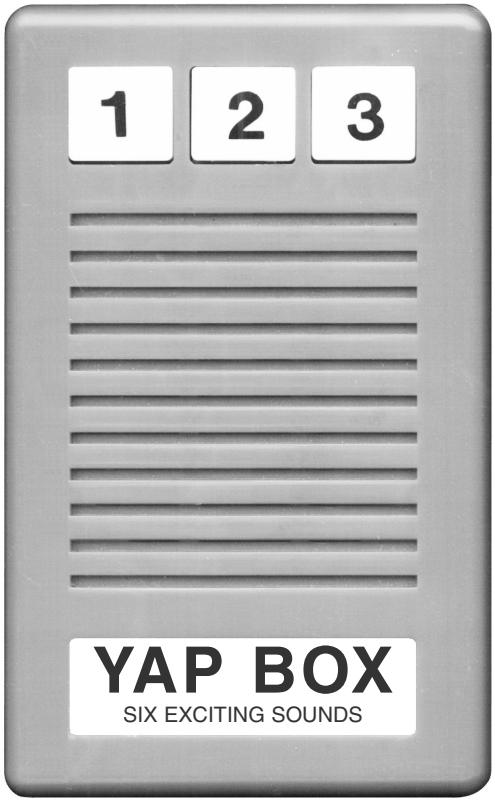
YAP BOX KIT

MODEL K-22A



Assembly and Instruction Manual

Elenco® Electronics, Inc.

 Revised 2009 REV-H 753222

PARTS LIST

If you are a student, and any parts are missing or damaged, please see instructor or bookstore.
If you purchased this kit from a distributor, catalog, etc., please contact Elenco® Electronics (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	Description	Color Code	Part #
❒ 1	R15	120Ω 5% 1/4W	brown-red-brown-gold	131200
❒ 2	R1, R9	10kΩ 5% 1/4W	brown-black-orange-gold	151000
❒ 1	R4	18kΩ 5% 1/4W	brown-gray-orange-gold	151800
❒ 2	R6, R7	100kΩ 5% 1/4W	brown-black-yellow-gold	161000
❒ 1	R10	180kΩ 5% 1/4W	brown-gray-yellow-gold	161800
❒ 3	R2, R11, R13	220kΩ 5% 1/4W	red-red-yellow-gold	162200
❒ 1	R3	330kΩ 5% 1/4W	orange-orange-yellow-gold	163300
❒ 4	R5, R8, R12, R14	1MΩ 5% 1/4W	brown-black-green-gold	171000

CAPACITORS

Qty.	Symbol	Value	Description	Part #
❒ 1	C2	330pF (331)	Discap	223317
❒ 2	C3, C5	.001µF (102)	Discap	231035
❒ 1	C9	.01µF (103)	Discap	241031
❒ 1	C8	.047µF (473)	Mylar	244717
❒ 1	C6	.1µF (104)	Discap	251010
❒ 2	C1, C7	10µF	Electrolytic (Lytic)	271045
❒ 2	C4, C10	100µF	Electrolytic (Lytic)	281044

