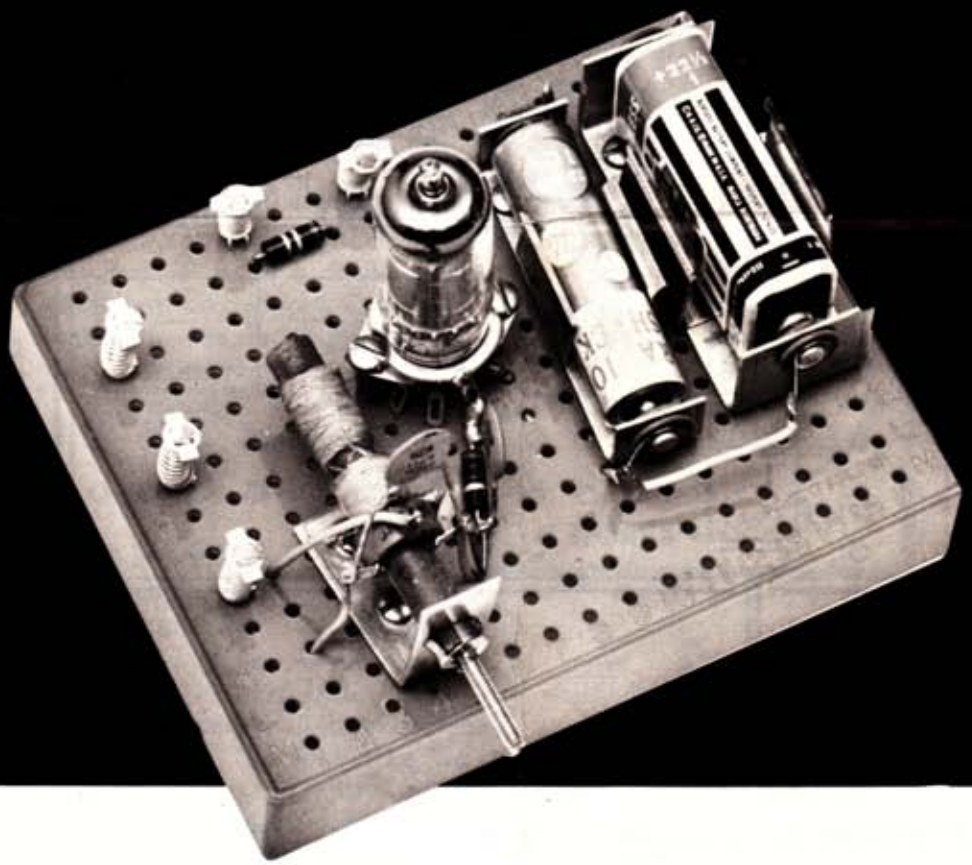
Science Fair™

INSTRUCTION MANUAL **PRICE: 50¢**



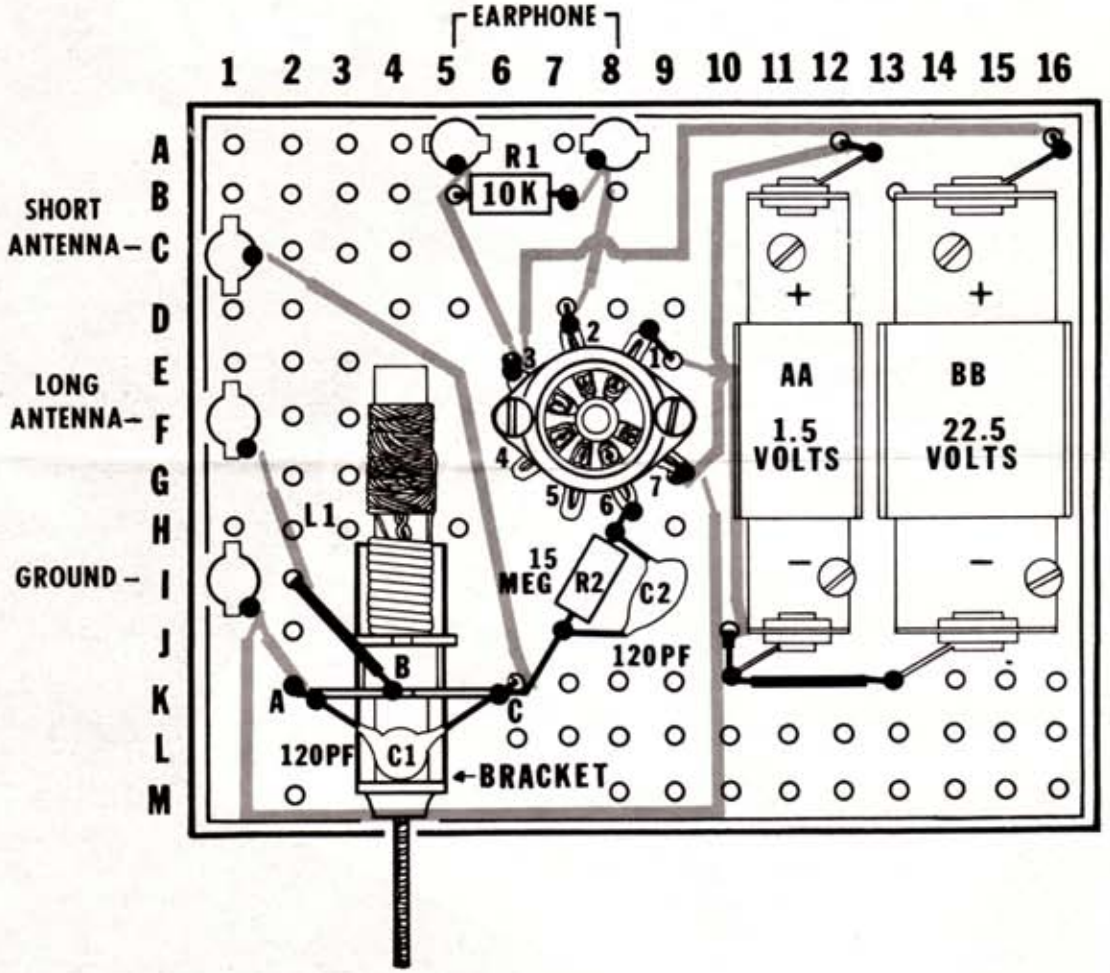
ELECTRONIC PROJECT KIT #28-100
ONE TUBE RADIO

This tuning radio is similar to the first receivers ever built. It is simple to construct and fun to build. You can enjoy endless hours of listening pleasure with the radio you built yourself as well as learning more about the fascinating world of electronics.

The signal is picked up by the antenna. The antenna coil and capacitor C1 serve to filter out all the radio signals except the one which you wish to hear. The tube removes the sound signal from the radio signal and then amplifies it so that it can be heard in the earphone.

FIG. 1 PICTORIAL DIAGRAM

TOP VIEW



PARTS LIST

Quantity	Description	Identification	Part Number	Price
1	Antenna Coil	L1	99-3-001	.70
1	1T4 Tube	1T4	99-4-001	1.50
2	120 PF Capacitor	C1 & C2	99-2-002	.20
1	10K resistor	R1	99-1-002	.20
1	15 meg. resistor	R2	99-1-005	.20
1	7 pin tube socket		99-7-004	.20
1	Earphone		99-5-002	1.00
1	Small Battery holder	AA	99-7-002	.20
1	Large Battery Holder	BB	99-7-001	.20
5	"Push-in" terminals		99-7-006 (Set of 5)	.50
2	Plastic Standoff tubes		99-7-010 (Set of 2)	.20
2	4-40 X 1" screws		99-8-001	
6	4-40 X 3/8" screws		99-8-003	
8	4-40 nuts		99-8-002	
	#24 Wire		99-7-005	

Science Fair™ kits are supplied with first quality parts engineered into "trouble free" circuits. However, if replacement parts are necessary, they can be obtained directly from the factory. When ordering parts be sure to include the Science Fair™ stock number and payment according to the above price schedule with your order. Minimum parts order $1.00. Send orders to: Parts Dept., Science Fair Electronics, 2615 W. Seventh St., Ft. Worth, Texas 76107.

