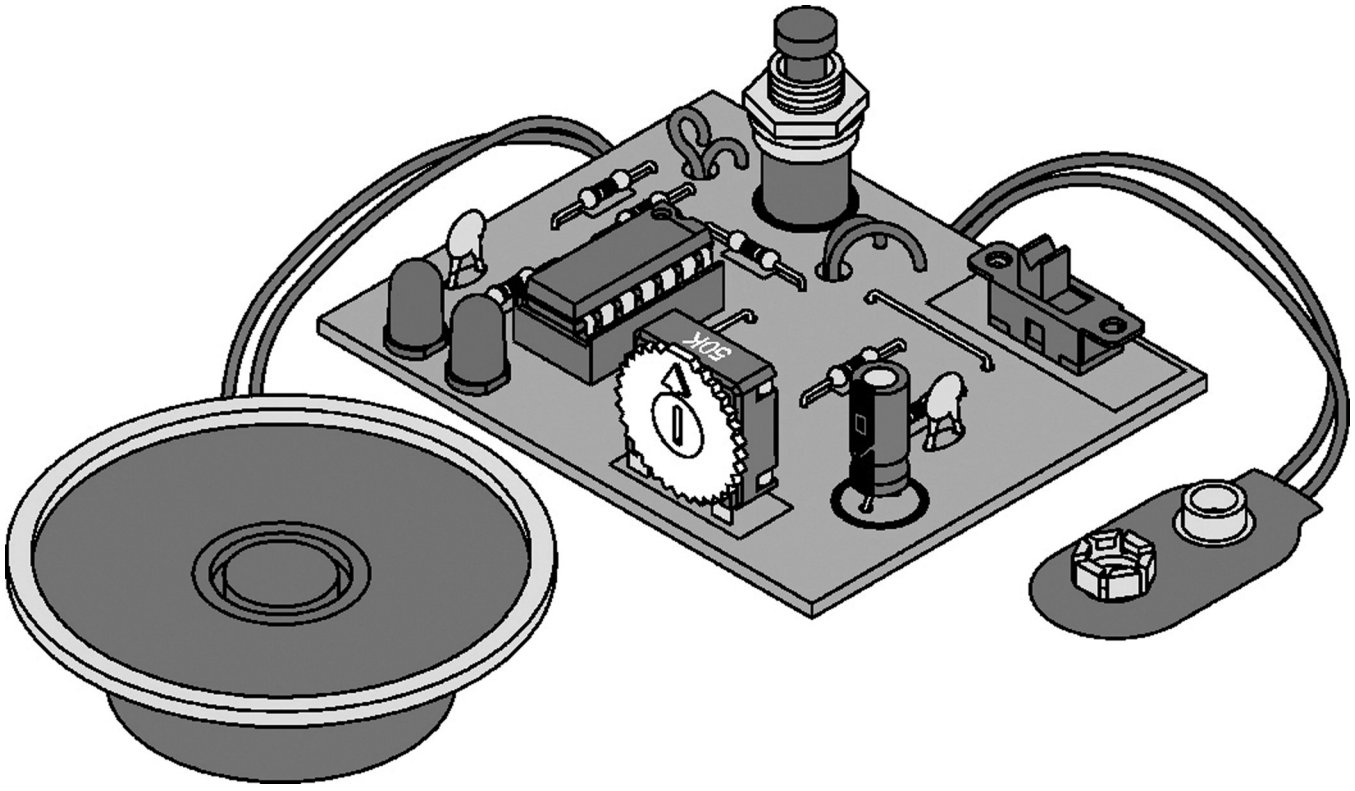
SPACE WAR GUN KIT

MODEL K-10



Assembly and Instruction Manual

Elenco® Electronics, Inc.

