

Ottawa Vintage Radio Club

April 12, 2023

Radio Repair Clinic

A Note About Safety

- Tube radios use voltages that can kill you.
- The components used in these radios were not designed for 80 years of life. The fact that they work at all is a small miracle.
- Remember that these parts could fail at any time, possibly rendering the radio dangerous.
- These few slides of advice are **NOT ENOUGH** to prevent you from hurting yourself or others.

A Note About Safety

- Furthermore, safety standards have improved over the years. Many of these radios would not pass contemporary safety standards.
- Proceed only if you are confident in your abilities to understand electrical safety, and are willing to “Do Things Right”.
- This is about YOU and anyone else who might come in contact with the radio!

Radio Repair Safety Tips

- Use an isolation transformer.
- Keep one hand behind your back.
- Capacitors can hold a charge for many minutes or even hours after a radio is unplugged. Discharge them.
- Do not solder, disassemble, or lift a live radio.
- Do not trust the on-off switch. Unplug the radio before handling.

Safety Tips

- Remove your jewelry, especially your watch. Keep your body and the area around your bench dry.
- While the radio is running, use only insulated test leads or well insulated tools when poking around the radio.
- Do not “float” your test equipment! (Do not connect the ground of your test equipment to ungrounded nodes in your radio)*

* People do this, but it is dangerous!

Making a Radio Safe

- If you repair radios for other people, you should be concerned about liability: fire and electrical shock.
- If a radio you repair causes personal injury (shock or death) or property damage (fire), you could be sued (by your friend's insurance company).
- Absolutely, replace the power cord and capacitors connected to it.

AC sets



- With a power transformer. Usually the radio chassis is exposed at the back.
- Use a 3-prong plug.
- Ground wire goes to chassis (on its own fastener).
- Hot power cord wire goes to fuse then switch.
- If there were capacitors from line to chassis, they will likely be unnecessary. Remove them.



AC/DC sets



- If there is no exposed hardware, you might get away with a polarized 2-prong plug.
 - No chassis bolts (unless insulating bushings are used), rivets, knob set-screws, metal hardware. Nothing exposed on the cabinet should connect to the chassis.
 - Back of radio is completely covered with only small holes.
 - No antenna connection, or antenna connection well isolated with safety capacitors.

AC/DC Sets

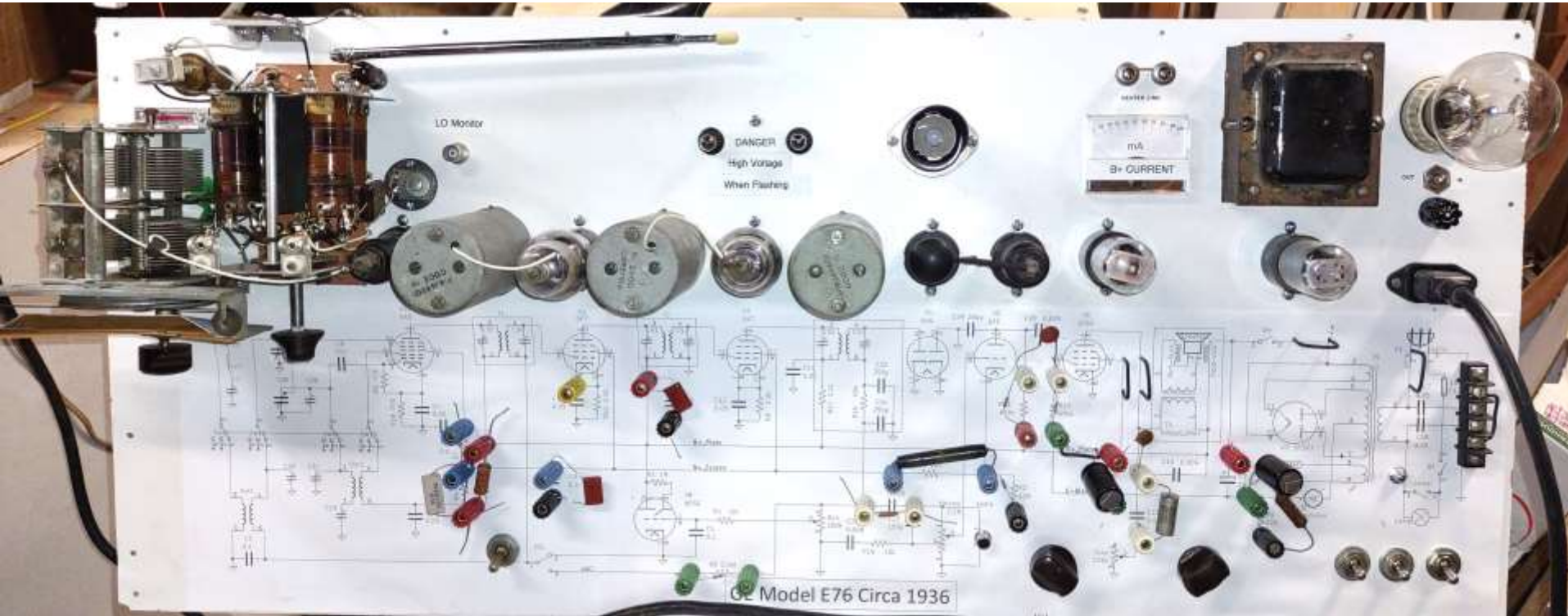
- Hot power cord wire (black) to fuse then power switch. (Often, these sets have the switch on the neutral. This must be changed)
- Chassis connects to neutral thru a capacitor or R-C. Capacitor must be safety (Y) type.
- If using a 3 wire power cord, green ground goes to chassis.

