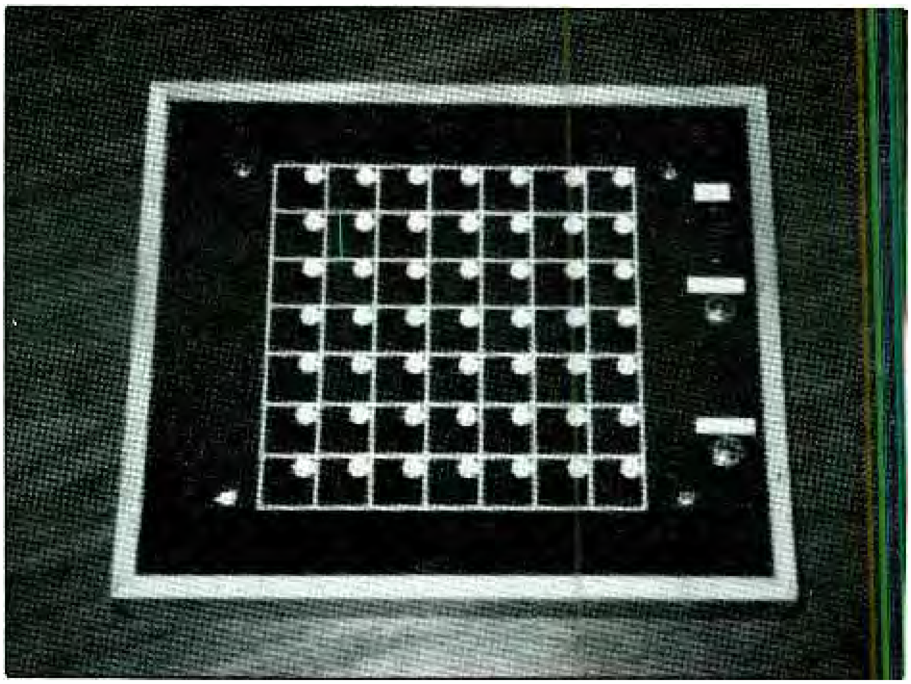
6/49 Lottery Number Selector

Allows you to choose six random numbers from a possible 49 for playing Pick Six state lotteries

By Walter W. Schopp



Many states have adopted the Pick Six (from 49 numbers) for their official lotteries. With payoffs frequently topping tens of millions of dollars, "lottery fever" is sweeping the country. Picking six numbers (hence the name of the lotteries) is easy. Players often select their numbers based upon birthdays, Social Security numbers, ZIP codes, etc. A more sophisticated way of selecting numbers is to use our all-electronic "6/49 Lottery Number Selector," though we do not guarantee that this project will provide you with "better" numbers than you can arrive at using other selection methods.

Our 6/49 Lottery Number Selector choices of six numbers are displayed by light-emitting diodes that are laid out in a 7 × 7 matrix layout. Using this arrangement, rather than a series of numeric displays, keeps down the cost of the project. The project is very easy to use, requiring only that you power it up and press a pushbutton switch to get it started selecting numbers. If you do not like the numbers selected on any try, you simply press and release a RESET button and once again press the first button. That is all there is to it.

Predicting Random Numbers

Very few rules govern the prediction of random numbers. One is that, on the first draw, the number chosen will have a close to 50-50 chance of being either odd or even. Since there are 24 even and 25 odd numbers in the 1 through 49 range used for Pick Six lotteries, however, odd and even selection of numbers will not be exactly 50-50. Too, on the first draw, the number has an even chance of being above or below 25 and a 1 in 49 chance of being 25.

Beyond the foregoing, the odds start changing as more odds or evens and highs and lows are removed with each selection from the original 49 numbers. One law of probability states that out of six numbers chosen, it is possible that three will be odd and three will be even. This same law implies that three numbers will be high (in this case, greater than 25) and three will be low (less than 25).

As is the case with most laws, the "laws" of probability have certain stipulations that limit their application. For the foregoing statement to be true, an extremely large number of samples—thousands to millions—must be taken, tallied and averaged. In the real world, you are interested in just six unique numbers out of the possible 49. Hence, you would "roll" the project only six times. As you do so, you might discover that your selections, based on such a limited number of samples, are weighted more heavily on the odd or even side or/and on the high or low side. Consequently, for all practical purposes, selection of any six consecutive num-