 Revised 2010 REV-J 753210A

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	R5	47Ω 5% 1/4W	yellow-violet-black-gold	124700
❒ 2	R1, R2	100Ω 5% 1/4W	brown-black-brown-gold	131000
❒ 1	R6	560Ω 5% 1/4W	green-blue-brown-gold	135600
❒ 1	R3	1kΩ 5% 1/4W	brown-black-red-gold	141000
❒ 1	R4	56kΩ 5% 1/4W	green-blue-orange-gold	155600
❒ 1	P1	Trim Pot 50kΩ		191552

CAPACITORS

Qty.	Symbol	Description	Part #
❒ 2	C2, C3	.01μF Discap (103)	241031
❒ 1	C1	220μF Electrolytic	282244

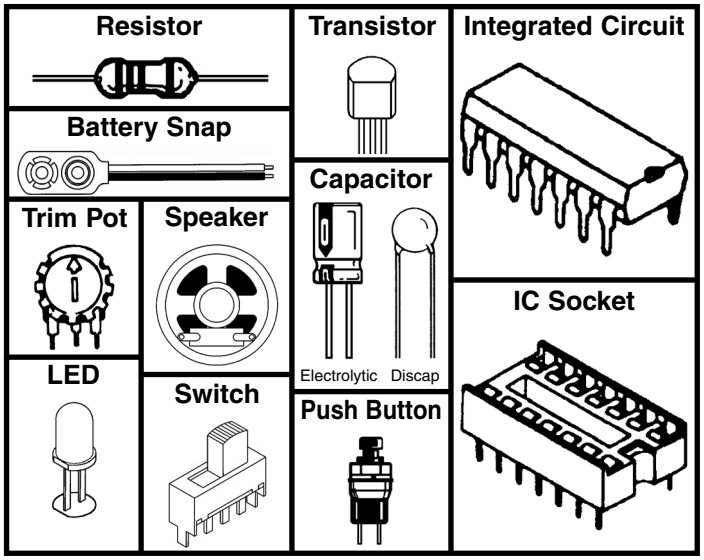
SEMICONDUCTORS

Qty.	Symbol	Description	Part #
❒ 1	IC1	LM556 Integrated Circuit	330556
❒ 1	D1	LED (Light Emitting Diode) Red	350002
❒ 1	D2	LED (Light Emitting Diode) Green	350010

MISCELLANEOUS

Qty.	Symbol	Description	Part #
❒ 1		PC Board	518010
❒ 1	S1	Switch Push Button	540001
❒ 1	S2	Switch Slide	541102
❒ 1	B1	Battery Snap 9V	590098
❒ 1	SPK1	Speaker 8Ω	590102
❒ 1		IC Socket 14-pin	664014
❒ 2		Wire 4" Blue	814620

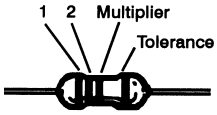
PARTS IDENTIFICATION



IDENTIFYING RESISTOR VALUES

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

BAND 1 1st Digit		BAND 2 2nd Digit		Multiplier		Resistance Tolerance	
Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
Black	0	Black	0	Black	1	Silver	±10%
Brown	1	Brown	1	Brown	10	Gold	±5%
Red	2	Red	2	Red	100	Brown	±1%
Orange	3	Orange	3	Orange	1,000	Red	±2%
Yellow	4	Yellow	4	Yellow	10,000	Orange	±3%
Green	5	Green	5	Green	100,000	Green	±.5%
Blue	6	Blue	6	Blue	1,000,000	Blue	±.25%
Violet	7	Violet	7	Silver	0.01	Violet	±.1%
Gray	8	Gray	8	Gold	0.1		
White	9	White	9				



IDENTIFYING CAPACITOR VALUES

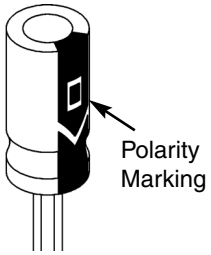
Capacitors will be identified by their capacitance value in pF (picofarads), nF (nanofarads), or μF (microfarads). Most capacitors will have their actual value printed on them. Some capacitors may have their value printed in the following manner.

The above value is 10 x 1,000 = 10,000pF or .01μF
The letter K indicates a tolerance of ±10%
The letter J indicates a tolerance of ±5%

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

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

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.

CIRCUIT OPERATION

Figure 1 shows the circuit of the Space War Gun. It consists of two 555 integrated circuits (IC) packaged in one IC 556. A 555 timer is well known for its ability to operate as an astable multivibrator oscillator. This oscillator can put out a square wave or pulses depending on the value of the resistors. The first 555A IC oscillates at about 2000 cycles per second. The 555A IC drives the 555B IC to give the weird space sounds.

