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

*Note: Please refer to page 13 for the resistor reading exercise. This will familiarize you with the resistor color band coding.*

<table>
<thead>
<tr>
<th>Qty.</th>
<th>Symbol</th>
<th>Value</th>
<th>Color Code</th>
<th>Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R3</td>
<td>68Ω 5% 1/4W</td>
<td>blue-gray-black-gold</td>
<td>126800</td>
</tr>
<tr>
<td>2</td>
<td>R1, R7</td>
<td>470Ω 5% 1/4W</td>
<td>yellow-violet-brown-gold</td>
<td>134700</td>
</tr>
<tr>
<td>1</td>
<td>R2</td>
<td>1kΩ 5% 1/2W</td>
<td>brown-black-red-gold</td>
<td>141001</td>
</tr>
<tr>
<td>2</td>
<td>R8, R9</td>
<td>10kΩ 5% 1/4W</td>
<td>brown-black-orange-gold</td>
<td>151000</td>
</tr>
<tr>
<td>2</td>
<td>R4, R6</td>
<td>22kΩ 5% 1/4W</td>
<td>red-red-orange-gold</td>
<td>152200</td>
</tr>
<tr>
<td>1</td>
<td>R5</td>
<td>47kΩ 5% 1/4W</td>
<td>yellow-violet-orange-gold</td>
<td>154700</td>
</tr>
<tr>
<td>2</td>
<td>R4A, R6A</td>
<td>56kΩ 5% 1/4W</td>
<td>green-blue-orange-gold</td>
<td>155600</td>
</tr>
<tr>
<td>1</td>
<td>VR1</td>
<td>200Ω Trim Pot</td>
<td></td>
<td>191321</td>
</tr>
</tbody>
</table>

CAPACITORS

<table>
<thead>
<tr>
<th>Qty.</th>
<th>Symbol</th>
<th>Value</th>
<th>Description</th>
<th>Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>C4, C5</td>
<td>.02μF (203) or .022μF (223) Discap</td>
<td>242010</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C1, C2, C3</td>
<td>10μF Electrolytic (Lytic)</td>
<td>271045</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>C6</td>
<td>100μF</td>
<td>Electrolytic (Lytic)</td>
<td>281044</td>
</tr>
</tbody>
</table>

SEMICONDUCTORS

<table>
<thead>
<tr>
<th>Qty.</th>
<th>Symbol</th>
<th>Value</th>
<th>Description</th>
<th>Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Q1, Q2</td>
<td>2N3904</td>
<td>Transistor NPN</td>
<td>323904</td>
</tr>
<tr>
<td>1</td>
<td>IC1</td>
<td>555 or 1455</td>
<td>Integrated Circuit (Timer)</td>
<td>330555</td>
</tr>
<tr>
<td>2</td>
<td>LED1, LED2</td>
<td>Red LED (Light Emitting Diode)</td>
<td>350002</td>
<td></td>
</tr>
</tbody>
</table>

MISCELLANEOUS

<table>
<thead>
<tr>
<th>Qty.</th>
<th>Symbol</th>
<th>Description</th>
<th>Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PC Board</td>
<td></td>
<td>511500</td>
</tr>
<tr>
<td>1</td>
<td>Solder Wick</td>
<td></td>
<td>556000</td>
</tr>
<tr>
<td>1</td>
<td>Battery Snap</td>
<td></td>
<td>590098</td>
</tr>
<tr>
<td>1</td>
<td>Speaker</td>
<td></td>
<td>590102</td>
</tr>
<tr>
<td>3</td>
<td>Wire 22AWG Topcoat Blue 12&quot; (save one piece for the speaker assembly)</td>
<td>814600</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Solder Tube Lead-free</td>
<td></td>
<td>9LF96</td>
</tr>
</tbody>
</table>

For AK-100 only:

<table>
<thead>
<tr>
<th>Qty.</th>
<th>Description</th>
<th>Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Soldering Iron</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Side Cutters</td>
<td></td>
</tr>
</tbody>
</table>

PARTS IDENTIFICATION
IDENTIFYING RESISTOR VALUES
Use the following information as a guide in properly identifying the value of resistors.

