AUDIO VOLUME BOOSTER OVERCOMES OUTSIDE NOISE

Increases audio level when external noise is too high

By William Stamile

IF YOU live near a busy airport, highway, or railroad, you are very familiar with the problem of interrupted radio, TV, and audio system listening because external noise frequently overcomes the level of the program you want to hear.

The automatic audio augmenter described in this article constantly monitors external noise, and if that noise rises above a preset level, the augmenter raises the volume of the audio system to which it is connected. When the interfering noise subsides below a preset threshold, the augmenter returns the audio volume to normal.

Circuit Operation. As shown in Fig. 1, the external noise is picked up by a speaker mounted at a window or other location external to the listening area. The speaker is transformer-coupled to SENSITIVITY control *R1* for application to audio amplifier *IC1*. The amplified noise signal is coupled via *C2* and step-up transformer *T2* to a voltage doubler consisting of *C3, C4, D1,* and *D2* that converts the audio signal into a dc voltage. This voltage is stored in *C5*, which is constantly being discharged by *R2, R4,* and *R3*. DELAY control *R3* allows the discharge time to be adjusted. (The stored dc voltage can be measured at test point *TP1.)*

The dc voltage across *C5* is applied to the threshold and trigger (pins 6 and 2 respectively) of timer *IC2*. As a monostable, *IC2* is triggered by bringing the trigger input below a lower threshold (about 2 V). This makes pin 3 go high. When the trigger level rises above the upper TTL threshold, pin 3 goes low and remains low until the trigger level again drops below the 2-V threshold.

When pin 3 on *IC2* is high, transistor *Q1* conducts and closes the contacts of relay *K1*. This action applies a dc voltage, via *R7*, to the center connector of phone jack *J1*, whose outer shell is ground. When pin 3 goes low, *Q1* cuts off, *K1* is released, and the voltage is removed from *J1*.

A second part of the device—consisting of *LED2*, photo-sensitive

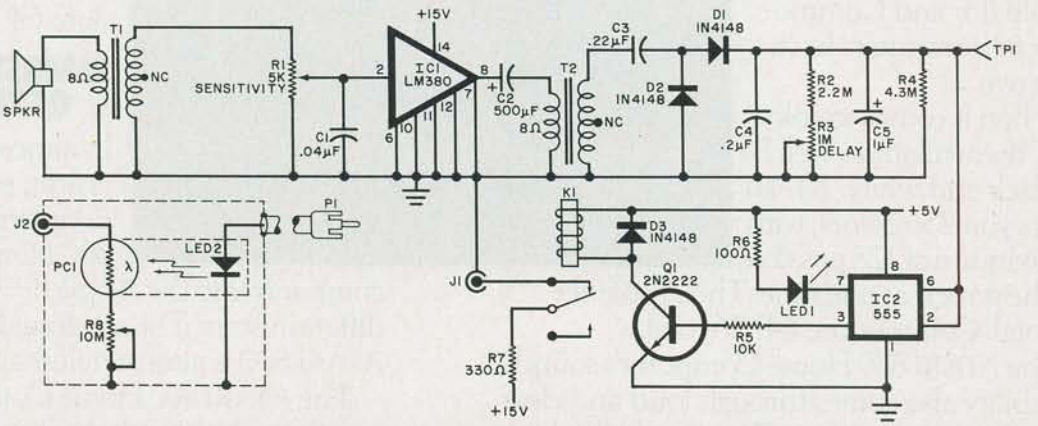

Fig. 1. Schematic of the circuit.

PARTS LIST

C1—0.04-μF capacitor
C2,C6—500-μF electrolytic
C3—0.22-μF capacitor
C4—0.2-μF capacitor
C5—1-μF tantalum capacitor
C7—220-μF electrolytic
D1,D2,D3—1N4148 diode
IC1—LM380 audio amplifier
IC2—555 timer
IC3—7815 I5-V regulator
IC4—7805 5-V regulator
J1,J2—Phono jack
K1—5-V relay (Radio Shack 275-216 or similar)
LED1,LED2—Red light-emitting diode
P1,P2—Phono plug
PC1—Photoresistor, 5 megohms dark/100 ohms light (Radio Shack 276-116 or similar)
Q1—2N2222 transistor
R1—5000-ohm audio-taper potentiometer
R2—2.2-megohm resistor
R3—1-megohm trimmer potentiometer
R4—4.3-megohm resistor
R5—10,000-ohm resistor
R6—100-ohm resistor
R7—330-ohm resistor
R8—10-megohm potentiometer
RECT1—Bridge rectifier, 50 V, 1 A
SPKR—8-ohm speaker
T1,T2—Audio transformer, 1000 ohms CT/8 ohms (Radio Shack 273-1380 or similar)
T3—Transformer, 24 V, 10 VA
Misc.—Suitable enclosure (2), phono shielded cable, electrician's tape, mounting hardware, etc.

resistor *PC1*, and level-set potentiometer *R8*—is cable-connected via *P1* to *J1*. This part of the audio augmenter circuit is arranged so that when the LED is powered, its emitted light falls on the sensitive surface of *PC1*. When *PC1* is illuminated, its resistance decreases, and when it is in the dark, its resistance increases. This resistor, in series with *R8*, is connected across *J2*.

