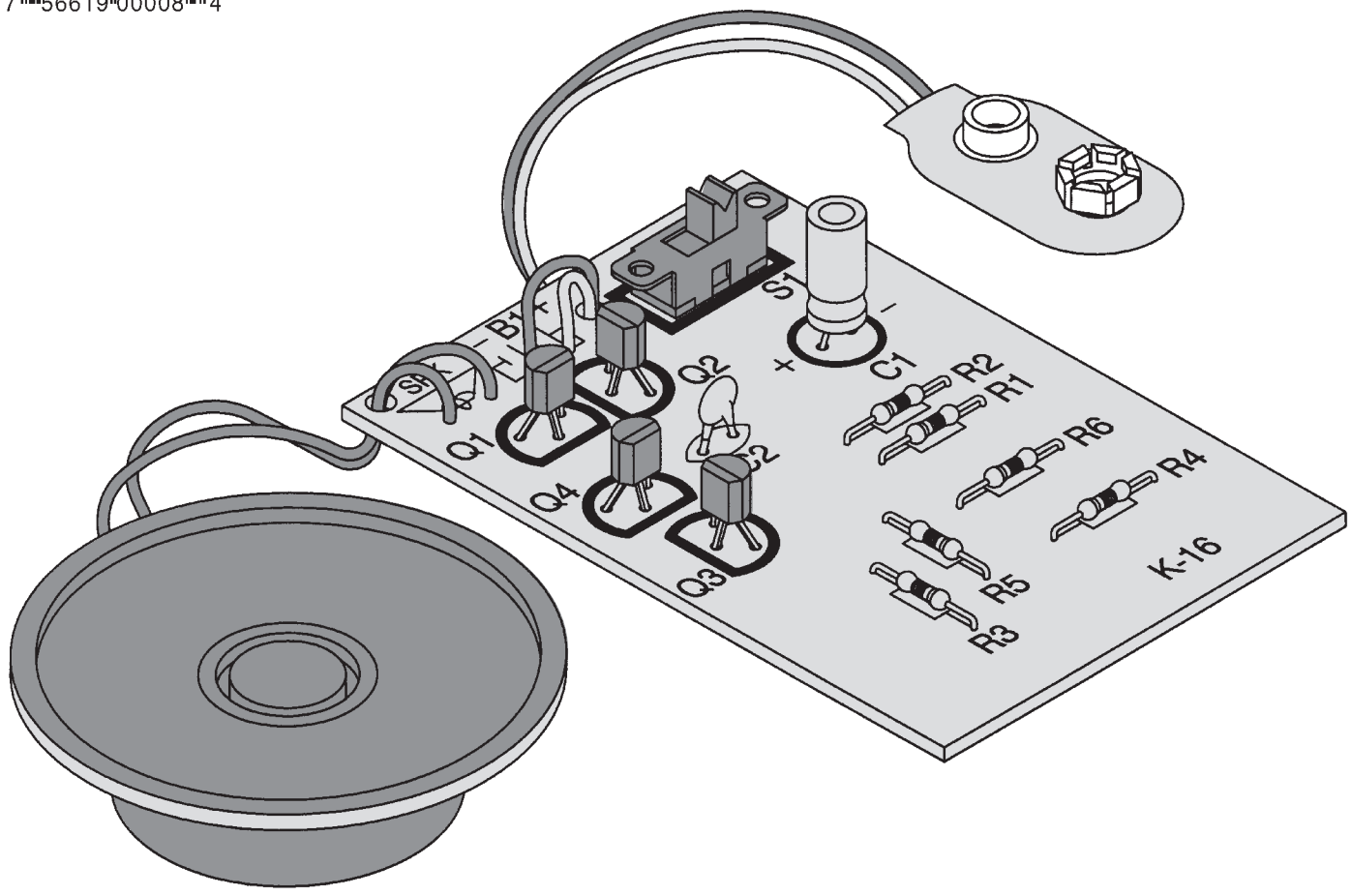
ELECTRONIC CRICKET KIT

MODEL K-16



Assembly and Instruction Manual

Elenco™ Electronics, Inc.

 Revised 2003 REV-E 753216

PARTS LIST

If you are a student, and any parts are missing or damaged, please see instructor or bookstore.
If you purchased this electronic cricket 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.