<table>
<thead>
<tr>
<th>BAND 1</th>
<th>BAND 2</th>
<th>Multiplier</th>
<th>Resistance Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Digit</td>
<td>2nd Digit</td>
<td>Color</td>
<td>Digit</td>
</tr>
<tr>
<td>Black 0</td>
<td>Black 0</td>
<td>Black</td>
<td>0</td>
</tr>
<tr>
<td>Brown 1</td>
<td>Brown 1</td>
<td>Brown</td>
<td>1</td>
</tr>
<tr>
<td>Red 2</td>
<td>Red 2</td>
<td>Red</td>
<td>2</td>
</tr>
<tr>
<td>Orange 3</td>
<td>Orange 3</td>
<td>Orange</td>
<td>3</td>
</tr>
<tr>
<td>Yellow 4</td>
<td>Yellow 4</td>
<td>Yellow</td>
<td>4</td>
</tr>
<tr>
<td>Green 5</td>
<td>Green 5</td>
<td>Green</td>
<td>5</td>
</tr>
<tr>
<td>Blue 6</td>
<td>Blue 6</td>
<td>Blue</td>
<td>6</td>
</tr>
<tr>
<td>Violet 7</td>
<td>Violet 7</td>
<td>Violet</td>
<td>7</td>
</tr>
<tr>
<td>Gray 8</td>
<td>Gray 8</td>
<td>Gray</td>
<td>8</td>
</tr>
<tr>
<td>White 9</td>
<td>White 9</td>
<td>White</td>
<td>9</td>
</tr>
</tbody>
</table>

BANDS

1. 2nd Digit 2. Multiplier 3. Tolerance

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.

<table>
<thead>
<tr>
<th>Multiplier</th>
<th>For the No.</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiply By</td>
<td>1</td>
<td>10</td>
<td>100</td>
<td>1k</td>
<td>10k</td>
<td>100k</td>
<td>.01</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

First Digit  
Second Digit  
Multiplier  
Tolerance  
Maximum Working Voltage

The value is 10 x 1,000 = 10,000pF or .01μF 100V

METRIC UNITS AND CONversions

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Means</th>
<th>Multiply Unit By</th>
<th>Or</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>Pico</td>
<td>.000000000001</td>
<td>10^{-12}</td>
</tr>
<tr>
<td>n</td>
<td>Nano</td>
<td>.000000001</td>
<td>10^{-9}</td>
</tr>
<tr>
<td>μ</td>
<td>Micro</td>
<td>.00001</td>
<td>10^{-6}</td>
</tr>
<tr>
<td>m</td>
<td>Milli</td>
<td>.001</td>
<td>10^{-3}</td>
</tr>
<tr>
<td>u</td>
<td>Unit</td>
<td>1</td>
<td>10^0</td>
</tr>
<tr>
<td>k</td>
<td>Kilo</td>
<td>1,000</td>
<td>10^3</td>
</tr>
<tr>
<td>M</td>
<td>Mega</td>
<td>1,000,000</td>
<td>10^6</td>
</tr>
</tbody>
</table>

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
RESISTOR READING EXERCISE

Before starting assembly of your solder practice project, you should be thoroughly familiar with the 4-band color code system. Many of the resistor values will be identified by color bands and it is easy to mistake their value if you read the colors incorrectly or read the value from the wrong end. Do the following exercise in resistor values. Place your answer in the box beneath the resistor. Answers are on the bottom of this page.

1) brown-green-red-gold

(1) brown-green-red-gold

2) brown-black-orange-gold

(2) brown-black-orange-gold

3) brown-black-yellow-gold

(3) brown-black-yellow-gold

4) red-red-orange-gold

(4) red-red-orange-gold

5) yellow-violet-brown-gold

(5) yellow-violet-brown-gold

6) blue-gray-orange-gold

(6) blue-gray-orange-gold

7) yellow-violet-black-gold

(7) yellow-violet-black-gold

8) brown-blue-brown-gold

(8) brown-blue-brown-gold

9) orange-orange-red-gold

(9) orange-orange-red-gold

10) green-brown-red-gold

(10) green-brown-red-gold

11) brown-black-green-gold

(11) brown-black-green-gold

12) brown-gray-orange-gold

(12) brown-gray-orange-gold

Answers to Resistor Reading Exercise:

1) 1.5kΩ ±5%; 2) 10kΩ ±5%; 3) 100kΩ ±5%; 4) 22kΩ ±5%; 5) 470Ω ±5%;
6) 68kΩ ±5%; 7) 47Ω ±5%; 8) 160Ω ±5%; 9) 3.3kΩ ±5%; 10) 5.1kΩ ±5%;
11) 1MΩ ±5%; 12) 18kΩ ±5%
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.

