

A Wireless TV Audio Mute

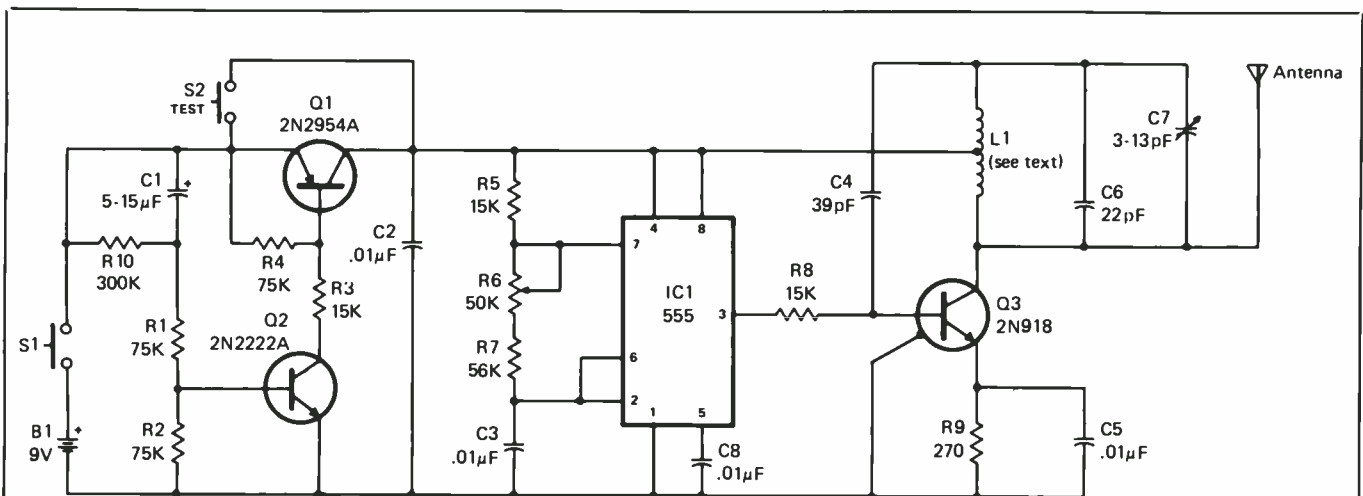
This one-button project mutes the sound of any TV receiver that does not have wireless remote-control facilities

By Desi Stelling

TV commercials can be annoying in more ways than one. If they're not irritatingly louder than normal program material, they're repeated so often that the annoyance factor seems to be over-

whelming. If you're not fortunate enough to have a remote-controlled TV receiver with an audio mute function, you either have to suffer through the commercials or make frequent trips to your set to turn down the volume when the commercials start and turn it up again when the program resumes.

Having been a long-time sufferer of annoying TV commercials, one evening I had had enough and decided to liberate my family and myself by designing and installing in my set a wireless audio mute function. Putting the old thinking cap on, I came up with a neat one-button Wireless Audio Mute system that



TRANSMITTER PARTS LIST

Semiconductors

IC1—555 timer
Q1—2N2945A transistor
Q2—2N2222A transistor
Q3—2N918 transistor

Capacitors

C1—5- to 15- μ F, 15-volt electrolytic
C2, C3, C5, C8—0.01 μ F
C4—39 pF
C6—22 pF
C7—3-to-13-pF trimmer

Resistors ($\frac{1}{4}$ -watt, 10% tolerance)
R1, R2, R4—75,000 ohms

R3, R5, R8—15,000 ohms
R7—56,000 ohms
R9—270 ohms
R10—300,000 ohms
R6—50,000-ohm, linear-taper potentiometer