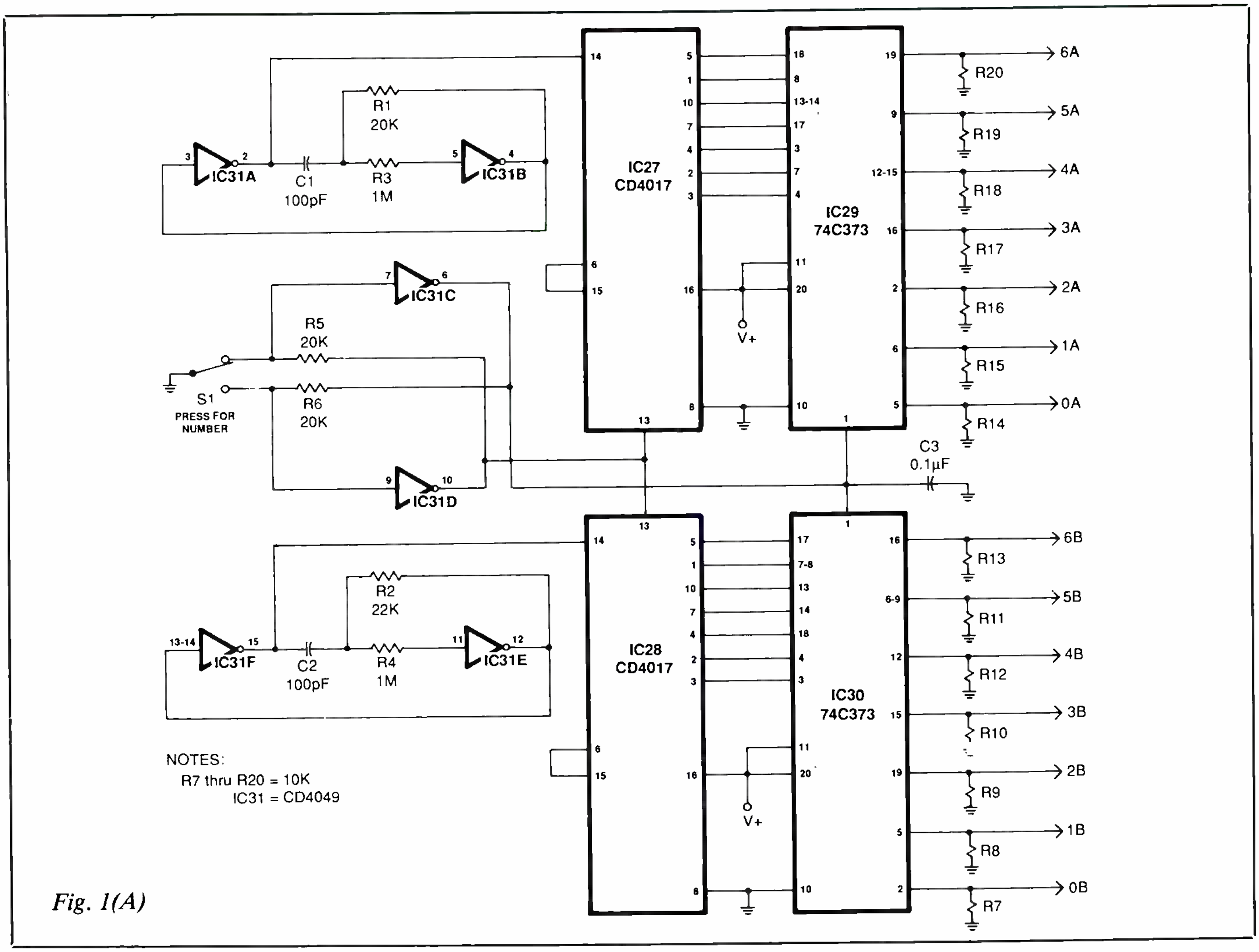


Fig. 1(A)

Fig. 1. Complete schematic diagram is shown here in three parts: (A) dual oscillator/counter/driver; (B) gate/flip-flop/LED system; and (C) power distribution and capacitor bypassing.

bers can have just as good a chance of winning as do six very carefully chosen numbers. Obviously, then, picking numbers for a lottery, no matter how sophisticated or crude the method used, still requires an abundance of luck to win.

