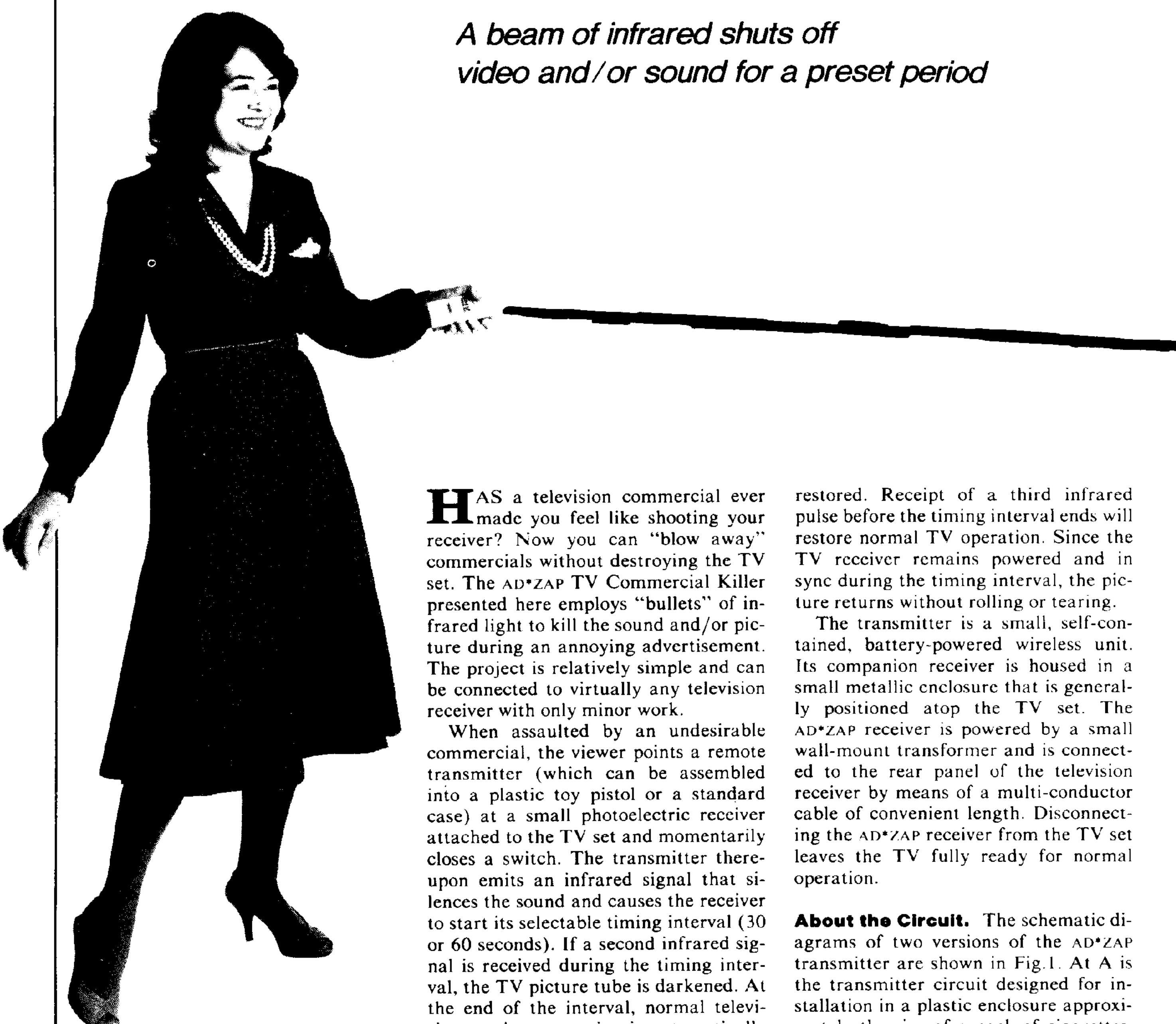
WIRELESS AD*ZAP TURNS OFF TV COMMERCIALS



A beam of infrared shuts off video and/or sound for a preset period

HAS a television commercial ever made you feel like shooting your receiver? Now you can "blow away" commercials without destroying the TV set. The AD*ZAP TV Commercial Killer presented here employs "bullets" of infrared light to kill the sound and/or picture during an annoying advertisement. The project is relatively simple and can be connected to virtually any television receiver with only minor work.

When assaulted by an undesirable commercial, the viewer points a remote transmitter (which can be assembled into a plastic toy pistol or a standard case) at a small photoelectric receiver attached to the TV set and momentarily closes a switch. The transmitter thereupon emits an infrared signal that silences the sound and causes the receiver to start its selectable timing interval (30 or 60 seconds). If a second infrared signal is received during the timing interval, the TV picture tube is darkened. At the end of the interval, normal television-receiver operation is automatically restored. Receipt of a third infrared pulse before the timing interval ends will restore normal TV operation. Since the TV receiver remains powered and in sync during the timing interval, the picture returns without rolling or tearing.

The transmitter is a small, self-contained, battery-powered wireless unit. Its companion receiver is housed in a small metallic enclosure that is generally positioned atop the TV set. The AD*ZAP receiver is powered by a small wall-mount transformer and is connected to the rear panel of the television receiver by means of a multi-conductor cable of convenient length. Disconnecting the AD*ZAP receiver from the TV set leaves the TV fully ready for normal operation.

About the Circuit. The schematic diagrams of two versions of the AD*ZAP transmitter are shown in Fig.1. At A is the transmitter circuit designed for installation in a plastic enclosure approximately the size of a pack of cigarettes.

BY DIETRICH SEAMAN

The circuit shown at B is almost identical and is designed to be mounted in a plastic-body six-shooter similar to the type used in some electronic target-practice games.

When switch *S1* is closed, battery power is applied to the astable multivibrator comprising 555 timer *IC1* and associated components. The multivibrator begins to oscillate and, when the output pulse causes pin 3 of *IC1* to be low (about 25% of the time), high-level current pulses flow through infrared emitter *LED1*. The LED radiates bursts of infrared at a rate of approximately 3.2 kHz. The exact pulse rate is determined by the setting of trimmer potentiometer *R2*. Capacitor *C3* ensures that enough current is available to the circuit during the time that *LED1* is conducting.

