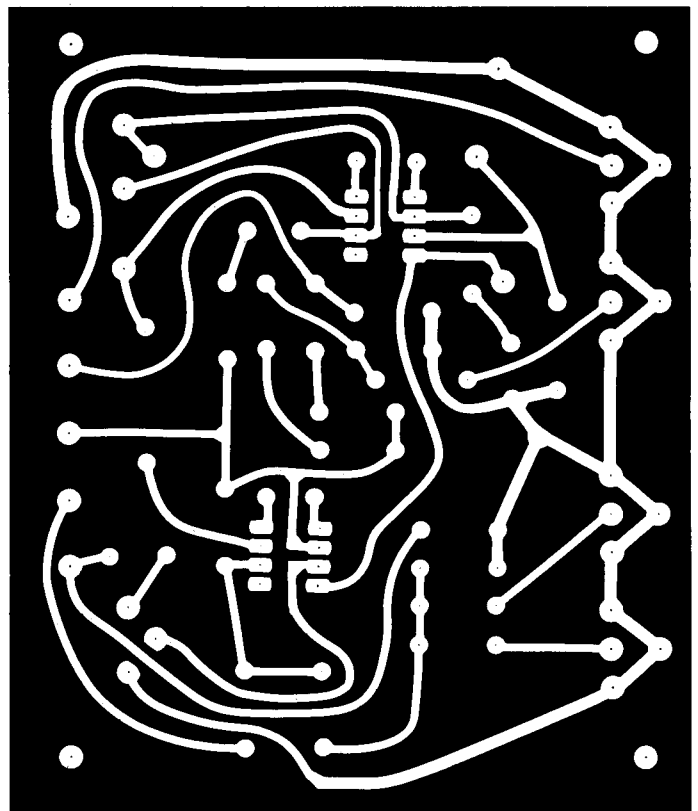


Fig. 2. Actual-size foil pattern for a pc board is at right; component layout above.



### KIT ORDERING INFORMATION

The following is available from PAIA Electronics, Inc., P.O. Box 14359., Oklahoma City, OK 73116; complete kit of parts No. 6730K, including front panel for \$24.95 plus \$3 postage. Also available separately: pc board No. 6730pc for \$9.95. Add \$5 handling charge for foreign orders.

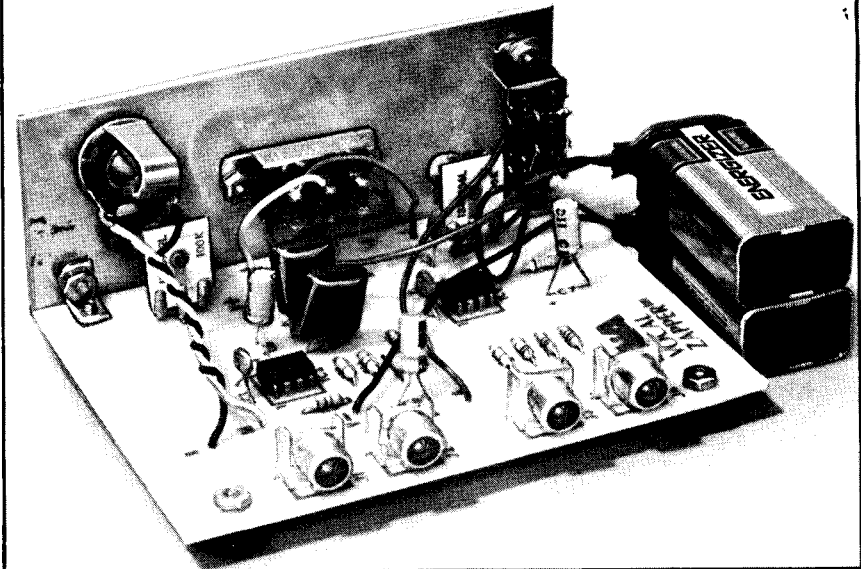


Fig. 3. Photo of the interior of the author's prototype. Right-angle pc-mount jacks were used for J1 through J4.

ranged to supply  $\pm 9$  volts, referenced to signal ground.

**Construction.** The Zapper is best assembled on a printed-circuit board (see Fig. 2) or perforated board with solder clips. In either case, sockets are optional, but recommended, for IC1 and IC2.