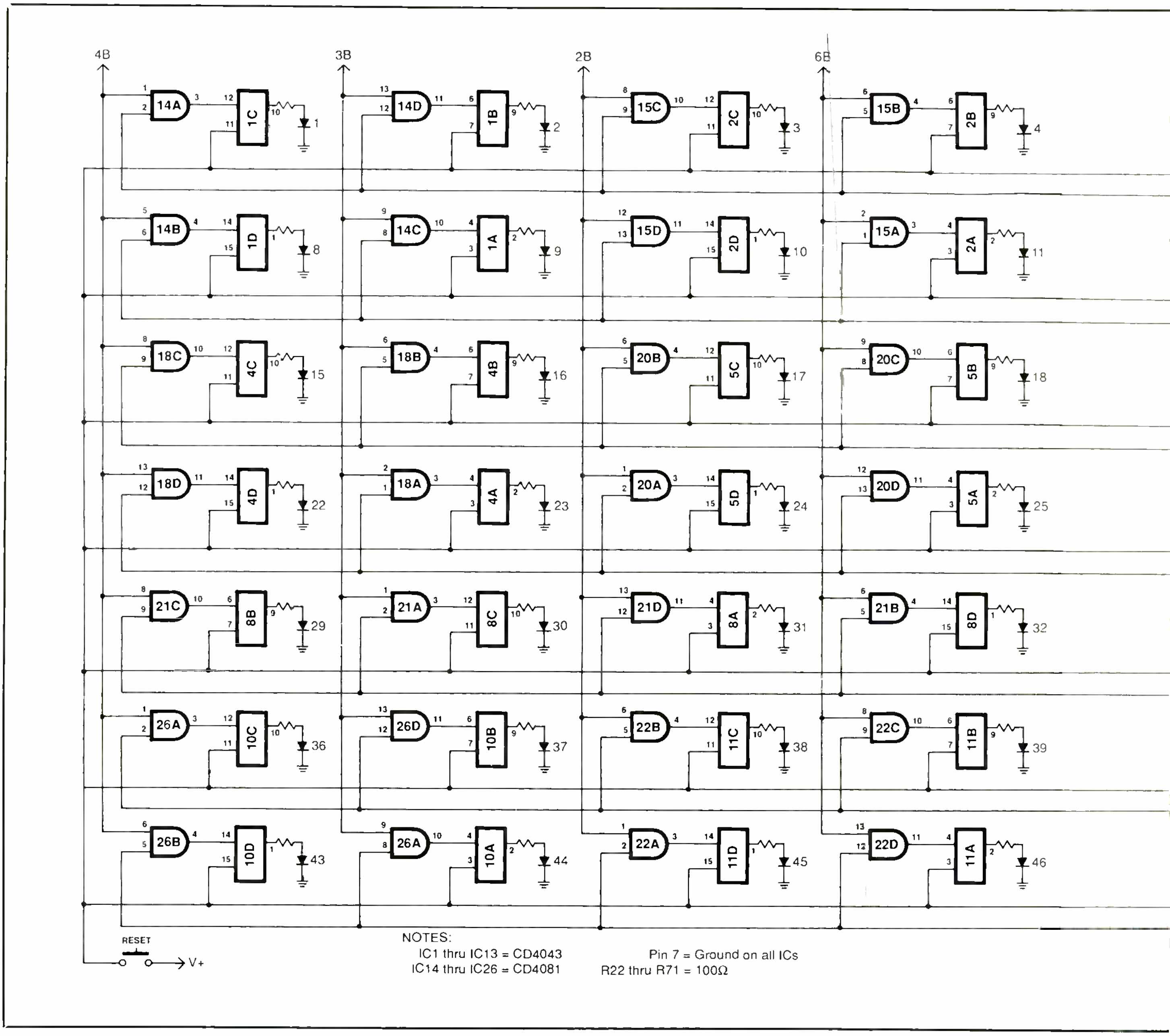
Picking numbers randomly by electronic means is difficult to accomplish because random-number generators are so precise that they always follow a repeatable pattern. If the span of the pattern is long enough, though, a few numbers selected from the pattern will appear to be truly random—even if they really are not.

To make the selection of numbers truly random, the human factor must be added. In our Number Selector, a matrix is used. Each side of the matrix is fed a different counting frequency. This arrangement produces a very long repeatability pattern. If each number were automatically chosen by electronic circuitry at a precise time interval during the span, the same number would be chosen each time. Hence, by making you do some of the work (pressing a button), the human element brings into the equation the random factor.

You select your six numbers by pressing a PRESS FOR NUMBER button on the project an equal number of times. Since there is no way you can accurately time the presses of the button down to a few microseconds, the numbers you pick with this project will be almost totally random.

As you can see, with this project you can pick six truly random numbers with which to play the lottery. The way the system works is like having a bin of 49 numbers pass you by at a rate of thousands of numbers per second so that you cannot see individual numbers as you "draw" one of them at a time until you have the six needed for the lottery card.

Built into the project is a memory system that stores each number as it is drawn. You keep drawing until six numbers are displayed. These numbers will continue to be displayed un-



til you press a RESET switch. At this point, you can once again press the PRESS FOR NUMBER switch to draw six more numbers for the next game on your card.

Though selecting numbers for the Pick Six lottery is one fun way to use the Number Selector, you can also use the project to study the laws of probability. You do this by selecting many sets of random numbers and see how they apply to the game.

About the Circuit

Because of its very large size, the schematic diagram of the Lottery Number Selector is shown in Fig. 1 in four parts. Part (A) contains the circuitry for the dual-oscillator/counter/driver circuit; Part (B) contains the circuitry for the gate/flip-flop/LED circuits; and Part (C) shows power distribution and capacitor bypassing for all ICs.

Our discussion begins with the two pulse generators that are the heart of the project. Each pulse generator is made up of two inverter/buffer stages and RC components, and both operate at a frequency of about 100 kHz.

Clocking pulses for counter *IC27* are delivered from the first pulse generator. This generator is made up of inverters *IC31A* and *IC31B*, resistors *R1* and *R3*, and capacitor *C1*. Similarly, counter *IC28* is clocked by the

