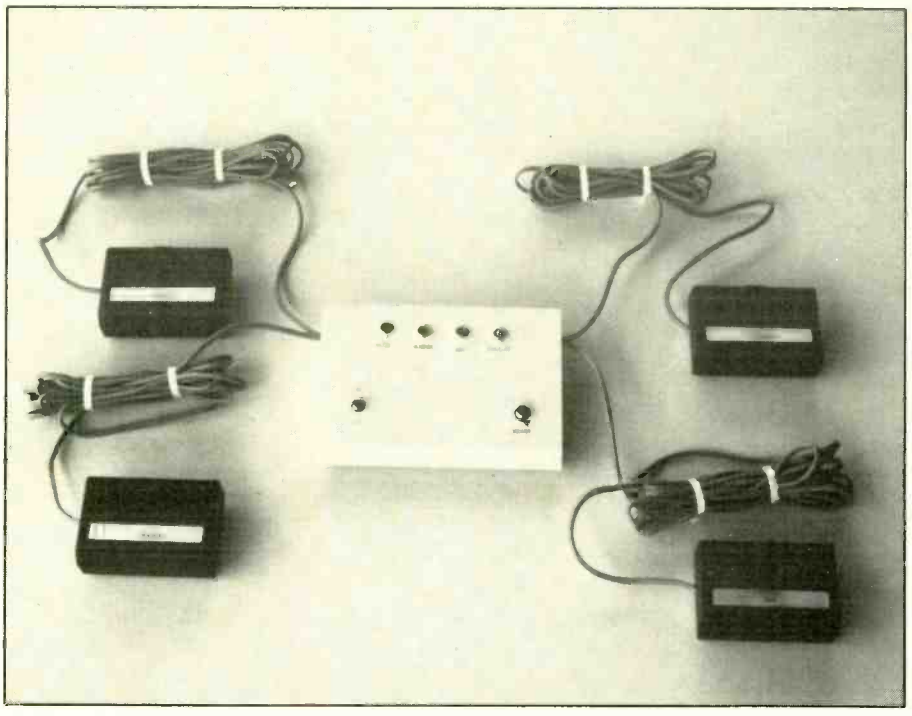
First-Answer Selector

A games-playing "judge" whose decisions are impartial and totally accurate

By Mike Rigsby



Trivia-style and other types of games have become very popular. In such a game, players are asked a question and are required to respond as fast as possible with the answer. The first player to respond correctly wins the round. If two or more players claim to have responded first, there can be an argument. The judge must decide who was the first to respond. If the judge is a person, his decision is frequently questioned by the players who lost the decision. So the solution is to use a totally impartial judge whose decision is impossible to question.

Enter the First Answer Selector, an electronic "judge" whose decision is impartial and totally accurate. Similar to those devices used on TV game shows, the First Answer Selector responds to only the first player to press a button. Even if two or more players press their buttons within a fraction of a second of each other, only the first response will register by lighting that player's LED indicator and sounding a buzzer. Other players can press their buttons as much as they like without affecting the play decision. With no arguments to slow things down, games proceed at a faster pace and with more competitive spirit on the part of the players.

