Gamble away to your heart's content

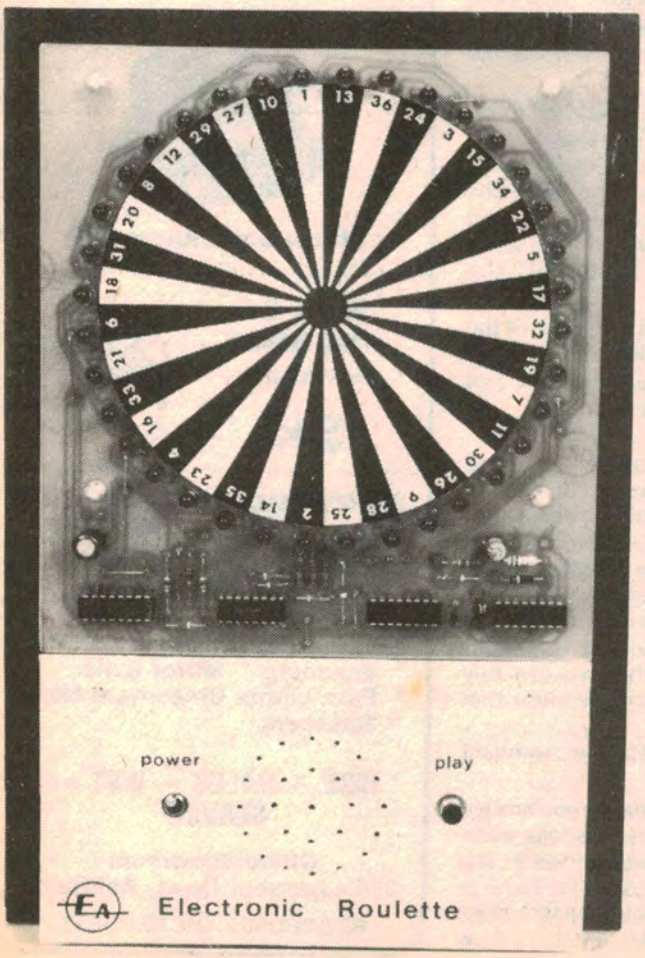
Electronic roulette wheel

— with realistic sound effects

Centrepiece to the glamorous casinos of Las Vegas, Monte Carlo and Wrest Point, the roulette wheel seems to be particularly effective in separating people from their money. Although it does not represent particularly good value for the gambler, people are drawn to it as sailors to the sirens. If you've always wanted to try your hand but don't fancy the element of risk, build the EA Electronic Roulette wheel and play "on the house".

by COLIN DAWSON

This electronic roulette wheel has 36 LEDs arranged in a circle. These function as a chaser so that the light appears to rotate. Although both the ball and the wheel rotate in a real roulette wheel, it is clearly not practical for us to rotate the wheel – we must settle for the ball. When the play button is depressed, the ball rotates at about 240 RPM and gradually slows when the button is released. This simulates the inertia of a real roulette wheel with the "cliffhanger" finishes.



Another touch of realism is provided by integral sound effects. This consists of a clicker which represents the ball bouncing from one number to the next.