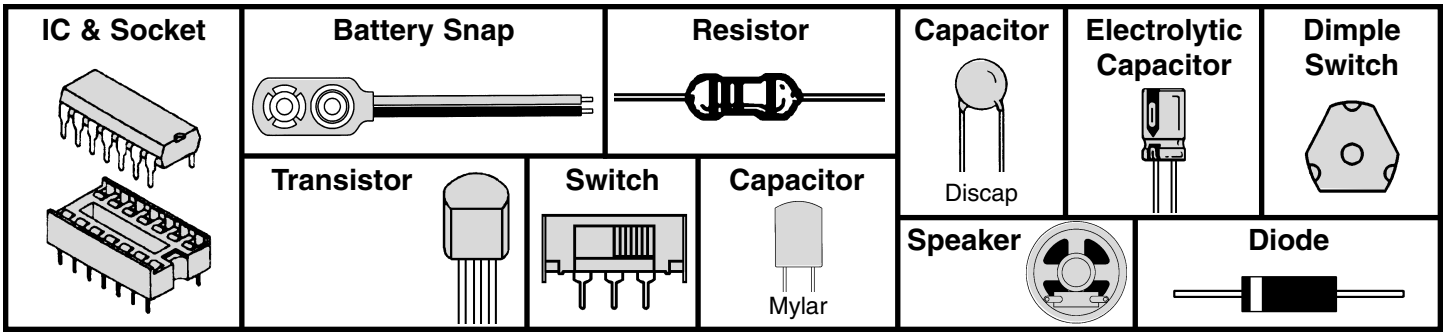
SEMICONDUCTORS

Qty.	Symbol	Value	Description	Part #
❒ 8	D1 - D8	1N4148	Diode	314148
❒ 1	Q1	2N3904	Transistor	323904
❒ 1	Q2	2N6521	Transistor	326521
❒ 1	IC1		IC 3086	333086

MISCELLANEOUS

Qty.	Symbol	Description	Part #
❒ 1		PC Board	510001
❒ 1	S4	Switch	541010
❒ 3		Dimple Cap	546100
❒ 3	S1, S2, S3	Dimple	546101
❒ 1	BT	Battery Snap	590098
❒ 1	SP1	Speaker	590101
❒ 1		Case	623350
❒ 1		Socket 14-Pin	664014
❒ 1		Label	720400
❒ 4”		Wire	814620

PARTS IDENTIFICATION



BATTERIES

- Do not short circuit the battery terminals.
- Never throw batteries in a fire or attempt to open it.
- Use only 1.5V “AA” type (not included).
- Insert batteries with correct polarity.
- Non-rechargeable batteries should not be recharged.
- Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
- Do not mix old and new batteries.
- Remove batteries when they are used up.
- Batteries are harmful if swallowed, so keep away

INTRODUCTION

The Yap Box is a most interesting kit to build. It produces six exciting sounds: Space Gun, Siren, Laser Gun, Diesel Horn, Puppy Bark, and Wolf Whistle. By pressing two or more buttons, other interesting sounds can be produced.
You can amuse your friends and be a hit at parties. Use it as and attention getter or a bike horn.

CIRCUIT DESCRIPTION

The Yap Box circuit diagram is shown on the back page of this manual. It consists of a special integrated circuit which contains three built-in oscillators. By activating each oscillator with the touch buttons, the exciting sounds are produced.

The Yap Box has three basic circuits, 1) the power supply, 2) the oscillator circuits, and 3) the output circuit. We shall analyze each of these circuits to give you a better understanding of their operations.

The Power Supply

The power supply uses a 9V battery. There are three push button switches connected to the battery. These switches supply the power to the oscillators. The circuit is designed to use no current until the buttons are pressed. This eliminates the need for an ON/OFF switch and prevents draining of the battery, should you forget to turn off the switch.

The Oscillators Circuits

The Yap Box is designed around a special integrated circuit which contains three complicated transistor circuits. The theory of operation is too advanced for our discussion, and we shall limit our study to the support components in the circuit.

Capacitor C1 is placed across the space gun switch. When the switch is pressed, the oscillator starts putting out the complex voltage to produce the space gun sound. When the switch is released, the capacitor starts to charge, keeping the current flowing in the oscillator. As the capacitor charges up, the current through the oscillator reduces until it finally drops to zero. This decreasing current causes the oscillator to give the tailing-off sound when the button is released.

Capacitor C2 produces the wobbly sound in the space gun. The charge into C2 is limited by resistor R1. As the voltage increases across C2, the space gun frequency will increase. When the space gun switch is released, the voltage across C2 will drop, thus giving the lowering of the oscillator frequency. Capacitor C1 is added to supply voltage to the space gun during the decay period.

Capacitor C3, C4, C5 and resistors R5, R6, and R7 control the frequency of the siren oscillator. Capacitors C8, C9 and resistors R2, R3, and R4 control the frequency of the space gun. Capacitor C6 and resistors R8 and R9 control the frequency of the laser gun.

The Output Circuit

Figure A shows the output circuit needed to power the speaker. Transitor Q2 is a power transistor which drives the speaker. When the voltage at the base of Q2 goes above 0.7V, the transistor will conduct current through the collector and emitter of Q2. The same current flows through the speaker. Thus, when the oscillator pulses are applied to the base of Q2, much amplified current pulses flow through the speaker producing the audio equivalent of the electrical pulses. Transistor Q1 is a current amplifier which reduces the loading on the oscillator circuits. Note that when there are no oscillators active, no current flows through the transistors. This saves battery power and eliminates the need for an ON/OFF switch.