About the Circuit

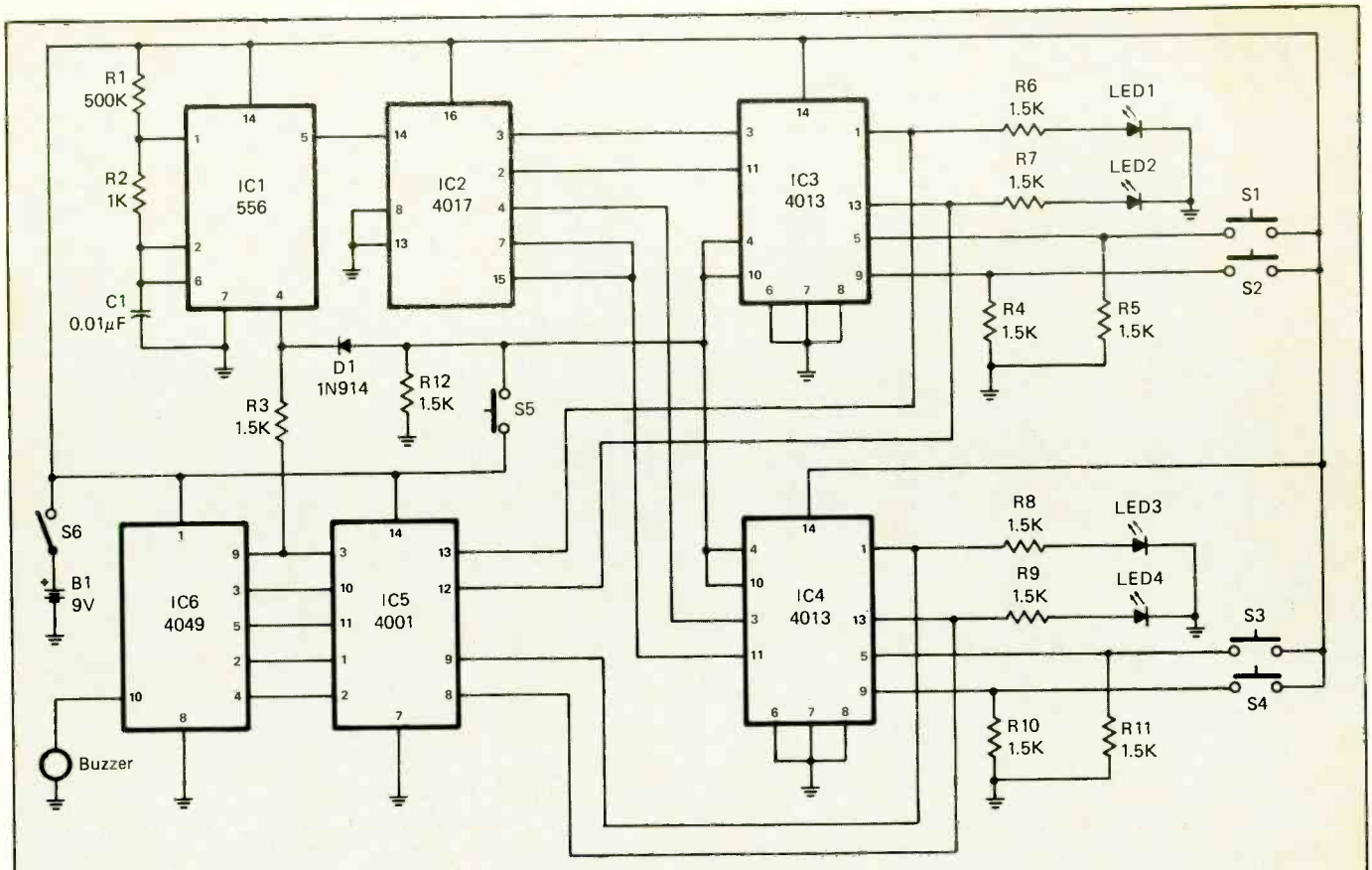
In Fig. 1, timer *IC1* operates as an astable multivibrator that serves as the clock pulse generator for the system. Its pulse repetition rate is determined by the values of *R1*, *R2*, and *C1*. Oscillator frequency is not critical; it just has to be greater than a few hundred pulses per second.

When reset pin 4 is brought high, *IC1* oscillates and delivers a train of pulses to pin 14 of decade counter/divider *IC2*. (With pin 14 high and low, *IC1* oscillates and stops oscillating, respectively.) As *IC2* counts the pulses, its output lines are sequentially brought high, one at a time. When pin 7 of *IC2* makes a transition from high to low, reset pin 15 is activated. Thereafter, the next clock pulse causes pin 3 to go high to initiate a new cycle.

Output pin 3 of *IC2* provides the clock pulse for one of the two flip-flops in *IC3*. When the Set1 line at pin 6 of *IC3* is low and the Reset1 line at pin 4—which is normally held low by *R12*—is low, the flip-flop is prepared for normal action. The status of the D1 input at pin 3 of *IC3*, normally held low by *R5*, is passed to the Q1 output at pin 1 when a clock signal appears at the pin 3 clock1 input. This puts a low on both sides of *LED1* so that it does not light.