RESISTORS

Qty.	Symbol	Value	Color Code	Part #
☐ 1	R6	360Ω 5% 1/4W	orange-blue-brown-gold	133600
☐ 1	R5	1kΩ 5% 1/4W	brown-black-red-gold	141000
☐ 1	R3	1.5kΩ 5% 1/4W	brown-green-red-gold	141500
☐ 1	R2	22kΩ 5% 1/4W	red-red-orange-gold	152200
☐ 1	R4	100kΩ 5% 1/4W	brown-black-yellow-gold	161000
☐ 1	R1	1MΩ 5% 1/4W	brown-black-green-gold	171000

CAPACITORS

Qty.	Symbol	Value	Description	Part #
☐ 1	C2	.01μF (103)	Discap	241031
☐ 1	C1	100μF	Electrolytic	281044

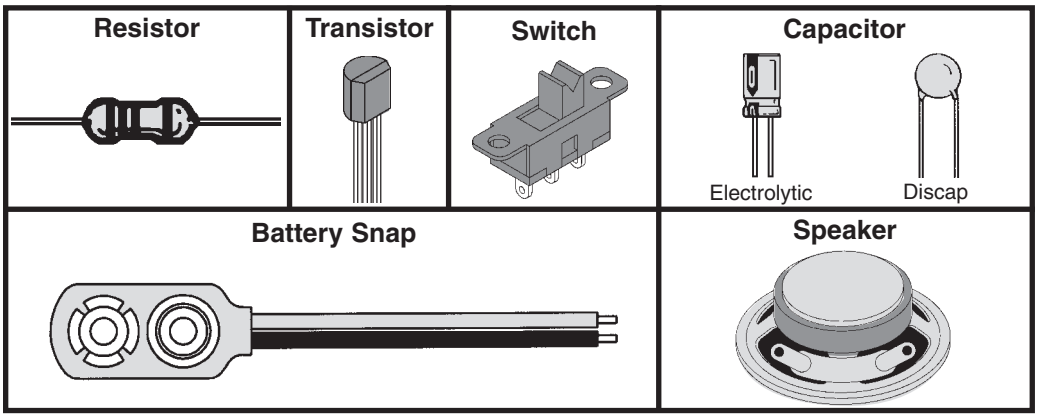
SEMICONDUCTORS

Qty.	Symbol	Value	Description	Part #
☐ 2	Q1, Q3	2N3904	Transistor NPN	323904
☐ 2	Q2, Q4	2N3906	Transistor PNP	323906

MISCELLANEOUS

Qty.	Symbol	Description	Part #
☐ 1		PC Board	518016
☐ 1	SW1	Switch	541102
☐ 1		24” Solder Roll	551124
☐ 1	B1	Battery Snap	590098
☐ 1	SPK1	Speaker 8Ω	590102
☐ 2		4” Wire	814620

PARTS IDENTIFICATION



IDENTIFYING RESISTOR VALUES

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

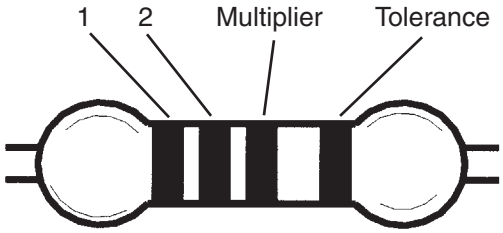
BAND 1 1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

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	±.5%
Blue	±.25%
Violet	±.1%

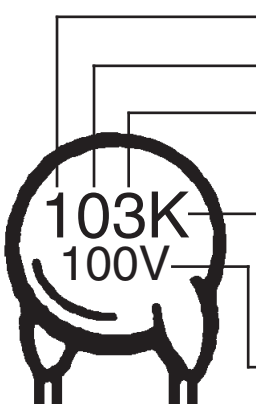
BANDS



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.

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

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

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

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

CIRCUIT OPERATION

Basically, the Electronic Cricket is a very high frequency oscillator which is turned on for a very short period of time, which makes it very difficult to find.

