Parts List: Project 7

Semiconductors	
Q1	BF549, general-purpose silicon NPN transistor—low noise
Resistors	
R1	1 MΩ, 1/8 W, 5%—brown, black, green
R2	10 kΩ, 1/8 W, 5%—brown, black, orange
R3	470 Ω, 1/8 W, 5%—yellow, violet, red (see text)
Capacitors	
C1	47 µF, 12 WVdc, electrolytic
C2, C3	10 µF, 12 WVdc, electrolytic
C4	47 µF, 12 WVdc, electrolytic
Miscellaneous	
J1, J2	Input and output jacks
S1	SPST, toggle or slide switch
B1	9 V battery
Printed circuit board, battery clip, plastic box, shielded cable, wires, solder, etc.	

1.15 Ultrasonic Sources

White and pink are not the only noise types that can be used by the EVP researcher as a support or carrier in these experiments. The stochastic resonance effect needs some kind of energy to fill the ambient to manifest undetectable signals, carrying them to a higher level, as described already, but not necessarily in the audio frequency range.

Many experimenters use forms of energy other than audible sound waves. One of them is *ultrasonic* waves. Sounds at frequencies higher than the human sensory limit (that is, above approximately 18,000 Hz) can be used to fill an ambient and perform many experiments.

Some simple circuits can be used to fill an ambient with ultrasonics. Notice that these circuits produce mechanical (compression) waves in air in the range between 18,000 and 30,000 Hz rather than magnetic fields or electromagnetic waves in the same frequency range.

Beat

Beat is a phenomenon that takes place when vibrations at two different frequencies are combined at a certain point in space. At the meeting point, the two waves will act in a manner that causes them to produce two new vibrations. That is, the point will vibrate at a frequency that is the sum of the original frequencies and, at the same time, at a frequency that is the difference between the two original frequencies.

Notice that, if two ultrasonic frequencies are combined (e.g., 20,000 and 25,000 Hz), the sum (45,000 Hz) is higher than the audible limit of the human ear, but the difference (5,000 Hz) can be heard, because it is in the audible frequency range. When we fill an ambient with ultrasonics, the beat, along with other inaudible vibrations as produced by the EVP, can be changed to the audible range and registered on tape. Therefore, the use of ultrasonic sounds can extend the range of frequencies to be investigated by researchers and add new possibilities for experimentation.

Project 8: Low-Power Ultrasonic Source

The simple oscillator described here can fill small ambients with ultrasonic waves in the range between 18,000 and 30,000 Hz (depending on the transducer). Powered from common cells or a small power supply, the circuit is very compact and uses easy-to-find parts.

The researcher can place the circuit near the microphone or a tape recorder as shown in Fig. 35, adding a new form of energy to the experiments. This energy can be modulated by the voices and also combined by *beat* with the white noise needed for the experiments.

The experimenter can try several combinations of white/pink noise generators and the ultrasonic generator to make these experiments. Two ultrasonic generators, operating at different frequencies, can be used to create beats for experiments involving EVP.

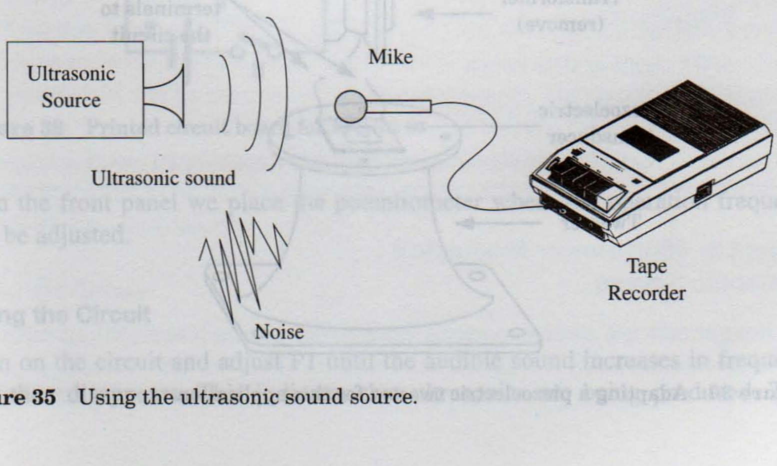

Figure 35 Using the ultrasonic sound source.

How It Works

The ultrasonic signal source is an oscillator based on one of the four Schmitt NAND gates of a CMOS 4093 IC. The frequency can be adjusted within a wide range of values by means of potentiometer P1.