Since none of the *S1* through *S4* switches has been pressed, all Q lines in *IC3* and *IC4* are maintained at a low level. Therefore, no LEDs will light, and pins 10 and 11 of *IC5* will be high because pins 8, 9, 12 and 13 are all low.

Outputs at pins 10 and 11 of *IC5* are inverted by *IC6* and are passed to input pins 1 and 2 of *IC5* at low



PARTS LIST

Semiconductors

D1—1N914 switching diode
LED1 thru LED4—Light-emitting diode (Radio Shack Cat. No. 276-068 in chrome holder or plain LED mounted in rubber grommet—see text)
IC1—556 timer
IC2—4017 decade counter/divider
IC3,IC4—4013 dual D flip-flop
IC5—4001 quad 2-input NOR gate
IC6—4049 hex inverter

Capacitors

C1—0.01-μF metal-film

Resistors (¼-watt, 5% tolerance)

R1—500,000 ohms
R2—1,000 ohms
R3 thru R12—1,500 ohms

Miscellaneous

B1—9-volt battery
S1 thru S5—Spst momentary action normally open pushbutton switch
S6—Miniature spst slide or toggle switch
Perforated board and Wire Wrap hardware or printed-circuit board (see text); 4-to-28-volt dc (5-mA at 12 V) buzzer (Radio Shack Cat. No. 273-060); suitable enclosure (see text); separate boxes for S1 thru S4 (see text); connector for B1; 14-pin (5) and 16-pin (1) sockets for ICs; flexible 2-conductor cable; rubber grommets; small-diameter heat-shrinkable tubing; dry-transfer lettering kit; clear spray acrylic; machine hardware; hookup wire; solder; etc.

Fig. 1. Overall schematic diagram of the First Answer Selector.

levels. Therefore, pin 3 of *IC5* will deliver a high to *IC1* pin 4, which continues to generate clock pulses. Pin 3 of *IC5* is also tied to pin 9 of *IC6*, resulting in a low at pin 10 of *IC6*; the buzzer will not sound.

Pressing *S1* (we will use this switch to explain circuit operation, though any of the *S1* through *S4* switches could be used in like manner) changes operating conditions. Pin 1 of *IC3* is pulled high, resulting in a high output at Q1 output pin 1 and causing *LED1* to light. The high signal on pin 1 of *IC3* travels to pin 13 of *IC5* and causes pin 11 to go low.

The low at pin 11 of *IC5* goes to pin 4 of *IC1*, where it stops the timer from generating clock pulses. With no more pulses being generated, there can be no further effect on the circuit by pressing any of the *S1* through *S4* switches. Because the low on pin 3 of *IC5* creates a high at pin 10 of *IC6*, the low-current buzzer is powered and sounds.

