Hi-Fi Sound Converter For Your TV

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You don't have to settle for poor sound quality from your TV set any more. This easy-to-build project will get great sound from any set—and no internal modifications are required!

OVER THE PAST FEW YEARS SOME EXCITing things have happened to TV that have dramatically improved the medium. For example, cable/pay TV has brought quality movies and sports into the home, making your couch "the best seat in the house." Furthermore, television receivers themselves have been undergoing numerous improvements, and picture quality is noticeably better on some of the latest sets. Those improvements are making TV viewing better than ever, and are inducing people to watch TV more often.

Unfortunately, a TV set's sound system is usually its most overlooked area, and that is sad. With the exception of a few of the latest sets, the average TV has a four-inch speaker, a one-watt audio amplifier, and no tone controls. The result is sound quality that's good enough for the news, but that can't do justice to musical programs or feature movies. Combine that low-quality sound with a good picture, and you lose half of your potential viewing pleasure! But don't despair—now you can do something about it!

That's where our TV Sound Converter comes in. It's designed to correct the deficiencies of most TV sound-systems and to improve the sound quality to match that of the picture produced by the best sets. The project features a separate high-quality FM detector; treble and bass tone-controls; a loudness-compensated volume control, and an audio power-amplifier. Connect the TV Sound Converter to a good speaker system, and you'll be amazed at how good TV sound can be!

There are no solder connections or modifications required at the TV receiver. That eliminates a potential shock hazard, and is sure to be appreciated by people who don't want to tear into their TV's. Other features of the converter include a sound input for your videocassette recorder (VCR), so you can improve the sound from that source, too. A muting circuit (which suppresses the between-station noise that you get when you change channels) is also included. And, on top of that, the converter can be used with any TV, whether it's a tube-, transistor-, or IC-type receiver.

The TV Sound Converter is moderately priced and easy to build. To keep the cost to a minimum, a special effort was made to use as many commonly available parts as possible. (Check the ads in **Radio-Electronics.**) Most of the circuitry—three IC's, two power transistors, and an assortment of inexpensive and readily available passive components—is contained on a hand-sized PC board. It cost us about $45 to build, but that figure might be higher if you don't have a well-stocked junkbox. Construction is straightforward and is pretty much limited to stuffing the printed-circuit board with parts, and to connecting the external controls, input jack, and power transformer to the board. One potential area of concern is the three coils used in this project. But don't worry about having to wind them; you can buy them prewound. The only coil winding that you'll have to do is to wind five turns of wire around one of the prewound coils. That's a job that anyone can handle, even someone who's never wound a coil before! So if you are concerned about ease of construction, don't worry—this project is not bad at all!

How it works

There are many ways to improve the sound quality of your TV receiver, and each has its advantages and disadvantages. Let's discuss some of the methods briefly, because it will help you to appreciate the circuitry used here. The cheapest and simplest way to improve the sound is to disconnect the set's internal speaker, and substitute a quality speaker-system. While the cost is low, the drawbacks include impedance-matching problems (many new sets use 32–45 ohm

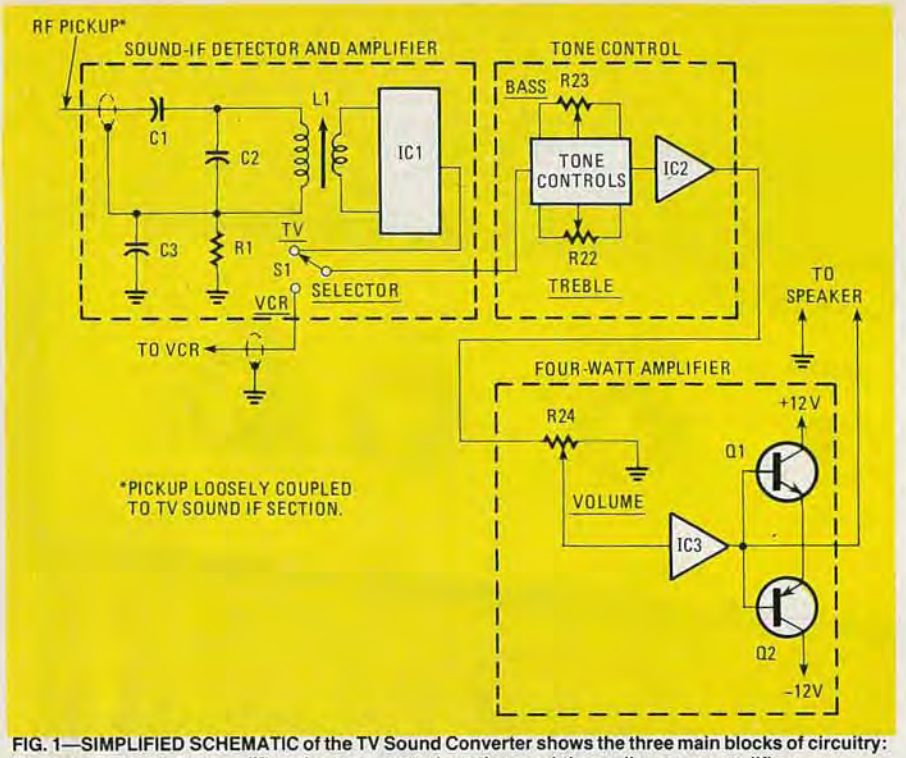

FIG. 1—SIMPLIFIED SCHEMATIC of the TV Sound Converter shows the three main blocks of circuitry: the sound-IF detector/amplifier, the tone-control section, and the audio power-amplifier.

