# ELECTRONIC ROULETTE KIT

## MODEL AK-300


## Instruction & Assembly Manual

# ELENCO®

 Revised 2015 REV-H 753031

## PARTS LIST

If you are a student, and any parts are missing or damaged, please see instructor or bookstore. If you purchased this roulette kit from a distributor, catalog, etc., please contact ELENCO® (address/phone/e-mail is at the back of this manual) for additional assistance, if needed. **DO NOT** contact your place of purchase as they will not be able to help you.

### RESISTORS

| Qty. | Symbol | Value | Color Code | Part # |
|---|---|---|---|---|
| ❒ 1 | R22 | 1kΩ 5% 1/4W | brown-black-red-gold | 141000 |
| ❒ 4 | R1 - R4 | 1.2kΩ 5% 1/4W | brown-red-red-gold | 141200 |
| ❒ 1 | R19 | 1.5kΩ 5% 1/4W | brown-green-red-gold | 141500 |
| ❒ 5 | R5 - R9 | 10kΩ 5% 1/4W | brown-black-orange-gold | 151000 |
| ❒ 2 | R15, R16 | 20kΩ 5% 1/4W | red-black-orange-gold | 152000 |
| ❒ 1 | R13 | 47kΩ 5% 1/4W | yellow-violet-orange-gold | 154700 |
| ❒ 1 | R17 | 56kΩ 5% 1/4W | green-blue-orange-gold | 155600 |
| ❒ 2 | R11, R20 | 100kΩ 5% 1/4W | brown-black-yellow-gold | 161000 |
| ❒ 1 | R24 | 270kΩ 5% 1/4W | red-violet-yellow-gold | 162700 |
| ❒ 1 | R14 | 330kΩ 5% 1/4W | orange-orange-yellow-gold | 163300 |
| ❒ 1 | R10 | 820kΩ 5% 1/4W | gray-red-yellow-gold | 168200 |
| ❒ 1 | R23 | 1.8MΩ 5% 1/4W | brown-gray-green-gold | 171800 |
| ❒ 1 | R12 | 2.2MΩ 5% 1/4W | red-red-green-gold | 172200 |
| ❒ 1 | R18 | 3.3MΩ 5% 1/4W | orange-orange-green-gold | 173300 |
| ❒ 1 | R21 | 4.7MΩ 5% 1/4W | yellow-violet-green-gold | 174700 |

### CAPACITORS

| Qty. | Symbol | Value | Description | Part # |
|---|---|---|---|---|
| ❒ 1 | C4 | 0.001μF | Discap (102) | 231036 |
| ❒ 1 | C2 | 0.0033μF | Mylar (332) | 233317 |
| ❒ 1 | C1 | 0.02μF or 0.022μF | Discap (203 or 223) | 242010 |
| ❒ 1 | C5 | 0.47μF | Electrolytic (Lytic) | 254747 |
| ❒ 2 | C3, C6 | 1μF | Electrolytic (Lytic) | 261047 |
| ❒ 2 | C7, C8 | 100μF | Electrolytic (Lytic) | 281044 |

### SEMICONDUCTORS

| Qty. | Symbol | Value | Description | Part # |
|---|---|---|---|---|
| ❒ 2 | D41, D43 | 1N4001 | Diode | 314001 |
| ❒ 3 | D39, D40, D42 | 1N4148 | Diode | 314148 |
| ❒ 7 | Q1 - Q4, Q7 - Q9 | 2N3904 | Transistor | 323904 |
| ❒ 2 | Q5, Q6 | 2N3906 | Transistor | 323906 |
| ❒ 2 | U1, U3 | 4017 | Integrated circuit (IC) | 334017 |
| ❒ 1 | U2 | 4069 | Integrated circuit (IC) | 334069 |
| ❒ 36 | D1 - D36 | | LED red | 350002 |
| ❒ 2 | D37, D38 | | LED green | 350010 |

### MISCELLANEOUS

| Qty. | Symbol | Description | Part # | Qty. | Symbol | Description | Part # |
|---|---|---|---|---|---|---|---|
| ❒ 1 | | PC board | 517100 | ❒ 4 | | Flat washer black | 645404 |
| ❒ 1 | S1 | Push button switch | 540101 | ❒ 3 | | Flat washer white | 645600 |
| ❒ 1 | BT | Battery holder 9V | 590096 | ❒ 1 | U2 | 14-pin socket | 664014 |
| ❒ 1 | BZ1 | Buzzer piezoelectric | 595201 | ❒ 2 | U1, U3 | 16-pin socket | 664016 |
| ❒ 4 | | Plastic spacer | 624010 | ❒ 1 | | Paper clip | 680018 |
| ❒ 3 | | Screw 2-56 x 5/16” | 641231 | ❒ 1 | | 4” Wire 22ga. black solid | 814120 |
| ❒ 8 | | Screw 4-40 x 1/4” black | 641433 | ❒ 1 | | 40” Wire 22ga. bare | 845000 |
| ❒ 3 | | Nut 2-56 hex | 644201 | ❒ 1 | | Lead-free solder tube | LF99 |

****** SAVE THE BOX THAT THIS KIT CAME IN. IT WILL BE USED ON PAGE 10. ******

## IDENTIFYING RESISTOR VALUES

Use the following information as a guide in properly identifying the value of resistors.

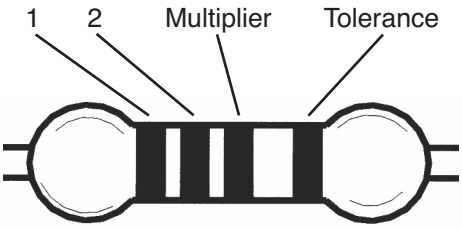
| BAND 1 1st Digit | |
|---|---|
| **Color** | **Digit** |
| Black | 0 |
| Brown | 1 |
| Red | 2 |
| Orange | 3 |
| Yellow | 4 |
| Green | 5 |
| Blue | 6 |
| Violet | 7 |
| Gray | 8 |
| White | 9 |

| BAND 2 2nd Digit | |
|---|---|
| **Color** | **Digit** |
| Black | 0 |
| Brown | 1 |
| Red | 2 |
| Orange | 3 |
| Yellow | 4 |
| Green | 5 |
| Blue | 6 |
| Violet | 7 |
| Gray | 8 |
| White | 9 |

| Multiplier | |
|---|---|
| **Color** | **Multiplier** |
| Black | 1 |
| Brown | 10 |
| Red | 100 |
| Orange | 1,000 |
| Yellow | 10,000 |
| Green | 100,000 |
| Blue | 1,000,000 |
| Silver | 0.01 |
| Gold | 0.1 |

| Resistance Tolerance | |
|---|---|
| **Color** | **Tolerance** |
| Silver | ±10% |
| Gold | ±5% |
| Brown | ±1% |
| Red | ±2% |
| Orange | ±3% |
| Green | ±0.5% |
| Blue | ±0.25% |
| Violet | ±0.1% |

**BANDS**



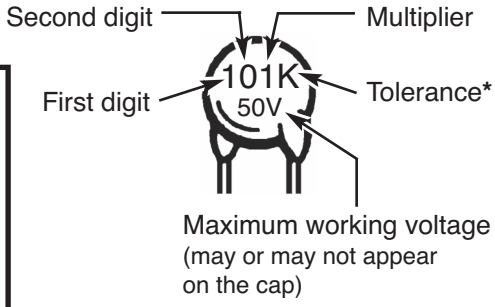

## IDENTIFYING CAPACITOR VALUES

Capacitors will be identified by their capacitance value in pF (picofarads), nF (nanofarads), or μF (microfarads). Most capacitors will have their actual value printed on them. Some capacitors may have their value printed in the following manner. The maximum operating voltage may also be printed on the capacitor.

Electrolytic capacitors have a positive and a negative electrode. The negative lead is indicated on the packaging by a stripe with minus signs and possibly arrowheads. Also, the negative lead of a radial electrolytic is shorter than the positive one.

