

Science Fair®

Cat. No. 28-176

AM Short Wave Radio Kit

An Exciting
Do-it-Yourself
Kit for All Ages

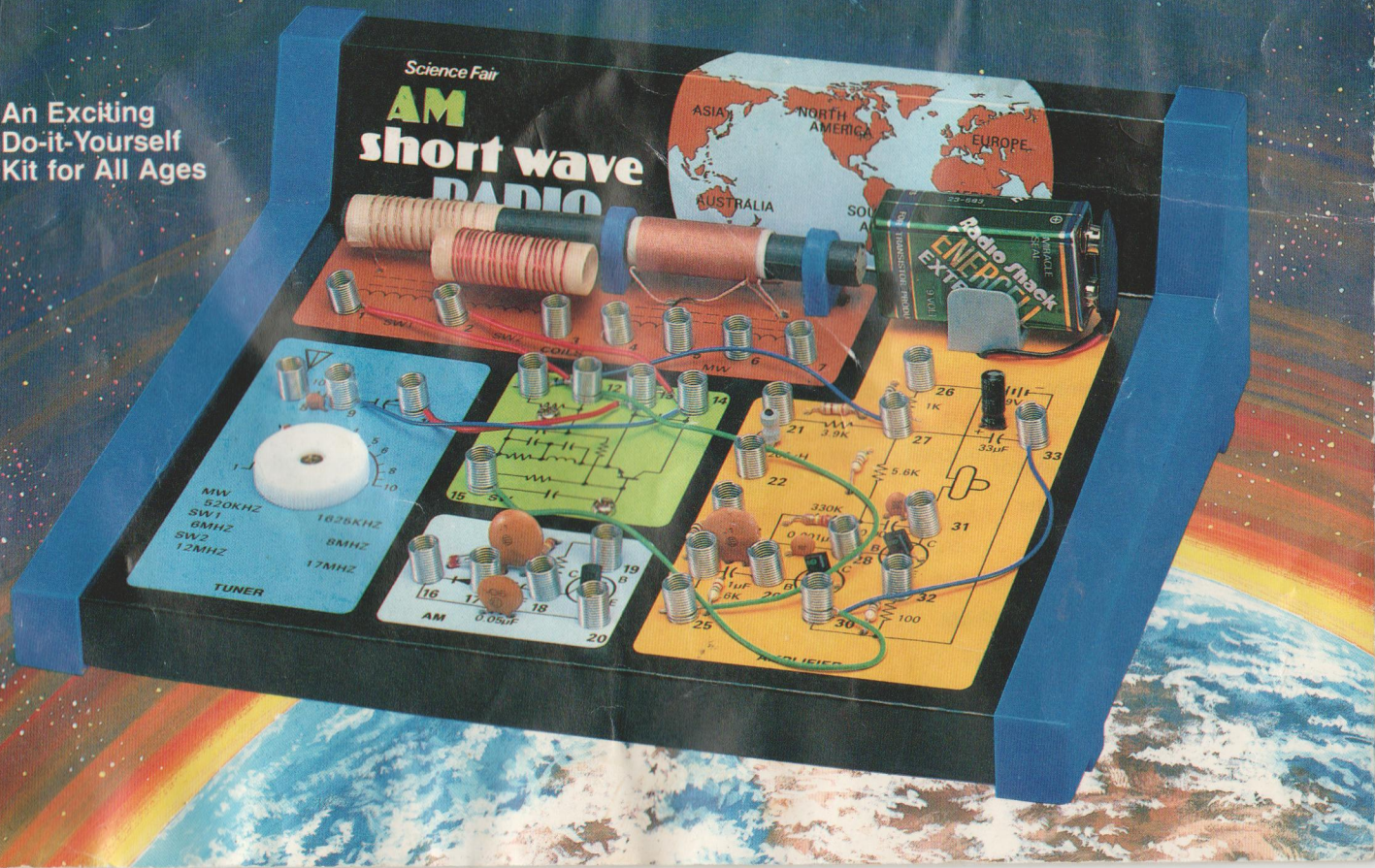


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Your AM-SW Radio Kit uses one Printed Circuit Board, three transistors, 8 resistors and 8 capacitors including a variable capacitor.

It has high sensitivity and covers a wide range of frequencies: the AM covers from 520KHz to 1625KHz, the SW1 (Short Wave 1) from 6MHz to 8MHz, and the SW2 from 12MHz to 17MHz.

