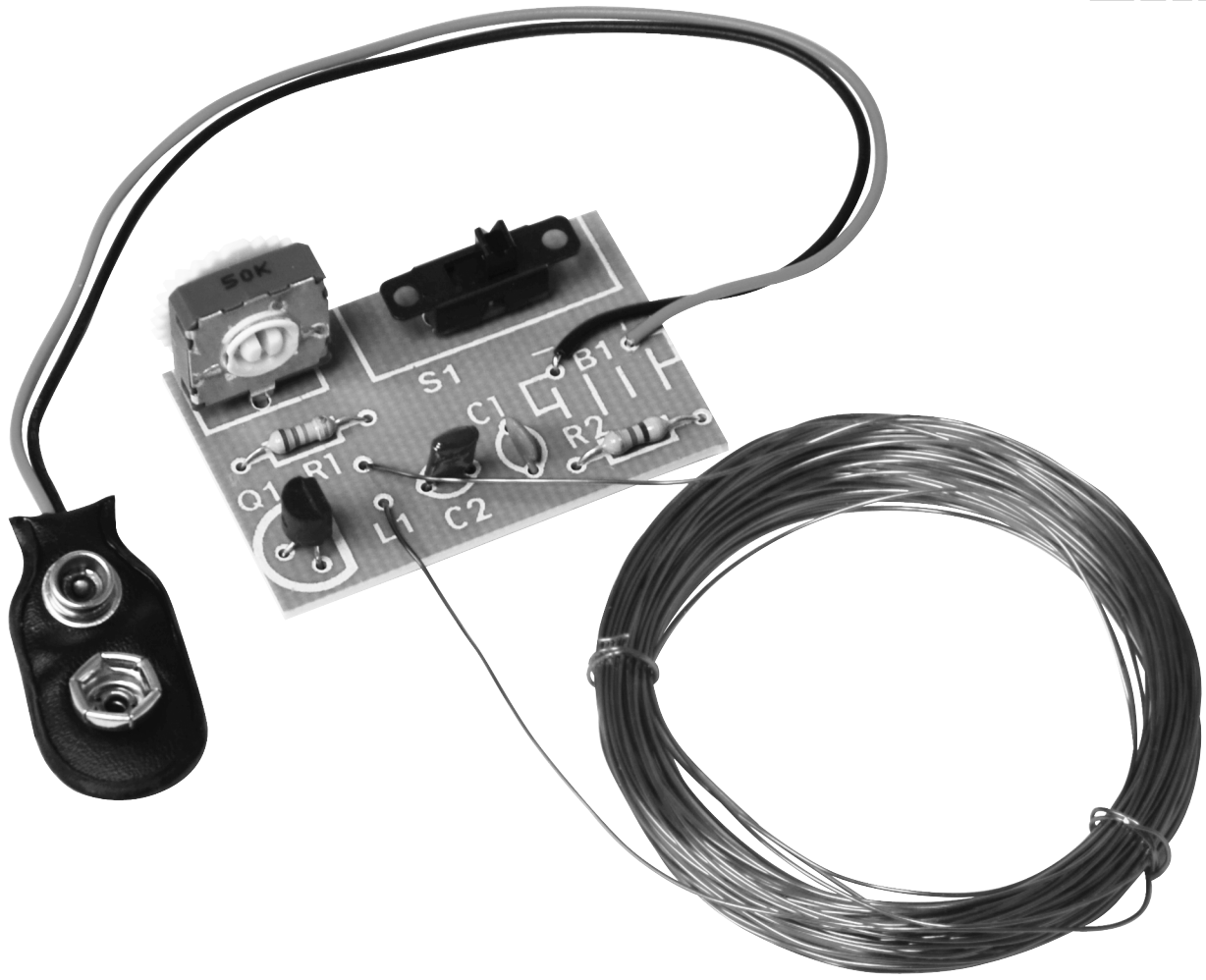
METAL DETECTOR KIT

MODEL K-26



Assembly and Instruction Manual

ELENCO®

 Revised 2012 REV-F 753226

PARTS LIST

If you are a student, and any parts are missing or damaged, please see instructor or bookstore.
If you purchased this metal detector kit from a distributor, catalog, etc., please contact ELENCO™ (address/phone/e-mail is at the back of this manual) for additional assistance, if needed.