RADIO DEMONSTRATION BOARD

Radio Demonstration Board

1936 GE Radio Spread Out

6A8 - 6K7 - 6K7 - Eye - 6H6 - 6F5 - 6F6 - 5W4



Originally it looked like this...

I've had it for probably 50 years, never had a cabinet for it.

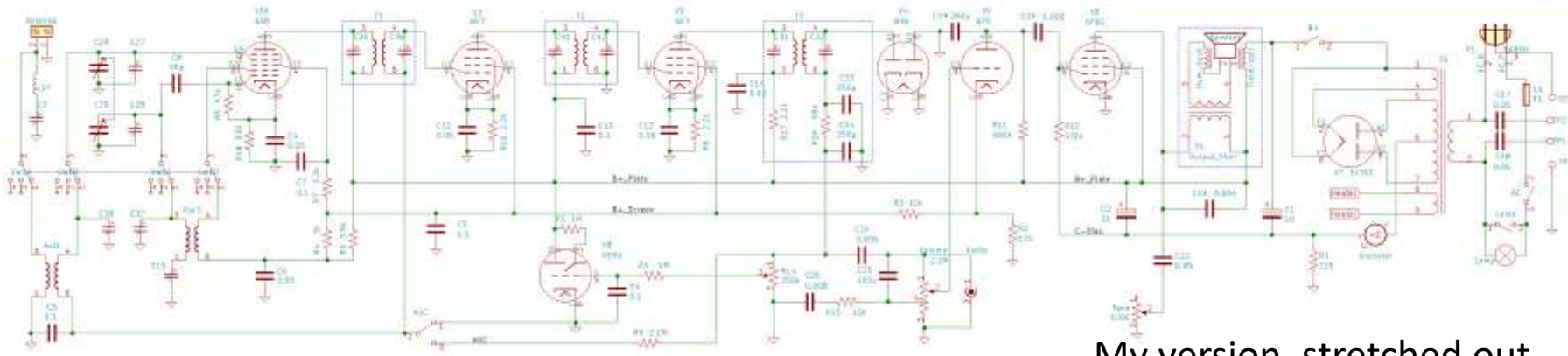


Features

- 1936 GE 3-band radio. 2 IF stages. Fairly conventional design, spread out on a board.
- 100W lamp in series with AC line.
- B+ switch (with surge reduction), B+ ammeter, flashing lights when B+ is on.
- AGC switch.
- Mute switch (makes it quieter).
- Added a tuning eye and tone control.