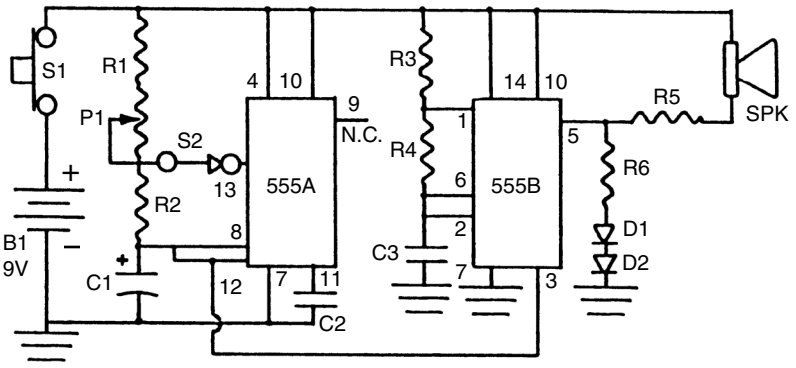


Figure 1

THE 555 IC TIMER

Let's study the right side of Figure 1 which shows the 555B circuit. Resistor R3, R4 and capacitor C3 control the frequency of oscillation of this circuit. Capacitor C3 charges through resistors R3 and R4, but discharges through resistor R4 and the IC. Since the value of R3 and R4 are 1kΩ and 56kΩ respectively, their total value equals 57kΩ. Thus, C3 charges through 57kΩ and discharges through 56kΩ. The charge and discharge time is about equal. The output at pin 5 will be a square wave as shown in Figure 2. The frequency of oscillation will be around 2,000 cycles per second. If a speaker is connected to output pin 5, we will hear the 2,000 cycle tone. When the two LEDs are connected to this output, they will light whenever the output goes positive. Resistor R6 is added to limit the current in the LEDs. Resistor R5 is added to limit the current in the speaker.

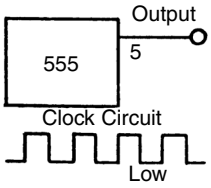


Figure 2

The operation of the 555A IC differs quite a bit from the 555B IC. Note the value of the capacitor C1, it is 220μF or 22,000 times bigger than the .01μF used in the 555B. This means that the frequency of oscillation will be much lower. Also, resistor P1 is made a 50,000Ω variable. Resistor R2 is only 100Ω. Thus, the charge time on capacitor C1 is through the 100Ω. With the pot at the maximum position, the charge to discharge will be 500:1. Figure 3A shows the pulse as it appears in the output in 9. Figure 3B shows the voltage across capacitor C1. By varying the value of P1, the distance between the pulses will be made shorter of the frequency will be increased. At the minimum position, the charge time will be twice the discharge time (200Ω versus 100Ω). Thus, varying P1 will change the frequency between .1 cycles to 45 cycles. This change in frequency adds to the effects of the Space War Gun.

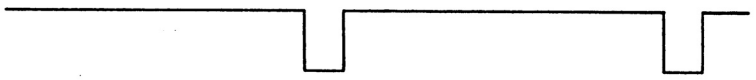


Figure 3A

Figure 3B

VOLTAGE CONTROLLED OSCILLATOR (VCO)

The 555 timer is designed to allow the output frequency to be varied by changing the DC voltage. If we raise the voltage at the 555B input pin 3, the output will decrease in frequency. In the Space Gun design, the VCO of the 555B is connected to the voltage across capacitor C1. This voltage is sawtooth in shape as shown in Figure 3B. As this voltage increases, the pitch-frequency of the 555B timer is constantly changing at a rate determined by the voltage amplitude of the 555A timer.

CONSTRUCTION

Introduction

The most important factor in assembling your K-10 Space War Gun 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.**

Safety Procedures

- Wear eye protection when soldering and during all phases of construction.
- Locate soldering iron in an area where you do not have to go around it or reach over it.
- **Do not hold solder in your mouth.** Solder contains lead and is a toxic substance. Wash your hands thoroughly after handling solder.
- Be sure that there is adequate ventilation present.

Assemble Components

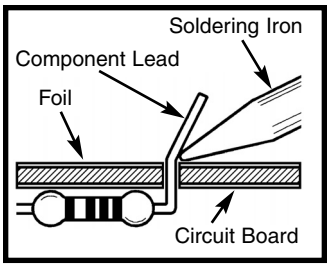
In all of the following assembly steps, the components must be installed on the top side of the PC board unless otherwise indicated. The top legend shows where each component goes. The leads pass through the corresponding holes in the board and are soldered on the foil side.
Use only rosin core solder.

