BUILD

Automatic Noise Eliminator

Tired of kicking up the volume control to overcome noise on a busy road, then having to turn it down again when everything is stopped for light? This Automatic Noise Eliminator solves the problem.

by LARRY WILSON

THIS "SET-IT-AND-FORGET-IT" NOISE eliminator automatically maintains your car radio volume proportionally above the noise level whether on the freeway at 6:00 pm or a residential street at 6:00 am. The Automatic Noise Eliminator eradicates the effects of wind noise, road noise, engine noise, (even back seat driver noise!) by turning up the radio volume to overcome it. If the noise level goes down, radio volume goes down a matching amount.

What this means to you is: at freeway speeds the radio is loud to overcome wind, road, and engine noise and (without twiddling any knobs!) quiet, docile, and non-blare when stopped at the traffic light. This is a true automatic control system that can be built inexpensively in an evening or two.

How it works

The automatic noise eliminator is an automatic feedback control system that compares a wired-in signal to an acoustically coupled signal containing both program and noise, then adjusts radio loudness to maintain a fixed signal-to-noise ratio for the listener. Fig. 1 is a functional block diagram and Fig. 2 a schematic of the instrument.

A pickup—in this case a 2-inch permanent magnet speaker—is placed near the driver and "listens" to whatever the driver hears. Q1 and Q2 amplify the audio from the pickup. The network consisting of C4, D2, D4, C5 and R7 converts the audio into a dc level proportional to the average sound intensity at the pickup. Note that the pickup is exposed to the same environment as the radio listener and "hears" both the radio program, or S, and the combined road, wind, and engine noise, N. The dc level from C5 to ground is proportional to S + N.

The reference or feedback channel is brought into T1 by wires connected across the radio speaker. T1 steps up the audio voltage so it can be rectified and filtered to obtain a dc level proportional only to S. D1 and C3 are arranged to make the wired-in signal negative with respect to ground. At C5 we have a dc level proportional to S + N, and at C3 a dc level proportional to –S. These signals are summed at the base of Q3 to produce (S + N) + (–S) = N, a signal proportional only to the ambient noise.

The signal at Q3's collector, then, is proportional to the ambient noise. Q3 drives emitter follower Q4 which in turn drives the lamp/photocell module PL-1. The photocell (photoresistor) is connected across the radio's volume control (through R16) in voltage divider fashion such that the brighter the lamp the lower the photocell resistance and the lower the volume. With no noise at the pickup, Q3's collector will be at supply voltage and the lamp will be its brightest. As ambient noise increases (such as by revving the engine or by driving away), the amplified noise signal drives Q3's collector toward ground reducing lamp current in Q4, increasing PL-1 photocell resistance, and increasing radio volume. The rate at which volume changes in the presence of noise is controlled by the load on Q3. R12 is adjustable to make the radio volume "track" the noise to maintain the selected signal-to-noise ratio over the ambient noise range.

R8, R9, R10, R11, C6, and C7 establish time constants long enough to prevent volume fluctuations due to silences and pauses. The ratio of R9 + R11 to R8 + R10 sets the signal-to-noise ratio (and dynamic range). R6 allows the –S signal to be balanced with the +S signal to assure that the N signal is all that is amplified by Q3. R1 and D3 compensate the base-emitter forward voltage drop to provide true class-B operation over the temperature range. Q5 and R12 reduce collector voltage drift with tempera-