With the values shown in the diagram, the circuit can produce ultrasounds in a range between 10,000 and 30,000 Hz. The audible part of the band is important, as it can be used to test circuit operation. The signals are amplified by the other three NAND gates wired as digital amplifiers.

For the transducer, we recommend the use of a piezoelectric tweeter. Many piezoelectric tweeters provide good performance when reproducing sounds between 18,000 and 22,000 Hz. However, to use the tweeter, some modifications must be made to this component.

The tweeter (high-frequency loudspeaker) is a low-impedance device, due to the presence of a small transformer inside. As our circuit has a high-impedance output, it is necessary to remove the small transformer inside the tweeter as shown in Fig. 36. Accessing the piezoelectric ceramic transducer, we can wire it directly to the output of our circuit.

The circuit can provide a few milliwatts of ultrasonics when powered from AA cells or a 9 V battery. This power is enough to conduct experiments in which it is placed near the microphone.

Assembly

The complete circuit of the low-power ultrasonic source is shown in Fig. 37. A small printed circuit board is used to mount the components.

The layout for this printed circuit board is suggested in Fig. 38. The components, including the piezoelectric tweeter and the battery holder, can be housed in a small plastic box.

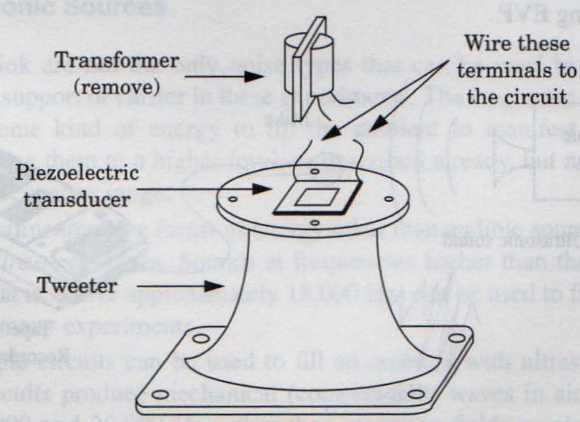

Figure 36 Adapting a piezoelectric tweeter for this application.

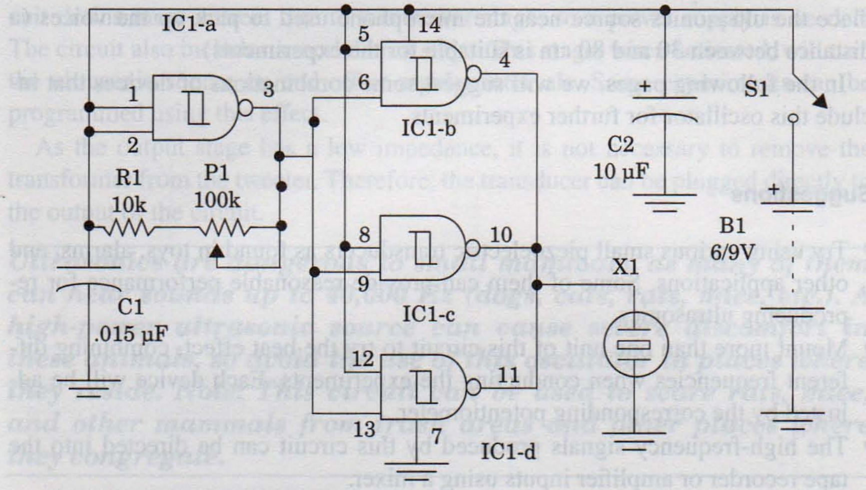

Figure 37 Ultrasonic source.

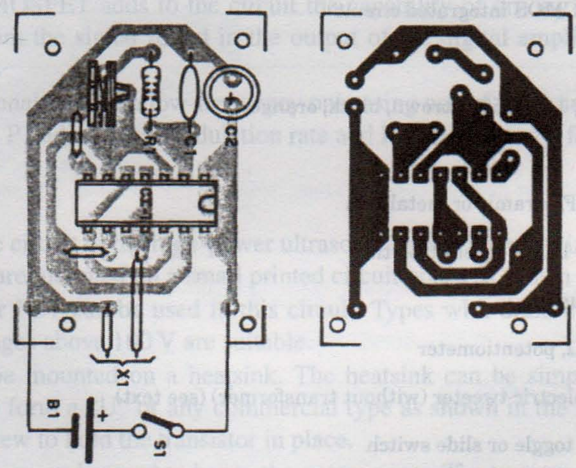

Figure 38 Printed circuit board for Project 8.