At this point, the moderator

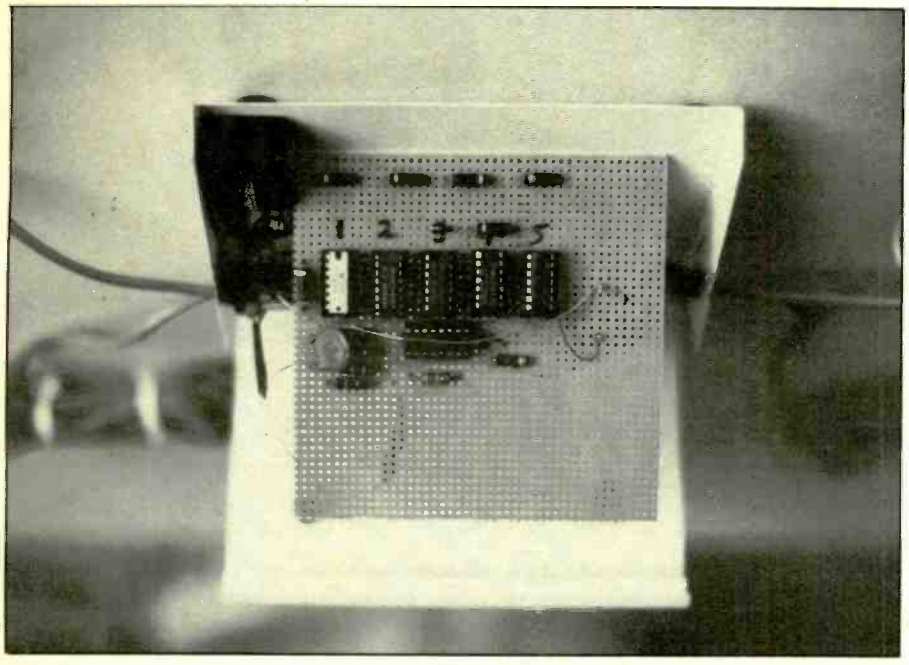


Fig. 2. Perforated board and suitable Wire Wrap hardware were used in prototype. A home-made pc board can be designed and used if desired.

knows that someone has pressed a button by the sound of the audible alert. Furthermore, he knows which person has pushed the button by the fact that that person's LED is lit (*LED1* in this example). Conditions remain in this state until RESET switch *S5* is pressed and released.

Whenever *S1* is pressed and released, a high is applied to pin 4 of *IC1*. This starts the clock pulse generator operating. Simultaneously, the high delivered to the reset lines at pins 4 and 10 of both *IC3* and *IC4* causes Q output pins 1 and 13 of both ICs to go low and turn off all LEDs. The circuit is now ready to capture the response of the first person to press his switch.

Diode *D1* is included in the circuit to assure proper operation. Under normal operating conditions (none of the *S1* through *S4* switches pressed), pin 4 of *IC1* is high and the reset lines of *IC3* and *IC4* are low.

Use of CMOS ICs makes it possible for the project to run for a long time on a single 9-volt battery (*B1*). The only time the circuit is drawing more than a few milliamperes is when any of the LEDs is on and the buzzer is sounding.

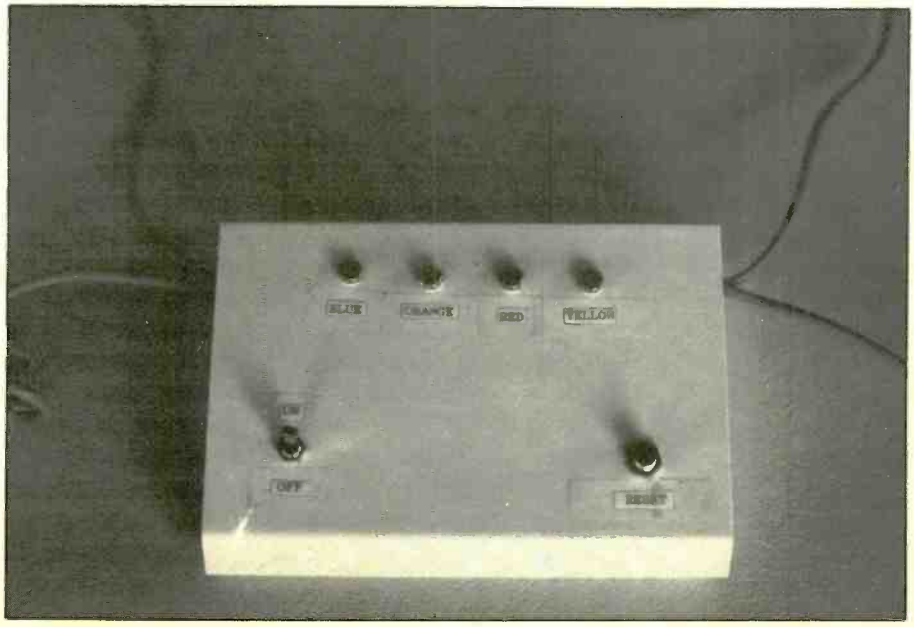
Construction

The prototype circuit for the First-Answer Selector was assembled using perforated board and Wire Wrap hardware (Fig. 2). However, if you wish, you can design and fabricate a printed-circuit board on which to mount the components that make up the circuit.

Wire the board as shown in Fig. 1. Keep in mind that the LEDs and switches all mount off the board, with *S1* through *S4* completely external to the box in which the main project is housed. Use sockets for the ICs, and make sure you properly index the ICs and diode. Also, mark the cathode connection points for the LEDs with the letter "K" for easy identification when the time comes to wire them into the circuit.