The schematic diagram of the AD•ZAP receiver is shown in Fig. 2. Pulsed infrared from the transmitter causes phototransistor *Q1* to turn on and off at around 3.2 kHz. Before infrared signals reach the phototransistor, they pass through an optical bandpass filter that attenuates much of the incident visible light that would otherwise affect the operation of *Q1*.

Voltage pulses developed across the phototransistor are amplified 60 dB by ac-coupled amplifiers *IC1F* and *IC1E*. These stages, as well as the high-Q, active state-variable filter that follows (*IC1A, IC1B, IC1C*), are part of a CD-4069 hex inverter. Although this CMOS chip is usually employed in a nonlinear operating mode, it is used here as linear amplifier inverter gates, much as low-gain op amps.

Also employed in this fashion is unity-gain buffer amplifier *IC1D*. This buffer supplies filtered pulses to the detector comprising *C6, C7, D1, D2*, and *IC3A*. Diode *D1* is a biased clamper that limits negative excursions of *IC1D*'s output to a level determined by the setting of THRESHOLD potentiometer *R16*. Half-wave rectifier *D2* passes pulsed positive dc to filter *R17C7*. After approximately 10 milliseconds, the voltage across *C7* increases to a level sufficient to trigger the Schmitt trigger—*IC3A, R19*, and *R20*. The output of *IC3A* thus goes to logic 1 when an infrared pulse reaches phototransistor *Q1*. Gate *IC3A*, together with *C8, R21* and *R23*, also acts as a debouncer that generates a clean logic pulse when manual control switch *S1* is closed.

The output of *IC3A* is applied to dual D flip-flop *IC2*. This chip is wired to function as a ÷3 counter. The first pulse applied to it causes pin 1 of *IC2A* (the Q output of the first flip-flop) to go to logic 1. As a result, relay driver *Q2* receives base drive from gate *IC3D* via *R29* and begins to conduct. Relay *K1* interrupts the circuit between the audio output stage of the TV set and the TV loudspeaker, and SOUND OFF indicator *LED1* begins to glow. Also, the logic-1 output of gate *IC3D* is inverted by *IC4A*, and the output of this NAND gate brings the RESET input of multistage counter *IC5* to logic 0. The counter then begins to tally the 60-Hz pulses that are derived from the ac power line, filtered by passive network *C2R34*, and squared up by Schmitt trigger *IC3B*.

If a second pulse appears at the output of *IC3A* due to either the receipt of another burst of infrared or a closure of switch *S1*, the Q output of *IC2A* (pin 1) returns to logic 0 and the Q output of *IC2B* (pin 13) goes to logic 1. The output of *IC3D* remains at logic 1, keeping *Q2* in saturation, but *Q3* begins to receive base drive from the Q output of *IC2B* via *R26*. As a result, relay *K2* becomes energized and PICTURE OFF indicator *LED2* begins to glow. The relay contacts are connected to the nodes of the television receiver's brightness-determining circuit. Closure of contacts D and F causes the screen to darken.

Both relays remain energized until either a third burst of infrared is received, switch *S1* is closed, or counter *IC5* has tallied 1800 pulses for a 30-second delay or 3600 pulses for a 60-second delay, depending on the setting of *S2*. If the counter runs through its cycle undisturbed, it will reset itself via *IC4B* and *IC4A* and will reset *IC2A* and *IC2B* via *IC4B*, *IC4A*, and *IC3C*. Both relays will then be deenergized and normal television reception will be reestablished. The counting cycle can be interrupted and the relay(s) deenergized at any time by a closure of *S1*. Passive components *C9* and *R24* generate a 100-millisecond pulse when power is first applied to the circuit. This pulse is routed to the RESET inputs of *IC2A* and *IC2B* via *IC3C* and ensures that both flip-flops are properly initialized and the relays deenergized in spite of any turn-on transients.

Power required by the AD•ZAP receiver is furnished by the simple supply shown in the lower right corner of Fig. 2. Unregulated dc provided by bridge rectifier *D3* through *D6* and filter capacitor *C11* powers the relay and LED indicator circuits. The CMOS logic ICs are powered by +5 volts regulated, which is furnished by integrated regulator *IC6*. This particular supply voltage was chosen for the CMOS ICs because such circuits when operated in the linear mode exhibit higher gains at lower supply voltages.

Construction. The use of printed-circuit construction techniques is recommended. Suitable full-size etching and drilling guides for the two versions of the AD•ZAP transmitter are shown in Figs. 3A and 3B. The receiver pattern is shown in Fig. 4. The full-size etching and drilling guide of the circuit board that accommodates relays *K1* and *K2* and protective diodes *D7* and *D8* appears in Fig. 5. This latter board should be mounted inside the TV receiver's cabinet. Corresponding component-placement guides for these boards appear in Figs. 6A, 6B, 7, and 8.

Most components mount directly on the boards or via sockets. Exceptions include phototransistor *Q1*, resistor *R1*, and plug-in wall transformer *T1*. To suppress feedback-induced oscillations, one end of *R1* is connected directly to the base lead of *Q1*. The other end of *R1* and the collector and emitter leads of *Q1* are connected to the appropriate pc foil pads via short lengths of insulated hookup wire. Similarly, *LED1* and *LED2* are connected to the board with insulated hookup wire.

It is good practice to install lengths of spaghetti or heat-shrinkable tubing on the exposed leads of all components that are mounted off the board to prevent accidental short circuits. The AD•ZAP receiver circuit board *must* be housed in a metallic enclosure.