In the front panel we place the potentiometer where the operation frequency can be adjusted.

Using the Circuit

Turn on the circuit and adjust P1 until the audible sound increases in frequency and then disappears. This indicates that ultrasonics are being produced. Then place the ultrasonics source near the microphone used to pick up the voices (a distance between 30 and 80 cm is suitable for the experiments).

In the following pages, we will suggest some combinations of devices that include this oscillator for further experiments.

Suggestions

- Try using various small piezoelectric transducers as found in toys, alarms, and other applications. Some of them can provide reasonable performance for reproducing ultrasonics.
- Mount more than one unit of this circuit to try the beat effect, combining different frequencies when conducting the experiments. Each device will be adjusted by the corresponding potentiometer.
- The high-frequency signals produced by this circuit can be directed into the tape recorder or amplifier inputs using a mixer.

Parts List: Project 8

Semiconductors

IC1	4093, CMOS integrated circuit

Resistor

R1	10 kΩ, 1/8 W, 5%—brown, black, orange

Capacitors

C1	0.01 µF, ceramic or metal film
C2	10 µF, 12 WVdc, electrolytic

Miscellaneous

P1	100 kΩ, potentiometer
X1	Piezoelectric tweeter (without transformer) (see text)
S1	SPST, toggle or slide switch
B1	6 to 9 V, 4 AA cells or 9 V battery

Printed circuit board, battery clip or holder, plastic box, knob for P1, wires, solder, etc.

Project 9: High-Power Modulated Ultrasonic Source

The next circuit can produce several watts of ultrasonic waves, filling medium- and large-size ambients for experiments with the EVP. An additional high-power stage and a compatible power supply are added to the previous project. The circuit drains more current due to this power stage, so a power supply is needed. The circuit also includes a modulation stage. This stage, when activated, will turn the ultrasonic source on and off at regular intervals. Some experiments can be programmed using this effect.

As the output stage has a low impedance, it is not necessary to remove the transformer from the tweeter. Therefore, the transducer can be plugged directly to the output of the circuit.

Ultrasonics are dangerous to small mammals, as many of them can hear sounds up to 40,000 Hz (dogs, cats, rats, mice, etc.). A high-power ultrasonic source can cause severe discomfort in these animals, so avoid the use of this oscillator in places where they reside. Note: This circuit can be used to scare rats, mice, and other mammals from trash areas and other places where they congregate.

Operation

The circuit operates in the same manner as the previous one. We have only added a power output stage using a power FET, plus a low-frequency oscillator. The use of a power MOSFET adds to the circuit the capability of driving a low-impedance load from the signal found in the output of the digital amplifier using the 4093.

The additional stage is a low-frequency one, using one of the four NAND gates of a 4093 IC. P1 adjusts the modulation rate and P2 the ultrasonic frequency.

Assembly

The complete circuit of the high-power ultrasonic source is shown in Fig. 39. The components are mounted on a small printed circuit board as shown in Fig. 40.

Any power FET can be used in this circuit. Types with drain currents above 2 A and voltages above 100 V are suitable.

Q1 must be mounted on a heatsink. The heatsink can be simply a piece of metal bent to form a "U" or any commercial type as shown in the figure and affixed by a screw to hold the transistor in place.

A plastic box can be used to house the components. The tweeter can be placed outside the box. A cable with plugs can be used to plug the circuit to the power supply. A suitable power supply for this project is shown in Fig. 41.

The transformer has a secondary winding with 12 to 15 V × 1 A, and the diodes are 1N4002 or equivalents.

Using the Circuit

The circuit is used in the same manner as the previous one. See the suggestions for experiments at the end of this chapter. If Q1 tends to heat excessively, wire a 10 Ω × 5 W resistor in series with the tweeter.

