

You Just Brought an Old Radio Home: Now What Do You Do?

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Whether you are just beginning to collect antique radios or you have been at it for a number of years, if you are thinking about doing more than just admiring your radio, this article may be of some help to you.

We begin by taking a quick look at the steps involved in radio restoration, and then get into a little more detail. Of course, an article like this could go on for many pages on each topic, but this article introduces you to the overall approach to take and goes into some detail.

Where to Begin

1. Carefully look over your radio both inside and out. Is everything there including knobs and the chassis mounting hardware? If not, make a note of what you must replace. These items all cost money and can help you to value the radio you own or are considering purchasing.
2. Turn the knobs. Do the controls work? Is the volume or tone pot (a pot is a potentiometer, basically a variable resistor) frozen or stiff? Does the dial pointer move or does the tuning knob just turn without anything happening? When testing it, don't force a stuck pot to turn because you can damage the control. Just note that you will have to fix it. (After you remove the chassis later, you will spray them with contact cleaner and work them gradually to clean them up.)
3. Is there a back on the radio? Should there be one there? If there should be one and it is missing, you'll may want to consider reproducing it from Masonite.

4. How about the antenna? If you can see it (sometimes it is inside on the back of the back cover) does it look intact? Does it look as though all windings are unbroken? A broken antenna winding usually requires replacement of the antenna.
5. Is the power cord flexible or stiff? Has it been patched or spliced? If it's not in good condition, just cut it off now and throw it out. Put a new one on later.
6. Look at the chassis while it's in the cabinet. Are there any tubes missing? If so, again you'll have to spend money to replace them. Is there rust or a dirty film on the chassis? If so, you'll need to clean off the rust or film. A sticky smoker's film is not unusual, but also not fun to clean off. Still, it has to be done because leaving it there can cause overheating, not to mention that it's nasty.

OK, you've looked it over, now you want to know if you can plug it in and give it a tryout. **If there is a power transformer in the radio then you absolutely cannot power it on.** You risk shorting out your transformer. If the radio is a transformerless AC/DC type, you can power it on. If it doesn't power up, you may have a bad tube.



HINT: I power up AA5 type radios to listen for signs of silver migration disease in the IF transformers. This helps me plan my repairs.

Ensure You Have a Basic Understanding of How Radios Work

Before we start taking this radio apart, let's take a minute and go through how these radios actually work. It will really help your troubleshooting later if you run into a problem. (See Figure 1.)

1. The first stage involves the antenna and tuning capacitor. Together they form a resonant circuit that allows you to select an individual frequency

- from everything that is out there. This circuit creates a small microvoltage current that is fed into the grid of the first tube in the radio. This RF (radio frequency) tube amplifies the incoming signal.
2. Did you notice the second tuning capacitor next to the one for the antenna? This capacitor is for the oscillator and is tuned to be the exact IF frequency (such as 455kc) above the tuned frequency of the antenna capacitor. This resonant circuit uses its own coils and tube or part of a tube before being mixed with the RF signal. This mixing allows the magic of heterodyning to occur. A weak RF frequency is mixed with a strong oscillator frequency. The result is a strong signal at the IF frequency that can be passed on the next stage in the radio. This signal processing can all occur in one tube (the usual norm) or be split between two tubes.
 3. The middle stage in the radio is the IF (Intermediate Frequency) stage. It consists of a pair of IF transformers and an amplifying tube between the transformers. The transformers are constructed to resonate at the IF frequency that carries the tuned signal and allow this signal to pass through. They will reject signals at other frequencies. Each transformer has a pair of trimmers to allow fine tuning to the numbered IF frequency. The further amplified signal is then passed to the final stage.
 4. The Audio Stage consists of a detector, an audio output tube(s), the audio output transformer and speaker. The detector removes the audio signal from the IF frequency and passes it to the output tube. Here the audio signal is greatly amplified. The output transformer matches the impedance from the output tube to that of the speaker. And then the radio plays your selected station.