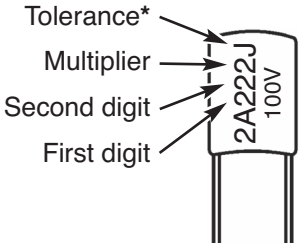
| Multiplier | For the No. | 0 | 1 | 2 | 3 | 4 | 5 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| | Multiply By | 1 | 10 | 100 | 1k | 10k | 100k | .01 | 0.1 |

**CERAMIC DISC**




The value is 10 x 10 = 100pF, ±10%, 50V

**MYLAR**




The value is 22 x 100 = 2,200pF or 0.0022μF, ±5%, 100V

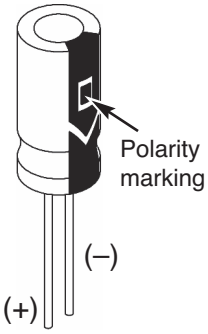
* The letter M indicates a tolerance of ±20%
The letter K indicates a tolerance of ±10%
The letter J indicates a tolerance of ±5%

**Note:** The letter "R" may be used at times to signify a decimal point; as in 3R3 = 3.3

### Warning:

**If the capacitor is connected with incorrect polarity, it may heat up and either leak, or cause the capacitor to explode.**


**Axial**




**Radial**

## METRIC UNITS AND CONVERSIONS

| Abbreviation | Means | Multiply Unit By | Or |
|---|---|---|---|
| p | Pico | 0.000000000001 | $10^{-12}$ |
| n | nano | 0.000000001 | $10^{-9}$ |
| μ | micro | 0.000001 | $10^{-6}$ |
| m | milli | 0.001 | $10^{-3}$ |
| – | unit | 1 | $10^{0}$ |
| k | kilo | 1,000 | $10^{3}$ |
| M | mega | 1,000,000 | $10^{6}$ |

| | |
|---|---|
| 1. 1,000 pico units | = 1 nano unit |
| 2. 1,000 nano units | = 1 micro unit |
| 3. 1,000 micro units | = 1 milli unit |
| 4. 1,000 milli units | = 1 unit |
| 5. 1,000 units | = 1 kilo unit |
| 6. 1,000 kilo units | = 1 mega unit |

## INTRODUCTION

Electronic Roulette (roo-let) replaces the ivory ball with a circuit of flashing light emitting diodes (LEDs). Red LEDs are arranged in a circle next to a black or red number and two green LEDs are positioned next to “0” and “00”. When the switch is pushed, the LEDs light one after another, in a sequence that represents the movement of the ivory ball. The number next to the lit LED when movement stops is the winning number. During movement, the sound of a bouncing ball is generated. If the switch is not pressed again, the circuits will automatically turn off, to conserve the battery power. A constant tone will alert you to check your number before automatic shut down.

## THEORY OF OPERATION

### THE BLOCK DIAGRAM

The function of many of the circuits will be presented in the form of an analogy (similar operation, but easier-to-understand system). In this manner, the operation of a circuit can be explained without the use of mathematics and equations.

Figure 1 shows a Block Diagram of the Electronic Roulette circuits. The Timer circuit is used to turn all the other circuits on and off. The Pulse Generator makes pulses that create the sound and force the ring counter to move the position of the lit LED. The Sound Circuit generates the sound of a bouncing ivory ball, and a warning tone a few seconds before power down. The Ring Counter lights each LED in a circular sequence. The LEDs represent the position of the ivory ball.

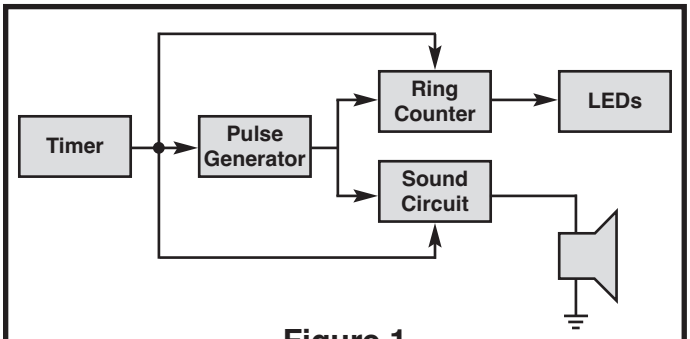



Figure 1

### THE TIMER

When S1, the start button, is pushed, capacitor C7 (Figure 2, Schematic Diagram) is charged to the battery voltage. This is similar to flipping the “Timer Glass” shown in Figure 2a to produce the condition shown in Figure 2b. Just as the sand runs down holding the lever arm up (Figure 2b), the charges in th capacitor C7 forces transistors Q6, Q8, and Q9 on. As long as the lever arm is up in Figure 2b, the other circuits are powered through the contact C1 on switch X1. At first, due to the weight of the sand (similar to capacitor C7 being fully charged), the contact C2 will open and remain open. Right before the sand totally runs out (capacitor C7 has lost most of its charge), the contact C2 will close, as shown in Figure 2c, and sound an alarm to warn you that the contact C1 is about to open and turn all the power off, including the power to the warning circuit. Eventually all the sand runs out of the “Timer Glass” (capacitor C7 has discharged) and the power is turned off (Figure 2a). To make the timer stay on longer, you could get a bigger “Timer Glass” (larger capacitor for C7) that holds more sand and replace the smaller one.

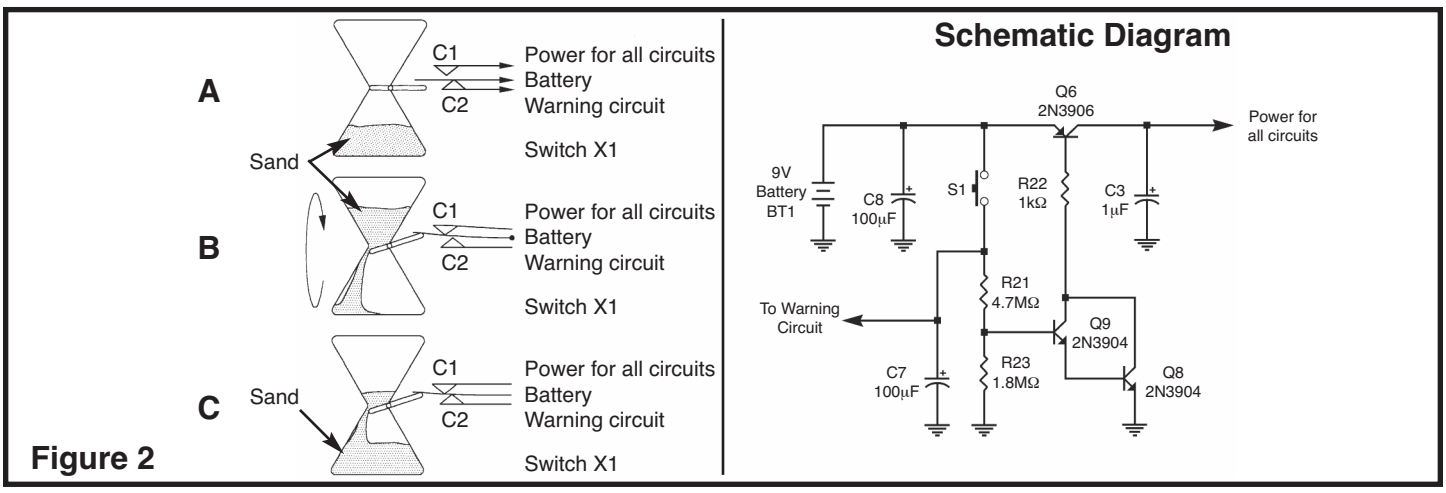



Figure 2

## THE PULSE GENERATOR

Assume that part of the sand from the "Timer Glass" in Figure 2 is poured into a bucket as shown in Figure 3a. When the bucket has enough sand, it will flip and dump as shown in Figure 3b. Each time it flips, it closes switch X2, sending the battery voltage to the Ring Counter and it strikes the "Drum" producing a sound. The bucket in Figures 3a & 3b represents capacitor C6 in the schematic diagram on page 12. Capacitor C6 charges (charging = filling the bucket with sand) through resistor R20 and discharges (dumping the sand) through resistor R19 and diode D41. Each time the sand changes buckets, a pulse is sent to the Ring Counter and to the Sound Circuit. When the bucket is empty, the spring returns it to the filling position shown in Figure 3a. The sand going into the bucket will flow slower as the "Timer Glass" in Figure 2 runs out of sand. It will take longer and longer to fill the bucket as the sand runs out. This produces more space between the pulses sent to the ring counter and has the effect of slowing down the rotation of the lights, similar to the ivory ball slowing down on a roulette wheel.