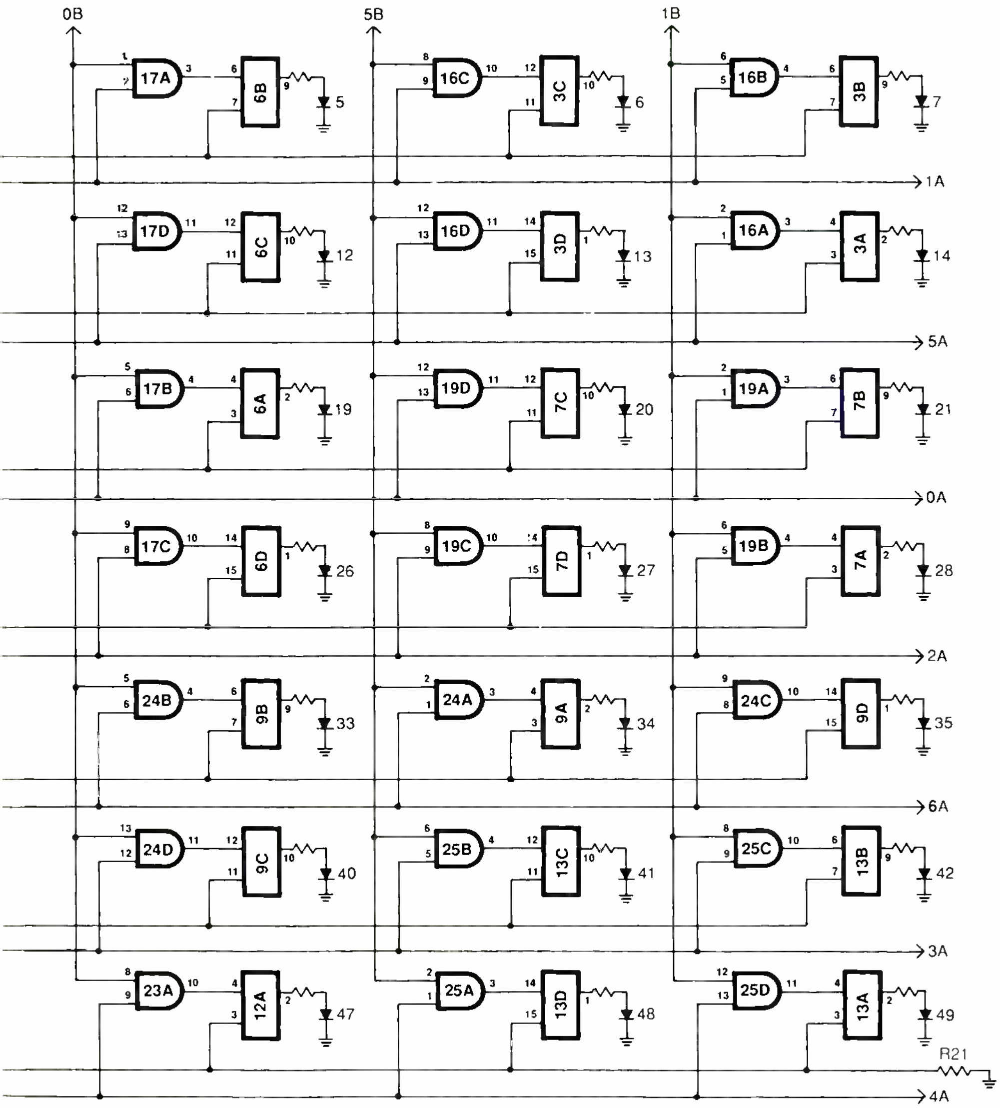


Fig. 1(B)

PARTS LIST

Semiconductors

IC1 thru IC13—CD4043 quad set/reset flip-flop

IC14 thru IC26—CD4081 quad 2-input AND gate

IC27,IC28—CD4017 decade counter

IC29,IC30—74C373 tri-state octal buffer

IC31—CD4049 hex inverter/buffer

LED1 thru LED49—Jumbo red light-emitting diode

Capacitors

C1,C2—100-pF ceramic disc

C3 thru C6—0.1-μF ceramic disc

Resistors (⅛- or ¼-watt, 10% tolerance)

R1,R5,R6—20,000 ohms

R2—22,000 ohms

R3,R4—1 megohm

R7 thru R21—10,000 ohms

R22 thru R79—100 ohms

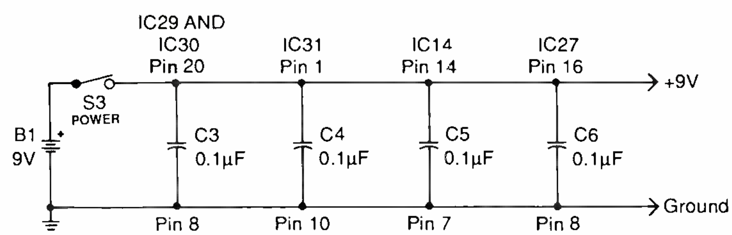
Miscellaneous

B1—9-volt battery (six AA cells in series)

S1,S2—Momentary-action pushbutton switch (Radio Shack Cat. No. 275-407)

S3—Miniature spst toggle switch (see text)

Printed-circuit board or perforated board with holes on 0.1″ centers and suitable soldering or Wire Wrap hardware (see text); suitable enclosure (see text); sockets for all ICs; six AA-cell holders for B1; red-tinted clear-plastic sheet for top panel of enclosure; labeling materials (see text); narrow graphing tape (see text); ½-inch spacers; machine hardware; hookup wire; solder; etc.



