Project 39: Binary Random Number Generator

This circuit generates a number between 0 and 15 in a binary form. The numbers will appear with values between 0000 and 1111, given by the combination of four LEDs according to the table below.

Number	LED1	LED2	LED3	LED4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

The numbers are given by four LEDs, each of which can represent 0 (off) and 1 (on). They can be on or off in any combination as shown in the table.

When you press S, the LEDs will flash to produce random combinations. When S is released, the LEDs will remain in one of the combinations correspondent to the generated number. Unlike the previous project, this circuit does not have an "inertia" circuit that causes a delay in arriving at the generated number.

The circuit is powered from AA cells and can be used in basically the same experiments suggested for Project 38.

Experiments

▪ The subject must guess what number will be generated. As suggested in the previous project, there are several ways to improve the tests. The LEDs can be

associated with combined elements such as number and color, or a table with 16 different symbols can be created.

- As in the previous project, the subject can perform PK experiments by trying to set the generated number using his mental powers. See the next project for more suggestions about experiments of this type.
- In transcendental meditation and biofeedback, the LEDs running in many combinations can help the subject to reach the necessary mental states to make experiments in this area. The speed of the LEDs can be reduced, as indicated in the "Suggestions" section, to help the experimenter if appropriate.
- For radiesthesia experiments, the influence of a pendulum on the results can be tested.
- *UFOs and ghosts:* How can ghosts be detected by a generated number? Can the presence of paranormal phenomena in a particular location influence the numbers generated by this circuit? You can experiment to find out.

How It Works

Two of the four NAND gates of a TTL IC 7400 are used as an oscillator whose frequency is determined by R1 and C1. This circuit applies its signal to a third NAND gate, controlled by S1 in a manner such that pulses pass through it only if S1 is pressed. This means that, when pressing S1, the pulses generated by the oscillator are applied to the second block of the circuit, formed by IC2.

IC2 is a divider by 2 and divider by 8 in a single chip. This means that it is a binary divider that can count up to 16 and give the results in four outputs, Q1, Q2, Q3, and Q4.

To each output is connected an LED that indicates its state. The LED will glow when the output is high, representing a 1, and will remain off if the output logic level is a 0.

As with all TTL circuits, the power supply voltage must be 5.0 V. In practice, the circuit will function with any voltage between 4.5 and 5.5 V. This means that four AA cells are *not* a suitable power supply for this circuit. To power the circuit from AA cells, we have to add two common diodes in series with them as shown in Fig. 177.
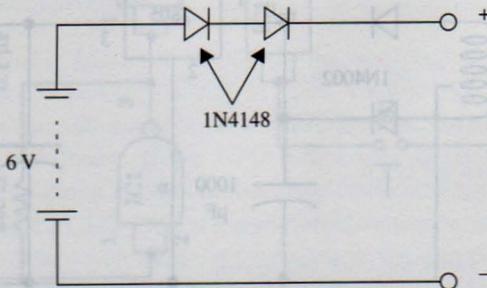

Figure 177 Powering the circuit from AA cells.

Each diode will produce a voltage drop of about 0.6 V in the power supply voltage, reducing the total voltage applied to the circuit to 4.8 V. This is a suitable value for its operation.

You can also power the circuit using the power supply shown in Fig. 178. The input transformer has a primary winding rated for the ac power line (117 Vac), a secondary winding of 7.5 to 9.0 V, and currents in the range between 50 and 300 mA.

The diodes have a voltage rating of 12 V or more. It is not necessary to place the IC 7805 on a heatsink, as the circuit drains a very low current.

Assembly

Figure 179 shows the complete diagram of the binary random number generator. The components can be placed on a small printed circuit board as shown in Fig. 180.

Observe the position of the polarized components, such as the LEDs. If they are reversed, the circuit will not function properly. The LEDs can be mounted with long terminals to allow them to pass through holes in the panel as described in the previous project.

The circuit can be installed in a plastic or wooden box. The size will depend on the battery holder format and size or if the assembler intends to use a power supply with a transformer.