speakers), excessive hum and distortion, and a severe shock hazard. You should know that power transformers have quietly disappeared from recent TV's, and that can make adding an external speaker a dangerous proposition. Another approach is simply to connect an external audio-amplifier across the TV's volume control. That costs more, and it requires modifications to your TV. It will eliminate the other problems mentioned earlier—except for the shock hazard. A serious drawback, however, is that many new TV's use a DC control-voltage to control the volume and, as a result, there is no audio signal at the volume control. That's why that approach is often ruled out.

That leads us to the TV Sound Converter, which uses a different (and better) approach. The device uses a complete sound-IF amplifier plus an audio amplifier to do the job. Careful design results in the best possible sound quality, and the elimination of the shock hazard. While cost might be considered a disadvantage to this method, the build-it-yourself nature of the converter keeps that under control.

The TV Sound Converter contains three "blocks" of circuitry. Figure 1 shows those blocks in a simplified schematic of the converter. The first block is a complete sound-IF amplifier and detector. Its circuitry is preceded by a special input-network made up of C1, C2, C3, L1, and R1. (Switch S1 bypasses this IF amplifier section for VCR inputs.) The combination of C2 and L1 is tuned to the TV-sound frequency (4.5 MHz) and rejects other frequencies that could interfere. The secondary winding of L1 is an impedance-matching device. It provides the IC with the low impedance that it needs to see at its input. Capacitor C3 and resistor R1 are included to provide an RF ground for the input, and to minimize a shock hazard. That is important in case the input cable should somehow short itself to live TV-circuitry. The gain of the circuit is so high that simply placing the input cable *near* the TV-sound section will make it work. No electrical connections are required. In fact, with some TV's, the input cable can be placed on the outside of the rear cover with excellent results!

The second block is the tone-control section. That is nothing more than the usual treble and bass controls, plus an amplifier to make up for losses in that section. Finally, the third block is an four-watt power amplifier. Four watts is more enough power to drive a set of quality speakers to good volume with low distortion.

Now let's look at the circuitry in more detail, referring to the schematic in Fig. 2. The TV sound-IF signal is picked up by a "probe" that is loosely coupled to the sound-IF section of the TV. The signal is fed to the IF IN terminals of the converter. Capacitor C2 and coil L1 are resonant at 4.5 MHz, providing selectivity for the IF amplifier. The IF signal is transformer-coupled into the IF amplifier via pin 1 of IC1. It is amplified by a factor of about 80 dB, and appears at pin 8 of the IC. Coil L2 reduces the signal level to about 150 millivolts, which is necessary for proper muting-circuit operation. The 150-millivolt signal appears at pin 9 of IC1 and goes to two places.

First, it drives a quadrature-type detector contained inside the IC. That works in conjunction with C9, L3, and R3 to produce a demodulated audio signal. That signal goes to an internal amplifier, and ultimately to pin 6, the output of IC1.

At the same time, the signal from pin 9 drives an internal level-detector circuit that generates the muting function. The output of the level detector appears at pin 12 of IC1. The output is divided by R4, R5, and R6, and filtered by C12. Potentiometer R5 sets the muting threshold. The voltage applied to pin 5 of IC1 controls an amplifier inside the IC that switches audio to pin 6 when there is a signal of sufficient strength present. Finally, the detected audio appears at pin 6 of IC1. A simple de-emphasis network made up of C13 and R7 restores its proper-high frequency response. The audio appears at the AF OUT terminals and goes to a switch, S1, that determines whether the rest of the circuit (the tone-control and amplifier blocks) will act on that audio or the audio from your VCR.

The tone-control section consists of a standard bass and treble network and an amplifier. Audio coming from S1 (the switch that selects IC1 or the VCR as the signal source) is applied to the AF IN terminals. A simple bass-control circuit made up of C15, C16, R9, R10, and R23 boosts or cuts the bass frequencies. The treble frequencies are handled by a simple boost/cut circuit made up of C17, C18, and R22. Resistor R11 is included to minimize interaction between the bass and treble controls. The signal output from the tone controls is taken from the slider of the TREBLE potentiometer, and drives op-amp IC2. That device is a simple non-inverting amplifier with a gain of 50—enough to overcome the losses that take place in the tone-control circuitry. The amplified signal from IC2 drives an external volume control, which features loudness compensation (bass frequencies are boosted and the treble reduced slightly at low volume-levels) to improve the audio quality. The loudness compensation-circuit is made up of C29 and R25, which are connected to a tap on the volume control.