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, two LED's will alternately flash, and the speaker will produce a wailing sound.

**Safety Precautions**

Like all electrical devices, the solder station must be handled with care. The soldering iron and tip can reach high temperatures and these simple safety rules should be followed.

- Keep children out of reach of the soldering station.
- To protect your eyes, use safety goggles.
- Keep flammable material away from the soldering iron.
- **DO NOT cool iron** by dipping it into any liquid or water.
- Always assume that the tip is hot to avoid burns.
- Work in an area that is well ventilated.
- Be careful that the hot soldering iron tip or the barrel of the iron does not come in contact with any electrical cord.
- **Do not hold solder in your mouth.** Solder contains lead and is a toxic substance. Wash your hands thoroughly after handling solder.
- Locate soldering iron in an area where you do not have to go around it or reach over it.

**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 63/37, 60/40, and 50/50. The first number indicates the amount of tin, and the second is lead. A 60/40 solder has 60% tin and 40% lead. 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 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.

**Surface Preparation**

In order for the solder to adhere to the connection, the metals must be clean and free of nonmetallic materials. Flux in the solder can remove oxides from metal but not other materials like dirt or grease. To remove these, use a small steel brush or fine emery cloth.

**Mechanical Connection**

When all the surfaces are clean, the metals should have a solid mechanical connection. Wires should be tightly wrapped around each other or to the terminal. This will eliminate large gaps that create weak solder joints. Solder should not be used as a mechanical connection.
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. For working on PC boards, irons ranging from 15 to 40 watts are suitable, or a station with a range of 15 to 40 watts. 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.

Solder Tips
The tip is the very important part of the iron. The material that the tip is made from is an essential factor. The soldering iron tip contains four different metals as shown in Figure 3. The core consists of copper. Since the copper is a soft material, it is plated with iron. Chrome plating is used on the area where no soldering takes place to prevent oxidation. Then the tip is plated with tin, because it can be easily cleaned.

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.

Tip Cleaning
A good clean solder tip makes soldering much easier. The tip should be tinned by lightly coating it with solder to prevent it from oxidizing. The tip can become pitted (black spots) from normal use. It is important to clean the tip by wiping it with a wet sponge or rag. For tips that need a good cleaning, the tip tinner and cleaner (#TTC1) should be used. **Never use a file or abrasive material to clean the tip.** Using such methods will damage the plating and ruin the tip. Do not remove the excess solder from the tip before storing. The excess solder will prevent oxidation.

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.
**SOLDER PRACTICE**

**Double Pads**
Before we begin to assemble and solder the components to the solder practice PC board, we will start first by practice soldering to the double pads on the edge of the PC board (see Figure 3).

1. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil.
2. Place the iron on the top half of pad and then apply the solder (see Figure 4). Allow the solder to flow around the pad. Then, remove the solder and the iron and let the solder cool. The solder should be neat and smooth.
3. Repeat step 2 on the top row of the pads (see Fig. 4).

**Single Pads**
Now practice using the single pads. Use the same soldering procedures as the large double pads. Be sure there are no solder bridges between the pads. (Refer to the Solder Bridge Section below).

**Solder Bridge**
Solder bridges occur when solder runs between circuit paths and creates a short circuit. This is usually caused by using too much solder. Using the top row of single pads, try intentionally to make a solder bridge on each section (see Figure 5). Then, remove it by simply dragging your soldering iron across the solder bridge as shown. It is best to wipe the iron tip with a wet sponge to remove the solder. You can also use solder wick as described on page 7.

**Solder Resist**
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 to the covered pad. You will find that it is impossible to solder.