The panel can be designed to use cardboard panels with symbols as described in the previous project.

Testing and Using the Circuit

Place the cells in the cell holder and press S1. The LEDs will flash at a fast rate. In some cases, you will have the sensation that the LED connected to Q1 and Q2 glows with low brightness because of its flash speed. When you release S1, the LEDs will stop in one of the combinations shown in the table. Try it a few more
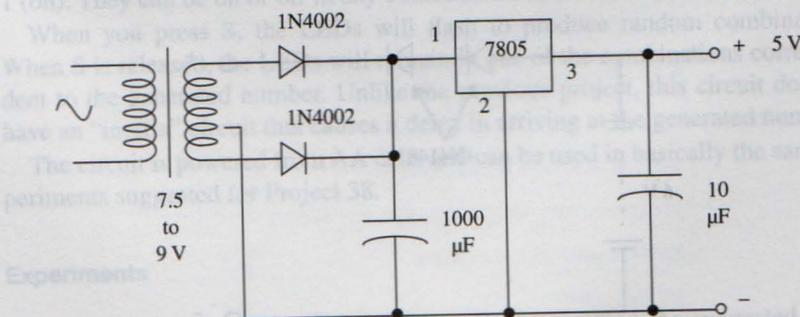

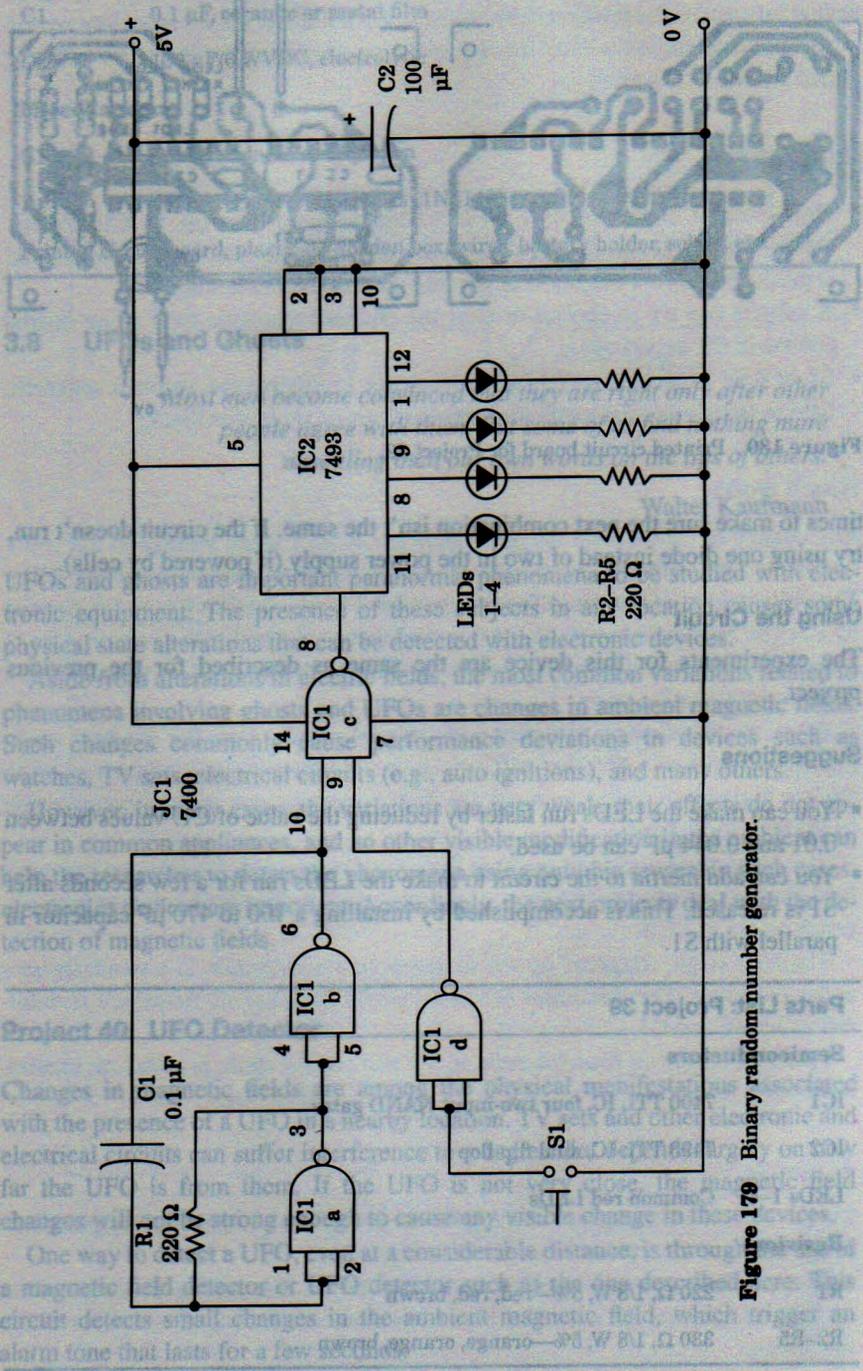**Figure 178** Power supply for Project 39.

