Chapter 12
Sound Effects

Most commercial video games feature some interesting sound effects. Such effects are rarely a vital part of the games, themselves, but they add to the fun of the whole thing.

Rather than presenting a wide variety of sound-generating circuits that have specific applications, this chapter shows how certain classes of sounds can be generated, leaving it to the know-how and imagination of the experimenter to apply them as desired.

TONES FROM THE V-COUNT SIGNALS

Figure 12-1 lists some of the frequencies in the audio range that are available directly from the V-count outputs of the Sourcebox unit. These tones are available continuously as long as the Sourcebox unit is turned on. To get a good idea how these signals sound, connect any one of them directly to the AUDIO IN pin on the Sourcebox, adjusting the volume control for a comfortable listening level.

Steady tones are rarely useful for video games, however, so there must be some provisions for switching them on and off at the appropriate times. Figure 12-2 shows an experimental breadboard circuit for controlling the tone from a negative-going control pulse.

The circuit in Fig. 12-2 is basically a monostable multivibrator built around a 555-type timer. Whenever switch S is depressed, a short negative-going pulse is coupled through C1 to the trigger input of the monostable circuit. Its output from pin 3 then goes to a logic-1

V-COUNT OUTPUT	FREQUENCY (Hz)
1V	7893
2V	3945
4V	1973
8V	987
16V	493
32V	247
64V	123
128V	62
256V	62

Fig. 12-1. Approximate frequencies from V-count sources.

level for a period of time determined by the product of 1.1 times the values of R3 and C2.

Setting the pin-3 output of the 555 to logic 1 in this fashion opens the 2-input NAND gate, allowing the 4V signal to pass through to the audio amplifier in the Sourcebox unit. The player thus hears a 1973-Hz tone which, in this particular case, lasts about 110 ms. The sound is very much like that of a table-tennis ball hitting a paddle.

Of course the tone duration can be modified by altering the values of R3 and C2, and the tone frequency can be changed by selecting a different V-count input.

The circuit is perfectly compatible with any of the video games that include a figure-contact operation. Most of these operations generate a negative-going pulse that can be connected to the timer through C1. R1 and S can be normally omitted in such cases.

This circuit can also be connected to the SWING pushbutton on the Golf game (Chapter 8). The effect is a "plink" sound every time the player hits the ball.

Connect this circuit to the HIT terminal in the Pinball game (Chapter 10), and you will hear the "plink" sound every time the ball rebounds from one of the barriers or paddles.

It is sometimes desirable to generate more than one "plink" frequency in a game. Suppose, for example, you want two different sounds of this sort, each switched on by a different event on the screen. Figure 12-3 shows how this can be done.

Basically, the circuit ORs together the tones from the two "plink" circuits. The occurrence of event A switches on IC1-A, and allows the 4V frequency to pass through IC2-A and IC2-B to the audio amplifier in the Sourcebox unit. By the same token, the occurrence of event B switches IC1-B to its active state, allowing the 8V frequency to pass to the audio amplifier.

In this particular example, event A causes the player to hear a 1973-Hz tone that lasts only about 0.1 second. Event B, on the other hand, causes a 987-Hz tone that lasts about 0.25 second. The overall effect is a higher-pitched and shorter "plink" sound for event A, and a lower-pitched and longer "ploonk" sound for event B.

Again, any of the timing values for the monostables and the V-inputs can be altered to suit your own needs.

Replacing IC2-B, the output that effectively ORs together the different tones, with a 4-input NAND gate allows the circuit to respond to four different kinds of events calling for an equal number of different tones and tone durations.

Deedle-Deedle Sounds

Space games and ray guns call for weird little sounds that cannot be easily generated from single V-count sources. They can be created, however, by rapidly alternating between two different tone sources. See the example in Fig. 12-4.

IC1-A in Fig. 12-4 is connected as a free-running multivibrator having a frequency fixed by the values of R2, R3, and C2. In this particular case, the frequency is on the order of 4 Hz. This circuit determines the "deedle-deedle" rate.

The output of IC1-A alternately gates on IC2-C and IC2-B. Whenever the output of IC1-A is at logic 1, IC2-C is gated on,

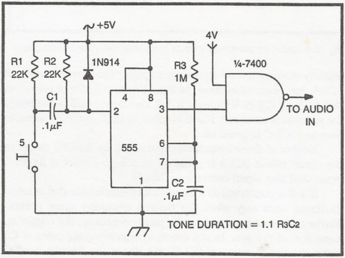

Fig. 12-2. Experimental circuit for gating V-count tones on and off.

