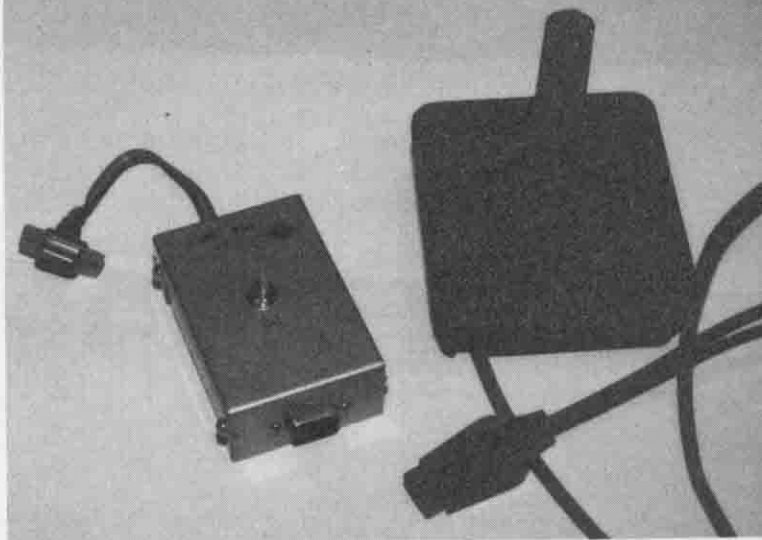# Build FIRE-FLI

JIM STEPHENS

—an automatic firing circuit for your Atari VCS that'll keep your stingers and rays zapping aliens and dragons faster than you can blink!

NOT ALL VIDEO GAMES ARE CREATED EQUAL. THAT IS especially true of some of the games written for the *Atari 2600*. Did you ever notice that some games have features that others don't? Why do some of the more intricate games leave out things like automatic restart, or automatic fire while holding down the fire button? The reason is simple: They ran out of space in the VCS memory. But all is not lost; we can still have some of those important functions. All we need to do is to add a few electronic circuits to take up where the game maker's software quits.

Some games for the Atari *do* have automatic firing. That function is found in *Demon Attack* and *Space Invaders*, for example. Firing operates automatically when the fire button is held down. Not only does that function save wear and tear on the joystick, but also wear and tear on the fingers, and thus, permits longer playing periods without fatigue. The first week that my two boys had their Atari, I thought I would certainly die of thumb cramp from squeezing the fire button.

My favorite game, *Defender*, does not have auto-fire. The circuit described in Fig. 1 adds that important feature and makes that game a thrill to play. The two IC's in the heart of Fire-Fli turn *Defender* into a wild frenzy of zap or be zapped.

Circuit description

The Atari joystick has a total of six connections. One of those, marked F in Fig. 1, is the ground for the power supply. By shorting various combinations of the remaining five connections to F, all the different functions of the control stick (joystick) are obtained.

The *fire* button operates by shorting connection F and E. Therefore, to get the joystick to fire repeatedly, a circuit must be devised that will short those two lines at a fast rate and not interfere with other functions of the control stick. That can be handled using two inexpensive and readily available integrated-circuit chips, the 4066 bilateral switch and the 555 timer chip. Though several other components and miscellaneous parts are needed, the basic parts are few and the basic electronic circuit is quite simple and easy to construct.

The 4066 chip contains four independent switches that have a very high resistance when their control pins are held at ground. By connecting one side of a switch to the F connection and the other side to the E connection, we have the means to short those two lines together by just varying the voltage on the control pin from positive to negative. The voltage switching can easily be done with the 555.

Fig. 1 illustrates the components and connections that are necessary in order to make the 555 timer, U1, oscillate at a rate determined by the value of R2. A value of 20,000 ohms was chosen for R2 because that value gives a fire rate of about five cycles per second. Another value may be substituted here for different rates or that could be a variable resistor in the 25,000-ohm range.