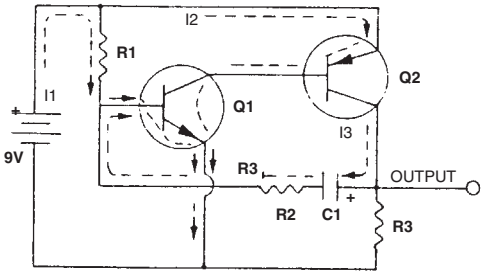
Figure 1

Figure 1 shows the block diagram of the Electronic Cricket. The circuit consists of two oscillators, a very low frequency one cycle every two minutes and a very high 10,000 cycles per second. The low frequency oscillator controls the high frequency oscillator and will allow it to oscillate for about 5 seconds every two minutes. The circuit will automatically turn off the 10,000 cycles oscillator until it's ready for the next cycle.

OPERATION OF THE LOW FREQUENCY OSCILLATOR

Figure 2 shows the schematic diagram of the low frequency oscillator. When the power is turned on, a current (I1) will flow through resistor R1, turning on the base of transistor Q1. This in turn produces a much larger current (I2) in the collector of Q1 and into the emitter base of Q2, turning transistor Q2 on very strongly. Now, the collector of Q2 produces a comparatively larger current I3, rapidly charging capacitor C1. C1 sends a current into the base of Q1 which further increases current I2 and I3. This action is known as positive feedback and occurs in about 5 seconds. Note that C1 charges through the 22,000 ohm resistor R2. Once this happens, current in C1 reverses itself turning transistor Q1 and Q2 off. Capacitor C1 reverses itself turning transistor Q1 and Q2 off. Capacitor C1 now must discharge through R2, R3 and R1. These values add up to 1,023,500 ohms or a very long time compared to the 22,000 ohm charging resistance. The result is a very short on time and very long off time for transistor Q1 and Q2 as shown in Figure 3.

Figure 2



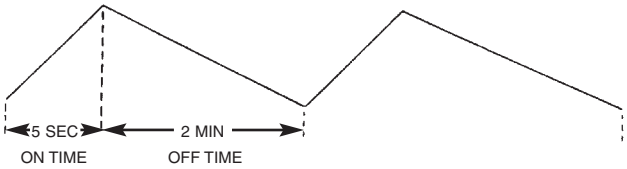
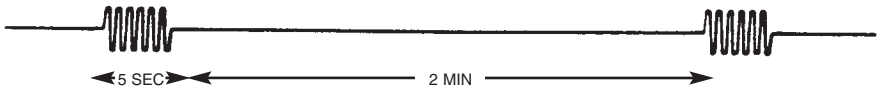


Figure 3

OPERATION OF THE HIGH FREQUENCY OSCILLATOR

Refer to the schematic diagram on page 5. Note that transistor Q3 and Q4 form a second oscillator very similar to oscillator Q1 and Q2. The only difference is the value of capacitor C2 and resistor R5. C2 is much smaller in capacitance. This causes the oscillator to oscillate at a much higher frequency, 10,000 cycles per second. Also, note that the input of Q3 is driven from the same point as the input of transistor Q1. (R1 is very high in value and not important for this consideration). This results in transistor Q3 being on when Q1 is on, remembering Q1 is on only for about 5 seconds every two minutes. Therefore, oscillators Q3 and Q4 will only oscillate for 5 seconds every two minutes (refer to Figure 4). The resulting burst of oscillation are fed to the speaker, which is then heard as our mysterious noise.



If you wish to change the duration of the burst, you can change the value of resistor R2. A larger value will lengthen the burst. To change the time between bursts, you must change the value of resistor R1. Lowering the value of R1 will decrease the time between bursts. Resistors R4 and R5 will change the frequency of the high frequency oscillator.

CONSTRUCTION

Introduction

The most important factor in assembling your K-16 Electronic Cricket 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.
- 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

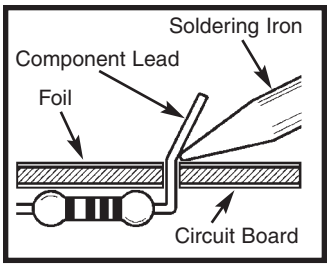
In all of the following assembly steps, the components must be installed on the top side of the PC board unless otherwise indicated. The top legend shows where each component goes. The leads pass through the corresponding holes in the board and are soldered on the foil side.
Use only rosin core solder of 63/37 alloy.