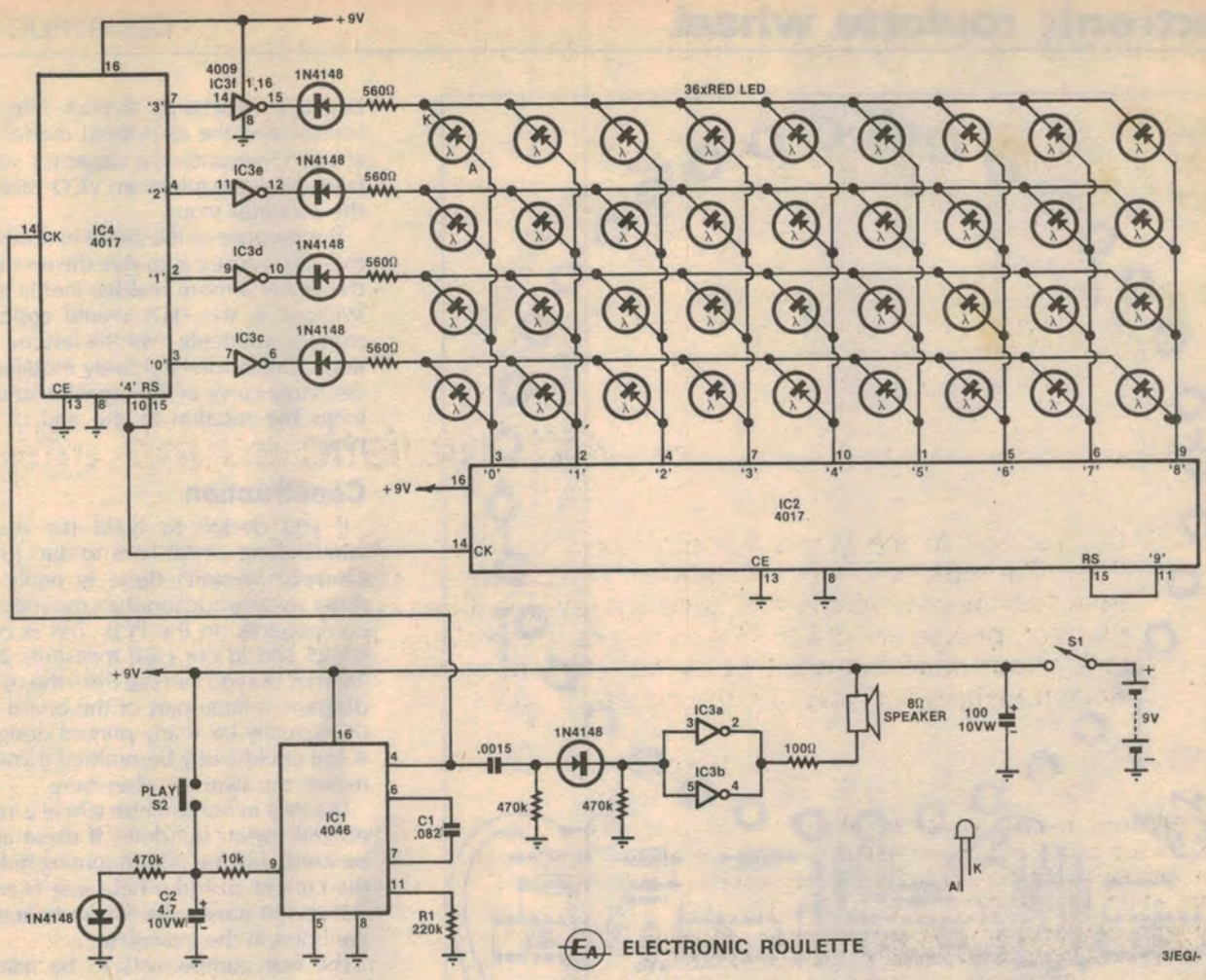
Actually we presented an electronic roulette wheel about six years ago. This was a mains powered and rather expensive project, whereas the latest version has been designed for the budget minded gambler. It requires only a 9V battery for power.

In operation the wheel appears to be completely random – we were not able to detect any bias and the chances of selecting a winning number are one in 36. Actually, this compares favourably with casinos which have either a 1 in 37 or 1 in 38 chance of selecting the winning number. This is due to the inclusion of a "0" (Europe) and "00" (US) on the wheel. Since the payout is fixed at 35:1 for a single (or "straight up") bet, the house has an advantage – particularly in the US casinos.

The LEDs are driven by a clock and counter arrangement. Whilst this may sound simple enough, there are some interesting refinements. The clock, for example, must vary in speed to simulate the inertia of the wheel. The counter – rather than employing 36 separate outputs – has a much more economical 9 x 4 arrangement which is used to drive the LEDs in a matrix.