	+9V pin	Ground pin
IC1–IC26	14	7
IC27, IC28	16	8
IC29, IC30	20	10
IC31	1	8

Fig. 1(C)

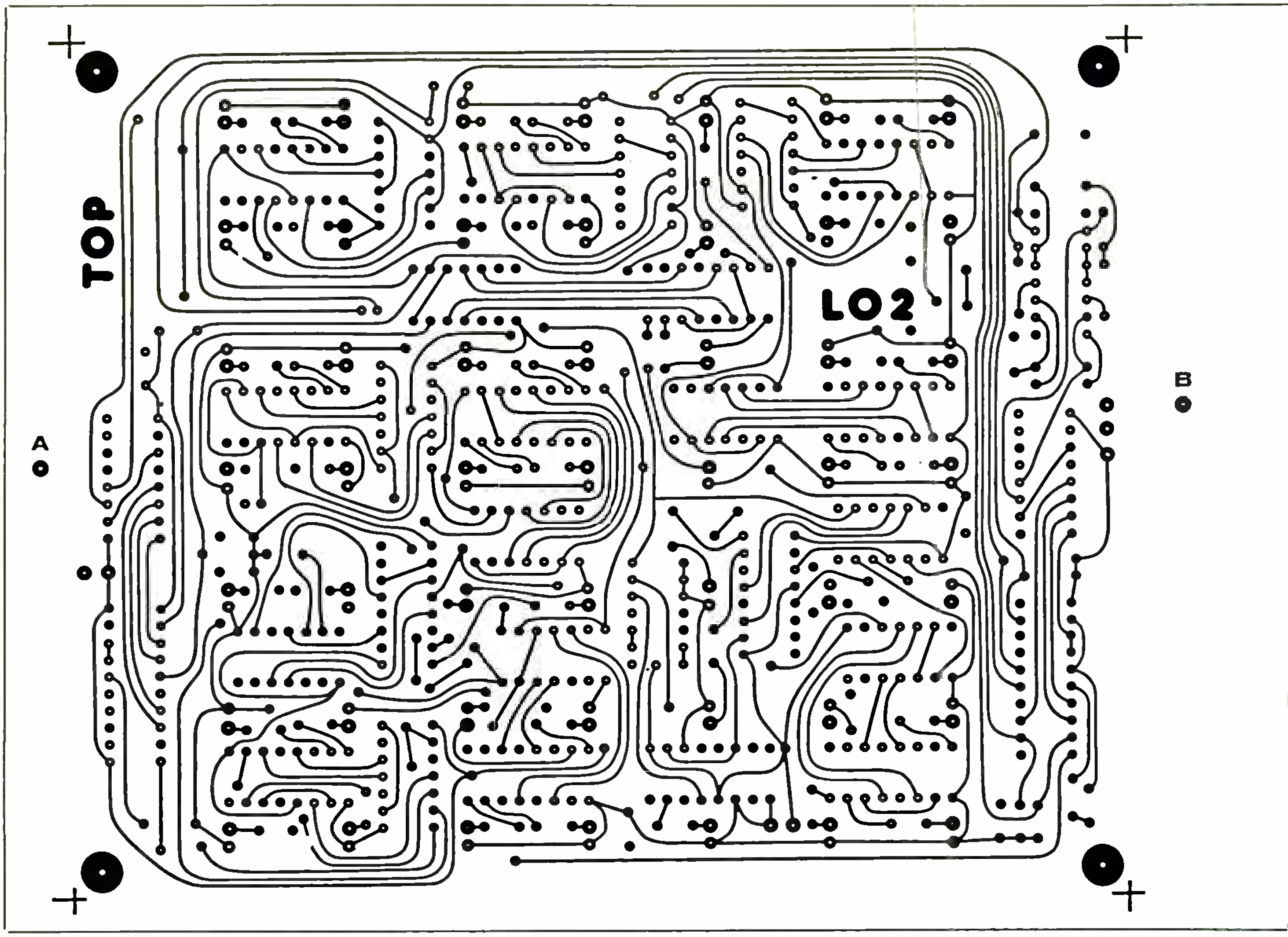


Fig. 2. Actual-size etching-and-drilling guides for top (left) and bottom (right) of printed-circuit board

pulse generator made up of inverters *IC3E* and *IC3F*, resistors *R2* and *R4*, and capacitor *C2*.

