BUILD THIS

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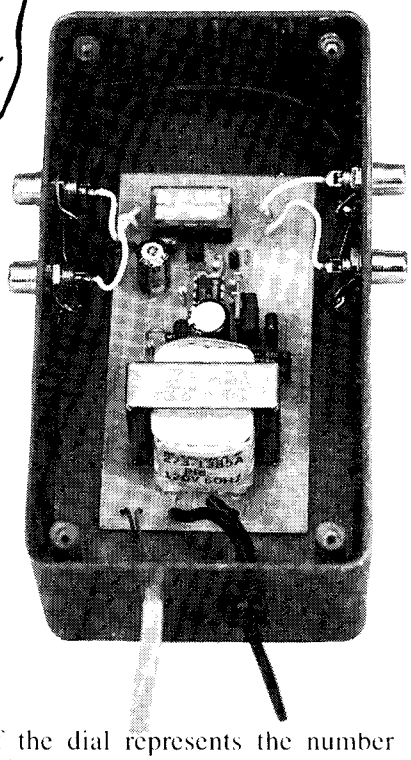
PHONE-ACTIVATED AUDIO-MUTING CIRCUIT



Automatically silence your stereo or TV as soon as your telephone rings.

IF YOU'RE USING A TELEPHONE, THE SOUND from a radio, stereo, or TV can be annoying. To avoid that nuisance, build this phone-activated audio-muting circuit. It cuts off the audio from a radio, stereo, or TV when your phone rings, or when the handset is picked up to make an outgoing call. About five seconds after a phone is hung up or stops ringing, the audio resumes.

To use the audio-muting circuit, just connect it anywhere prior to the speaker(s) of your radio, stereo, or TV. That applies to low-power mono or stereo audio, whether from a radio, stereo system, or TV. For use with high-power audio (above 20 watts), place it between preamp and power amplifier. Most recent stereo gear has a rear-panel jack for audio-signal processing like enhancement or compression prior to power amplification. If your equipment doesn't have such a jack, and if you're not using a separate preamp and power amp, you might want to install the audio-muting circuit in the tape loop.

Circuit description

The schematic of the audio-muting circuit is shown in Fig. 1. A standard phone line has about 48-volts DC on it when open (on hook), and about 5-volts DC when in use (off hook). The ring signal is a low-frequency AC voltage superimposed on the DC. Rotary phones dial by intermittently making and breaking the phone-line connection, toggling it from 5 to 48 volts and back. That is, the number of make/break pulses in a single rotation of the dial represents the number being dialed. About five seconds after the phone is hung up or stops ringing, the audio resumes.

The reason for that delay is that rotary-dial phones operate by making and breaking a phone line connection, and the central-office equipment would count the number of pulses for each digit of a phone number. If the delay weren't present, the audio would be cut off when the phone handset is lifted up, but when a number is dialed, the user would hear the pulses of the dial intermittently

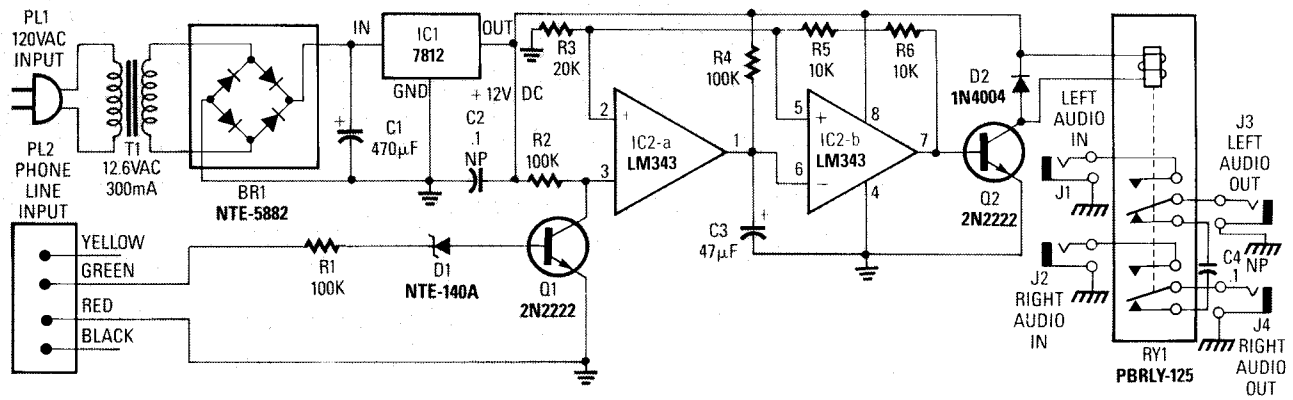


FIG. 1—SCHEMATIC OF THE AUDIO-MUTING CIRCUIT; RY1 switches audio inputs J1 and J2 through J3 and J4, respectively, or shorts J3 and J4 when the phone on PL2 rings or is picked up. That continues for about five seconds after the phone stops ringing or is picked up.

between the audio.