In these SW bands, you can enjoy listening to the Voice of America, BBC, Radio Moscow, Radio Nederland and many other international stations.

This manual contains easy-to-follow, step-by-step instructions and plenty of drawings to help make them clear.

After you've tuned in an AM or SW signal, it is then amplified by the 2 transistor amplifier circuit.

The broadcast current coming from the antenna is tuned by the coil and variable capacitor circuit

which selects the station.

The broadcast signal consists of high-frequency (radio frequency) waves modulated with low-frequency (audio frequency) waves.

The process of detection is used to select or separate the low-frequency current out of the broadcast current, as this current is the carrier of the signals for sounds. The weak current that flows in the antenna is intensified many times through step by step amplification.

The SW circuit is on the small Printed Circuit Board. It gets its signal from terminals 11 and 12. The AM circuit is in the lower center of the front Panel. Its signal comes from terminals 18 and 20.

The circuit that is to the right of terminals 21, 22, 23, 24 and 25 is the 2-transistor amplifier which amplifies the audio frequency part of the AM and SW signal.

- Each is marked with its value.
- 2 large - marked .1 or 104.
 - 1 large - marked .05 or 500.
 - 1 small - marked .002 or 202.
 - 1 small - marked .001 or 102.
 - 1 small - marked 100 or 101.

Capacitor (1)

Diode (1) - This is germanium type with black or red band.

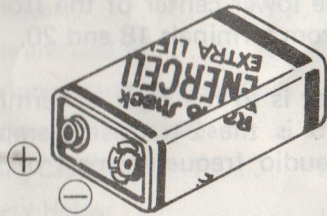
Coil (1) - This coil looks like small one with two leads.

REQUIRED TOOLS

You will only need a few simple tools to build your kit.

- * Small Phillips screwdriver
- * A pair of long-nose pliers
- * Wire cutters

You will also need one 9V battery. We recommend Radio Shack's 23-464 or 23-583.



GETTING STARTED

The first thing any good kit builder does with a new project is to make sure all the necessary parts are included in the kit.

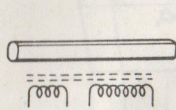
To do this, check the contents of your kit against the parts list.

The parts list is separated into two sections — electrical items (resistors, transistors and so forth) and mechanical parts (nuts, screws, wires, etc.). As you check off the parts, put them in a safe place so they will not get lost or damaged. Keeping them in the lid of the kit box is a good idea.

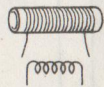
Each electronic part has its picture and "schematic symbol" next to the description in the parts list. The schematic symbol will help you locate the correct position for the parts on the kit's cardboard panel.

PARTS LIST

Electrical Components

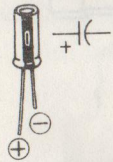


- Bar Antenna (1) — This is a ferrite rod.



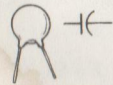
- Antenna coils (3) — Two are for SW Bands and one is for AM Band.

Capacitors (7) — There are two kinds of capacitors in your kit: electrolytic and ceramic. The electrolytic capacitor looks like a tiny tin can. You should have only one.



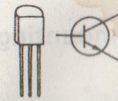
- 1 — marked $33\mu\text{F}$, 10V or 16V or 25V

The ceramic capacitors are small and circular. Each is marked with its value.

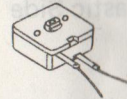


- 2 large — marked .1 or 104.
- 1 large — marked .05 or 503.
- 1 small — marked .002 or 202.
- 1 small — marked .001 or 102.
- 1 small — marked 100 or 101.

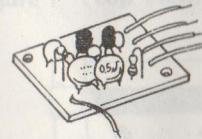
- Resistors (8) — these are the small, tan tubular objects with colored stripes. The stripes will help you identify them later.



- Transistors (3) — Transistors have three connections (instead of two like the other parts you have seen). All are marked "C945" or "C828" or "C1815" or "C711" or "9013" or "9014".



- Variable Capacitor (1) — This is a special capacitor that will be used to tune in the frequency you want with the Bar Antenna.



- Tuner Assembly for SW1 and SW2 (1) — The SW Tuner circuits are assembled on the small Printed Circuit Board.



- Earphone, magnetic (1)



- Diode (1) — This is germanium type with black or red band.



- Coil (1) — This coil looks like small can with two leads.

