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## Introduction

If you ask any 86-89 C4 owner what one word describes the Delco/Bose stereo system in their corvette, I bet you would get a multitude of responses including; useless, complicated, and broken. But one word that doesn't come to mind and really should, is the word popular. According to the Corvette Black Book, between the model years of 1986 and 1989, of the 114,942 corvettes sold, 104,648 buyers checked the box for option code UU8 (Stereo System, Delco-Bose). That means 91% of all corvettes sold during that time have this system.

The Internet and forums are rife with stories of failed units; speakers that crackle or don't work at all, and the dreaded cassette tape failure mode which consists of your tape deck flipping the sides of the tape and then simply ejecting back at you, leaving you to wonder why your radio has forsaken you.

After owning and frame-off rebuilding a 78 Silver Anniversary Corvette, I was itching for a project, which led me to purchase the 86 convertible on the cover of this doc. Bose system, check. Crackly speakers, check. Broken cassette deck, check. I knew the system was finicky when I bought the car, but figured I would be able to find the information needed on the forums. That's where things got interesting.

What I found was no shortage of complaints about broken systems but not too much help honestly. Many nights were spent chasing down thread after thread, and piecing together little nuggets of wisdom. Most threads ended with people recommending removing and replacing the system. I considered doing this, but two things really held me back; I like the interiors of my cars to look stock and remind me of when they were built, and the 1.5 DIN size of the radio head unit. Oh yeah, I also have a thing for tough problems and lost causes, so getting the system working was right up my alley.

Over time, I was able to gather the information in this document from multiple sources and get my system working as good as the day it rolled off the assembly line, and even improve it with an auxiliary input which allows me to connect my cell phone or iPod.

These systems, in good repair, sound very nice. The parts are plentiful out on eBay (I bought an entire system from an 87 coupe including the radio to learn on before I attempted to work on my own unit for \$60) and doing the refurbishment is mostly an investment of your time if you have the necessary information.

Enter this document. To preserve, consolidate and distribute this information I wanted to create a document that might encourage folks to take a second look at their systems and try and save them.

You now have the information, don't rip, refurb!

## Disclaimers

Before you go any further, let me just say a few things....

- I am not affiliated with any of the products I reference in this doc. There's no money in this for me.
- The information provided in this document is provided as-is, without any guarantees to correctness for your application. The information presented in this document represents my experience with the units I own. It should be transferrable, but the reader should use caution and common sense.

- I am providing you with information only. Any work you do to your personal radios is your responsibility.
- This is not a repair manual, but It might help you identify problems and work through solving them, it is intended to give you the information to help erase some of the years of wear on your units.
- There are several vendors who perform radio refurbishment, and many come highly recommended. At first glance, the pricing of their services may seem high, but I can tell you from first hand experience, this is a very labor-intensive process. If you can't do the work yourself, I would recommend using a professional vendor, they do provide value.

## Acknowledgements

I want to acknowledge a fellow forum member, without whose kindness this document would not exist. JFB took the time to respond to a PM I sent him relating to a thread from 2010 (8 years prior) where he mentioned having a schematic. JFB was actually in possession of a set of factory service manuals specific to the radio and one for the speakers/amps. He took the time to dig them out and send them to me as he no longer needed them. They have been invaluable, so thank you.

## Skills/Tools Needed

The work described in this document varies in its difficulty, but all the processes require you to be comfortable doing the following:

- De-soldering components and using either a solder sucker, or de-soldering braid (my preferred method)
- Soldering components to a PC board. These boards are from the 80's, so the components are fairly large, it's not like you have to solder components in your cell phone.
- The ability to put things back together in the reverse order you took them apart. The radio has quite a few pieces and can be a bit daunting at times. Take lots of pictures while you are working so you can reference them for re-assembly.

In terms of tools, at a minimum you will need the following:

- Basic soldering/de-soldering equipment. I used a 40W iron and it seemed to work pretty well.
- Good quality solder and de-soldering braid
- TV Tuner Contact Cleaner/Lubricant
- Compressed air source, either your compressor or in a spray can.
- Assorted screwdrivers
- Very small needle nose pliers and wire cutters.
- ¼ inch, 3/16 inch sockets or nut drivers to disassemble the radio
- General tools to remove the speakers and disassemble the cases
- 70% isopropyl alcohol for cleaning up the cassette deck surfaces and circuit boards
- Toothbrush and Q-Tips
- Degausser (de-magnetizer) for the tape head, pinch roller, and capstan assemblies (optional)
- Hobby knife
- Whit Lithium Grease

I'm not going to discuss any techniques, there are plenty of good videos on how to solder and de-solder as well as disassemble your car to remove the speakers and radio on YouTube. I would suggest watching them.

## A Word or Two Regarding Electrolytic Capacitors

Capacitors are used in many circuits for a variety of reasons and come in different types. The type dealt with in this document are aluminum electrolytic capacitors, but there are many types including; ceramic film, paper and tantalum.

The basic unit of measure for capacitance is the Farad (F), and capacitors will typically be labeled with three important pieces of information:

- Capacitance in farads (F) or Microfarads ( $\mu$ F)
- Maximum Voltage in Volts (v)
- Maximum Operating Temperature in Degrees Celsius ( $^{\circ}$ C)

When choosing replacement capacitors you should match the capacitance as closely as possible. For voltage and maximum operating temperature, you can safely choose any value that is equivalent or higher without adverse effect.

### Why and How Capacitors Degrade

Within every capacitor there are three basic components, an anode, a cathode and a substance between the two known as the dielectric. In some types of capacitors, like ceramic film capacitors, the dielectric is a solid. These types of capacitors seldom go bad on their own and will last for their designed lifespan.

So just how long is the desired lifespan of a capacitor? Well, if you look at the manufacturer spec sheet for the capacitors being used in this refurbishment, you will find a lifespan stated at 1000hrs@105 $^{\circ}$ C. That means the capacitor is designed to last for 1000 hours of usage at the maximum operating temperature. If you do the math, that works out to almost 42 solid days of use at the maximum temperature. That seems a bit short, but thankfully we don't run these things at 105 $^{\circ}$ C in our cars. According to the fine folks at Wikipedia, aluminum electrolytic capacitors endurance is related to and affected by the operating temperature. For an electrolytic capacitor, the endurance is doubled/halved for every 10 degrees Celsius different the operating temperature is from the maximum temperature. This is known as the '10-degree rule' for capacitors.

