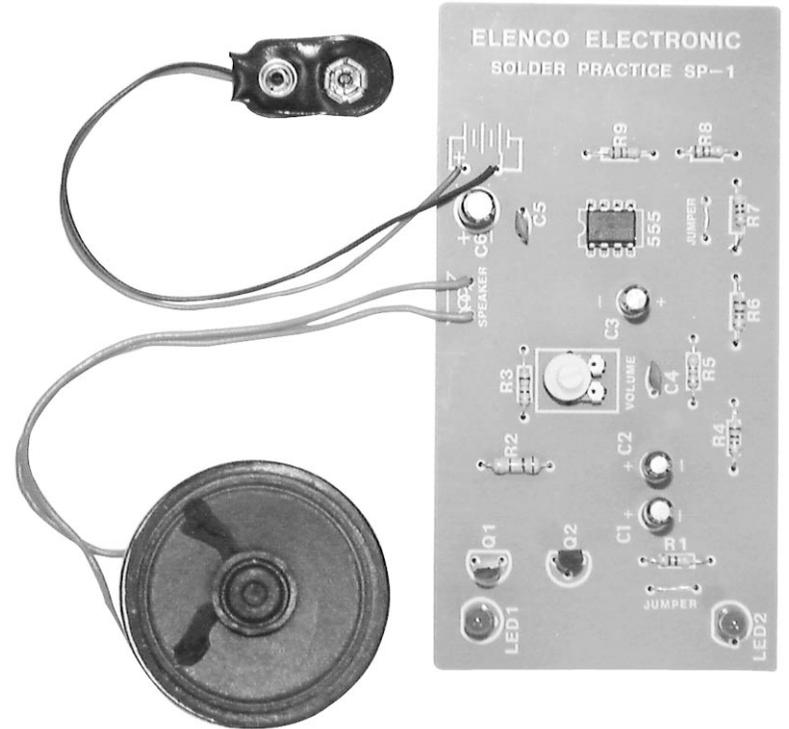


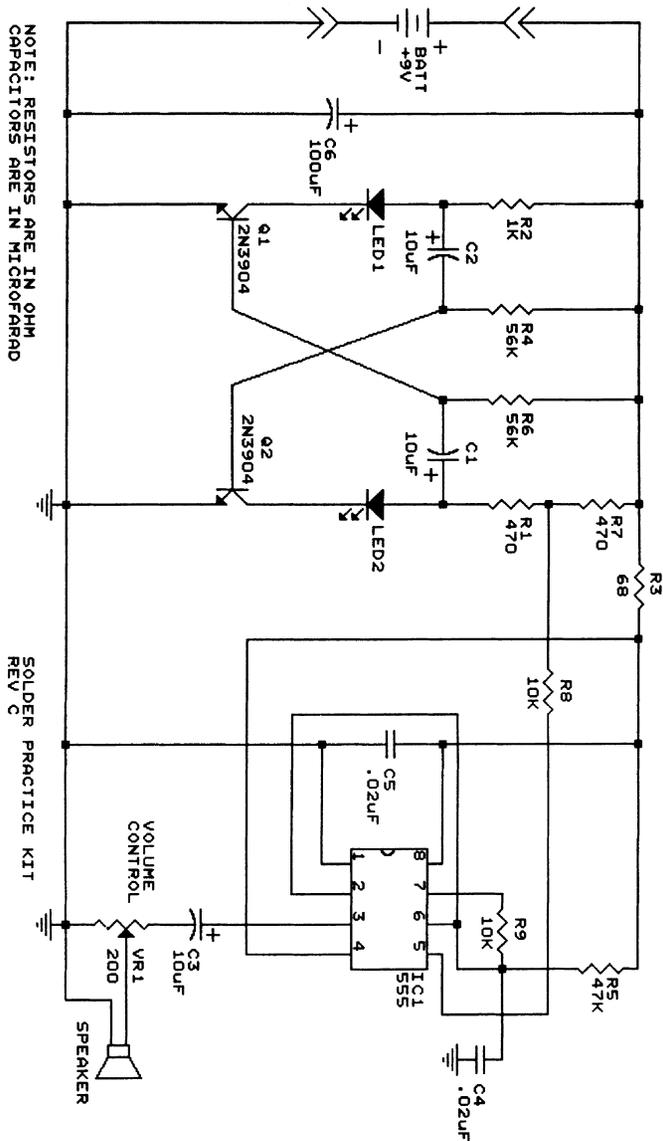
Solder Practice Kit

MODEL AK-100



Lesson Manual

Elenco Electronics, Inc.