DO NOT USE ACID CORE SOLDER!

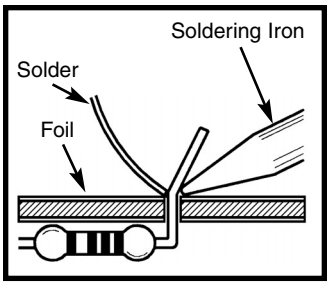
What Good Soldering Looks Like

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

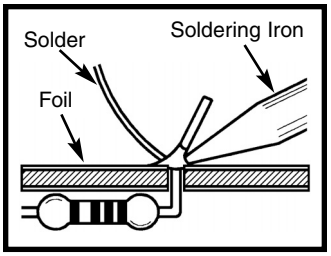
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



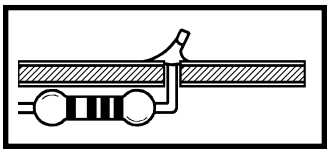
2. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and the circuit foil to melt the solder.



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.

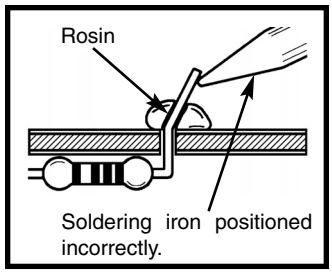


4. Here is what a good solder connection looks like.

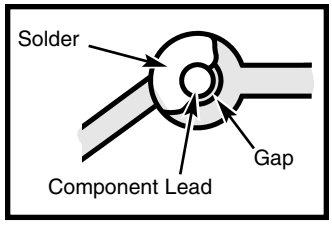


Types of Poor Soldering Connections

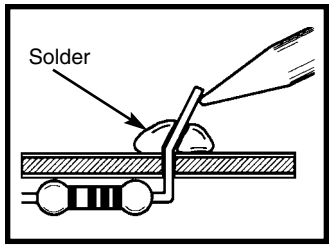
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



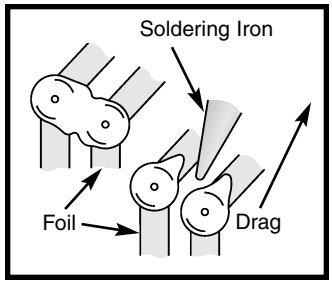
2. **Insufficient solder** - let the solder flow over the connection until it is covered. Use just enough solder to cover the connection.



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

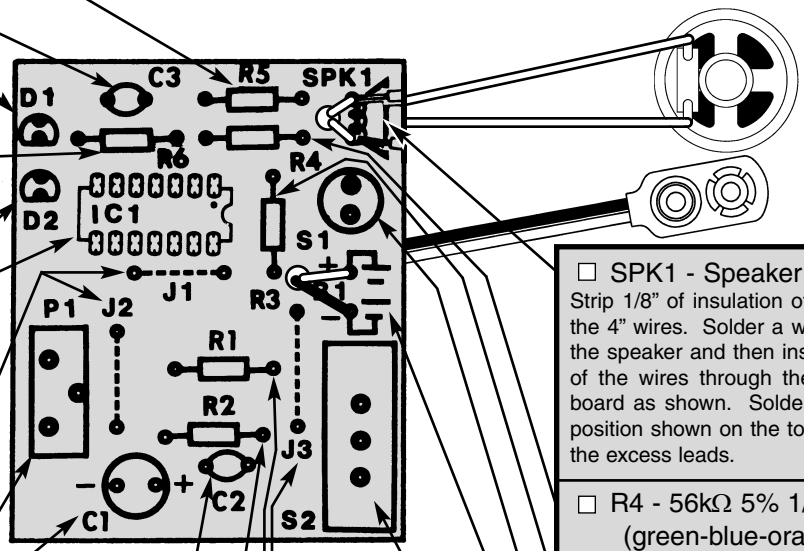


4. **Solder bridges** - occur when solder runs between circuit paths and creates a short circuit. This is usually caused by using too much solder. To correct this, simply drag your soldering iron across the solder bridge as shown.