If we assume that our units will operate at 55 $^{\circ}$ C (131 $^{\circ}$ F), that 50 degree difference translates into a multiplier of 32 for our endurance or lifespan. That means the capacitor should have a lifespan of 1333.12 Days (3.65 years) of continuous use. If your vette has 100K miles on it, and you drove an average speed of 30mph (shame on you 😊), and listened to the sweet sounds coming from your Bose stereo that whole time, you would be driving for only 138.9 days. That's only 10% of our projected endurance for the capacitors. There's no way these capacitors are wearing out due to use.

In an aluminum electrolytic capacitor, the dielectric is a liquid, and that's the issue. Over time, in addition to natural wear due to use, the liquid evaporates. This evaporation occurs constantly, regardless of how often you use the stereo. As the electrolyte evaporates, the performance degrades.

The key point is that these units aren't breaking, they have a finite lifetime due to the evaporation. We should be looking at them as a wearable part like brake shoes or clutches! Periodic replacement and refurbishment should be the expectation as these cars age and searching for the prized NOS part will not help (remember the evaporation is time based, not use based).

## One Method for Replacing Electrolytic Capacitors

I'm no expert on electronic or soldering, and I would encourage you to develop a style which is comfortable and produces your best results, but in case you might be interested, I will describe the basic procedure I used for replacing the capacitors in the radio and speaker amplifiers below. Describing it once up front will make each section smaller.

Before you start removing components from your circuit board, take some digital pictures, they could prove invaluable if you need them. Also, remember that aluminum electrolytic capacitors are polarized, which means that they have a positive (longer) and negative (shorter) lead. The negative lead is also always on the side of the capacitor that has a stripe on it.

I also found it handy to take a marker and mark the solder connections for the capacitors before I started working on them. This prevented me from inadvertently removing the wrong component.

### Removing the Old Capacitors

In general, you want to perform the removal quickly to avoid transferring too much heat to the board and components, so take your time and let your soldering iron get up to temperature. After your soldering iron is heated, grab the capacitor with your fingers and melt the solder on one of the connections. You should be able to gently pull on the capacitor and see that post move up into the hole. Repeat the process on the other connection while pulling up on the capacitor.

By alternating you should be able to walk the capacitor out of the holes, leaving solder behind.

### Cleaning up the Circuit Board

Place the desoldering braid on one of the connection points, and then place your iron on the braid. You should see the braid start to fill with any remaining solder from the connection. Clean the connection points until you can see the mounting holes and the circuit board ring clearly.

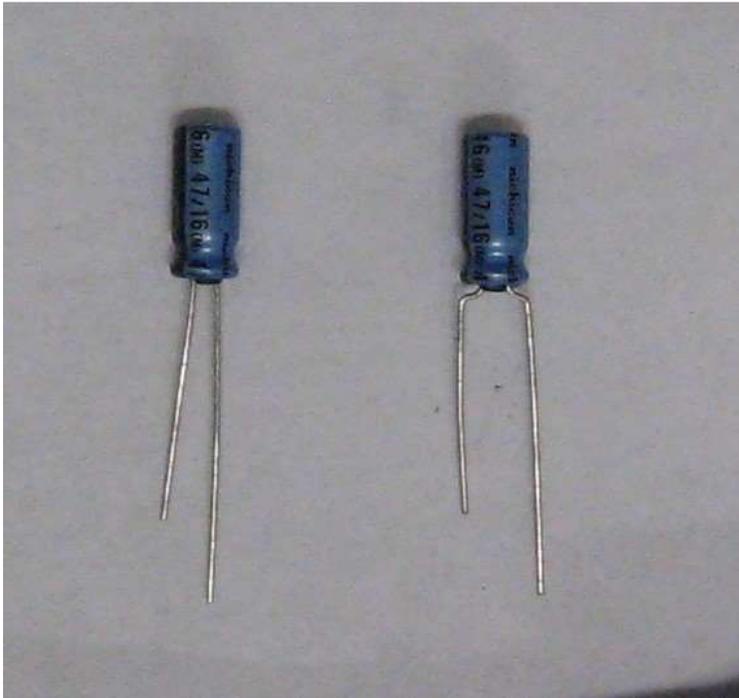
The image below shows one of the rear amp boards from my project. In it, you can see the red marker denoting the connections to remove, and the condition of the connections after they have been cleaned with the desoldering braid. This board is ready for new components.



### Prepping and Inserting the Replacement Capacitor

If you insert the capacitor into the circuit board directly, you will notice that the holes in the board are spaced farther apart than the lead spacing on the capacitor itself. In order to properly match the capacitor to the mounting hole, you will need to use a pair of micro needle nose pliers to put two 90°

bends in each lead as shown in the picture below.



Matching the original bends from the removed capacitors will help ensure that you don't run into any space issues when re-assembling the radio and amplifier units.

Insert your replacement capacitors, making sure to have the correct polarity. Once you insert the capacitors, grasp the capacitor leads and bend them to the sides at about a 45° angle. This will help hold the new capacitor in place until you solder the connections.

### Soldering the New Capacitor Connections

Once your capacitor is in place, you are ready to solder the joints. Before proceeding, make sure your soldering iron is up to temperature. Once you start soldering, remember that each joint will take heat from the iron. After several joints, let the iron come back up to temperature.

My preferred method of soldering these capacitors in was to place the tip of the soldering iron so it was in contact with both the lead on the capacitor and the circuit board. I would then place my solder against the circuit board connection at the opposite end of the connection circle. Once the solder starts to melt, you can feed in enough to cover the connection and make good contact with the capacitor lead. Don't overdo the amount of solder. Use the factory solder joints for the other components on the board as your guide to getting just the right amount and also for look and feel of the completed joint.

If you get a good solder joint, all you need to do is clip the remaining capacitor leads at the solder joint to make it nice and clean.

## 86-89 Delco/Bose Stereo Cassette Head Unit and System

### Introduction

In the days before Bluetooth speakers and soundbars came to dominate the home audio scene, high quality stereo systems were built from individual components. At the heart of the system was usually the receiver which combined an AM/FM tuner, some tone controls that also allowed you to select what component to listen to and the power amplifier to drive the speakers. At the higher end of the market, systems would have individual components for the tuner, tone controls and input selector, called a pre-amplifier, and power amplifier. It helps to think of the Delco/Bose radio in these terms, with the head unit containing the AM/FM tuner, cassette deck and pre-amplifier modules with the power amplifier modules being present at each of the speakers.

