Inexpensive Wireless Headphones

A simple induction system lets you listen to audio sound in privacy without disturbing others in the same room

By Philip Kane

Have you ever wished you could hear the sound from your TV receiver, radio or hi-fi system without bothering anyone else in the same room — but dislike using headphones with a long cable tether? Perhaps you thought of buying a commercially available infrared wireless headphone system but didn't want to pay its hefty price. If you'd really like the convenience of wireless headphone listening without breaking your budget, our low-cost mono induction headphone system provides an inexpensive solution.

You can build this wireless headphone system for about $25, including the low-cost phones (if you don't already have them). The project is built around readily available components, many of which you may already have on hand. Though our wireless headphones do not provide for stereo listening, they do produce good audio quality for mono listening.

How it Works

Three basic elements make up the wireless headphone system: a transmitter, an antenna and a receiver. The transmitter you already have in the form of your TV receiver, radio, hi-fi system or shortwave receiver. All you need to transform these into a transmitter of audio signals are a resistor and a long loop of wire to serve as a load/antenna system. The receiver can be any battery-powered audio amplifier that is small enough for you to conveniently carry around. All you need to convert the amplifier into a "receiver" is an inductive pickup coil that you can purchase from your local electronic parts store.

A loop of wire you string completely around the perimeter of the room in which you have the equipment to which you wish to listen serves as the transmitting antenna. As shown in Fig. 1, the loop connects across the "transmitter's" output terminals. Since this wire is rarely long enough to have a safe enough resistance to prevent damage to the equipment's amplifier, load resistor *R9* must be installed in series with the antenna as shown.

The value and power rating of *R9* must be chosen to match the characteristics of the speaker output of the transmitting amplifier. For example, if your amplifier is rated at 25 watts into 8 ohms, you would use a 25-watt power resistor whose value, when added to the resistance of the wire used for the antenna, is 8 ohms.

The system works in much the same manner as an ordinary transformer does. That is, the transmitter's antenna and the receiver's telephone pickup coil serve as the primary and secondary windings, respectively, of the "transformer." The ac signal (the audio signal) is coupled through the "primary," which creates an electromagnetic signal that travels through the air. This signal is intercepted by the "secondary," which converts it into a current that is then coupled into an amplifi-

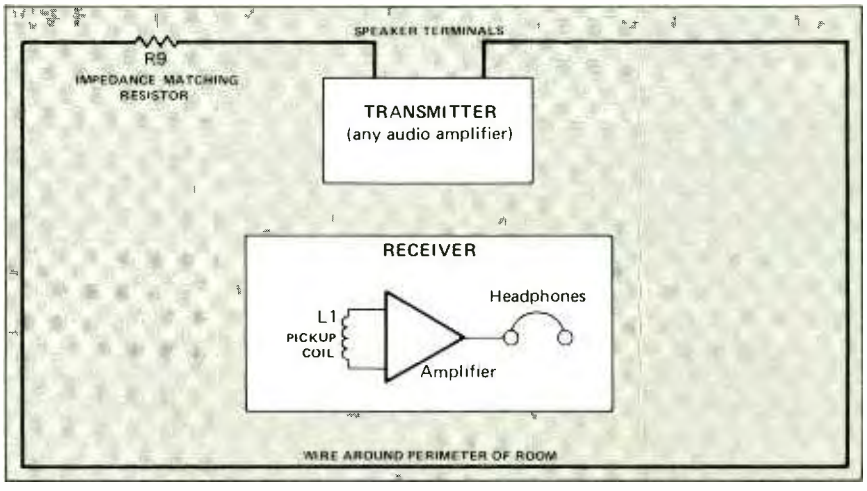


Fig. 1. Overall functional diagram of inductive wireless headphone system.

er. The "receiver" then amplifies the weak signal to a level sufficient to drive headphones.

Though you can purchase a compact battery-powered audio amplifier that can serve as the receiver for your wireless headphone system, it is more fun—and usually less expensive—to build your own. A typical example of a circuit for such an audio amplifier is shown in Fig. 2.