RESISTORS

Qty.	Symbol	Description	Color Code	Part #
❒ 1	R2	4.7kΩ 1/4W 5%	yellow-violet-red-gold	144700
❒ 1	R1	15kΩ 1/4W 5%	brown-blue-orange-gold	151500
❒ 1	P1	Trim Pot 50kΩ		191552

CAPACITORS

Qty.	Symbol	Description	Part #
❒ 1	C1	680pF Discap (681)	226880
❒ 1	C2	0.0015μF Discap (152)	231517

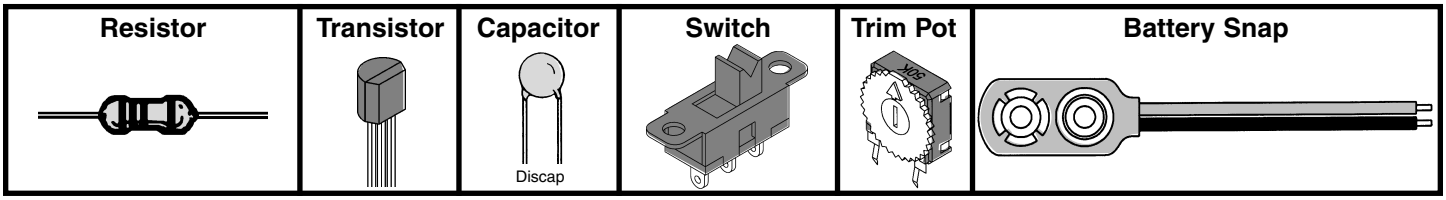
SEMICONDUCTORS

Qty.	Symbol	Description	Part #
❒ 1	Q1	Transistor MPS5172	325172

MISCELLANEOUS

Qty.	Symbol	Description	Part #
❒ 1		PC Board	518026
❒ 1	S1	Switch	541102
❒ 1	B1	Battery Snap 9V	590098
❒ 1		Wire #26 Enamel 45’	846000

PARTS IDENTIFICATION



IDENTIFYING RESISTOR VALUES

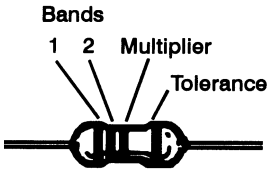
Use the following information as a guide in properly identifying the value of resistors.

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

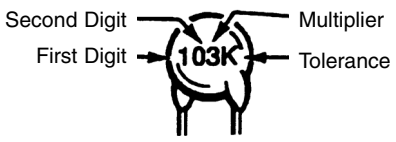
Multiplier	
Color	Multiplier
Black	1
Brown	10
Red	100
Orange	1,000
Yellow	10,000
Green	100,000
Blue	1,000,000
Silver	0.01
Gold	0.1

Resistance Tolerance	
Color	Tolerance
Silver	±10%
Gold	±5%
Brown	±1%
Red	±2%
Orange	±3%
Green	±.5%
Blue	±.25%
Violet	±.1%



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

INTRODUCTION

There are many buried treasures waiting to be found. While everyone dreams of finding a fortune in gold coins, few do anything to look for them. Now with the K-26 Metal Detector, you have a chance. Although you may not find a fortune in gold, you should find a few silver coins if you work the beaches or parks. If nothing else, you're sure to have fun with this metal detector.

The Metal Detector basically is an oscillator that transmits in the AM radio band. When a radio is placed near the oscillator, it will emit an audible tone. The frequency transmitted by the oscillator will vary when brought close to a metal object. Thus, the tone produced by the radio will vary in pitch, indicating that a metal is present. We shall study the theory of how the oscillator works and why its frequency changes when brought near a metal object.