PARTS LIST FOR FIRE-FLI
SEMICONDUCTORS
U1—4066 CMOS quad bilateral switch integrated circuit
U2—555 CMOS timer integrated circuit

RESISTORS
(All resistors are ¼-watt, 10% fixed units)
R1—100,000-ohm
R2—20,000-ohm

ADDITIONAL PARTS AND MATERIALS
C1—1-µF 16-WVDC, electrolytic capacitor
S1—DPDT slide switch (See text)
1—Female RS232 9-pin type D subminiature plug (RADIO-SHACK 276-1538)
1—Male RS232 9-pin type D subminiature plug (RADIO SHACK 276-1537)
Small utility box or plastic case, board (1 × 2-inch) made from perfboard, 2—pin soldertail, IC sockets (Radio Shack 276-1999), 6-strand ribbon cable or flexible hook-up wire, battery—4.5V Duracell alkaline #PX21 (see text), ⅛-inch miniature phone plugs (optional power connection, see text)

NOTE: A complete set of components less case, battery and phone jacks is available from SYNTRONICS, 2324 Dennywood Drive, Nashville, TN 37214. $15.50
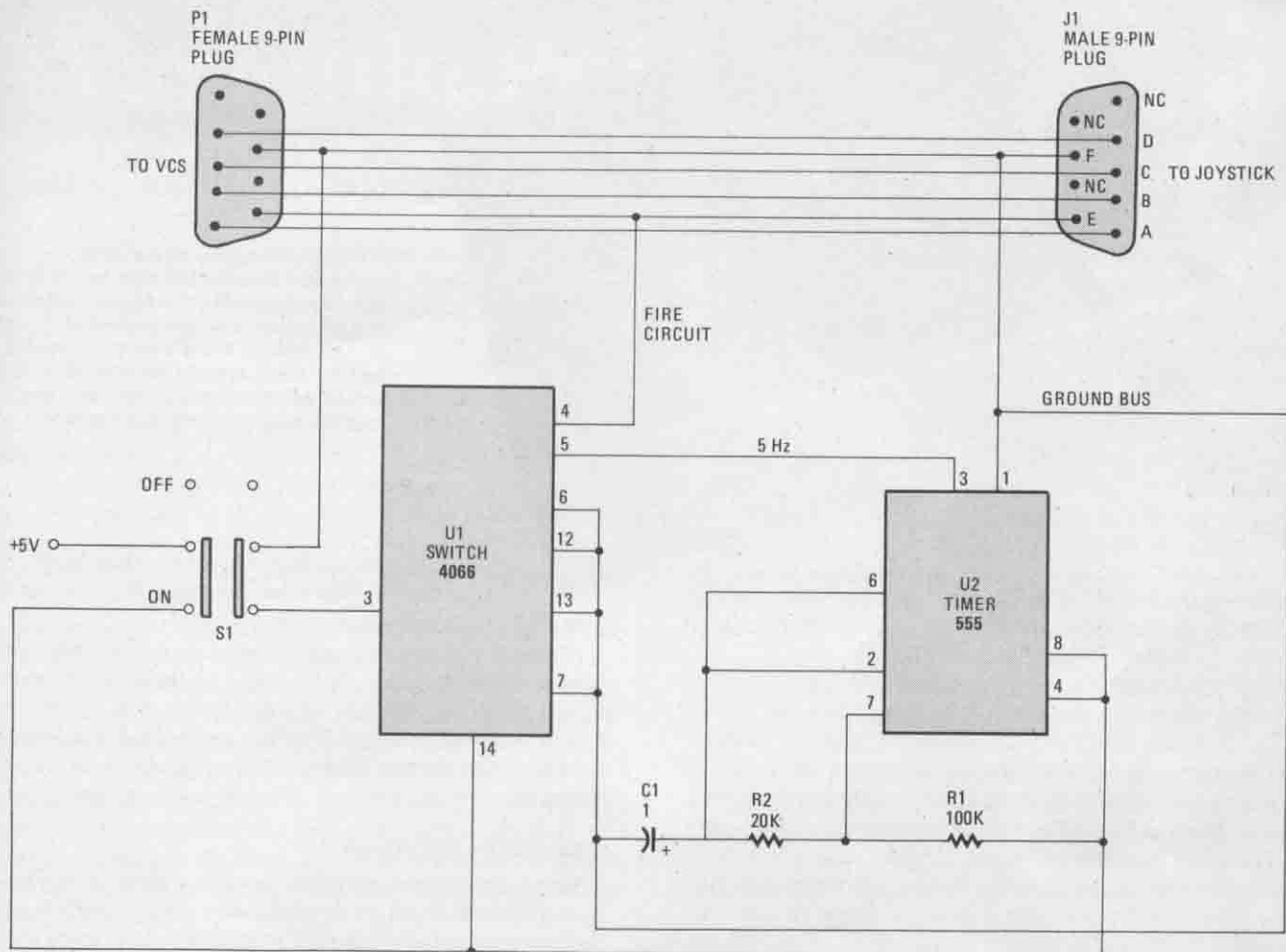
FIG. 1—SETTING S1 to the ON position powers the add-on circuits. Resistor R2 sets the timer rate at about 5 shots per second. One of the quad switches in U1 grounds bus E to actuate a missile firing.