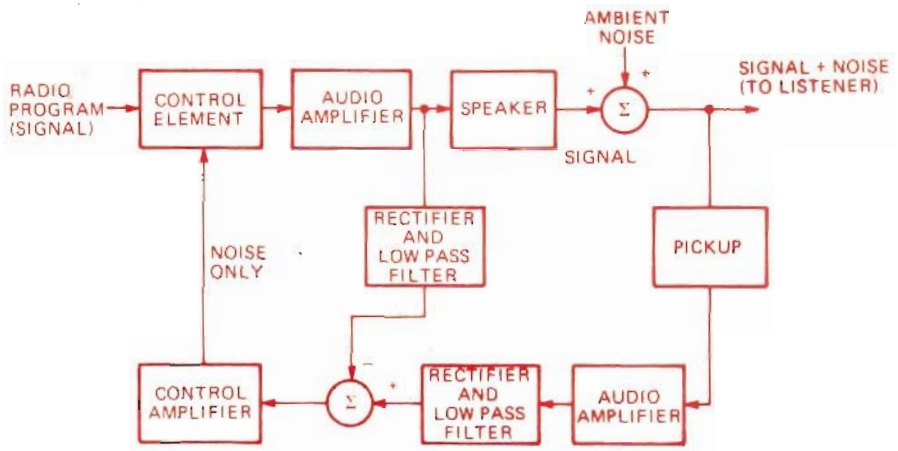


FIG. 1—HOW THE ELIMINATOR WORKS. The microphone at far right picks up a mixture of noise and signal, amplifies and rectifies it. The signal is subtracted from the noise, sending a pure noise signal to the control amplifier. The control element then turns up volume as ambient noise increases.

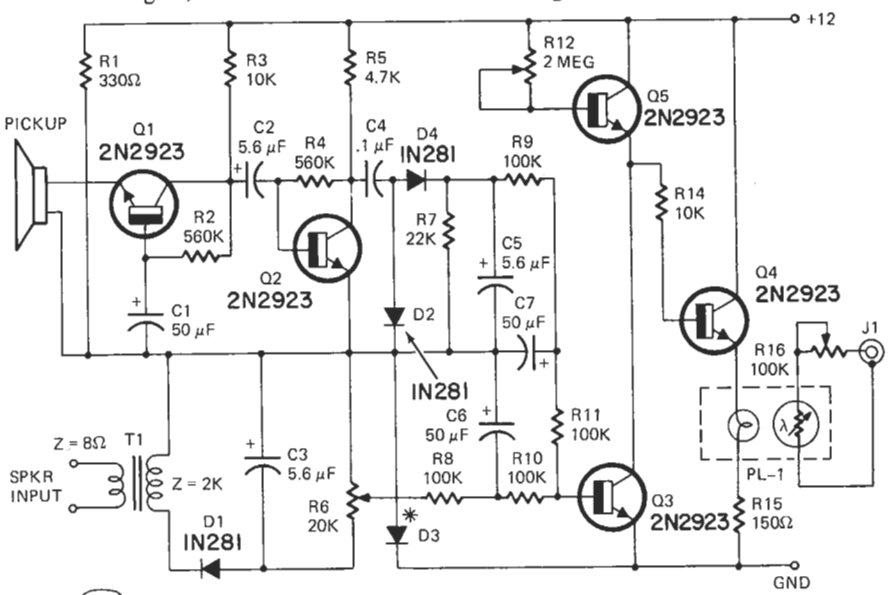
ture by functioning as an active load for Q3 that varies with beta variations.

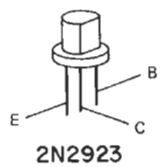
Since the radio's volume control is rendered ineffective R16 is added to control the static or noise-free volume.

Constructing the eliminator

The noise eliminator can be assembled on the printed-circuit board shown in Fig. 3, or on Vector board using the layout shown in Fig. 4. Layout is not critical but it is a good idea to keep the speaker and volume control circuits separated to prevent feedback. Use shielded cable throughout for the radio volume control circuit, and make sure that the phono plug does not ground against the chassis. The feedback control (R6 and the tracking control R12) should be mounted "up front" for ready access, as the final adjustments are best made with the eliminator installed in the car.

Mount the speaker (pickup) in a plastic lid from a medium sized aerosol can, as shown in Fig. 5. The base shown in the figure is carved from wood and painted. You can also make the PL-1 module yourself (Fig. 6). Choose a CdS cell that has a 1-megohm minimum dark resistance, and a lamp rated at about 10 volts. Photocell resistance should be about 500 ohms with 12 to 15 mA flowing through the lamp.





✳SEE TEXT

FIG. 2—SCHEMATIC FORM of the Fig. 1 block diagram. Only one transistor type is used. The volume is controlled with a lamp/photocell unit.

