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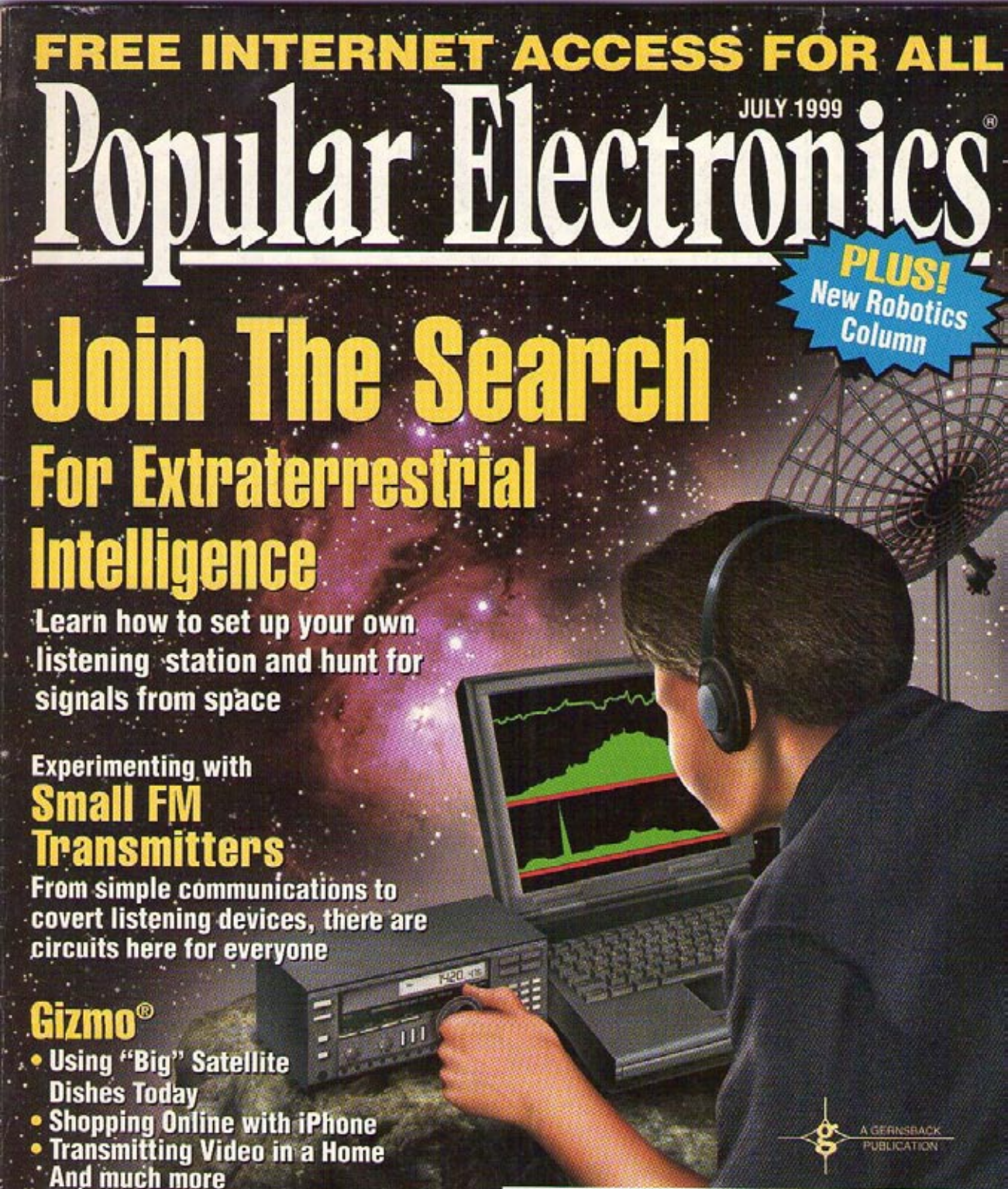

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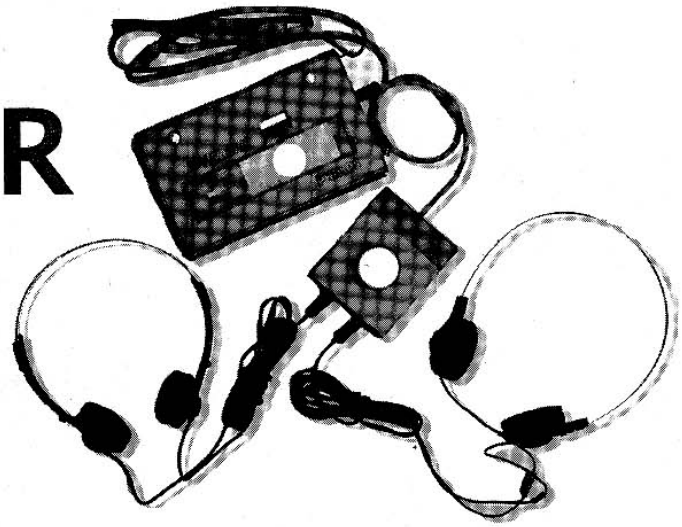
SOUND PARTNER



This simple circuit allows you to connect a second set of headphones to your portable personal-sound system without concern that doing so could destroy the unit's output drivers.