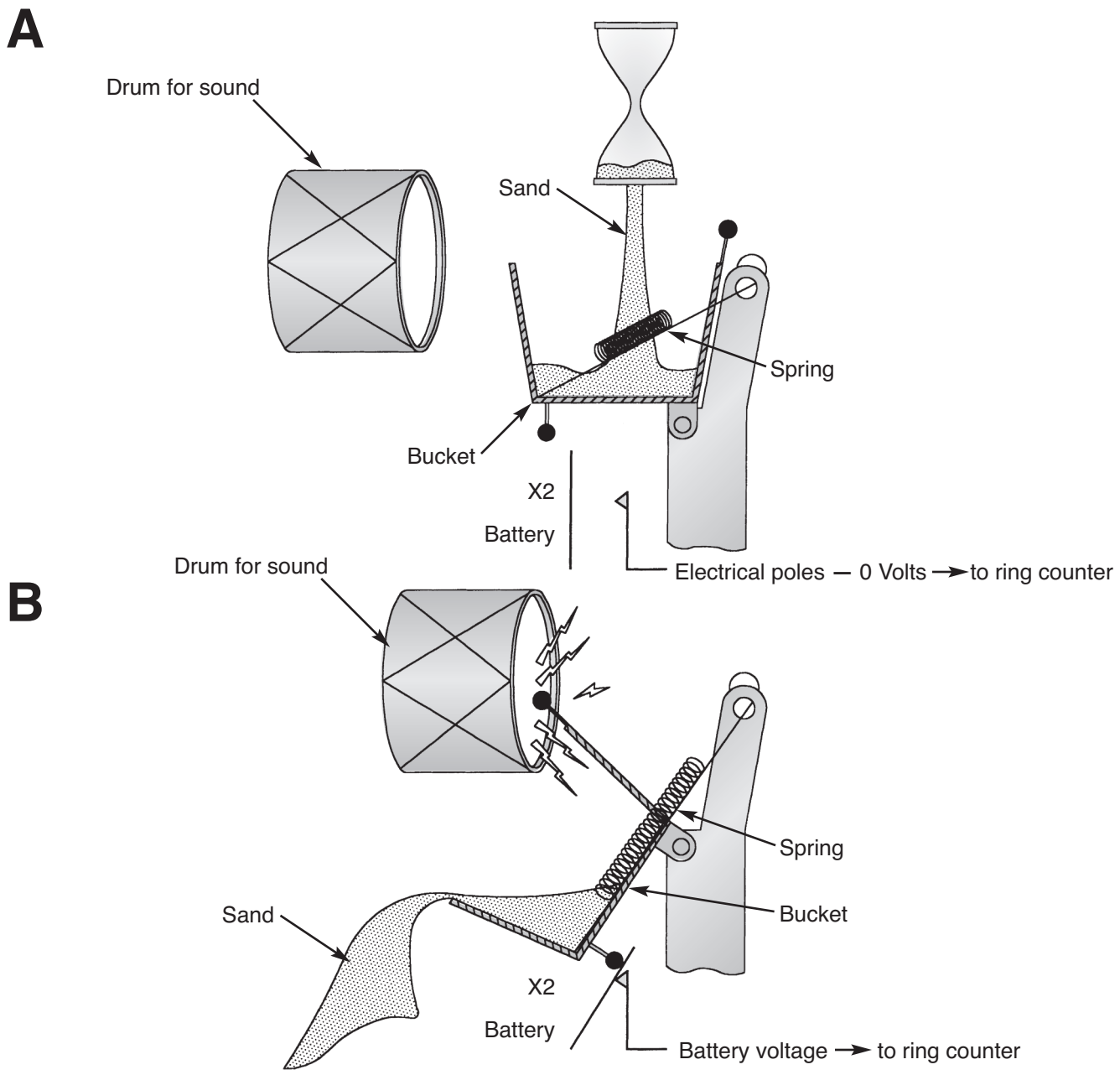



**Figure 3 Pulse Generator**

## THE SOUND CIRCUIT

In the sound generator circuit, a 500Hz oscillator is always running. This oscillator is represented by the spinning wheel in Figure 4a. No sound is heard because the spinning wheel is not hitting the drum. When the bucket in Figure 3 dumps sand, the lever arm pushes the spinning wheel against the stop and the small balls on the spinning wheel hit the drum, producing a high frequency sound (Figure 4b). The lever arm turns the sound on and represents transistor Q7 in Figure 4c. When the lever arm is removed, the spring pulls the spinning wheel away from the drum and the sound stops. In much the same way, transistor Q7 turns off shortly after a pulse is received. This action stops electrical current from flowing through the piezoelectric buzzer (drum), eliminating the sound. Just before power down, transistor Q7 is turned on and kept on to produce the warning sound.

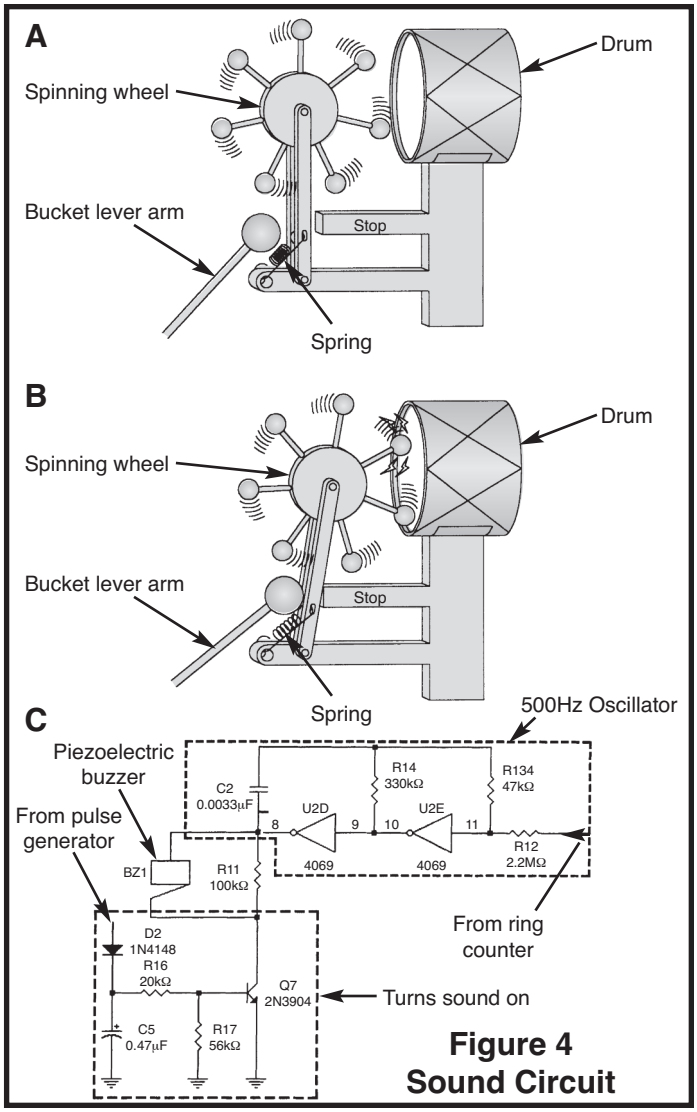



**Figure 4**
**Sound Circuit**

## THE RING COUNTER

In its simplest form, the ring counter can be compared to a circle of buckets with only one bucket filled with sand as shown in Figure 5a. Because of the weight of the sand, the filled bucket hangs lower than all of the rest. When a pulse is received from the pulse generator circuit, it pushes the sand to the next bucket as shown in Figure 5b. This process continues passing the sand from bucket to bucket in a circle, until no more pulses are received from the pulse generator.

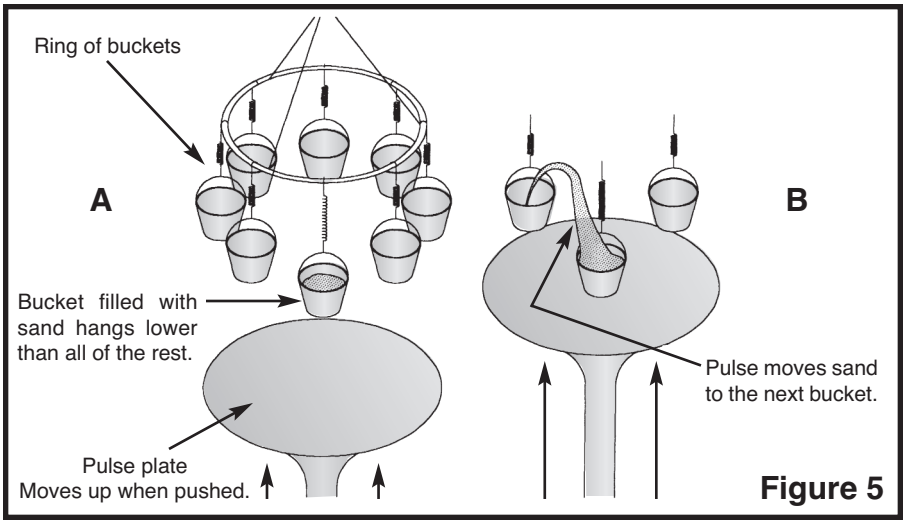



**Figure 5**

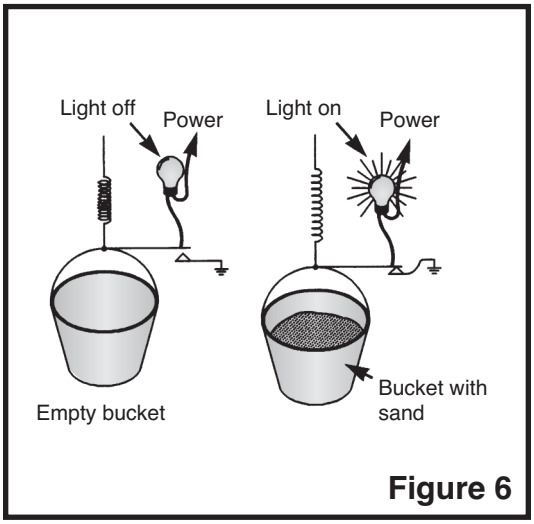



**Figure 6**

## THE LEDs

The Light Emitting Diodes (LEDs) are no more than small electronic lights. If they are arranged in a circle and connected to a ring counter, they can be used to represent the ivory ball position on the roulette wheel. When the buckets filled with sand stretch out the springs in Figure 5, they could also close a switch as shown in Figure 6. This would light the next light in the circle and produce the effect of a ball spinning around the roulette wheel. As the pulses get further and further apart, the electronic ball will appear to slow down and eventually stop.

# CONSTRUCTION

## Introduction

The most important factor in assembling your AK-300 Electronic Roulette Kit is good soldering techniques. Using the proper soldering iron is of prime importance. A small pencil type soldering iron of 25 watts is recommended. **The tip of the iron must be kept clean at all times and well-tinned.**

## Solder

For many years leaded solder was the most common type of solder used by the electronics industry, but it is now being replaced by lead-free solder for health reasons. This kit contains lead-free solder, which contains 99.3% tin, 0.7% copper, and has a rosin-flux core.