5V +

C2 100 µF +

0V

2 3 10

12
1
9
8
11

5

IC2 7493

LEDs 1–4

R2–R5 220 Ω

8

IC1 c

14

IC1 7400

9
7

10
6

IC1 b

4 5

C1 0.1 µF

IC1 d

3
R1 220 Ω

IC1 a

1 2

S1
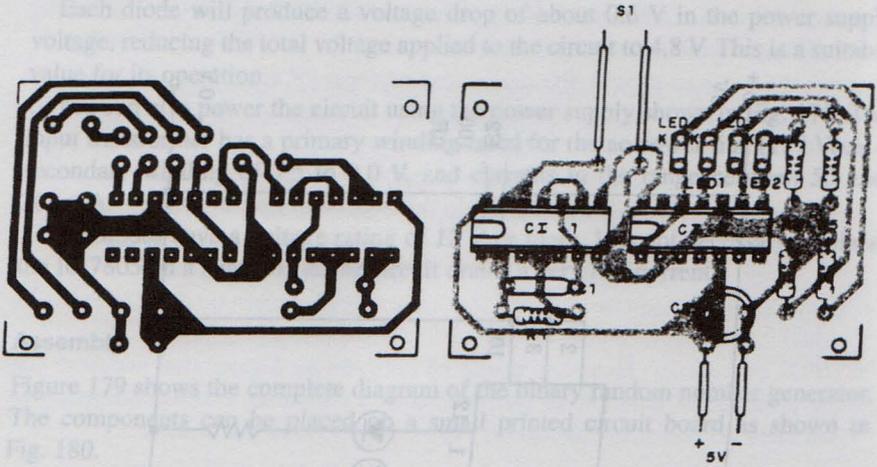
Figure 179 Binary random number generator.

Figure 180   Printed circuit board for Project 39.

times to make sure the next combination isn't the same. If the circuit doesn't run, try using one diode instead of two in the power supply (if powered by cells).

Using the Circuit

The experiments for this device are the same as described for the previous project.

Suggestions

- You can make the LEDs run faster by reducing the value of C1. Values between 0.01 and 0.044 µF can be used.
- You can add inertia to the circuit to make the LEDs run for a few seconds after S1 is released. This is accomplished by installing a 100 to 470 µF capacitor in parallel with S1.

Parts List: Project 39

Semiconductors

IC1	7400 TTL IC, four two-input NAND gates
IC2	7493 TTL IC, dual flip-flop
LEDs 1–4	Common red LEDs

Resistors

R1	220 Ω, 1/8 W, 5%—red, red, brown
R2–R5	330 Ω, 1/8 W, 5%—orange, orange, brown

Capacitors

C1	0.1 µF, ceramic or metal film
C2	100 µF/6 WVDC, electrolytic

Miscellaneous

S1	Pushbutton, normally open
B1	Four AA cells + two diodes (1N4148) or a 5 V power supply

Printed circuit board, plastic or wooden box, wires, battery holder, solder, etc.