STEP-BY-STEP WIRING AND ASSEMBLY DIRECTIONS

Be sure to carefully follow all the directions. Do one step at a time and then check off the step in the box provided. Before beginning, read over the enclosed page labeled "Construction Hints."

The step by step instructions indicate a soldering requirement; however, these connections can be made by firmly twisting joining wires together. If the connection is secure the circuit will work for temporary or testing purposes. If you wish a more permanent circuit, it is always best to secure these connections by soldering. Before soldering, read the instructions in "Construction Hints."

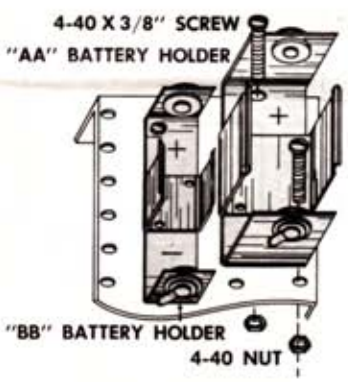
1. ( ) Check the parts list to see that everything listed is included. Check each step as you progress (✔).

2. ( ) Place the pictorial diagram near the perfboard chassis so that the pictorial can be used as a guide for exact placement of parts. The perforations (holes) on the board are numbered and lettered as in Fig. 1. The numbered perforations run from left to right while the letters run from top to bottom. Any point on the board may be identified by this combination of numbers and letters. For example, resistor R1 uses points B5 and B7. The gray lines in the pictorial diagram indicate components and wires which are mounted under the circuit board. The solid lines indicate components and wires mounted on top of the circuit board.

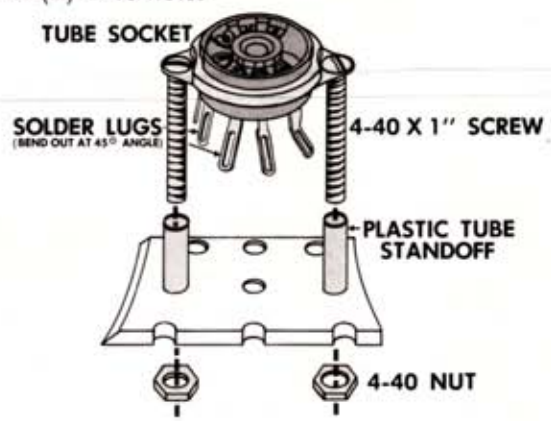
3. ( ) Insert "push-in" terminal in holes I1, F1, C1, A5, A8.

4. ( ) Slightly enlarge holes C14, I16 with soldering iron reamer, or drill, to accommodate a 4-40 X 3/8" (short) screw. Mount large BB battery holder in the position shown in the pictorial diagram Fig. 1 using the two (2) screws and two (2) 4-40 nuts.

5. ( ) Slightly enlarge holes I12 and C11 to accommodate a 4-40 X 3/8" screw. Mount small AA battery holder in the position shown in the pictorial diagram Fig. 1 with two (2) screws and two (2) 4-40 nuts.

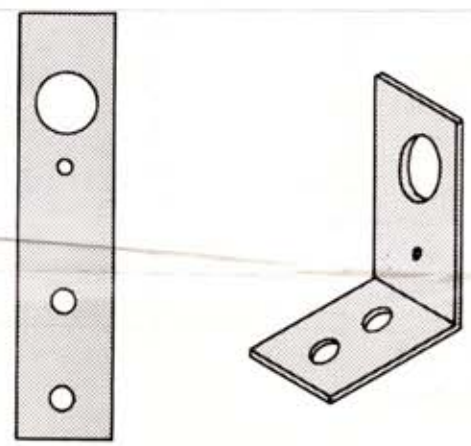


6. ( ) Slightly enlarge holes F6 and F9 to accommodate two (2) 4-40 X 1" (long) screws. Mount the tube socket using the two (2) screws, two (2) plastic tube standoffs, and two (2) 4-40 nuts.