DO NOT USE ACID CORE SOLDER!

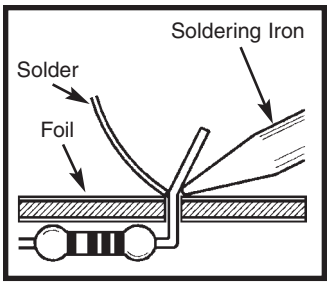
What Good Soldering Looks Like

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

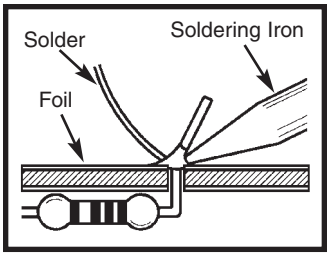
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



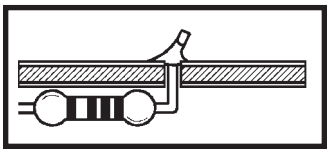
2. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and the circuit foil to melt the solder.



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.

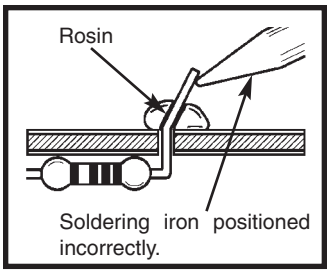


4. Here is what a good solder connection looks like.

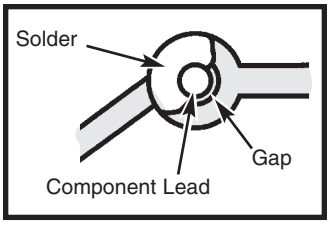


Types of Poor Soldering Connections

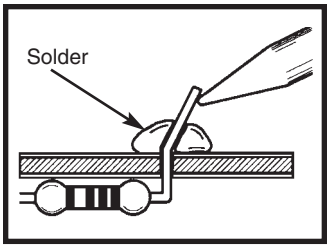
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



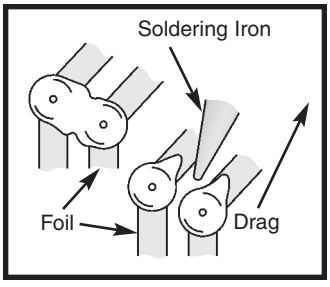
2. **Insufficient solder** - let the solder flow over the connection until it is covered. Use just enough solder to cover the connection.