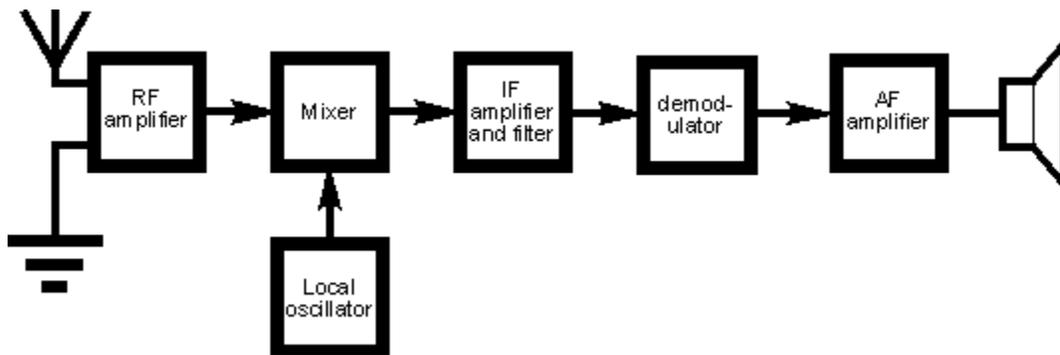


Figure 1: How Radios Work Diagram. This image retrieved from <http://www.radio-electronics.com/info/rf-technology-design/superheterodyne-radio-receiver/block-diagram.php>.

Let's Get Started

Before you pull the chassis out of the radio, locate a schematic. These are available for free at nostalgiaair.org. You will need the radio's manufacture and model number to locate it. Once you have found a schematic, get started.

1. Pull the chassis out of the cabinet and look it over. Has it been worked on in the past? (You can tell because some parts may look newer than others, or the layout may not match the schematic.) Ask yourself, have the electrolytic or paper [capacitors](#) (caps) been replaced? What is the condition of the wiring? Have there been any modifications made? Make a note for your repair plan.
2. Give the chassis a thorough cleaning.



I always remove, clean, and test the tubes at this point. It's a good time to do any needed rust removal treatment using Naval Jelly.

3. Are you going to replace all the paper capacitors or just the filter caps? I always replace all paper caps. I don't replace mica caps unless they show up on troubleshooting as possibly bad. Locate all the filter caps and check their values against the schematic. Replacement filter caps should

not be tacked onto the old filters. Ideally, the old terminals should be cut off and new connections made using a new terminal strip.

4. Controls need to be cleaned and lubed. Check for continuity across switches. Does the dial cord need restringing? Now's the time to put on the new power cord.
5. Connect the radio to the [Variac](#) (Variable Voltage Output Transformers) and let's power this thing up! (Here's where you hope for the best.) Does it power up and play or do you have a troubleshooting problem?

If it powers up and plays, congratulations. Now make the case beautiful.

If it doesn't power up and play, then it has a problem. Let's work through this and get this radio playing.

Working Through Problems When Your Radio Won't Play

The AC/DC radios (those without transformers) should be (for safety) first connected to an isolation transformer before powering up an exposed chassis.

These sets can have a hot chassis that can electrocute and kill if proper safety precautions are not followed. Never touch the chassis with two hands. Always keep one hand away from the chassis.

You also can plug into the Variac, which is then plugged into the isolation transformer and you can power up gradually. Now, you can troubleshoot your radio.

Start with the power supply to make sure it can power the radio. If the power supply is not working, troubleshoot it as explained in the following instructions.

Once you have a working power supply, you then will troubleshoot the rest of the radio in backwards order – from the back end (the audio output) to the front end (the RF receiving/antenna stage.)

Troubleshooting the Power Supply

1. Once the chassis is connected to the Variac, power up slowly the Variac and watch to see if the dial lamp on the radio begins to glow. Raise the voltage, and then check for glowing in the tubes. Look for smoke and arcing. If you see, hear or smell either, power off immediately. Check the chassis to find where the problem is coming from. You will have to fix that problem before you can move forward.
2. If no power, check for AC voltage at the power cord connections using a DMM (Digital Multi Meter). You should see around 120v. Check for AC voltage on each side of the on/off switch while moving the switch on and off. Power switch failure is very common. The switch will need to be replaced or rebuilt.
3. A.) If this is a radio with a transformer, unplug the radio and put the probes on each blade of the power cord, and then move the switch to on. You should see around 10 – 20 ohms for the primary side of the transformer. Check the high voltage (HV) secondary side by placing one probe on the rectifier plate and the other on the HV center tap. Expect around 150 -175 ohms on each plate. Abnormal readings could mean a shorted or open transformer winding. This means the transformer is bad and will have to be replaced.

B.) For an AC/DC radio (no transformer), check AC voltage at the On side of the switch and where the other side of the power cord is connected to the rectifier.