Having the amps at the speakers seems like an overly complicated design but does make some sense when you look at the Bose program. The premise behind the Bose systems is that the sound is shaped to fit each individual car interior, providing an optimized listening experience for the passengers. The Bose system is not unique to the Corvette and is available on several manufacturers vehicles.

Providing this custom sound across many vehicle manufacturers meant that they had to isolate the Bose specific components to items that they could control. By moving the amplifiers to the speakers, all Bose had to require was a standard line level input. This freed the manufacturers to design whatever functionality and form factor they wished in the head unit.

In his book, *Corvette from the Inside*, Dave McClellan describes how Chevrolet sent Bose the wooden mockup of the C4 interior to use in designing the system. Shaping the sound to individual car interiors was done by altering the circuitry within the amplifiers using several Bose specific integrated circuit chips and by altering the value of the capacitors on the amplifier board. The modularity of the system allowed Bose to use the same methods and provide a product for many vehicles and manufacturers. A custom product for mass produced cars.

There are variations in the sound shaping between different car models, and even within the corvettes covered in this document. As you can see, the values of the capacitors in the convertible rear amplifiers are different from those in the coupe's rear amplifiers. It is for this reason, that it is better for you to rebuild your own equipment than to grab working 'replacement' amps from online resellers as many different cars had the same connectors. The amplifiers will work but will not be optimal.

The head unit on these systems seems to be generally reliable with the most common point of failure occurring in the auto-reverse cassette deck. Many folks report their cassette decks dying with the symptom of changing the side twice and then ejecting the tape when any cassette is inserted. I've read that people suspect that the fault is in the sensor which detects tape motion. Aftermarket folks will not refurbish your tape deck as part of a radio refurbishment due to the lack of parts availability. To get my unit working, I had to scavenge parts from two different cassette decks.

These units are fine in terms of playing the radio and of course they have the stock appearance but, being 30 years old they do lack features we have come to expect in modern day radios, like an auxiliary input. While you can utilize FM transmitter modulators, or cassette adapters (if your cassette deck works), the best sound quality is achieved by inserting the auxiliary signal (iPod, phone, etc.) at the line level. By inserting it at the line level at the right point, it's just like adding another component to the

home stereo described above and provides an extremely clean, crisp sound that does not have the overly bassy tonal quality endemic in these systems.

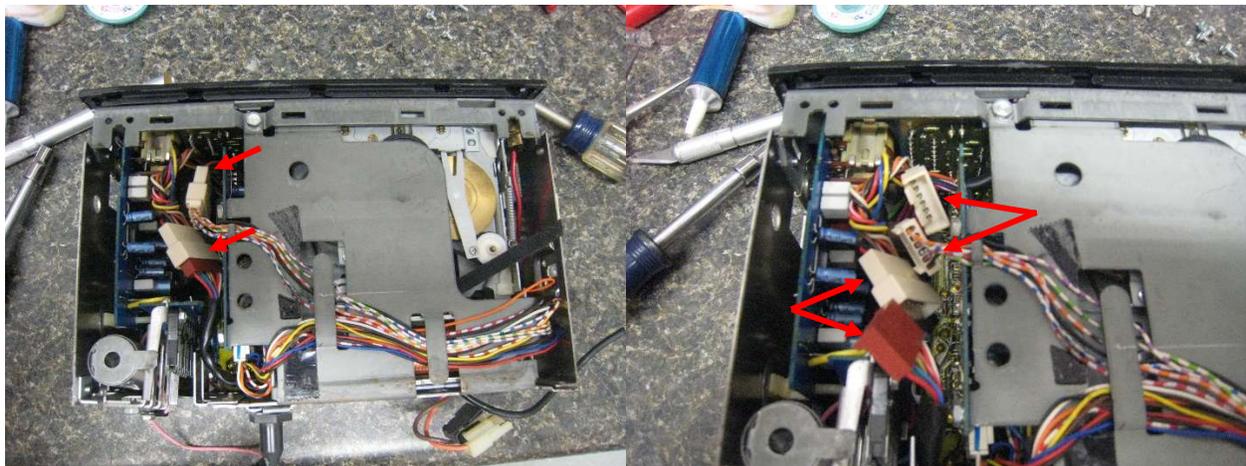
The below text will give you an overview of replacing the electrolytic capacitors in the head unit as well as maintaining the cassette deck. Before you start, you will obviously need to remove the stereo from the car. Good luck!

### Refurbishing the AM/FM and Logic Board Assemblies

After removing the head unit from the car, start the disassembly by removing the knobs and the buttons from the bass and treble sliders. Next, remove the top and bottom covers of the radio. Each is held on by three screws as shown in the pictures below:



Once the top and bottom are removed the faceplate should be loose. Before removing the faceplate, you must disconnect the cassette controls from the cassette unit and slide the cassette deck back to create a space for the cable to go through the front of the radio. Turn the radio over so the cassette side is up. Disconnect the two connectors for the cassette unit as shown below:

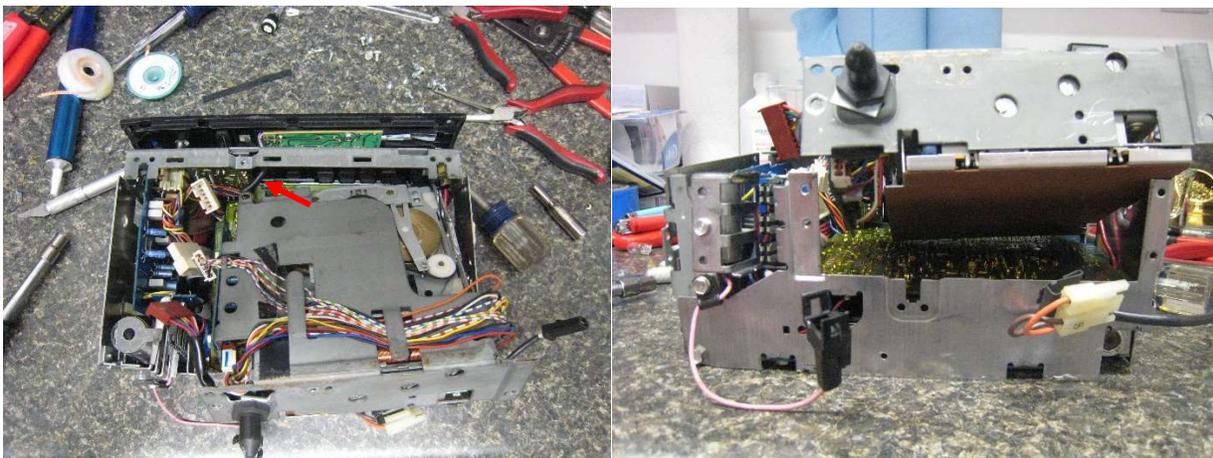


Next, remove the three screws that hold in the cassette deck unit. Two of these screws are 1/4" heads, but the third, which is located on the side of the unit is a 3/16" head. The images below show the locations of the screws holding the cassette deck.