The input stage, composed of R1, 10-volt Zener D1, and the base-emitter junction of Q1, places a high-impedance loop across the green (tip) and red (ring) phone-line wires. The current through the phone line should be:

$$I_{phone} = (V_{tip} - V_{D1} - V_{BE1})/R1,$$
$$= (48\ V - 10\ V - 0.7\ V)/100K,$$
$$= 373\ \mu A.$$

That causes about a 1-volt drop from the 48-volt level, that drives Q1 into saturation at about 200 millivolts. If the phone rings or is picked up, Q1 cuts off and the inverting input of IC2-a goes to 12 volts. Next, voltage divider R3-R5 biases the noninverting input of IC2-a and the inverting input of IC2-b at:

$$V_{BIAS} = V_{CC} \times [R3/(R3 + R5)],$$
$$= 12\ V \times [20K/(20K + 10K)],$$
$$= 8\ V.$$

At that point, the output of IC2-a goes low, discharging C3. The output of IC2-b goes high, turning Q2 on and driving it into saturation via R6, and activating relay RY1, breaking the audio path between J1 and J2, and J3 and J4. After the phone stops ringing, or is hung up, the output of IC2-a goes high, charging C3 through R4, with a time constant of:

$$\tau = R4 \times C3$$
$$= 100K \times 47\ \mu F$$
$$= 4.7\ seconds.$$

If the phone rings before C3 reaches 8 volts as set by R3 and R5, C3 discharges and the timing cycle restarts. After a certain exponential charging interval, the potential across C3 reaches 8 volts, and the output of IC2-b goes low, turning off Q2 and RY1 and reconnecting the audio. The final charging voltage in that case is $V_f = V_{CC} = 12$ V, and the target voltage is $V_t = 8$ V. Since τ is known, the charging interval is:

$$T = -2.303 \times \tau \times Log_{10}[1 - (V_t/V_f)],$$
$$= -2.303 \times 4.7\ seconds$$
$$\times Log_{10}[1 - (8\ V/12\ V)],$$
$$= 5.164\ seconds.$$

When RY1 energizes and the audio is cut off, audio output terminals J3 and J4 are shorted through C4 to prevent any hum introduced when the audio-muting circuit switches line-level audio. Here, D2 prevents reverse-bias spikes, generated by switching RY1, from destroying Q2.

PARTS LIST

All resistors are ¼-watt, 5%, unless otherwise indicated.
R1, R2, R4—100,000 ohms
R3—20,000 ohms
R5, R6—10,000 ohms
Capacitors
C1—47 μF, 16 volts, electrolytic
C2, C4—0.1 μF, 50 volts, nonpolarized (NP) ceramic disc
C3—47 μF, 10 volts, electrolytic
Semiconductors
BR1—NTE-5332 1-amp, 600-volt PIV 4-pin DIP bridge rectifier
D1—NTE-140A 10-volt Zener diode
D2—IN4004 rectifier
Q1, Q2—2N2222 NPN transistor
IC1—7812 5-volt regulator
IC2—LM393N 14-pin DIP dual voltage comparator
Other components
T1—120-volt/12.6-volt, 300-mA transformer
RY1—5-volt, DPDT, 8-pin DIP Relay
PL1—AC line cord with plug
PL2—four-conductor modular telephone cord with plug
J1–J4—RCA phono jack
Miscellaneous: Case, AC line cord grommet, two straight-line TO-3 transistor sockets, an 8-pin DIP IC socket, wire, solder, and drill with bits.

NOTE: A kit of parts is available for $29.95 from Applitron Services, 2721 Creswell Road, Bel-Air, MD 21014. It includes an etched and drilled PC board, but excludes the AC line plug and cord PL1 with grommet, modular telephone plug and cord PL2, and the case. The PC board alone is $15.00, should you wish to obtain the parts locally. Please enclose $1.95 postage and handling; allow 4–6 weeks for delivery. Relay RY1 can be obtained separately from All-Electronics Corp., P.O. Box 567, Van Nuys, CA 91408, (800) 826-5432, for $2.50.