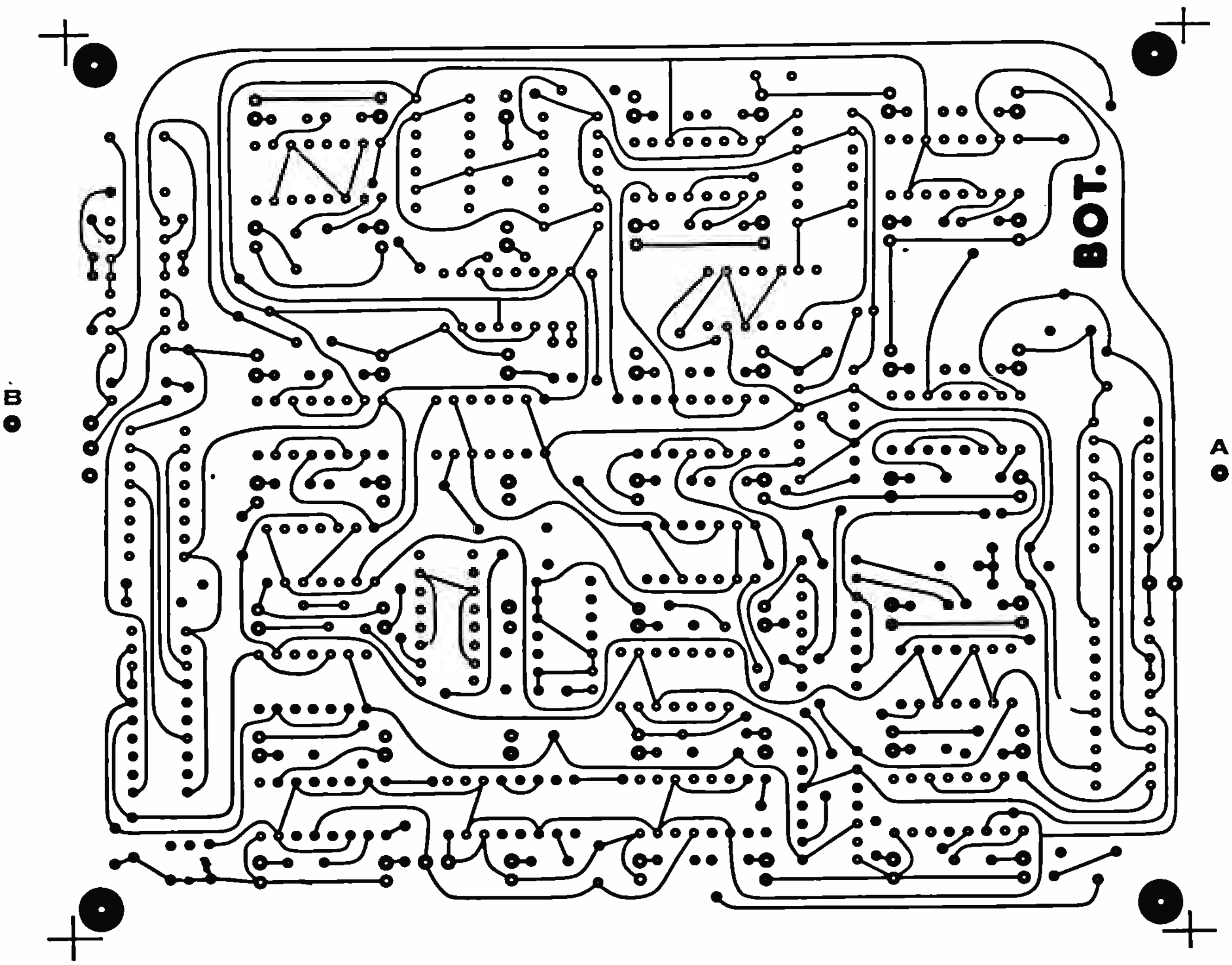
Decade counters *IC27* and *IC28* count the pulses applied to their pin 14 inputs. At the seventh count, they reset. The outputs of the counters are applied to the inputs of tri-state buffers *IC31* and *IC32*. These two buffers supply count pulses to the two sides of the seven-by-seven matrix network.

Note here that two buffers, *IC31B* and *IC31C*, are used to condition the inputs from PRESS FOR NUMBER switch *S1* to prevent the circuitry from responding to each pulse generated due to mechanical contact vibration. Thus, the two inverter/buffers make *S1* "bounceless."

Switch *S1* is shown in its normal "run" position. Pushing it down, breaks the circuit to the upper contact and makes the circuit to the lower contact. When this occurs, a positive voltage is applied to enable pin 13 of *IC27* and *IC28*, which stops the count operation. At the same time, a negative voltage is applied to pin 1 of *IC29* and *IC30* to enable the outputs of the tri-state buffers. When this occurs, one vertical and one horizontal lines of the matrix are made positive. When *S1* is released and its contacts return to their normal closed and open conditions, the counter starts running again and the buffers float.

When the two intersecting lines of the matrix are positive, the appropriate AND gate (*IC14* through *IC25*) is turned on and sets one of the set-reset flip-flops (*IC1* through *IC13*) and applies a voltage to the LED connected to the output of that particular flip-flop. Because of the latching action of the flip-flop, the LED remains on until RESET switch *S2* is pushed and released. When *S2* is operated, all flip-flops, except the last one that was set, are reset.

One of the quirks of this type of circuit is that the counter must rest on one output, leaving one output on when it is stopped. This always leaves the LED for the last number selected



lit after RESET switch *S2* is pressed and released. The way around this when you are selecting numbers with the project is to press and release the RESET switch after selecting the first number of the series. This way, the first number will be retained, while the last number of the previous set will be "erased." After doing this, proceed with selecting your next five numbers by pressing and releasing PRESS FOR NUMBER switch *S1* five more times.

As you can see by examining Fig. 1 and the Parts Lists, the entire Lottery Number Selector circuit is built around low-power CMOS devices. The only devices that draw appreciable current are the light-emitting diodes, of which a maximum of only seven can be on at any given time. Thus, the power demands of the circuit are minimal. Consequently, you can easily use a 9-volt battery made up of six AA cells connected in series to power the project, making it a truly portable device that you can take right to the lottery-ticket vendor for on-site number selections.

Construction

Except for the battery and two switches, all components that make up the Lottery Number Selector circuit mount on a single circuit board. You can fabricate a double-sided board using the actual-size etching-and-drilling guides shown in Fig. 2. If you prefer not to make a pc board, you can use perforated board that has holes on 0.1-inch centers and suitable Wire Wrap or soldering hardware.