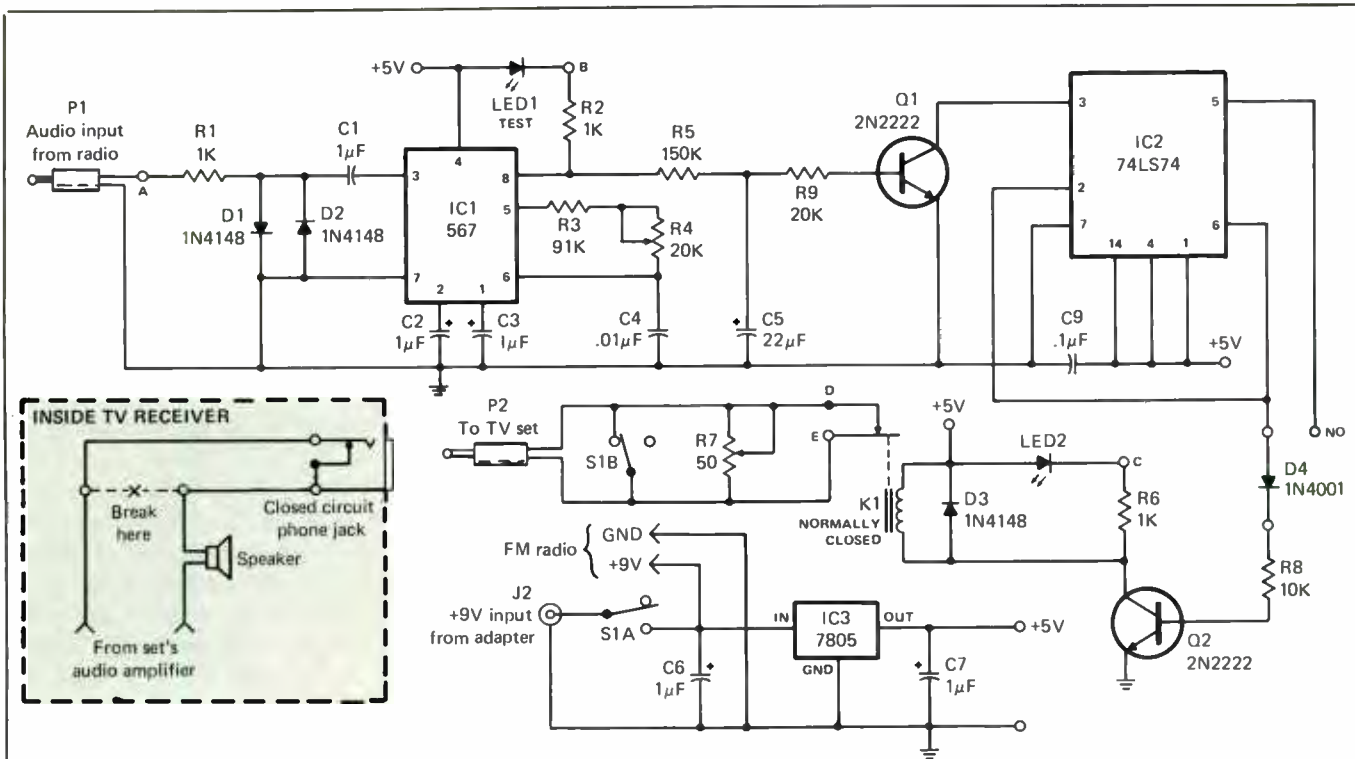
Miscellaneous

B1—9-volt transistor battery
L1—Coil (printed on circuit board; see text)
S1—Magnetic spst switch
S2—Miniature normally open spst pushbutton switch

Printed-circuit board; antenna; 9-volt battery connector; plastic case; machine hardware; hookup wire; solder; etc.

Note: The following items are available from DDS Systems, P.O. Box 5715, Glendale, AZ 85312: transmitter pc board for \$6.95; other transmitter parts on request; complete kit of decoder parts for \$34.95; decoder pc board for \$7.95. Add \$3.50 P&H. Arizona residents, please add sales tax.

Fig. 1. This is the complete schematic diagram of the transmitter. It is very compact and draws very little power from its 9-volt transistor battery.