Mechanical Parts



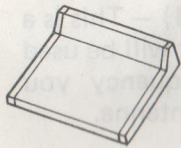
- Battery Snap for 9V Battery (1)



- Antenna Holders for mounting Bar Antenna (2)



- Battery Holder for one 9V Battery (1)



- Cardboard Panel with Plastic Side Frames (1)



- Nuts (3)



- Screws:
Long Phillips — head (3)



- Short Phillips — head (3)



- Spacers (2)



- Spring Terminals (33)



- Tuning Knob (1)



Wires:

- Red, (3") 75mm (5)
- Blue, (4") 100mm (3)
- Green, (6") 150mm (2)
- Yellow, for antenna, 16' (4.8m) (1)

Refer to the following illustrations of complete unit when you are building the kit:

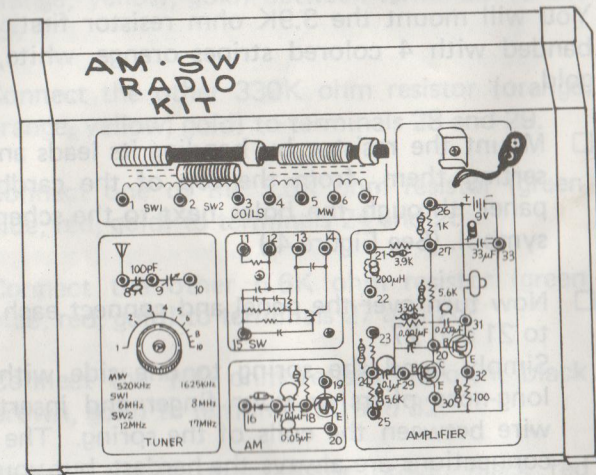


Figure 1 (Top View)

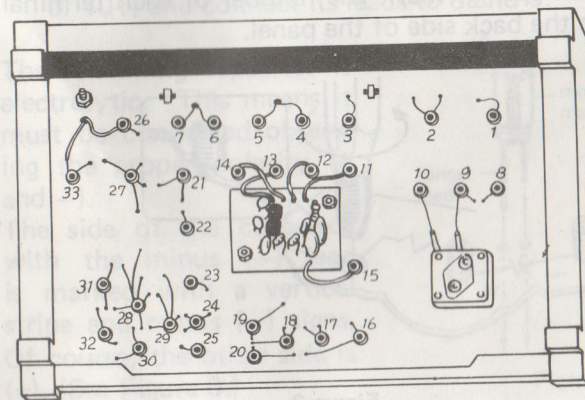


Figure 2 (Bottom View)

ASSEMBLY/INSTALLATION

Spring terminals

The spring terminals provide an easy way to make electrical connections without the use of solder.

- From the top side of the cardboard panel, install 33 spring terminals into the 33 large, numbered holes. The smaller end of the spring should be at the bottom. To make installation easier, use the pointed end of a pencil or ball-point pen to push the spring through the holes then twist them slightly. (See Figure 3.)

You will make many of your connections on the back side of the cardboard panel. As you install each spring, mark the number of each terminal on the back side of the panel.

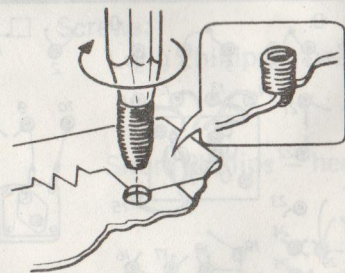


Figure 3

Resistors

You will mount the 3.9K ohm resistor first. It is banded with 4 colored stripes orange, white, red, gold.

- Mount the resistor by bending its leads and inserting them, from the top of the cardboard panel, through the holes next to the schematic symbol. (See Figure 4.)
- Now turn over the panel and connect each lead to 21 and 27. Simply bend the spring to one side with the long-nose pliers or your finger and insert the wire between the coils of the spring. The first connections are always the hardest, but you will soon learn to do this easily.

Remember, you will identify the resistors by their colored bands.

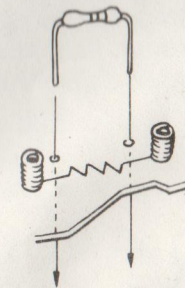


Figure 4

- Connect the 10K ohm resistor (brown, black, orange, gold) to terminals 23 and 24.