THE BASIC OSCILLATOR

Figure 1 shows the basic circuit of the oscillator. When the switch SW1 is closed, a current will flow in the P1-R1 ciricuit. This will turn on transistor Q1 and send a current into the inductor-capacitor circuit (LC circuit). The inductor is made by winding a 5" diameter coil with 30 turns of copper wire. The LC circuit is the heart of the oscillator. Every LC circuit has its own resonance frequency. The resonance frequency of this circuit is in the AM radio band.

If we take part of the energy in the LC circuit and feed it to the emitter of Q1, the transistor will amplify this signal and cause the circuit to oscillate at the LC resonance frequency. By varying P1, the current through transistor Q1 will change, thus forcing the frequency of the oscillator to change slightly.

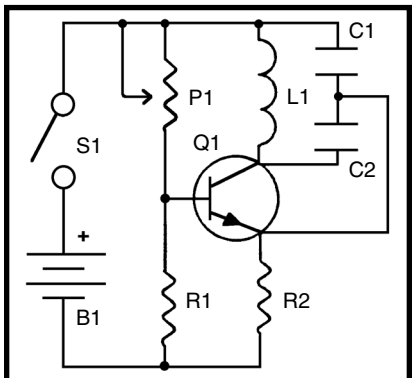


Figure 1

THE METAL DETECTOR OPERATION

Obtain a small portable AM radio and place it near the Metal Detector. Tune the radio around the midband and away from radio stations, you should hear only static. If there are AM stations nearby you will get whistling. This is because the metal detector oscillator is mixing with the frequency of the AM station. Now turn control P1 until the static gets quiet. The metal detector is now tuned to the AM radio frequency. Now take a piece of iron metal and bring it close to the detector. Note the change in the static in the radio or a change in the pitch of the whistle. This is because you have increased the inductance of the coil and thus changed the resonance frequency of the circuit. The radio is now tuned to the new oscillator frequency.

Magnetic fields move easier in the presence of iron, nickel and other materials. Thus the inductance of the coil will increase when these metals are present. This increase in inductance will cause the LC circuit to oscillate at a lower frequency. These magnetic fields are disturbed when in the presence of silver, aluminum, copper and other highly conductive metals. Thus, when these metals are brought near the coil, the frequency transmitted by the oscillator increases. The radio responds to the oscillator changes.

Now you have some understanding of how the Metal Detector works. Go out and look for your fortune. Wish you lots of luck.

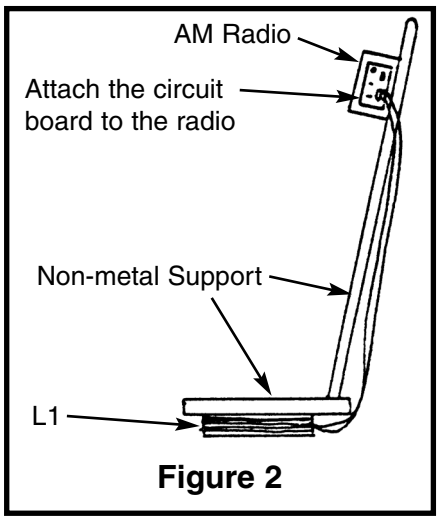


Figure 2

CONSTRUCTION

Introduction

The most important factor in assembling your Metal Detector Kit is good soldering techniques. Using the proper soldering iron is of prime importance. A small pencil type soldering iron of 25 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

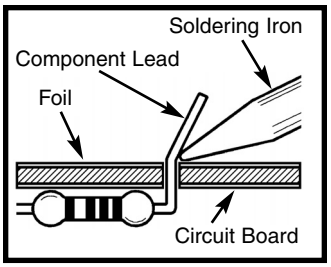
In all of the following assembly steps, the components must be installed on the top side of the PC board unless otherwise indicated. The top legend shows where each component goes. The leads pass through the corresponding holes in the board and are soldered on the foil side.
Use only rosin core solder.

DO NOT USE ACID CORE SOLDER!