Perhaps surprisingly, the design of this project owes more to the "Selectalott" Lotto selector than the original roulette wheel. It shares the concept of driving the LEDs by means of a matrix although originally a 6 x 7 matrix was used rather than the 9 x 4. (A 6 × 6 arrangement could have been used in place of 9 × 4, but the 9 × 4 combination made for an easier layout, and saved a few minor components.)

In the interest of minimising the expense, we have not built the "wheel" into an enclosure. All the components, except the battery and speaker, are mounted on the printed circuit board (PCB). This was subsequently mounted on a piece of Masonite, although constructors may well choose an alternative mounting system.



How it works

All the counting and LED driving functions are performed by four CMOS ICs. This contributes to the low power consumption – around 5mA to be specific.

Clock pulses are provided by IC1, a 4046 phase locked loop. Although this IC is capable of a number of functions, we have utilised only its voltage controlled oscillator (VCO). By varying a reference voltage on its input (pin 9) the output frequency can be controlled over a large range. The maximum speed is determined by C1 and R1 and in this case is about 180Hz.

At this speed it is just possible to tell where the "ball" is at any given time during rotation. Admittedly, this can encourage a certain type of player to indulge in sleight-of-hand techniques (ie, attempt to release the play switch at the same point each time). Apparently some people are such bad sports at gambling that they actually expect to win. However, they will be disappointed with the EA roulette wheel, since it would require super-human reflexes to achieve this.

The output of the VCO (pin 4) is connected to the clock input (pin 14) of IC4, a 4017 decade counter. Normally, each of the 10 outputs, labelled "0" to "9" goes high for one clock cycle. Only one output can be high at any given time and after the "9" count the IC resets to "0" and the process repeats. By connecting any output to the reset pin (15) the device can be reset before it reaches the "9" count and in fact we have configured it to reset at "4".

The count cycle is effectively "0", "1", "2" "3" and reset. The "4" output is high for such a short time before reset occurs that there is no apparent delay between the "3" and "0" counts. However, the "4" output is connected to the clock input of IC2 (the other 4017) and the brief pulse is sufficient to clock IC2. Normally, the carry out (pin 12) would be used for this function. This goes high at reset and stays high until the "4" count. It is apparent that with a reset at "4", the carry out will never go high and therefore can not be used in this circuit.

The "9" output of IC2 is connected to its reset so that it is effectively an 0 to 8 counter. Hence IC4 counts 0 to 3 and then clocks IC2. After nine cycles of IC4 (or 36 clock pulses) IC2 will have completed its cycle. In this way, the 36 different outputs are obtained.