Lead-free solder is different from lead solder: It has a higher melting point than lead solder, so you need higher temperature for the solder to flow properly. Recommended tip temperature is approximately 700ºF; higher temperatures improve solder flow but accelerate tip decay. An increase in soldering time may be required to achieve good results. Soldering iron tips wear out faster since lead-free solders are more corrosive and the higher soldering temperatures accelerate corrosion, so proper tip care is important. The solder joint finish will look slightly duller with lead-free solders.

Use these procedures to increase the life of your soldering iron tip when using lead-free solder:

- Keep the iron tinned at all times.
- Use the correct tip size for best heat transfer. The conical tip is the most commonly used.
- Turn off iron when not in use or reduce temperature setting when using a soldering station.
- Tips should be cleaned frequently to remove oxidation before it becomes impossible to remove. Use Dry Tip Cleaner (Elenco® #SH-1025) or Tip Cleaner (Elenco® #TTC1). If you use a sponge to clean your tip, then use distilled water (tap water has impurities that accelerate corrosion).

## Safety Procedures

- **Always wear safety glasses or safety goggles to protect your eyes when working with tools or soldering iron, and during all phases of testing.**
- Be sure there is **adequate ventilation** when soldering.
- Locate soldering iron in an area where you do not have to go around it or reach over it. Keep it in a safe area away from the reach of children.
- **Do not hold solder in your mouth.** Solder is a toxic substance. Wash hands thoroughly after handling solder.

## Assemble Components

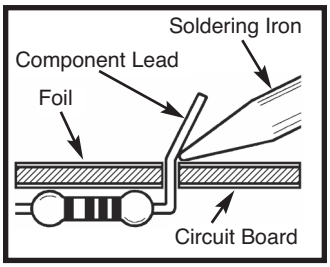
In all of the following assembly steps, the components must be installed on the top side of the PC board unless otherwise indicated. The top legend shows where each component goes. The leads pass through the corresponding holes in the board and are soldered on the foil side.
**Use only rosin core solder.**

**DO NOT USE ACID CORE SOLDER!**

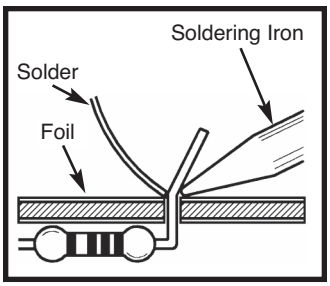
## What Good Soldering Looks Like

A good solder connection should be bright, shiny, smooth, and uniformly flowed over all surfaces.

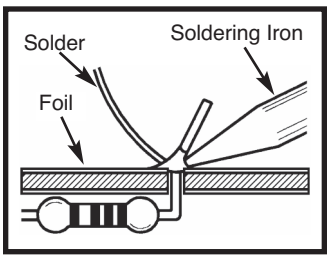
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



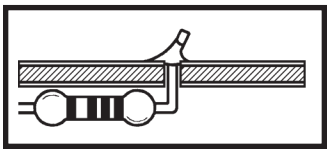

2. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and the circuit foil to melt the solder.




3. Allow the solder to flow around the connection. Then, remove the solder and the iron and let the connection cool. The solder should have flowed smoothly and not lump around the wire lead.

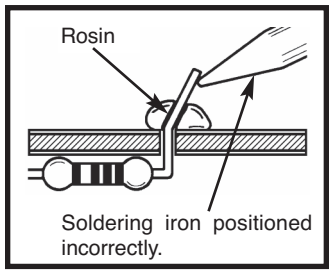



4. Here is what a good solder connection looks like.

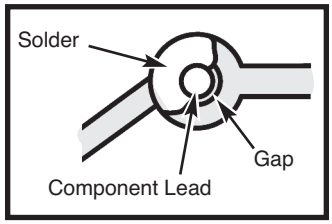


## Types of Poor Soldering Connections

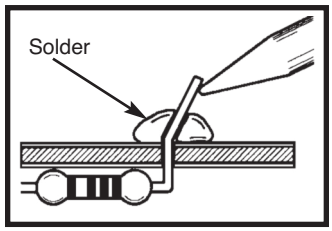
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



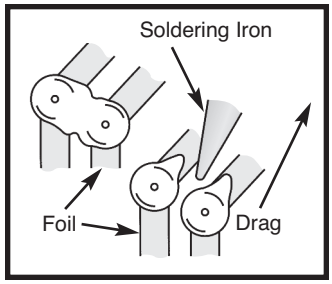

2. **Insufficient solder** - let the solder flow over the connection until it is covered.
   Use just enough solder to cover the connection.




3. **Excessive solder** - could make connections that you did not intend to between adjacent foil areas or terminals.




4. **Solder bridges** - occur when solder runs between circuit paths and creates a short circuit. This is usually caused by using too much solder.
   To correct this, simply drag your soldering iron across the solder bridge as shown.



## ASSEMBLE COMPONENTS TO THE PC BOARD

Identify and install the following parts as shown. After soldering each part, place a check ☑ in the box provided. Space the LEDs with a paper clip (use size shown below) so that they are 1/4” off of the PC board.

☐ U1 - 16-pin IC socket
☐ U1 - 4017 Integrated circuit (IC) (see Figure B)

☐ R1 - 1.2kΩ 5% 1/4W Resistor
☐ R2 - 1.2kΩ 5% 1/4W Resistor
☐ R3 - 1.2kΩ 5% 1/4W Resistor
☐ R4 - 1.2kΩ 5% 1/4W Resistor (brown-red-red-gold)

☐ Q1 - 2N3904 Transistor
☐ Q2 - 2N3904 Transistor
☐ Q3 - 2N3904 Transistor
☐ Q4 - 2N3904 Transistor (see Figure C)

☐ R5 - 10kΩ 5% 1/4W Resistor
☐ R6 - 10kΩ 5% 1/4W Resistor
☐ R7 - 10kΩ 5% 1/4W Resistor
☐ R8 - 10kΩ 5% 1/4W Resistor (brown-black-orange-gold)

☐ Q5 - 2N3906 Transistor (see Figure C)

☐ U3 - 16-pin IC socket
☐ U3 - 4017 Integrated circuit (IC) (see Figure B)

☐ C4 - 0.001μF (102) Capacitor

☐ C5 - 0.47μF Electrolytic (see Figure D)

☐ R10 - 820kΩ 5% 1/4W Resistor (gray-red-yellow-gold)

☐ R11 - 100kΩ 5% 1/4W Resistor (brown-black-yellow-gold)

☐ D38 - LED Green (see Figure A)

☐ Q7 - 2N3904 Transistor (see Figure C)

☐ R16 - 20kΩ 5% 1/4W Resistor (red-black-orange-gold)

☐ C6 - 1μF Electrolytic (see Figure D)

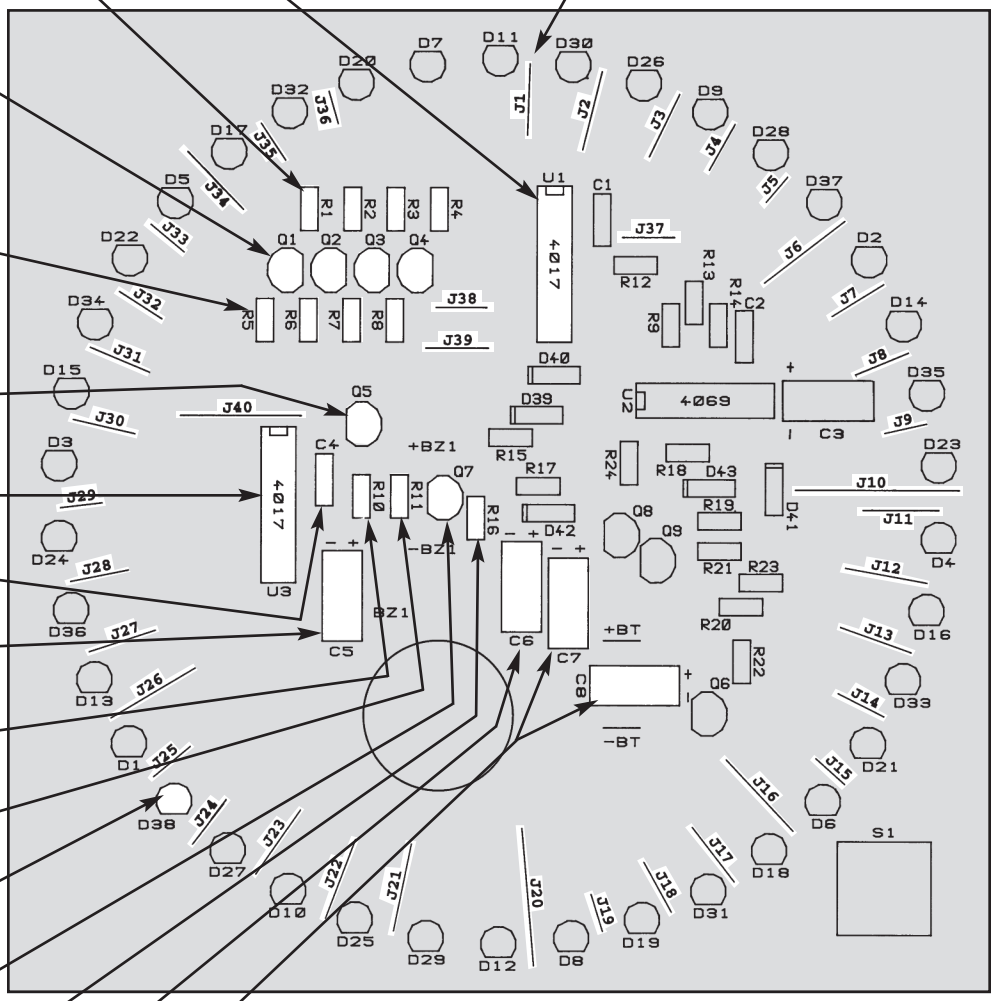
☐ C7 - 100μF Electrolytic
☐ C8 - 100μF Electrolytic (see Figure D)

**Note: Install the jumper wires first.**

Install jumper wires J1 – J40 using bare wire.