Substitutions should not lightly be made for phototransistor *Q1*. For the device specified and the parameters of the circuit shown in Fig. 2, the phototransistor should function in the linear portion of its response curve for ambient light levels of up to 50 foot-candles of incandescent light or 150 foot-candles of daylight. Sensitivity of the device specified can vary over a 7:1 range. Therefore, the circuit incorporates means to compensate for such sensitivity variations. For example, it may be necessary to change the value of resistor *R3* or to even substitute another phototransistor of the same type. (Note that photodarlingtons have too much gain and will, therefore, not

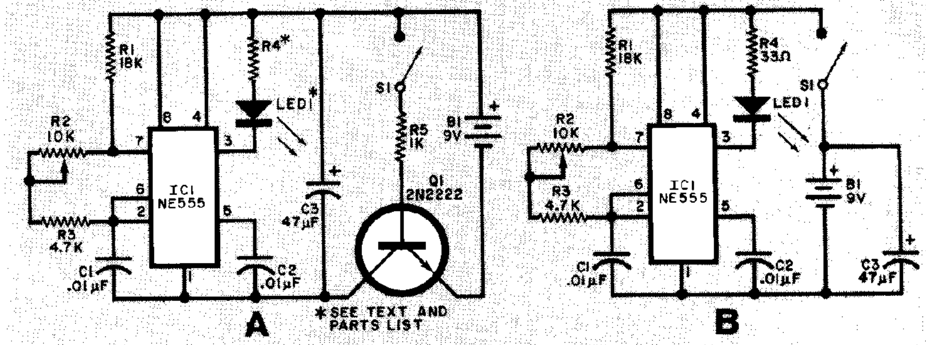


Fig. 1. Schematic diagrams of the box-style (A) and gun-style (B) infrared transmitters.

BOX-STYLE TRANSMITTER PARTS LIST

B1—9-volt transistor battery
C1—0.01µF, 10% tolerance Mylar capacitor
C2—0.01-µF disc ceramic capacitor
C3—47-µF, 10-volt radial-lead aluminum electrolytic or tantalum capacitor
IC1—NE555 timer
LED1—TIL32 unlensed infrared-emitting diode or TIL31 or LED55C lensed infrared-emitting diode
Q1—2N2222 npn silicon switching transistor
The following, unless otherwise specified, are ¼-watt, 10% tolerance, carbon-composition fixed resistors.
R1—18 kΩ
R2—10 kΩ, linear-taper horizontal pc-mount trimmer potentiometer
R3—4.7 kΩ
R4—33 Ω if *LED1* is a TIL32 unlensed diode, 15 Ω if *LED1* is a TIL31 or LED55C lensed diode
R5—1 kΩ
S1—Spst, normally open, momentary-contact pushbutton switch
Misc.—Mounting collar for *LED1*, lens for *LED1* if a TIL32 device is used, printed-circuit board, battery clip, suitable enclosure, solder, pc-board standoffs, suitable hardware, etc.

Note—Pushbutton switch S1 is a Panasonic No. EVQ-P1R component that is available from Digi-Key, Box 677, Highway 32 South, Thief River Falls, MN 56701.

GUN-STYLE TRANSMITTER PARTS LIST

B1—9-volt transistor battery
C1—0.01-µF, 10%-tolerance Mylar capacitor
C2—0.01-µF disc ceramic capacitor
C3—47-µF, 10-volt radial-lead aluminum electrolytic or tantalum capicitor
IC1—NE555 timer
LED1—TIL32 infrared-emitting diode
The following, unless otherwise specified, are ¼-watt, 5%-tolerance, carbon-composition fixed resistors.
R1—18 kΩ
R2—10 -kΩ, linear-taper vertical pc-mount trimmer potentiometer
R3—4.7 kΩ
R4—33 Ω
Misc.—Printed-circuit board, battery clip, plastic-body Coleco electronic-game gun with trigger-actuated switch (*S1*) and lens system, solder, etc.
Note—The Coleco gun is available from Meshna Electronics, Box 62, 19 Allerton Street, East Lynn, MA 01904.