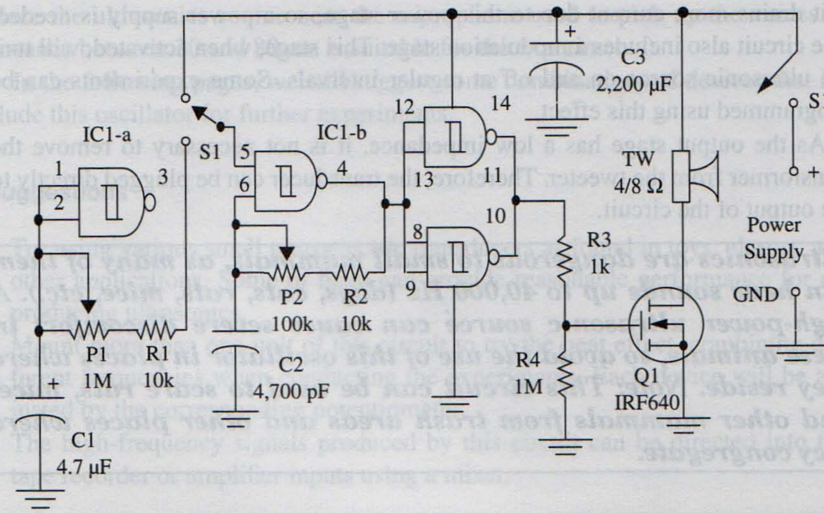

Figure 39 High-power modulated ultrasonic source.

Parts List: Project 9

Semiconductors	
IC1	4093, CMOS integrated circuit
Q1	IRF640 or any equivalent (see text)
Resistors	
R1, R2	10 kΩ, 1/8 W, 5%—brown, black, orange
R3	1 kΩ, 1/8 W, 5%—brown, black, red
R4	1 kΩ, 1/8 W, 5%—brown, black, green
Capacitors	
C1	4.7 µF/12 WVdc electrolytic
C2	4,700 pF, ceramic
C3	2,200 µF, 25 WVdc, electrolytic
Power Supply	
D1, D2	1N4002, silicon rectifier diodes
T1	Transformer, primary according the ac power line; secondary 6 or 9 V × 1 A

C1	1,000 µF/16 WVdc, electrolytic
Miscellaneous	
P1	1 MΩ, potentiometer
P2	*100 kΩ, potentiometer*
TW	4/8 Ω, piezoelectric tweeter
S1	DPST, toggle or slide switch
S2	SPST, toggle or slide switch

Printed circuit board, heatsinks, fuse holder, power cord, wires, solder, plastic or metallic box, plastic knob, etc.

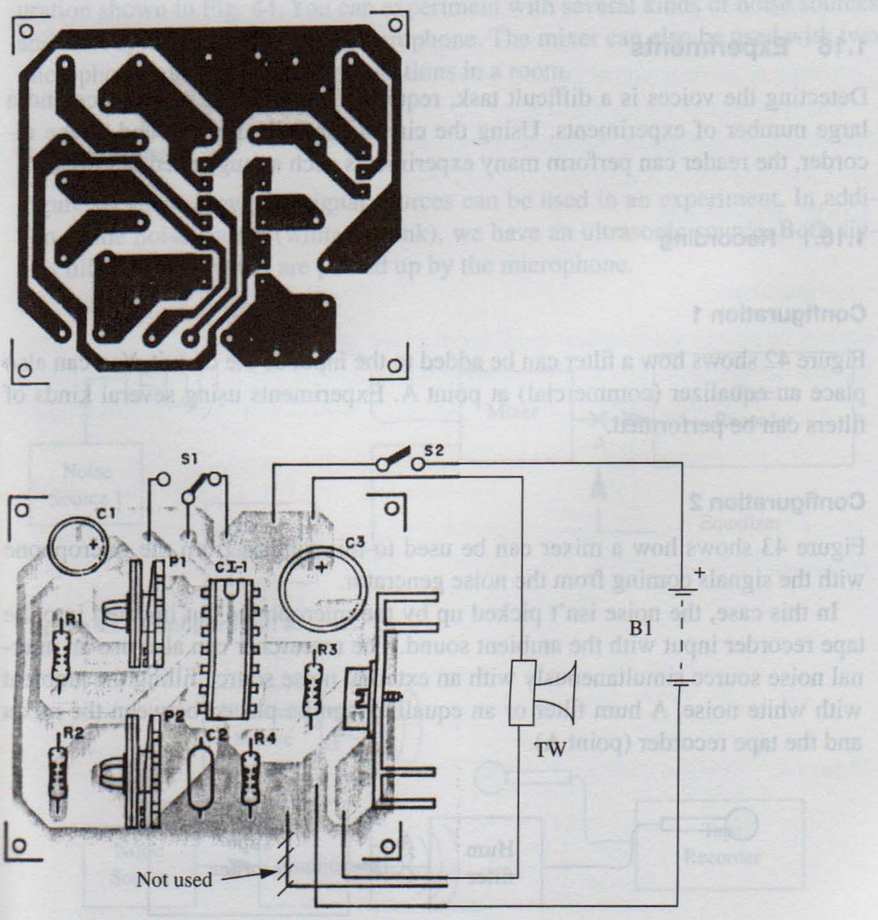

Figure 40 Printed circuit board used in Project 9.