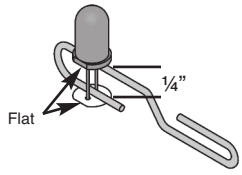
☐ J1 – J40 - Jumper wires (see Figure G)


**LED spacer** (Actual size)



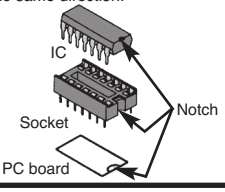

### Figure A

Mount the LED onto the PC board with the flat side of the LED in the same direction as marked on the PC board. Space the LEDs with a paper clip. Make sure that it is ¼”.



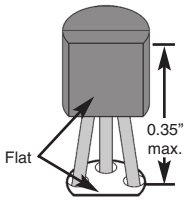

### Figure B

Mount the IC socket onto the PC board with the notch in the same direction as marked on the PC board. Then, mount the IC onto the socket with the notches in the same direction.




### Figure C

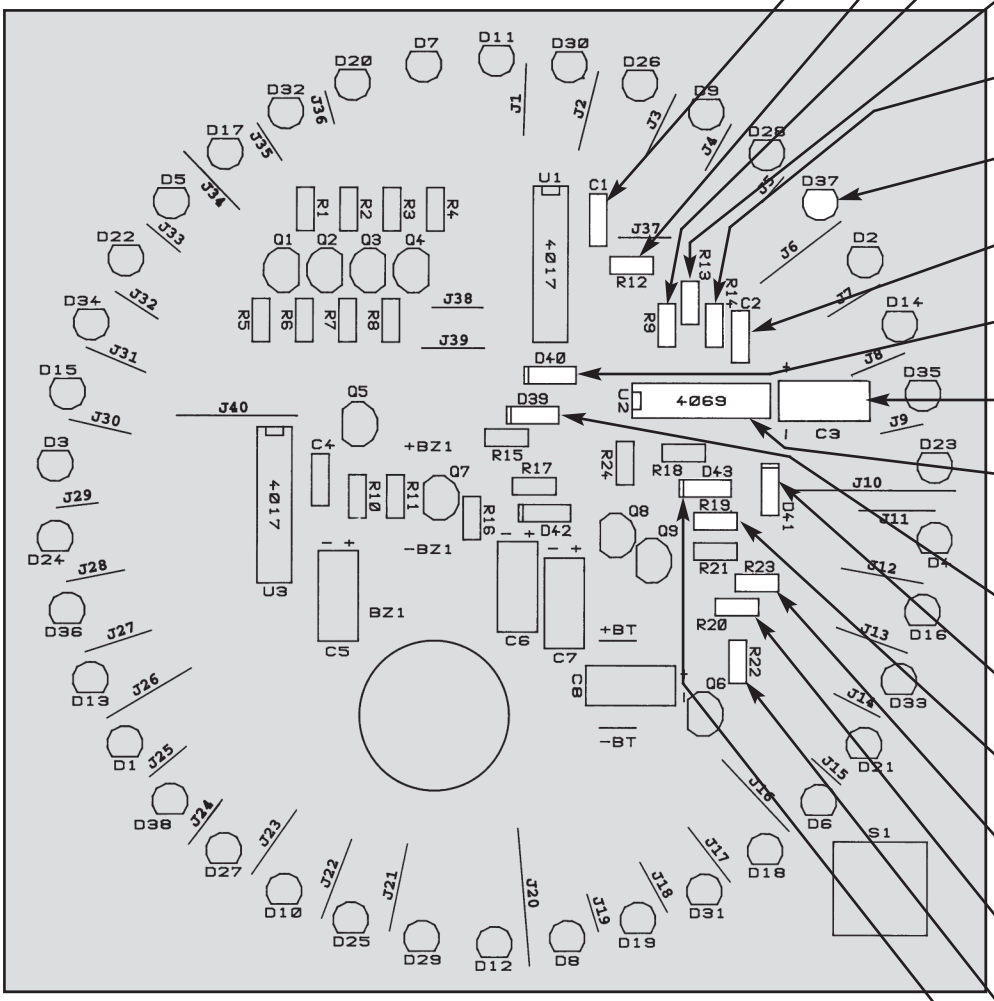
Mount the transistor with the flat side in the same direction as marked on the PC board.



## ASSEMBLE COMPONENTS TO THE PC BOARD

Identify and install the following parts as shown. After soldering each part, place a check ☑ in the box provided. Space the LEDs with a paper clip (use size shown below) so that they are 1/4” off of the PC board.


**LED spacer** (Actual size)



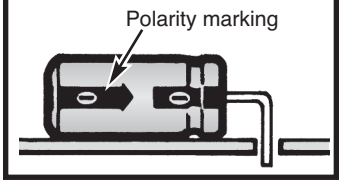

- ☐ C1 - 0.02μF or 0.022μF (203 or 223) Discap
- ☐ R12 - 2.2MΩ 5% 1/4W Resistor (red-red-green-gold)
- ☐ R9 - 10kΩ 5% 1/4W Resistor (brown-black-orange-gold)
- ☐ R13 - 47kΩ 5% 1/4W Resistor (yellow-violet-orange-gold)
- ☐ R14 - 330kΩ 5% 1/4W Resistor (orange-orange-yellow-gold)
- ☐ D37 - LED green (see Figure A)
- ☐ C2 - 0.0033μF (332) Mylar cap. (see Figure F)
- ☐ D40 - 1N4148 Diode (see Figure E)
- ☐ C3 - 1μF Electrolytic (see Figure D)
- ☐ U2 - 14-pin IC socket
- ☐ U2 - 4069 Integrated circuit (IC) (see Figure B)
- ☐ D39 - 1N4148 Diode (see Figure E)
- ☐ D41 - 1N4001 Diode (see Figure E)
- ☐ R19 - 1.5kΩ 5% 1/4W Resistor (brown-green-red-gold)
- ☐ R23 - 1.8MΩ 5% 1/4W Resistor (brown-gray-green-gold)
- ☐ R20 - 100kΩ 5% 1/4W Resistor (brown-black-yellow-gold)
- ☐ R22 - 1kΩ 5% 1/4W Resistor (brown-black-red-gold)
- ☐ D43 - 1N4001 Diode (see Figure E)

### Figure D

Electrolytic capacitors have polarity. Be sure to mount them with the negative (–) lead (marked on the side) in the correct hole. Bend the capacitor 90° as shown below.

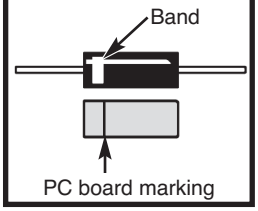
Be sure that the negative lead is in the correct hole on the PC board.

**Warning:** If the capacitor is connected with incorrect polarity it may heat up and either leak or cause the capacitor to explode.



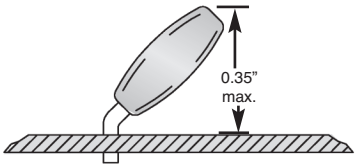

### Figure E

Mount the diode with the band in the same direction as marked on the PC board.




### Figure F

Mount the mylar capacitor at a 45° angle to the PC board with 0.35” maximum height as shown below.




### Figure G

Use the bare wire supplied to form a jumper wire. Bend the wire to the correct length and mount it to the PC board.

## ASSEMBLE COMPONENTS TO THE PC BOARD

Identify and install the following parts as shown. After soldering each part, place a check ☑ in the box provided.