Installing the unit

Since R16 replaces the radio volume control, the noise eliminator should be mounted in a handy location, such as under the dash near the driver, so pickup and driver "hear" the same things. If possible, the pickup should be exposed to the wind noise (if wind noise is to be eliminated). A good location is on the console or drive shaft tunnel between the bucket seats. You *can* hide the pickup under the front seat, but this tends to shield it from wind noise and will reduce effectiveness.

Use double-sided transparent or masking tape to keep the pickup from sliding about. (It's important that the pickup doesn't move once adjustments have been completed). Miniature audio zip cord connects the pickup to the circuit board inconspicuously.

PARTS LIST

R1—330 ohms, ½ watt
R2, R4—560,000 ohms, ½ watt
R3, R14—10,000 ohms, ½ watt
R5—4,700 ohms, ½ watt
R6—20,000-ohm trimmer potentiometer, linear taper (Mallory MTC24L1 or similar)
R8, R9, R10, R11—100,000 ohms, ½ watt
R12—2-megohm trimmer pot, linear taper (Mallory MTC26L1 or similar)
R15—150 ohms, ½ watt
R16—100,000-ohm pot, audio taper
C1, C6, C7—50 µF, 6 V, electrolytic
C2, C3, C5—5.6 µF, 25 V, electrolytic
C4—0.1 µF
D1, D2, D4—1N281 or similar general-purpose *germanium* diode
D3—Any general-purpose *silicon* diode
J1—RCA phono jack
Pickup—2-inch PM speaker, 80-100 ohm voice coil
PL-1—Vactec VT10030 Vactrol photocell-lamp module. See text and Fig. 6.
Q1 through Q5—2N2923
T1—miniature audio output transformer, 8 ohm secondary, 500–2,000-ohm primary.
Miscellaneous—4 x 2¼ x 2¼-inch utility box, miniature audio zip cord, etched circuit board.

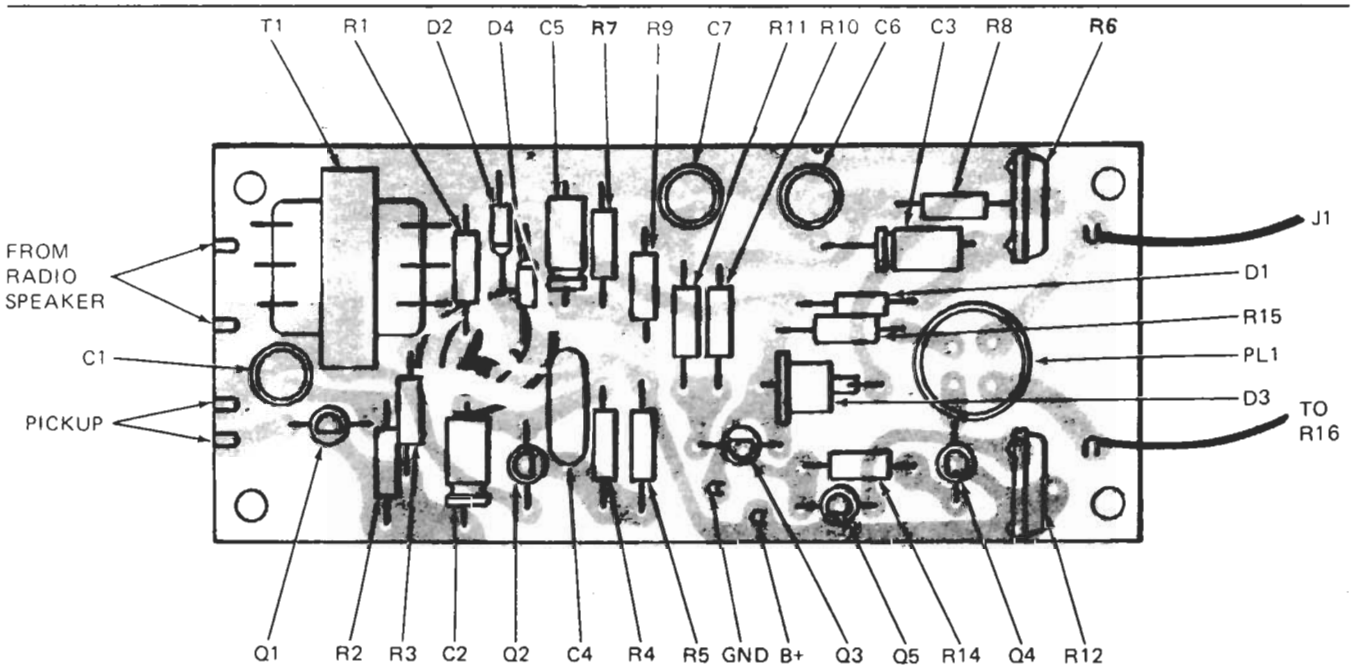


FIG. 4—TOP SIDE OF THE PC BOARD. Parts placements is clearly shown.