As U1 oscillates, a positive-going pulse is output at pin 3. That pin is connected to the 4066, U2, control pin to turn its internal switch on and off. The other control pins of the 4066 (6, 12, and 13) are grounded to keep the output of the other switches off, and thus not affect the one which we are using.

Some means of powering the two chips must be provided. I chose to use a 4.5-volt "C" cell because I was trying to fit the circuit into a very small case (an idea I discarded). A 9-volt transistor battery could be used but might make it necessary to change the value of R2 for the correct frequency.

Another (less expensive) method would be to borrow the power from the VCS. That could be done by placing a matching power jack into the Fire-Fli's case and extending a power lead through the case to the VCS which would be terminated by a matching power plug.

The Fire-Fli circuit pulls only 2.5 mA, so the battery should last a fairly long time depending on the amount of use.

Circuit Wiring Method

Since there are so few connections and components, this would be an excellent time to etch a small printed-circuit board. I chose to use a perforated board with .100 spaced holes and to wire point to point. I used two 14-pin soldertail sockets for the integrated-circuit chips. Figure 2 shows the layout of the five components whose placement on the board is not critical.

The two matching RS232 plugs that connect the joystick and the VCS are directly wired using an eight-inch length of

6-lead ribbon cable. or using regular hook-up wire.

The switch should be a double-pole, double-throw since it is actually doing two jobs: It disconnects the power supply and disconnects the F lead from the 4066 chip, U2 and controls power. If the power jack was installed, some expense could be saved on the switch since it would only have to be a single-pole, single-throw to disconnect the F lead.

The case, or chassis box, can be most any that you might have available and could easily be just a small plastic parts box. I used an aluminum utility box.

Operation and Checkout

Once the circuit is wired, check the wiring closely—an error in wiring the power could throw direct power into the VCS, and could harm the VCS system. Be very careful when
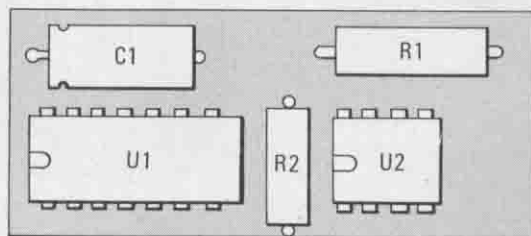
THE CIRCUIT FOR FIRE-FLI is so simple, no printed-circuit board was designed. The author used a piece of scrap perfboard and came up with the parts layout shown.

FIRE-FLI fits neatly into a small aluminum chassis box and has only one operating control—the power switch, S1. In those games where excessive firing scores against the player, or causes a penalty delay should the shot miss the target, set the switch at OFF, and the joystick returns to normal operation.

connecting the power leads. Double check to make sure that the correct pins on the chips have the right voltage because they can be ruined if wired incorrectly.

The joystick should be connected to the male RS232 plug, P1, and switch S1 should be set to OFF. Plug the female RS232 jack, J1, into the VCS and verify that the game is working normally—that is, the game joystick controls and fire button provide normal game situations. If not, the circuit has a problem and the wiring should be checked again before the Fire-Fli is energized.

