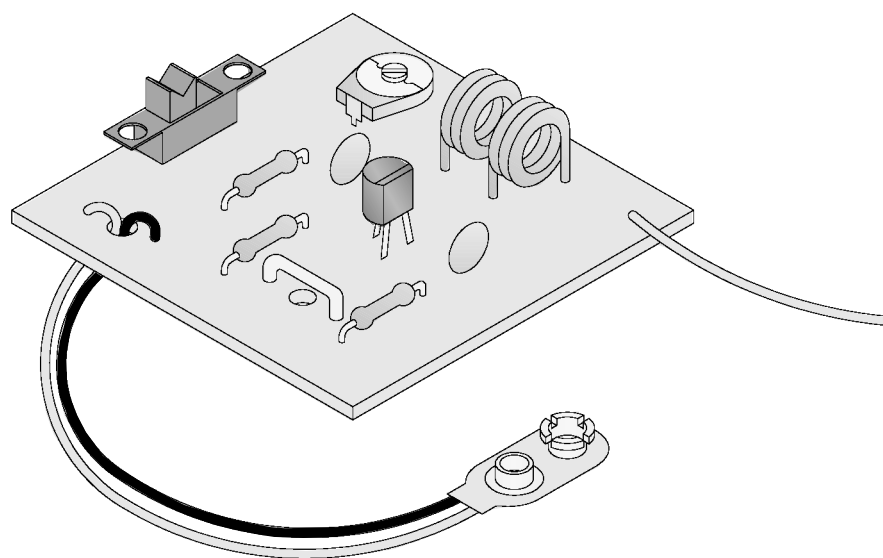


# TV/FM OSCILLATOR KIT

MODEL K-29



7 56619 00021 3



Assembly and Instruction Manual

## Elenco Electronics, Inc.

## PARTS LIST

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) for additional assistance, if needed.

### RESISTORS

Qty.	Symbol	Description	Color Code	Part #
□ 1	R3	1kΩ 5% 1/4W	brown-black-red-gold	141000
□ 1	R2	10kΩ 5% 1/4W	brown-black-orange-gold	151000
□ 1	R1	22kΩ 5% 1/4W	red-red-orange-gold	152200

### CAPACITORS

Qty.	Symbol	Description	Part #
□ 1	C2	4-45pF Trimmer Cap	201088
□ 1	C3	10pF (10) Discap	211011
□ 1	C1	.001μF (102) Discap	231036

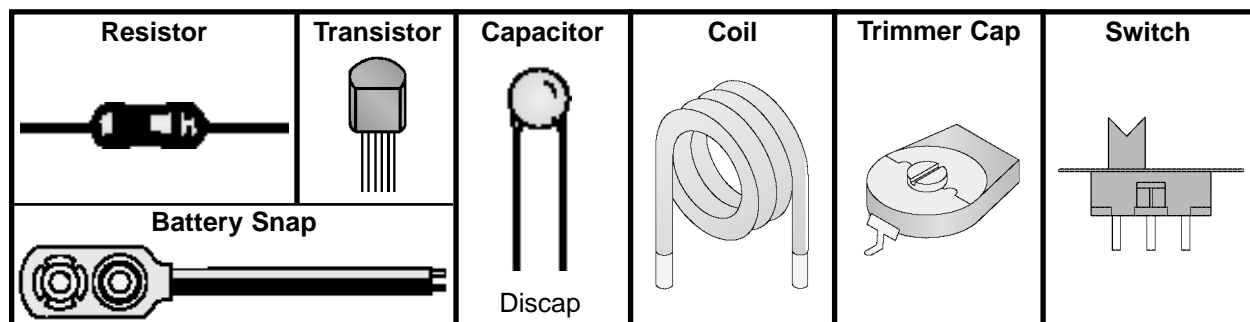
### SEMICONDUCTORS

Qty.	Symbol	Description	Part #
□ 1	Q1	Transistor 2N3904 NPN	323904

### MISCELLANEOUS

Qty.	Symbol	Description	Part #
□ 2	L1, L2	Coil Form 3-Turn	462203
□ 1		PC Board	518029
□ 1	S1	Switch	541102
□ 1		Solder Roll 24"	551135
□ 1	BT1	Battery Snap 9V	590098
□ 1	ANT	Wire 4"	814620