NEWTON C. BRAGA

In these times, it's not unusual to see people listening to personal radios, cassettes, or even CD players through a set of headphones while walking, or while riding on buses or trains. Those devices are just fine for the individual. But what about those times when you find yourself traveling with a companion with whom you'd like to share a particularly memorable cut from a tape or CD, or a song on the radio? Of course, you could plug a dual-headphone adapter into your audio device, allowing you to connect two headphones.

At first glance taking that route might seem the ideal solution, but there is an unforeseen downside. Such adapters simply (as shown in Fig. 1A) tie the two sets of headphones in parallel. That reduces by half the total impedance seen by the output driver of your personal sound system and places unnecessary strain on the sound system's output circuits. And that, in turn, could lead to overheating and other problems that could possibly cause irreversible damage. Even if connecting the adapter and a second headphone doesn't completely destroy the unit's output driver, the loading effect is sure to severely distort the output audio to a point where it's almost unintelligible. Alternatively, if the two headphones are series connected to the personal sound system (as shown in Fig. 1B), the increased (doubled) impedance produces power losses and could possibly severely distort the output signal.

Enter the *Sound Partner*—a small low-power audio amplifier designed to provide sufficient output current to drive a second set of headphones without distorting the output audio or loading the unit's output driver. The Sound Partner, based on National Semiconductor's LM386 low-power audio amplifier and powered from 4 AA-cell batteries (*i.e.*, a 6-volt source), can output up to 100 mW.

A Little Background. The Sound Partner, as shown in Fig. 2, is extremely easy to use. You simply connect it to the headphone jack of your personal sound system and then connect two headphones to the Sound Partner. Note from Fig. 2

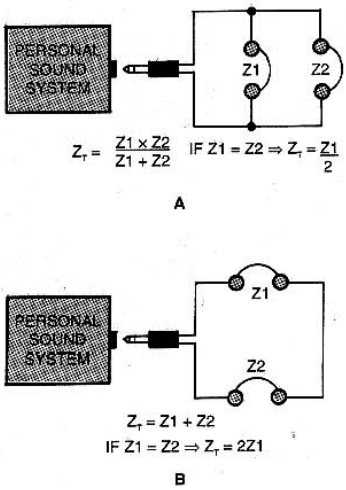


Fig. 1. Dual-headphone adapters (as shown in A) simply tie the two sets of headphones in parallel. If the two headphones are series connected to the personal sound system (as shown in B), the increased impedance produces power losses and possibly distortion.

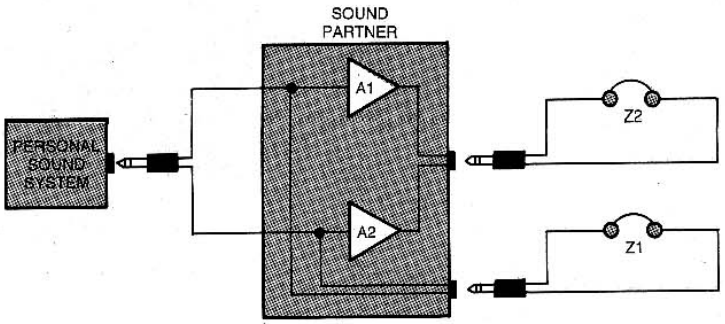


Fig. 2. The Sound Partner is configured such that audio from a personal sound system is fed to the headphones connected to J1 without modification, while the same two-channel audio is fed to a pair of amplifiers, which provide two-channel audio to a second set of headphones.

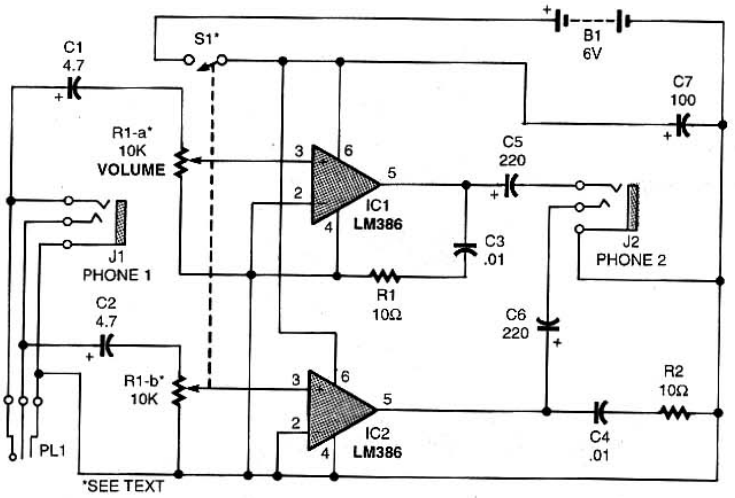


Fig. 3. The Sound Partner, which is built around a pair of LM386 low-power audio amplifiers (IC1 and IC2), can be used with headphones with impedances ranging from 16 to 100 ohms.