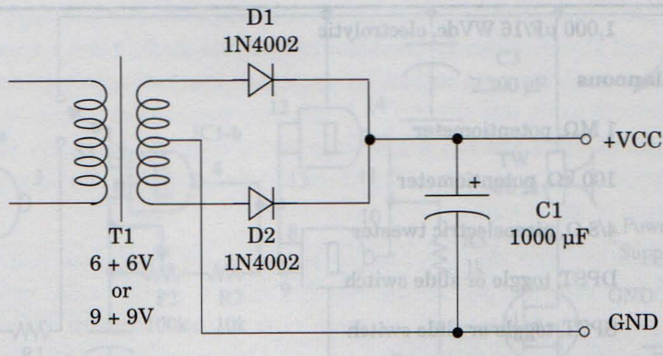

Figure 41 Power supply for Project 9.

1.16 Experiments

Detecting the voices is a difficult task, requiring a great dose of patience and a large number of experiments. Using the circuits described above and a tape recorder, the reader can perform many experiments such as suggested below.

1.16.1 Recording

Configuration 1

Figure 42 shows how a filter can be added to the input of the circuit. You can also place an equalizer (commercial) at point A. Experiments using several kinds of filters can be performed.

Configuration 2

Figure 43 shows how a mixer can be used to mix signals from the microphone with the signals coming from the noise generator.

In this case, the noise isn't picked up by the microphone but injected into the tape recorder input with the ambient sound. The researcher can also use an internal noise source simultaneously with an external noise source filling the ambient with white noise. A hum filter or an equalizer can be placed between the mixer and the tape recorder (point A).

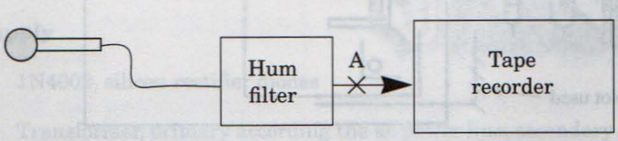

Figure 42 Configuration 1.

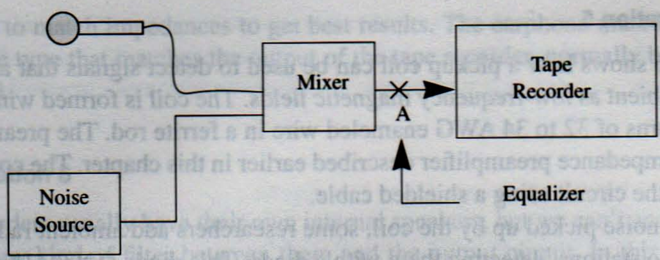

Figure 43 Configuration 2.

Configuration 3

Experiments using two different noise sources can be performed with the configuration shown in Fig. 44. You can experiment with several kinds of noise sources and pick up the signals using a microphone. The mixer can also be used with two microphones placed at different locations in a room.

Configuration 4

Figure 45 shows how two signal sources can be used in an experiment. In addition to the noise source (white or pink), we have an ultrasonic source. Both signals fill the ambient and are picked up by the microphone.

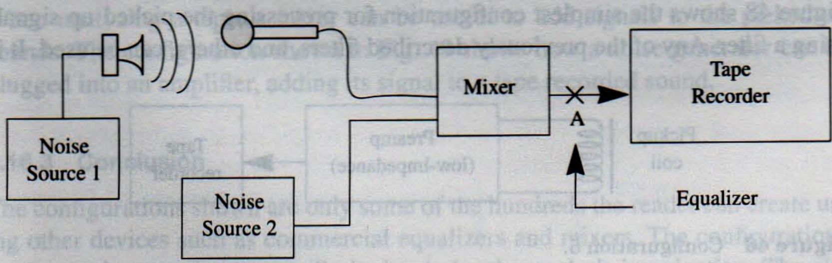

Figure 44 Configuration 3.

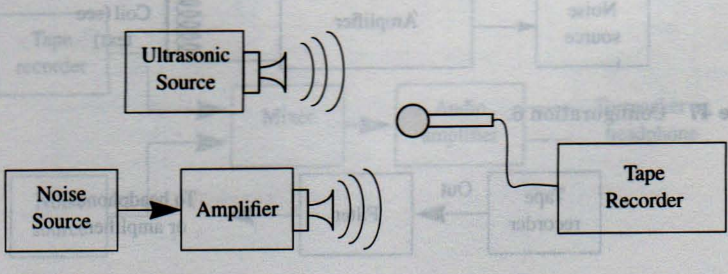

Figure 45 Configuration 4.