Once the eliminator is in place connect the two wires from T1 to the radio speaker terminals. Connect the power leads (B+ and ground) to the switched side of the ignition switch. If possible, tap into the same wire that powers the radio and after the fuse. For positive-ground cars simply observe the proper polarities when installing.

Radio modification

Your car radio requires a minor modification to work with the noise

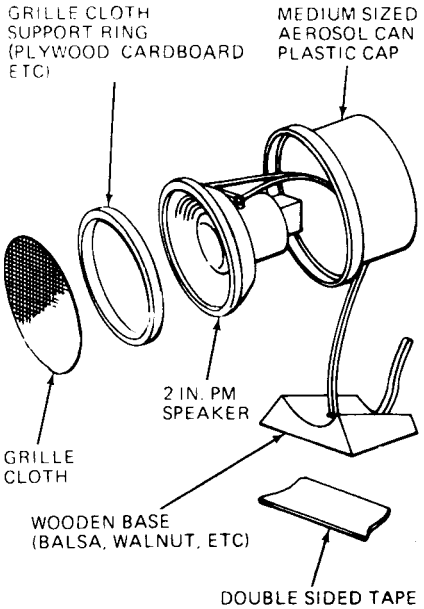
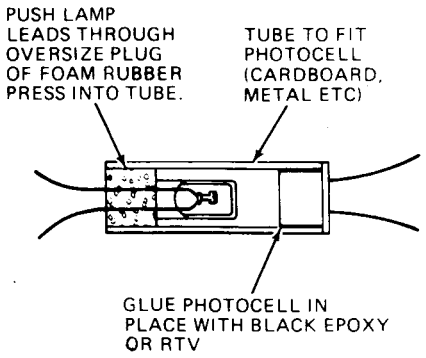


FIG. 5—THE MICROPHONE PICKUP is actually a small loundspeaker mounted in the top from an aerosol spray can.

eliminator. Remove the radio from the car and expose the volume control. Basically, there are two types of volume control circuits used by the different manufacturers, as shown in Fig. 7. For many radios simply connect the inner conductor of a shielded cable to the volume control wiper (center terminal) and the shield braid to the low side (left hand terminal looking at the rear of the control). *Do not let the shield braid touch chassis ground!* Delco radios require different treatment. Add the resistor-capacitor net-



NOTE:

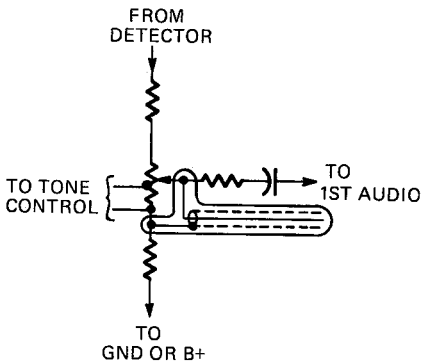
CHOOSE A CdS TYPE PHOTOCELL THAT HAS A 1MEGOHM MINIMUM DARK RESISTANCE. THE LAMP AND PHOTOCELL COMBINATION SHOULD GIVE 500 OHMS CELL RESISTANCE WITH 12-15 MILLIAMPS FLOWING THROUGH LAMP. THE LAMP SHOULD BE RATED AT ABOUT 10 VOLTS

FIG. 6—YOU CAN MAKE YOUR OWN photocell unit if parts are available.