Each of the outputs of IC2 drives 4 LED anodes. These four LEDs will have con-

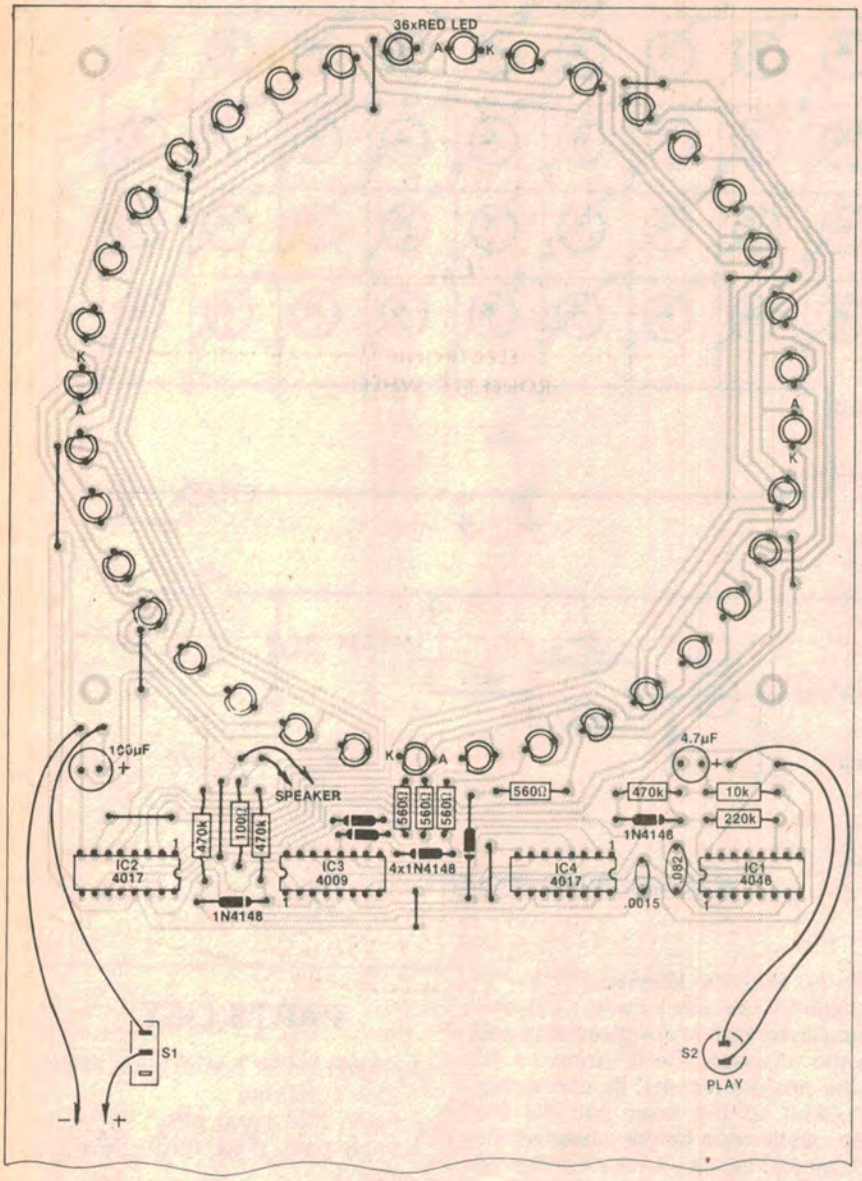
PARTS LIST

1 printed circuit board, code 83eg5, 250 × 160mm
4 nylon PCB stand offs
1 Single pole, single throw (SPST) switch
1 SPST momentary contact switch
1 8Ω miniature loudspeaker
1 9V battery, Eveready 216 or equivalent
1 battery clip to suit

SEMICONDUCTORS
2 4017 CMOS decade counters
1 4009 CMOS hex inverting buffer
1 4046 CMOS phase locked loop
6 1N4148 diodes
36 LEDs

CAPACITORS
1 100μF/10VW electrolytic
1 4.7μF/10VW electrolytic
1 .082μF greencap (metallised polyester)
1 .0015μF greencap

RESISTORS
3 x 470kΩ, 1 x 220kΩ, 1 x 10kΩ, 4 x 560Ω, 1 x 100Ω.



Note that three of the wire links are mounted on the underside of the board.

secutive positions on the wheel and each will come on in turn as IC2 cycles through its 0-3 count. Since we want a LED to be on when the two IC outputs corresponding to its position are high, it is necessary to invert the output of one of the ICs. In fact IC4 drives each of its LED strings through IC3 – a 4009 hex inverting buffer. A 560Ω current limiting resistor is also included in each string, as is a diode which prevents reverse biasing of the LEDs when they are turned off.

Since IC3 is a hex buffer package, there are two "spare" buffers and these are put to good use driving the loudspeaker. Although they buffer the output of IC1, it is not simply a matter of connecting their inputs (pins 3 and 5) to IC1. This would result in two clicks per clock cycle-one on the positive edge and one on the negative edge. Since the counters only advance on the positive edge, this would be unsatisfactory.

The .0015µF capacitor, 470kΩ resistor and diode feeding the two buffer inputs allow only one click per clock cycle – on the positive edge. This occurs simultaneously with the ball moving to successive positions. Connecting the two buffers in parallel may seem a little unusual. But this has been done to increase the current drive to the loudspeaker. The 100Ω resistor limits the speaker current to a safe value for the buffers.