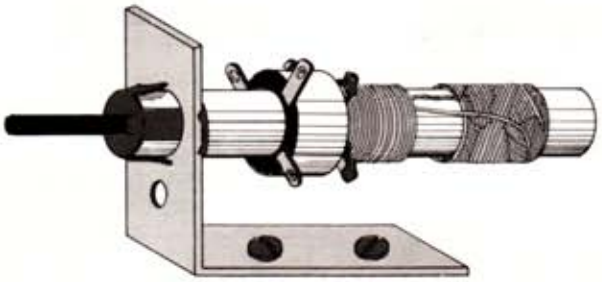


The lugs are numbered 1-7 on the base of the tube socket. Carefully line up the socket so that the numbers are in the same location as in the pictorial diagram Fig. 1. Bend the lugs out at a 45° angle to make soldering easier.

7. ( ) A mounting bracket is included for the antenna coil. Place the bracket on the angle of a table and bend to form an "L" shape.



Enlarge holes K4 and I4 to accommodate two (2) 4-40 X 3/8" screws. Mount the antenna bracket in the position shown in the pictorial diagram using the two screws and two (2) 4-40 nuts.



Mount the antenna coil L1 by carefully pushing it through the large hole until it clicks into place.

8. ( ) Mount 10K resistor R1 (brown, black, orange) from B5 to B7. Connect one lead to "push-in" terminal A5. Connect the other end to "push-in" terminal A8. See "Construction Hints" Fig. 1.

9. ( ) Remove 1/4" of insulation from both ends of a two 2" piece of wire. Connect one end to lug 3 of tube socket. Insert through hole E6 and connect the other end to "push-in" terminal A5 and solder.

10. ( ) Remove 1/4" of insulation from both ends of a 2" piece of wire. Connect one end to lug 2 of the tube socket and solder. Insert through hole D7 and connect the other end to "push-in" terminal A8 and solder.

11. ( ) Remove 1/4" of insulation from both ends of a 5" piece of wire. Connect one end to lug 3 of tube socket and solder. Connect the other end to positive terminal ( ) of large BB battery holder and solder.

12. ( ) Remove 1/4" of insulation from both ends of a 3-1/4" piece of wire. Connect one end to lug 1 of the tube socket and solder. Insert down through E9 and back out J10. Connect to the minus (–) terminal of the small AA battery holder.

13. ( ) Remove 1/4" of insulation from both ends of a 1-1/2" piece of wire. Connect one end to the negative (–) terminal of the small AA battery holder and solder. Connect the other end to the negative (–) terminal of the large BB battery holder and solder.

14. ( ) Remove 1/4" of insulation from both ends of a 3" piece of wire. Connect one end to the positive ( ) terminal of the small AA battery holder and solder. Insert down through A12 and back up through G9. Connect to lug 7 of the tube socket.

15. ( ) Remove 1/4" of insulation from both ends of a 5" piece of wire. Connect one end to lug 7 of the tube socket and solder. Insert through hole G9 and route as shown in pictorial diagram Fig. 1. Connect the other end to "push-in" terminal I1.

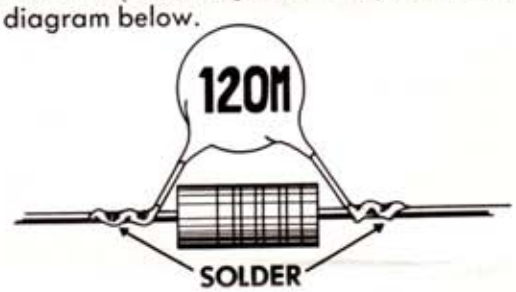
16. ( ) Remove 1/4" of insulation from both ends of a 2" piece of wire. Connect one end to lug A of antenna coil. Connect the other end through hole K2 to "push-in" terminal I1 and solder.

17. ( ) Remove 1/4" of insulation from both ends of a 2-1/2" piece of wire. Connect one end to lug B of antenna coil and solder. Connect the other end through hole I2 to "push-in" terminal F1 and solder.

18. ( ) Remove 1/4" of insulation from both ends of a 4" piece of wire. Connect one end to lug C of the antenna coil. Connect the other end through hole K6 to "push-in" terminal C1 and solder.

