Build an Audio Interface for your Telephone

Record and play back telephone conversations with the highest possible audio quality

BY GEORGE BELVA

Have you ever needed to record a conversation or some other type of communication directly from the phone line, but found it difficult, if not impossible, to get quality audio using inexpensive equipment? Or, on the flip side, have you ever want to playback a recording over the phone and have it sound half-way decent? Putting a speaker against the telephone mouthpiece is not the answer, and using one of those cheap (literally) magnetic couplers is often worse.

Of course, there are some fancy (read that as "very expensive") electronic do-dads that provide excellent two-way audio coupling, but such equipment would be overkill for occasional needs and most budgets. The gadget—the *Telephone Audio Interface*—described in this article is a very simple and compact coupler (measuring only 1.95 × 2.2 × .8 inches) that allows you to alternately pick audio from or feed audio into the phone line with surprising quality.

The interface requires no power (not even from the phone line) to operate. It is also easily portable, and can be use with any recorder (cassette or otherwise) that has a microphone or line input and an earphone or line output.

About the Circuit. A schematic diagram of the Telephone Audio Interface is shown in Fig. 1. The interface (with its deceptively simple appearance) provides the isolation necessary to connect the phone line to an audio circuit without presenting any danger to the phone line, audio gear, or the operator. Essentially, the interface is a simple isolation circuit, built around 4 components (C1, R1, R2, and T1), 3 connectors (PL1, PL2, and SO1), a switch (S1), and some wire.

In the interface circuit, C1 prevents the phone line's 48-volt DC from saturating transformer T1, and hence the phone loop from signaling an off hook condition (otherwise, callers would get a busy signal). It also prevents the ring voltage (which can get up to the 90 volts, at 20- to 30-Hz) from reaching the audio circuit and possibly damaging it, while allowing audio (an alternating signal) to pass through the transformer to the connected equipment. Finally, C1 prevents the phone-line voltage from shorting through T1 (remember, to DC, a transformer appears to be a dead short).

The capacitor's 250-volt rating allows plenty of room to drop the ringing voltage without any danger of damaging the capacitor. Most of the 90-volt, 20- to 30-Hz ring signal is dropped across the capacitor, which, at that frequency exhibits a high impedance. The transformer's impedance (although slightly elevated at that frequency) is comparatively low. One the other hand, the in-coming and out-going audio "sees" a much lower capacitive impedance.

The value of C1 can range from less than 1 μF upward; it really isn't critical. However, whatever value you choose, it should be rated for no less than a 250 volts; remember the ringing voltage can average around 90 volts, and with surges, can rise far beyond that level.

Transformer T1 is a 600:600-ohm miniature audio transformer that has a reasonable audio response. Its function in the circuit is to completely isolate the phone line from the audio equipment. That's necessary since any grounding or voltages presented to the phone line may damage or adversely affect phone-company equipment; for example, the equipment might hang up, signal an off-hook condition, short out, etc. The isolation also allows you to place just about anything you want on the secondary of the transformer.

One word of caution here, however: It is still possible to load down the phone line (audio wise) so that a

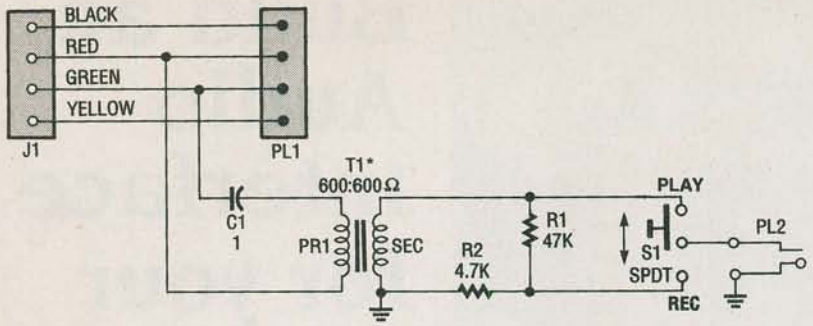

Fig. 1. The Telephone Audio Interface—essentially, a simple isolation/coupler circuit—isolates the phone line from any connected audio circuit without presenting any danger to the phone line, the equipment, or the user.

weak DTMF (tone-dialed) phone will no longer signal the phone company equipment properly. (That event will be discussed in the "Modifications and Limitations" portion of this article).