When the "Play" button is depressed, C2 immediately charges to the supply voltage and takes the VCO input (pin 9) high in doing so. While ever the button is held down, the VCO operates at its maximum frequency of about 180Hz. When the button is released, the capacitor begins to discharge through the 47kΩ resistor and the associated diode. After about 15 seconds the capacitor voltage falls below the minimum VCO value and the oscillator stops.

The purpose of the diode in series with the 47kΩ resistor is to give the rotation of the wheel a more realistic inertia effect. Without it, the LEDs would appear to stop too suddenly over the last few positions. The diode effectively modifies the discharge curve of the capacitor and prolongs the rotation at the end of each play.

Construction

If you decide to build the roulette wheel along similar lines to ours (the "El Cheapo" version!) there is really little more to construction than mounting the components on the PCB. This is coded 83eg5 and in our case measures 250 × 160mm. As you can see from the overlay diagram, a large part of the board does not actually have any printed design on it and could easily be omitted if you can mount the switches elsewhere.

The PCB in our roulette wheel is retained with nylon standoffs. If these are to be used, drill the PCB mounting holes to the correct size (the hole size is critical with nylon stand offs). Mark out and drill the holes in the baseplate.

The first components to be installed are the links. There are 10 of these in all, with three mounted on the foil side of the board. It is most important that the appropriate links be installed underneath the board, otherwise they will interfere with the wheel artwork.

Having obtained a photocopy of the roulette wheel artwork, cut it to size and glue it in place. Be particularly careful that the "wheel" is centralised. In this respect, the glued paper should prove much easier to handle than Scotchcal. If you are using the full size PCB (with control panel) the rest of the artwork could also be used.

There are two traps to watch for when mounting the LEDs – the polarity of each LED, and the position of the first LED, ie, making sure that it is fitted to a genuine "pair" of holes, rather than a false "pair", made up of one hole from each of two adjacent pairs. Both problems are taken

We estimate that the current cost of components for the project is approximately

$24

This includes sales tax.

HOW TO PLAY ROULETTE

Roulette is played with a roulette wheel, chips and a betting table. Bets are made by placing chips on the specially marked table. The wheel is then used to select a winning number at random. A normal wheel, as used at a casino, has 36 numbers, and one or two zeros. The zeros are to provide a bias in favour of the casino. Our Electronic Roulette Wheel does not have any zeros.

At least two players are required, one of whom becomes the banker. Players bet against the banker, but cannot bet amongst themselves. Each player should be supplied with an equal number of chips. If possible, each player should have different coloured chips, to avoid confusion when many bets are laid on the table.

The banker should be supplied with larger numbers of chips of all colours, to lessen the chance of "breaking the bank". Chips can be improvised from buttons, coloured counters or similar objects.

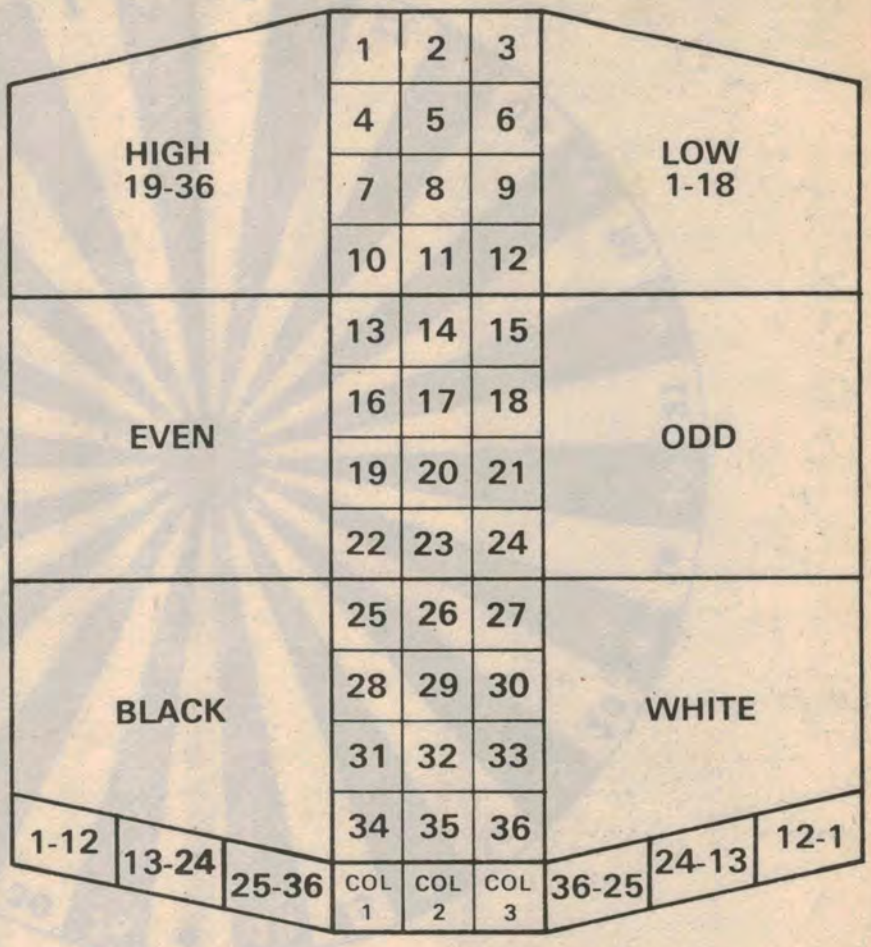
A large copy of the table layouts should be made, marked with the numbers as shown. This can be as large as desired. A foolscap size table is suitable for up to six players. The various types of bets, how they are made, and the odds they pay are explained below.

