Play 'random chance'

Fun to build, more fun to use—that's the Modern Electronics solid-state lottery game. Construction is simple, costs are less than $10, and you can set the odds from 1 to 2 to 1 in 1024.

by Jeff Sandler
Contributing Editor

Barnum said one was born every minute. Here's an interesting electronic lottery that'll help you find out which of your friends old P.T. was talking about. It's a completely self-contained, totally unpredictable lottery where you can set the odds from 1:2 to 1:1024. Once you've set the odds, all you do is push the scramble button for a second or two, then let the contestant hit a touch plate. If he's a winner, the buzzer will sound; if not, nothing happens.

The circuit consists of a switch operated free-running oscillator driving a counter, a diode matrix and alarm, and an interrogate flip-flop. Closing the scramble switch causes the free-running oscillator to drive the counter at a high rate. When the switch is opened, the counter freezes at whatever count it has attained.

When a contestant hits a touchplate, it triggers a one second flip-flop, which signals its activation by turning on an LED indicator. It also advances the counter by one count.

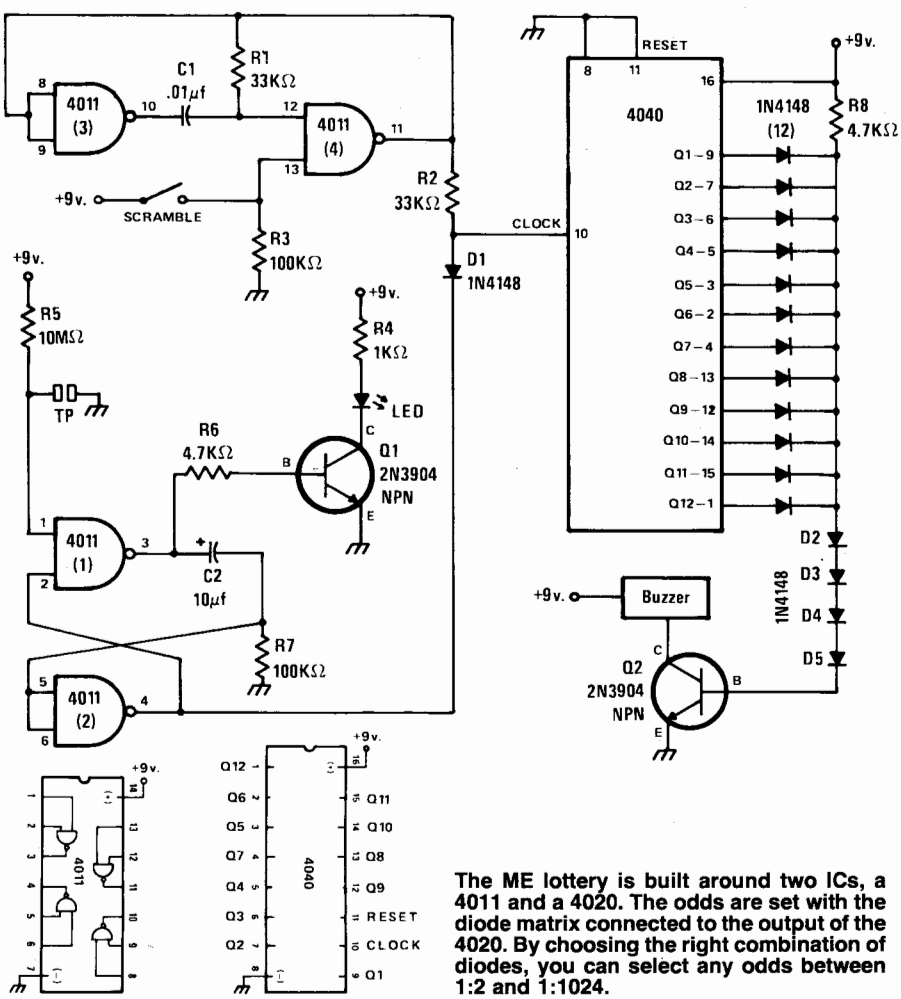
If the counter was frozen at one count less than that needed to go through the diode matrix, hitting the touchplate will advance the count and turn on the alarm buzzer signifying a winner. But, if the counter is frozen at any other count, advancing it by one will not produce the required number, and nothing will happen, signifying a loser.