Elenco Electronics, Inc.

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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	Part #
<input type="checkbox"/> 1	R3	68Ω 5% 1/4W (blue-gray-black-gold)	126800
<input type="checkbox"/> 2	R1, R7	470Ω 5% 1/4W (yellow-violet-brown-gold)	134700
<input type="checkbox"/> 1	R2	1kΩ 5% 1/2W (brown-black-red-gold)	141001
<input type="checkbox"/> 2	R8, R9	10kΩ 5% 1/4W (brown-black-orange-gold)	151000
<input type="checkbox"/> 1	R5	47kΩ 5% 1/4W (yellow-violet-orange-gold)	154700
<input type="checkbox"/> 2	R4, R6	56kΩ 5% 1/4W (green-blue-orange-gold)	155600
<input type="checkbox"/> 1	VR1	200Ω Potentiometer	191321

Capacitors

Qty.	Symbol	Description	Part #
<input type="checkbox"/> 2	C4, C5	.02μF Discap (203) or .022μF (223)	242280
<input type="checkbox"/> 3	C1, C2, C3	10μF Electrolytic (Lytic)	271045
<input type="checkbox"/> 1	C6	100μF Electrolytic (Lytic)	281044

Semiconductors

Qty.	Description	Part #
<input type="checkbox"/> 2	Transistor 2N3904	323904
<input type="checkbox"/> 1	IC 555 or 1455	330555
<input type="checkbox"/> 2	LED Red	350002

Miscellaneous

Qty.	Description	Part #
<input type="checkbox"/> 1	Printed Circuit Board	511500
<input type="checkbox"/> 1	Battery Snap	590098
<input type="checkbox"/> 1	Speaker	590102
<input type="checkbox"/> 12"	Wire	814800
<input type="checkbox"/> 1	Soldering Iron	9SR1
<input type="checkbox"/> 1	Side Cutters	9ST1
<input type="checkbox"/> 1	Solder Roll	9ST4

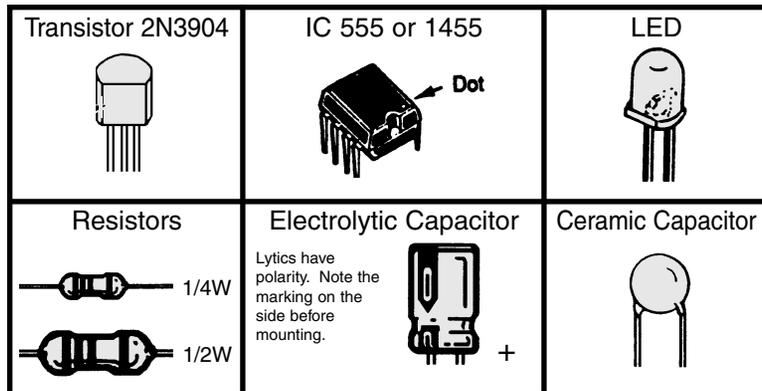


Figure 1, Parts Identification

8. When two adjacent foils accidentally touch, it is called
 - A. a jumper.
 - B. a blob.
 - C. a solder hole.
 - D. a solder bridge.

9. What ratio has the greatest amount of tin?
 - A. 20/60
 - B. 40/60
 - C. 50/50
 - D. 60/40

10. A good solder connection should be
 - A. dull and rough.
 - B. shiny, bright and smooth.
 - C. lumped around the connection.
 - D. soldered on one side of the connection.