Experienced gamblers may have noticed that we have used a black and white table instead of the more usual black and red one. This was because we found it easier to fabricate a black and white front panel for our Electronic Roulette Wheel. However, there is no reason why a constructor with suitable facilities could not make a red and black panel, as is usually used in casinos. Alternatively, it would be possible to paint or otherwise colour the white sections red. In any case, the table layout should match the front panel of the wheel.

There are six ways of wagering on an even chance. One can bet that the next number will be black or white, even or odd, or high or low. This is done by placing a chip (or chips) on the relevant areas of the table. You may bet on more than one occurrence (eg, black and odd), and more than one player can bet on the same occurrence.

All these wagers pay even money, ie, if you wager one chip on the black, and a black number comes up, you receive your original stake back, as well as an extra chip (your winnings). If a white number comes up, you lose your stake.

Odds of 2 to 1 are paid on bets in the nine boxes at the bottom of the table. The centre three boxes represent all the numbers in the columns directly above them. The boxes on either side represent the numbers marked in them. Bets are made by placing chips in the appropriate box. A winning bet is tripled, the winner receiving his original wager plus twice as much.



This diagram should be enlarged and copied onto cardboard. The final size will depend on the number of players and the size of the chips to be used.

To receive odds of 35 to 1, you may bet on any single number, by placing your chips in the appropriate box. Odds of 17 to 1 are obtained by betting on two numbers. These numbers must be next to one another on the table, and the bet is made by placing your chips on the dividing line between the two numbers. You win if either number comes up.

To bet on three numbers at once, and receive odds of 11 to 1, place your chips on either side wall of any row. Thus to bet on 13, 14 and 15, place your chips either on the right hand wall of box 15, or the left hand wall of box 13. You will win if either 13, 14 or 15 comes up.