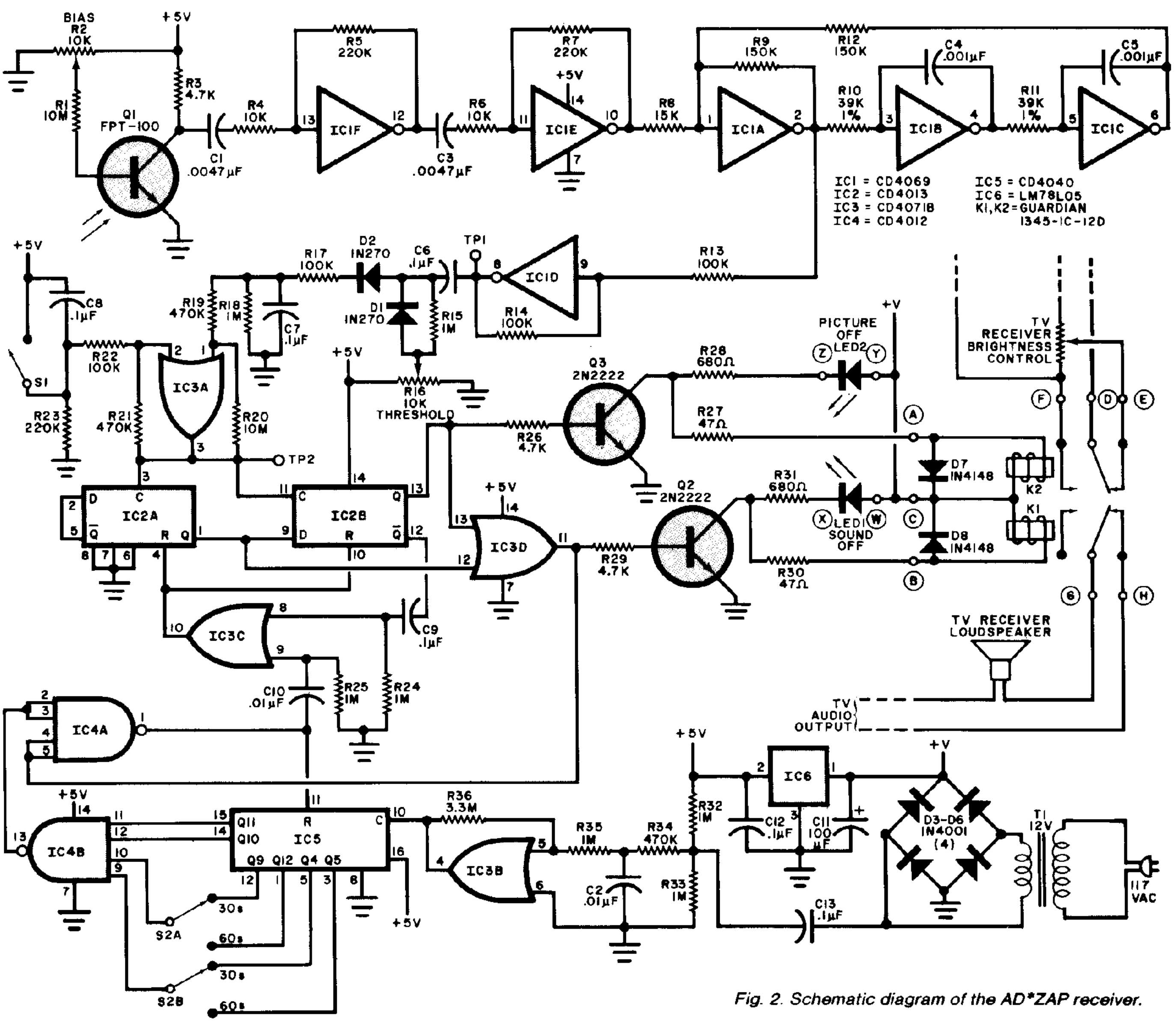


*Fig. 2. Schematic diagram of the AD*ZAP receiver.*

RECEIVER PARTS LIST

C1,C3—0.0047-µF disc ceramic capacitor
C2,C10—0.01-µF disc ceramic capacitor
C4,C5—0.001-µF, 5% tolerance Mylar or polystyrene capacitor
C6,C7,C8,C9,C12, C13—0.1-µF disc ceramic capacitor
C11—100-µF, 25-volt axial-lead aluminum electrolytic
D1,D2—1N270 or equivalent germanium diode
D3 through D6—1N4001 rectifier
D7,D8—1N914 or 1N4148 silicon switching diode
IC1—CD4069 hex inverter
IC2—CD4013 dual D flip-flop
IC3—CD4071B quad 2-input OR gate (device must have B suffix)
IC4—CD4012 dual four-input NAND gate
IC5—CD4040 12-stage binary counter
IC6—LM78L05 5-volt, 100-mA regulator
K1,K2—Spdt relay with 12-volt dc, 1400-ohm coil (Guardian No. 1345-1C-12D or equivalent)
LED1—Yellow light-emitting diode
LED2—Red light-emitting diode
Q1—FPT-100 phototransistor (Fairchild)
Q2, Q3—2N2222 npn silicon switching transistor
The following, unless otherwise specified, are ¼-watt, 5% tolerance, carbon-composition fixed resistors.
R1, R20—10 MΩ
R2, R16—10-kΩ linear-taper, horizontal pc-mount trimmer potentiometer
R3,R26,R29—4.7 kΩ
R4, R6—10 kΩ
R5, R7, R23—220 kΩ
R8—15 kΩ
R9, R12—150 kΩ
R10, R11—39 kΩ, 1%-tolerance, ¼-watt, metal-film
R13, R14, R17, R22—100 kΩ
R15, R18, R24, R25, R32, R33, R35—1 MΩ
R19, R21, R34—470 kΩ
R27, R30—47 Ω
R28, R31—680 Ω
R36—3.3 MΩ
S1—Spst, normally open, momentary-contact pushbutton switch
S2—Dpdt miniature slide switch
T1—12-volt ac, 100-mA wall-mount plug-in transformer
Misc.—Printed circuit board, suitable metallic enclosure, LED mounting collars, grommets, infrared bandpass filter (see note below), heat-shrinkable tubing, hookup wire, solder, pc standoffs, suitable hardware, etc.

Note 1—Pushbutton switch S1 is a Panasonic No. EVQ-P1R component that is available from Digi-Key, Box 677, Highway 32 South, Thief River Falls, MN 56701.

Note 2—There are several possible items that can be used as an infrared bandpass filter. The author used a ¼-inch circular piece of Eastman Kodak Wratten No. 89B gelatin filter. Kodak advises that a piece of unexposed but processed Kodachrome slide film can also be used, as it blocks visible light almost completely but is transparent to infrared. Gelatin Wratten filters measuring 2 inches square are available from Eastman Kodak dealers for approximately $5.00 each.

work.) The phototransistor should be mounted on the front panel of the AD•ZAP receiver's enclosure. The device specified just fits a standard 0.200-inch (Jumbo) LED mounting collar.

An infrared optical filter is mounted in front of the phototransistor's aperture. Use black silicone cement or some similar opaque material to ensure that no light can leak in behind the filter. The two indicator LEDs can also be mounted on the receiver enclosure's front panel. To facilitate interconnection of the receiver circuit and relay board, a multiconductor connector should be mounted on the enclosure.

For convenience, the author mounted his relay board inside the television receiver with which the AD•ZAP system was to be used. If you plan to use your system with more than one TV set, a separate relay board can be used in each. You can substitute the relays specified so long as their coils are rated at 12 volts dc and have resistances of 400 ohms or more. If a dpdt relay is employed for *K1*, the second set of contacts can be used to stop the transport of a video tape recorder during commercial messages.

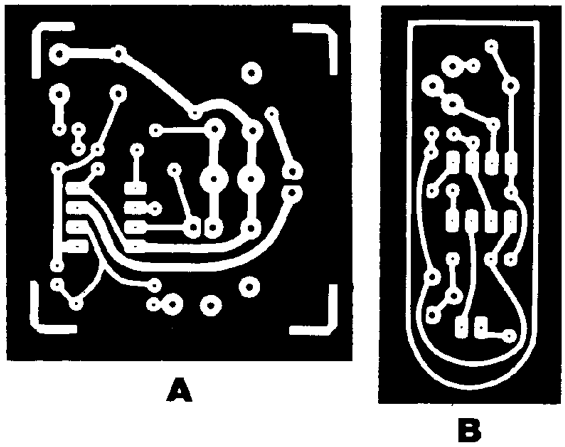


Fig. 3. Full-size etching and drilling guides for the box-style (A) and gun-style (B) transmitter pc boards.