From that point, the audio signal goes to IC3, an LM377 two-watt audio amplifier IC. That's a rather unusual application for that IC, which is intended for lower-power applications. The circuit was abstracted from the 1980 edition of the National Semiconductor *Audio Handbook*. The output of the IC drives the speaker through R20. At low levels (below about 100 mW) the IC provides all power. But as the output rises, the voltage drop across R20 also rises, and that causes transistors Q1 and Q2 to turn on. They act as emitter followers and boost the power level. As a result, it is possible to get more than four watts of power from a two-watt IC. The technique is simple, low cost, and effective. Resistors R17 and R18 set the gain of the circuit, while

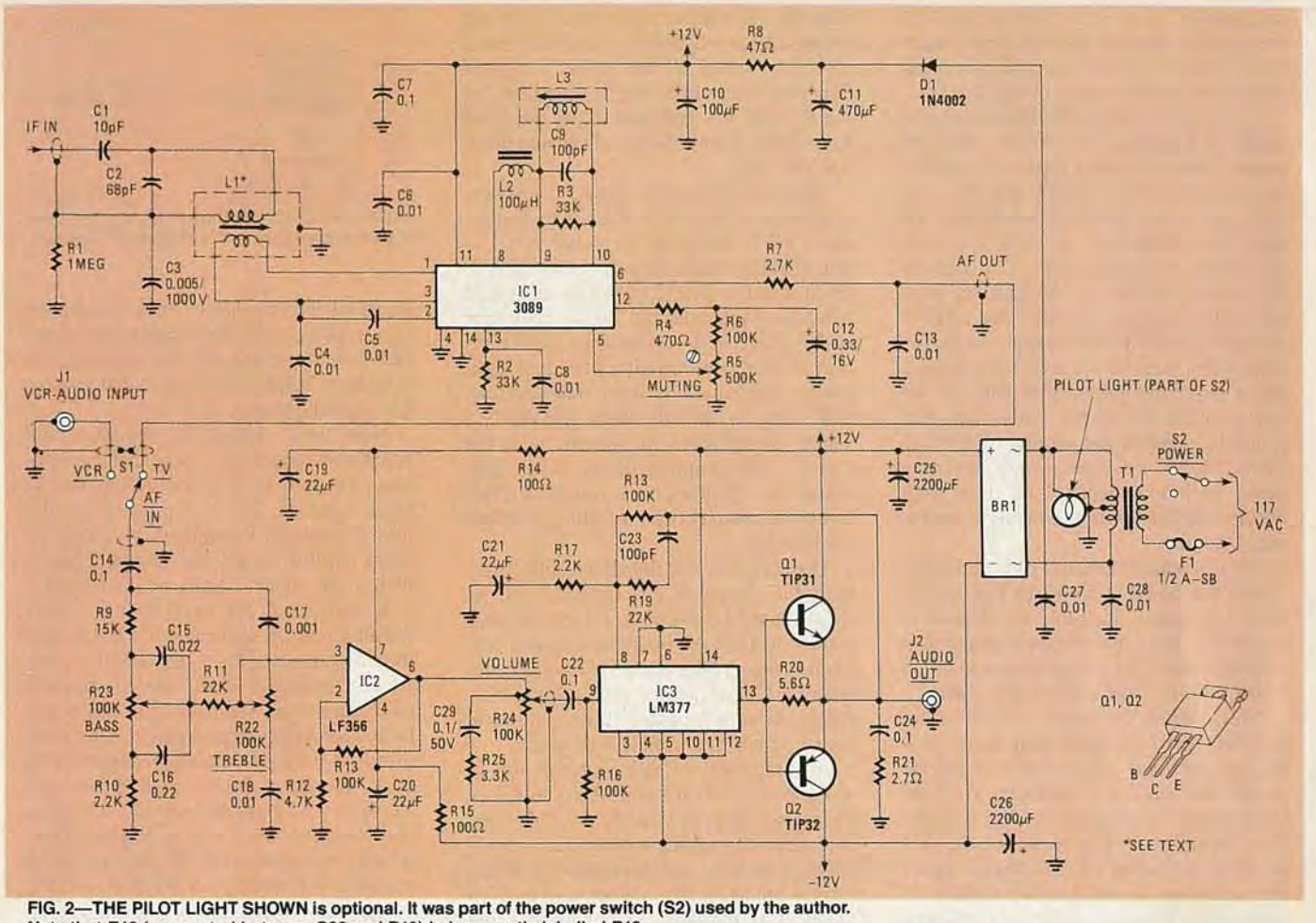

FIG. 2—THE PILOT LIGHT SHOWN is optional. It was part of the power switch (S2) used by the author. Note that R18 (connected between C23 and R19) is incorrectly labelled R13.

C21, C23, and R19 shape the frequency response.

All that's left are the power supplies (+12 and −12 volts). The amplifier section uses a conventional ± 12-volt supply, made up of T1, BR1, C25, and C26. The IF section has its own 12-volt power supply: D1, C11, C10, and R8. A separate supply is needed for that section because it was found that powering it from the same supply used by the amplifier generated noticeable hum.