**Tack Soldering**
You will make 14 tack solder connections by soldering seven wires to the top row of pads.

1. Cut seven 1 1/2” wires and strip 1/8” insulation off both ends (see figure below).
2. Place the iron and the wire on top right pad as shown in Figure 7. Allow the solder to flow around the wire. Then, remove the iron and let the solder cool. You may need to add some more solder. The solder should be neat and smooth.
3. Pull the wire to make sure you have a good solder joint.
4. Bend the wire and solder it to the next pad, as shown in Figure 7.
5. Now solder the remaining wires to the pads as shown in Figure 7.
Hairline Cracks
The hairline cracks can develop in the copper foil if the PC board is flexed. This can be easily repaired by making a solder bridge across the two foils. The solder should smoothly flow across the foil as shown in Figure 8. If the solder does not adhere to the foil, it will sit on the foil as a blob as shown in Figure 9.

1. Make five solder bridges using the second row of single pads, starting from the left side (see Figure 10).

Reinforcing a Repair
A solder bridge repair can be reinforced using a solid wire. Now add a wire to the five solder bridges you just made.
1. Strip a 1/2" of insulation off one end of the wire and then tin it.
2. Hold the tinned wire on top of the solder bridge.
3. Place the iron on the wire until the solder melts.
4. Remove the iron while holding the wire in place against the foil. Make sure the wire does not move until the solder hardens.
5. Check for a good solder connection.
6. Solder the wire to the lower pad.
7. Cut the wire off as close to the solder joint as possible (see Figure 11).
8. You can hold the wire down with a screwdriver and resolder the wire.
9. Practice this procedure four more times on remaining pads.

Wide Gaps
For wider gaps in a copper foil, a solder bridge cannot be used. A small wire would be used to bridge the copper as shown in Figure 11. Six bridges will be made across the two rows of small pads.

1. Place the iron on the top half of pad and then apply the solder. Allow the solder to flow around the pad. Then, remove the solder and the iron and let the solder cool. The solder should be neat and smooth.
2. Repeat Step 1 on the lower pad.
3. Strip 1/2" of insulation off one end of the wire and then tin it.
4. Hold the wire on the top pad and then place the iron on the wire. The solder will melt and the wire will press down against the pad (see Figure 11). Remove the iron while holding the wire in place against the foil. Make sure the wire does not move until the solder hardens.
5. Check for a good solder connection.
6. Solder the wire to the lower pad.
7. Cut the wire off as close to the solder joint as possible (see Figure 11).

-7-
Desoldering wick is a braided wire coated with non-corrosive rosin flux. It is the simplest and safest tool for removing solder from a solder connection. When the braided wire is heated, the flux cleans and breaks up the surface tension so the melted solder from the connection flows into the braid by capillary action.

Included in this kit is a six inch length of solder wick (desoldering braid).

Using the Solder Wick

- Place the solder wick on one of the pads and the iron on top of it (see Figure 12).
- As the solder melts, it will be drawn into the wick.
- When the iron and wick are removed, the solder should be removed. You need to repeat the process if some solder remains.

If necessary, repeat the procedure until all of the unwanted solder is removed.

After the excess solder has been wicked away by the desoldering braid, clip off and discard the solder-saturated portion of the braid. For best results, always use a fresh area of the braid for each procedure.

CAUTION: Wick gets HOT - use long nose pliers to hold wick.

Figure 12

Using solder wick to remove excess solder.

Figure 13

A close-up view of the accumulation of solder onto the solder wick (desoldering braid).
THEORY OF OPERATION

The solder practice kit consists of a circuit oscillating at one hertz (one cycle per second). The oscillator consists of two transistors Q1 and Q2, and resistors, R1 - R11 and capacitors C1 and C2. This configuration is known as a multivibrator circuit.

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. The LED's will light when current is passing through them. Resistors R2, R1 and R7 determine the current passing through the LED's.

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.

SCHEMATIC DIAGRAM

![Schematic Diagram]

NOTE: RESISTORS ARE IN OHM
CAPACITORS ARE IN MICROFARAD

SOLDER PRACTICE KIT
REV C
SOLDERING

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.

What Good Soldering Looks Like
A good solder connection should be bright, shiny, smooth, and uniformly flowed over all surfaces.

Soldering a PC board
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.