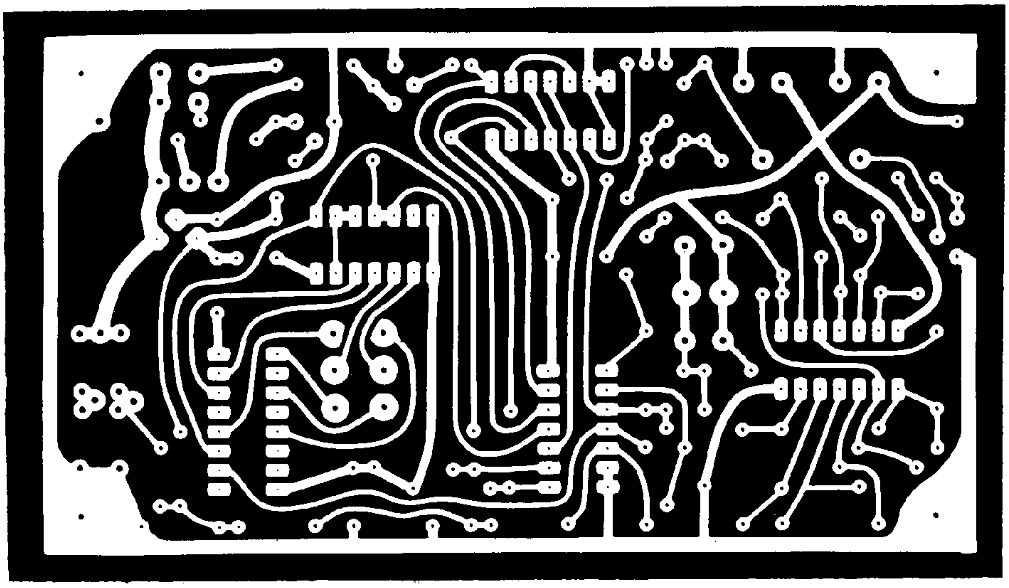


Fig. 4. Full-size etching and drilling guide for the receiver pc board.

The transmitter can be housed in a standard plastic enclosure or, for dramatic fun, a plastic six-shooter such as that used by the author. The "gun," manufactured by Coleco for use in a game, contains a trigger-actuated switch and a lens system. The pc board pattern of Fig. 3B was designed for use with this gun. Careful attention to dimensions will ensure proper alignment of the LED with the lenses, giving a narrow, correctly aimed beam.

To fit a nine-volt battery into the handle of the pistol, the internal plastic posts between the holes for the two handle screws must be cut away. This can be done with a heated knife or with a hobby power tool and its saw blade. Also, the terminals on the rear of the trigger-actuated switch must be cut off. The necessary electrical connections between the switch and the rest of the transmitter circuit should be made by soldering suitable lengths of hookup wire directly to the switch's leaf springs. Use a vise to hold the switch and then tin the leaf springs and the ends of the lengths of hookup wire. Place the tinned end of each wire next to the appropriate leaf spring and remelt the solder to form the connection. Work quickly to avoid losing the temper of the springs. Finally, make a 1/8-inch hole in the plastic body over the position occupied by trimmer potentiometer *R2* so that the circuit's frequency of oscillation can be conveniently adjusted.

If you prefer a more conventional transmitter enclosure, you will need a lens to focus the infrared beam. Focusing the invisible beam is difficult. Alter-

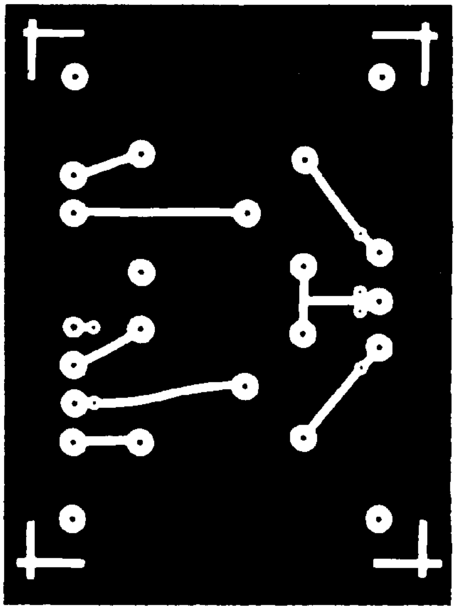
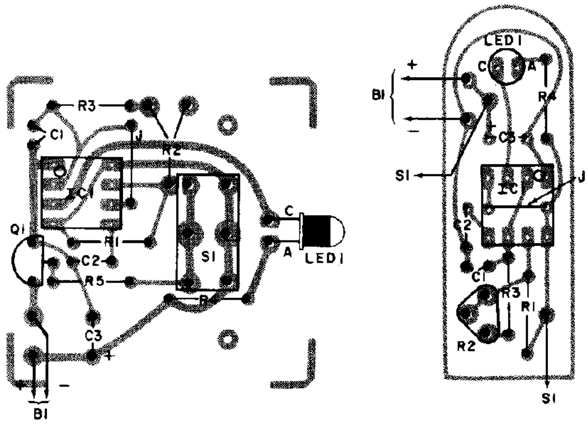


Fig. 5. Etching and drilling guide for relay pc board.



A **B**

Fig. 6. Parts placement guides for the box-style (A) and gun-style (B) infrared transmitters.