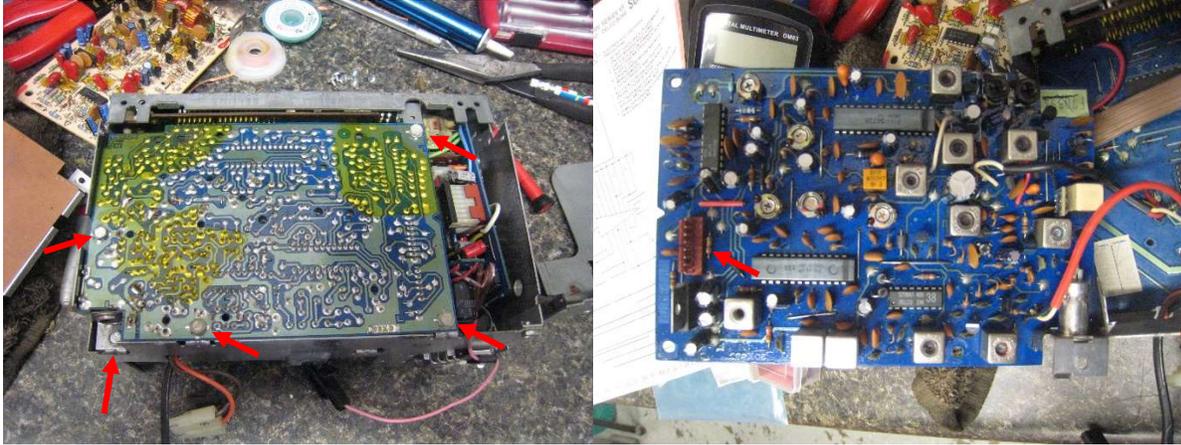
Removing the 3/16" screw was particularly hard on my unit. The screws used by Delco have very thin heads on them and it was tough to get the socket to grip. You might be spending some time here.

Once the three screws are removed, you can remove the cassette deck unit. First, slide and tilt the unit up and to the rear to disengage it from the faceplate. Once it is dislodged, as shown below, you will now have room to pull the cassette control cable through the front of the radio and remove the faceplate assembly. (Shown with red arrow)



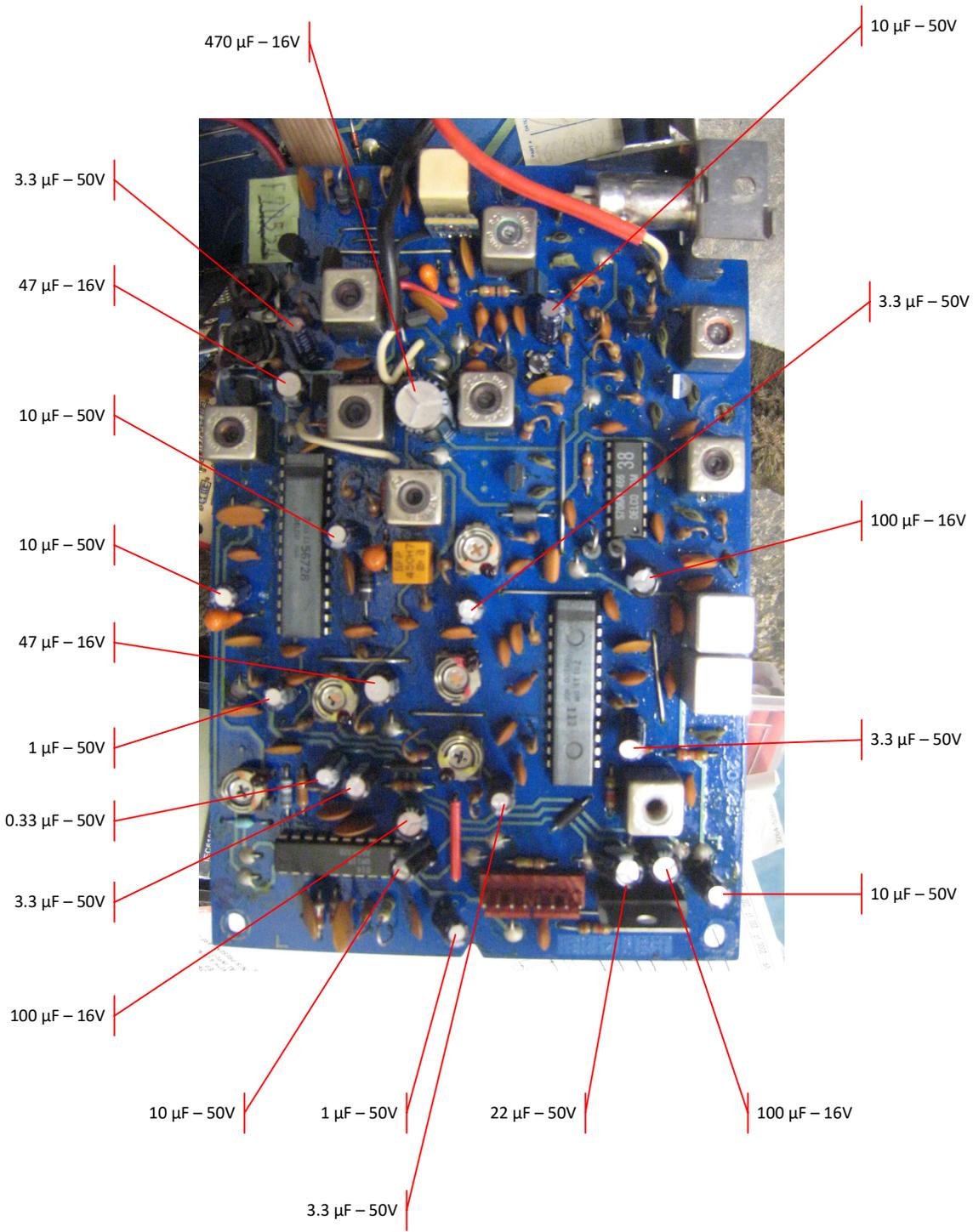
Put the faceplate and all the plastic lighting components off to the side. Also, there will be several rubber gaskets and pieces of felt designed to block light and protect the unit. Ensure you note how they go on the unit and put them aside as well.