In addition to its avowed function, T1 also provides a 600-ohm match to the phone line. Although that match is not perfect, it is good enough for what we are doing. The reason for choosing a 600:600-ohm transformer is for its simplicity while providing a reasonable match in extreme conditions, which will be encountered when switching from record to play using an average cassette recorder.

When S1 is in the REC position, the incoming audio is fed through a resistor-divider network (comprised of R1 and R2), which, at the resistor junction, provides a close approximation of a line-level audio signal that is excellent for recording. The network was designed to give a hot-mike-like level since the circuit is meant to be used with a cassette recorder that's equipped with automatic-level control. That helps to equalize the differences between the local audio level and the in-coming audio. When S1 is in the PLAY position, the audio signal (from the recorder or other source) is fed directly to T1 for playback over the phone line.

Construction. The circuit is so simple that no board of any kind is required; instead, the author's unit was assembled in a surface-mount modular telephone jack enclosure using point-to-point wiring techniques. Note however, that not all such jacks are created equal. The one used in the author's prototype is an 8-contact type. The photo shown in Fig. 2 will give you some idea of what to look for if your unit is to be assembled and packaged in the same way. If you choose to do otherwise, you can house the unit in any type of enclosure that you choose. Note that a kit is offered by the supplier listed in the Parts List.

If you decide to take the same approach, the jack enclosure used must have no screws through the center and enough hollow space within to accommodate the parts. Pop off the cover; you'll have to drill holes in the cover to accommodated the switch's mounting hardware and its slide lever. The jack housing used to house the author's unit is shown at the top-left of Fig. 2. Note that that unit has 8 terminal positions: one in each of the four corners, and two each on either side of the enclosure.

The screw terminals must be adjusted so that all four are in the center four holes: the wires from th RJ-11 jack must be disconnected from the terminals: Do not cut the spade lugs off those wires. Once disconnected, move the wires up and back so that the maximum amount of inner box space is exposed. Place the box in front of you with the RJ-11 jack at the top and the holes for the wires at the bottom (closer to you).

Place the capacitor in the box (as shown in the top-center of Fig. 2) at the connector end. Depending on the physical dimension of the unit, the capacitor may be a snug fit. Should that situation arise, simply file away some of the plastic box until the unit fits. Wrap the right lead of the capacitor under the lower-right screw terminal of the box.

Twist one lead of the two resistors together and solder. Clip off the center tap on both sides of the transformer. Bend the small tabs of the transformer (if any are present) over and flat. Place a piece of tape across the bottom side of the transformer. Make sure it is completely covered with a good electrical tape. Solder the resistors to the transformer leads (either primary or secondary). Make sure the 4.7k resistor is on the right side with the junction of the two resistors pointing away (up) from you.

Bend other lead of the capacitor in toward the capacitor body and up so that it can be soldered to the left lead of the transformer (opposite from where resistors are soldered). The right lead of that side of the transformer is then soldered to the crimp end of the spade lug that's attached to the red wire coming from the enclosure's internal RJ-11 jack. The spade lug is then placed under the upper right screw terminal. (Placing the spade under the terminal first, then lightly tightening the screw, and finally soldering the transformer lead to the spade lug makes things a bit easier). At this point the assembly should resemble the one shown at the top-right of Fig. 2.

Remove about 2 inches of the outer insulation from the quad telephone

PARTS LIST FOR THE TELEPHONE AUDIO INTERFACE

R1—47,000-ohm, ¼-watt, 5% resistor
R2—4700-ohm, ¼-watt, 5% resistor
C1—1-μF, 250-WVDC, metallized-polyester capacitor
T1—600:600-ohm, 75-mW, miniature audio transformer
S1—SPDT miniature slide or toggle switch
PL2—3.5-mm phone plug
PL1—4-conductor modular telephone plug
J1—4-conductor surface-mounted modular telephone jack
Single-conductor, shielded audio cable, quad-conductor modular telephone cable, small plastic cable tie, wire, solder, hardware, etc.

Note: A kit of parts is available from Belva Electronics (309 Third Ave., Vestal, NY 13850) for $15.00; a working unit is also available for $25.00. New York State residents, please add appropriate sales tax.