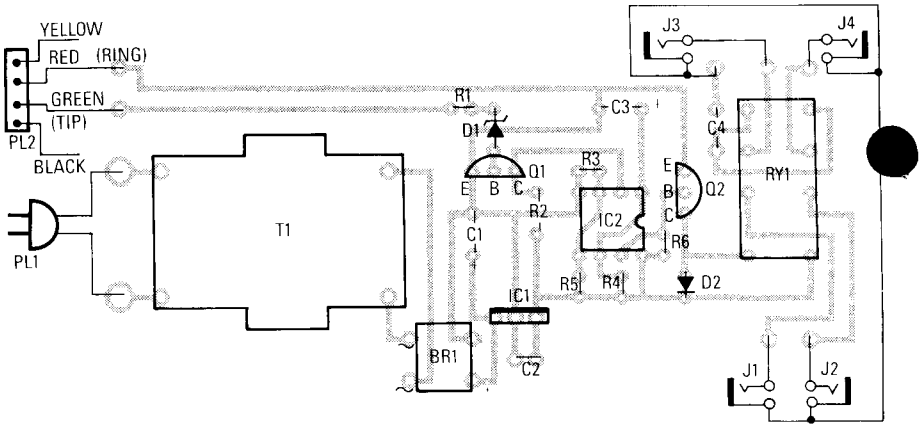


FIG. 2—PARTS-PLACEMENT DIAGRAM for the audio-muting circuit. Note the spacing of the pins of RY1, for orientation purposes.

Finally, the grounds for J1–J4 in Fig. 1 are separate from those of the rest of the circuit. The ground symbol for the main part of the audio-muting circuit is the normal downward-pointing, three-line, triangular arrow, whereas the ground symbol for J1–J4 is a downward-pointing open triangle. The reason is that the radio, stereo, or TV, shouldn't share a common ground with the rest of the audio-muting circuit.

Also, the ground terminals aren't connected J1-to-J3 and J2-to-J4, to attempt to separate the channels and avoid crosstalk. The radio, stereo, or TV will have one common ground for all four terminals within its own cabinet, so joining all four ground terminals of J1–J4 shouldn't make any difference. Similarly, you wouldn't connect J1-to-J2 and J3-to-J4, since that would isolate input and output, preventing the speakers from being properly grounded, and might damage whatever audio source is connected to J1 and J2.

You can also use the audio-muting circuit with two mono sources, like two TV's, instead of one stereo source, but you have to isolate the grounds for the two channels. In that case, *don't connect all four grounds for J1–J4 together*, or you might get one really nasty shock, and/or some pretty spectacular fireworks. You can connect the grounds of J1 and J3 and

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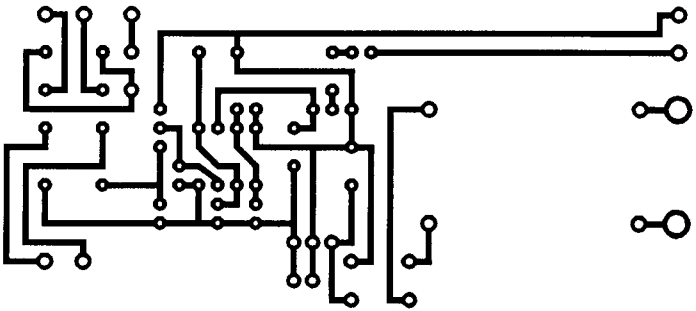
the grounds of J2 and J4, but leave both pairs separate.

That isolates the two channels, but make certain that there's no accidental short between the two channels, like a solder splash. Thus, only in the case of two mono sources, should there be three separate grounds; the main one for the audio-muting circuit, the one for the J1-J3 channel, and a separate one for the J2-J4 channel. (Figs. 1–3 show the two grounds that would normally be present for stereo audio.)

Construction

This is a very simple project to build. The parts-placement diagram is shown in Fig. 2, and the foil pattern is shown below. You might, however, want to build the circuit on either breadboard or perfboard. You can stuff the PC board in any order, and you might want to use sockets for Q1, Q2, and IC2, even though they weren't used in the prototype. When you're finished building the circuit, check for mistakes like solder splashes, or diodes, transistors, or IC's inserted backwards. The completed board can be installed in any suitable case. **R-E**



Audio-muting circuit's solder-side foil pattern