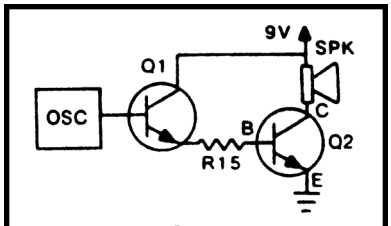


Figure A

IDENTIFYING RESISTOR VALUES

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

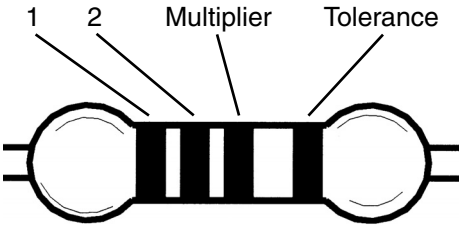
BAND 1 1st Digit	
Color	**Digit**
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

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



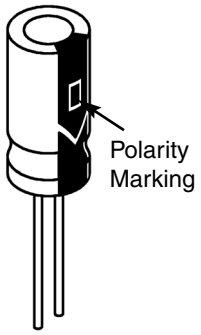
IDENTIFYING CAPACITOR VALUES

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.

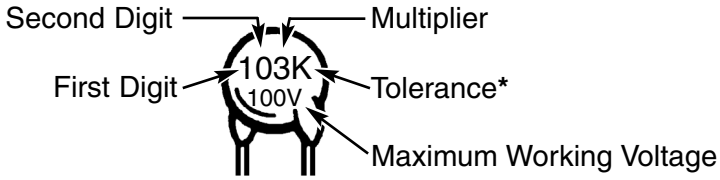
Electrolytic capacitors have a positive and a negative electrode. The negative lead is indicated on the packaging by a stripe with minus signs and possibly arrowheads.

Warning:

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



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



The value is 10 x 1,000 =
10,000pF or .01μF 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

METRIC UNITS AND CONVERSIONS

Abbreviation	Means	Multiply Unit By	Or
p	pico	.000000000001	10^{-12}
n	nano	.000000001	10^{-9}
μ	micro	.000001	10^{-6}
m	milli	.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

CONSTRUCTION

Introduction

The most important factor in assembling your K-22A Yap Box Kit is good soldering techniques. Using the proper soldering iron is of prime importance. A small pencil type soldering iron of 25 - 40 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 700°F; 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

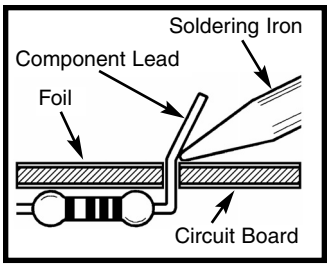
In all of the following assembly steps, the components must be installed on the top side of the PC board unless otherwise indicated. The top legend shows where each component goes. The leads pass through the corresponding holes in the board and are soldered on the foil side.
Use only rosin core solder.

DO NOT USE ACID CORE SOLDER!

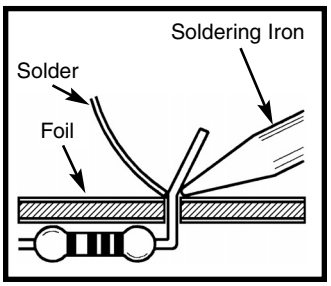
What Good Soldering Looks Like

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

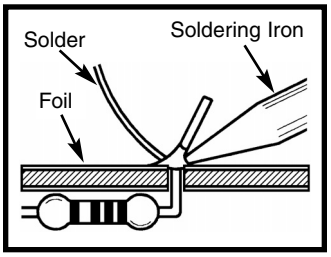
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



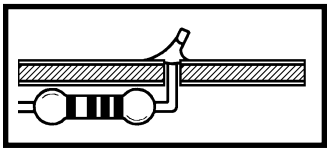
2. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and the circuit foil to melt the solder.



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.