The odds are set by the diode matrix connected to the output of the 4040 counter IC. These diodes form an AND gate. Each and every diode connected in the matrix must be biased *off* for transistor Q2 to turn on and sound the alarm, signifying a winner.

The output of the 4040 counter is a binary number representing the count attained while the scramble switch is closed. Each character in a binary number is either a *zero*—low—or a *one*—high. The diodes in the matrix are biased off when their associated 4040 output is high.

Suppose you only connected the diode at output Q1 of the 4040, which is pin 9. Regardless of the count in the 4040, the odds are 50-50 that Q1 will be high. So, connecting only the Q1 diode, you set the odds at 1:2. By adding a second diode at output Q2, pin 7, you increase the odds to 1:4. Adding the diode at Q3, pin 6, the odds double to 1:8. In fact, you'll double the odds each time you add a diode to the next higher Q output.

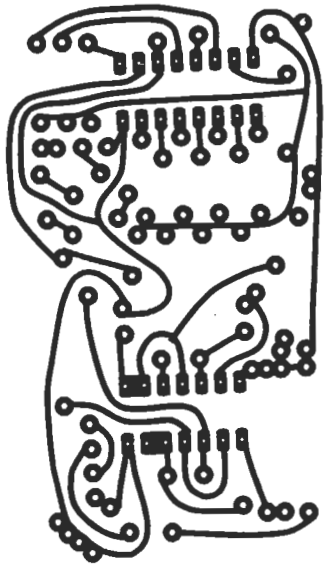
You can get away from the 2, 4, 8, 16 progression of odds by skipping some of the diodes. Just remember the odds are set in binary. So, if you wanted to set the odds at 1:10, you'd connect the diodes to



The ME lottery is built around two ICs, a 4011 and a 4020. The odds are set with the diode matrix connected to the output of the 4020. By choosing the right combination of diodes, you can select any odds between 1:2 and 1:1024.

outputs Q2 and Q4, which gives binary 1010, or 10. If you're not up on binary numbers, you'll find a short explanation at the end of this article.

If you set the odds at several times the number of players, you won't have to scramble the counter after each try. That's because there's no way of knowing what the counter contents are, or how many more attempts will be needed to get a winner. However, if the odds are relatively low, it's a good idea to scramble after each attempt.



Printed circuit layout for ME's lottery game showing the foil side of the board.

The circuit is really a lot simpler than its operation might lead you to believe. The scramble circuit and the player's interrogate circuit are built around a single 4011. The scramble switch can be any single pole, single throw unit you have handy. If you plan to buy a new switch, a miniature momentary contact unit such as the Radio Shack 275-1547 is ideal.

The touchplate used for taking a shot at the lottery consists of two metal strips separated by about one-sixteenth of an inch. Bridging the gap with your finger will trip the flip-flop, lighting the LED and advancing the count. The LED can be any unit you have handy. You may have to change the value of R4 to get the proper brilliance from the LED you use, however.

Although 2N3904 transistors are specified on the schematic, you can use most any small signal NPN transistor. The buzzer shown connected to the collector of transistor Q2 can be any unit with current ratings within those of the transistor, or you can connect a relay into the circuit to handle heavier loads. Remember to put a protection diode across the relay coil.

Parts layout isn't critical. If you're ful, you can use perfboard. But, with de matrix and two ICs, you're

please turn to page 88

Binary numbers— what are they?

A quick look at ones and zeroes

When does 1 + 1 = 10? When you're using binary numbers, that's when.

Binary numbers are the kind used by computers. And even though computers can process numbers representing billions, even trillions of units in just a fraction of a second, the largest single digit is 1! That's right, the entire universe of computer numbers runs from zero to one.