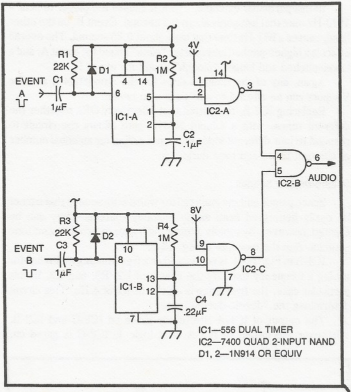

Fig. 12-3. Circuit for combining V-count tones from two different sources.

thereby allowing the 4V frequency to pass. The inverter action of IC2-A, however, transforms the logic 1 from IC1-A to a zero level that gates off IC2-B. Whenever IC1-A switches to its 0 output state, the situation is reversed: IC2-B is gated on to allow the 8V signal to pass and IC2-C is gated off.

Neither of these frequencies appears at the AUDIO output of the circuit unless IC3-A is gated on by a logic-1 level at its pin-2 input. And that signal comes from IC1-B.

IC1-B is connected as a monostable multivibrator that is set to its timing state only when the desired triggering event occurs. Maybe this event occurs when the player depresses the trigger on some sort of ray gun. In any event, a negative-going pulse at C1 starts the timing action of IC1-B and allows the "deedle-deedle" sounds to pass through IC3-A to the audio amplifier.

The timing interval for IC1-B is fixed by the values of R4 and C3. In this example, it is set for about 1 second. The circuit is thus normally silent. But when the triggering event occurs, IC1-B allows the "deedle-deedle" sounds to be heard for 1 second.

It is possible to achieve a wide variety of audio effects from this one simple circuit. The "deedle" frequencies can be altered by applying different pairs of V-count inputs to IC2-C and IC2-B. The "deedle-deedle" rate can be changed by experimenting with the values of R2, R3, and C2. And finally, the duration of the funny sounds can be modified by changing the values of R4 and C3.

SOUNDS FROM SOURCES OTHER THAN V-COUNT SOURCES

Some of the most common sounds for video games are built around noise or static sounds. Gunshots and explosions are both good examples of this sort of audio feature.

Figure 12-5 is the schematic diagram for a noise generator. The noise (or static) is generated by the reverse-breakdown of the

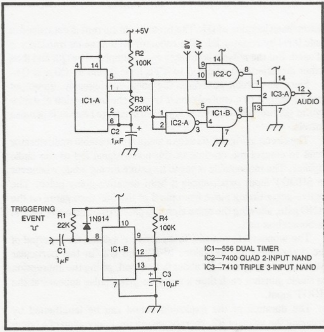

Fig. 12-4. Circuit for creating "deedle-deedle" tones from V-count sources.

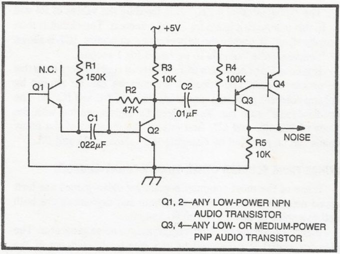

Fig. 12-5. A basic noise generator for explosion effects.

emitter-base junction of Q1. The breakdown current is controlled at a safe level by resistor R1. The collector on that same transistor is not used. But the noise it generates can be amplified by Q2, and then further amplified and adjusted to TTL logic levels by Q3 and Q4.

Since this circuit generates the noise continuously, its output must be applied to a control circuit to give the impression of explosions or gunfire. The circuits in Fig. 12-6 illustrate two kinds of noise controls.

The circuit in Fig. 12-6a uses a simple monostable multivibrator circuit to control the on-time of the noise signal fed to the audio amplifier. The monostable is set to its active timing mode whenever the SHOOT input experiences a brief negative-going pulse. The positive-going timing pulse from pin 3 of the 555 then gates on the NAND gate, allowing the noise signal to pass to the audio amplifier in the Sourcebox unit.

The monostable remains in its active condition for a period of time determined by the values of R2 and C2. In this particular instance the timing is set for about 0.1 second, giving the impression of a single gunshot each time a negative-going pulse appears at the SHOOT input.

The duration of the explosion sound can be lengthened by increasing the value of R2, thereby giving the impression of a bomb exploding.