Flip the unit over so that the antenna input is facing upwards and the rear of the unit is closest to you as shown below. Remove the 5 screws that hold the AM/FM tuner board and lift the board up at the right side. There is a ribbon cable connected to the tuner board that must be disconnected to allow you to flip up the tuner board fully. The connector I am referring to is shown in the right image below with the red arrow.



At this point, I would recommend replacing the capacitors on the tuner board. There will be further disassembly of the radio, but replacing the capacitors on the tuner board now will allow you to use the head unit to keep the other boards together and avoid putting any unnecessary strain on any connecting cables.

The diagram below displays the AM/FM tuner board, highlighting the capacitor locations and type for replacement. The full component list including digi-key part numbers is located at the end of this section.

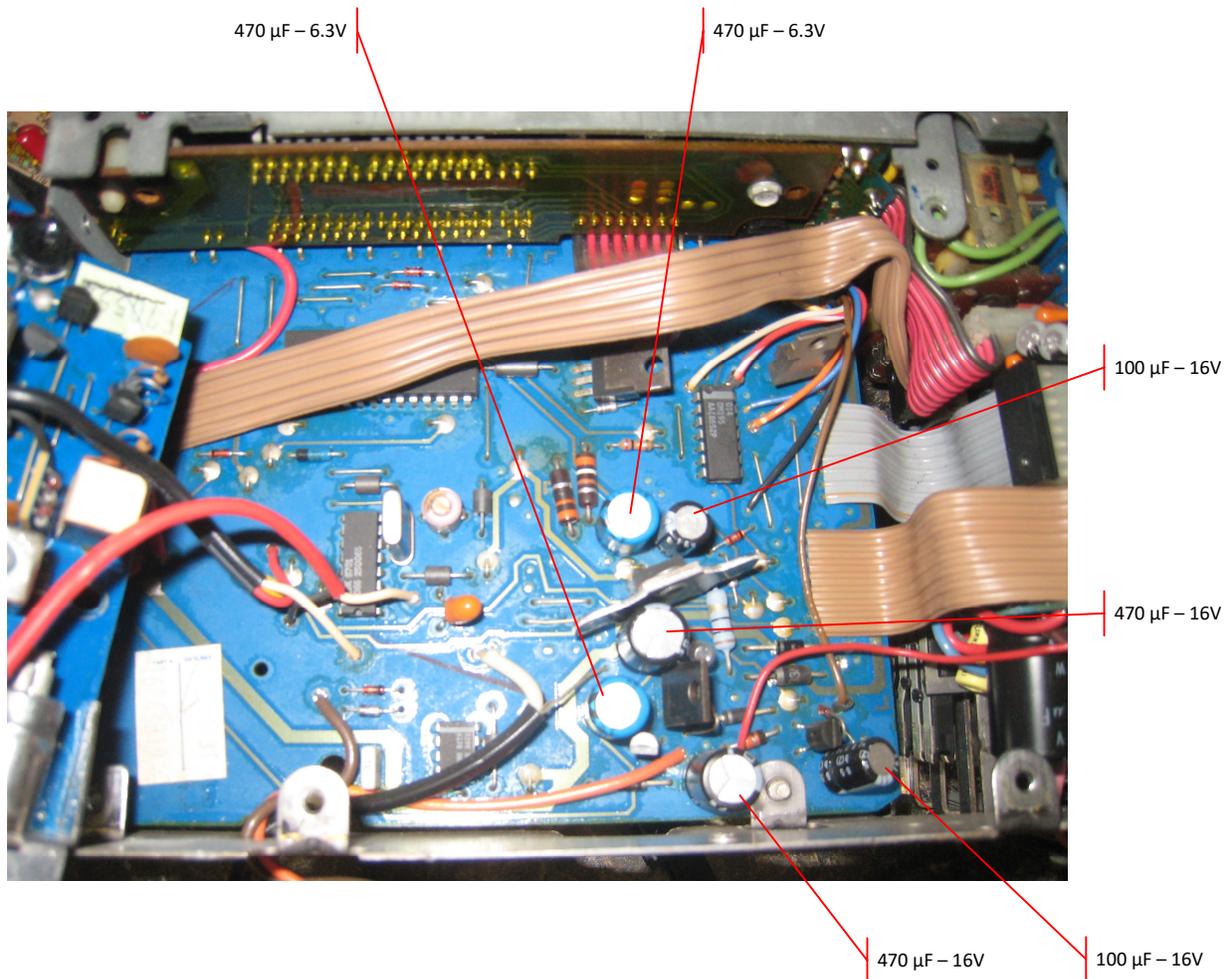


Replace the capacitors in whatever order you like but pay very good attention to the polarity. Unlike the speaker amplifier boards, these boards do not have the capacitor connections labelled. On the boards in the radio, the capacitor anodes (+) and cathodes (-) use different sized holes. On these boards, the anode is folded over on itself so it will look like a U on the underside of the board. If you get into

trouble, just remember the striped side of the capacitor goes into the smaller hole. I would suggest printing out a copy of this page and marking the polarity on the copy as you work.

When you have finished the tuner board, go ahead and replace the capacitors on the Equalization/Logic board. It is easier to do this while the board is still in the case.

The diagram below displays the Equalization/Logic board (removed from the unit), highlighting the capacitor locations and type for replacement. The full component list including digi-key part numbers is located at the end of this section.



The good news is that you have now replaced most of the capacitors. The bad news is that to replace the remaining capacitors, we will need to disassemble the remainder of the radio.

NOTE: Remember this point in the radio's assembly/disassembly. If you are adding the iPod adapter, this is how you want the radio to look.