- Connect one of the 330K ohm resistor (orange, orange, yellow, gold) between terminals 18 and 19.
- Connect the other 330K ohm resistor (orange, orange, yellow, gold) to terminals 28 and 29.
- Connect one of the 5.6K ohm resistor (green, blue, red, gold) to terminals 24 and 25.
- Connect the other 5.6K ohm resistor (green, blue, red, gold) to terminals 27 and 28.
- Connect the 100 ohm resistor (brown, black, brown, gold) to terminals 30 and 32.
- Connect the 1K ohm resistor (brown, black, red, gold) to terminal 26 and 27.

Capacitors

From the top of the cardboard panel, insert the two leads of each capacitor through the holes next to its schematic symbol. (See Figure 5).

Then, on the back side of the panel, connect the leads to the designated spring terminals.

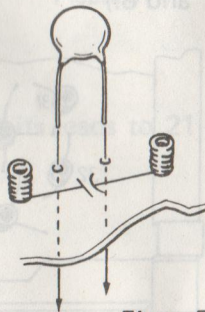


Figure 5

- Mount one of the $0.1\mu\text{F}$ capacitors (large, marked .1 or 104) to the holes above terminals 17 and 18 and connect its leads to 17 and 18.
- Mount the other $0.1\mu\text{F}$ capacitor and connect its leads to 24 and 29.
- Mount the $0.05\mu\text{F}$ capacitor (large, marked .05 or 503) and connect its leads to 16 and 20.
- Mount the $0.002\mu\text{F}$ capacitor (small, marked .002 or 202) and connect its leads to 28 and 31.
- Mount the $0.001\mu\text{F}$ capacitor (small, marked .001 or 102) and connect its leads to 28 and 29.
- Mount the 100pF capacitor (small, marked 100 or 101) and connect its leads to 8 and 9.

The remaining capacitor is electrolytic. This means it must be connected observing the proper polarity (+ and -).

The side of the capacitor with the minus (-) lead is marked with a vertical stripe and minus (-) signs. Of course, the other side is (+). (See Figure 6.)

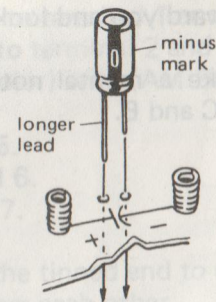


Figure 6

- Connect the 33 μ F capacitor to terminals 27 (+) and 33 (-).
- Now go back and carefully check your work. Be sure you have positioned each part in the right place. Be sure the minus(-) side of the electrolytic capacitor is toward the proper terminal. Double-check these parts. On the bottom side, cut off any excess wire ends.

Transistors

Transistors each have 3 leads. **Each lead MUST go into the correct hole in the Panel Board.** Pick up the Transistors and look at the bottom, where the leads come out.

Now, look at the Transistor, with the flat side toward you and look at Figure 7.

Make a mental note of the position of each lead, E, C and B.

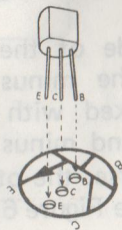


Figure 7

OK, got that? Now let's proceed.

- Mount a Transistor marked C945 or 828 or C1815 or C711 or 9013 or 9014 between 18, 19 and 20. **Position it so the flat side is toward spring 25.** Insert the leads through the holes provided. On the bottom, connect the upper lead to 19, the center lead to 18 and the lower lead to 20. (See Figure 7 and 8.)
- Mount another Transistor between 28, 29 and 30. **Position it so the flat side is toward 28.** Insert the leads through the holes provided. On the bottom, connect the left lead to 29, the center lead to 28 and the right to 30. (See Figure 7 and 8.)
- Mount the remaining Transistor between 28, 31 and 32. **Position it so the flat is toward 31.** Insert the leads through the holes provided. On the bottom, connect the left lead to 28, the center to 31 and the right to 32. (See Figure 7 and 8.)

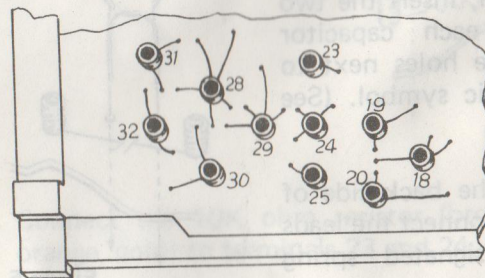


Figure 8

- Since the Transistors are so important, **you must be sure you get them in correctly.** Double-check them to be sure! Be sure each lead goes into the correct hole and that you didn't cross over the leads on the bottom side.