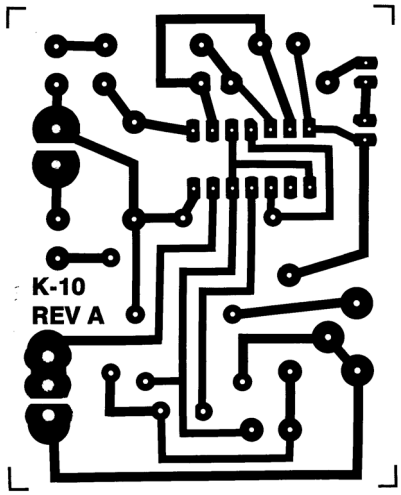


ASSEMBLE COMPONENTS TO THE PC BOARD

- ☐ R5 - 47Ω 5% 1/4W Resistor (yellow-violet-black-gold)
- ☐ C3 - .01μF (103) Discap
- ☐ D1 - LED Diode Red (see Figure A)
- ☐ R6 - 560Ω 5% 1/4W Resistor (green-blue-brown-gold)
- ☐ D2 - LED Diode Green (see Figure A)
- ☐ IC1 - IC Socket 14-pin
- ☐ IC1 - 556 Integrated Circuit (see Figure B)
- ☐ J1 - Jumper Wire
- ☐ J2 - Jumper Wire (see Figure C)
- ☐ P1 - Trim Pot
- ☐ C1 - 220μF Electrolytic Capacitor (see Figure D)



- ☐ SPK1 - Speaker
  Strip 1/8" of insulation off of both ends of the 4" wires. Solder a wire to each lug of the speaker and then insert the other end of the wires through the hole in the PC board as shown. Solder the wires in the position shown on the top legend. Cut off the excess leads.
- ☐ R4 - 56kΩ 5% 1/4W Resistor (green-blue-orange-gold)
- ☐ R3 - 1kΩ 5% 1/4W Resistor (brown-black-red-gold)
- ☐ S1 - Push Button Switch
- ☐ B1 - Battery Snap - Insert the red and black wire through the hole in the PC board as shown. Install the red wire into the positive (+) hole and the black wire into the negative (--) hole. Solder and cut off the excess leads.
- ☐ S2 - Slide Switch
- ☐ J3 - Jumper Wire (see Figure C)
- ☐ R1 - 100Ω 5% 1/4W Resistor (brown-black-brown-gold)
- ☐ R2 - 100Ω 5% 1/4W Resistor (brown-black-brown-gold)
- ☐ C2 - .01μF (103) Discap



Foil Side of PC Board

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.

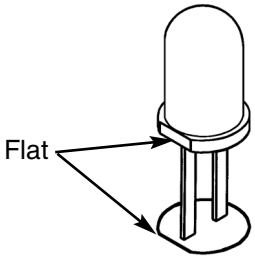


Figure B

Insert the IC socket into the PC board with the notch in the direction shown on the top legend. Solder the IC socket into place. Insert the IC into the socket with the notch in the same direction as the notch on the socket.

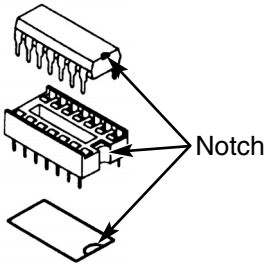


Figure C

Use an excess lead to form a jumper wire. Bend the wire to the correct length and mount it to the PC board.

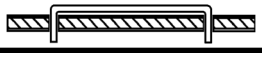
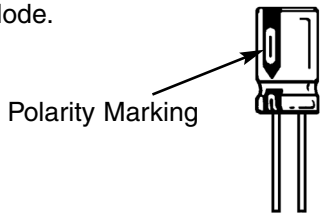


Figure D

Electrolytic capacitors have polarity. Be sure to mount them with the negative (–) lead (marked on side) in the correct hole.