## PARTS IDENTIFICATION

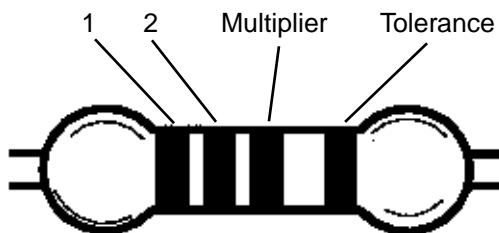


## IDENTIFYING RESISTOR VALUES

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	±0.5%
Blue	6	Blue	6	Blue	1,000,000	Blue	±0.25%
Violet	7	Violet	7	Silver	0.01	Violet	±0.1%
Gray	8	Gray	8	Gold	0.1		
White	9	White	9				

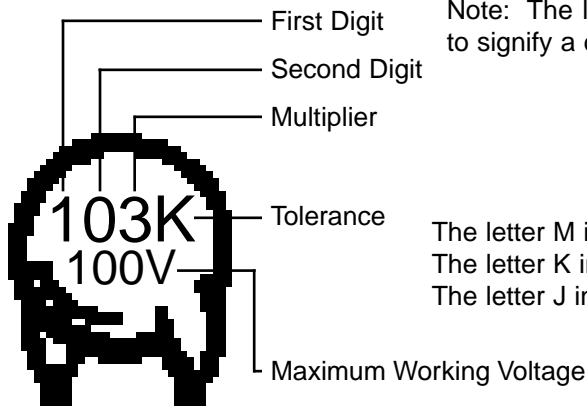
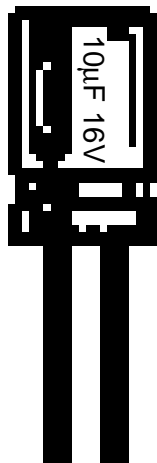
### BANDS



## 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	0.01



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  $10 \times 1,000 = 10,000\text{pF}$  or  $.01\mu\text{F}$  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	$10^6$

1,000 pico units = 1 nano unit	1,000 nano units = 1 micro unit
1,000 micro units = 1 milli unit	1,000 milli units = 1 unit
1,000 units = 1 kilo unit	1,000 kilo units = 1 kilo unit

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## MINIATURE RADIO TRANSMITTER

The TV/FM Oscillator is really a miniature radio transmitter. The oscillator transmits an unmodulated (no audio message) carrier frequency between 50MHz - 200MHz, to a distance of 5 to 30 feet. Your TV/FM is designed to receive a signal in this frequency range. While your miniature radio transmitter puts out a very weak signal at close range, it is strong enough to override the standard broadcast stations. Therefore, your television set gets the regular broadcast station plus your oscillator signal. The results will be an interference signal on the TV set. By varying the trimmer capacitor slightly, the interference pattern will vary, giving interesting results.

With the addition of an ordinary speaker, the oscillator can be used as an FM transmitter that will send your voice to a nearby FM receiver. To operate the device in this manner, see the instructions presented in the assembly section of this kit.

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## THE BASIC TRANSMITTER

This kit is basically an RF oscillator which produces high frequency alternating currents. These currents are sent up and down an antenna wire and converted into electromagnetic radiation, more commonly known as radio waves.

The heart of the oscillator is the tune circuit, see Figure 1. This circuit consists of capacitor C2 and two coils, L1 and L2. You may consider L1 and L2 as a single coil with its center tapped.