Mount the resistors, capacitors, trimmer potentiometers, and ICs (or their sockets) as shown in the compo-

nent-placement guide. Don't forget to install the two jumpers at the locations labelled *J*. You have the option with J1 through J4 of using either right-angle pc-mount jacks (see Fig. 3) or standard panel-mount jacks.

Referring to the lead photo, prepare a front panel to accommodate POWER and NORM/ZAP switches S1 and S2 and MIC jack J5 and to provide access to CANCEL TRIM and MIC GAIN controls R12 and R11. (Note: Select a

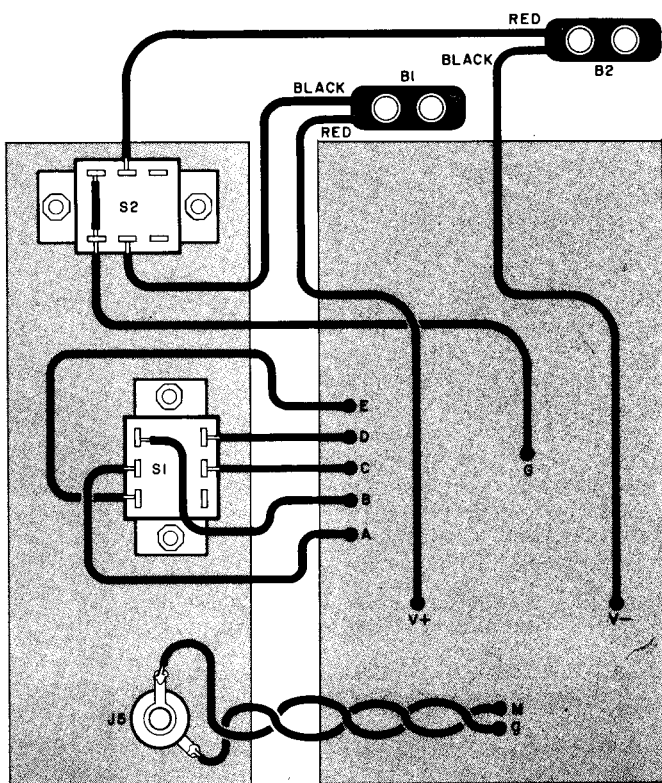


Fig. 4. Follow this wiring diagram to connect the front panel to the components on the pc board.

## vocal zapper

jack that mates with the connector on the microphone you plan to use with the Zapper and drill a hole just large enough to accommodate it.) Then mount the panel to the pc assembly edge with the letters A through E on it with a pair of small L brackets.

Loosely twist together two lengths of different colored insulation hookup wire or substitute a length of shielded cable and solder one end to the lugs on the MIC jack. Being careful to maintain proper polarization, connect and solder the other end of the twisted pair or shielded cable to points M (hot) and g (signal ground) on the pc board. This step and the remainder of off-board wiring are shown in Fig. 4.

**Installation and Use.** Snap a pair of batteries into their connectors, but leave the POWER switch off. Then connect the Zapper into your stereo system's TAPE OUT/TAPE MONITOR loop. From now on, when you wish to use the Zapper, all you do is activate the receiver or amplifier tape-monitoring function.

After installation, turn on power first to the Zapper and then to the stereo system. Set your stereo system's input selector to PHONO but leave the TAPE MONITOR switch in the out position. When you play a stereo record, you should now hear normal stereo sound. Set the Zapper to NORM and switch in the stereo system's tape-monitor function. The stereo spread should now disappear and be replaced by mono sound. You might also note a slight drop in overall volume.

Now switch to the ZAP mode and listen to the sound. The lead vocal should be absent, but the stereo spread should remain. If you can hear the lead vocal (don't confuse this with any reverb that may have been added), adjust the CANCEL TRIM control for maximum cancellation, which should occur somewhere near the center of the pot. The CANCEL TRIM control need not be touched again.

Once the Zapper is operating properly, plug headphones into the amplifier and then a microphone into the Zapper. (Don't attempt to listen through speakers with a live microphone. If you do, acoustic feedback can damage your system.) As you sing into the microphone, adjust the MIC GAIN control for the proper blend between microphone and program material. At first, you might tend to set mike gain too high, which could result in distortion. With a little practice, you'll soon be using the MIC GAIN control with the proper "touch." ♦