that audio from the personal sound system is fed to the input of the Sound Partner, where the signal is split into distinct and separate left and right channel signals that divide along two paths. In the first path (going to the first set of headphones), the unaffected signal is applied to Z1. In the second path, the left and right channel audio is applied to a pair of low-power amplifiers. Because the two amplifiers have a very high impedance, the Sound Partner offers no loading to the personal sound system.

How It Works. A schematic diagram of the Sound Partner is shown in Fig. 3. The circuit, built around a pair of low-cost LM386 low-power audio amplifiers (IC1 and IC2), can be used with common headphones with impedances ranging from 16 to 100 ohms.

The audio from the portable sound system is routed though PL1 (a stereo phone plug) to the Sound Partner, where the stereo signal is broken down into its left and right channel components. The stereo (the left and right channel) audio is AC coupled through a pair of 4.7-µF capacitors (C1 and C2) to VOLUME CONTROL R1 (a 10k dual-ganged audio-taper potentiometer with a piggy-backed SPDT switch, S1). Capacitors C1 and C2 are used to prevent any DC from reaching the circuit. After signal level adjustment, the left- and right-channel signals are fed to a pair of LM386 amplifiers, where the signal is ramped up to a level sufficient to drive a set of stereo headphones. The amplified outputs of IC1 and IC2 are routed through C5 and C6, respectively, to jack J2 and applied to the connected headphones.

Power for the Sound Partner is provided by a 6-volt power source, B1 (comprised of 4 AA-cell batteries). The source voltage is filtered by C7, a 100-µF electrolytic capacitor, to establish a relatively ripple-free power source for the Sound Partner.

Construction. There is nothing critical about the construction of the Sound Partner, so the circuit can be put together using any assembly method with which you are comfortable. The author's prototype of the circuit was assembled on a printed-circuit board, measuring 1 9/16 by 1 7/16 inches. A full-size template of the author's printed-circuit layout is shown in Fig. 4.

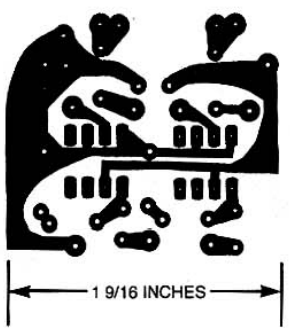


Fig. 4. The author's prototype of the circuit was assembled on a printed-circuit board, measuring 1 9/16 by 1 7/16 inches. A full-size template of the author's board is shown here.

Once you've obtained all of the components listed in the Parts List, construction can begin. If you intend to build the circuit on perfboard, using point-to-point wiring techniques, assemble the circuit using the schematic diagram (Fig. 3) as a guide. If you take a non-printed-circuit approach to assembling the circuit, be sure to pay strict attention to the electrical orientation of the polarized components. For those who prefer the printed-circuit approach, assemble the Sound Partner's printed-circuit board guided by the parts-placement diagram shown in Fig. 5. Note that with the exception of the input and output jacks, the batteries and battery holder, and the VOLUME control (R1), all of the components mount to the printed-circuit board. The off-board components can be wired to the rest of the circuit using 22- or 24-gauge stranded wire. **Note:** If desired, separate components can be used in place of R1-a, R1-b, and S1. Once completed, the circuit can be housed in any plastic or other non-metallic enclosure, with the printed-circuit board fixed in position using a few (2 or 3) machine screws with nuts and washers. If the board is housed in a metallic enclosure, it is wise to mount the board on quarter-inch spacers to prevent shorting.

Prior to mounting the circuit board and off-board assembly into its enclosure, carefully drill holes at convenient locations in the enclosure wall(s) to accommodate the off-board components—S1, J1, J2, PL1, B1 (along with its 4 AA-cell battery holder), and R1 (the VOLUME control). Be careful when drilling holes in a plastic enclosure: Too much pressure can cause the plastic to crack.

Testing. Once the circuit has been completely assembled, check your work for the usual construction errors—solder bridges, misoriented or mispositioned (*e.g.*, improperly located) components, *etc.* When you are satisfied that the circuit contains no construction errors, it is

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JOIN THE SEARCH

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and orbiting relay stations.