Operation of the Fig. 2 audio amplifier is quite simple. An ordinary telephone pickup coil plugged into INPUT jack *J1* serves as the receiver's antenna that picks up the audio signal from the transmitter. This signal is passed through *R1* into the base of preamplifier *Q1*, which boosts the low-level signal to drive the *IC1* operational amplifier via its noninverting (+) input. Additional gain is provided by *IC1*, sufficient to drive mono headphones plugged into OUTPUT jack *J2*. Potentiometer *R1* serves as the volume control for the receiver.

Resistors *R6* and *R7* and capacitors *C2* and *C3* isolate the *Q1* preamplifier and *IC1* amplifier stages from each other. This is done to prevent feedback that could otherwise result in unwanted circuit oscillation.

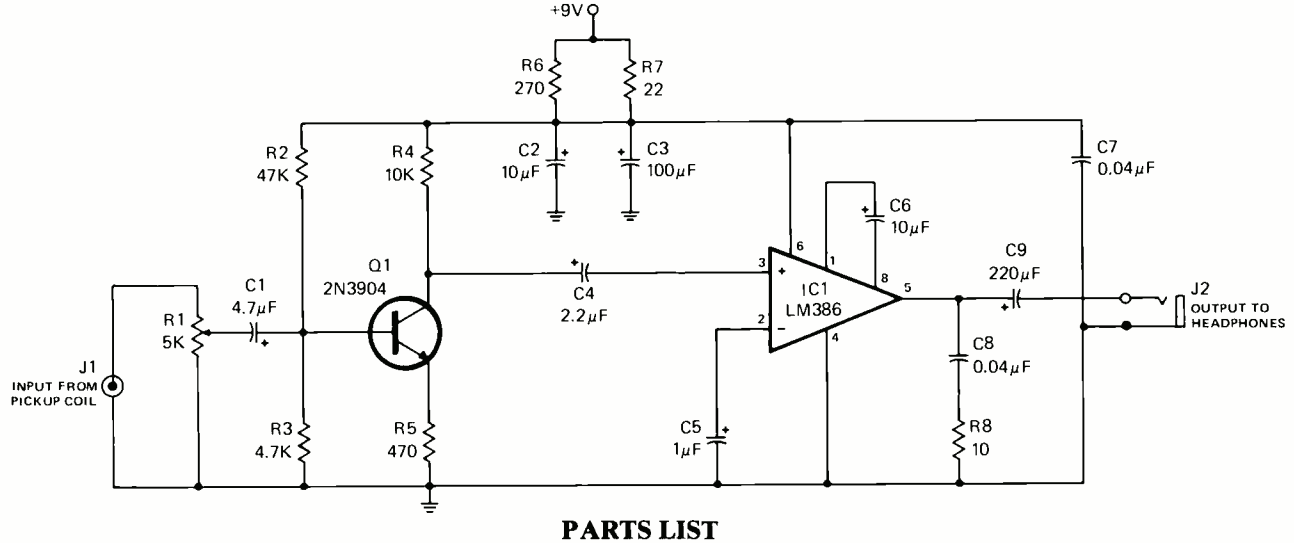
Power for the amplifier is provided by an ordinary 9-volt transistor battery connected between the +9 V terminal and circuit ground. You might wish to install an spst switch between the positive terminal of the battery and amplifier circuit.

Note in Fig. 2 that a phono jack is shown at the receiving amplifier's INPUT. This jack is optional. If you plan on using the amplifier as a dedicated mono headphone receiver, you can permanently wire the telephone pickup coil directly across *R1* and eliminate *J1* altogether.

Construction

The very simple receiver circuit can be assembled with any of the traditional wiring techniques. You can fabricate and use a printed-circuit board of your own design or assemble the circuit on perforated board using a socket for *IC1* and other soldering hardware. In fact, the circuit is so simple, it can be assembled on a small solderless socket.