Configuration 5

Figure 46 shows how a pickup coil can be used to detect signals that are present in the ambient as low-frequency magnetic fields. The coil is formed with 1,000 to 10,000 turns of 32 to 34 AWG enameled wire in a ferrite rod. The preamplifier is the low-impedance preamplifier described earlier in this chapter. The coil must be wired to the circuit using a shielded cable.

To the noise picked up by the coil, some researchers add ambient radio signals from radio stations, detecting them with a diode. This diode (1N34, 1N60, or any other germanium type) is wired in series with the coil.

Configuration 6

Another way to fill the ambient with noise, but in the form of a low-frequency magnetic field, is shown in Fig. 47. The noise is amplified and applied to a coil that produces a low-frequency magnetic field. Placing the coil near another coil to pick up the signals, the noise can be mixed with any signal (picked up by a microphone or another signal picked up by the receiver coil).

The transmitter coil is formed by 50 to 200 turns of 26 to 28 AWG wire on a ferrite rod. The amplifier can be either the one using the LM386 or the TDA2002.

1.16.2 Processing

Configuration 7

Figure 48 shows the simplest configuration for processing the picked-up signals using a filter. Any of the previously described filters, and others, can be used. It is

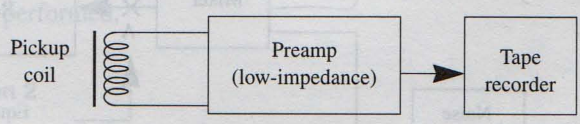

Figure 46 Configuration 5.

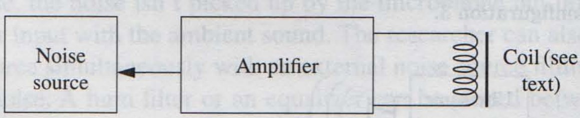

Figure 47 Configuration 6.

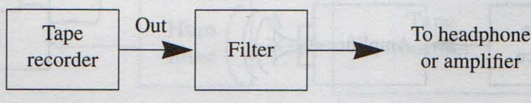

Figure 48 Configuration 7.

important to match impedances to get best results. The earphone must be a low-impedance type that matches the output of the tape recorder, normally between 8 and 100 Ω.

Configuration 8

Tape recorders usually have their own internal speakers, but we can't access them to place any kind of filter between them and the output circuit. In this case, we can use the tone control to help us find the voices, but tone controls are not very efficient. The use of an external audio amplifier makes it possible to place a filter between the audio source and the loudspeaker.

Any low-impedance filter, such as the ones described previously, can be used between the output of a tape recorder (earphone output) and the amplifier. In some cases, it will be necessary to place a 100 Ω resistor in parallel with the filter's output to avoid distortion.

Configuration 9

If hum appears in a tape, a hum filter can be placed between the tape recorder and the amplifier. In some cases, a 100 Ω resistor must be wired in parallel with the amplifier's input to avoid distortion.

Configuration 10

When analyzing a tape, a mixer can be useful to add signals to the picked-up sounds. The configuration shown in Fig. 49 shows how a noise generator can be plugged into an amplifier, adding its signal to a tape recorded sound.

1.16.3 Conclusion

The configurations shown are only some of the hundreds the reader can create using other devices such as commercial equalizers and mixers. The configurations used to make experiments are limited only by the reader's imagination. The cir-

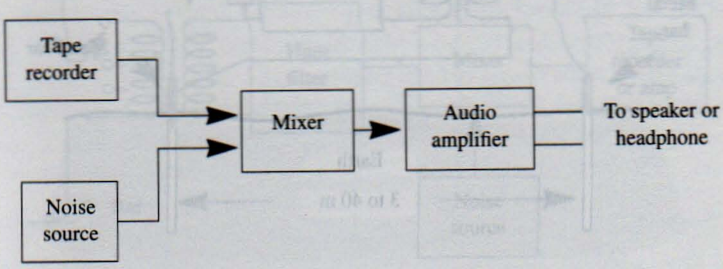

Figure 49 Configuration 10.

cuits shown previously are very flexible and noncritical. The reader can alter those circuits and try other combinations. Remember that the secret of success in this kind of research is found in the correct combination of circuits that makes it possible to tune in the voices.