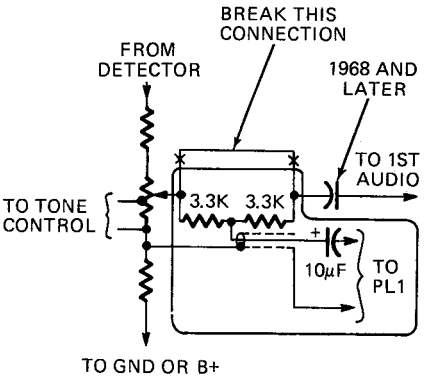
work noted in Fig. 7. If there is room in the radio, you may want to install an *insulated* phono jack for later plug-in convenience. Otherwise, attach a phono plug on the free end of the cable. Make sure the cable is long enough to plug into the installed eliminator.

Initial adjustments

First adjust feedback pot R6. With power applied to both the radio and the eliminator and R12 set at about midrange, turn up the radio volume control almost to maximum (if the eliminator is working properly, the volume control should have no effect until nearly at maximum). Back the control up slightly when volume does begin to increase. Whistle steadily into the pickup and adjust R6 with an insulated tool until the volume slowly increases then levels off and then decreases as you whistle, then stop. Should radio volume increase exponentially to maximum loudness adjust R6 for more negative feedback until the eliminator "takes hold" and cuts volume back. Use a portable FM radio tuned between stations for a noise source rather than whistling if you like. Now set the tracking control R12 until the volume gets louder and louder *smoothly* as the noise increases. Improper adjustment of R12 will



7-a) TYPE 1 VOLUME CONTROL ARRANGEMENT. USED BY FORD, CHRYSLER CORP., RAMBLER. SIMPLY ADD THE SHIELDED CABLE (SHOWN CIRCLED). DO NOT LET THE SHIELD BRAID TOUCH CHASSIS GROUND!



7-b) TYPE 2. USED BY GENERAL MOTORS. ADD THE TWO 3.3K RESISTORS INSIDE THE RADIO, THE 10μF CAPACITOR INSIDE THE NOISE ELIMINATOR. THIS METHOD IS SATISFACTORY FOR NEARLY ALL RADIOS AND CAN BE USED WHERE ANY DOUBT EXISTS ABOUT CIRCUIT TYPE.

FIG. 7—CAR RADIO VOLUME CONTROL arrangements. 7-a is used by Ford, Chrysler and Rambler; 7-b is the circuit in G-M cars, and shows the modifications necessary for them, or for radios where the circuit type is uncertain.

cause the volume either to lead or lag the noise more and more as noise increases. This adjustment is perhaps best made during a test drive (take a friend along and let *him* adjust while *you* drive for safety's sake).

Properly adjusted, the noise eliminator will keep you happily listening to an auto radio that is always at the proper volume whether blasting down the freeway with the top down or creeping through downtown traffic waiting for the lights to change. **R-E**

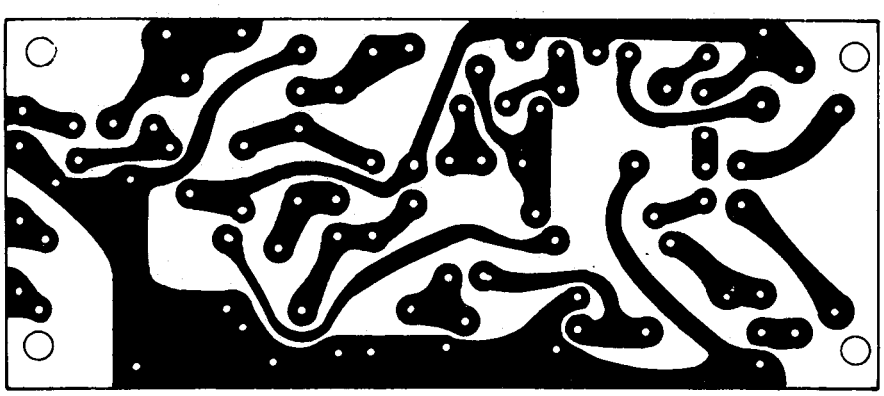


FIG. 3—FULL-SIZE CIRCUIT BOARD. You can copy it or use your own layout on Vector or Vero board.

AD CORRECTION

In the Leader ad which appeared in both the October and December 1973 issues, the price shown for the LSG-231 FM multiplex stereo generator was incorrect. The correct price should have been $299.95.