Heat Sinking
Electronic components such as transistors, IC's, and diodes can be damaged by the heat during soldering. Heat sinking is a way of reducing the heat on the components while soldering. Dissipating the heat can be achieved by using long nose pliers, an alligator clip, or a special heat dissipating clip. The heat sink should be held on the component lead between the part and the solder joint.

---

-10-
**PC BOARD ASSEMBLY**

**NOTE:** Before beginning assembly, please refer to page 13 for the resistor reading exercise. This will familiarize you with the resistor color band coding.

- Solder the following parts to the PC board:
  - Battery Snap (see Figure A)
  - C5 - .02μF or .022μF Discap
  - C6 - 100μF Electrolytic (Lytic) (see Figure B)
  - IC1 - 555 or 1455 Timer (see Figure C)
  - VR1 - 200Ω Potentiometer (see Figure D)
  - R9 - 10kΩ 5% ¼W Resistor (brown-black-orange-gold) (see Figure E)
  - R8 - 10kΩ 5% ¼W Resistor (brown-black-orange-gold) (see Figure E)
  - Jumper Wire (see Figure F)
  - R7 - 470Ω 5% ¼W Resistor (yellow-violet-brown-gold) (see Figure E)
  - R6 - 22kΩ 5% ¼W Resistor (red-red-orange-gold) (see Figure E)
  - C3 - 10μF Electrolytic (Lytic) (see Figure B)

**Figure A**

Solder the Red Positive (+) lead of the battery snap to the hole marked (+) on the PC board. Solder the Black Negative (–) lead to the hole marked (–) on the PC board. Cut off the excess leads.

**Figure B**

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

**Figure C**

Mount IC1 in the location shown below onto the PC board. Be sure that the notch or dot on the IC is in the same direction as the marking on the PC board (see drawing below). Solder and cut off the excess leads.

**NOTE:** Do not keep the soldering iron on the IC leads for extended periods of time. You run the risk of overheating the IC, thus damaging it.

**Figure D**

Mount VR1 into the three holes in the PC board as shown below. Note that the other two holes are not used. Solder and cut off the excess leads.

**Figure E**

Mount the resistor flat against the PC board as shown.
OPERATION

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 LED’s should alternately light and the speaker should sound a wobbling siren. Continue to the Desoldering Practice/Component Replacement Section.

Note: Refer to the Troubleshooting Section if your circuit does not work.
TROUBLESHOOTING

If any parts are missing or damaged, see instructor or bookstore. **DO NOT** contact your place of purchase as they will not be able to help you. Contact Elenco® Electronics (address/phone/e-mail is at the back of this manual).

If you are experiencing a problem, first read the theory of operation to familiarize yourself with the operation.

**Component Check**

1. Be sure that all components have been mounted in their correct places.

2. Make sure that C1 and C2, the electrolytic capacitor is mounted correctly. The negative lead should be in the hole as shown on the top legend.

3. Have LED’s LED1 and LED2 been installed correctly? The flat side of their bodies should be in the same direction as marked on the top legend. If the LED’s 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.

**Problems**

1. **No LED’s Light**
   - Check the solder connections for the battery wires and switch.
   - Check that all parts are in the correct way.

2. **LED1 Does Not Light**
   - Check C1, LED1 and Q1.

3. **LED2 Does Not Light**
   - Check C2, LED2 and Q2.

4. **LED1 or LED2 is Always On**
   - Check C1 and C2 for opens.
   - Check Q1 and Q2 for shorts.

Remember that 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 backward.

**DESOLDERING PRACTICE/COMPONENT REPLACEMENT**

In this exercise you will replace the 22kΩ resistors R4 and R6 with two 56kΩ resistors. You unsolder the resistors using the solder wick and then install new resistors.

1. Remove the battery from the battery snap.

2. Locate the pads that resistor R4 is soldered to.

3. Place the solder wick on one of the pads and the iron on top of it (refer to page 8).

4. As the solder melts, it will be drawn into the wick.

5. When the iron and wick are removed, the solder should be removed. You need to repeat the process if some solder remains.

6. Unsolder the other lead and remove then remove the resistor.

7. Follow the same procedure and remove resistor R6.

Now use the resistors R4A and R6A mounted on the component card, and install them on the PC board. Reconnect the battery and the kit should oscillate at the correct frequency.
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°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.
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. oxidizing.

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.

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.


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