Troubleshooting the Audio Circuit

1. Quick test for the audio circuit is to inject an audio signal (using a signal generator) at the grid of the first audio tube. Normal result is a loud tone heard from the speaker. This point is connected to the middle terminal lug of the volume control pot (potentiometer – basically the rotating volume knob) and can be alternately tested by tapping the lug

- with a screw driver. You should loud noise when attempting this. If there is no sound then there is a problem in the audio output circuit. If no sound, go to step 2. If there is sound, go to “Troubleshooting the IF Circuit.”
2. The primary and secondary sides of the output transformer should be checked for continuity. The primary comes from the output tube and the secondary runs to the speaker. The primary is a common point of failure and may be open. If this occurs, the output transformer needs to be replaced.
 3. The speaker voice coil can be checked by connecting test leads to each side and connecting the other ends to a small battery (I use a AA battery). When the battery connection is made by tapping on the battery terminal, you should hear a scratching sound in the speaker if the voice coil is good. If your speaker is an electrodynamic type, you need to check the resistance of the field coil. An open field coil is common in old speakers. A bad field coil means you either must (1) replace it with a field coil that has similar field coil resistance, or convert it to a permanent magnet speaker (a modern one), but you will have to make changes to the radio to accommodate this.
 4. If none of this finds the problem, you will have to take individual voltage readings at each tube pin to isolate the problem. Resistors should be checked. Normal is + or – 20% of the given value. Usually a resistor that has drifted way high will be the problem. This is the time when any suspicious mica caps can be replaced.

Troubleshooting the IF Circuit

1. To check the IF section, inject an RF signal from a signal generator set at the intermediate frequency at the plate of converter/mixer tube (tube just before the 1st IF transformer). Normal results will be a loud tone heard from the speaker.

2. Common problems found include: a bad tube, badly aligned IF transformer, open coil in an IF transformer, or bad cathode resistor. Continuity testing of the IF coils can easily be done to eliminate them as an issue. An open IF coil requires removal of the transformer from the radio. A break near one of the terminal lugs can usually be found and can be repaired by unwinding a turn of wire and re-soldering the connection.
 - If there is a bad tube, replace it.
 - If the IF transformer alignment is off, align the trimmers.
 - If it has a bad coil, replace or repair it.
 - If it has a bad cathode resistor, replace it.

Troubleshooting the Converter (Oscillator and Mixer) Circuits

Most AM circuits use a combination mixer/oscillator tube. The cathode and first grid are for the oscillator circuit and the RF input grid, screen and plate are for the mixer circuit.

1. To test the oscillator section, set the radio receiver to 600kc and, using a signal generator, inject an RF signal of 600kc at the mixer grid (RF input grid). As the receiver is tuned around the 600kc range, a tone should be heard as the tuner passes through 600kc, if the oscillator is working properly.
2. If the radio is not oscillating, try another tube or two. Oscillator tubes are very finicky and a tube can test good on a tester but not oscillate in the radio.
3. Check the voltage on the oscillator grid (grid 1 of the tube). It must have negative voltage of at least -7v to oscillate. If voltage is 0, check the oscillator coil for continuity and be suspicious of the cathode-to-grid resistor.
4. Problems in the mixer circuit are usually detected by checking pin voltages. An abnormal reading will lead to the part of the circuit that is not functioning properly.

Troubleshooting RF Input

Problems with RF input usually involve an antenna problem.

1. To test for an antenna problem, inject an RF signal at the antenna input. You should hear a load, clear tone. If you do not hear a tone, bypass the antenna by injecting the signal directly to the tuning capacitor. If the radio plays, the problem is in the antenna circuit.
2. Oscillation or poor quality sound may be due to improper shielding (tube shields need to be grounded) or poor ground connections in the chassis. Rivet grounding connections get loose and lose contact. Any poor or cold solder joints should be re-soldered. A spooze stick (basically a non-conductive stick you can use to tap items in the radio while testing for issues) can be tapped on the ground points and solder joints to see if they cause any noises or make things better.

Now that you have gone through your radio and got it working, it's time to mount the chassis back into the radio. Turn it on again. It's not completely unheard of for a radio that was working while the chassis sat on your workbench to stop working once you put the chassis back in. Don't be discouraged, just pull it back out and take another look at it. It might be as simple as a loose antenna connection that was knocked free when putting the chassis back into its cabinet.

Don't get discouraged. If worse comes to worse, you can always have someone else take a look at it for you. And if nothing else, shine up and make beautiful the cabinet. It still will look great in your collection.