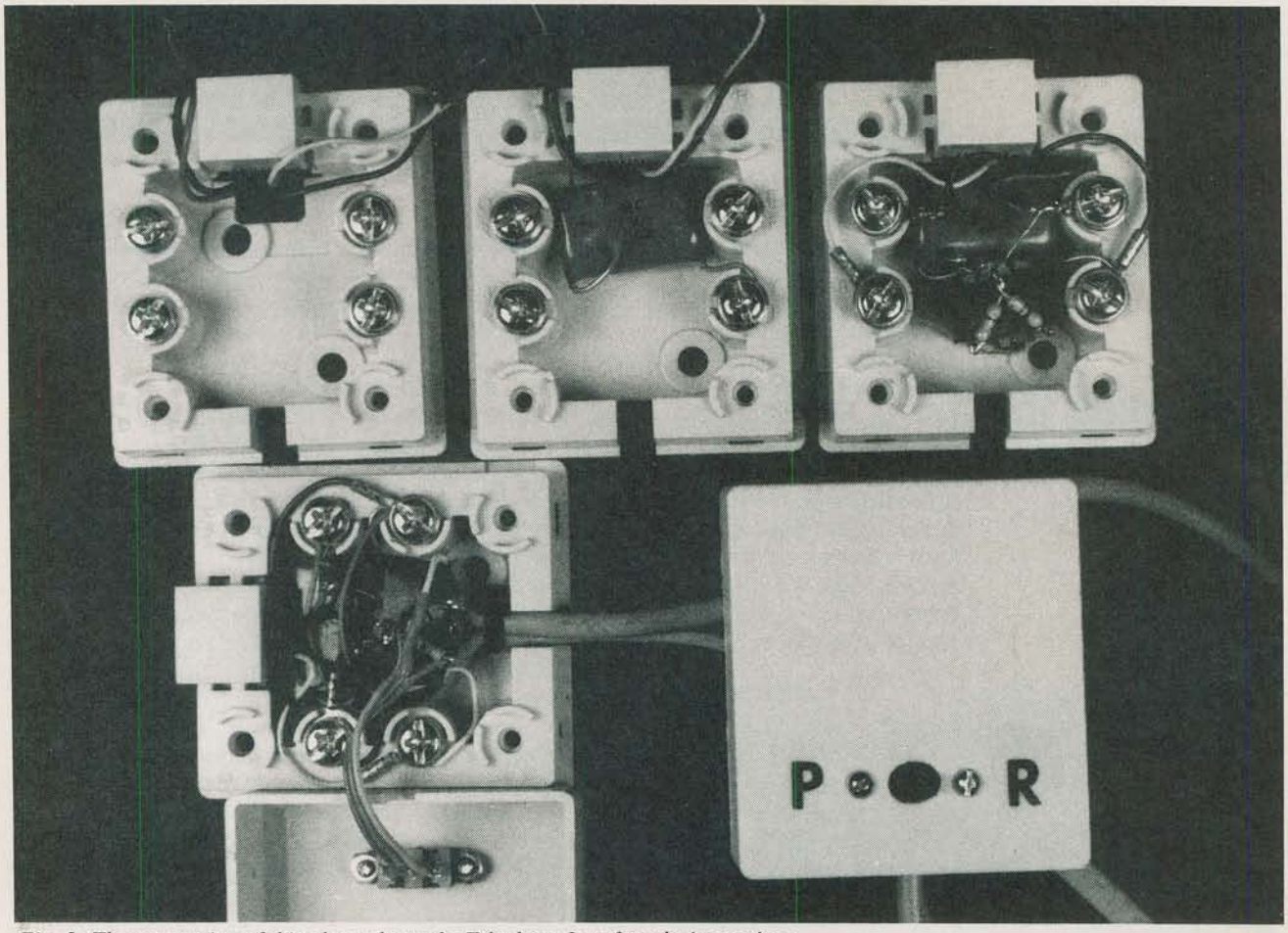

Fig. 2. The top portion of this photo shows the Telephone Interface during various stages during construction; the bottom portion shows internal and external views of the finished project.

cable, remove about a half inch of the color-coded insulation from the individual leads, and then tin the leads. Remove about a half inch of the audio cable's outer insulation to expose its center conductor and copper braid. Twist the copper braid and then remove about ⅛-inch of insulation from the center conductor. Place the two cables together so that the ends of the outer jackets line up, and secure them together with a cable tie placed about ⅜-inch down from the ends of the outer jackets. Make sure that they are tied tight.