19. ( ) Clip both leads of 120 PF capacitor C1 to 3/4" long. Connect one lead to lug A of the antenna coil and solder. Connect the other lead to lug C of the antenna coil. See "Construction Hints" Fig. 4.

20. ( ) Connect the two leads of 120 PF capacitor C2 to the two leads of 15 meg. resistor R2 (brown, green, blue) as shown in diagram below.



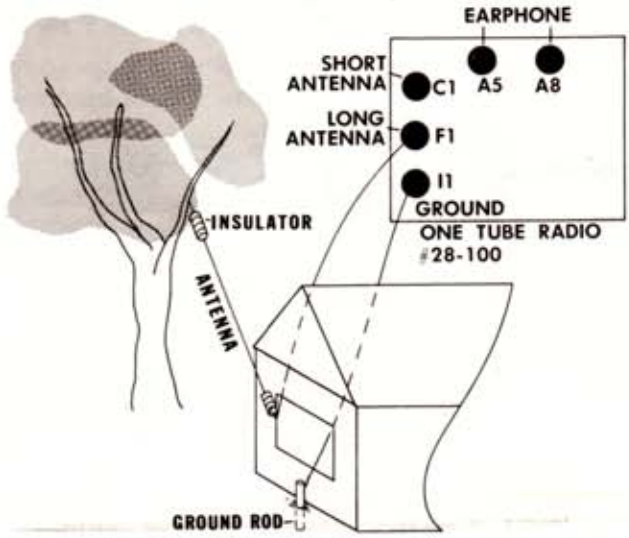
Connect one end of this combination to lug C of the antenna coil and solder. Connect the other end to lug 6 of the tube socket and solder.

NOTE: Clip all extra wires at the soldered points. You have completed all connections, both wiring and soldering. Carefully double check the work against the pictorial diagram.

Operation

This radio depends upon a good antenna and ground to work properly. Connect the ground "push-in" terminal I1 to any good earth ground. You may use a cold water pipe for ground, however, a metal rod driven 2 to 4 feet into the ground works best. The antenna terminal should be connected to an outdoor antenna of the type illustrated in Fig. 3. (Radio Shack Cat. #278-1373). However; if this is impractical you may use a long wire strung around the room or you can connect to the metal dial stop on your telephone. NOTE: For longer antenna use antenna connection at "push-in" terminal F1 and for shorter antenna use antenna connection at "push-in" terminal C1.

Insert a 1-1/2 volt AA penlite battery (Radio Shack Cat. #23-468 or equivalent) in the small AA battery holder. Insert a 22-1/2 volt Burgess U15 battery (Radio Shack Cat. #23-907, or equivalent) in the large BB battery holder. Be sure to observe polarity (+ and −). The radio will not work if the batteries are inserted incorrectly.



TYPICAL ANTENNA INSTALLATION

You can tune your radio by turning the slug (the metal screw sticking out of the antenna coil) in the antenna coil. Be careful not to break the antenna by twisting too hard when the slug has been turned as far as it will go.

HOW IT WORKS

Every circuit carrying alternating current radiates a small amount of electromagnetic energy. If the circuit is matched to an antenna of the proper length for the frequency at which it is alternating then this energy will be radiated into space very efficiently. The lower the frequency of alternation, or oscillation, the longer the antenna needed. For instance, to efficiently radiate energy at 60 cycles per second, as in your house wiring, it would take an antenna 3000 miles long. Most radios operate between 500,000 cycles (or 500KHz) and 500,000,000 (or 500MHz) with some transmissions such as radar and microwave above 1,000,000,000 cycles (or 1 GHz).

Alternating current is electrical energy which is constantly swinging from a plus value to a minus value at some constant rate. A pictorial representation of this swinging, or oscillation, is shown in fig. A. The number of times that the current swings from a plus value to a minus value and then back again in one second represents the frequency of oscillation. A typical radio signal which this radio will receive oscillates back and forth 1,000,000 times a second or has a frequency of 1 MHz. Radio signals of this frequency, when induced into an antenna of the proper length and of sufficient strength, will travel virtually around the world.