Construction

The first step in building the TV Sound Converter is to obtain or make a PC board. You can make your own board—the full-size foil pattern is shown in Fig. 3. A pre-etched and drilled board is available (from the supplier indicated in the Parts List). Whichever you choose, you should note that, because of the high sensitivity of the IF amplifier, a PC board is a necessity for this project. If you try to breadboard the device, the chances are that it will oscillate and do other strange things. Play it safe and use a PC board!

Once you have a board, the next step is to obtain the parts. Generally, they should be available from many sources. As for the Miller coils, they should be available from larger parts-distributors. Shields are required for those coils—you can use

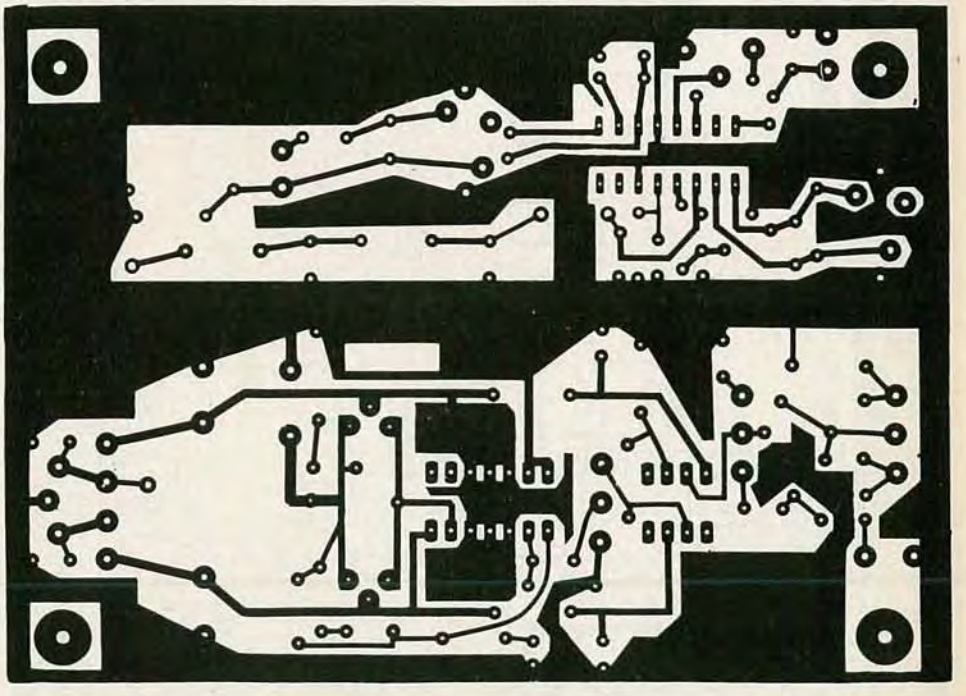

FIG. 3—YOU MUST USE A PC board for the converter. If you don't, the chances are that the circuit will oscillate.

commercial ½ × ½ × 1-inch ones, IF-transformer shields from junked American car radios, or you can make your own from sheet brass (more on that later).

A number of parts substitutions can be made in building this device. For example, there are many types of rectifiers that can be used for BR1 and D1, and there are many possible substitutes for transistors Q1 and Q2. As for IC3, several substitutes are permissible: You can use the newer LM1877 or the LM378, with no circuit changes. In fact, the LM378 will give greater power output. As for the capacitors, their values aren't too critical, but it is recommended that you use the types called for in the Parts List. For example, substituting ceramic-disc types for the Mylar tone-control capacitors may cause problems because of their high leakage, which can upset the high-impedance circuitry.

Once you have the parts you can simply "stuff the board." Refer to Fig. 4, the parts-placement diagram, for details as you work. Note that the parts-placement diagram shows the component side of the board with the foil side facing down.

Now install the parts. (We'll cover only the board-mounted parts here; we'll discuss the rest when we're ready to mount the board in a cabinet.) With the board positioned as shown, start with the IC's: Install a 16-pin socket at the IC1 position as shown. If the socket has a pin-1 marking, orient it so that it points to your right. Then go to the IC2 position and install an 8-pin socket. Be sure to orient any pin-1 marking as shown. Do not install either IC1 or IC2 until you are told to do so. Move on to IC3. *Do not* install a socket at this position; the IC must be soldered in place (the foil of the board acts as a heatsink). Install IC3 and carefully solder all the leads. I suggest that you solder one row of pins first, let the IC cool off, and then solder the other row. There's less chance of causing damage that way.

The next step is to install the power transistors and rectifiers. Start by installing a TIP31 transistor as shown at Q1—note that the metal tab points toward IC3. Then install a TIP32 transistor at the Q2 position—note that the metal tab points *away* from IC3. (Heatsinks aren't required on those transistors because their power dissipation is low, but you may still want to include them for safety's sake). Install BR1 as shown, with the "plus" side pointing down. After that, install D1. Double check your IC socket, transistor, and rectifier installation before continuing.

The next step is to install the coils. Start with L3. Insert a 23A155RPC coil as shown in the L3 position. Be sure to push it flush against the board before you solder it in place. Then move to the right and install a 100 μH choke (L2) against IC1. Again, be sure to push it flush against the board before you solder it in place.