DECODER PARTS LIST

Semiconductors

- D1, D2, D3—1N4148 diode
- D4—1N4001 diode
- IC1—567 tone decoder phase-locked loop
- IC2—74LS74 dual D flip-flop
- IC3—7805 voltage regulator
- LED1, LED2—Light-emitting diode
- Q1—2N2222 transistor
- Q2—2N2219 transistor

Capacitors

- C1—1-μF nonpolarized
- C2, C3, C7—1-μF, 15-volt electrolytic
- C4—0.01-μF disc

- C5—22-μF, 15-volt electrolytic
- C6—100-μF, 25-volt electrolytic
- C8—0.1-μF disc
- Resistors** (1/4-watt, 10% tolerance)
- R1, R6—1000 ohms
- R2—2000 ohms
- R3—91,000 ohms
- R5—150,000 ohms
- R8—10,000 ohms
- R9—20,000 ohms
- R4—20,000-ohm pc-type trimmer potentiometer
- R7—35-ohm, 5-watt resistor or equivalent potentiometer

Miscellaneous

- K1—5-volt dc spst relay
- P1, P2—Subminiature phone plug
- S1—Dpdt slide or toggle switch
- Pc board; IC sockets (optional); subminiature phone jack; plug-in 9-volt dc power adapter; suitable case; pocket FM radio; machine hardware; audio cable or speaker cord; machine hardware; hookup wire; solder; etc.

Note: See Transmitter Parts List for availability of items for the decoder assembly.

Fig. 2. This is the complete schematic of the decoder. Note the modification of the TV receiver's speaker circuit in the boxed-off area and the power supply that can be used with both the decoder and the FM pocket radio.

operates on r-f FM modulation, rather than the usual infrared.

The Transmitter

The Wireless Audio Mute system consists of a compact, hand-held FM transmitter and a remote receiver/decoder. The transmitter radiates r-f energy at a power level of less than 100 mW. Hence, it doesn't require FCC licensing to build and use. In-

stead of having to build your own FM receiver, which would be a time-consuming and expensive project (not to mention that it would require a battery of expensive test equipment to align once built), an inexpensive pocket FM radio is used to feed the control signal into a decoder.

Being that this is an FM tone-modulated r-f remote-control system, it allows you to operate the mute func-

tion from anywhere in your home—not just in the same room as your TV set is located, as would be the case with the usual infrared system.

The Fig. 1 transmitter circuit has an automatic-shutoff feature that removes power 5 to 10 seconds after S1 is closed and held that way. This prevents rapid battery rundown if the transmitter accidentally gets caught between a seat cushion and the side of

an easy chair. A magnetic-type switch is recommended for *S1* to assure long operating life and positive closure. Ordinary spring-contact switches will not bear up to everyday use.

Carrier frequency for the transmitter is tunable between 88 and 108 MHz to keep it within the standard FM broadcast band and to make it possible for it to be set to an unoccupied spot on the FM dial. The r-f signal is gated on and off at a 1-kHz rate by 555 timer *IC1*. This IC provides precision timing with the help of only four external components (*C3*, *R5*, *R6* and *R7*), thus reducing the cost of the project and keeping it to compact dimensions.

Resistor *R9* sets the current through output transistor *Q3*, assuring less than 100 mW is radiated by the antenna. Coil *L1* is a center-tapped inductor that is part of the printed-circuit board's conductor pattern. Making *L1* part of the pc pattern has two benefits: it simplifies project construction, and—more importantly—assures greater stability and accuracy. R-f tuning is accomplished with trimmer capacitor *C7*.

Built into the transmitter is a test feature that is activated by pressing *S2*. When *S1* and *S2* are closed simultaneously, the *Q1/Q2* circuit is bypassed and battery power is delivered directly to the *IC1* circuit. This lets you quickly check whether or not the 555 timer and r-f output transistor *Q3* sections are operating properly.

The tone-encoded r-f output from the transmitter is radiated to the receiver via the antenna, which consists of a 3" length of insulated hookup wire contained inside the transmitter's plastic case. Power for the transmitter is supplied by 9-volt transistor battery *B1*.

The Receiver/Decoder

At the receiving end of the system is the pocket FM radio that feeds the Fig. 2 tone-decoder circuit. The decoder, in turn, makes and breaks one