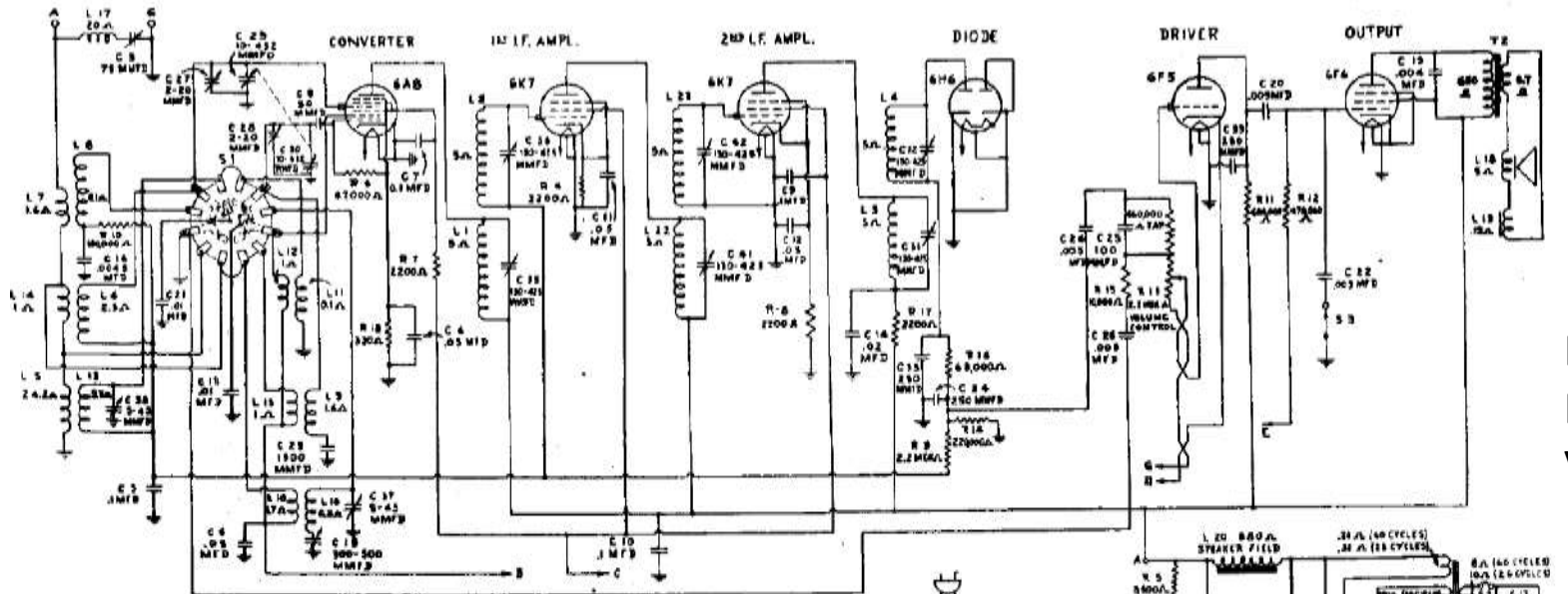
Features

- Many components are on binding posts to allow for easy voltage measurement and component substitution.
- Loops for current measurement.
- Different options for capacitors at AC line input.
- RF input stage untouched from original radio (wire length is critical).



GE Model E76 Circa 1936

My version, stretched out

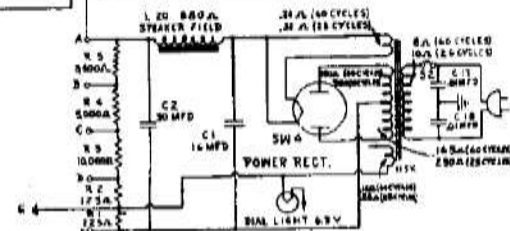
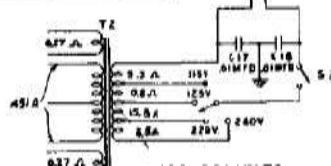


From:
Riders,
Vol. 7

ALIGNMENT FREQUENCIES

I. F.	Band "B"	Band "D"	Wave Trap
465 kc.	580 kc.	18,000 kc.	465 kc.
	1500 kc.		

Tuning Frequency Range



Today's Challenge

- I have introduced problems by installing some bad parts.
- Let's see if you can figure out what's wrong.

Before You Start

- Preliminary. To test tubes or not to test tubes?
 - I usually don't bother. Why? Sometimes, tubes that test bad work fine. Sometimes tubes that test good need to be replaced.
 - Besides, a truly dead tube usually makes itself known quickly. (Does not light up or get hot, takes no current, one part of the circuit is dead).
 - If the repair is for someone else, I might test them later.
- Visual inspection.
 - A burnt resistor will usually be caused by something else.
 - A burnt capacitor is always bad.
 - A leaky (wax dripping) capacitor is suspect.
 - Look for missing parts, previous repairs, broken wires, missing insulation.
 - I recall a time that I was working on a piece of test equipment. An important signal was missing. After a couple of hours of troubleshooting, I discovered that a large transformer was missing. Gone. Had been removed. I should have seen it immediately!

Safety: Tube Radios use Lethal Voltages

- Safety. Line cord. Fuse. Line capacitors. Isolation transformer.
 - AC-DC sets: use an isolation transformer for safety.
 - AC sets: use an isolation transformer anyway!
 - Note that an isolation transformer makes a radio more safe, BUT NOT SAFE!!! ***Don't get complacent!***
 - For repairs done for other people, I usually replace the line cord with either a polarized cord set or a 3-prong cord set. And, I replace any capacitors connected to the line with class Y safety capacitors.
- High Voltage rules: keep one hand in your pocket. Don't wear a metal watch or any dangly jewelry.