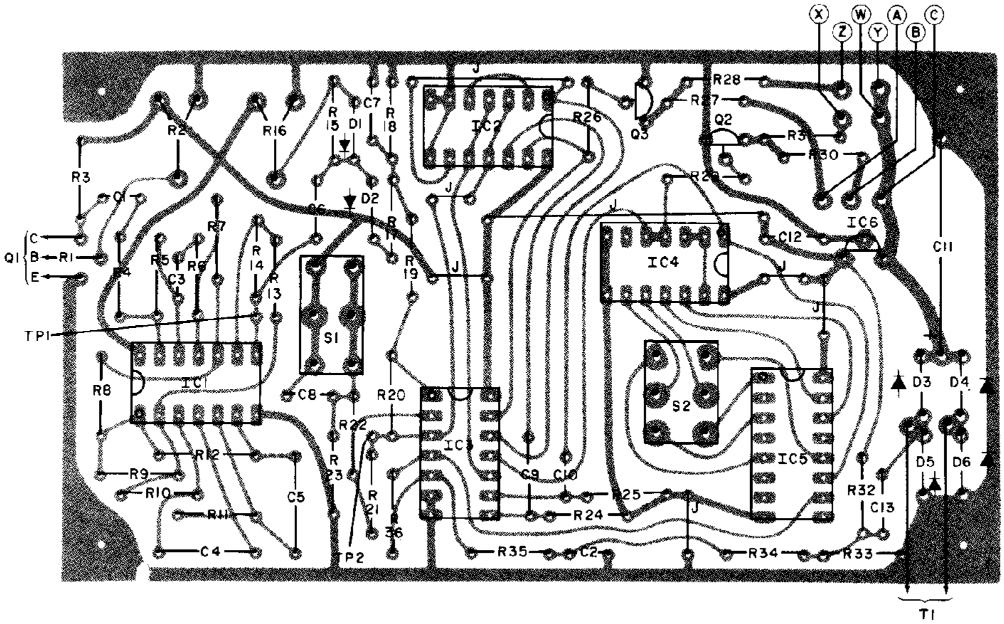


*Fig. 7. Parts placement guide for the AD*ZAP infrared receiver printed circuit board.*

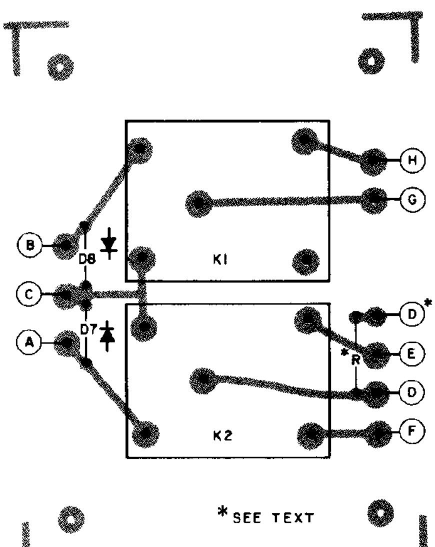


Fig. 8. Component placement guide for the relay pc board.

natively, you can use a Texas Instruments TIL31 or General Electric LED55C infrared-emitting diode. These include internal reflectors and glass lenses and mount in standard 0.200-inch LED mounting collars. They also tolerate larger forward currents, allowing reduction of the value of *R4* in the transmitter to 15 ohms. Pass transistor *Q1* and base resistor *R5* in the circuit of Fig. 1A allow switch *S1* to be a light-action, low-current keyboard switch.

Adjustment. After the receiver and transmitter have been assembled, plug *T1* into a wall socket. With the top of the receiver enclosure removed, monitor the voltage across resistor *R3* with a high-impedance multimeter. Place an unshaded, lighted 60-watt light bulb two feet away from the filter that shields phototransistor *Q1*, and set the wiper of trimmer potentiometer *R2* fully counterclockwise. The voltage across *R3* should be 2.5 ±0.5 V. If necessary, change the value of *R3* to obtain this reading. Should this prove impossible,

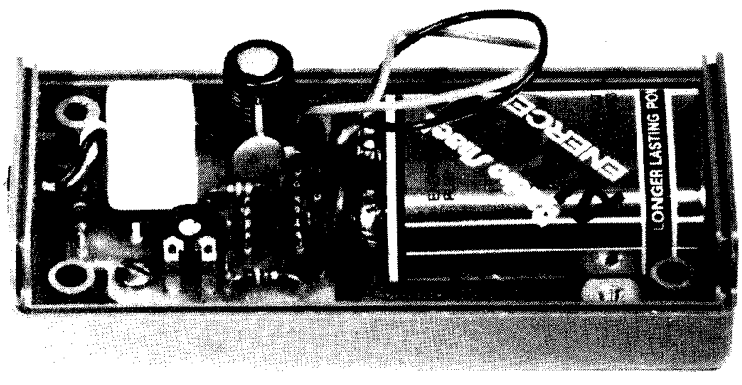
- try another FPT-100 phototransistor.

When the voltage across *R3* is correct, cover the filter aperture with a totally opaque shield and adjust *R2* so that 0.25 volt appears across *R3*. Then remove the opaque shield.

Next, turn *R16* fully counterclockwise and check the voltage at *TP2*. This should be 0 volt. Slowly turn *R16* clockwise. At some point, *TP2* should suddenly go to +5 volts. When this happens, back *R16* off and stop just past the point at which *TP2* returns to 0 volt. Depress switch *S1* momentarily and verify that *TP1* goes to +5 volts with *S1* closed and returns to 0 volt when it is opened; if *TP2* fails to return to 0 volt when *S1* is released, turn *R16* a bit further counterclockwise.

Finally, to set the frequency of the transmitter's astable multivibrator to match the receiver's filter passband, connect an ac voltmeter or oscilloscope between *TP1* and ground. Have a friend monitor the voltage reading while you stand several feet away and "fire" the transmitter at the receiver's infrared filter. Hold the transmitter switch *S1* so that a continuous infrared output is generated. (With a pistol transmitter, pull the hammer back all the way and hold it.) Adjust transmitter trimmer potentiometer *R2* for a maximum voltage reading on the test instrument.