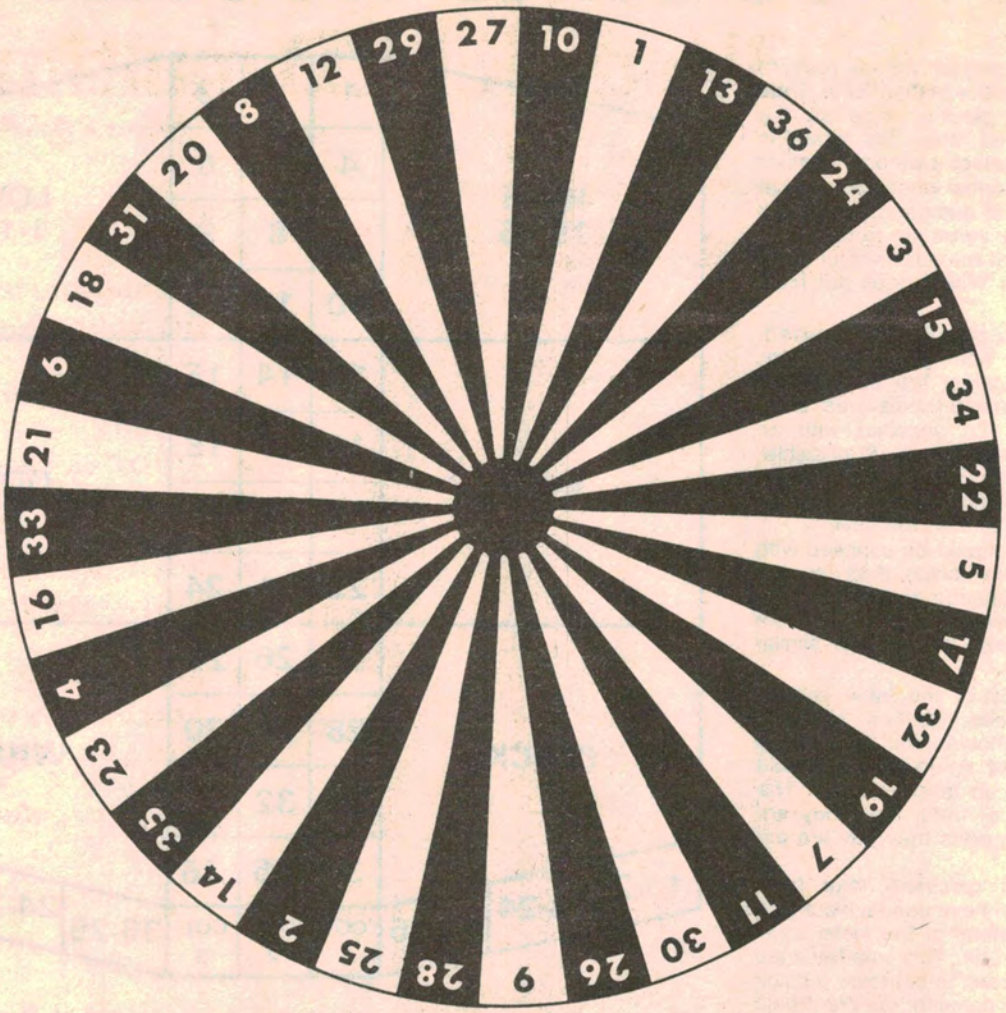
Odds of 8 to 1 are obtained by betting on four numbers at once. This is done by placing your chips on the common corner of four numbers. It is not possible to bet on four numbers which are not adjacent. By placing your chips on the side walls so that they cover two rows, you receive odds of 5 to 1, and win if any of the numbers in either of the rows comes up.

These are the only bets which can be made. A player may make as many bets at one time as he desires, and as many players as wish can bet on any one number or combination of numbers. When all bets have been laid, the banker calls "no more bets", and spins the wheel.

When the wheel stops spinning, the banker calls the winning number, eg, "ten on the black", and then removes all losing wagers from the table. He then pays out all the winning bets to those fortunate few. No more bets should be laid on the table until all winning bets have been paid. This will avoid confusion, and prevent unscrupulous players from making bets after the result has been decided.

The game can then continue, until either all the players or the banker goes broke.