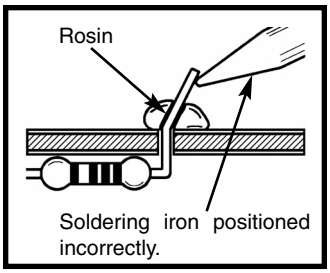


4. Here is what a good solder connection looks like.

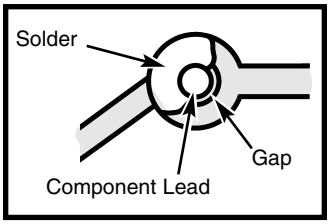


Types of Poor Soldering Connections

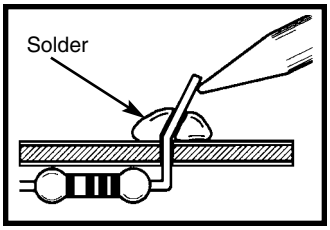
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



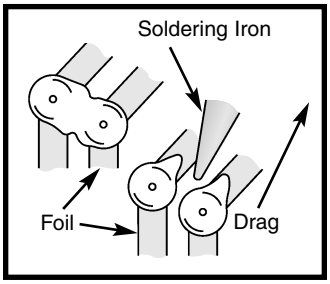
2. **Insufficient solder** - let the solder flow over the connection until it is covered.
Use just enough solder to cover the connection.



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

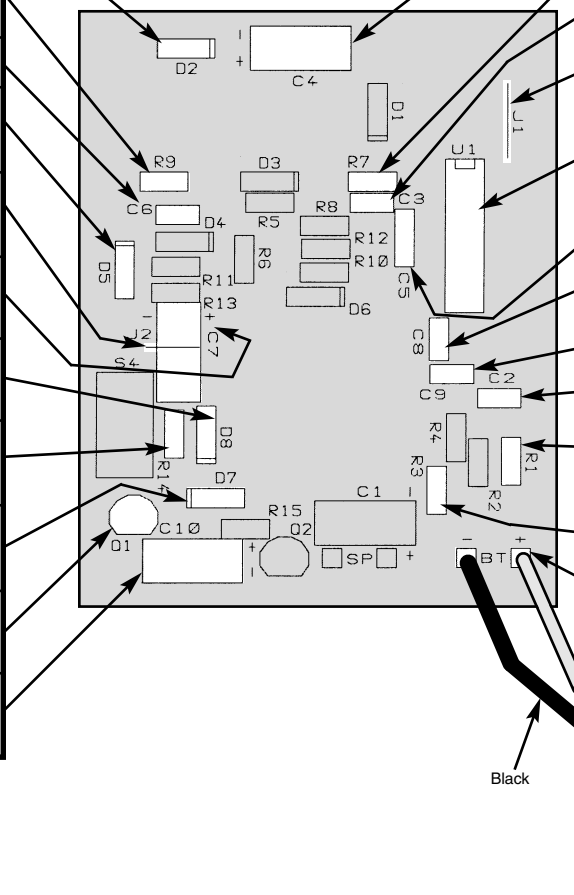


4. **Solder bridges** - occur when solder runs between circuit paths and creates a short circuit. This is usually caused by using too much solder.
To correct this, simply drag your soldering iron across the solder bridge as shown.



ASSEMBLE COMPONENTS TO THE PC BOARD

- ☐ D2 - 1N4148 Diode (see Figure 1)
- ☐ R9 - 10kΩ 5% 1/4W Resistor (brown-black-orange-gold)
- ☐ C6 - .1μF (104) Discap
- ☐ D5 - 1N4148 Diode (see Figure 1)
- ☐ J2 - Jumper Wire (see Figure 5)
- ☐ C7 - 10μF Electrolytic Cap. (see Figure 2)
- ☐ D8 - 1N4148 Diode (see Figure 1)
- ☐ R14 - 1MΩ 5% 1/4W Resistor (brown-black-green-gold)
- ☐ D7 - 1N4148 Diode (see Figure 1)
- ☐ Q1 - Transistor 2N3904 (see Figure 4)
- ☐ C10 - 100μF Lytic Capacitor (see Figure 2)