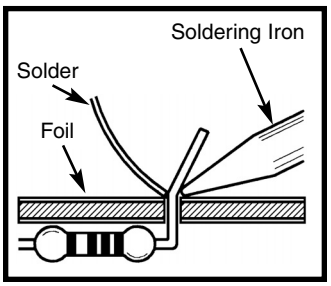
What Good Soldering Looks Like

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

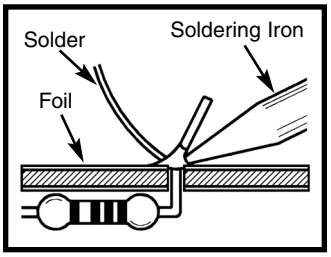
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



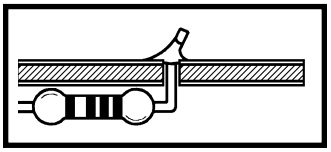
2. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and the circuit foil to melt the solder.



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.

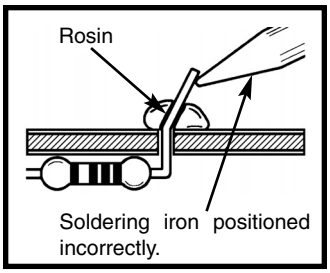


4. Here is what a good solder connection looks like.

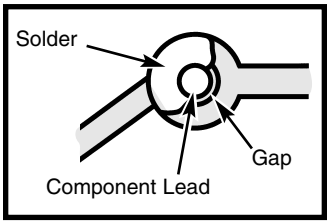


Types of Poor Soldering Connections

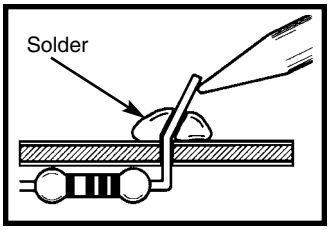
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



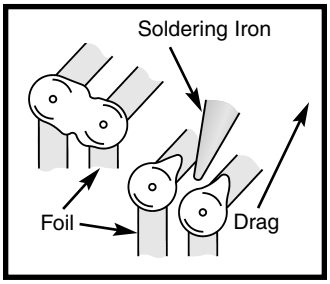
2. **Insufficient solder** - let the solder flow over the connection until it is covered.
Use just enough solder to cover the connection.



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

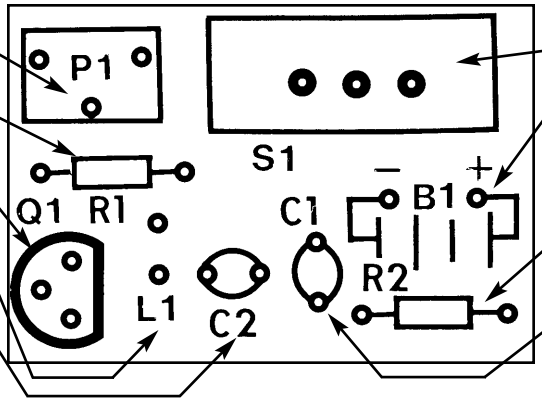


4. **Solder bridges** - occur when solder runs between circuit paths and creates a short circuit. This is usually caused by using too much solder.
To correct this, simply drag your soldering iron across the solder bridge as shown.



ASSEMBLE COMPONENTS TO THE PC BOARD

- ☐ P1 - 50kΩ Potentiometer
- ☐ R1 - 15kΩ 5% 1/4W Resistor (brown-green-orange-gold)
- ☐ Q1 - MPS5172 Transistor (see Figure A)
- ☐ L1 - Coil (see Figure B)
- ☐ C2 - .0015μF Capacitor (152)



- ☐ S1 - Switch
- ☐ B1 - Battery Snap - Install the red wire into the positive (+) hole and the black wire into the negative (--) hole. Solder and cut off the excess leads.
- ☐ R2 - 4.7kΩ 5% 1/4W Resistor (yellow-violet-red-gold)
- ☐ C1 - 680pF Discap (681)

Figure A

Mount the transistor to the PC board at the location shown. Note the flat side of the transistor and the marking on the PC board. Solder and cut off the excess leads.