**LED Spacer** (Actual Size)

☐ D1 – D36 - LED Red (be sure to note the flat side when installing). (see Figure A)

☐ R15 - 20kΩ 5% 1/4W Resistor (red-black-orange-gold)

☐ R17 - 56kΩ 5% 1/4W Resistor (green-blue-orange-gold)

☐ D42 - 1N4148 Diode (see Figure E)

☐ R24 - 270kΩ 5% 1/4W Resistor (red-violet-yellow-gold)

☐ R18 - 3.3MΩ 5% 1/4W Resistor (orange-orange-green-gold)

☐ R21 - 4.7MΩ 5% 1/4W Resistor (yellow-violet-green-gold)

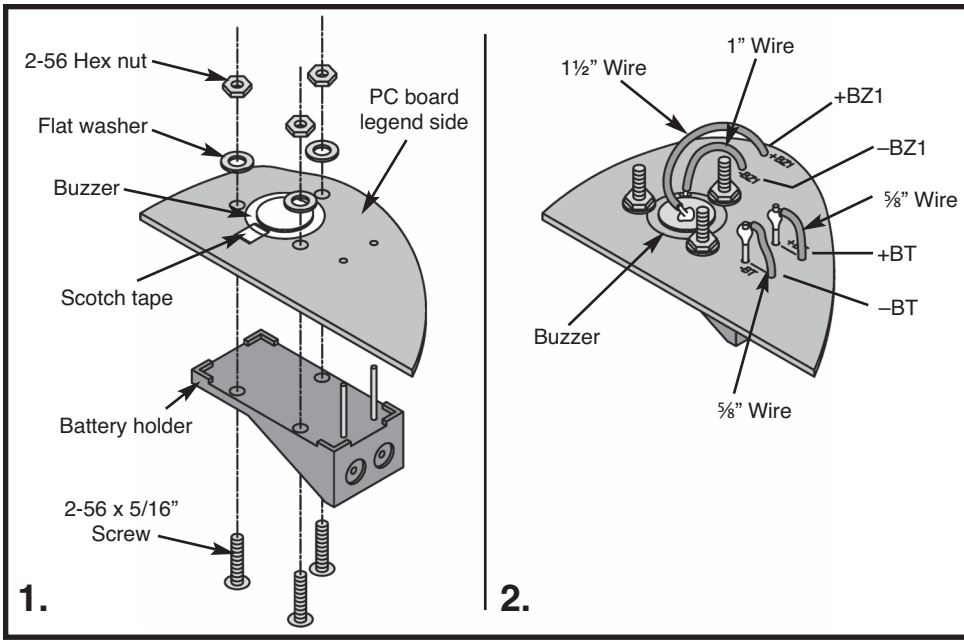
☐ Q9 - 2N3904 Transistor (see Figure C)

☐ Q8 - 2N3904 Transistor (see Figure C)

☐ Q6 - 2N3906 Transistor (see Figure C)

☐ S1 - Switch

☐ BT - Battery holder
☐ BZ1 - Buzzer
☐ 3 Screw 2-56 x 5/16”
☐ 3 Nut 2-56 Hex
☐ 3 Flat Washer White
☐ 4” Wire 22 ga. (see Figure H)




### Figure H

Mount the battery holder and buzzer to the PC board as shown (1). **Note:** Use a piece of Scotch Tape on the brass part only to hold the buzzer in place. Solder a ⅝” wire from the positive (+) battery holder lead to the +BT point on the PC board (2). Solder a ⅝” wire from the negative (–) battery holder lead to the –BT point on the PC board. Solder a 1” wire from the outer edge of the buzzer to –BZ1. Solder a 1½” wire from the inner circle of the buzzer to +BZ1. **Note:** Do not let the flat washers touch the silver part of the buzzer of let the solder from the wire from the outer edge touch the silver part.

## COMPONENT CHECK

- ❒ Make sure that all components have been mounted in their correct places.
- ❒ Make sure that the LEDs have been installed correctly. The flat side of the LEDs should be in the same direction as shown on the top legend.
- ❒ Make sure that diodes D39 - D43 have not been installed backwards. The band on the diodes should be in the same direction as shown on the PC board.
- ❒ Make sure that transistors Q1 - Q9 are installed with their flat sides in the same direction as marked on the PC board.
- ❒ Are capacitors C5 - C8 installed correctly? These capacitors have polarity. Be sure that the negative lead is in the correct hole.
- ❒ Make sure that the ICs are installed correctly. The notch should be in the same direction as shown on the top legend of the PC board.
- ❒ Put a 9V alkaline battery into the battery holder and push the switch.

## TROUBLESHOOTING

One of the most frequently occurring problems is poor solder connections.

1. Tug slightly on all parts to make sure that they are indeed soldered.
2. All solder connections should be shiny. Resolder any that are not.
3. Solder should flow into a smooth puddle rather than a round ball. Resolder any connection that has formed into a ball.
4. Have any solder bridges formed? A solder bridge may occur if you accidentally touch an adjacent foil by using too much solder or by dragging the soldering iron across adjacent foils. Break the bridge with your soldering iron.

## FINAL ASSEMBLY

- ❒ Mount the four plastic spacers onto the four corners of the PC board from the foil side with four 4-40 x ¼” black screws (see Figure I).
- ❒ Punch out and save the chips from the box as shown in Figure J. Slide the PC board into the box and mount the PC board with four 4-40 x ¼” screws and four black washers (see Figure K). Cut the strip off of the box as shown.
- ❒ Tape the box lid shut (see Figure L) and you’re ready to go!

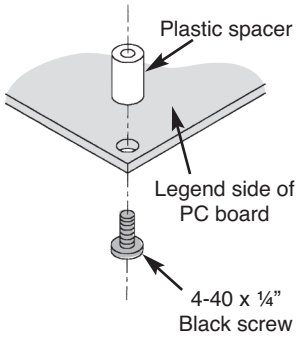


Figure I

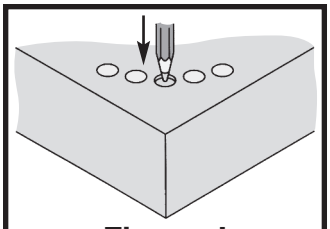


Figure J

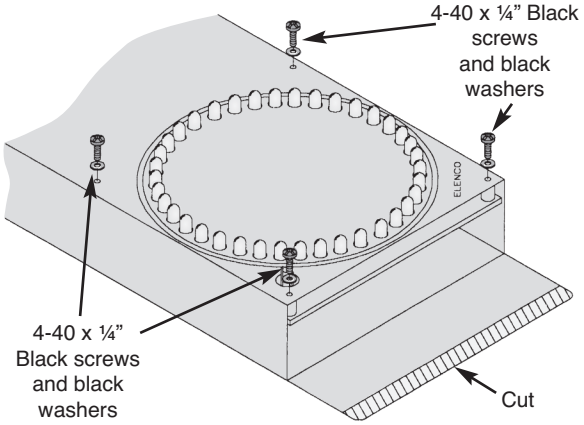


Figure K

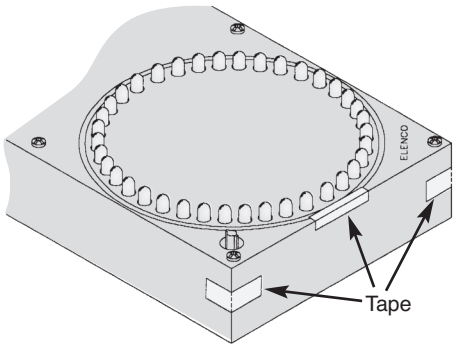


Figure L

## OPERATING INSTRUCTIONS

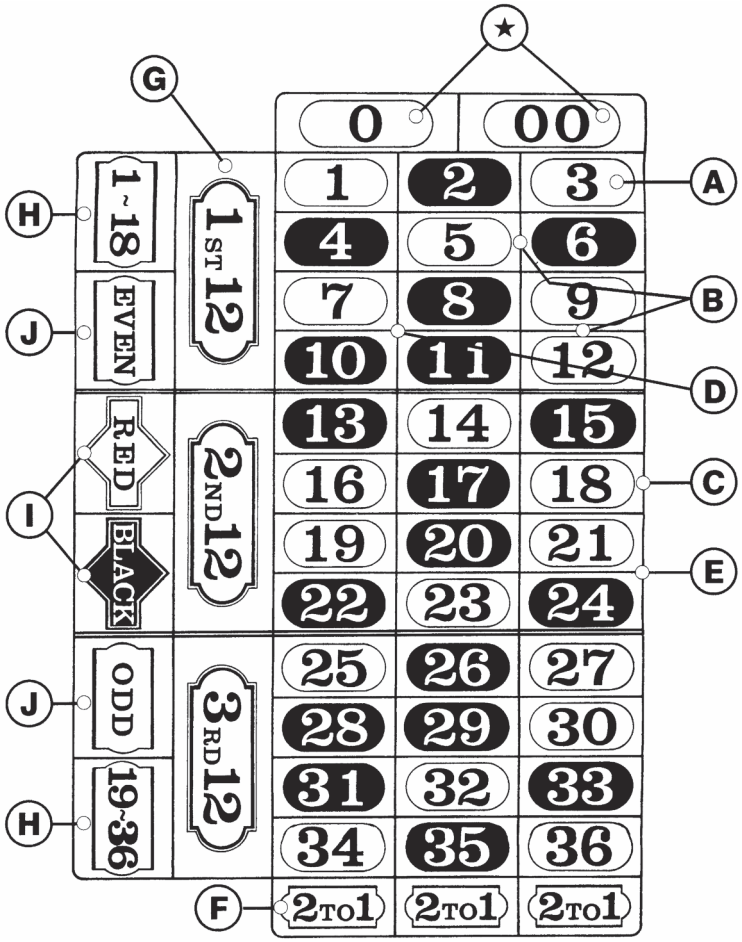
### CHART A

| Strategies | Explanation | Payoff |
|---|---|---|
| A) Single Straight | Chips on a number from 1-36 including 0 and 00. | 36 times |
| B) Split | Chips on two numbers vertically or horizontally next to one another. | 18 times |
| C) Street | Chips on three numbers horizontally in one line. | 12 times |
| D) Corner | Chips on four numbers vertically and horizontally next to one another. | 9 times |
| E) Line | Chips on six numbers in two horizontal lines next to one another. | 6 times |
| F) Column | Chips on twelve numbers in one vertical line. | 3 times |
| G) 1ST Dozen<br>2ND Dozen<br>3RD Dozen | Chips on twelve numbers in 1ST twelve, 2ND twelve, or 3RD twelve. | 3 times |
| H) Low or High | Chips on eighteen numbers either from 1 to 18 or from 19 to 36. | 2 times |
| I) Red or Black | Chips on "Red" or "Black" Betting on all numbers which are red or black. | 2 times |
| J) Odd or Even | Chips on "Odd" or "Even" Betting on all numbers which are either odd or even. | 2 times |

**Chip Values**

Gold.....$100
Green.....$25
Red.....$5
White.....$1

### CHART B




★ If the LED stops at 0 or 00 (green LEDs), only the players who have wagered directly on these numbers win with a return of 35 times. Players who have wagered on individual numbers do not lose on 0 or 00. They may take back their wager or leave it for the next game at full value.