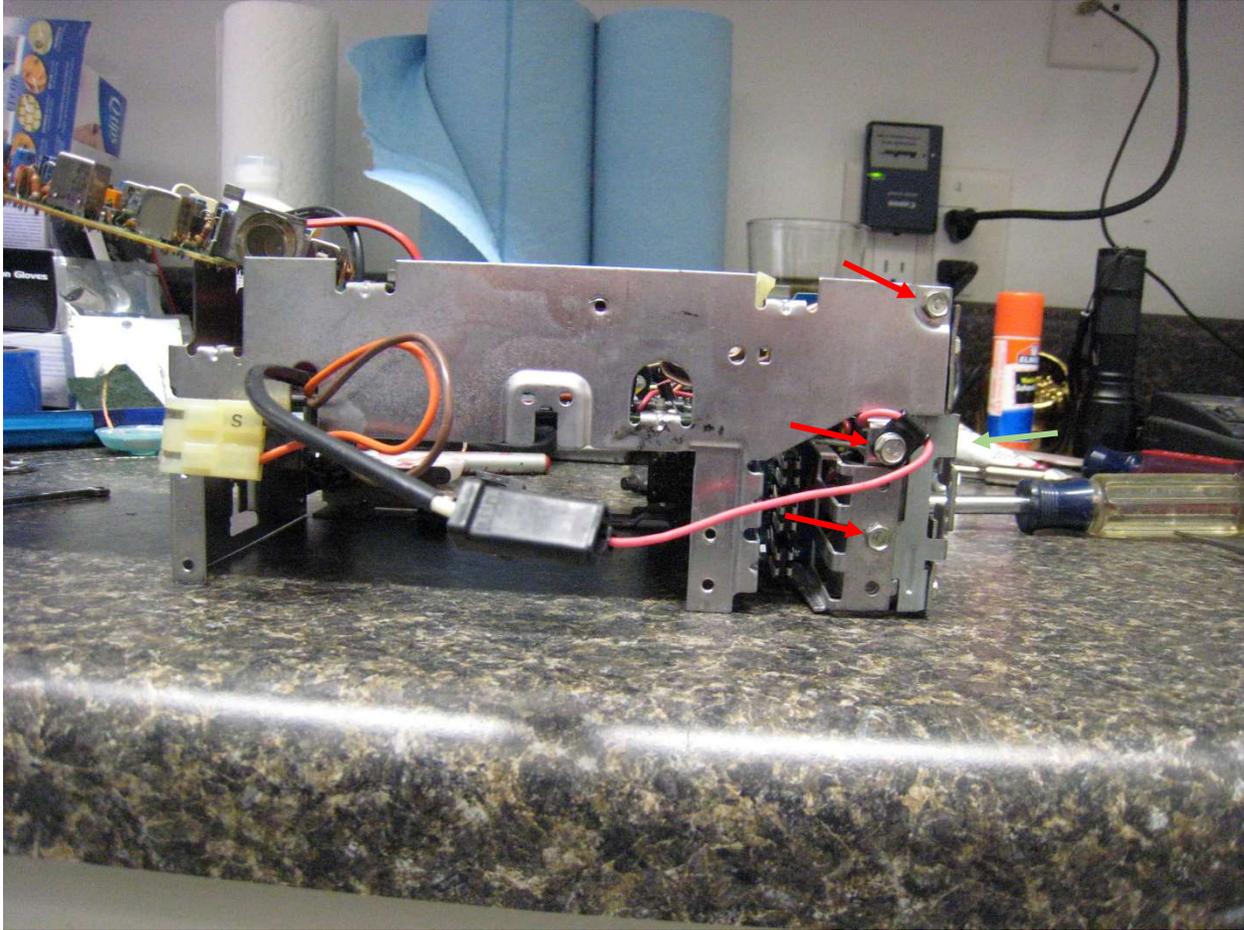
To get the tone controls out of the radio, begin by removing the 10mm nuts on the radio knob shafts, and the 3/16<sup>th</sup> in bolt illustrated by the red arrows in the diagram below.



Next, turn the radio so you are looking at the side panel closest to the knobs. Remove the two ¼" bolts illustrated by the red arrows in the picture and take note of the plastic stand-off labelled with the green arrow, that's important for the next step.