At this point we make a brief stop to wind some wire on a coil. Refer to Fig. 5 for details. Simply wind five turns of no. 28 enameled magnet wire over L1's body between its base and the windings, being careful not to let the magnet wire overlap the existing winding. Then twist the free ends of the new winding once to hold them in place. Now refer back to Fig. 4. You are going to install the coil at the L1 position. Insert the wires of the coil you wound in the two small holes and then

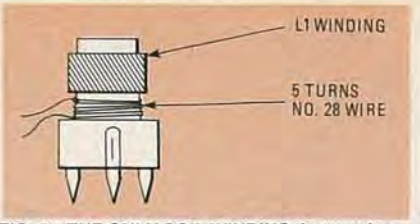

FIG. 5—THE ONLY COIL WINDING that you have to do is shown here and is explained in the text.

insert L1 into the larger ones. Solder the coil in place, and then solder the wires. (Be sure to scrape off the magnet-wire insulation before soldering so that you can get a good connection.)

Now we'll install the resistors and capacitors around IC1. Note that the components in that area are intentionally close together; that's to prevent oscillation. Because it's cramped, you must be extra careful to get the components in their right places. Start by installing a 33K resistor at R3 (next to L3). Then install a 100-pF disc capacitor at C9, and moving farther to the right, install a 0.01-μF disc capacitor at C6. Be sure to push all components flush against the board before soldering them in place. After that, install a 0.33-μF tantalum capacitor at C12; note that the + sign points up. Move to your right and install a 470-ohm resistor at R4. Then next to it install 0.01-μF disc capacitor at C8. To the right of C8 install a 33K resistor at R2 and install a 0.1-μF disc capacitor at C7. Finish up work in this area by installing a wire jumper at "J." A piece of leftover resistor-lead will work fine. Now, stop and examine your work, and correct any mistakes you may find before going on.

Continuing with the IC1 components, install a 0.01-μF disc capacitor at C13 and a 2.7K resistor at R7. Next to it, at R5, install a 500,000-ohm trimmer potentiometer. Move to the right and install 0.01-μF disc capacitors at C4 and C5. Finish up the circuitry around IC1 by installing a 100,000-ohm resistor at R6 as shown. Note that R6 is installed about an inch over the top of the IC. Place short lengths of insulated tubing over the leads and then install them in the places shown. That takes care of IC1; on to the less-critical circuitry!

The remaining resistors are installed next, starting at the left-hand side of the board and working toward the right. Begin by installing a 2.2K resistor at R10 and a 22K resistor below it at R11. Move down a bit and install a 15K resistor at R9 and then jump over to IC2 and install a 4,700 ohm resistor at R12, and a 100K resistor at R13. After that, install a 100-ohm resistor at R15, above IC3. On the other side of IC3 install a 100K resistor at R16 and, next to it, install a 100-ohm resistor at R14. After that, install a 2.2K resistor at R17. Move up to the center of the board and install a 47-ohm resistor at R8. Move up still farther and install a

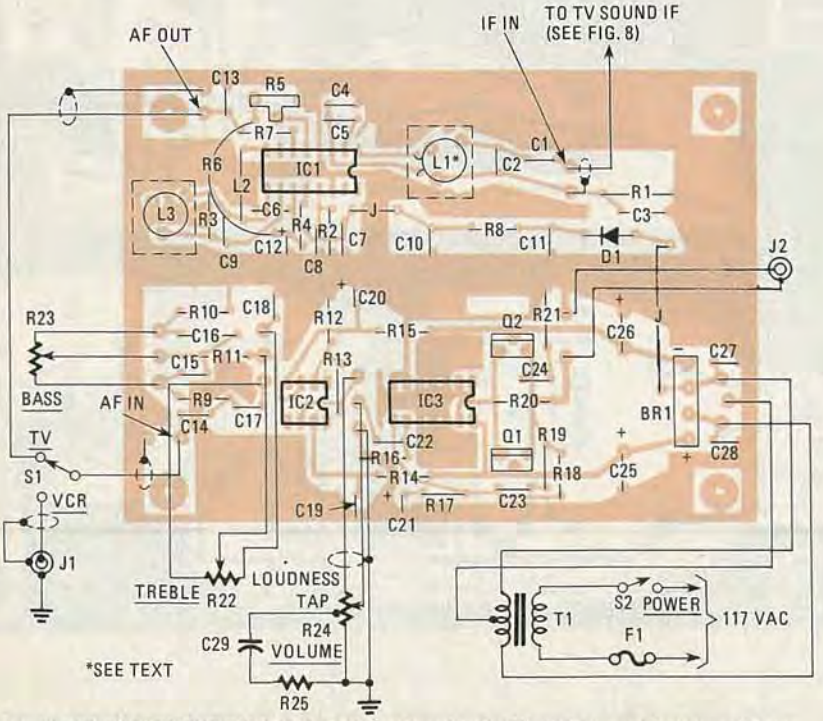

FIG. 4—PARTS-PLACEMENT DIAGRAM. Both on-board and off-board connections are shown.