Diode and Coil

The diode must be mounted only one way.

- From the top of the cardboard panel, insert the two leads of the diode through the holes next to the schematic symbol. Banded end to terminal 16. (See Figure 9.)

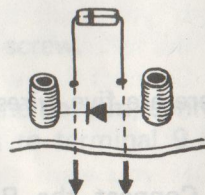


Figure 9

- Connect the leads to terminal 16 (banded end) and 17.
- Mount the coil and connect its leads to 21 and 22.

Bar Antenna and Antenna Coils

- Examine the antenna Coils. They have some very thin wires coming from them. Handle them with care.
- Insert the Holders into the holes of the Board and rotate them to accommodate the coils.
- Position the Coils as shown. Insert the leads down through the holes provided. (See Figure 10.)
- Slip the Bar into the SW1 (gold) and AM Coils and the holders. Don't mount the SW2 (red) Coil on the bar.
- Turn the Panel over and very carefully connect the wires from the Antenna Coils as shown:
 - Gold wires (SW1 Band) to terminal 1 and 2.
 - Red wires (SW2 Band) to terminal 2 and 3.
 - White (or other light color) wire (AM Band) to terminal 4.
 - Black wire to terminal 5.
 - Yellow wire to terminal 6.
 - Green wire to terminal 7.

Note: Be sure to connect the tinned end to each spring. Do not let wires cross each other.

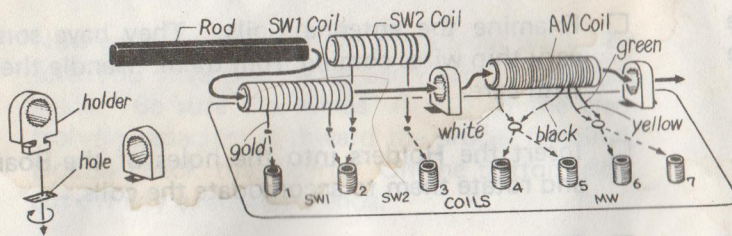


Figure 10

SW Tuner Assembly Board

You must use extreme care when you handle and mount this assembly — try not to touch any parts on the Board. Hold it only by the edges.

- Look at Figure 11 (and Figure 2) and mount the SW Tuner Assembly to the bottom of the Panel Board. Insert the two long screws from the top of the Panel.
- Turn the panel over and mount the spacer on the screws. Then place the Assembly Board on the screws and tighten each screw and nut with a Phillips type screw-driver and long-nose pliers. Do not over tighten.

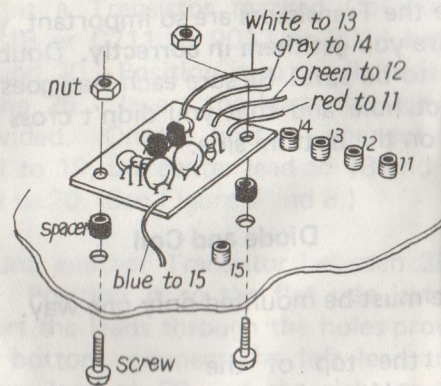


Figure 11

There are five wires coming out of the Tuner assembly.

- Connect the Red wire to spring terminal 11. (See Figure 11.)
- Connect the Green wire to spring terminal 12.
- Connect the White wire to spring terminal 13.
- Connect the Gray wire to spring terminal 14.
- Connect the Blue wire to spring terminal 15.

Tuning Capacitor

- Mount the tuning Capacitor from the bottom of the panel and position as shown on Figure 12.
- On the top, fasten it with two small screws.
- Mount the Tuning Knob on the Tuning Capacitor.
- Make sure the red mark is at the left side around the shaft when you rotate the knob counter-clockwise.
- Fasten the knob with a small screw.
- Turn the Panel over and on the bottom, connect the Tuning Capacitor leads to terminal 9 and 10. (See Figure 12.)