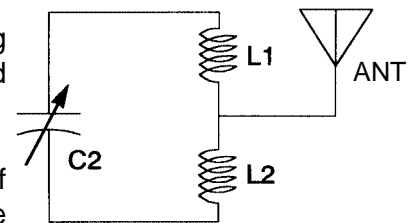


Figure 1

All LC circuits have a resonance frequency, that is, a frequency where the resistance of the coil and capacitor are equal. At this frequency, there is a build-up of current between the coil and capacitor. By varying the capacitor (adjusting the trimmer) or coil (squeezing the coil) you will change the resonance frequency. By tightening the trimmer or squeezing the coil the resonance frequency will go down. The reverse is true if you loosen the trimmer or coil. The capacitance in the trimmer varies between 4 and 45 pico farads (pF). At the 4pF, the LC frequency will be at its maximum or around 200MHz. At the 45pF setting, the LC setting, the LC frequency will be at minimum or around 50MHz.

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## THE TRANSISTOR LC CIRCUIT

In order to get any power out of a LC circuit, we need a transistor amplifier stage. The transistor will amplify the weak currents of the LC circuit and send it to the antenna.

To get a transistor to operate, it must be properly biased. The collector must be connected to a positive voltage. The emitter connected to a negative voltage and the base to a slightly less positive voltage than the collector.

To get the transistor to oscillate, you need positive feedback. This means that the signal at the collector LC circuit must be fed back to the base-emitter junction "in phase" to build up oscillation. Normally a signal on the base is 180° out of phase with the collector, while a signal on the emitter is in phase. Therefore, for positive feedback we must couple the collector signal to the emitter. This is done with capacitor C3. With this feedback, the circuit will oscillate at the resonance frequency of the LC circuit.

Other components used are resistors R1 and R2 to bias on the transistor. Capacitor C1 is a bypass capacitor used to remove the signal from the base. Resistor R3 is a load resistor to allow the feedback signal to appear at the emitter-base junction.

# CONSTRUCTION

## Introduction

The most important factor in assembling your K-29 TV/FM Oscillator 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.

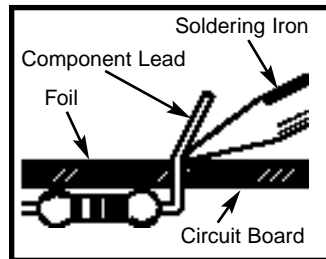
**Use only rosin core solder of 63/37 alloy.**

**DO NOT USE ACID CORE SOLDER!**

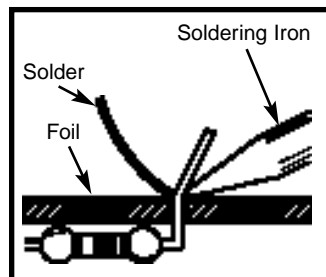
## What Good Soldering Looks Like

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

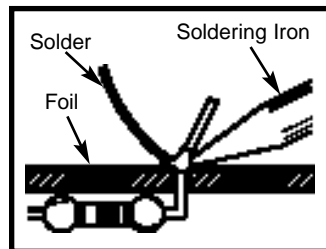
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



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.

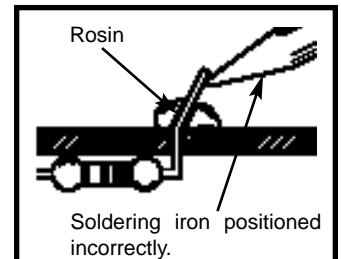


4. Here is what a good solder connection looks like.

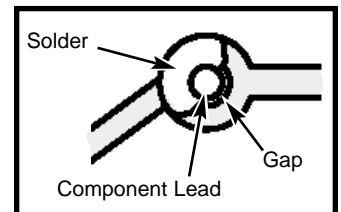


## Types of Poor Soldering Connections

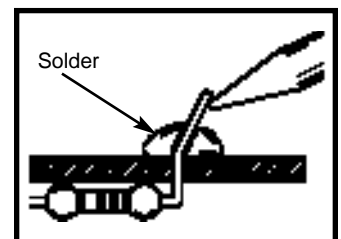
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



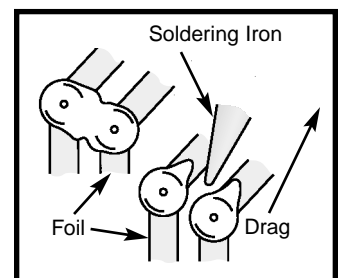
2. **Insufficient solder** - let the solder flow over the connection until it is covered. Use just enough solder to cover the connection.