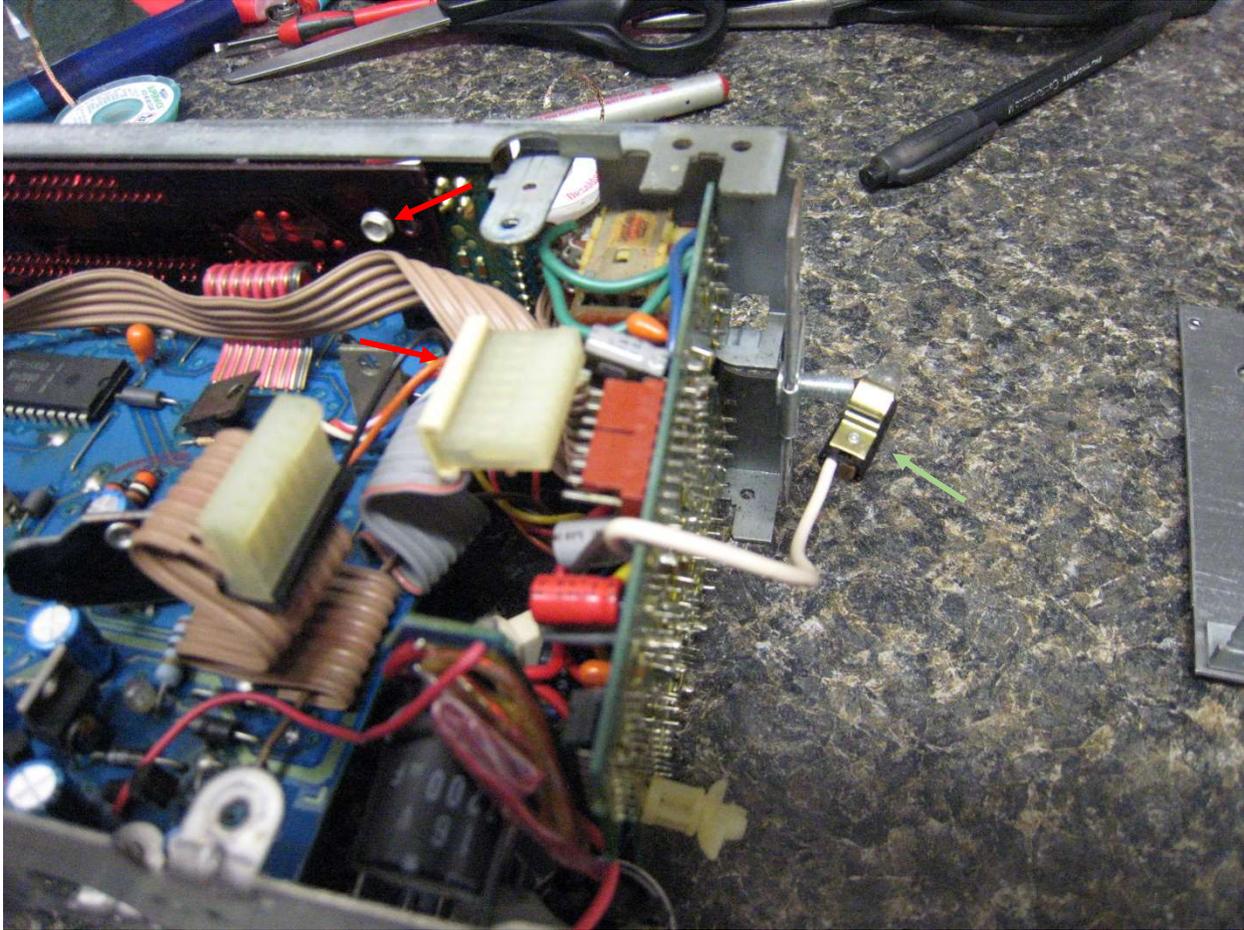


Rotate the unit so you are facing the rear panel. Remove the three ¼" bolts illustrated with a red arrow in the picture below.



Pinch the nylon stand-off (green arrow above) and push it through the hole. You should now be able to remove the side panel of the radio.

Looking down at the radio, remove the connector (red arrow) and the radio light (green arrow) from the picture below next. The radio light is removed by pushing the light socket towards the front of the radio until the clip disengages. You can then pull the light back through the hole.

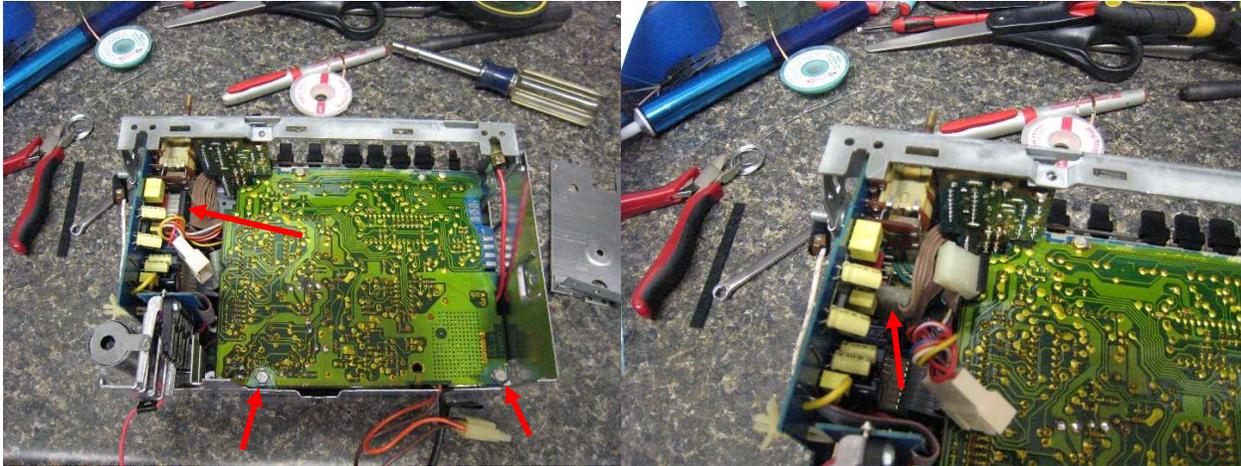


To free the tone controls and power supply board, you need to unscrew the equalizer logic board and the radio display. Start by removing the 3/16" bolt in the figure above (red arrow). Once removed, spin the radio so you can work on the face as shown in the picture below.



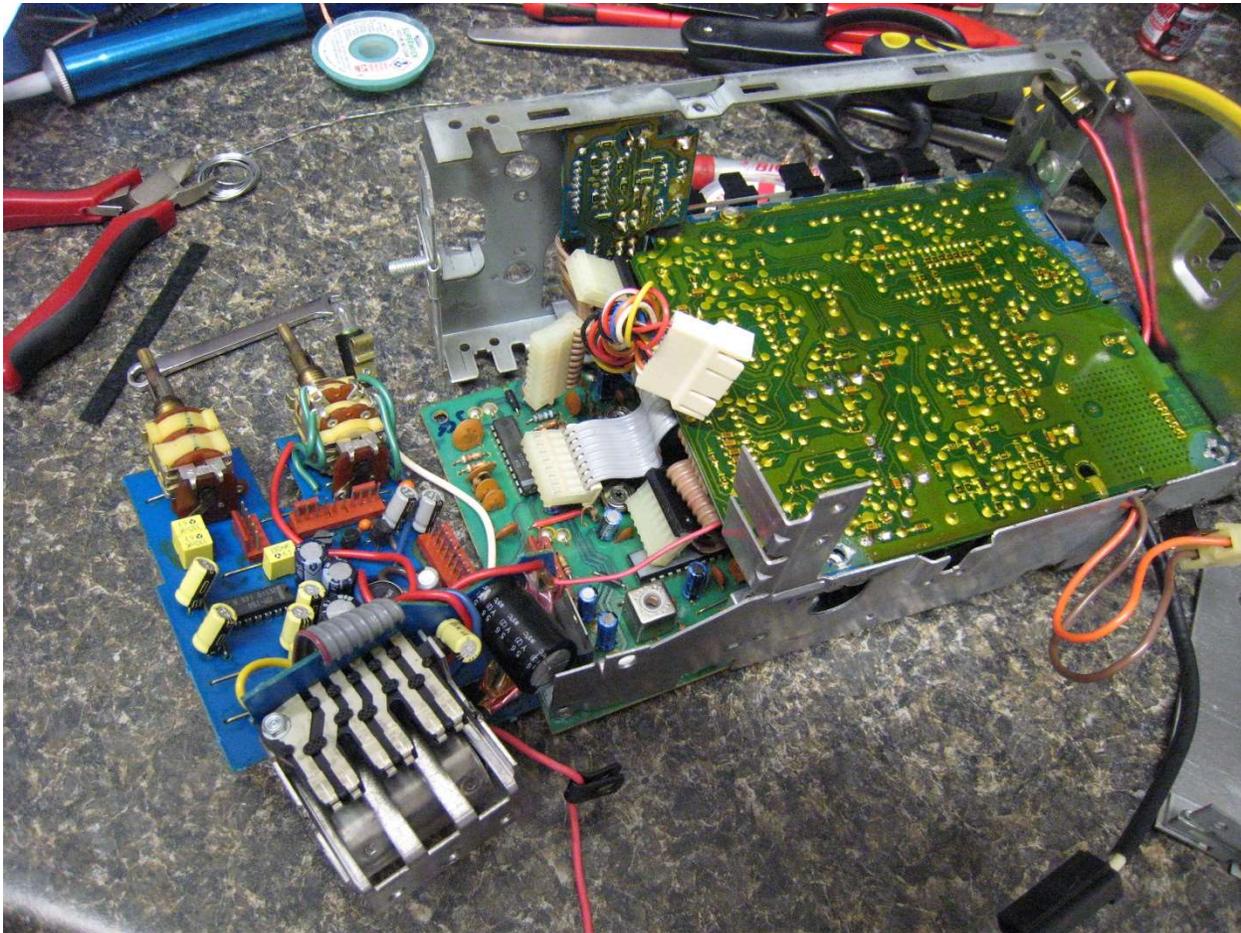
Remove the 3/16" bolts (red arrow) shown in the picture above. You might also choose to remove the tuner memory buttons as they will likely fall off when you remove the board. If you do, note the position of the button as they are not symmetrical top to bottom. After removing the bolts, pinch the nylon standoff (green arrow) shown in the picture above and push it through the hole to release it. At this point, all the fasteners holding in the logic board have been removed.