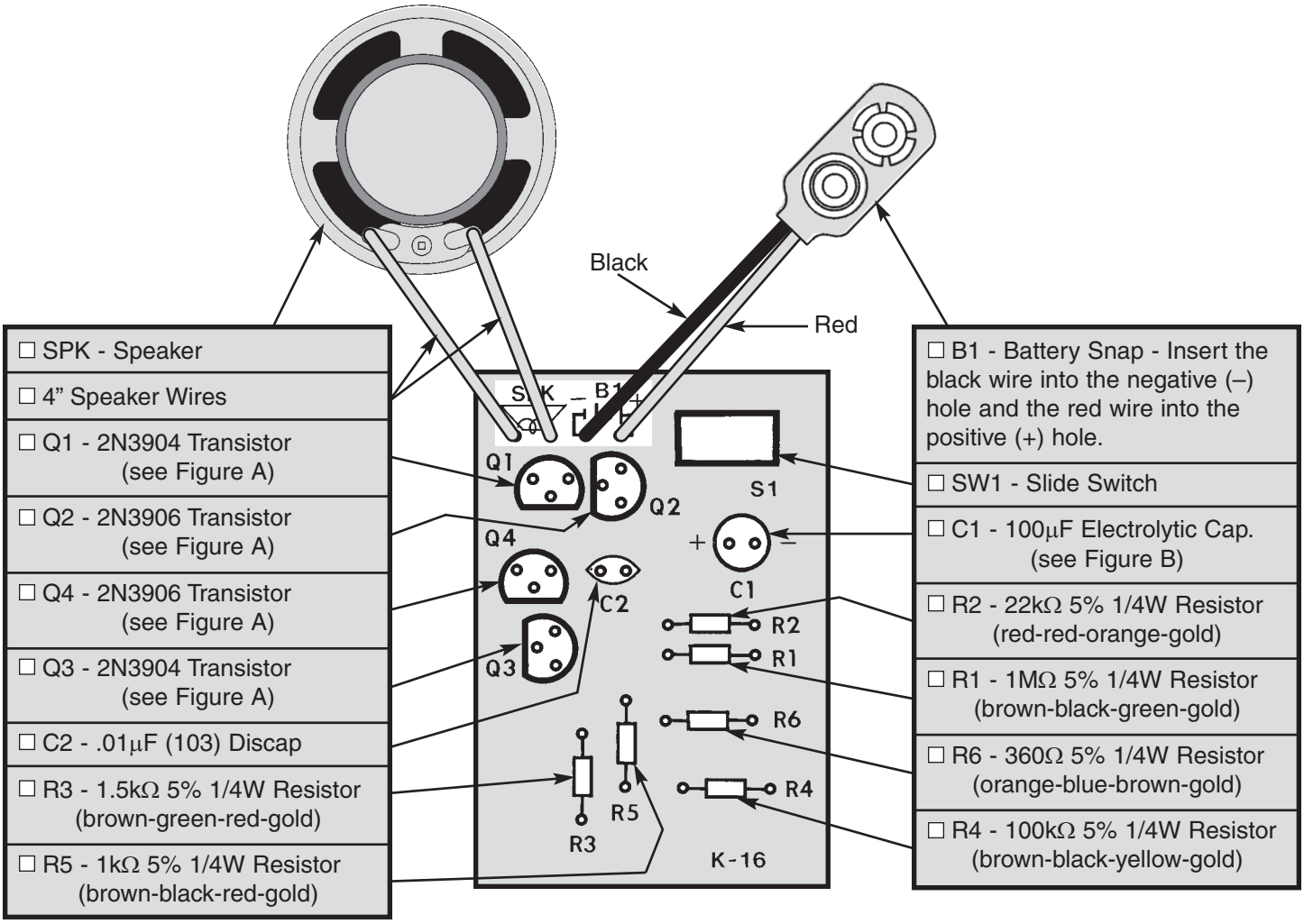
3. **Excessive solder** - could make connections that you did not intend to between adjacent foil areas or terminals.



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



- ☐ SPK - Speaker
- ☐ 4” Speaker Wires
- ☐ Q1 - 2N3904 Transistor (see Figure A)
- ☐ Q2 - 2N3906 Transistor (see Figure A)
- ☐ Q4 - 2N3906 Transistor (see Figure A)
- ☐ Q3 - 2N3904 Transistor (see Figure A)
- ☐ C2 - .01μF (103) Discap
- ☐ R3 - 1.5kΩ 5% 1/4W Resistor (brown-green-red-gold)
- ☐ R5 - 1kΩ 5% 1/4W Resistor (brown-black-red-gold)
- ☐ B1 - Battery Snap - Insert the black wire into the negative (–) hole and the red wire into the positive (+) hole.
- ☐ SW1 - Slide Switch
- ☐ C1 - 100μF Electrolytic Cap. (see Figure B)
- ☐ R2 - 22kΩ 5% 1/4W Resistor (red-red-orange-gold)
- ☐ R1 - 1MΩ 5% 1/4W Resistor (brown-black-green-gold)
- ☐ R6 - 360Ω 5% 1/4W Resistor (orange-blue-brown-gold)
- ☐ R4 - 100kΩ 5% 1/4W Resistor (brown-black-yellow-gold)

Figure A

Mount the transistor on the position shown. Make sure that the flat side of the transistor agrees with the flat side of the marking on the PC board. Leave 1/4” between the transistor and the PC board.

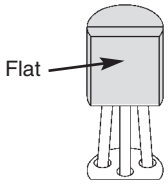
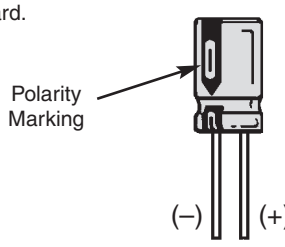
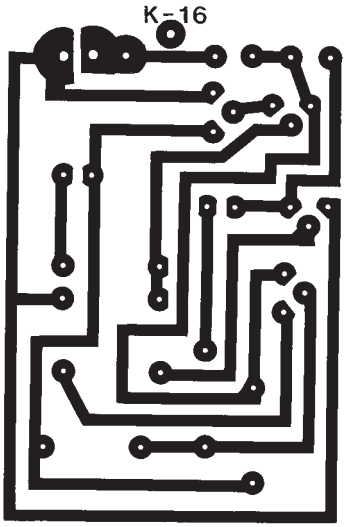


Figure B

Electrolytic capacitors have polarity. Mount the capacitor with the positive lead in the hole marked (+) on the PC board.