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



COMPONENT CHECK

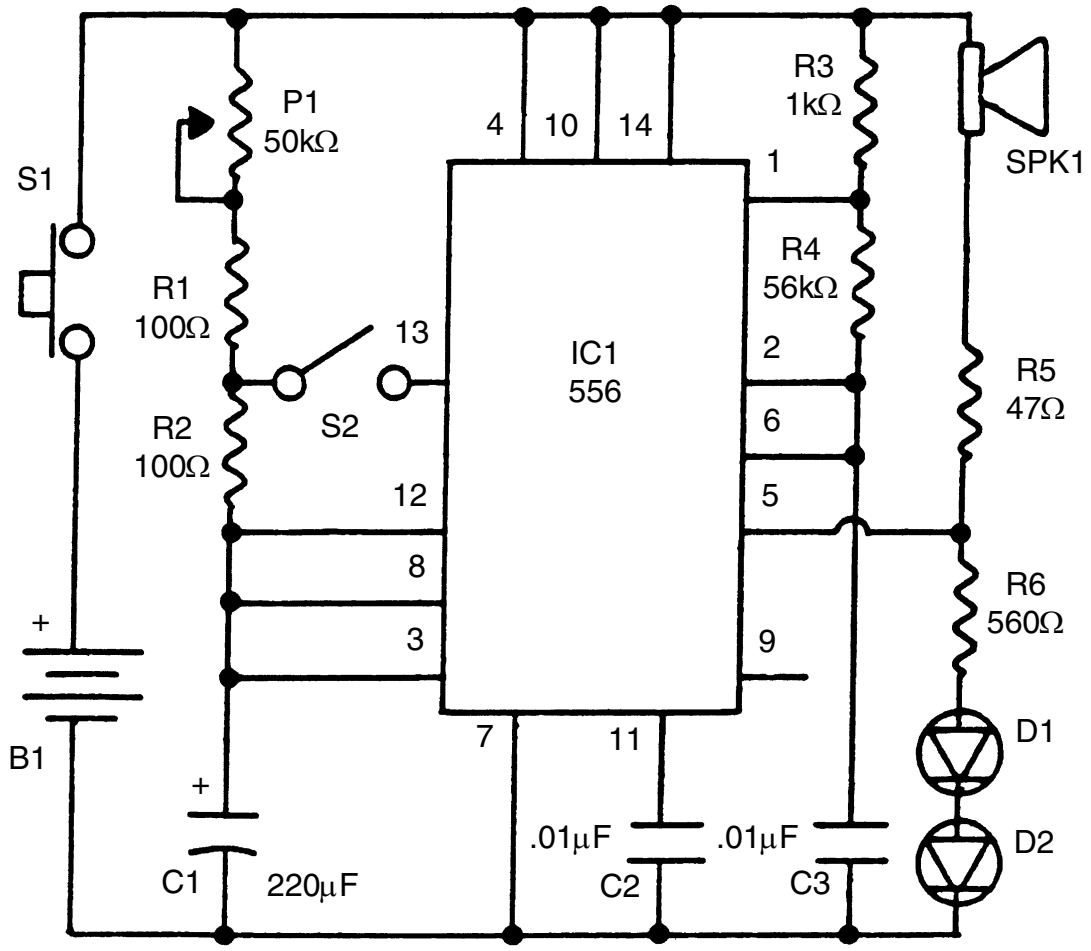
1. Be sure that all components have been mounted in their correct places.
2. Make sure that C1, the electrolytic capacitor is mounted correctly. The negative lead should be in the hole as shown on the top legend.
3. Have LEDs D1 and D2 been installed correctly? The flat side of their bodies should be in the same direction as marked on the top legend. If the LEDs are in backwards, they will not light.
4. Pay close attention to the red and black wires of the battery snap. The red wire should be installed in the positive (+) hole and the black wire in the negative (–) hole. Snap in a fresh 9-volt battery.

TROUBLESHOOTING

Contact Elenco Electronics if you have any problems. DO NOT contact your place of purchase as they will not be able to help you.

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

SCHEMATIC DIAGRAM



QUIZ

1. The Space War Gun has two _____ _____ oscillators.
2. Capacitor C3 and resistors R3 and R4 controls the _____ of oscillation.
3. The charge time of capacitor C3 is through resistors _____ and _____.
4. The discharge of capacitor C3 is through resistor _____ and the _____.
5. The 555B timer operates at a _____ frequency than the 555A timer.
6. Increasing the value of capacitor C2 will _____ the frequency of oscillation.
7. Increasing the voltage of VCO pin 3 of the 555B timer will _____ the frequency of oscillation.
8. VCO stands for _____ _____ _____.
9. In the Space War Gun design, the 555A timer controls the frequency of the _____ timer.
10. Resistor R6 is added to _____ the current in the LEDs.

Answers: 1. astable multivibrator; 2. frequency; 3. R3, R4; 4. R4, IC; 5. higher; 6. lower; 7. decreases; 8. voltage controlled oscillator; 9. 555B; 10. limit

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