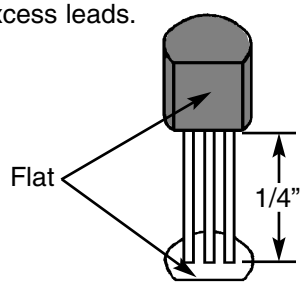
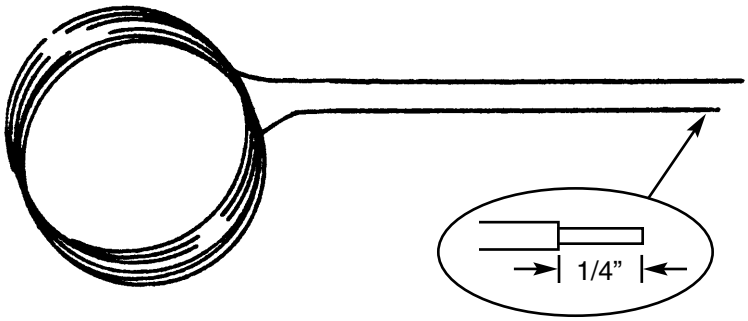


Figure B

Find the two ends of the coil. Using a file or a razor blade, strip the enamel insulation from the wire 1/4” so the solder will make good contact with the wire. Insert the ends of the coil into the PC board. Solder and cut off the excess leads.



TROUBLESHOOTING

Contact ELENCO® 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.

   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.

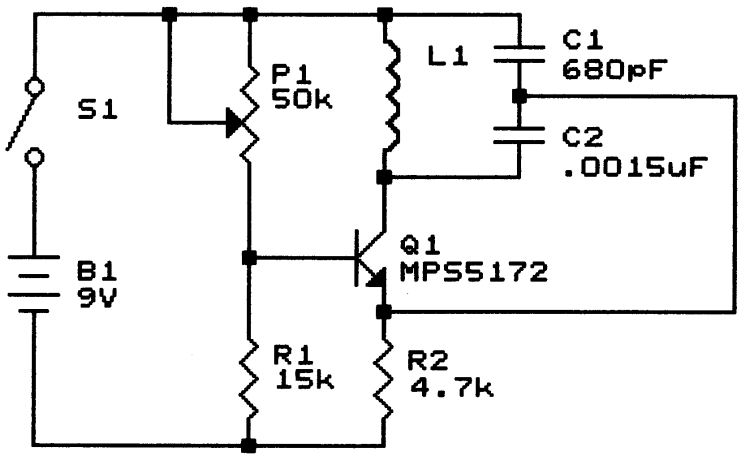
2. Be sure that all components have been mounted in their correct places.

   a) Use a fresh 9V battery.

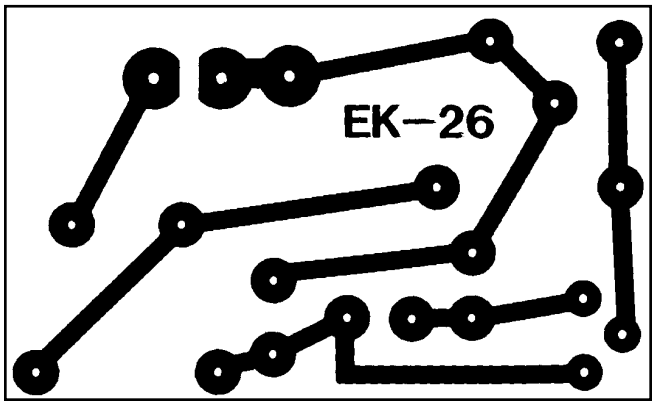
   b) Be sure that the coil is soldered properly. The two ends of the wire should be clear of insulation, so that the solder can make good contact with the wire.

   c) Your most likely problem will be tuning the metal detector oscillator to the radio. Start at around the 1,000kHz spot on the radio. Pick a spot that is clear of radio stations. You should hear only static. Rotate the potentiometer P1 very slowly until the static gets quiet. If you cannot quiet the radio, tune the radio to a higher frequency, around 1,300kHz and try adjusting the potentiometer again. If still no luck, try a lower frequency, around 700kHz. You should be able to find a spot when the metal detector oscillator has an effect. Moving a piece of metal around the coil should produce changes in the sound from the radio.