In addition to analyzing signals, some SETI League computers also control the station. Remember the computer-controlled microwave receivers discussed above? They can often be tuned by software, driven from the PC's serial, parallel, or universal-serial-bus (USB) port. Antennas can similarly be computer-aimed, if they're equipped with software-driven azimuth and elevation rotors. Some SETI computers make lights flash and bells ring whenever they detect something interesting. And the most advanced of the computers used by SETI League members also dial into the Internet when an interesting candidate signal is received, automatically alerting other participants that their assistance in signal verification is required.

(More SETI computer information may be found in the "Software" chapter of *The SETI League Technical Manual.*)

Putting It All Together. When I built my first amateur dish more than twenty years ago, I was going it alone. That was frustrating, because I had to learn from my own mistakes. Today there's assistance. The nonprofit, membership-supported SETI League exists to help you become one of the 5000 active *Argus* observers. Though only 1000-members strong at present, The SETI League is still a young organization, just three years into its search. The group's volunteer regional coordinators in over 50 countries on six continents have already helped more than five dozen members to put stations on the air. The SETI League's extensive Web site and various books and articles are already attracting hundreds of like-minded enthusiasts into the SETI community. To come on line with The SETI League, e-mail them your postal address (join@setieague.org), call their membership hotline (800-TAU-SETI), or write for a free brochure. Together, amateur SETI volunteers may well end humanity's isolation in the universe. ■

SOUND PARTNER

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time to test the project. **Note:** No calibration adjustments are needed. Simply plug PL1 into the headphone output of the personal sound system and connect two 16- to 100-ohm stereo headphones to the Sound Partner outputs (J1 and J2). Set power switch S1 (ganged to R1) to the off position, install the batteries in their holder, and the Sound Partner is ready for use.

Adjust the audio level for headphone 1 (J1) using the volume control of the personal-sound system. After that, adjust volume of headphone 2 by adjusting R1. **Caution:** Never use the Sound Partner without a headphone connected to J1. Doing so could damage your personal sound system.

When all is working properly, there is nothing left to do but seal the project into its enclosure, plug it into your personal sound system, and share that must-hear tune. ■

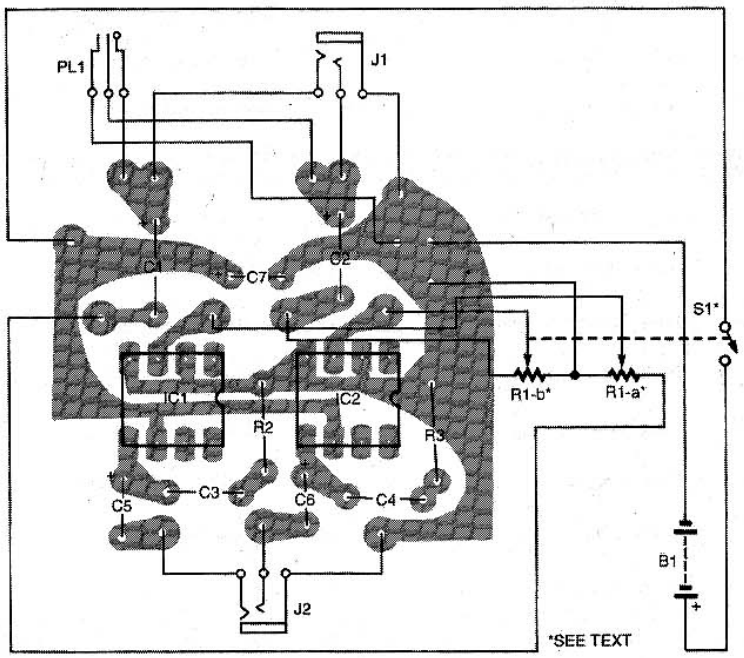

Fig. 5. Assemble the Sound Partner's printed-circuit board guided by this parts-placement diagram. Note that with the exception of the input and output jacks, the battery with its holder, and the VOLUME control (R1), all of the components mount to the printed-circuit board.

PARTS LIST FOR THE SOUND PARTNER

RESISTORS

(All fixed resistors are ¼-watt, 10% units.)
R1—10,000-ohm dual-gang audio taper potentiometer with SPST switch (see text)
R2, R3—10-ohm

CAPACITORS

C1, C2—4.7-μF, 16-WVDC, miniature electrolytic
C3, C4—0.01-μF, ceramic-disc or metal-film
C5, C6—220-μF, 16-WVDC, miniature electrolytic
C7—100-μF, 16-WVDC, miniature electrolytic

ADDITIONAL PARTS AND MATERIALS

IC1, IC2—LM386 low-power audio-amplifier, integrated circuit
B1—6-volt battery, see text
J1, J2—⅛-inch stereo phone jack (see text)
PL1—⅛-inch stereo phone plug (see text)
S1—SPST (ganged to R1)
Printed-circuit materials, 8- to 100-ohm headphones, plastic knob, enclosure, battery holder, IC sockets, wires, solder, hardware, *etc.*