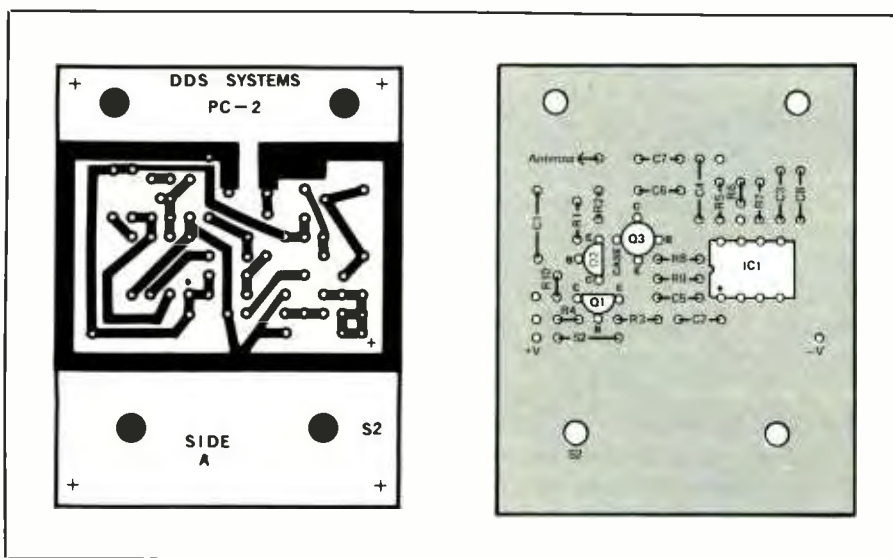
of the speaker lines in your TV receiver via the contacts of relay *K1*. With the FM radio on, the audio tone that modulates the r-f carrier from the transmitter is fed to the radio's earphone output jack and into the decoder via INPUT jack *J1*, where it is clamped to a safe level by diodes *D1* and *D2*. From there, it is coupled into tone-decoder phase-locked loop (PLL) *IC1*.

Once the tone is present at input pin 2 of *IC1*, internal circuitry decodes it and sends it to output pin 8, pulling this pin low. If the tone is present for longer than a second, the charge on *C1* drops below 0.5 volt.

As the charge on *C5* drops below 0.6 volt, *Q1* cuts off, causing pin 3 of divide-by-two flip-flop *IC2* to go high. The first rising edge toggles the output one way, and the next rising edge toggles it the other way, allowing *K1* to be either a normally closed or a normally open relay. The arrangement shown in Fig. 2 is for a normally closed relay and, hence, has the anode of *D4* connected to the "N.C." point in the circuit. If the relay were normally open, the anode of this diode would be connected to the point labeled "N.O."

When *K1*'s contacts are closed, the resistance in series with the TV set's speaker is zero, allowing the sound to be at the level to which the TV receiver's volume control is set. Opening *K1*'s contacts puts potentiometer *R7* in series with the speaker and reduces the volume of the sound. (If you wish, you can substitute a 35-ohm, 5-watt resistor for the potentiometer.) The potentiometer (or resistor) prevents the audio output drive circuit in your set from being damaged.

Note the TV receiver's circuit modification shown in the boxed-off shaded area in Fig. 2. To make this modification, the set's back panel must be removed to provide access to the speaker wires coming from its internal audio amplifier. This is the dashed line with "X" through it. Once this line is cut, and the subminiature shorting-type phone jack shown is installed, a convenient means for accessing the TV set's speaker is made. (Caution: Turn off the set's power and unplug its cord from the ac line before attempting to remove the back panel. Potentially lethal voltages are present inside the set, even with power removed; so exercise extreme caution.)