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

Quiz

1. Solder is comprised of what two materials?
 - A. gold and copper.
 - B. tin and lead.
 - C. zinc and copper.
 - D. lead and aluminum.
2. What type of flux should be used in electronics?
 - A. chloride.
 - B. organic.
 - C. rosin.
 - D. corrosive.
3. When working on PC boards, what wattage range of iron is ideal?
 - A. 15-40 watts.
 - B. 50-100 watts.
 - C. 1-10 watts.
 - D. 100-200 watts.
4. Tinning the soldering tip will prevent it from
 - A. heating.
 - B. melting.
 - C. soldering.
 - D. oxidating.
5. Proper solder adhesion requires that the metal surface to be
 - A. solder free.
 - B. clean.
 - C. greasy.
 - D. cold.
6. Solder wick is used to
 - A. remove solder.
 - B. solder in small parts.
 - C. cleaning the soldering iron tip.
 - D. removing flux.
7. A cold solder joint is caused by
 - A. a solder bridge.
 - B. using 60/40 solder.
 - C. insufficient heat.
 - D. acid core solder.

Introduction

Almost every electronic device today has a printed circuit board whether you are assembling a PC board or repairing it, you must understand the basics of working with these boards.

A poorly soldered joint can greatly affect small current flow in circuits and can cause equipment failure. You can damage a PC board or a component with too much heat or cause a cold solder joint with insufficient heat. Sloppy soldering can cause bridges between two adjacent foils preventing the circuit from functioning.

Good soldering requires practice and an understanding of soldering principles. This solder practice project will help you achieve good soldering techniques, help you to become familiar with a variety of electronic components, and provide you with dynamic results. If the circuit has been assembled and soldered properly, the LED will alternately flash and the speaker will produce a wailing sound.

Solder

Solder is a fusible alloy composed of tin and lead. Some solder may contain small amounts of other material for use in special purposes to enhance its characteristics. Solder has a melting temperature around 360° to 370°, making it ideal for forming a metallic joint between two metals.

Solder is identified by the ratio of tin-to-lead. The most common ratios are 40/60, 50/50 and 60/40. Solder with a greater tin content melts at a lower temperature, takes less time to harden, and generally makes it easier to do a good soldering job. The ratio of tin is a main factor in the strength of the solder joint. Solder with a greater tin content has a greater holding ability under stress. Solder with a tin ratio of 60% is the strongest, while solder with less than 30% would be undesirable.

Flux

Most solder contains flux in the hollow core of the solder allowing it to be applied automatically when you heat the solder. The flux will remove any oxide film on the metals soldered creating a good metal-to-metal contact. This is called "wetting the metal". There are three types of solder of solder fluxes: chloride, organic and rosin. In the electronics industry, only the rosin type is used. Rosin flux comes in two types, pure and active. The most reliable is the pure type, since it doesn't cause dendrites between tracks on the PC board as the active type does. Due to the highly corrosive and moisture attracting characteristics of the chloride and organic type fluxes, they should not be used in electronics.

Types of Soldering Devices

A number of different types of soldering devices: irons, guns and stations are available today. Irons are used for light to medium work and guns are for medium to heavy-duty work. The station type can range from light to heavy-duty. When working on PC boards, a soldering iron is ideal. Iron sizes vary from 15 to over 500 watts. For working on PC boards, irons ranging from 15 to 40 watts is suitable. If you use an iron with a higher wattage rating than 40 watt, you may damage the copper tracks on the PC board. The higher wattage irons are best suited for heavy-duty electrical jobs.