The reason computers have to use a number system that contains just two digits is that even the most sophisticated computer consists of nothing more than a large number of on-off switches. Since the switches can only be on or off, their position can be described by only two labels. So, when a switch is off, it's said to be in its *zero* state. When its on, its in its *one* state.

In the decimal number system you're used to using, you have ten digits to play with—0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. But even with this much larger group of numbers, you have to use more than one digit to represent large quantities. It's exactly the same with binary numbers.

What makes binary numbers so difficult to understand is that the digit 1 can represent what seem to be a random collection of quantities. In decimal numbers, each place going from right to left is ten times greater than the preceding place. So, its *one* hundred, *one* thousand, *one* hundred thousand, *one* million, and so forth.

In binary numbers, each place from right to left is *two* times the preceding place. So, instead of representing 1, 10, 100, 1000, 10000, binary numbers represent 1, 2, 4, 8, 16, 32, 64, 128 and so on.

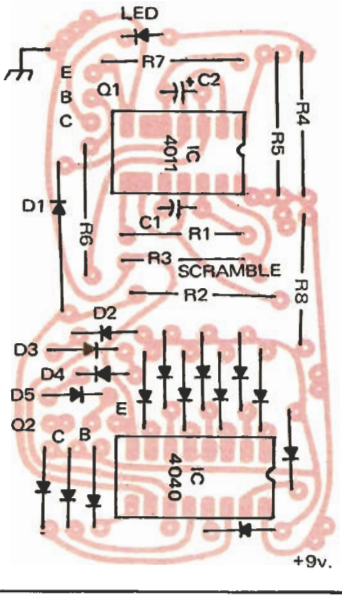
A binary number of 10, therefore, doesn't mean a quantity of ten things. Rather, it means a quantity of *two* things *plus* a quantity of *zero* things, or a total of two. That's why 1 + 1 = 10. Using binary numbers, a quantity of one hundred would be written as 1100100. When reading the number, remember that it really means "add 64, add 32, *do not* add 16, *do not* add 8, add 4, *do not* add 2, *do not* add 1." If you do the addition, you'll see that 64 + 32 + 4 = 100.

There's no question about it, binary numbers can be difficult to handle mentally. But, for the computer, which after all only knows on and off, binary numbers are the only way to go.

binary numbers						decimal
32	16	8	4	2	1	number
0	0	0	0	0	1	1
0	0	0	0	1	0	2
0	0	0	0	1	1	3
0	0	0	1	0	0	4
0	0	0	1	0	1	5
0	0	0	1	1	0	6
0	0	0	1	1	1	7
0	0	1	0	0	0	8
0	0	1	0	0	1	9
0	0	1	0	1	0	10
0	0	1	0	1	1	11
0	0	1	1	0	0	12
0	0	1	1	0	1	13
0	0	1	1	1	0	14
0	0	1	1	1	1	15
0	1	0	0	0	0	16
0	1	1	1	1	1	31
1	0	0	0	0	0	32
1	0	0	0	0	1	33
1	1	1	0	1	0	58
1	1	1	0	1	1	59
1	1	1	1	0	0	60
1	1	1	1	0	1	61
1	1	1	1	1	0	62
1	1	1	1	1	1	63

Binary numbers are written from right to left, just as are decimal numbers. The rightmost digit is the smallest quantity, the leftmost digit the largest. When reading a binary number, bear in mind that the 0 and 1 are not themselves numerals, but no-yes indicators. The binary number 111100 does not mean one-hundred eleven-thousand, one hundred as it does in the decimal system. Rather, it means *yes*, add 32, *yes* add 16, *yes* add 8, *yes* add 4, *no*, *do not* add 2, *no*, *do not* add 1. Following these instructions, 32 + 16 + 8 + 4 + 0 + 0 = 60.

continued from page 43



Parts loading for ME's lottery game as seen from parts side of the board.

better off using a PC board. Although you can make up your own board, a template is provided, along with a parts loading diagram.

The lottery game can give you hours of fun at your next party. And a lot of fun building it. If you take your time, it should work the first time out.