- ☐ C4 - 100μF Lytic Capacitor (see Figure 2)
- ☐ R7 - 100kΩ 5% 1/4W Resistor (brown-black-yellow-gold)
- ☐ C3 - .001μF (102) Discap
- ☐ J1 - Jumper Wire (see Figure 5)
- ☐ U1 - 3086 Integrated Circuit (see Figure 3)
- ☐ C5 - .001μF (102) Discap
- ☐ C8 - .047μF (473) Mylar (see Figure 6)
- ☐ C9 - .01μF (103) Discap
- ☐ C2 - 330pF (331) Discap
- ☐ R1 - 10kΩ 5% 1/4W Resistor (brown-black-orange-gold)
- ☐ R3 - 330kΩ 5% 1/4W Resistor (orange-orange-yellow-gold)
- ☐ BT - Battery Snap

Figure 1

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

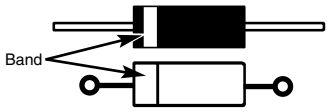


Figure 2

These capacitors are polarized. Be sure to mount them with the "+" lead in the correct hole as marked on the PC board. Mount the capacitor lying flat on the PC board as shown below.

Warning:

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

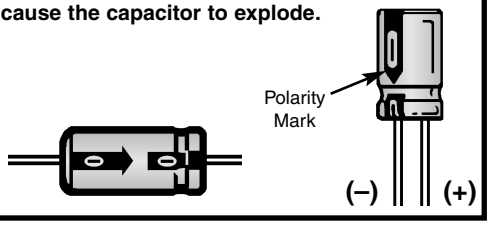


Figure 3

Mount the IC and socket to the PC board with the notch in the same direction as shown on the PC board.

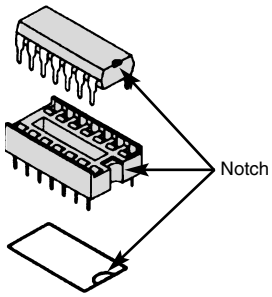


Figure 4

Mount the transistor with the flat side in the direction shown on the top legend.

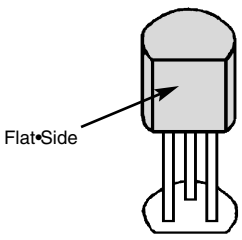


Figure 5

Use a discarded resistor lead to make a jumper wire.

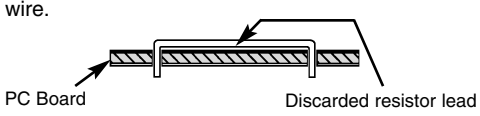
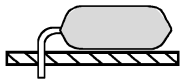


Figure 6

Bend the capacitor as shown.



ASSEMBLE COMPONENENTS TO THE PC BOARD

☐ D1 - 1N4148 Diode
(see Figure 1)

☐ D3- 1N4148 Diode
(see Figure 1)

☐ R5 - 1MΩ 5% 1/4W Resistor
(brown-black-green-gold)

☐ D4 - 1N4148 Diode
(see Figure 1)

☐ R6- 100kΩ 5% 1/4W Resistor
(brown-black-yellow-gold)

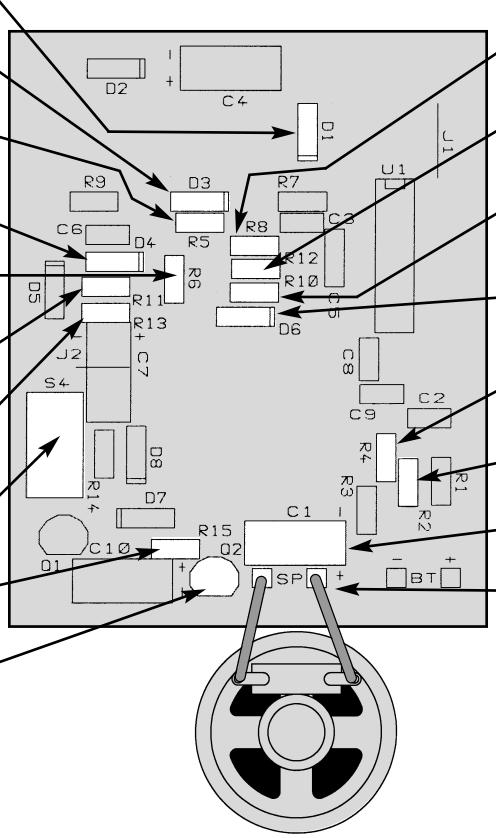
☐ R11 - 200kΩ 5% 1/4W Resistor
(red-red-yellow-gold)