Whichever wiring scheme you decide to use, sockets are recommended for all ICs. Note, though, that if you fabricate a double-sided board you will not be able to use ordinary DIP sockets, which do not give top- and bottom-of-the board soldering access to all pin pads. However, you can easily solve this dilemma by substituting strips of Molex Soldercon socket connectors.

Assuming you are using printed-

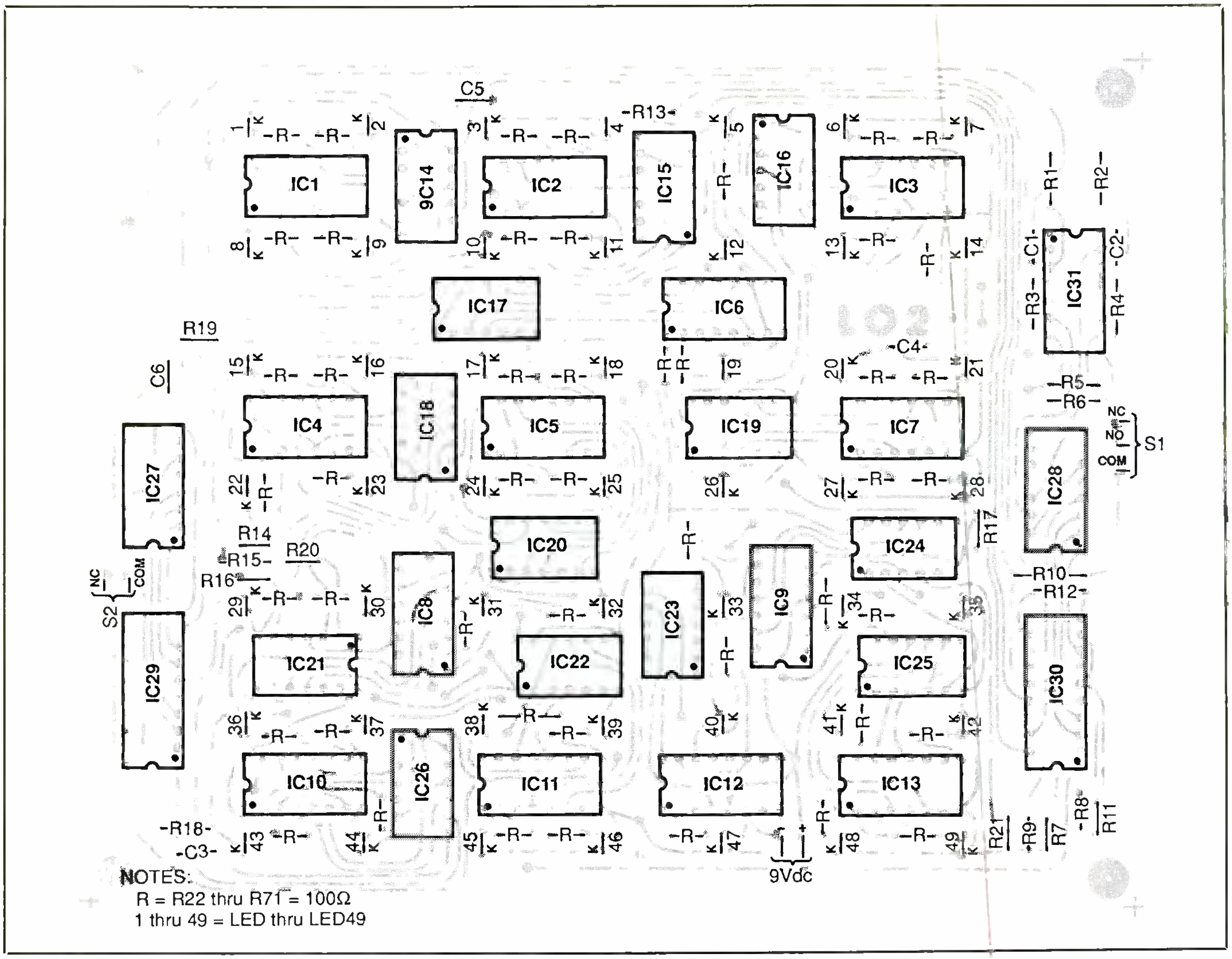


Fig. 3. Wiring guide for pc board. Use this as a rough guide to laying out components if you opt for perforated-board construction instead of a pc board.

circuit construction, orient the board in front of you as shown in the wiring diagram in Fig. 3. (Use this illustration as a rough guide to component placement if you assemble the project on perforated board.) Note that Fig. 3 shows component installations against the conductor pattern on the *top* side of the board.

Begin populating the board by installing and soldering into place the strips of Soldercons. Do *not* install the ICs in the Soldercon "sockets" until after you have performed preliminary voltage tests. Follow with installation of the capacitors and then the resistors. The pc board conductor pattern was laid out to accommodate ⅛-watt resistors, though you can use ¼-watt ones instead if you mount them upright. You will note that there are a number of locations for the resistors identified with an "R." These are the *R22* through *R79* 100-ohm current-limiting resistors for the LEDs.