As shown in Fig. 2, a shielded cable is connected to *J2*, via *P2*, to the system volume control. The illustration shows how connections should be made to two of the most common types of volume-control circuits. Experiment with shielded/center-conductor wiring polarity to minimize hum pickup.

Thus, when no external noise is detected, *LED2* glows and a low-resistance shunt consisting of *PC1* and *R8* is connected across the system volume control. This causes the system volume level to assume a relatively low level that is set by the system control and the adjustment of *R8*.

But when an external noise is detected, *K1* opens to remove power from *LED2*. When this LED extinguishes, *PC1* reverts to its very high resistance state, thus removing the effect of the *PC1-R8* shunt from the system volume control. As a result, the system volume increases.

When the external noise ceases, the audio volume remains high until the dc voltage across *C5* is discharged. (This time period is determined by the setting of *R3*.) Once *C5* has discharged, *IC2*'s pin 3 goes high, causing *LED2* to glow and place the *PC1-R8* shunt back across the system volume control, reducing the audio to normal, preset levels. Note that when high volume (augmenting) is required, *LED1* glows.

The power supply required is conventional, and uses a bridge rectifier and 15- and 5-V regulators (Fig. 3).

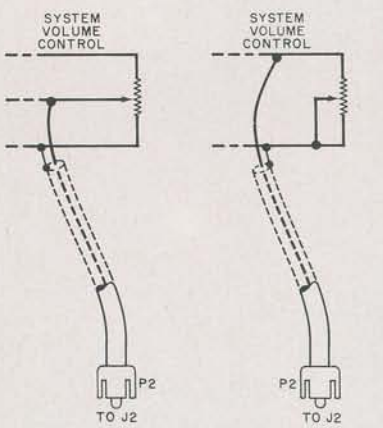

Fig. 2. Connect a shielded cable to the system volume control.

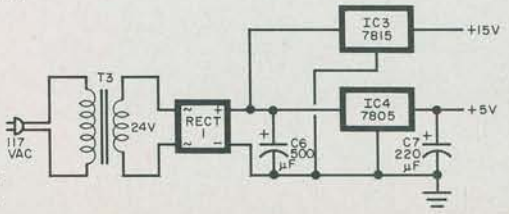

Fig. 3. Schematic of a suitable power supply.

Construction. Since layout is not critical, either perf-board or wire-wrap can be used, or a small pc board can be designed and fabricated. All components except the speaker, *LED2, PC1,* and *R8* can be installed on the selected circuit board.

LED2 and *PC1* are physically mounted so that the glowing face of the LED is adjacent to the sensitive surface of *PC1*. The two are then taped with dark electrician's tape to form an optoisolator in a light-tight package.

This optoisolator, together with *R8* and *J2,* is mounted within a small enclosure that can be cable-connected via *P1* to *J1* on the main electronics package. Everything else is mounted in an enclosure with the power supply. *LED1* should be mounted so that it is visible through the cover, and a dial plate should be used for SENSITIVITY control *R1*. The power cord can exit via a grommetted hole on the rear apron.

To test the system, connect an ohmmeter between the center and ring of *J2*. With the power off, there should be a very high resistance (many megohms) at this point. A few moments after the operating power has been turned on, this resistance should drop to a much lower value—which can be adjusted via *R8*. You may hear relay *K1* click as power is applied.

Now create a loud noise or tap the speaker and note that the resistance across *J2* goes up, and remains up for a brief interval after the noise ceases. The delay observed is determined by the setting of *R3*.

Use a schematic of your radio, TV, or audio system to determine where to attach the leads coming from *J2*, in accordance with Fig. 2. If you have a transformer-less "ac/dc" system, keep in mind that the system chassis may be "hot" with respect to the power line and ground. This can be a problem, since it could make the augment chassis potentially dangerous.

Measure for an ac voltage between the volume control and earth ground—it should be zero. If there is an ac voltage present, reverse the line cord plug at the wall socket and re-check for the ac voltage. It should be zero. If it is not, you cannot use the augmenter safely unless the audio system's power supply is modified to run off a transformer.

If reversing the wall plug results in a zero ac voltage between the system volume control and ground, make sure that this plug orientation cannot be tampered with, in the interests of user safety. This is very important.

Adjustment. The augmenter's speaker (SPKR) should be mounted at a window, or outside if possible, so that it will pick up external noise easily. Conventional speaker leads can be used to make the connection to *T1*. Locate the optoisolator close to the audio system being controlled, and connect it to the main augmenter circuits via a cable to *P1*.

With the augmenter connected and no noise present, turn on the audio system and set its volume to normal listening level. (This volume will now be determined by both the regular volume control and the setting of *R8*.) Now, when the augmenter detects noise, the system volume should automatically rise. Trial-and-error will determine the best location for the augmenter's speaker, the settings of the SENSITIVITY control and *R8* for increased volume, and the adjustment of *R3* for providing time delay. ◇