## PROBABILITY

If among (F+U) equi-probable and mutually exclusive events, F is regarded as favorable and U as unfavorable, then for a single event, the probability of a favorable outcome is:

$$\frac{F}{F+U}$$

The probability of an unfavorable outcome is 1 minus the probability of a favorable outcome. In other words, since there is the same chance that any number may win on any spin (mutually exclusive events), the chances of winning equals the number of winning numbers divided by the total number of possible numbers. Roulette has 38 possible numbers that may win. Therefore, F+U is always equal to 38. If you wager on a single number, the chances of winning are 1 divided by 38 or approximately 2.63%. Your odds of losing that wager is approximately 97.37%. If you win, the house pays you 36 times your wager. Multiplying your chance of winning times your payback shows the advantage for the house. In this case, the number is 94.74% which means the house has a 5.26% advantage over the players wagering on a single number.

If a wager is placed on black or red, the probability of winning is 18 divided by 38 because the number of black numbers and the number of red numbers is 18. The probability of a favorable outcome is one color is wagered equals 47.4%. The payout if you win is 2 to 1. This yields an advantage for the house of 1 - (0.474 x 2) or approximately 5.26%. As you can see, the house always has a 5.3% advantage.

## RULES FOR PLAYING ROULETTE

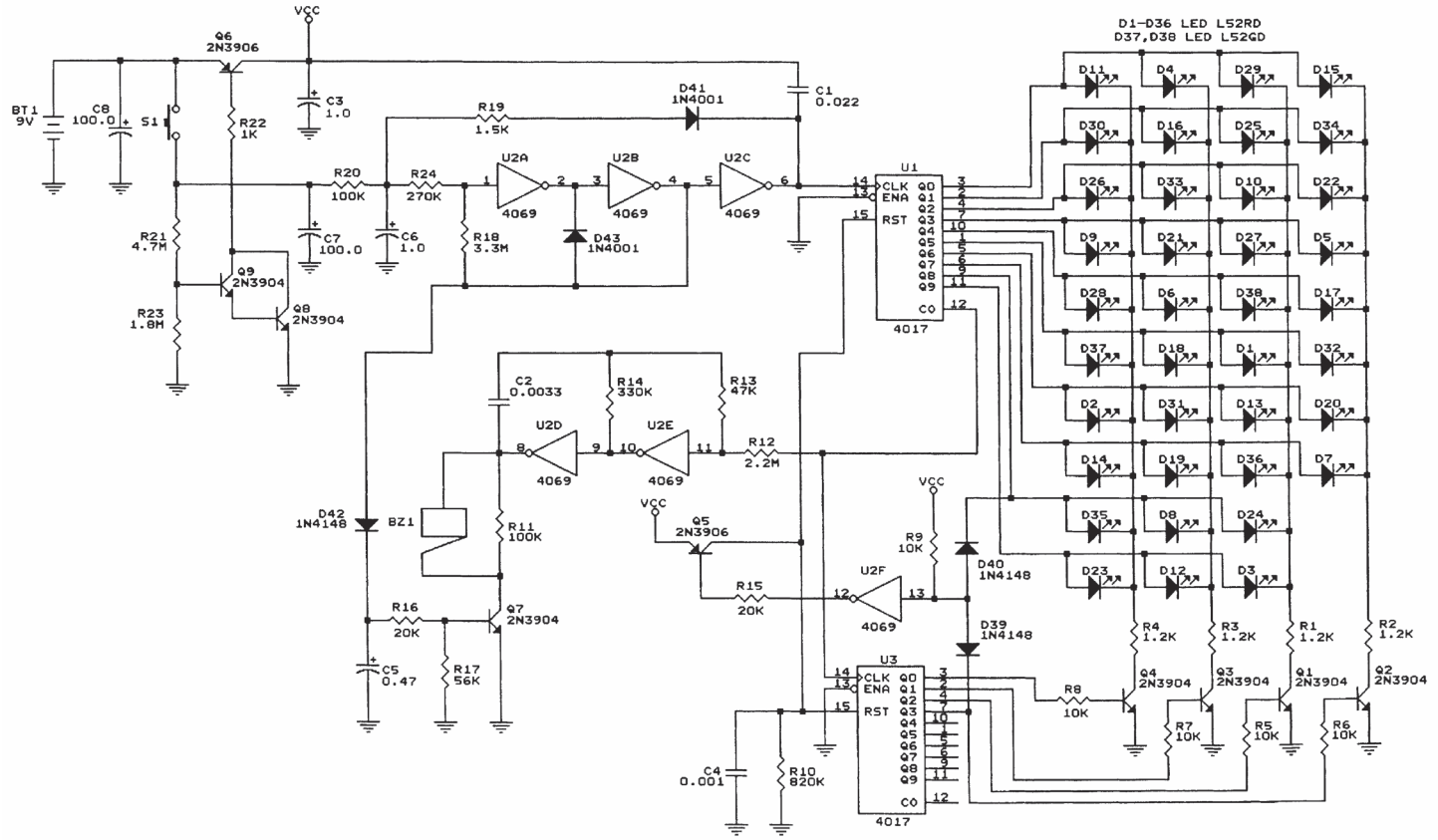
The object of the game is to increase the value of your chips more than any other player. Chips with gold centers are worth $100.00, green centers = $25.00, red centers = $5.00, and white centers are worth $1.00. Each player starts with 1 green, 2 red, and 5 white chips ($40.00). All the rest of the unused chips belong to the house. Determine how long the roulette table will be open, one hour for example. One person must act as the Croupier (kroo-pee-eh). The Croupier is the attendant who collects and pays the stakes using the houses money. Since there is no way to predict the outcome of each spin, the Croupier may also be a player. It is possible for a person to play roulette alone and try to beat the house by increasing his total chip value.

The very first action in roulette is to place your wager on the gaming table. The types of bets and their rates of return are listed in Chart A. The method for placing a wager is shown in Chart B. Placing wagers starts when the Croupier announces “Place your Wagers!”. All wagers must be in place when the Croupier announces “No more wagers!”.

After all wagers have been placed, the start button is pressed by the Croupier and the lit LED that represents the ivory ball races around the circle adding excitement and anticipation to the game. The number next to the lit LED, when the motion stops, is the winning number. All wagers are paid by the Croupier according to the rates of return listed in Chart A.

The game ends when the house runs out of chips or the predetermined time period expires. To prevent a person from doubling his wager until he wins, a maximum limit of $100 should be placed on each wager. When a player loses all of their chips, they may borrow from other players at whatever interest rate that player demands. At no time may a player borrow more than $40.00. Once a player owes $40.00 and has lost all of their chips, they are bankrupt and can no longer place wagers. A bankrupt player may assume the position of Croupier and earn $1.00 from the house for every 10 spins to remain in the game. A Croupier who is not bankrupt is paid no salary by the house.

## SCHEMATIC DIAGRAM



# WORD GLOSSARY

**Capacitor** An electrical component that can store electrical pressure (voltage) for periods of time.

**Cold Solder Joint** Occurs because insufficient heat was applied or the connection was moved before the solder had set. Connection looks crystalline, crumbly, or dull.

**Flux** A substance that is used to cleanse the surface of oxide before it is soldered. Always used in electronics work. Most of the solder used in electronics has flux built right into it.

**Heat Sinking** A process of keeping the component from becoming overheated during soldering. Any metal object that can be clamped to the component lead will work as an effective heat sink. An alligator clip or pliers work well.

**Integrated Circuit (IC)** A type of circuit in which transistors, diodes, resistors, and capacitors are all constructed on a semiconductor base.

**Jumper Wire** A wire that is connected from one place to another on a PC board, thereby making a connection between two pads.

**LED** Common abbreviation for light emitting diode.

**Light Emitting Diode** A diode made from gallium arsenide that has a turn-on energy so high that light is generated when current flows through it.

**Oxidation** Most metals, when exposed to air, form an oxide on their surface which prevents solder from adhering to the metal.