SCHEMATIC DIAGRAM



PC BOARD FOIL SIDE



QUIZ

1. The Metal Detector basic circuit is an _____.
2. The Metal Detector transmits in the _____ radio band.
3. The frequency of the oscillator changes when brought near _____.
4. The LC circuit is the _____ of the oscillator.
5. All LC circuits have a _____ frequency.
6. An LC circuit has a coil and a _____.
7. An inductor can be made by winding some wire into a _____.
8. If part of the energy in the LC circuit in Figure 1 is fed to the emitter of Q1, the circuit will _____.
9. When the radio and Metal Detector oscillators are at the _____ frequency, the radio will be quiet.
10. Iron causes the LC circuit to oscillate at a _____ frequency.

OTHER ELENCO® KITS

Listed below are more kits that should be interesting and fun-to-build. They all perform different functions in the field of electronics.

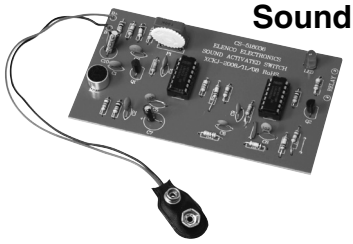
Lie Detector Kit
Model K-44

The sound will tell if you are lying. The sound gets louder the more you lie. Fun at parties!

0-15VDC Variable Voltage DC Power Supply Kit
Model XP-15K

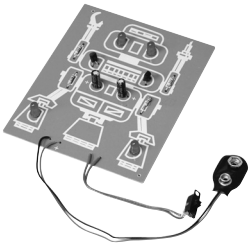
A handy portable power supply with a variable output voltage of 15VDC. Mounted in a ventilated plastic case. Ideal for students, technicians, and hobbyists. Great for breadboarding.

Sound Activated Switch Kit
Model K-36



Clap your hands and the light comes on . . . clap again and off it goes. Many other uses. Complete with microphone.

LED Robot Blinker Kit
Model AK-400 / K-17



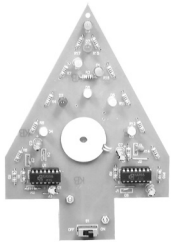
With the LED Robot Blinker, you will learn about free-running oscillators. You'll have fun building, displaying and learning about the LED Robot Blinker.

FM Microphone Kit
Model AK-710 / K-30

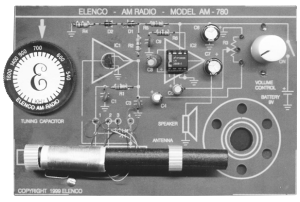
Transmit your voice on any FM radio. Range up to 100 feet. Learn about microphones, audio amplifiers, and RF oscillators.

Christmas Tree Kit
Model K-14

Produces flashing colored LEDs and three popular Christmas melodies!



Two IC AM Radio Kit
Model AM-780K



New Design - Easy-to-build, complete radio on a single PC board. Unique design allows you to place parts over their corresponding symbol on the PC board. Teaches the basic theory of AM radio operation. Detailed instructions and illustrations make it an easy and educationally sound project.

Two IC FM Radio Kit
Model FM-88K

The FM-88K Kit is a monophonic, two-IC, FM (frequency modulation) receiver designed to receive FM signals in the frequency range (88-108MHz). It uses electronic auto-scan to search for FM stations. This scan system is done with two button switches - one switch scans up, the other resets to the start of the tuning position.

Answers: 1. oscillator; 2. AM; 3. metal; 4. heart; 5. resonance; 6. capacitor; 7. coil; 8. oscillate; 9. same; 10. lower

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