Spin the radio around so the back is towards you and the cassette tape hole is up. Next, remove the horizontal connector (red arrow) shown in the image below on the left and the two 1/4" bolts on the rear of the logic board (red arrows).



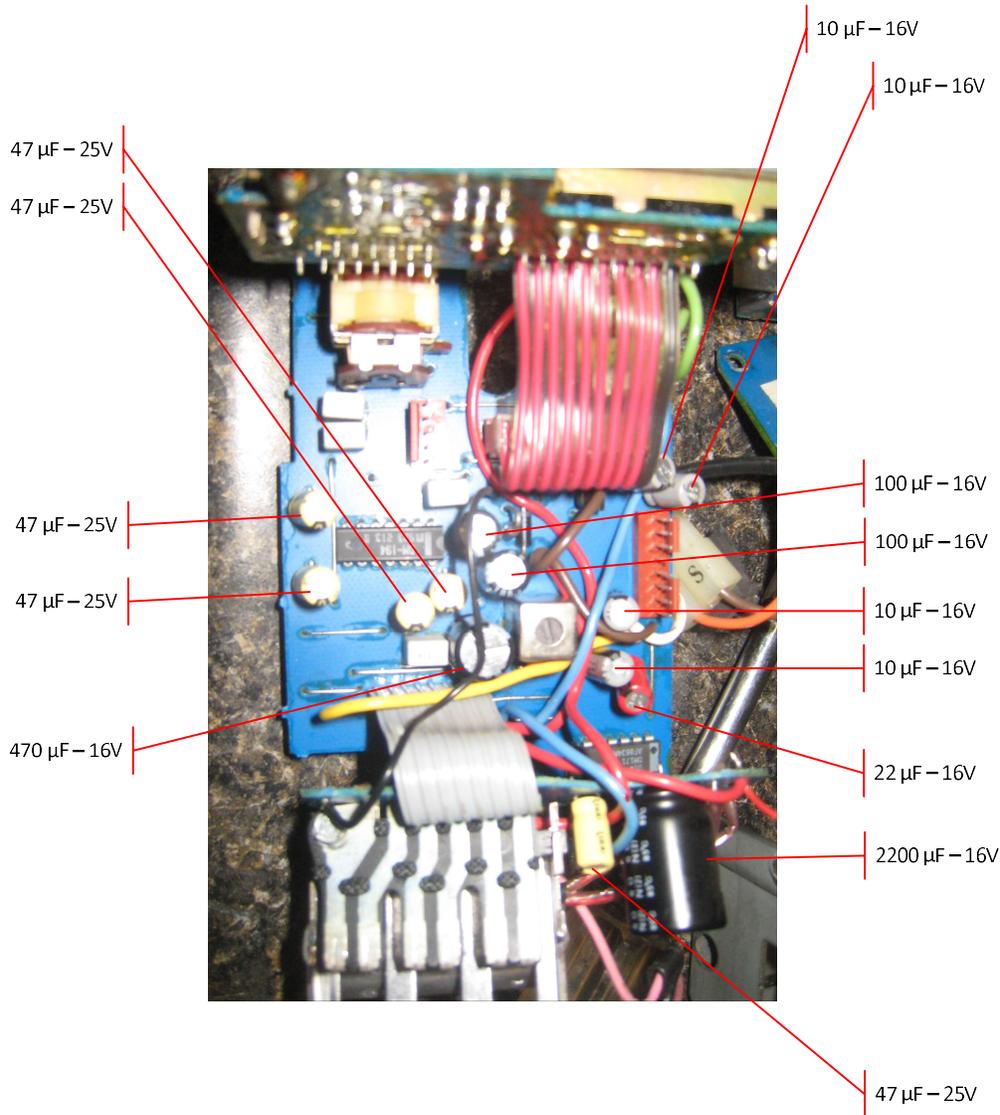
Next, remove the vertical connector shown in the picture above on the right (red arrow).

Being gentle, you should be able to maneuver the logic board to give you enough room to pull the tone control/power supply out of the front of the radio panel. There are several wires connecting the tuner board to the tone control/power supply board, so just lay it down as shown in the picture below.



Proceed with replacing the capacitors on the tone control/power supply board.

The diagram below displays the Tone Control/Power Supply board, highlighting the capacitor locations and type for replacement. The full component list including digi-key part numbers is located at the end of this section.



Once you have replaced the capacitors, you are ready to clean and lubricate the controls themselves. The process for doing this is straightforward. Spray tuner cleaner/lubricant spray (DO NOT USE WD-40) into the radio knobs one at a time. After spraying the cleaner/lubricant, work the knobs back and forth across their full range for a minute or two. Remember to work both the inner shaft (knob) and the outer shaft (outer knob [fader]) to ensure you get them all clean. The image below to the left shows where I sprayed the cleaner/lubricant. When you are done, wipe the excess lubricant from the components.