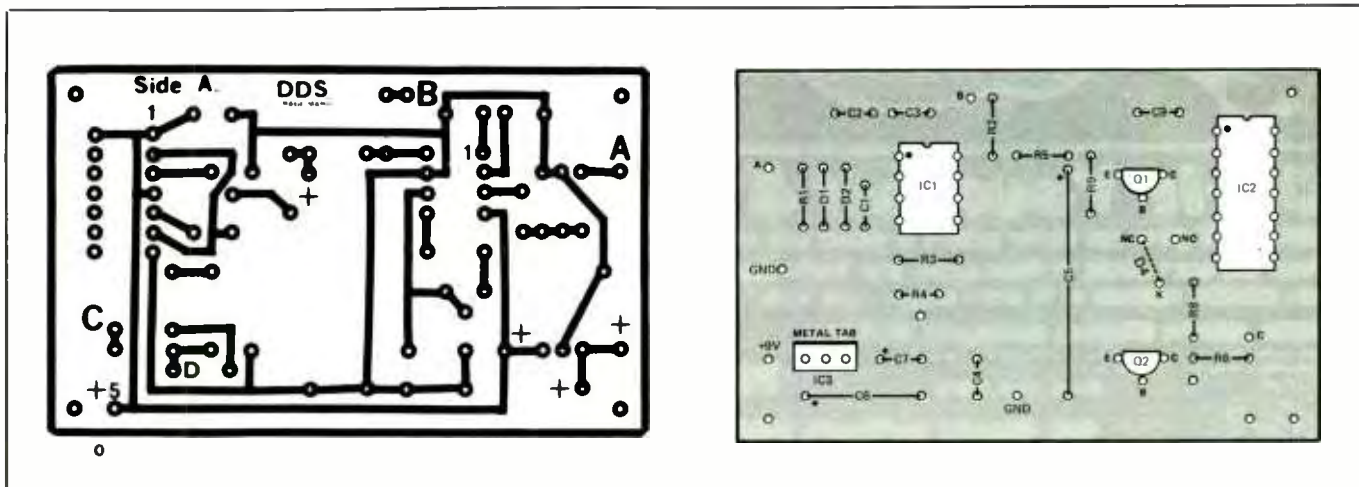


Fig. 4. Shown here are the actual-size etching-guide (left) and components-placement diagram (right) for the decoder.

When the set's speaker circuit is wired as shown, the break in the speaker line is bridged by the shorting action of the jack when the decoder is not plugged in and the set operates as normally. Plugging in the J2 cable from the decoder transfers speaker control to the contacts of the relay.

Two light-emitting diodes are incorporated into the decoder. The first, LED1, comes on when the TEST button is pressed in the transmitter and tells you when the tone that activates the mute function is present and the PLL decoder chip is operating properly. The second, LED2, turns on when mute is on.

Power for the decoder can be obtained from either of two sources. The most convenient is the battery in the FM pocket radio. However, this may exhaust the radio's battery too quickly. Therefore, you have the option of using a standard 9-volt dc adapter that plugs into the ac line. In either case, power for the circuit enters through POWER jack J2. Note, too, that you can power both the FM radio and the decoder circuit from the adapter, obviating the need to periodically replace the battery in the pocket FM radio.

Construction

The transmitter must be assembled

on a single-sided epoxy-fiberglass pc board, the actual-size etching-and-drilling guide and components-placement diagram for which are shown in Fig. 3. Mount the parts exactly as shown, making sure they're as close to the board as possible. Also, keep excessive solder off L1 (the heavy conductor that surrounds the component area) to prevent the inductance of the coil from changing. Mount potentiometer R6 and trimmer capacitor C7 on the copper-trace side of the board.

You can assemble the decoder in any accepted breadboard manner, though it would also benefit from pc construction. (For the actual-size etching-and-drilling guide and components-placement diagram for the decoder, refer to Fig. 4.) Because this circuit handles only audio-frequency signals, there are no critical construction procedures to be followed.

(Note: though sockets are not necessary, use of them is recommended in both the transmitter and the decoder to facilitate easy replacement should any of the ICs go bad in the future.)

Select cases for the transmitter and decoder to be just large enough to accommodate the circuit boards and, in the case of the transmitter, the 9-volt battery. Machine the cases as needed. For the transmitter, this means drill-

ing holes for mounting the switches and antenna, providing tuning-wand access to trimmer capacitor C7 and the mounting of the circuit board and battery B1. For the decoder, drill mounting holes for the circuit board, power jack, switch, and LEDs and for exit of the wires to the FM radio and your TV receiver's speaker circuit. Also, drill several small holes through the decoder case's end wall to permit heat built up by R7 to escape.

You can use either coaxial audio cable or standard speaker cable for the input to the decoder from the FM radio and for the output from the decoder to the jack connected to your TV set's speaker. Terminate both cables with standard subminiature phone plugs. Make absolutely sure to insulate *all* connections you make inside your TV receiver.

In Closing

Using the Wireless Audio Mute system described here with your TV receiver does wonders to relieve the annoyance and stress that result from too-loud and too-frequently-repeated TV commercials. Just the press of a button silences irritating sounds, while another touch restores normal sound when the program returns—from the comfort of your easychair. **ME**