Place the top on the receiver enclosure and secure it in place. Connect the relay board to the rest of the receiver circuit and, if necessary, button up the transmitter enclosure. Making certain that the receiver is getting operating power, aim the transmitter at the receiver's infrared filter. When transmitter switch *S1* is closed momentarily, relay



Photograph of the author's prototype box-style transmitter.

INSTALLATION WHEN SCREEN CAN'T BE DARKENED

Here are possible ways of darkening the screen even if it doesn't go fully to black when the BRIGHTNESS control is at minimum. First, you will need a schematic of the television receiver. (If one was not supplied with the receiver or is not available from the manufacturer, try the Sams Fotofact series of publications.) Next, you will have to determine how the brightness of the CRT is controlled, and how the range of the BRIGHTNESS potentiometer is affected by the "one-button" color preset, if any.

Several methods of brightness control are common; the simplest is found in many vintage color receivers and in many contemporary monochrome models. (Figure 9 is typical.) The video signal is capacitively coupled to the cathode of the picture tube, and the BRIGHTNESS potentiometer controls the dc bias voltage that sets the average beam current. The lower the bias voltage, the higher the beam current and the brighter the picture. Resistor *R34* limits the beam current to a maximum value.

Brightness-control circuits of this type almost always are able to send the CRT well past cutoff (screen completely dark). If you have a color receiver that employs a similar circuit (the partial schematic illustrated is of a General Electric HB color chassis), note that the red, green and blue SCREEN controls interact with the BRIGHTNESS control. While a video signal is being received, try adjusting the SCREEN controls for cutoff with the BRIGHTNESS control at its minimum setting. Then if the CRT image is too dim when the BRIGHTNESS control is advanced to its maximum setting (this will rarely be the case), make the value of *R34* half as large. Check to see that the high voltage is at its specified value before making a substitution for *R34*.

The more usual approach to brightness control in today's solid-state receivers is to vary the dc bias at the input of one of the video amplifiers. Video is either dc or ac-coupled (or a combination of the two) into the stage, and is sometimes clamped to the bias voltage during the blanking interval. The BRIGHTNESS potentiometer can be wired into the circuit either as a voltage divider (as a three-terminal device) or as a variable resistor (a two-terminal device). In the latter case, the potentiometer is only part of a voltage-dividing network. The Sharp Model XR-2194 typifies the first method, the Sony 9000U the second.

In the Sony, the bias voltage of the Y DRIVE amplifier is mixed with the video signal. The video signal is positive, that is, white is more positive than black. Blanking the screen can therefore be accomplished by bringing the base of the Y DRIVE stage to ground, either directly or by opening the path between the voltage divider that sets the bias and the low-voltage supply from which the bias is derived. In the Sharp receiver, the "one-button" color-preset switch selects between the BRIGHTNESS control and a screwdriver adjustable trimmer potentiometer that is preset at the factory. Both the front-panel BRIGHTNESS control and the trimmer have range-limiting series resistors that prevent them from cutting off the CRT totally. Blanking can be achieved by having the relay disconnect the ends of the front-panel and trimmer potentiometers that are tied together from the source of the low voltage which supplies them.

In some sets, the "one-button" color preset leaves the front-panel BRIGHTNESS control in the circuit, but restricts its effective range. One receiver that uses such a circuit is Toshiba's Model C345, chassis TAC-9310. The base of the fourth video amplifier is biased through a fixed resistor by a voltage divider composed of a fixed resistor and the BRIGHTNESS control, one end of which receives positive voltage via a SUB-BRIGHTNESS control. This latter control limits CRT brightness.

When the receiver's "one-button" color preset is engaged, a fixed resistor is placed in parallel with the front-panel BRIGHTNESS control. This restricts the effective range of the control to its upper half. To have AD*ZAP totally darken the screen, relay *K2* can be wired either to ground the wiper of the SUB-BRIGHTNESS control or connect a fixed resistance of approximately 5000 ohms between the base of the fourth video amplifier and ground. The use of such a resistor rather than a direct short to ground prevents the total loss of the demodulated video signal, which would also disable the sync circuits. This way, when *K2* is deenergized, the picture returns instantly—in sync and with no rolling or tearing. The relay pc board includes provisions for such a resistor (*R*) at point D*.

PARTS AND KIT AVAILABILITY

The following are available from Videomega, 2715 N.E. 14th Avenue, Portland, OR 97212. Prices do not include shipping and handling charges ($2 per order). Kits of all components for one transmitter, receiver, and relay board, enclosures, and a nine-volt battery for the transmitters: complete kit for AD*ZAP system employing gun-style transmitter (limited quantities available). No. KZ-S, for $69.00; complete kit for AD*ZAP system employing box-style transmitter, No. KZ-T, for $69.00; complete kit for AD*ZAP system capable of controlling VTR pause circuit, employing gun-style transmitter, and including VTR control cable (limited quantities available) No., KZ-SV, for $79.00; complete kit for AD*ZAP system capable of controlling VTR pause circuit, employing box-style transmitter, and including VTR control cable, No. KZ-TV, for $79.00. Individual kits for additional receivers, transmitters, and relay boards are also available. Write for prices.

Drilled, solder-plated and silk-screened (component-placement legend) printed-circuit boards are also available separately: Set of boards for receiver, relay circuit, and gun-style transmitter, No. AZ-S, for $16.00; set of boards for receiver, relay circuit, and box-style transmitter, No. AZ-T, for $16,00; set of boards for receiver, relay and VTR pause-control circuits, and gun-style transmitter, No. AZ-SV for $16.00; set of boards for receiver, relay and VTR pause-control circuits, and box-style transmitter No. AZ-TV, for $16.00; receiver board only, No. AZ-A for $7.50.

K1 should pull in and *LED1* glow. When transmitter switch *S1* is closed a second time, *K2* and *LED2* should do likewise. At the end of the interval determined by the setting of receiver switch *S2*, both relays should drop out and both LEDs darken. If *S1* is closed a third time before the receiver times out, this too should de-energize the relays and LEDs. Closure of receiver switch *S1* should initiate the timing sequence or, if it has already begun, interrupt it.