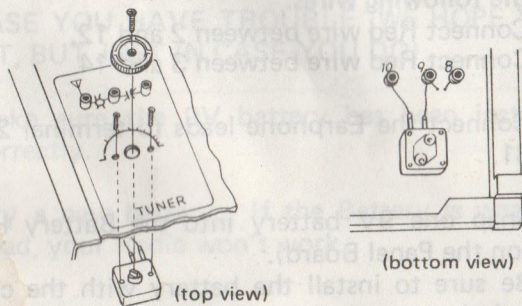


Figure 12

Battery Holder

- Mount the Battery Holder to the top of the Panel Board. Use the long screw (from the top of the Panel Board). Fasten with a nut. (See Figure 13.)
- Connect the Red wire of the Battery snap to terminal 26 and the Black wire to terminal 33.

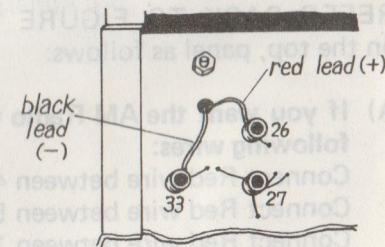
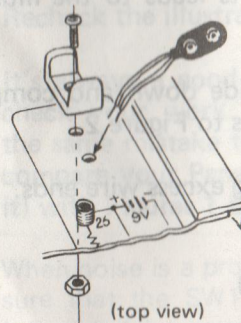


Figure 13

This completes most of the wiring on the Panel Board. Before you finish up, check your work once more:

1. Be sure the transistor leads are connected properly. Study Figure 7 and 8 once more and be sure each lead has been correctly connected.
2. Place your Board next to Figure 1 and compare each part and its leads to the illustration.
3. Turn the Board upside down and compare your wire connections to Figure 2.
4. Cut off any remaining excess wire ends.

Wiring

REFER BACK TO FIGURE 1 and connect wires on the top, panel as follows:

- A) If you want the AM Radio to work, connect the following wires:
- Connect Red wire between 4 and 9.
 - Connect Red wire between 5 and 10.
 - Connect Red wire between 18 and 23.
 - Connect Red wire between 20 and 30.
 - Connect Red wire between 22 and 23.

- Connect Blue wire between 6 and 19.
- Connect Blue wire between 30 and 33.
- Connect Green wire between 7 and 16.
- Connect Green wire between 9 and 20.

B) For both SW1 and SW2 wiring:

- Connect Blue wire between 9 and 14.
- Connect Red wire between 10 and 13.
- Connect Blue wire between 11 and 27.
- Connect Blue wire between 30 and 33.
- Connect Green wire between 12 and 25.
- Connect Green wire between 15 and 30.

C) If you want the SW1 Radio to work, connect the following wires:

- Connect Red wire between 1 and 12.
- Connect Red wire between 2 and 14.

D) If you want the SW2 Radio to work, connect the following wires:

- Connect Red wire between 2 and 12.
- Connect Red wire between 3 and 14.

- Connect the Earphone leads to terminal 26 and 31.

- Snap one 9V battery into the Battery Holder (on the Panel Board).
Be sure to install the battery with the correct polarity — as shown in the Battery Holder.

Your AM/SW Radio is now ready to use.

Place the Earphone in your ear. You will hear AM or SW signals by adjusting the tuning knob, assuming you have made the correct wire connections.

For AM and SW reception, you can connect an external or outdoor antenna.

For best Radio reception, you should connect wires as follows:

Connect the yellow wires to terminal 8. Then extend the other end out a window or attach it to the metal stop on a dial-type telephone or to wire-type window screen.

Or, you can use an outside antenna and connect it to this terminal.