1 megohm, ½-watt resistor at R1 and a 2.7-ohm resistor at R21. Note that it may be necessary to pre-form the leads before installation; the holes are spaced widely apart. Continue by installing a 5.6-ohm resistor at R20. If you can't find the half-watt (R20) resistor, simply use two 10-ohm, ¼-watt resistors in parallel. Move down and install a 22K resistor at R19, next to Q1. Finish up the resistors (finally!) by installing a 100K resistor at R18 as shown. Check your resistor installation carefully before continuing and correct any mistakes now before you forget about them.

Install the capacitors next. Again, work from left to right. Install a 0.22-μF Mylar capacitor at C16 and a 0.022-μF Mylar at C15. After that install a 0.1-μF Mylar capacitor at C14, and a 0.001-μF Mylar at C17. (Incidentally, a good source of those capacitors is junked imported radios and other similar equipment.) Continue by installing a 0.01-μF Mylar capacitor at C18. Now for a few electrolytics—watch the polarities any time you install electrolytics! Install 22-μF electrolytics at C19, C20, and C21. After that, install a 0.1-μF Mylar capacitor at C22, next to IC3. Moving up, install a 100-μF electrolytic at C11. Make sure the capacitors are installed properly before continuing.

Now install a 68-pF disc capacitor at C2, and a 10-pF disc capacitor at C1. Moving on, install a 0.005-μF, 1-kV disc capacitor at C3. After that, install 2200-μF capacitors at C26 and C25. Make sure those capacitors are installed properly before continuing. Then install a 0.1-μF Mylar capacitor at C24 and a 100-pF disc at C23 (at the lower edge of the board.) Finish up the capacitor installation with 0.01-μF discs at C27 and C28, next to BR1. Check your work and correct any errors before you continue.

All that's left to do on the board is to install a jumper and the coil shields. The jumper comes first. Cut a 2-inch piece of insulated hookup wire, strip the ends, and connect it at the holes near BR1 and D1.

Before you install the coil shields, wrap pieces of plastic electrical tape over the terminals of L1 and L3. That helps to prevent shorts. Then snap the coil shields into place and solder them to the board.

If you don't have access to commercial shields, or to a junked American-made car radio for the shields from its IF transformers, you can make them yourself. Here's how: Cut a strip of sheet brass (available from hobby shops) into two 1¾ × 1-inch pieces. Then roll each strip into two ½-inch (diameter) by 1-inch (high) cylinders. Solder the edges to keep the metal in place. Then solder pieces of solid wire to the edges of the cylinders. Those are the mounting terminals. Insert your new coil shields into the board and solder them in place. That completes the constructure of the board. And if you're done things correctly, the completed board should look like that shown in Fig. 6.

PARTS LIST

All resistors ¼-watt, 5% unless otherwise specified
R1—1 megohm, ½ watt
R2, R3—33,000 ohms
R4—470 ohms
R5—500,000 ohms, trimmer potentiometer
R6, R13, R16, R18—100,000 ohms
R7—2700 ohms
R8—47 ohms
R9—15,000 ohms
R10, R17—2200 ohms
R11, R19—22,000 ohms
R12—4700 ohms
R14, R15—100 ohms
R20—5.6 ohms, ½ watt (see text)
R21—2.7 ohms
R22, R23—100,000 ohms, potentiometer, audio-taper
R24—100,000 ohms, potentiometer, audio-taper with loudness tap (Radio Shack 271-1723 or equivalent)
R25—3300 ohms

Capacitors
C1—10 pF, 1000 volts, ceramic disc
C2—68 pF, 1000 volts, ceramic disc
C3—0.005 μF, 1000 volts, ceramic disc
C4, C5, C6, C8, C13, C27, C28—0.01 μF, 50 volts, ceramic disc
C7—0.1 μF, 16 volts, ceramic disc
C9, C23—100 pF, 1000 volts, ceramic disc
C10—100 μF, 16 volts, radial-lead electrolytic
C11—470 μF, 16 volts, radial-lead electrolytic
C12—0.33 μF, 16 volt, tantalum
C14, C22, C24, C29—0.1 μF, 50 volts, Mylar
C15—0.22 μF, 50 volts, Mylar
C16—0.22 μF, 50 volts, Mylar
C17—0.001 μF, 50 volts, Mylar
C18—0.01 μF, 50 volts, Mylar
C19, C20, C21—22 μF, 16 volts, radial-lead electrolytic
C25, C26—2200 μF, 16 volts, radial-lead electrolytic

Semiconductors
IC1—LM3089 FM receiver IF system
IC2—LF356N monolithic JFET op-amp or TL081 general purpose BIFET op-amp
IC3—LM377 dual 2 watt audio amplifier or LM1877 dual audio-power amplifier
Q1—TIP31 NPN power transistor
Q2—TIP32 PNP power transistor
D1—1N4002
BR1—full-wave bridge rectifier, 1 amp, 50 volts
T1—18 volts, 2 amps, center tapped
L1, L3—10–19 μH adjustable coils, J.W. Miller 23A155RPC
L2—100 μH RF choke, J.W. Miller 9210-76
F1—½ amp slow-blow fuse
J1—RCA phono jack
J2—Two-contact connector
S1—SPST toggle switch
S2—SPST power switch (with optional 16-volt pilot lamp)

Miscellaneous: 5 feet RG-174 coaxial cable, 6 inches no. 28 enameled wire, one 16-pin IC socket, one 8-pin IC socket, coil shields, cabinet, hardware, 3 knobs, AC line cord with plug, fuse holder, etc.