Soldering Iron

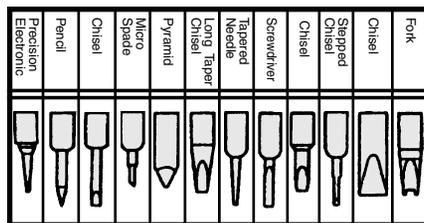
Soldering Gun

Soldering Station

Solder Tips

The material that the tip is made from is an important factor. Most tips are made of copper coated with some other material. The molten solder on the tip will wear it down. To increase their lifetime, tip can be coated with iron, but this decreases the heat transfer rate. The tip should be tinned by lightly coating it with solder. This will prevent it from oxidating. The tip becomes pitted (black spots) from normal use. You can remove these spots by scraping them with a knife or filing item. After removing the spots, you should re-tin the tip. It is important to clean the tip by wiping it with a wet rag or sponge. A good clean solder tip makes soldering much easier.

Today, tips are manufactured in a variety of different shapes (see figure below). The chisel shape is one of the most common. Having a choice of tip styles allows you to choose the one best suited for your soldering needs. Due to the high heat, removable tips can bond themselves to the heating element if left in place for extended periods of time. Periodic removal of the tip is therefore advisable.



Theory of Operation

The solder practice kit produces the sound of the European siren. It consists of two oscillators, a one hertz (one cycle per second) and a 1500Hz. The one hertz oscillator consists of two transistors Q1 and Q2, and resistors R1, R2, R6 and R7 capacitors C1 and C2. This configuration is known as a multivibrator circuit.

When voltage is first applied to this multivibrator circuit, one transistor (possibly Q1) will conduct faster, causing transistor Q2 to stay off. Q1 will continue to conduct until it saturates. At this point, Q2 will start to conduct, causing Q1 to rapidly cutoff. This process continues alternately causing Q1 or Q2 to conduct. The output will be a square wave. The frequency is determined by the time constants of resistor R6 and capacitor C1, also R4 and C2. Two LED diodes are placed in the collectors of the transistors and will light when current is passing through them. Resistors R2, R1 and R7 determine the current passing through the LEDs.

Integrated circuit IC1 is the heart of the second oscillator. A 555 timer IC is used in the circuit. This IC contains many transistors and resistors on a silicon chip and thus eliminates many external parts. The frequency of this oscillator is determined by resistors R5, R9 and capacitor C4. Capacitor C3 couples the output of operations of IC1 via resistor R8. This changes the operations of IC1 during one half cycle of the multivibrator causing the frequency to change from 1500Hz to 2200Hz. This results in a speaker output that varies constantly in pitch. The multivibrator circuit not only causes the LED to flash, but also varies the pitch at the speaker output.