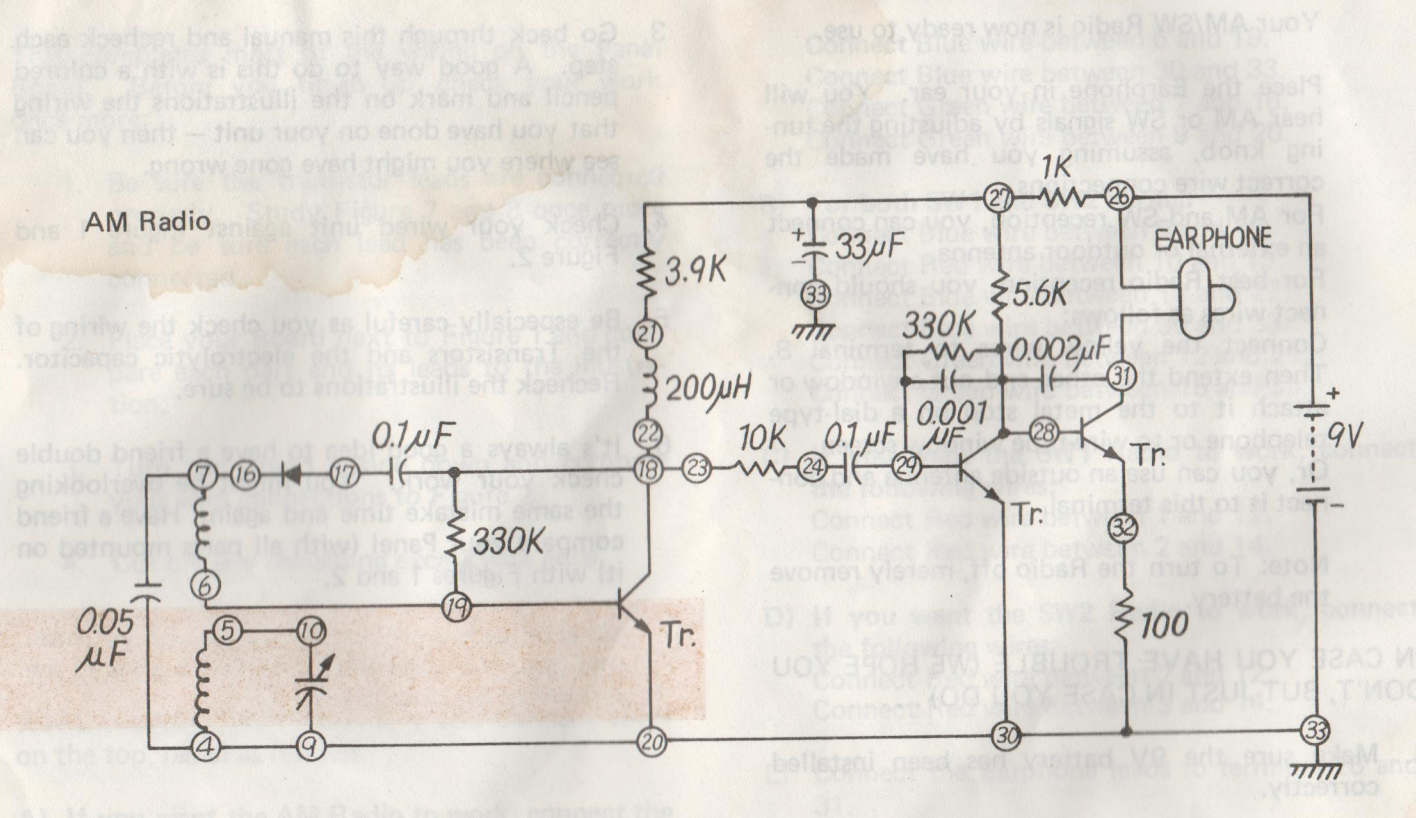
Note: To turn the Radio off, merely remove the battery.

IN CASE YOU HAVE TROUBLE (WE HOPE YOU DON'T, BUT JUST IN CASE YOU DO)