The following is available from Mendakota Products, PO BOX 20 HC, Orangehurst, Fullerton, CA. 92633: AUD-1 printed-circuit board, $12.00. California residents add 6% sales tax. Non-USA residents include an additional $3.50 for first-class postage and handling. Coils L1–L3 can be ordered from: Circuit Specialists, Box 3047, Scottsdale, AZ 85257. Price is $7.95 postpaid; please specify J.W. Miller part numbers when ordering; Arizona residents add 4% sales tax.

FIG. 6—THE ONLY CRAMPED AREA on the board is around IC1. That is intentional; it prevents unwanted oscillation.

Installing the converter

The next phase of construction is to install the board in a cabinet, and to wire the controls and power transformer to it. Let's start by discussing the cabinet. The converter is designed to be installed in almost any type of cabinet, plastic or metal. So, if you have a particular type of cabinet in mind, and there is room for the parts, go ahead and use it. In fact, you may even be able to mount the board inside your TV receiver and dispense with the cabinet entirely! However, if you decide to install the board inside the TV, remember to mount it well away from any heat-producing circuitry, and away from the TV's horizontal-output stage. The latter can introduce a buzz into your audio if the board is too close to it.

We built our version in the cabinet of a discarded UHF converter; the chassis and front panel came from an old aluminum chassis-box. All that was required was a little work to make the cabinet components presentable, and the cost was zero. No doubt you can find a suitable cabinet if you raid your junkbox or shop around a bit.

Once you have a cabinet, you can drill all the mounting holes for the parts. The photograph shown in Fig. 7 should give you an idea of where to place them. The board itself is mounted on the bottom of the cabinet using ¼-inch spacers. Drill the holes, clean up the cabinet, and paint

FIG. 7—THE OFF-BOARD components should be mounted before they are wired to the board.

it if necessary. Label the controls with the press-on letters that are available from many electronics supply houses and art-supply stores. Then install the controls, connectors, and the power transformer. By this time you are ready for the final wiring.

All that is left to do is to connect the cabinet-mounted components to the board. Refer again to Fig. 4, the parts-placement diagram, for details. Start by stripping both ends of a 3-foot piece of RG-174 coax cable as shown in Fig. 8. Separate the shield braid on one end and twist it to form a separate lead. That end will be connected to the board shortly. As for the other end, strip off 1 inch of the insulation, but leave the center conductor untouched. Then cut the shield braid all of the way back to the insulation. Place a piece of ¼-inch heat-shrink tubing over the cable, positioning it so that it overlaps both the end of the center conductor and the braid, and then shrink it in place. That end of the cable is the RF pickup for the converter. It will be placed near the sound-IF section of your TV. Refer to Fig. 4 for the remaining connections. Connect the other end of the RG-174 cable to the IF pads on the board. Note that the shield goes to the pad that connects to C3/R1.

Now for some other shielded-cable connections. Conventional microphone cable can be used for those. Cut two short lengths (about 6 inches), and strip one end of each cable. Install one cable at the AF OUT (the output of the sound-IF detectors) connections, and the other at the AF IN pads. Cut another short length (about 6 inches) of dual-conductor shielded cable for the volume control. Note that if you don't have such cable, two pieces of regular, single-conductor shielded cable will do fine. Strip one end and connect it to the VOLUME pads as shown. That takes care of the shielded-cable connections.

The remaining connections can be made with conventional hookup-wire or ribbon cable. We used ribbon cable for a neater appearance. Start with the bass and treble controls. Cut short lengths of wire and install them as shown. If you used hookup wire, twist the bass-control wires together, and the treble-control wires together, so that they won't be confused. Then continue with the speaker leads. Cut two short lengths of wire, and install them as shown. Finally, cut three short lengths of wire for the power transformer, and install them as indicated in Fig. 4. That takes care of the board cable connections. Install the board in your cabinet and get ready to complete the wiring.

We still have to wire the POWER switch, S1. Route the cables to the switch, cut them to size, and connect them to the switch. Then connect J1. The shell of that jack is the only part of the converter circuit connected to ground that goes to the "outside world." Be absolutely certain that it does not come into contact with the TV set's chassis! (That also means that, if you are using a metal enclosure, that the jack should make good electrical contact with that enclosure.) Make the cable ground connections exactly as shown—that will minimize hum pickup.

The controls come next. Start with the bass control. Route the wires from the board over to the control and cut them to size. Connect the wires to the control as indicated. After that, connect the treble control in the same manner. The volume control (with the loudness tap) comes next. But first, install the loudness components. Connect a 33K resistor in series with an 0.1 μF capacitor and wire them to the volume control as shown in Fig. 4. Route the volume cable over to the control, cut it to size, and connect as has been indicated.