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



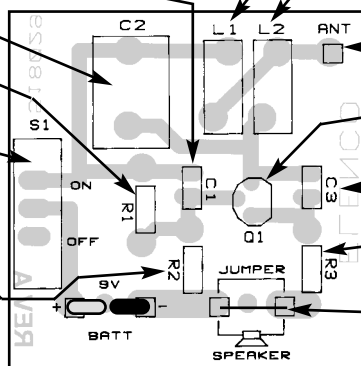
4. **Solder bridges** - occur when solder runs between circuit paths and creates a short circuit. This is usually caused by using too much solder. To correct this, simply drag your soldering iron across the solder bridge as shown.



# ASSEMBLE COMPONENTS TO THE PC BOARD

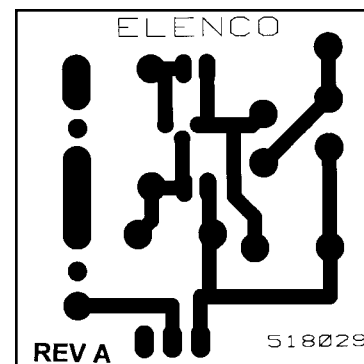
- C1 - .001 $\mu$ F (102) Discap
- C2 - 4-45pF Trimmer Cap
- R1 - 22k $\Omega$  5% 1/4W Resistor (red-red-orange-gold)
- S1 - Slide switch
- R2 - 10k $\Omega$  5% 1/4W Resistor (brown-black-orange-gold)
- 9V - Battery Snap - Solder the red wire to the positive (+) hole on the PC board and the black wire to the negative (-) hole.

- L1 - Coil form 3 turn
- L2 - Coil form 3 turn
- ANT - Antenna - 4 inch wire
- Q1 - 2N3904 Transistor (see Figure A)
- C3 - 10pF (10) Discap
- R3 - 1k $\Omega$  5% 1/4W Resistor (brown-black-red-gold)
- JUMPER - Jumper wire (see Figure B)



**Figure A**  
Mount the transistor with the flat side in the same direction as shown on the PC board. Solder and cut off the excess leads.

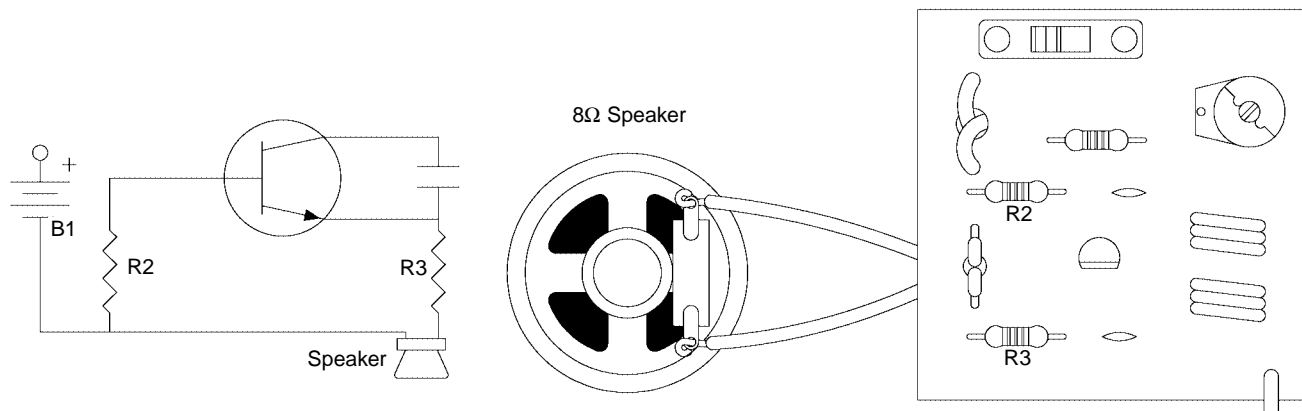
**Figure B**  
Use a discarded resistor lead to form a jumper wire.