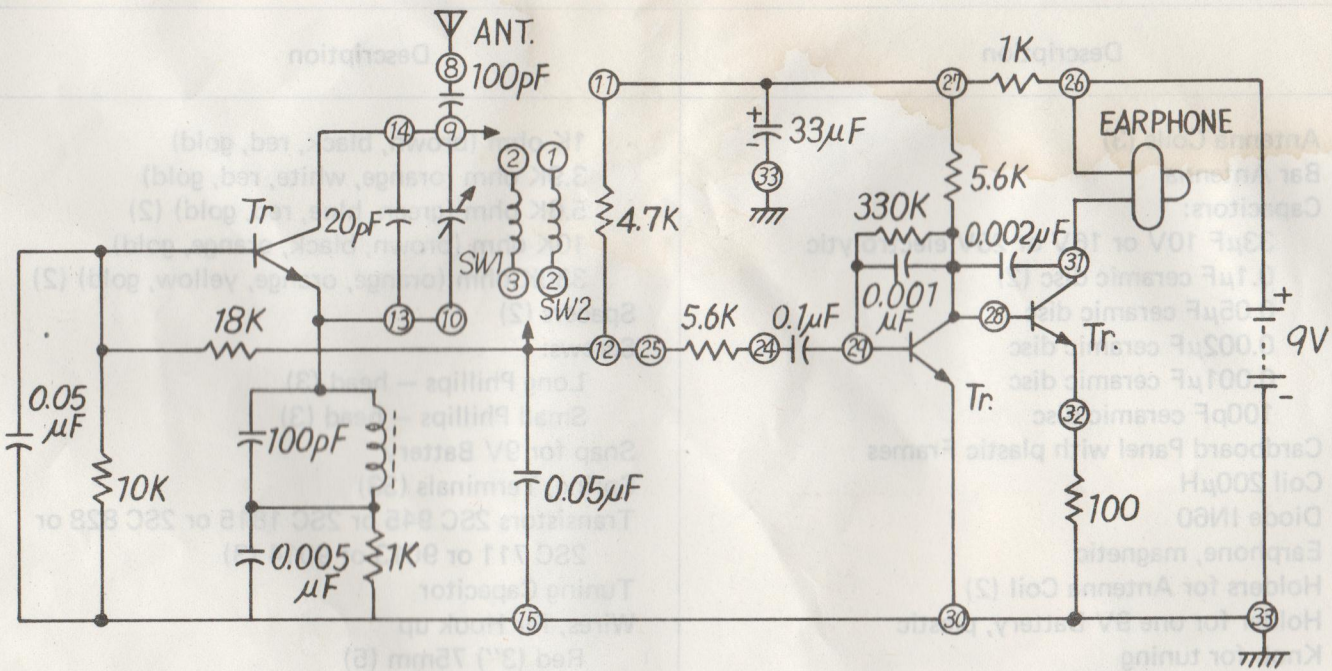
1. Make sure the 9V battery has been installed correctly.
2. Try a new battery. If the Battery is weak or dead, your Radio won't work.

3. Go back through this manual and recheck each step. A good way to do this is with a colored pencil and mark on the illustrations the wiring that you have done on your unit — then you can see where you might have gone wrong.
4. Check your wired unit against Figure 1 and Figure 2.
5. Be especially careful as you check the wiring of the Transistors and the electrolytic capacitor. Recheck the illustrations to be sure.
6. It's always a good idea to have a friend double check your work. You might be overlooking the same mistake time and again. Have a friend compare your Panel (with all parts mounted on it) with Figures 1 and 2.
7. When noise is a problem in SW1 reception, make sure that the SW1 antenna coil is flush with the left end of the antenna rod.

AM Radio



CIRCUIT DIAGRAM



SW1 and SW2 Radio

NOTES

MASTER PARTS LIST

Description	Description
<p>Antenna Coils (3)</p> <p>Bar Antenna</p> <p>Capacitors:</p> <p>33μF 10V or 16V or 25V electrolytic</p> <p>0.1μF ceramic disc (2)</p> <p>0.05μF ceramic disc</p> <p>0.002μF ceramic disc</p> <p>0.001μF ceramic disc</p> <p>100pF ceramic disc</p> <p>Cardboard Panel with plastic Frames</p> <p>Coil 200μH</p> <p>Diode 1N60</p> <p>Earphone, magnetic</p> <p>Holders for Antenna Coil (2)</p> <p>Holder for one 9V Battery, plastic</p> <p>Knob for tuning</p> <p>Nuts (3)</p> <p>Printed Circuit Board</p> <p>Resistors:</p> <p>100 ohm (brown, black, brown, gold)</p>	<p>1K ohm (brown, black, red, gold)</p> <p>3.9K ohm (orange, white, red, gold)</p> <p>5.6K ohm (green, blue, red, gold) (2)</p> <p>10K ohm (brown, black, orange, gold)</p> <p>330K ohm (orange, orange, yellow, gold) (2)</p> <p>Spacers (2)</p> <p>Screws:</p> <p>Long Phillips — head (3)</p> <p>Small Phillips — head (3)</p> <p>Snap for 9V Battery</p> <p>Spring, Terminals (33)</p> <p>Transistors 2SC 945 or 2SC 1815 or 2SC 828 or 2SC 711 or 9013 or 9014 (3)</p> <p>Tuning Capacitor</p> <p>Wires, for Hook up</p> <p>Red (3'') 75mm (5)</p> <p>Blue (4'') 100mm (3)</p> <p>Green (6'') 150mm (2)</p> <p>Yellow, for Antenna, 16' (4.8m) (1)</p>

**CUSTOM MANUFACTURED FOR RADIO SHACK
A DIVISION OF TANDY CORPORATION**

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