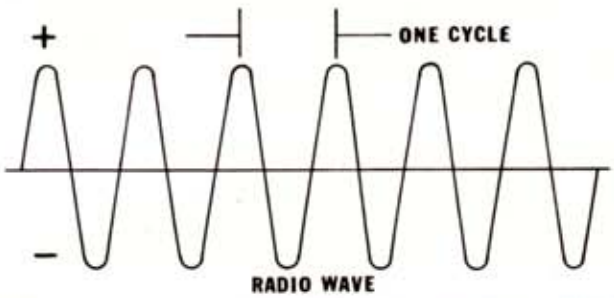


FIG. A

A radio wave is simply a carrier of information. If no information is added to the radio signal then nothing is picked up by the radio. Only when music or speech is superimposed on the radio signal do you hear anything on your radio. This addition of audio information on the radio signal is called modulation. On the broadcast band in which your radio works, the information is added to the radio signal by increasing or decreasing the strength of the signal in relation to the audio signal. This type of modulation is called amplitude modulation because the amplitude of the signal changes with the changes in the audio signal. Fig. B shows how the audio signal is added to the radio wave for amplitude modulation.

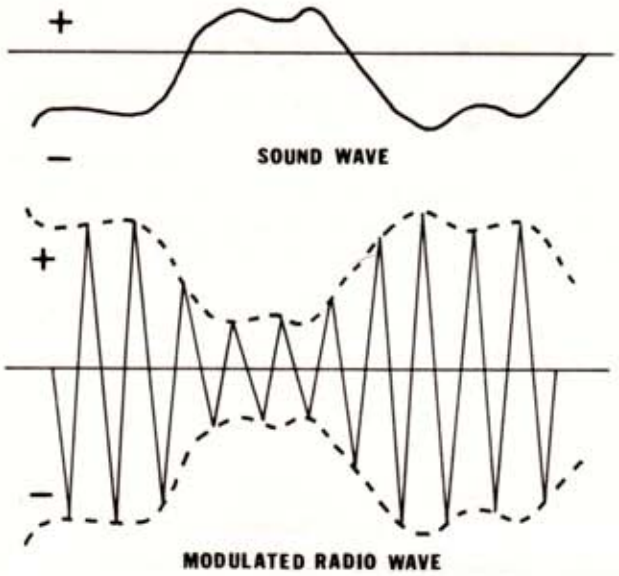


FIG. B

A radio has three basic functions. One is to select the proper signal out of the thousands of radio signals in the air. This job is done by the antenna coil L and the capacitor C1. They form a tuned circuit which accepts the signal that you wish to hear and rejects all other signals. The second function is that of removing the the audio signal from the radio wave. This task is called detection. It is accomplished by rectifying the signal, that is cutting the signal in half by allowing the signal to swing in one direction but not in the other. The tube has the responsibility for the function and in this radio the method is that of a grid leak detector. The signal is applied to the grid of the tube (pin 6) and the tube is allowed to conduct only when there is a signal present and then in only one direction. Fig. C shows the signal after detection.

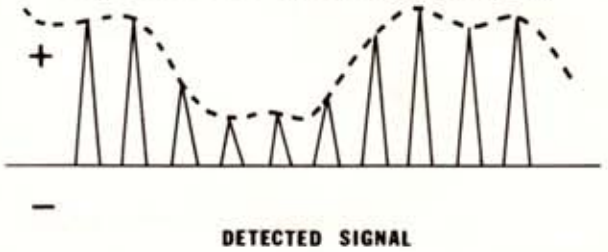


FIG. C

The third function of the radio is that of amplification. The signals from the air are seldom strong enough to be heard without some assistance from the electronic circuit. The tube not only detects the audio signal but it also adds additional signal strength so that it can be heard in the earphone. The tube is an electronic switch or, as it is called in England, a valve which can control a large number of electrons going out of the tube with only a small number of electrons controlling the action of the tube. Hence the small variations of the incoming signal become much larger variations in the earphone.

FIG. 2 SCHEMATIC DIAGRAM ONE TUBE RADIO