Troubleshooting

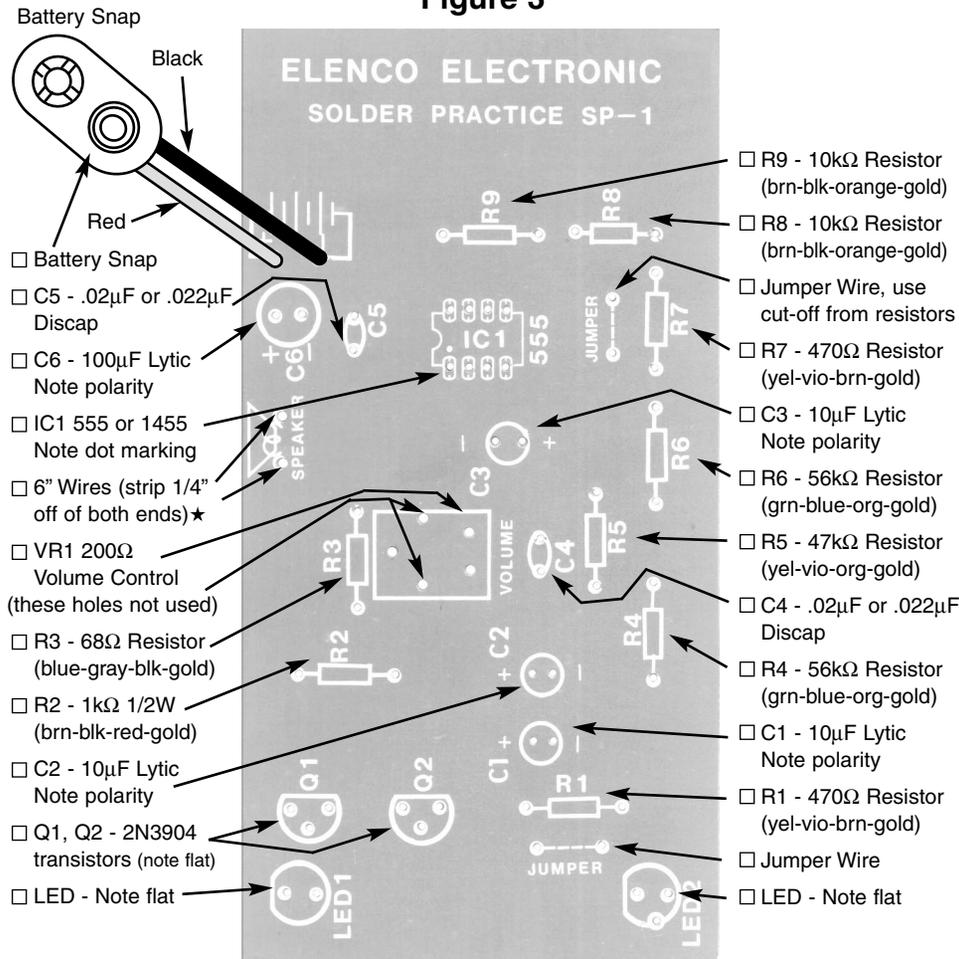
If you are experiencing a problem, first read the theory of operations to familiarize yourself with the operation. Remember, there are two oscillators. If no sound comes out of the speaker, but the LED flashes alternately, then the 555 timer is not working. Be sure that the volume control is at maximum. Check the components IC1, R5, R8, R9, C3, C4 and C5. Be sure that the IC is in properly.

If a steady sound (not wobbling) comes out of the speaker, then the multivibrator is not working. Check the components associated with transistor Q1 and Q2. Check the LED by shorting the transistor collector to the emitter. The LED should light. If not, then the LED is either open or backwards.

Circuit Board Assembly

Note that electrolytic capacitors, transistors, LEDs and the IC must be installed according to their polarity. Refer to Figure 1 for identification.

Figure 3



After completing the above assembly, twist the two speaker wires together and solder to speaker lugs.

★ Cut 12" wire into two 6" wires.

After completing the assembly of the kit, double back to see that the soldering looks good and all of the components are in their proper place. If everything is all right, attach the 9V battery to the battery snap. The LEDs should alternately light and the speaker should sound a wobbling siren.

Clean Connections

Proper solder adhesion requires that the metal surface to be free of dirt and grease. The flux only removes the oxides so a brush or rag can be used to clean metal. There are contact cleaners in aerosol cans and other solvents available.

Desoldering

Great care should be taken when repairing or correcting a mistake on a PC board. The metal foil can be easily pulled up or broken from excessive heat. Use the least amount of heat as possible. You can use a desoldering tool, bulb, wick or a station. These tools will remove the solder enabling you to correct the problem.



Desoldering Tool



Bulb



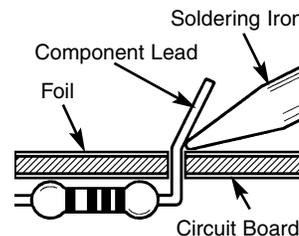
Solder Wick



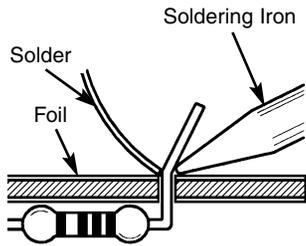
Desoldering Station

Soldering Components to the PC Board

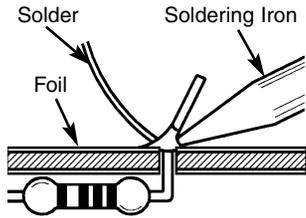
- A. A 15 to 40 watt pencil type soldering iron with a 1/8" or 3/16" pyramid works well.
- B. The soldering iron tip must be kept clean at all times. Wipe it on a wet sponge or cloth, then tin the entire tip to give it a wet look. This will prevent the tip from oxidizing.
- C. Always use rosin core solder, type 60/40 (60% tin, 40% lead). Never use acid core solder, for it will damage the components.