The next step is to connect the speaker wires. When routing them to J2, be sure to position them well away from the bass and treble cables. After that, connect the power transfomer. Connect the wires to T1 as shown, after routing them well away from all other wires. If your power switch has a built-in pilot light, connect it now: otherwise disregard that step. Finally, wire up F1 and S2. With that you have finished assembly, except for installing IC1 and IC2. You can do that after you have applied power to the board and verified that the proper supply-voltages are present at the IC sockets—+12 volts at pin 11 of IC1, and pin 7 of IC2, and −12 volts at pin 4 of IC2. (There should also be +12 volts at pin 14 of IC3 and −12 volts at pins 3–5 and pins 10–12 of IC3.)

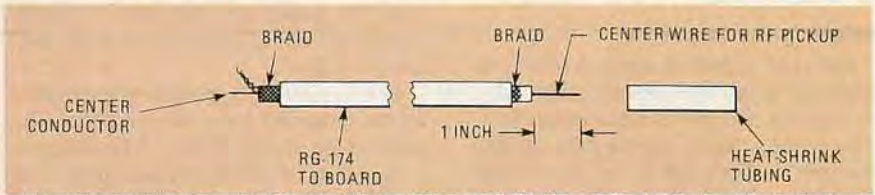

FIG. 8—THE RF-PICKUP cable. The shield should be twisted to form a lead at the board end. It should be cut off at the other end, and the center conductor and a bit of the braid and outer insulation covered with heat-shrink tubing.

Adjustments

One of the nice features of this device is that, although adjustments are required, no test equipment is necessary to make them. All you need is a TV receiver in good condition, and a plastic hex alignment-tool.

Start by presetting the adjustable components and checking the operation of the unit. Set the slugs of L1 and L3 to mid position. Then turn potentiomenter R5 fully clockwise. Connect a speaker, and apply power to the board. Set S1 to its VCR position, and connect a tuner or other high-output-level device to J1. At this point, the project should perform like any other high quality audio amplifier. If not, check your wiring, and correct any errors. Set S1 to the TV position. You should hear a roar of noise. If not, turn the potentiometer in the other direction. If you then hear the roar, you've wired the control backwards. Reverse the wiring (if necessary) and you are ready to try the converter with your TV.

Modern TV's can pose a serious shock hazard when operated with the back cover removed. Do not touch any components while the set is plugged in.

Remove the rear cover of your TV, and locate the sound section. Often that circuitry will be identified by a module or tube placement, or by a sticker inside the set. Once you have found the sound section, connect the power to the set and turn it on. Tune in a strong station and adjust the fine tuning for the best sound quality. Place the RG-174 cable from the converter near the sound-IF tube, transistor, or sound-detector IC. With some IC-type sets you can jam the pickup lead directly into the sound coil for a strong signal. You should now hear weak sound or per-

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haps the buzz of video from the project. Adjust coil L1 for maximum volume and then adjust L3 for the cleanest sound quality. Note that L3's tuning may be quite broad, and that the best results will be obtained over a range of several turns. That's normal, and all you need do is to center the adjustment. Repeat the adjustments several times for best results.

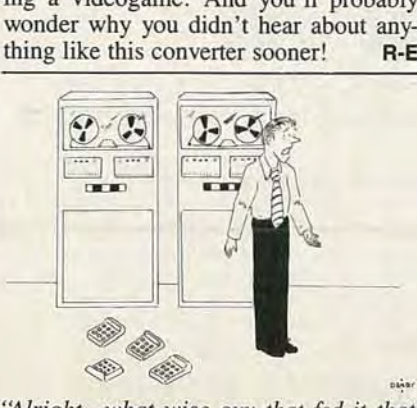
Try moving the RG-174 cable around, noting the volume of the sound. With some sets you will get great results with the cable taped onto the outside of the cabinet. With others you may have to leave the cable very near the sound section. Once you have found a convenient location, turn off the TV, unplug it, and secure the cable in place. A dab of RTV (silicone bathtub-sealer) is ideal for that. Replace the back cover of the TV.

Turn your TV set back on and tune to an unused channel. Adjust the fine tuning knob so that all you hear from the converter is noise. Adjust potentiometer R5 so that the noise is muted. Then turn back to the active channel and the sound should return. Note that this adjustment is also not too critical; the muting circuit doesn't have a sharp threshold like the one in a CB receiver.

Using the converter

Using the TV Sound Converter is a snap—once it is set up, no more attention is required. Turn on your TV and carefully adjust its fine-tuning control for the best possible sound and picture quality for each station in your area. Tune to unused channels, and adjust the fine tuning so that no sound from adjacent channels can be heard. That ensures that the converter's muting function will work properly. Then adjust the bass, treble, and volume controls to suit your taste. That's all there is to it!

You're now all set to enjoy great sound! With a good quality 8- or 16-ohm speaker attached, you'll probably be amazed at how good TV can sound, whether you're watching a movie, a sporting event, a musical feature, or even playing a videogame. And you'll probably wonder why you didn't hear about anything like this converter sooner! **R-E**



"Alright—what wise guy that fed it that sex program?"