When assembling the receiver circuit, make sure you observe the proper polarity of the electrolytic ca-



PARTS LIST

Semiconductors
IC1—LM386 operational amplifier
Q1—2N3904 or similar npn transistor
Capacitors (15 volts)
C1—4.7-μF electrolytic
C2,C6—10-μF electrolytic
C3—100-μF electrolytic
C4—2.2-μF electrolytic
C5—1-μF electrolytic
C7,C8—0.04-μF elecrolytic
C9—220-μF electrolytic
Resistors (¼-watt, 10% tolerance)
R2—47,000 ohms
R3—4,700 ohms
R4—10,000 ohms
R5—470 ohms
R6—270 ohms
R7—22 ohms
R8—10 ohms
R1—5,000-ohm audio-taper potentiometer
Miscellaneous
J1—Phono jack (optional; see text)
J2—Miniature phone jack
Printed-circuit board or perforated board and suitable soldering hardware (see text); socket for IC1; plastic enclosure for receiver; telephone pickup coil (available from Radio Shack telephone section and other electronic/telephone part stores); 9-volt transistor battery and snap connector; load resistor for transmitter antenna (see text for value/power rating); mono headphones with miniature plug; heat-shrinkable tubing; machine hardware; hookup wire; solder; etc.

Fig. 2. Schematic diagram of "receiver" amplifier.

pacitors, properly orient the transistor and operational amplifier, and keep all lead lengths as short as possible. It is just as important that you wire the battery's snap connector to the proper points in the circuit.

When you have your receiving amplifier assembled, select a suitably sized enclosure in which to house it. The enclosure should be plastic and should be large enough to accommodate the circuit assembly, 9-volt battery, jacks, power switch and volume control *R1*. If you plan on making the telephone pickup coil an integral part of the receiver, the enclosure selected should be large enough to accommodate it, too.

To make the transmitter, run a length of insulated hookup wire completely around the room in which you plan to listen. Strip about ⅜" of insulation from both ends of the wire and connect one end to either speaker output terminal on the transmitting amplifier. Using an ohmmeter, measure the resistance of the antenna wire. Then select a value for *R9* that, when added to the resistance of the wire, is the same as the output rating of the amplifier. For example, if the wire's resistance measures 1 ohm and your transmitting amplifier's output is rated at 8 ohms, *R9*'s value should be 8 ohms − 1 ohm, or 7 ohms. If you can't find a resistor of the calculated value, use the next higher standard value. In our example, you would use an 8-ohm resistor.

Remember, too, to choose a resistor for *R9* whose power rating is the same as or greater than the maximum output power rating of your transmitting amplifier. If you're using an amplifier rated to deliver 50 watts (use the per-channel rating if it's a stereo amplifier), *R9* should be rated at at least 50 watts. If in doubt, always use a higher-power resistor.

Clip both leads of *R9* to 1" in length and form a small hook in both. Prepare a 6" to 10" length of insulated hookup wire by removing ⅜" of insulation from both ends. Slip 2" lengths of small-diameter heat-shrinkable tubing over the free end of the antenna wire and the just prepared hookup wire. Crimp the free end of the antenna wire to one lead and one end of the hookup wire to the other lead of *R9*. Securely solder both connections. Then push the heat-shrinkable tubing over the connections and against the body of the resistor and shrink tight.

Connect the other end of the hookup wire to the other speaker terminal. If you are using a stereo amplifier as your "transmitter," make sure you use the speaker terminals for a single channel. Don't bridge from a speaker terminal in one channel to a speaker terminal in the other.

System Operation

To test your wireless headphone system, connect the telephone pickup coil and headphone to the receiving amplifier and turn on the "transmitter." Set the latter's volume control to a low to moderate level. Turn on the system's receiver and slowly turn up the volume via *R1* until you hear the audio signal. If you notice that power-line noise is interfering with reception, reorient the pickup coil to reduce it to a minimum. (Using a smaller value for *C1* will also help, though bass response of the system will suffer a bit.)

Once you know that your wireless headphone system works as designed, you're ready to listen in private. If you are using it with a "transmitter" that you wish to also use in the normal manner, you might wish to install a switch that will let you disable its speaker(s) and switch in the antenna as needed. **ME**