Foil Side of PC Board



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.

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

a) Tug slightly on all parts to make sure that they are indeed soldered.

b) All solder connections should be shiny. Resolder any that are not.

c) Solder should flow into a smooth puddle rather than a round ball. Resolder any connection that has formed into a ball.

d) 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.

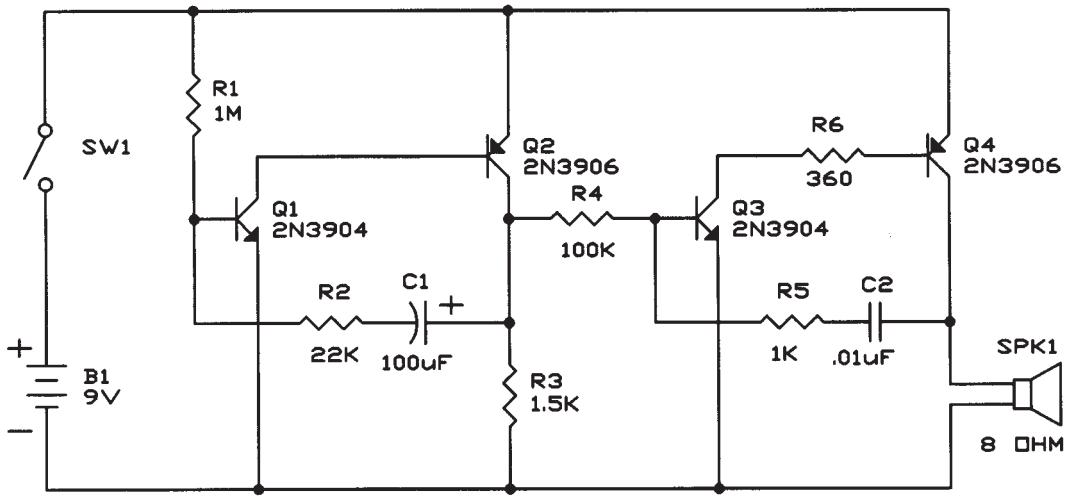
REMEDY - NO SOUND

1. **Battery** - Use a fresh 9 volt battery.
2. **Switch** - Check the switch by placing a clip lead across its terminals. If the cricket now works, then the problem is with the switch.
3. **Transistors** - Be sure that the transistors are in their correct positions. Also, look to see that the flat side is in the correct direction.
4. **Capacitor C1** - Be sure that the negative lead is in the correct hole in the PC board.

REMEDY - CIRCUIT WILL NOT TURN OFF

1. **Slow Oscillator Circuit** - The problem is C1 not discharging. Check resistors R1 and R2 to make sure that they are in the right place.

SCHEMATIC DIAGRAM



QUIZ

1. There are _____ oscillators in the Electronic Cricket.
2. The frequency of these oscillators are _____ cycles per two minutes and _____ cycles per second.
3. The on-time for transistors Q1 and Q2 of the low frequency oscillator is _____ seconds.
4. The off-time for transistors Q1 and Q2 of the low frequency oscillator is _____ minutes.
5. The on-time for the high frequency oscillator is _____ seconds.
6. Capacitor C1 and resistor R2 are part of the positive _____ for the oscillator.
7. Oscillators Q3 and Q4 are much higher on frequency because resistor R5 and capacitor C2 are _____ in value.
8. The charging path for capacitor C2 is transistor Q4, resistor R5 and transistor _____.
9. If you wish to decrease the time between sound burst, you must decrease resistor _____.
10. The output of transistor Q4 is fed to the _____.

Answers: 1. two; 2. one, 10,000; 3. five; 4. two; 5. five; 6. feedback; 7. smaller; 8. Q3; 9. R1; 10. speaker

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