☐ R13 - 200kΩ 5% 1/4W Resistor
(red-red-yellow-gold)

☐ S4 - Switch

☐ R15 - 120Ω 5% 1/4W Resistor
(brown-red-brown-gold)

☐ Q2 - 2N6521 Transistor
(see Figure 4)



☐ R8 - 1MΩ 5% 1/4 Resistor
(brown-black-green-gold)

☐ R12 - 1MΩ 5% 1/4 Resistor
(brown-black-green-gold)

☐ R10 - 180kΩ 5% 1/4W Resistor
(brown-gray-yellow-gold)

☐ D6 - 1N4148 Diode
(see Figure 1)

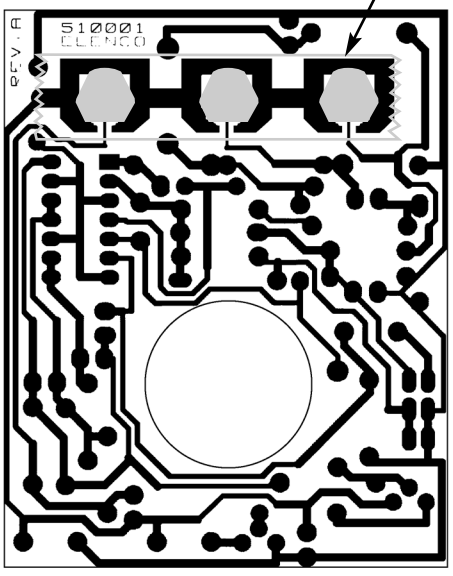
☐ R4 - 18kΩ 1/4W 5% Resistor
(brown-gray-orange-gold)

☐ R2 - 220kΩ 1/4W 5% Resistor
(red-red-yellow-gold)

☐ C1 - 10μF Lytic Capacitor

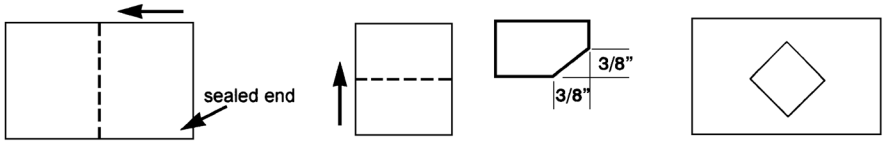
☐ SP - Speaker
Cut two 2" wires and strip 1/4" of insulation off of both ends. Solder a wire to each lug of the speaker. Insert the other ends of the wires to the PC board in the holes marked SP. Solder and cut off the excess leads.

☐ Put the three dimples in place with the concave side faces the copper side of the PC board. The dimples' three corners should all touch the surrounding pad, not the middle pad of the copper leading to the middle pad. Hold dimples in place using a piece of Scotch® tape as shown.



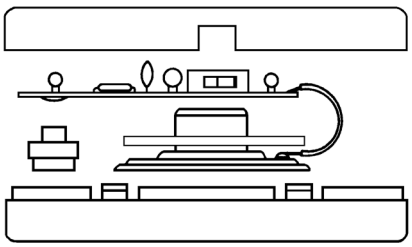
☐ Cut Plastic Parts Bag

1. Cut one of the plastic parts bags to 2" x 3" size.
2. Fold the bag in half, then fold it again in half.
3. Cut 3/8" of the lower right hand corner off as shown.
4. Unfold the bag and you should have a diamond shaped hole in the center.