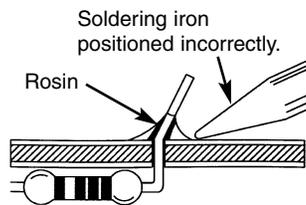
- D. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



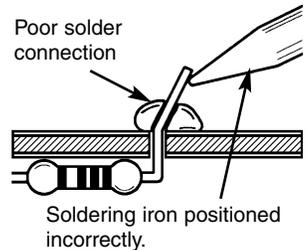
E. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and flow into the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and circuit foil to melt the solder.



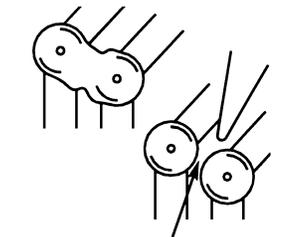
F. Allow the solder to flow around the connection. Then, remove the solder and iron and let the connection cool. The solder should flow uniformly and not lump around the wire. The connection should be bright, shiny and smooth.



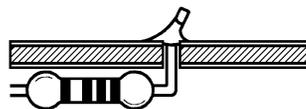
G. Poor solder connections occur when the lead is not heated sufficiently. This is called a "cold" solder joint. The solder will not adhere to the lead as shown. To correct this, reheat the connection and if necessary, apply a small amount of additional solder to obtain a good connection.



H. When the foil is not heated sufficiently, the solder will blob on the circuit board. To correct this, reheat the connection and if necessary, apply a small amount of additional solder to obtain a good connection.



I. A solder bridge may form if you accidentally touch an adjacent foil, particularly a previously soldered connection, use too much solder, or drag the soldering iron across adjacent foils. Remove any solder bridges with your soldering iron.



J. Do not allow components to move when solder is cooling. It may not solder properly and result in a cold solder joint. Components should be placed as close to the board as possible. Bend the leads to hold the part in place while soldering.

Soldering Project Procedure

Before we begin to assemble and solder components to the solder practice board, we will practice large pads on the edge of the PC board, see Figure 2. Soldering should be smooth and neat. Next, solder to the smaller pads. Be sure that there is no solder bridging. Try intentionally to make a solder bridge. Then, remove it by lifting the PC board over the soldering iron and the iron will draw the solder away from the pads. It is best to wipe the iron tip with a damp cloth to remove the solder. Finally, you will note the large rectangle pads. These are used to practice "tack soldering". Strip the end of the wire and practice soldering the wire to the pads. Remove the wire when finished.

The PC board is covered with solder resist over areas that are not to be soldered. This is done to reduce soldering shorts to adjacent metal runs. On the large pad, note that half of the pad is covered with solder resist. Try soldering the wire to the covered pad. You will find that it is impossible to solder.

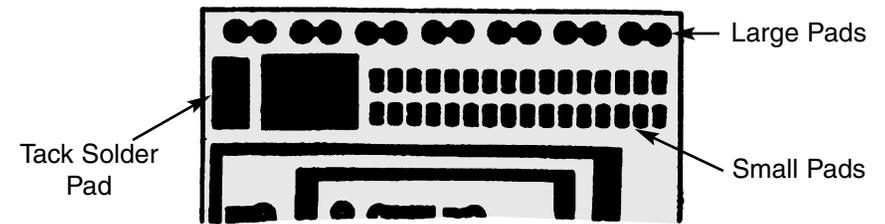


Figure 2 Practice Solder Area

Refer to Figure 3 and begin the PC board assembly with resistor R9. Be sure to identify the correct value by reading the color code (brown-black-orange-gold). Place the resistor into the PC board with the leads coming out on the copper foil side. Solder in place and clip off the excess wire close to the connection. Proceed clockwise with the other components. Check off the box when you have completed that step.