Place the cable assembly into the case as shown at the lower-left in Fig. 2. That may be a little tough because it was meant to be tight. The best way to accomplish that is to spread the cable ends apart above the wire tie so that the audio cable is on the right and the quad telephone cable is on the left. Use a flat-blade screwdriver and carefully force the assembly down and around the transformer. Solder the audio-cable shield to the lower right transformer lead. That's where the 4.7k resistor should already be soldered.

Connect the quad-conductor telephone cable's leads to the four screws. The red wire connects to the red wire from the case; the green wire connects with the other green wire under the lower-right screw with the capacitor lead. The black wire connects with the case black wire under the upper-left screw and the yellow wire connects with the case yellow wire under the lower-left screw. Note the position of each of the spade lugs under the screw terminals.

Next mount the switch. Depending on what you use for a switch, you may need one or three holes. If you elect to use a slide switch, start by marking two points on either side of the box about 0.45 inches up from the wire hole end of the case. Draw a line across the case intersecting those two points (figure seven). This is your center line for all three holes. Place a cross mark on that line one inch from either end of the box. That is your center hole. You may have to ream out the center hole and make it oblong for the slide switch to work. Alternately, you can use a miniature toggle switch. That requires only one round hole. Note however that you only have about a ¼-inch wide maximum space for the switch.

Regardless of the switch that you choose, prepare three, 2-inch lengths of #24 stranded wire. Solder them to the three switch terminals. Connect the center terminal of the switch (common) to the center conductor of the audio cable. You may want to use heat-shrink tubing on the connection. Connect the other two leads across the 47k resistor (R1). Decide which switch position you want for record and playback and then connect the wires as follows: The record position (for microphone recording) is the

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TELEPHONE INTERFACE

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junction of the two resistors. The playback position is the junction of the 47k resistor and the transformer's lower left lead.

Put a piece of electrical tape across the transformer leads (resistor end). That helps to protect things when closing the cover, forcing the switch down into that space. To close the cover start by hooking the jack hole on the cover over the end of the jack on the case. Carefully press the box cover down. You may have to fuss with the wires slightly to close the box completely. If everything went well, the cover should easily close and stay shut.

Modifications and Limitations. You can build the circuit into anything you want including a telephone itself. Any good 600:600-ohm audio transformer will work. The one used in the prototype (which measured 0.6 × 0.6 X 0.5 inches) fits nicely into the telephone-jack housing.

Be careful when placing audio on the phone line. The device has plenty of capacity to handle audio. The biggest limitation is the phone company. They simply clip audio when you try to get past a certain level. It will start to distort. The best thing to do is adjust your audio output so that you hear it in your earpiece just a little louder than normal. That should be plenty of level for someone on the other end.

You can leave the unit plugged into the phone line all the time! It will protect your audio equipment from ring voltages while protecting the phone line from your equipment. However, when you are connected to a low-impedance source, like an 8-ohm output from a cassette recorder, it will load down the line to audio. If you try phoning out using a lesser-quality tone-dialed phone, it may not have enough oomph to overcome the loading effect. The simple answer is to leave the audio plug out until you've established your connection and are ready to play the audio on the line. When the audio jack is plugged into a high-impedance input such as a microphone input on a tape recorder, you will not have that problem. It can be left in that condition all the time.

The unit will not work with digital telephone lines. You must have an analog signal path available.

Testing and Adjustments. Just plug the modular plug into your wall jack, plug the phone into the jack on the case. Plug the audio cable into a cassette's microphone input or any medium-to-high impedance input. Put a tape in the recorder, and the recorder in the record/pause mode. Press "one" on the phone to kill the dial tone or simply call someone and record the conversation.

Make sure you have the switch on the coupler in the correct position. You want the audio cable connected to the junction of the 47k and the 4.7k resistors through the switch for a microphone-input recording. The resistor divider just drops the audio down to a level that the automatic-level control in the tape recorder can handle. The full audio level (other switch position) would totally overdrive a microphone input.

Playback the cassette normally (not on the phone line yet) and listen for any hum that was not on the original audio. The cause of any hum will probably be the junction of the two resistors touching something. That is an extremely sensitive point. It should be totally insulated. That is why we recommend putting a piece of electrical tape on the transformer before soldering the resistors to it.

If the audio sounds good then remove the jack from the microphone input and place it in the headphone output. Change the switch position on the unit. You may have to leave the audio plug out until you make a call or at least get rid of the dial tone by pushing one button on the phone. Rewind your tape and play it. Listen on the phone. Adjust the audio level as described and you are done. ■