Protected Turn-On

- Power the radio up with 60- or 100- watt conventional (not LED or fluorescent!) lamp in series.
 - You can also use a variac to bring the voltage up slowly.
 - If the radio uses a transformer and has been stored in a damp location, some suggest bringing the radio up very slowly at low voltage (maybe shorting one of the secondaries, causing more heating), over hours, allowing it to dry out.
 - Lamp should light brightly at first, extinguish, then glow once plate current starts.
- Note that on this radio the lamp lights brightly.
 - Could be the transformer is shot!
 - Or, a filter cap is shorted.
 - Or a line capacitor is shorted?

Protected Turn-On

- Try without rectifier.
 - If lamp is no longer bright, then the problem is a shorted B+, probably a filter cap.
 - If the lamp is still bright, it may be the transformer. Sorry! That's a tougher repair!
- Note that lamp is not brightly lit when rectifier is pulled..
- Look at resistance to ground at the rectifier. (With power off!!!!)
 - If you see less than about 25K, that something is likely shorted.
 - Check each filter capacitor with an ohmmeter.

Audio

- Now, the radio powers up without excessive current.
- I leave the bulb in the circuit for now.
- But, it is not working. We hear distorted radio, whistles, more distortion at higher volume.
- Use a signal generator, or even just a screwdriver to see what part of the audio chain works.
 - The radio does not hum when I touch the 6F5 (1st audio stage) grid cap.
 - So, something around the 6F5 is suspect.
- Measure DC voltages.
 - You could also test the 6F5 tube. BUT you would later discover that even a mostly dead 6F5 still works.
 - Check 6F5 plate voltage. Low!!!!
 - Check 6F5 plate resistor. It's open!

Oscillation

- Now, the radio sort of works. But it whistles!
 - Likely there is an oscillation somewhere, probably in an IF amplifier.
 - Look for loose/missing tube shields.
 - Substitute in decoupling capacitors. (Decoupling capacitors in B+ keep signals from leaking from one stage to the next)
- Radio is distorted
 - Could be a gassy output tube?
 - Could be a badly biased output tube?
 - You should ALWAYS measure the voltage across the audio output grid resistor. There should be no voltage. Voltage there indicates a leaky coupling capacitor.

Other Routine Checks

- Measure AVC voltage, check that AVC works.
 - When tuned to a strong station, shorting the AVC line should cause the volume to increase.
 - You should see “several” to “many” negative volts on the AVC line when tuned to a strong station.
 - If not, possibly there is a shorted cap or open resistor in the AVC.
 - Or, possibly there is insufficient gain: bad IF stage, or alignment needed.
- Try a quick and dirty IF alignment.
 - Verify that each IF screw is peaked
 - Note that some IF adjustment screws could be “live” with >200V!!! Using a metal screwdriver could damage the radio or you!

- How important is the audio output tube?
 - Compare 6F6, 6K6, 6L6, 6V6, 6W6..., actually, they will all work OK.
- What happens if we plug in a weak audio triode?
 - Does not matter!

General Tips

- Tubes degrade when they are used. Sitting around unused, they do not degrade.
- Capacitors degrade with time (esp. if they are not used).
- Paper and electrolytic capacitors are the worst. Mica (rectangular domino-like capacitors) rarely fail.
- Some say that use (voltage applied) helps capacitors stay healthy.
- Most of the radios we work on are old but

General Tips

- Resistors tend to drift up with age.
- Most radios will work even if the resistors have changed by 20% or even 50%.
- Paper and electrolytic capacitor values are not critical. Use what ever value you have that is close. For electrolytics, the more the better.
- Mica capacitors are used for tuning so are critical. Count on realigning the radio if you replace one.
- Observe voltage ratings on capacitors.

General Tips

- Many problems can be located with nothing more than a voltmeter.
- Signal generator is also useful.
- I start at the speaker and move back. Does the speaker work? Does the output transformer work? Does the output tube work? Etc.
- Schematics available on the web (and on CDs) are very useful to establish the correct tubes, what voltages should be, what each tube does, alignment procedures.

Useful Tools

- Signal generator
- Multimeter
- Variac, Isolation xfmr, series bulb
- Soldering iron
- Tube Tester
- Clamp-on ammeter (both AC and DC)
- Filter capacitor substitution box
- R box, C box
- Some extra parts
- Oscilloscope