Modifying the TV Receiver. If control of only the audio output of the television is desired the AD*ZAP system can be used with any TV set and installation procedure is simple. However, achieving control of both sound and picture may be somewhat more difficult, depending on the TV set used. Two simple tests will tell you how much of a problem it will be to obtain picture control. If the CRT screen goes completely black when the BRIGHTNESS control is at minimum, installation will be easy. Alternatively, if the receiver has a "one-button" color preset, and the screen goes completely dark when the preset is engaged and the BRIGHTNESS control is at minimum, installation is again not complicated. However, if the screen cannot be wholly "blackened," installation will be more

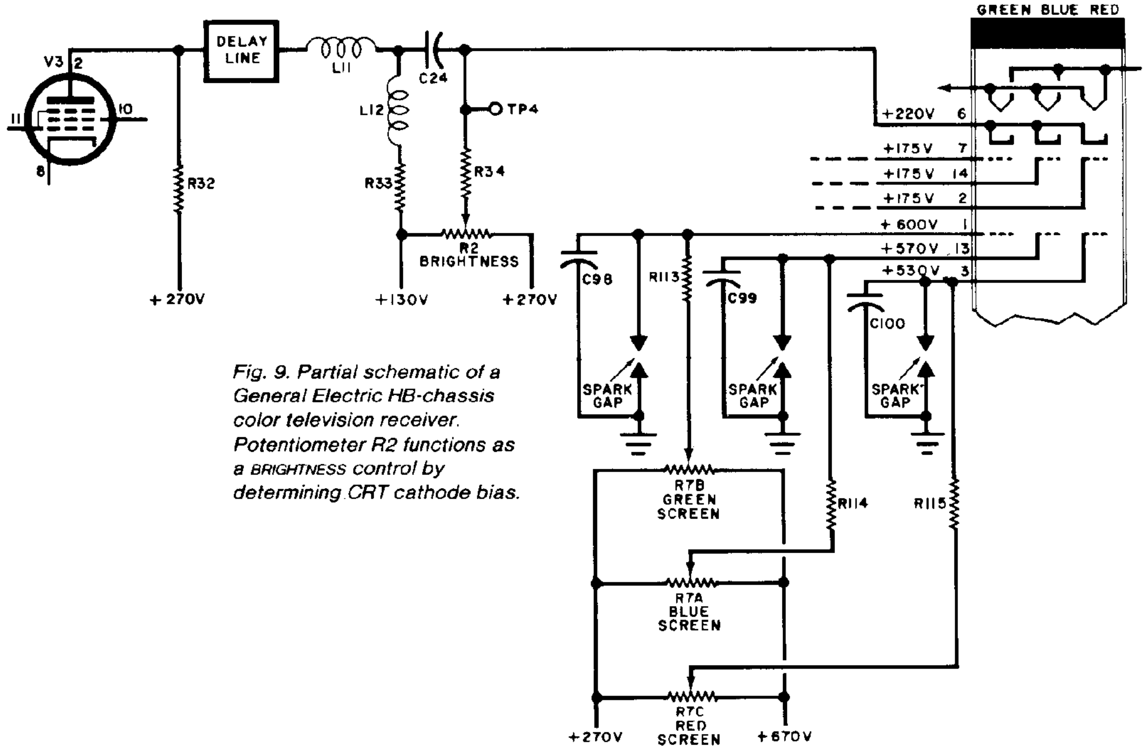
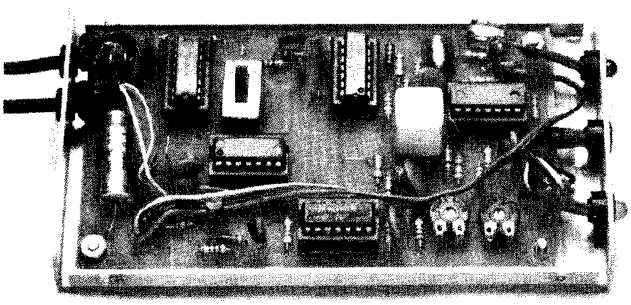


Fig. 9. Partial schematic of a General Electric HB-chassis color television receiver. Potentiometer R2 functions as a BRIGHTNESS control by determining CRT cathode bias.

troublesome, as detailed in a boxed section on the opposite page.

Here's the procedure that should be followed if test results are positive. Begin by removing the rear panel of the TV receiver (which should also remove ac power through the interlock) to gain access to the BRIGHTNESS control. Detach the wire connected to the center lug of the BRIGHTNESS control and connect it to point D on the relay printed circuit board. The free ends of the wires from points E and F on the relay board should be soldered to the center and left lugs, respectively, as seen from the *rear* of the BRIGHTNESS control. To control the audio, disconnect one of the two output leads from the loudspeaker and connect it to point H on the relay circuit board. If necessary, extend the length of this lead by splicing on a piece of hookup wire. Solder the splice and insulate it using PVC electrical tape or heat-shrinkable tubing. Then attach one end of suitable length of hookup wire to the free speaker lug, and the other end to point G on the relay circuit board. The relay board can be mounted inside the television cabinet using either screws and standoffs or two or three layers of double-sided adhesive foam tape.



*Photograph shows construction details of the prototype AD*ZAP infrared receiver.*

Photograph of the Coleco surplus plastic pistol modified by the author for use as a transmitter.

Using AD*ZAP. Although the receiver module includes an infrared filter, high levels of ambient light can affect phototransistor *Q1*. Therefore, avoid illuminating the sensor with bright sunlight, and keep incandescent lamps several feet away. The on-axis range of the six-shooter transmitter is more than 35 feet. That of the box-style transmitter is more than 20 feet. Because of its more diffuse radiation, the box-style transmitter need not be critically aimed.

Receiver switch *S1* should be set to provide the desired delay interval. The growing use of 30-second commercial messages on television prompted the inclusion of the switch. A few hour's attentive viewing of TV programs *and* commercials will enable you to judge which delay interval is more useful. To be certain not to miss any desired program material, you may want to avoid darkening the picture, at least at first. ◇