The light-emitting diodes are simply numbered 1 through 49, with no "LED" identifier preceding them. Mount the LEDs in the locations indicated, making certain that each is properly oriented before soldering its leads to the pads on both sides of the board. As you can see, the cathode lead in each case goes into the hole that is farther away from its associated IC than is the anode hole. Space each LED so that the bottom of its case is about ¼ inch above the surface of the board.

Strip ¼ inch of insulation from both ends of eight 6-inch-long hookup wires. If you are using stranded hookup wire, tightly twist together the fine conductors at both ends of each wire and sparingly tin with solder. Plug one end of these wires into the holes labeled 9VDC, *S1*, *S2* and *S3* and solder into place. Plug the wires into the holes labeled 9VDC from the *bottom* of the board.

At this point, all holes that should have component leads or pins plugged into them should be occupied. Any unoccupied holes—except the four large mounting holes in the corners of the board—must be filled with short wire jumpers. Use cut-off resistor leads or bare solid hookup wire for these jumpers, soldering them to the pads on both sides of the board in each case.

When you finish installing all jumper wires, carefully check all components for proper values and orientations. Also check your soldering against both top and bottom views of the board shown in Fig. 2. Remember that all connections must be soldered to the pads on both sides of the board. Solder any connection you might have missed, reflow the solder on any connection that looks suspicious and remove any solder bridges with desoldering braid or a vacuum-type desoldering tool.

Once you are satisfied that you installed each component in the correct location and in its proper orientation and that all soldering is okay, temporarily set aside the circuit-board assembly.

Now prepare an enclosure in which to house the project. You can use any enclosure that has interior dimensions of at least 6¼ × 5⅛ × 1 to 1½ inches. It can be made of plastic, metal, a mixture of both or even lumber and Masonite or Plexiglas.

Machining of the enclosure requires very little effort. All you need are three holes in which to mount the switches, four holes for mounting the circuit-board assembly in place and as many holes as are needed for mounting the AA-cell holders. Of course, if you are fabricating a wooden enclosure, you might want to add embellishments like insetting the circuit-board assembly into shallow grooves in the walls to eliminate mounting hardware and spacers.

Wire the battery holder into the circuit via the two wires coming from the bottom of the board. You need six cell holders in all for the AA cells that make up the battery. Wire the holders so that all are in series with each other. Then crimp and solder the free ends of the two 9VDC wires to the lugs at the ends of the series string, making sure you observe proper polarity. Temporarily set aside the circuit-board assembly.

Now, use either etching-and-drilling guide in Fig. 2 as a template to mark where the mounting holes for the circuit-board assembly and switches must be drilled in the top panel of the enclosure. This panel should be a sheet of transparent red-tinted plastic that both protects the circuit-board assembly from physical damage and enhances the visible effect of the LEDs when they are lit. Drill appropriate size holes in the marked locations.

Punch 49 ¼-inch-diameter rounds or cut ¼-inch squares of self-stick blank paper. Also, cut three ¼ × 1-inch pieces to use as labels for the switches. Mount the circuit-board assembly to the top panel using ½-inch spacers and suitable machine hardware. Determine where the dividing line for each square, containing a single LED in the center, will be and use ¹⁄₁₆-inch-wide graphics tape to make up a "checkerboard" pattern consisting of seven squares horizontally and seven vertically; this tape is available at many stationery stores.

When you are finished laying out the squares, place a self-adhering paper round or square in the upper-left corner of each square, where it will not interfere with your view of the LEDs. Number the rounds or squares from 1 through 49, starting at the upper-left and ending at the lower-right and working horizontally. Each round or square should bear the same number as the LED it goes with (see Fig. 3). Place the three long labels near the switch holes and label them accordingly.

Checkout & Use

With no ICs plugged into the sockets, power up the circuit-board assembly by flipping the POWER switch to ON. Now, using a dc voltmeter or a multimeter set to the dc-volts function, check out the voltage distribution in the circuit.

Clip the meter's common lead to any convenient circuit-ground point on the circuit-board assembly. Then use the "hot" lead to probe for the presence of +9 volts at the points indicated in the table that accompanies Fig. 1(C). If you do not obtain a reading of +9 volts (or whatever the potential of the battery) at any point in the circuit, power down the circuit-board assembly and check all wiring and soldering.

When checking out the circuit-board assembly, make sure that all connections have been made to both sides of the board, that all connections look okay and that no solder bridges have been created between the closely spaced IC pads and conductors. If you missed a connection, solder it. If a connection looks suspicious, reflow the solder on it. Use desoldering braid or a vacuum-type desoldering tool to remove any solder bridges discovered.

When you are satisfied that the project has been properly wired. Install the ICs in their respective sockets. Make certain that the correct IC goes into any given socket and that it is properly oriented. Also check to make sure that no IC pins overhang the sockets or fold under between ICs and sockets. Handle the ICs with the same precautions you would use for other CMOS devices.

Mount the circuit-board assembly to the top panel with the hardware you previously used to lay out the checkerboard pattern. Then mount the entire assembly inside the enclosure.

To use the project, simply flip the POWER switch to ON, press and release the RESET switch and press and release the PRESS FOR NUMBER switch six times to obtain your six lottery numbers. **ME**