Electronic roulette wheel

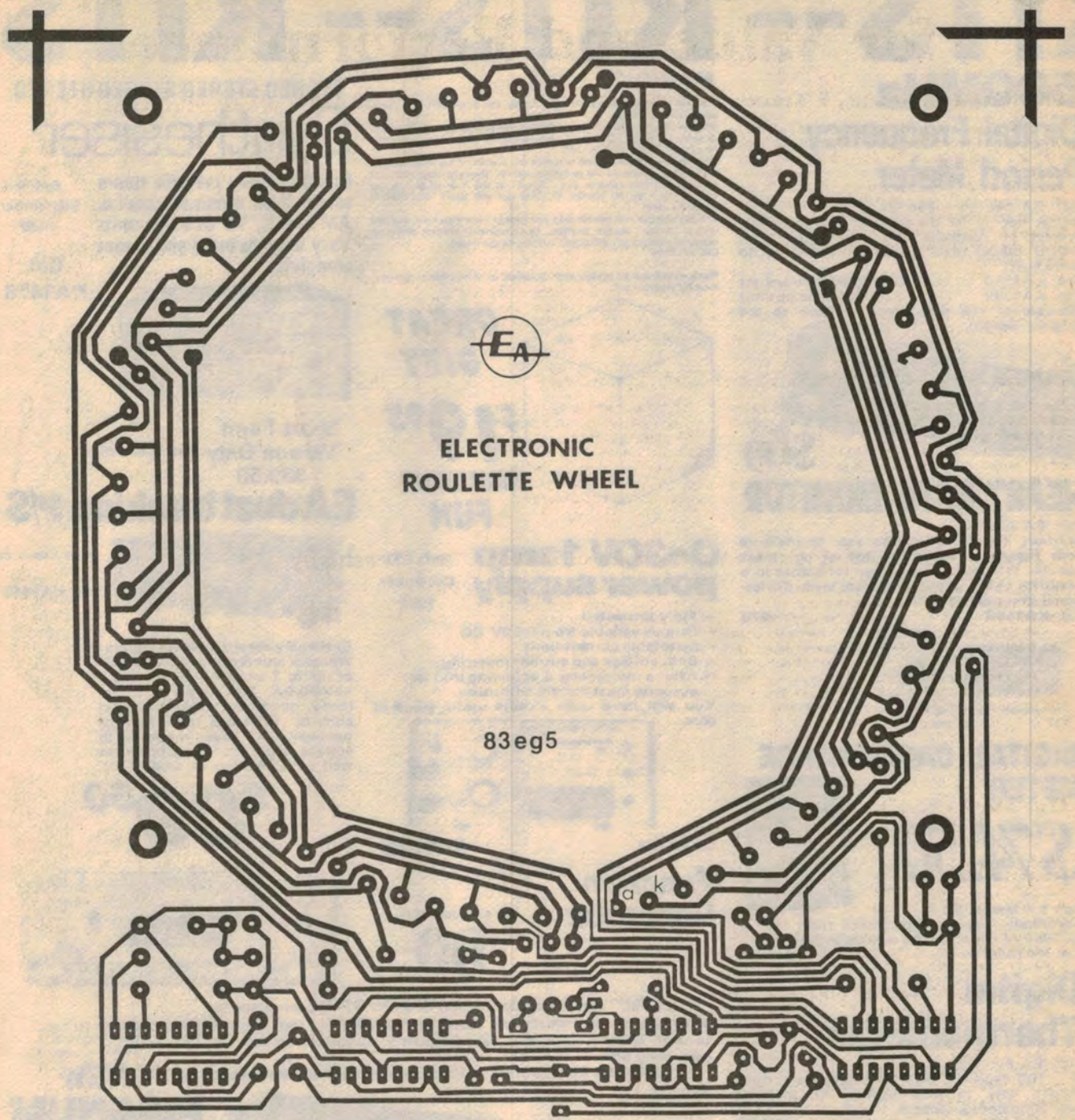


Photostat this page and use the design above on the front panel of the roulette wheel. Be certain that the design is centred on the panel. If the control panel is incorporated use the additional label shown below.

power +

play +

Electronic Roulette



The full-size PCB pattern for the upper section of the board. A 90mm section below the pattern carries the switches.

care of together; we have etched an "a" and "k" in the copper pattern to indicate the position and polarity of the first LED to be mounted. Once this one is correctly fitted, the remainder will fall into place naturally. (The longer of the two LED leads is the anode, and the flat on the plastic encapsulation is adjacent to the cathode.)

The rest of the components can now be mounted on the PCB. The ICs are all CMOS devices, so take the usual precautions. Wire up the switches, speaker and battery and let 'er roll!