Any type of enclosure that will accommodate the circuit board and battery with its holder will serve well for the project, though one with a sloping panel will probably look most attractive (Fig. 3). Machine the enclosure to permit mounting the board in place and to accommodate the RESET switch and the chrome holders or the small rubber grommets in which the LEDs mount. Additionally, drill holes for the cables to the player switchboxes and line

Fig. 3. Project is best housed inside enclosure with a sloping front panel.



them with rubber grommets. If you prefer, you can have the player switches interface to the project via phono jack/plug pairs. In this case, you might want to use a 4-jack strip mounted on the rear of the enclosure.

Before mounting any components in or on the enclosure, paint it if necessary. Otherwise, use a dry-transfer lettering kit to label the LED positions and POWER and RESET switches. (If you do paint the enclosure, wait until the paint has dried before labeling it.) Incidentally, one way to avoid having to label the enclosure is to use a different-color LED for each player. Fortunately, there are four distinct LED colors: red, orange (or amber), yellow and green. Since POWER and RESET switches *S5* and *S6* are slide or toggle and pushbutton, respectively, there is really no need to identify each. Spray two or three *light* coats of clear acrylic over the lettering (if you go this route) to protect it.

Clip the leads of the LEDs to about ¾" long and form each into a small hook. Carefully solder about 3" lengths of hookup wires to the LED leads. Then slip over the cathode connection of each LED a 1" length of small-diameter heat-shrinkable tubing. Push the tubing up against the bottom of the LED cases and gently shrink it.

Mount each LED on the front panel, either via its chrome holder or by pressing it into a rubber-grommet-lined hole, and connect and solder the trailing hookup wires to the appropriate points in the circuit. Trim the wires as needed and make sure the identified cathode leads connect to the K-identified points.

Mount RESET and POWER switches *S5* and *S6* in their respective holes and connect and solder to their lugs lengths of hookup wire. Then, if you are using the jack/plug arrangement for the cables to *S1* through *S4*, mount the individual jacks or 4-position jack strip in place and connect to it short lengths of hookup wire.

Connect and solder the free ends of the wires from *S1* and *S2* and the jacks to the appropriate points in the circuit (Fig. 1). Label each jack according to the player number to which it applies and spray on the clear acrylic to protect it. Then mount the circuit board in place with spacers and machine hardware. If you plan on wiring the player switches directly to the circuit board, pass the free ends of the four flexible cables (these should be about 10- to 12-feet long) through the rubber grommets, tie a knot about 6" from the ends inside the enclosure, and connect and solder to the appropriate points in the circuit *before* mounting the board in place.

Player switches *S1* through *S4* can mount in any convenient boxes or cases that will comfortably fit in a hand. Typical boxes include the small hinged type plastic ones that are readily available in hardware and housewares stores; mini project boxes available from electronics parts stores; plastic 35-mm film cans; and even aluminum cigar tubes. The last are probably the most comfortable for players to handle, but you will have to use miniature pushbutton switches and line the tubes to insulate the switches.

Whichever housing you use for the player switches, be sure to tie a knot in the cables going to the switches to serve as strain reliefs. Also, identify each switch with a number or color. If you are using different-color LEDs to identify each player, use matching colors on the switch cases.

Additional player switches, up to a maximum of 10, can be incorporated into the project with relative ease, thanks to the fact that *IC2* has 10 separate output lines. When adding switches, each LED/resistor network must be connected to a flip-flop (half of a 4013). NOR and inverting circuits, some of which can be the spares in *IC5* and *IC6*, must be used to insure that a low signal appears on pins of *IC6* and pin 4 of *IC1* if any LED is on.

Checkout and Use

When the First Answer Selector is first powered up, one or more LEDs and/or the buzzer may come on. This is normal. Therefore, always follow a power-up with a quick operation of the RESET pushbutton switch to initiate play.

The improved response and motivation of players makes a useful games-playing tool. The first Answer Selector is completely impartial. Its only purpose is to indicate the first player to respond. It does this with the unerring accuracy of a machine whose decision is beyond question **ME**