The circuit in Fig. 12-6b can create the sound of machine gun fire. In this instance the noise signal is gated on and off by a free-running multivibrator. As long as the FIRE input is at the logic-1 level, this oscillator runs at about 4 Hz, gating the NAND gate on and off, ultimately producing a string of staccato-like noise bursts. The firing rate can be adjusted by changing the values of R1 or R2, or both.

Another source of game sounds takes advantage of a simple digital-to-analog (D/A) converter circuit. The idea is to translate any source of digital words into a voltage level, and then use that voltage level to create tones of various frequencies. Such a scheme is useful for generating buzzing sounds that vary in pitch with the speed of a figure moving on the screen or whistling sounds for falling bombs.

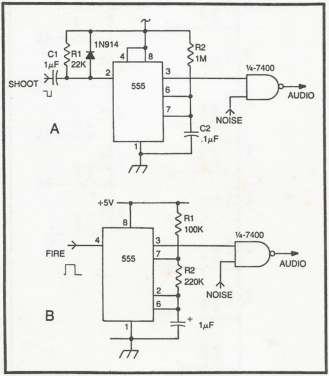

Fig. 12-6. Circuits for controlling noise sounds. (a) Single gunshots or explosions. (b) Machine gun effects.

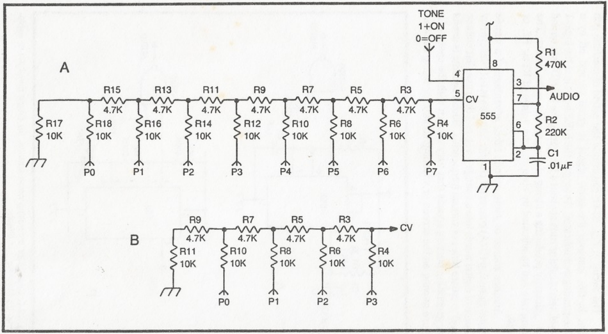

Fig. 12-7. Circuits for generating tones from digital sources. (a) 8-bit source inputs and oscillator. (b) A converter for 4-bit digital sources.

The basic D/A converter is made up of a resistor-ladder network. Two of them are shown in Fig. 12-7. The larger circuit in Fig. 12-7a can accept an 8-bit digital word at inputs P0 through P7, while the simpler one in Fig. 12-7b can be used with 4-bit digital words.

In either case, the voltage appearing at the junction of R3 and R4 is proportional to the value of the binary number applied to the P inputs. That voltage level is then used to set the frequency of a 555-type free-running multivibrator. The TONE input to the 555 oscillator is used for gating the sound on and off. When this input is at logic 1, the tones appear at the AUDIO output connection. Setting that TONE input to logic 0, however, silences the circuit.

The values of R1, R2, and C1 determine the range of frequencies available from the circuit. The larger these values, the lower the tones. The P inputs to the ladder network then determine the frequency within that selected range that will appear at the AUDIO terminal. While the analog voltage to the CV input of the 555 timer is proportional to the size of the binary number applied to the P inputs, it turns out that the selected frequency is inversely proportional to the binary number. The larger the number, the lower the audio tone.

So if the eight P inputs in Fig. 12-7a are connected to the outputs of an 8-bit binary counter, the tone sweeps downward when the counter is counting upward, and the tone sweeps upward when the counter is counting downward. Figure 12-8 shows a rather simple circuit for experimenting with the tone generator. The out-

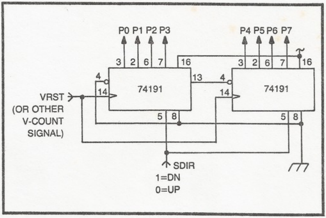

Fig. 12-8. An 8-bit counter for generating whistle effects from the circuit in Fig. 12-7a.

puts of the 74191 counters interface directly with the P inputs of the circuit in Fig. 12-7a.

It is possible to generate a lot of interesting sounds by combining the circuits in Fig. 12-7a and 12-8. It is left to the experimenter to play with the circuit and come up with sounds that seem fun and useful for custom TV games.

The smaller D/A converter in Fig. 12-7b is especially useful for translating the 4-bit VC or HC inputs to a slipping-counter circuit into audio tones. Simply replace the larger resistor network in Fig. 12-7a with the simpler one in Fig. 12-7b, and then connect the four P inputs to the VC or HC terminals of a slipping-counter control. Adjust the values of R1 and C1 to get the range of frequencies that seem most appropriate for the game scheme.