## OPERATING PROCEDURES

Attach a fresh 9 volt battery to the battery snap. Turn on your FM radio or TV and adjust the adjusting screw on the variable capacitor C2. Use a non-conductive tuning tool or a piece of plastic to tune the capacitor. Slowly turn the adjusting screw until you see or hear a disturbance in the television or radio. Then, with careful adjustment, you will completely blank out reception. If you do not blank out reception, slightly separate the turns of the wire in the two coils L1 and L2. Try adjusting the capacitor again. Each station requires a different setting of the variable capacitor.

To use this circuit as an FM transmitter, desolder the jumper and solder the leads from the 8 $\Omega$  speaker into the PC board. Use C2 for coarse adjustment and the tuning knob on the radio for fine adjustment, then speak into the speaker and hear yourself on the radio.



## TROUBLESHOOTING

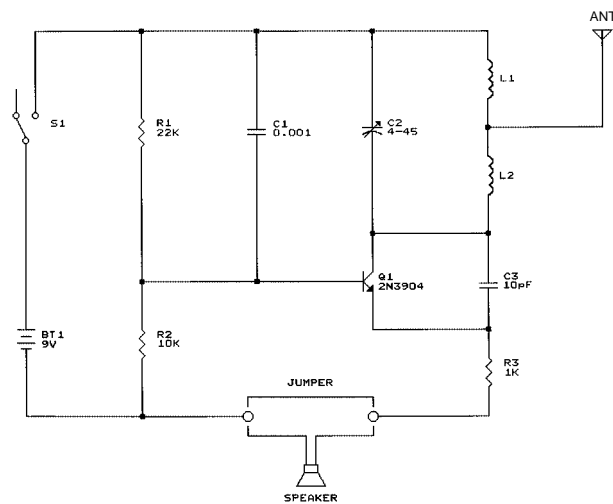
Consult your instructor or contact Elenco Electronics if you have any problems. **DO NOT** contact your place of purchase as they will not be able to help you.

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.

## COMPONENT CHECK

1. Be sure that all of the components have been mounted in their correct places.
2. Use a fresh 9 volt battery.
3. Be sure that transistor Q1 has been mounted with the flat side in the correct direction, as shown on the PC board.

## SCHEMATIC DIAGRAM



## QUIZ

1. The TV/FM oscillator is really a miniature \_\_\_\_\_.
2. The oscillator transmits a frequency range from \_\_\_\_\_ MHz to \_\_\_\_\_ MHz.
3. The oscillator transmits an \_\_\_\_\_ carrier frequency.
4. Electromagnetic radiation is more commonly known as \_\_\_\_\_.
5. The heart of the oscillator is the \_\_\_\_\_.
6. The tuned circuit consists of a \_\_\_\_\_ and \_\_\_\_\_.
7. All tuned circuits have a \_\_\_\_\_ frequency.
8. To get a transistor to operate, the collector must be connected to a \_\_\_\_\_ voltage. The emitter to a \_\_\_\_\_ voltage and the base to a slightly less \_\_\_\_\_ voltage.
9. To get a transistor to oscillate, you need \_\_\_\_\_ feedback.
10. In our oscillator, the feedback is between the collector and the \_\_\_\_\_.

Answers: 1. radio, transmitter; 2. 50, 200; 3. unmodulated; 4. radio waves; 5. tune circuit; 6. capacitor, coil; 7. resonance; 8. positive, negative, positive; 9. positive; 10. emitter

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