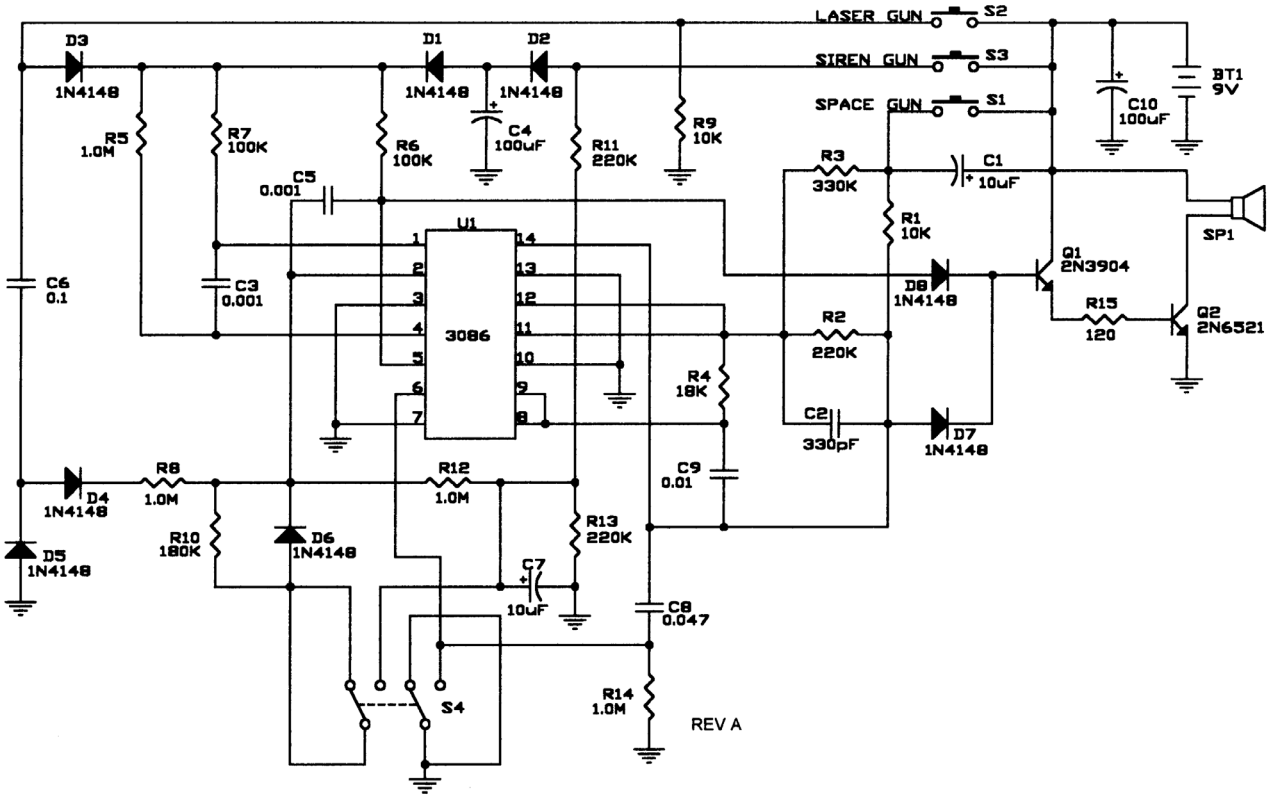
Final Assembly

1. Place the three plastic dimple caps into position in the case.
2. Push the speaker into the circle inlay and place the plastic bag over the speaker.
3. Place the PC board over the speaker. The end of the speaker will come through the hole in the PC board.
4. Snap the case together.



5. Attach the battery snap to a fresh 9-volt battery and insert it into the case. Slide the battery compartment lid into place.

SCHEMATIC DIAGRAM



OPERATING PROCEDURE

1. Flip the side switch to change the circuit over the three other sounds.

TROUBLESHOOTING

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

1. Tug slightly on all of the parts to make sure that they are indeed soldered.
2. All solder connections should be shiny. Resolder any that are not.
3. Solder should flaw 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 iron across adjacent foils. Break the bridge with your soldering iron.

COMPONENT CHECK

1. Be sure that all of the components have been mounted in their correct places.
2. Be sure that the electrolytic capacitors C1, C7, C4, and C10 have been installed correctly . These capacitors have polarity. The negative and positive leads must be in the correct holes.
3. Be sure that the diodes D1-D8 have not been installed backwards. The band on the diodes should be in the same direction as shown in the pictoral diagram.
4. Be sure that the speaker is not touching any of the copper traces on the PC board.
5. Be sure that the three dimples are not touching the middle pad. Oscillator will run continously if it touches.
6. If no sounds are produced, check 1) the battery, 2) the output circuit Q1 and Q2, and 3) the IC (it may be in backwards).

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