If the fire button and the other functions operate correctly, the switch is set to ON and automatic firing should start immediately. If not, turn the Fire-Fli off, open the chassis box, and recheck the unit's wiring.

It might be that the 555 oscillator, U1, is failing to start. If all the wiring appears to be correct, it might be that you might have to try different values for the other two components to

get the oscillator to start consistently. Try varying the value of resistor R2. I've not had a problem there, however.

Automatic fire can create various problems with some games. With *Defender*, for example, if the defender ship is moved below the horizon, all your smart bombs will be used in less than two seconds. That can be avoided, however, by holding down the fire button. That stops automatic fire and can be a very handy feature at some points in game play.

Your Game Improves

Of course, proper use of the joystick with the Fire-Fli will demonstrate that you are an *electronics genius*, and will make your game scores quite higher than others. But, more important, it will add new spice to games that have become boring and have not been taken out of the game-cartridge storage case for some time.

The construction will also demonstrate that hardware and software (the cartridge) can work together to improve those new contraptions called electronic games. **SP**
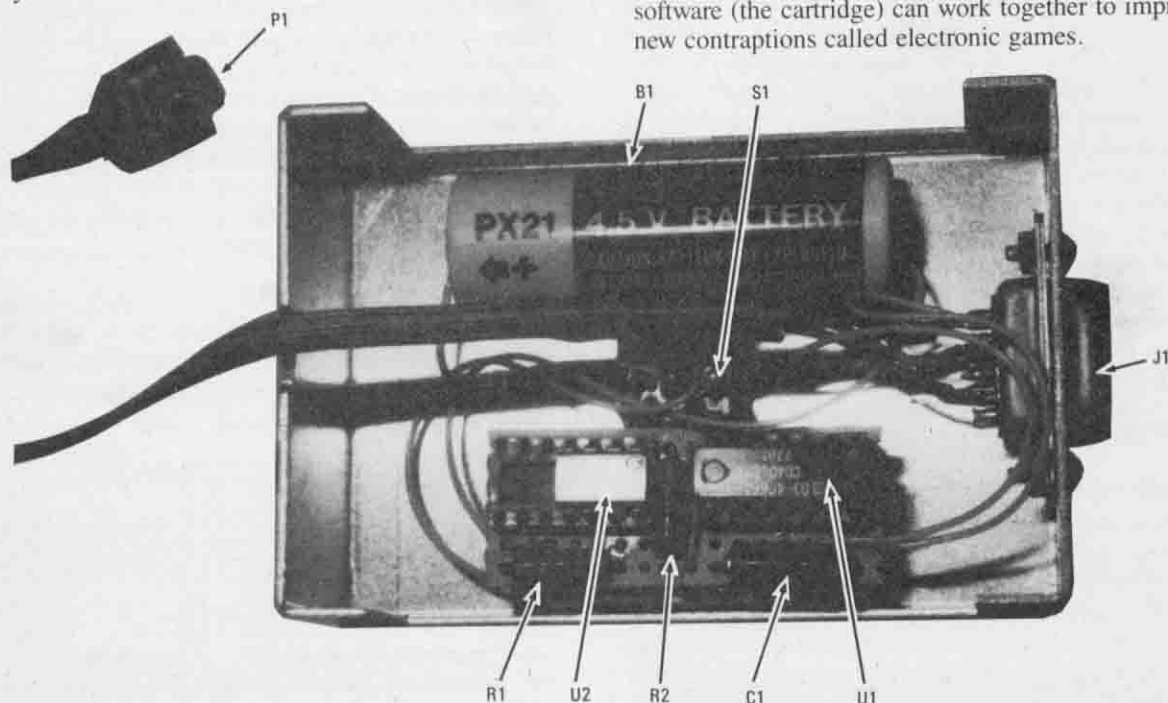
A PEEK INSIDE the Fire-Fli reveals that the battery takes up more space than the circuitry. One source of possible wiring error would be the interconnection of matching terminals on J1 and P1. Check the wiring carefully against the schematic diagram in Fig. 1. Variations of the layout should produce no problems.