**Polarity** The division of two opposing forces or properties.

**Printed Circuit Board** A board used for mounting electrical components.
Components are connected using metal traces “printed” on the board instead of wires.

**Resistor** Component used to control the flow of electricity in a circuit. It is made of carbon.

**Rosin Core Solder** The most common type of solder used in electronics generally referred to as 63/37 rosin core solder.

**Solder** A tin/lead alloy that melts at a very low temperature, used to join other metals together. It produces excellent electrical connections.

**Solder Bridge** An unwanted solder connection between two points that are close together.

**Solder Melting Point** The temperature at which a tin/lead alloy (solder) melts. The common solder used in electronics (63% tin / 37% lead) has a melting point of 370$^{O}$F.

**Solder Wick** Braided wire coated with flux to effectively remove solder from a connection.

**Soldering** The process of joining two or more metals by applying solder to them.

**Tack Soldering** A connection where the lead or wire does not have any mechanical support.

**Tinning the Tip** A process of coating the soldering iron tip with solder to minimize the formation of oxide on the tip, which would reduce the amount of heat transfer.

**Transistor** An electronic device that uses a small amount of current to control a large amount of current.

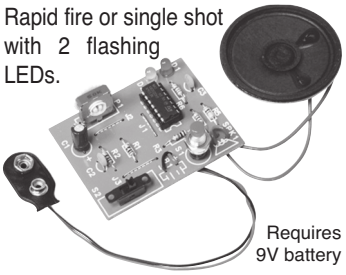
**Wire Gauge** Refers to the size of the wire. The bigger the number, the smaller the diameter of the wire.
18 gauge to 24 gauge is generally used for hook-up in electronics.

# EDUCATION KITS

## Complete with PC Board and Instruction Book

### Space War Gun
**K-10**

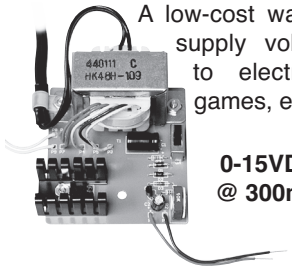
Rapid fire or single shot with 2 flashing LEDs.



Requires 9V battery

### 0-15V Power Supply
**K-11**

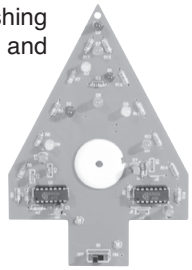
A low-cost way to supply voltage to electronic games, etc.



**0-15VDC @ 300mA**

### Christmas Tree
**K-14**

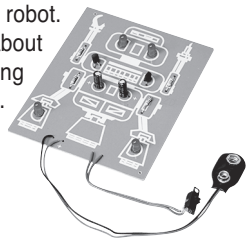
Produces flashing colored LEDs and three popular Christmas melodies.



Requires 9V battery

### LED Robot Blinker
**K-17**

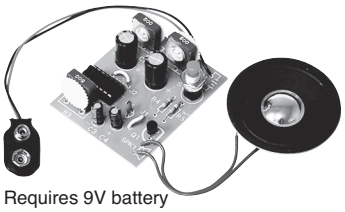
You'll have fun displaying the PC board robot. Learn about free-running oscillators.



Requires 9V battery

### Digital Bird
**K-19**

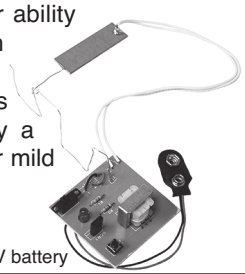
You probably have never heard a bird sing this way before.



Requires 9V battery

### Nerve Tester
**K-20**

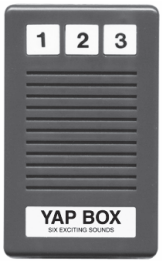
Test your ability to remain calm. Indicates failure by a lit LED or mild shock.



Requires 9V battery

### Yap Box
**K-22A**

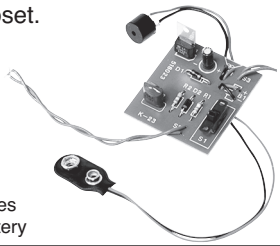
This kit is a hit at parties. Makes 6 exciting sounds.




Requires 9V battery

### Burglar Alarm
**K-23**

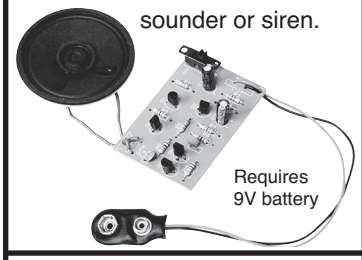
Alarm for your car, house, room, or closet.



Requires 9V battery

### Whooper Alarm
**K-24**

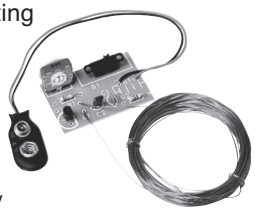
Can be used as a sounder or siren.



Requires 9V battery

### Metal Detector
**K-26**

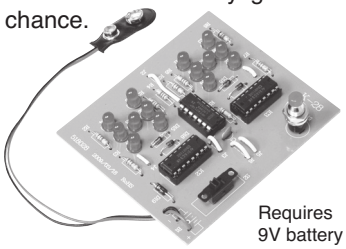
Find new money and old treasure. Get started in this fascinating hobby.



Requires 9V battery

### Pocket Dice
**K-28**

To be used with any game of chance.



Requires 9V battery

### FM Microphone
**AK-710/K-30**

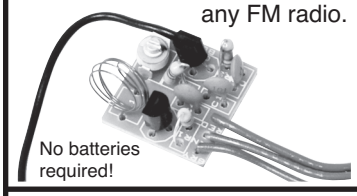
Learn about microphones, audio amplifiers, and RF oscillators. Range up to 100 feet.

Requires 2 "AA" batteries


Training course included

### Telephone Bug
**K-35**

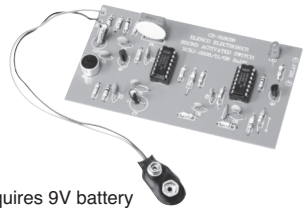
Our bug is only the size of a quarter, yet transmits both sides of a telephone conversation to any FM radio.



No batteries required!

### Sound Activated Switch
**K-36**

Clap and the light comes on . . . clap again and it goes off.



Requires 9V battery

### Lie Detector
**K-44**

The sound will tell if you are lying. The more you lie, the louder the sound gets.


Requires 9V battery

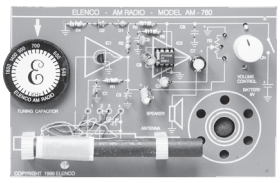
### Motion Detector
**AK-510**

Use as a sentry, message minder, burglar alarm, or a room detector.

Requires 9V battery

### Two IC AM Radio
**AM-780K**

New design - easy-to-build, complete radio on a single PC board. Requires 9V battery.




### Transistor Tester
**DT-100K**

Test in-circuit transistors and diodes.


Requires 9V battery

### 0-15VDC Variable Voltage DC Power Supply Kit
**XP-15K**

Ideal for students, technicians, and hobbyists. Great for breadboarding.


### Auto-scan FM Radio Kit
**FM-88K**

Unique design - two-IC FM receiver with training course.


Requires 9V battery

## QUIZ

1. In electronics, a capacitor is a . . .
   - ❒ A. counter.
   - ❒ B. generator.
   - ❒ C. light emitting device.
   - ❒ D. storage device.
2. The Timer Circuit is used to . . .
   - ❒ A. turn power on.
   - ❒ B. keep track of time.
   - ❒ C. turn power off.
   - ❒ D. make pulses.
3. The Ring Counter is triggered by . . .
   - ❒ A. the pulse generator.
   - ❒ B. the timer.
   - ❒ C. LEDs.
   - ❒ D. the sound circuit.
4. LED means . . .
   - ❒ A. light emitting device.
   - ❒ B. light emitting diode.
   - ❒ C. long electronic delay.
   - ❒ D. light electric diode.
5. The probability of winning a wager placed on four numbers in electronic roulette is . . .
   - ❒ A. 21%.
   - ❒ B. 89%.
   - ❒ C. 11.11111%.
   - ❒ D. 10.5263%.
6. The house advantage for a four-number wager in electronic roulette is . . .
   - ❒ A. 5.26%.
   - ❒ B. 11%.
   - ❒ C. 89.5%.
   - ❒ D. 21%.
7. In the sound circuit, the 500 hertz oscillator is . . .
   - ❒ A. a warning.
   - ❒ B. turned on by pulses.
   - ❒ C. turned on by counter.
   - ❒ D. always running.
8. The slowing down motion is due to . . .
   - ❒ A. the ring counter.
   - ❒ B. the timer.
   - ❒ C. pulses being further apart.
   - ❒ D. the probability changing.
9. The sound is turned on by . . .
   - ❒ A. LEDs.
   - ❒ B. the pulse generator.
   - ❒ C. the timer.
   - ❒ D. the 500 hertz oscillator.
10. An analogy is . . .
    - ❒ A. an electronic device.
    - ❒ B. a similar system.
    - ❒ C. a diagram.
    - ❒ D. a drawing.

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**Answers:** 1. D; 2. C; 3. A; 4. B; 5. D; 6. A; 7. D; 8. C; 9. B; 10. B